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Attentional biases in dysphoria when happy and sad faces are simultaneously presented

Ivan Blanco[a,b], Natalia Poyato[a], Ines Nieto[a], Teresa Boemo[a], Teodoro Pascual[c], Pablo Roca[a], Carmelo Vazquez[a,*]

[a] Department of Clinical Psychology, School of Psychology, Complutense University of Madrid, 28223, Madrid, Spain
[b] Department of Experimental, Clinical and Health Psychology, Ghent University, Belgium
[c] Department of Experimental Psychology, School of Psychology, Complutense University of Madrid, Center for Biomedical Technology, Polytechnic University of Madrid, 28223, Madrid, Spain

A R T I C L E I N F O

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Depression
Attentional biases
Emotional faces
Eye tracking

A B S T R A C T

Background and objective: Difficulties to engage attention to positive stimuli and to disengage attention from negative stimuli are typically found in depression. Yet, most of the evidence supporting these attentional biases comes from experimental paradigms in which emotional information (e.g., happy or sad faces) is simultaneously presented with neutral information. Few studies have explored attentional biases when emotional stimuli of different valence are presented simultaneously. The aim of the present study was to assess visual scan patterns of non-dysphoric and dysphoric participants when emotional information is presented simultaneously.

Method: Using an eye-tracker methodology, the gradient relation between attentional biases and depression scores as well as differences between groups in their attentional performance were assessed in non-dysphoric participants (N = 84) and dysphoric participants (N = 58). Three different pairs of faces were used: happy-neutral, neutral-sad, and happy-sad.

Results: First, we found that simultaneous presentation of emotional information (i.e., happy vs. negative faces) reduces the magnitude of attentional biases towards positive information. Second, we also found a significant negative relation between attentional biases towards positive information and depression scores. Finally, compared to non-dysphoric participants, dysphoric individuals marginally spent less time attending positive information in both happy-neutral and happy-sad trials.

Limitations: The cross-sectional nature of our study does not allow us to make inferences about causality. Further, only one type of simultaneous emotional faces presentation (i.e., happy-sad) was used.

Conclusions: These results support the need for further research on the processing of competing emotional stimuli in depression.

1. Introduction

Research on mood and cognition has found that attentional biases are one of the main features of depression (Beck & Bredemeier, 2016; Gotlib & Joormann, 2010). An attentional preference towards negative information has consistently been found in depression, and this finding has been reported in literature reviews (Bistricky, Ingram, & Atchley, 2011) and several meta-analyses (Armstrong & Olatunji, 2012; Peckham, McHugh, & Otto, 2013). These attentional biases are not only important as far as describing the psychopathology of depression but also because there is evidence regarding their role in both the onset and the maintenance of depression and negative mood (Gotlib & Joormann, 2010) as well as in the difficulties with emotional regulation associated with depression (Joormann & Vanderlind, 2014; Sanchez, Vazquez, Marker, LeMoult, & Joormann, 2013).

Attentional biases in depression have been assessed through a variety of experimental paradigms and methodologies, mostly based on reaction times (Peckham et al., 2013; Winer & Salem, 2016), in which participants' processing of emotional stimuli is compared to their processing of neutral stimuli. In these procedures, experimental stimuli usually consist of pairs of emotional and neutral objects (including faces, images or words) which compete to draw participants' attention. Research using this approach has consistently found that, in general, depressed participants show an attentional bias towards negative

* Corresponding author.
E-mail addresses: ivan.blanco.martinez@ucm.es (I. Blanco), nataliapoyatovega@ucm.es (N. Poyato), inenieto@ucm.es (I. Nieto), mboemo@ucm.es (T. Boemo), teodorop@ucm.es (T. Pascual), pabloroc@ucm.es (P. Roca), cvazquez@psi.ucm.es (C. Vazquez).

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stimuli, when paired with neutral ones, regardless of the types of objects used in the studies (Peckham et al., 2013). Yet, since the beginning of the study of attentional biases towards emotional stimuli in depression, only few studies have assessed attentional biases when pairs of emotional stimuli (e.g., positive and negative information) are simultaneously presented. For instance, Gotlib, McLachalan, and Katz (1988) used a color perception task, composed by pairs of neutral-depressed, neutral-maniac and depressed-maniac related words, to assess attentional bias in depressed and non-depressed participants. Similarly, Beevers and Carver (2003) used a reaction time paradigm (i.e., a modified dot-probe task) where they presented pairs of positive and negative words to assess attentional biases as prospective predictors of further dysphoria.

However, despite the fact that reaction time paradigms have several methodological limitations (see Vazquez, Blanco, Sanchez, & McNally, 2016) and their reliability has been widely questioned (Price et al., 2015), there are no studies that have been specifically designed to directly analyze participants' deployment of attention, using direct measures of attention such as eye-tracker methodology, when pairs of emotional stimuli are presented simultaneously. Thus, it would seem necessary to know how both healthy and depressed individuals react when facing these types of situations.The aim of this study was to directly analyze the attentional performance of dysphoric and non-dysphoric participants when processing pairs of emotional stimuli as compared to their processing of pairs of emotional and neutral stimuli using eye-tracker methodology. For this study, happy and sad faces were selected as emotional stimuli as there is ample evidence showing specific attentional biases associated with these stimuli in depressed participants (see Armstrong & Olatunji, 2012). Using eye-tracking paradigms, it has been found that depression is associated with a bias for sad versus neutral faces. For instance, in a study where emotional faces (i.e., happy, sad and angry) were presented alongside neutral faces, Duque and Vazquez (2015) found that clinically depressed participants spent more time looking at sad faces than never-depressed participants in a free-viewing task. Using a similar set of stimuli and eye-tracker methodology, Sanchez et al. (2013) found that clinically depressed individuals have difficulties disengaging from sad faces in trials where participants are required to look at the neutral face that appears in the same scene. On the other hand, a bias away from positive stimuli has also been found in eye-tracking studies where, compared to non-depressed participants, clinically depressed patients spend less time looking at happy faces when paired with neutral ones (Duque & Vazquez, 2015). Thus, despite this evidence for mood-congruent attentional biases in depression, there is no direct evidence using eye-tracking methodologies on the biases towards positive and negative materials when those are concurrently presented (Joormann & Tanovic, 2015).

Interestingly, this dual attentional bias (i.e., a bias towards negative materials and a bias away from positive materials) has been found in studies using emotional faces, in both dysphoric samples (Leyman, De Raedt, Vaeyens, & Philippaerts, 2011; Sears, Thomas, LeHuquet, & Johnson, 2010) and clinically depressed participants (Duque & Vazquez, 2015). Also, within dysphoric samples, cognitive biases in attention, memory and interpretation of negative information are significantly higher for participants with high depression scores than for participants with low depression scores (Everaert, Duyck, & Koster, 2014). Thus, it seems that the association between cognitive biases and level of depression follows a gradient.

To our knowledge, this is the first study that attempts to assess attentional biases, using direct measures of attention (i.e., eye-tracking methodology), of dysphoric and healthy participants when happy and sad faces are presented at the same time with no other surrounding distractors (e.g., other types of faces). Although some attentional studies have occasionally presented stimuli representing different emotions simultaneously in the same trial, specific analyses of attentional biases for each type of emotion have not been done. For instance, Kellough, Beevers, Ellis, and Wells (2008) presented four different emotional images at the same time (i.e., happy, sad, threat and neutral images of people and unanimated objects) to a sample of clinically and never-depressed participants. They concluded that clinically depressed participants, compared to never-depressed, had a bias towards negative images and a bias away the positive images. Yet, the design of these types of studies dos not allow investigators to specifically analyze attentional performance for each type of emotional image displayed in the stimulus array. In tasks using different arrays of emotional and neutral stimuli (e.g., a matrix of faces combining neutral and emotional faces) the deployment of participants' attention is unknowingly distributed throughout the different stimuli presented in the array and, also, participants' gaze patterns may be influenced by other uncontrolled factors, such as the spatial positions of the stimuli (e.g., right-left or up-down axes may be involved) or different combinations of faces that are competing among themselves to capture attentional resources. These methodological limitations made it difficult to develop or test specific hypotheses regarding attentional patterns when, for instance, a negative stimulus and a positive stimulus are presented simultaneously competing for participants' attention with no other distractors or additional factors competing for attentional resources allocation. The advantage of a procedure that presents just two faces (either with two emotions or one emotion and a neutral face), is that it allows us to explore in a very precise way the gaze patterns that specifically are activated when those two conditions, without any further stimulus interference, are implemented. In the case of depressed individuals, trials including selected competing pairs of a positive and a negative stimulus (i.e., emotional face) seem critical given the tendency to both engage in negative materials and disengage from positive ones. Also, as an additional methodological refinement of the study, factors such as low-level psychophysical properties of the emotional faces (e.g., luminance and visibility of the teeth) were systematically controlled in the present study, as previous research has shown they may affect attentional patterns (Blanco, Serrano-Pedraza, & Vazquez, 2017).

Following previous research, we first hypothesized that dysphoric participants, compared to healthy participants, would show a significantly less attentional bias towards happy faces, regardless of whether these faces were presented with sad or neutral faces. We also hypothesized that, when processing happy and sad faces at the same time, attentional differences between dysphoric and non-dysphoric participants would increase. Following a gradient hypothesis, based on results from studies on cognitive biases (e.g., Everaert et al., 2014) and emotional reactivity (e.g., Kahn et al., 2019), we hypothesized that attentional biases would be significantly associated with depression scores. Specifically, we expected that attentional biases towards positive information would be negatively associated to the severity of depression scores. All of these hypotheses assumed, based on previous research (Armstrong & Olatunji, 2012), that results would be significant in late processing stages (i.e., total time that participants spend looking emotional information) but not in initial orientation biases.

2. Method

2.1. Participants

A sample of 151 volunteer undergraduate students participated in the study. Participants received a monetary compensation (10 euro) or course credit in exchange for their participation. Nine participants (5.96%) were excluded from the final analysis due to poor eye-tracking quality (defined as having less than 80% of the eye-tracking signal on more than one third of the trials; Raila, Scholl, & Gruber, 2015).

2.2. Materials

2.2.1. Self-report measures

The Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown,

1996) was used to evaluate depressive symptoms of the sample. BDI-II is a 21-item self-report inventory. Each item has four statements ranging on a 0 to 3 scale. The internal consistency of our sample was very good (α = 0.88).

2.2.2. Experimental stimuli

Stimuli were a set of 36 emotional faces (18 happy, 18 sad) and their corresponding 18 neutral faces from the same actress/actor. Stimuli were selected from the Karolinska Directed Emotional Faces database (KDEF – Lundqvist, Flykt & Öhman, 1998). All emotional faces were frontal-view pictures, and there was the same number of female and male faces (9 female, 9 male). Non-informative areas surrounding the faces (i.e., neck, ears, and hair) were cropped and all pictures were converted to grey scale. To control the influence of the stimuli luminance and the teeth visibility of happy faces on participants' attention, all the stimuli were equated in contrast energy and the teeth were blurred using a grey Gaussian-type filter (see Blanco et al., 2017).

2.2.3. Apparatus

A Tobbi Tx-120 eye tracker was used to record participants' gaze patterns at a frequency of 120 Hz. A five-point calibration was done. The distance between participants' eyes and eye tracker was, approximately, 60 cm. Furthermore, the stimuli presentation was controlled by Tobbi Studio software (2.0.6) and all the stimuli were presented on a 24" LCD monitor (frame rate 60 Hz). Additionally, to control the luminance of the screen, the monitor was gamma corrected (mean luminance 42.3 cd/m2).

2.2.4. Attentional task

The task consisted of 108 trials with pairs of faces (36 happy vs. neutral; 36 neutral vs. sad; and 36 happy vs. sad). In each trial, one face appeared on the right and the other on the left side of the screen (14° horizontal visual angle between the two images) competing for participants' attention. The position of each face was counterbalanced, and each face was presented the same number of times. Each trial began with a grey screen (500 ms) followed by a white fixation cross in the center of the screen (1000 ms). To ensure that participants were looking at the center of the screen, a random number appeared replacing the fixation cross (1000 ms) and participants were instructed to say it aloud as quickly as possible. Thereafter, a pair of faces was displayed (3500 ms). Participants were asked to freely look at the faces without any further instruction until the next trial.

2.3. Procedure

In a soundproof room, participants read and signed the informed consent form and then filled out the Beck Depression Inventory-II. Afterwards, participants completed the attentional task. The entire session lasted approximately 20 min.

2.4. Attentional measures, data filtering and data reliability

Following Raila et al.'s method, eye-tracker reliability signal was defined as the percentage of time that participants spent looking and making saccades (i.e., dwell-time) within the screen area during the presentation of the stimuli in each trial. Thus, dwell-time on the entire screen for each trial was calculated and analyzed as a relative percentage of the stimuli duration (3500 ms) for each participant. Then, only those participants with more than 80% of the time looking and making saccades at the screen area on more than two thirds of the trials were included in the analysis. Three attentional measures were extracted to analyze the attentional processing of emotional information at different temporal stages. First Fixation Latency (i.e., time elapsed between appearance of the stimuli and the first fixation on each type of face in each trial) and First Fixation Duration (i.e., duration of the first fixation made on each type of face in each trial) were interpreted as measures of early stages of attentional processing. Total Fixation Duration (i.e., total time spent looking at each type of face in each trial) was interpreted as a measure of later stages of attentional processing. For each attentional measure, and following Shane and Peterson (2007), we computed an index of relative attentional bias towards the more positive face of the three pairs of faces (i.e., a bias towards the happy face in the happy-sad and happy-neutral pairs and a bias towards the neutral face in the sad-neutral pairs) - (see Lewis, Blanco, Raila, & Joormann, 2019). Thus, for instance, for total fixation duration to happy-neutral and happy-sad trials, we subtracted the average total fixation duration on the happy faces from the average total fixation duration on the neutral or sad faces, respectively. For the neutral-sad trials, the average total fixation duration on neutral faces was subtracted from the total fixation duration on sad faces. In the three types of pairs, positive values indicate an attentional bias towards the happiest, or less sad, face of the pair.

Further, and to ensure the reliability of the resulting attentional bias scores, split-half reliability analysis for each score was carried out. Results showed low to moderate reliability for those bias scores computed based on First Fixation Latency and First Fixation Duration (all rs < 0.44). However, the main outcome related to our hypothesis (i.e., Total Fixation Duration bias scores) showed a relatively high split-half reliability (all $rs > 0.67$). Additionally, to assess reliability of attentional bias scores (Price et al., 2015), we also computed average Intraclass Correlation Coefficients (ICCs), using a 2-way random effects model, which has been considered as a robust measure of internal consistency (see Price et al., 2015). Again, we found that attentional bias scores computed based on Total Fixation Duration measures showed high internal consistency (all ICCs > 0.85; $p < .001$) (see Table 1 for detailed information). Therefore, based on our reliability analyses, Total Fixation Duration bias score, a measure of late stages of processing, was the only measure used in the study.

3. Data analysis plan

First, in order to evaluate our gradient hypothesis (i.e., a negative relation between depressive symptoms and attentional biases towards positive information), the role of depression scores in the total fixation duration bias score to each type of trial (i.e., happy-neutral, neutral-sad, and happy-sad) was analyzed. With this aim, a repeated measure analysis of covariance (ANCOVA) of the total fixation duration bias score, with type of trial as within-subject factor and depression scores as a continuous covariate measure, was conducted. This ANCOVA, as

Table 1
Split-half reliability and Interclass Correlation Coefficient (ICC) analysis of all the attentional bias scores for each type of trial.

	Split-half reliability analysis		Intraclass Correlation Coefficient analysis	
	Correlation between forms (r)	Spearman-Brown Coefficient	ICC/α (average of all measures)	p
Time to First Fixation				
Happy-neutral	0.147	0.257	0.38	< .001
Neutral-sad	−0.151	−0.357	−0.037	0.602
Happy-sad	0.157	0.271	0.243	0.007
First Fixation Duration				
Happy-neutral	0.442	0.613	0.593	< .001
Neutral-sad	0.033	0.064	−0.178	0.90
Happy-sad	0.39	0.561	0.582	< .001
Total Fixation Duration				
Happy-neutral	0.763	0.866	0.917	< .001
Neutral-sad	0.668	0.801	0.854	< .001
Happy-sad	0.812	0.896	0.912	< .001

described in Field (2017), was used to analyze the heterogeneity caused on a dependent variable (i.e., total fixation duration bias score) by the influence of one independent variable (i.e., type of trial) and a quantitative variable or covariate (i.e., depression scores). Therefore, a significant interaction between the independent variable and the covariate (i.e., type of trial by depression scores) would reflect that the relation between the type of trial and participants' total fixation duration biases would be related to participants' depression scores. In other words, this procedure allows to analyze whether total fixation duration biases towards emotional faces (measured by three different types of trials) would differ according to depression scores. Finally, when a significant interaction was found, it was decomposed by separate bivariate Pearson correlations between depression scores and total fixation duration biases for each type of trial (see Sanchez, Romero, Maurage, & De Raedt, 2017, for a similar statistical approach).

Second, in order to evaluate our two hypotheses regarding differences between dysphoric and healthy participants on the time spent processing happy faces in the happy-neutral and happy-sad conditions, a mixed-design analysis of variance (ANOVA), using type of trial as a within-subject factor and group (dysphoric and non-dysphoric) as a between-subject factor, was carried out. For this analysis, participants were divided into two groups following Dozois, Dobson and Ahnberg's (1998) cutoff scores of the Beck Depression Inventory II (Beck et al., 1996) for undergraduate samples. In total, 58 participants comprised the dysphoric group (BDI-II:13 to 63), while 84 participants comprised the non-dysphoric group (BDI-II: 0 to 12).

4. Results

The gradient hypothesis: Relationship between depression scores and attentional biases towards emotional information.

The results of the ANCOVA, using type of trial (happy-neutral, neutral-sad, and happy-sad) as within-subject factor and depression scores as a covariate, revealed a significant main effect of type of trial, F (2, 280) = 22.64; $p < .001$; $\eta_p^2 = 0.14$. Bonferroni post-hoc analysis showed that, regardless depression scores, all participants spent significantly more time looking the happy face in the happy-neutral trial (i.e., the happy face) than the positive face in the neutral-sad and the happy-sad trials (all $ps < .016$). Also, participants spent significantly more time looking at the positive face in the happy-sad trials (i.e., the happy face) than in the neutral-sad trials ($p < .001$).

More importantly, a significant main effect of depression scores, F (1, 140) = 18.87, $p < .001$, $\eta_p^2 = 0.12$, was qualified by a significant type of trial by depression scores interaction, F(2, 280) = 7.56, $p = .001$, $\eta_p^2 = 0.05$. That is, the differences on the time that participants spent looking at the most positive face on each trial was related to participants' depression scores.[1] Therefore, to further analyze this association between depression scores and total fixation duration bias score a series of zero-order correlations were calculated for the three types of trials (i.e., happy-neutral, neutral-sad, and happy-sad) separately.

Results showed that depression scores were negatively associated with total fixation duration bias towards happy faces in both the happy-neutral condition ($r = -0.363, p < .001$) and the happy-sad condition ($r = -0.332$, $p < .001$) but were not associated with total fixation duration bias towards neutral faces in the neutral-sad condition ($r = -0.145$, $p = .085$) (see Fig. 1).

Differences between dysphoric and non-dysphoric on total fixation duration biases towards emotional information.

First, demographic characteristics of our groups were analyzed. Results showed that there were significant group differences in depression scores [$t(140) = -15.80$, $p < .001$, $d = 2.52$], age [t (140) = 2.12, $p = .035$, $d = 0.37$], and sex [X^2 (1, n = 142) = 6.15; $p = .013$] (see Table 2 for demographic information).

Second, a 2 (Group: Non-Dysphoric, Dysphoric) x 3 (Type of trial: happy-neutral; neutral-sad; happy-sad) mixed-design ANOVA was carried out to assess differences between groups in total fixation duration bias scores.

Results showed significant main effects for type of trial F (2, 280) = 15.174, $p < .001$, $\eta_p^2 = 0.098$, and group F (1, 140) = 11.11; $p = .001$, $\eta_p^2 = 0.074$. Also, a marginally significant group x type of trial interaction F (2, 280) = 2.76, $p = .065$, $\eta_p^2 = 0.019$ was found. Due to the relevance of this marginally significant interaction, Bonferroni post-hoc tests were carried out. Post-hoc analysis showed that dysphoric participants spent significantly less time viewing happy faces, in both the happy-neutral and happy-sad conditions, than non-dysphoric participants (all $ps < .003$). There were no significant differences in the time that dysphoric and non-dysphoric participants spent looking at neutral faces in the neutral-sad condition ($p > .075$).

In relation to groups, post-hoc analysis of the positive bias scores showed that non-dysphoric participants spent significantly less time viewing neutral faces (in the neutral-sad condition) than the happy faces (in both, the happy-neutral and the happy-sad condition) – (both $p < .001$). There were no differences between types of trials in the dysphoric group (all $ps > .085$) (see Fig. 2).

5. Discussion

The aim of the present study was to examine whether attentional biases towards positive or negative faces in dysphoria emerge not only when these emotional faces are processed in the presence of neutral faces but also when positive and negative faces are presented together in the same trial.

Our first hypothesis was that dysphoric participants, as compared to non-dysphoric participants, would show a reduced bias towards happy faces regardless of the type of accompanying stimuli (i.e., neutral or sad faces). Although marginally significant, results confirmed this hypothesis, which was based on the extensive literature comparing attentional performance of depressed and non-depressed individuals according to cut-off scores (Armstrong & Olatunji, 2012). Dysphoric participants spent less time than non-dysphoric ones looking at happy faces when they were paired with either neutral or sad faces. However, due to the marginal significance of our data, further research is needed to clarify whether the double bias found in depression and dysphoria (Duque & Vazquez, 2015; Leyman et al., 2011) also emerge when positive information is presented paired to sad information with no other distractors.

In regard to differences in the processing of happy faces when accompanied with a neutral face versus a sad face, which was the main aim of the study, an interesting pattern of results was found. First, across the entire sample (i.e., dysphoric and non-dysphoric participants), participants spent significantly less time looking at the happy face when it was paired with a sad face than when this happy face was paired to a neutral one. In other words, it seems that simultaneous presentation of positive and negative information (i.e., happy vs. sad faces) reduces the probability of appearance of the attentional bias towards positive information commonly found in healthy participants (Sanchez & Vazquez, 2014).

Second, this pattern of results was qualified by participants' total depression scores, which supports our gradient hypothesis. In fact, a

[1] BDI-II scores were not normally distributed in our sample, S–W = 0.91, df = 142, $p < .001$; showing positive skewness = 1.2, SE = 0.203, and kurtosis = 1.5, SE = 0.404. To test whether this distribution affected results, BDI-II scores were normalized via square root transformation (S–W = 0.986, df = 142, $p = .144$; skewness = −0.16, SE = 0.203; kurtosis = 0.214, SE = 0.404). ANCOVA analysis were then carried out using transformed BDI-II scores as a covariate. Analysis revealed a similar pattern of results: main effect of type of trial, F(2, 280) = 14.83; $p < .001$; $\eta_p^2 = 0.10$, a main effect of transformed depression scores, F(1, 140) = 18.77; $p < .001$; $\eta_p^2 = 0.12$ and a significant type of trial by transformed depression scores interaction, F(2, 280) = 5.78; $p = .003$; $\eta_p^2 = 0.04$.

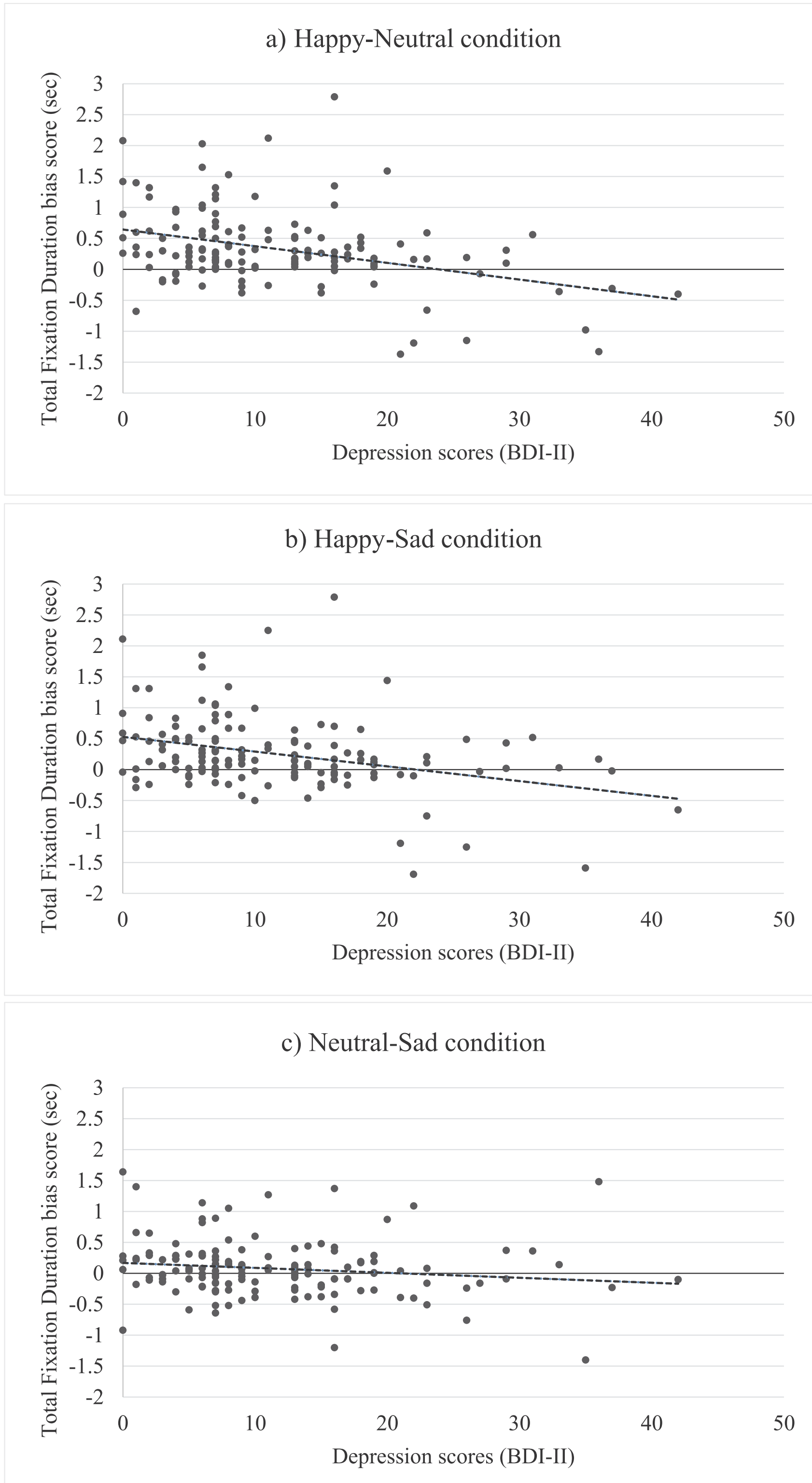

Fig. 1. Relation between total fixation duration bias scores and depression scores for each types of trial (a) Happy-Neutral, b) Happy-Sad, c) Neutral-Sad). In the three types of pairs, positive values indicate an attentional bias towards the happiest, or less sad, face of the pair.
Note. BDI-II = Beck Depression Inventory-II.

significant inverse correlation, for the happy-neutral and happy-sad trial types, emerged between depression scores and the magnitude of the bias towards happy faces. Participants with higher levels of depression showed a higher maintenance attentional bias away from happy faces in both the happy-neutral and happy-sad conditions. Thus, the use of these simultaneous presentations of emotional information (i.e., happy and sad faces) might be relevant in further studies assessing attentional biases in dysphoric or depressed samples.

Third, although according to the present results, the use of positive stimuli seems perfectly adequate to elicit biases associated with

Table 2
Differences in Demographic and group characteristics.

	Non-dysphoric (N = 84)	Dysphoric (N = 58)
	M *(SD)*	M *(SD)*
BDI-II	5.78 (*2.99*)	19.43 (7.06)
Age	21.2 (*2.53*)	20.38 (*1.72*)
Female (%)	70.2	87.9

Notes. M = Mean; SD = Standard Deviation; BDI-II = Beck Depression Inventory–II.

depression (Winer & Salem, 2016), it must be noted that pairs of sad-neutral faces did not yield any significant result in any of our analysis. For instance, the non-dysphoric group showed a tendency to look away from the sad face, but this bias did not reach statistical significance. Further, there was no significant correlation between depressive scores and attentional biases in the neutral-sad condition. Yet, similar studies with clinically depressed samples have shown that depressed patients have a bias towards sad faces when they are accompanied by neutral ones (Duque & Vazquez, 2015). Thus, it could be possible that the presence of bias in the sad-neutral pairs of faces is related to the severity of the depression condition. In fact, according to the results of our study, a preferential attentional bias away from positive information, rather than a preferential processing of negative information, seems to characterize dysphoria. A similar conclusion has also been found in previous studies where dysphoric participants did not show attentional biases towards negative information (Sears et al., 2010; Sears, Newman, Ference, & Thomas, 2011). Although somehow speculative, it might be hypothesized that in early stages of depression, or at subclinical levels (i.e., dysphoric mood), a "potentially protective" attentional bias (i.e., a bias towards positive information) is diminished, whereas at later stages of the disorder, or at clinical levels, biases towards negative information might then emerge. Meta-analytic evidence also supports this idea as it has shown that individuals meeting diagnostic criteria for major depressive disorder present a larger maintenance bias towards negative stimuli than individuals classified as dysphoric based on a cut-off score in a scale of symptoms (Armstrong & Olatunji, 2012). These results highlight two different ideas. First, appearance of attentional biases might depend on the course of the disorder and the levels of symptoms. Second, and perhaps more interesting, an attenuated processing of positive information might be more relevant to the onset of depressive disorder than a bias towards negative information. Recent research has highlighted the central role that positivity (i.e., positive affect and positive cognitions) plays in psychopathology (Vazquez, 2017; Blanco & Joormann, 2018) and, specifically, in depression (Watson & Naragon-Gainey, 2010). It might be possible that the absence of a positive protective bias (i.e., the tendency to preferentially processing positive information) is a more central cognitive mechanism in the onset of depression, whereas that negative biases (i.e., the tendency to preferentially process negative information) would mainly emerge, perhaps as a maintenance factor, once the depressive disorder has been established or when an individual faces significant life difficulties. Future studies using longitudinal designs with high vulnerable participants is needed to address these issues. Further, recent research in clinically depressed patients has shown that both attentional biases towards negative information and away from positive information can be modified through psychological treatment (see Vazquez et al., 2018). Therefore, studies using clinical samples would be very helpful to clarify the stability of both types of attentional biases, the temporal course of them as well as whether depressed patients are more likely to show negative attentional biases when antagonist emotional stimuli are simultaneously presented.

Another plausible explanation for these unexpected pattern of results (i.e., the absence of attentional biases towards negative information in the dysphoric sample) might be due to the interpretation that dysphoric participants do of neutral stimuli. Previous research has showed that depressed people tend to interprete ambiguous information, such as neutral faces, in a negative manner (Beevers, Wells, Ellis, & Fischer, 2009; Leppänen, Milders, Bell, Terriere, & Hietanen, 2004; Soltani et al., 2015). Therefore, it might be possible that this negative interpretation leads to the absence of differences in the attentional processing of neutral vs. sad information. This inference highlights the complexity of selecting proper stimuli when assessing cognitive

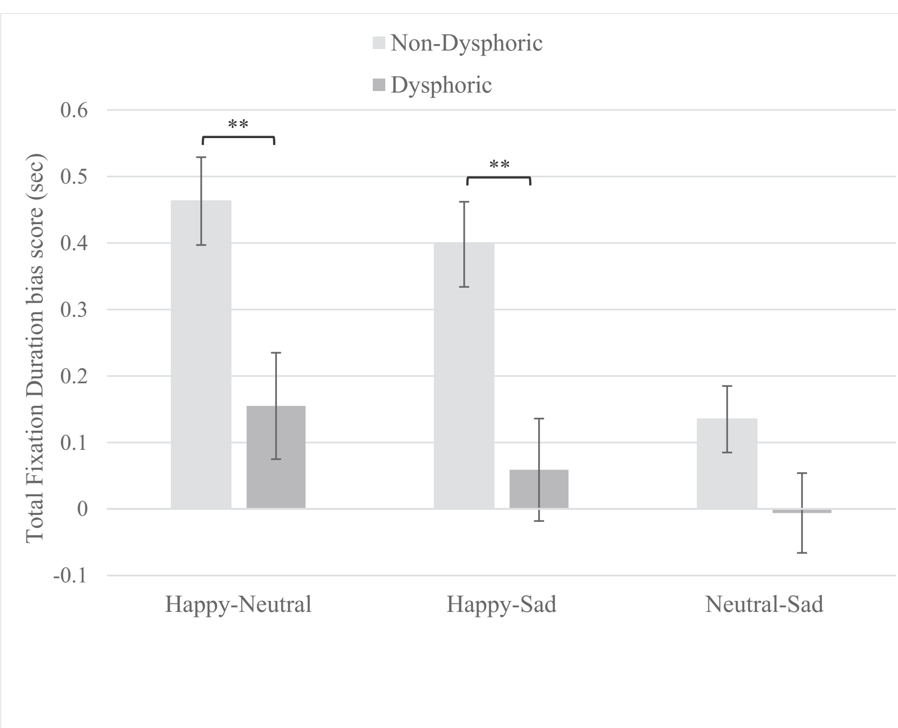

Fig. 2. Differences between groups on total fixation duration bias scores for emotional and neutral faces within different types of trial (Happy-Neutral, Happy-Sad, Neutral-Sad).
Note. ** = $p < .01$. Positive scores reflect a bias towards the first element of the pair of stimuli whereas negative scores reflect a bias towards the second element of the stimulus pair.

processing such as selective attention. Thus, further research should take this into account when using neutral information by, for instance, selecting less ambiguous neutral stimuli.

In summary, attentional biases towards positive information are apparent when positive information is presented with both neutral and negative information, and only in stages of attentional processing related to controlled processing (as measured by total time of fixation measures). Thus, it seems that the capacity of positive information to activate biases of processing is quite robust under a variety of experimental stimulus settings. Furthermore, the finding that the presentation of positive and negative stimuli simultaneously diminishes the attentional biases towards positive information should be considered in future studies.

The study has some strengths and limitations. Firstly, to the best of our knowledge, this is the first eye-tracking study that assesses attentional biases in depression when two emotional stimuli that represent antagonistic emotions are presented simultaneously to compete for the participants' attention. Furthermore, this is also the first study that systematically controls low-level features of facial stimuli when assessing attentional biases. Regarding the limitations, the cross-sectional nature of the present study does not allow us to make any inferences about the causal implications of the results. Moreover, dysphoria was only measured with an inventory of symptoms of depression but there was neither a clinical diagnosis using a structured interview nor any information on past episodes of depression. As other studies have shown, participants with past history of depression may still show cognitive biases of emotional information (Sears et al., 2011). Lastly, the study only included one type of negative stimuli (i.e., sad faces). As there is some controversy about whether other negative emotional faces (e.g., anger) may also elicit attentional biases in depressed participants (Gotlib, Krasnoperova, Yue, & Joormann, 2004; Sanchez et al., 2013), further research should explore whether different pairs of emotional stimuli, other than the happy-sad pairs, are capable of eliciting specific biases linked to depression.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the present study.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbtep.2019.101499.

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