Double attention bias for positive and negative emotional faces in clinical depression: Evidence from an eye-tracking study

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1. Introduction

According to cognitive models (Beck, 1967, 1976; Bower, 1981), biases in the processing of emotional information have a crucial role in the onset and maintenance of depressive symptoms. These theories predict that depressed individuals can be characterized as displaying negative biases in all aspects of information processing, including interpretation, memory, and attention.

Depressed individuals have been found to have attentional biases in some cognitive reaction-time tasks; however, evidence for this negative bias is mixed (Mogg & Bradley, 2005). In the emotional Stroop color-naming task, researchers have observed an increase in the interference by negative words in individuals with depression. However, this interference was only found in conditions when relatively long stimuli exposure durations of 1 s or more were used (Gotlib & Cane, 1987; Segal, Gemar, Truchon, Guirguis, & Horowitz, 1995). Studies in which words were presented for shorter durations have typically obtained null findings (Bradley, Mogg, Millar, & White, 1995; Mogg, Bradley, Williams, & Mathews, 1993). Similar results have been found with the dot-probe task. For example, Donaldson, Lam, and Mathews (2007) presented 72 pairs of words (36 words each at 500 ms and 1000 ms durations) to a sample of depressed patients. They found that individuals with clinical depression were faster than non-depressed controls in detecting dot-probes that appeared in the same location as a negative word when it was presented for 1000 ms. Both groups were observed to equally attend to stimuli presented for 500 ms durations. Given this pattern of findings, some authors have suggested that depression is characterized by elaborative, rather than automatic processing, in contrast to anxiety disorders (Mogg & Bradley, 2005). According to this notion, Teachman, Joormann, Steinman, and Gotlib (2012) have concluded that attentional biases in depression are conscious and intentional, while those observed in anxiety disorders are unconscious and unintentional.

In accordance with this view, other researchers have proposed that depressed individuals may not necessarily be quicker at directing their attention to negative information than control participants, but that once negative stimuli capture their attention they experience difficulties disengaging their focus (Gotlib & Joormann, 2010). Unfortunately, the reaction time tasks used in these studies are not able to directly assess whether the attentional
biases in depression are located in the orienting components presumed to be more automatic or the maintenance components presumed to be more elaborative.

In addition to the duration of stimulus presentation, studies that used more ecological stimuli such as images or scenes instead of words were more likely to find a negative attentional bias in depression. This phenomenon has been attributed to the fact that, in general, pictures are able to convey more affective information than words (Glaser & Glaser, 1989). The majority of studies have used images of emotional facial expressions. Gotlib, Kasch, et al. (2004) found that, compared to healthy individuals, clinically depressed participants showed an attentional bias to sad faces. Similar results have been obtained in other studies using facial expressions (Fritzsche et al., 2010; Gotlib, Krasnoperova, Neubauer, & Joormann, 2004; Joormann & Gotlib, 2007). It is also important to note that, with some exceptions (Leyman, De Raedt, Schacht, & Koster, 2007; Sanchez, Vazquez, Marker, Lemoult, & Joormann, 2013), this negative attention bias in depression tends to be specific to depression-related information and not to other types of negative stimuli, such as threatening cues (Gotlib, Kasch, et al., 2004; Gotlib, Krasnoperova, et al., 2004; Hankin, Gibb, Abela, & Flory, 2010). Oehlberg, Revelle, and Mineka (2012) recently demonstrated that attentional biases to dysphoric information appeared to only relate to depressive symptoms, while biases to anxiety-related information were associated with overall negative affect.

Additionally to greater attentional processing of negative stimuli, some studies have shown the absence of a “protective bias” in depressed patients. This bias is characterized by an attentional preference for positive information and is typically present in non-depressed individuals (McCabe & Gotlib, 1995; Shane & Peterson, 2007). The absence of a protective bias has been interpreted as evidence of insensitivity to reward, such that rewarding stimuli fail to capture attention (Armstrong & Olatunji, 2012). Reduced attention to positive stimuli could be related to deficits in positive affect, a factor that appears specific to depressive disorders (Clark & Watson, 1991; Watson & Naragon-Gainey, 2010).

The majority of studies that have already been discussed used response latency tasks, which assess attentional bias indirectly and do not differentiate between the different components of attention (e.g., orienting attention versus maintenance of attention; Yiend & Mathews, 2005). Moreover, they do not account for the possibility that attentional biases may be confounded by motor retardation in depressed individuals (Mathews, Ridgeway, & Williamson, 1996). To overcome these limitations, researchers interested in selective attention processes have turned to eye movement recording tasks because they provide a relatively continuous and direct measure of deployment of attention. The recent meta-analysis conducted by Armstrong and Olatunji (2012) reviews the existing eye-tracking research on depression and anxiety. In their review they included nine eye-tracking studies with depressed participants but only two of them were conducted with clinical samples. Results from these studies have revealed that analogue participants maintain longer gazes with negative stimuli (Caseras, Garner, Bradley, & Mogg, 2007; Leyman, De Raedt, Vaeyens, & Phillipaerts, 2011) and shorter gazes with positive ones (Ellis, Beevers, & Wells, 2011; Sears, Thomas, LeHuquet, & Johnson, 2010) compared with control participants. However, orienting biases to negative information have yet to be found, except by Sears, Newman, Ference, and Thomas (2011) who found a bias in the initial orientation to depression-related images.

Regarding the studies conducted with clinically depressed participants, the results are not conclusive because the two existing studies use very different experimental methodologies. Kellogg, Beevers, Ellis, and Wells (2008) designed a $2 \times 2$ matrix with dysphoric, aversive, positive, and neutral images. These authors found that depressed participants spent more time viewing dysphoric images relative to positive, aversive, and neutral ones in comparison to healthy controls. No orienting biases to negative information were found. On the other hand, Mogg, Millar, and Bradley (2000) designed an attentional task with pairs of images comprising an emotional and a neutral facial expression that were displayed for a relatively short period (i.e., 1000 ms). In this study, orienting components of attention were assessed (i.e., initial orientation and latency for the first orientation), but maintenance components were not. The data revealed that clinically depressed patients did not show orienting biases to negative information.

Despite these initial findings, further research using eye-tracking technology is necessary to clarify the role of attentional biases in depression. To better elucidate the mechanisms underlying attentional biases in depression, our study improved several methodological domains found in current literature. Firstly, our research builds upon existing literature by including participants with clinical depression rather than analogue samples. Secondly, unlike in earlier studies, we included in the same design orienting and maintenance measures to assess both components of attentional biases simultaneously. Another improvement of our study over previous research is that we included two different parameters to assess orienting and maintenance components. More specifically, we assessed orienting response by direction and latency of initial gaze, similar to Mogg et al. (2000), whereas we measured maintenance response by duration of the first fixation and total fixation time (see procedure below). Also, to enhance the detection of maintenance components (Gotlib & Joormann, 2010) we used a relatively long exposure time for the stimuli (i.e., 3000 ms). Therefore, the current study was designed to assess the different components of visual attention in depressed and non-depressed participants when presented with negative, positive, and neutral facial expressions in a free viewing paradigm. The advantage of using emotional faces is that they are more likely to be ecologically valid than words (Gross, 2005) and are better at attracting attention due to their higher interpersonal relevance. Based on previous studies of eye movement (Eizenman et al., 2003; Kellough et al., 2008) and reaction time tasks (Gotlib, Kasch, et al., 2004; Gotlib, Krasnoperova, et al., 2004), we hypothesized that depressed participants would show a negative bias in the maintenance of gaze specifically with regards to sad facial expressions (i.e., duration of the first fixation and total fixation time) but not in the orientation of gaze (i.e. direction and latency of initial gaze). With respect to happy expressions, our second hypothesis was that the depressed group would show an absence of positive bias in comparison with the control group in the maintenance of gaze indices (Ellis et al., 2011). Finally, in accordance with Oehlberg et al. (2012), we hypothesized that the severity of depression would be related specifically to the magnitude of attentional biases to sad facial expressions but not angry ones.

2. Method

2.1. Participants

A sample of 16 participants diagnosed with current MDD and 34 never-depressed controls (ND) took part in the study. Depressed patients were recruited from an outpatient university psychology clinic before therapy had begun. Trained interviewers administered the Structured Clinical Interview for the DSM–IV (SCID; First, Spitzer, Gibbon, & Williams, 1995) to patients during their first session in the study and those with a primary diagnosis of MDD were included in the depressed group. Individuals with current or lifetime diagnosis of Bipolar Disorder, psychotic symptoms, and
those who abused alcohol or other substances within the past 6 months were excluded. The ND group consisted of individuals who did not have a current diagnosis or past history of any Axis I disorder according to the SCID. All participants were between the ages of 18 and 55 and had normal or corrected-to-normal vision. All individuals were required to refrain from taking any psychotropic medication at the time of the study.

2.2. Self-report measures of depression

Participants completed the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996), a 21-item self-report measure of depression. Each item was rated on a Likert scale with four possible answer choices increasing in intensity from 0 to 3 to yield a total BDI-II score that ranged from 0 to 63. This measure has shown excellent reliability and validity (Beck et al., 1996). In the current study, the internal consistency of the BDI-II was very good (α = .93).

2.3. Eye-tracking paradigm

2.3.1. Materials

Stimuli consisted of pairs of images that were comprised of an emotional and a neutral facial expression made by the same person (see Fig. 1). A set of 28 faces (14 men and 14 women), each expressing happy, angry, sad, and neutral emotions, were selected from the Karolinska Directed Emotional Faces (KDEF) database (Lundqvist, Flykt, & Ohman, 1998). Original KDEF frontal view pictures were framed with an oval window to remove non-informative aspects of the faces such as the hair and neck. This editing procedure has been used in previous studies (Calvo & Lundqvist, 2008; Williams, Moss, Bradshaw, & Mattingley, 2005). Image selection was based on data from a previous validation study of KDEF emotional pictures (Sanchez & Vazquez, 2013), which measured emotional prototypicality of the faces for each corresponding emotion, and their emotional intensity (Schaefer, Nils, Sanchez, & Philippot, 2010). Specifically, prototypicality and intensity of each emotional face were measured by two independent 0–10 Likert scales, where 0 indicated “Not at all”, 5 “Some” and 10 “Extremely”. Analyses showed that the three types of emotional faces did not differ significantly in prototypicality, $F(2, 81) = 1.21$, n.s., $\eta^2 = .029$ or in their intensity, $F(2, 81) = 1.39$, n.s., $\eta^2 = .03$. The mean scores for emotional prototypicality for the happy, angry, and sad expressions were 5.53 (SD = .39), 5.39 (SD = .52), and 5.32 (SD = .62), respectively. Mean intensity scores were 5.55 (SD = .51), 5.86 (SD = .58), and 5.76 (SD = .94), respectively.

2.3.2. Apparatus

Eye location and visual gaze were assessed with a Tobii tx-120 infrared eye-tracker system that allowed for recording at a frequency of 60 Hz (coordinates were sampled every 16.7 ms). Head position was kept stable with the use of an anatomic chair. Participants’ eyes were kept at a distance of 60 cm from the eye-tracker and 73 cm from the screen. A five-point calibration was performed before each recording session. Eye movements that lasted for a minimum of 100 ms within a 1° visual angle were classified as a fixation. Tobii Studio software (2.0.6) was used for stimuli presentation and collection of visual fixation data. Two areas of interest were identified for each trial that corresponded with the total area for the emotional face and the neutral face.

2.4. Procedure

After signing informed consent, the SCID was administered at the first study visit. Selected participants returned one week later to take part in the experimental session. This two-session procedure is often used to minimize fatigue effects in clinically depressed participants (Gotlib, Kasch, et al., 2004; Gotlib, Krasnoperova, et al., 2004; Joormann & Gotlib, 2007). The attention task was administered upon completion of the BDI-II.

The free viewing task was comprised of 84 trials (28 images each of happy, angry, and sad expressions paired with the corresponding neutral expression by the same actor or actress) which were displayed on a 53 cm (width) × 30 cm (height) screen. Emotional and neutral expressions were presented equally as often on the left as on the right side of the screen. The display size of each facial expression was 9.5 cm (width) × 12 cm (height). Participants were seated in an anatomic chair at a distance of 73 cm from the screen, representing a horizontal visual angle of 14° between the two pictures.

Each trial began with presentation of a black screen for 500 ms, which was followed by the display of a white fixation cross in the middle of the screen for another 500 ms. Immediately after, a random 1-digit number (also in white) replaced the fixation cross for a duration of 1000 ms. Participants were instructed to fixate on the number and to verbalize it as quickly as possible to ensure that

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Fig. 1. Representation of actual data that portrays a participant’s eye-movement pattern in an experimental trial (faces AF13NES, AF13SAS). Circles depict fixations and their diameters indicate duration of each fixation. Lines connecting fixations represent the fixation sequence.
2.5. Dependent variables

Using gaze data collected by the eye-tracker system, four attentional indices were extracted for the present study:

a) Direction of initial gaze (i.e. location of the first fixation, either on the emotional or neutral facial expression, in each trial).

b) First fixation latency (i.e. time elapsed until the first fixation occurs on each type of facial expression in each trial).

c) First fixation duration (i.e. duration of the first fixation made on each type of facial expression in each trial).

d) Total fixation time (i.e. total time that each subject fixates on each type of facial expression in each trial).

2.5.1. Shane scores

Shane and Peterson (2007) asserted that relative bias scores might be more relevant indicators of depression-associated processing of emotional information than absolute indices comparing emotional with neutral information. Following this guideline, relative bias scores were computed for each attentional index associated with each emotional category. For direction of initial gaze, we calculated the percentage of trials in which a subject associated with each emotional category. For direction of initial emotional with neutral information. Following this guideline, processing of emotional information than absolute indices comparing might be more relevant indicators of depression-associated preference for neutral ones. With regards to latency, first fixation duration, and total fixation time, we calculated bias scores by subtracting the corresponding value obtained for the neutral expression from the corresponding value obtained for the emotional expression. Score indices based on differences as these have been employed in previous research (Duque, Sánchez, & Vázquez, 2014). Scores greater than zero were interpreted as a bias towards emotional expressions whereas those lower than zero indicated a preference for neutral ones.

2.6. Data analysis plan

A series of 2 (Group: depressed, never-depressed) × 3 (Emotional category: happy, angry, sad) mixed-model analysis of variance (ANOVA) was conducted to test our first and second hypotheses to investigate whether clinically depressed patients differed from never-depressed individuals in the attentional processing of emotional information. Bonferroni follow-up tests were used to further analyze significant differences.

A series of zero-order correlation analyses was conducted to explore the relationships between attentional bias indices and depressive symptoms in order to test our third hypothesis.

3. Results

3.1. Group characteristics

As shown in Table 1, participants in the depressed group reported significantly greater symptoms of depression than those in the control group, t (18.11) = 4.92, p < .001. Groups did not differ in age, t (48) = .11, p = .91, gender ratio, χ² (1, n = 50) = 1.24, p = .27, education level, χ² (1, n = 50) = .04, p = .83, or marital status, χ² (2, n = 50) = .54, p = .76.

3.2. Attentional processing of emotional information

Eye movement data were initially processed using Tobii Studio Software (2.0.6). Only participants with high quality recordings (>70%) were included in data analysis. Trials with missing data were removed from analyses. The MDD and ND groups did not differ in the number of trials removed, t (48) = .78, p = .44.

Outlier analysis was conducted using Cook’s distance. Cases with values larger than 1 are considered to possibly bias the results (Tabachnick & Fidell, 2007). In our sample, the maximum value for Cook’s distance was .29, suggesting no major outlier bias.

3.2.1. Direction of initial gaze

A 2 (Group: MDD, ND) × 3 (Emotional category: happy, angry, sad) mixed-model ANOVA was conducted to explore the location of the first fixation in each trial. Analyses showed a non-significant group × emotion interaction, F (2, 96) = .37, p = .69, η² = .008, and a non-significant main effect for group, F (1, 48) = .39, p = .53, η² = .008. There was a significant main effect of emotional category, F (2, 96) = 7.41, p = .001, η² = .13, which revealed a greater initial tendency to fixate on happy faces than on those with angry (p = .03) and sad (p = .001) expressions. To explore this attentional pattern in more detail, we compared each bias score with a value of 50% (no bias). Analyses showed that bias scores for happy, t (49) = 5.62, p < .001, angry, t (49) = 2.51, p = .01, and sad, t (49) = 2.20, p = .03, faces were statistically different from the no-bias criterion. Mean scores were 58.76% (SD = 11.03), 53.02% (SD = 8.51), and 52.32% (SD = 7.45), respectively. These results indicate that initially, participants tended to fixate more frequently on the emotional expression than on the neutral one in each emotional category. This bias was especially true for happy faces. Of note, one characteristic of this task is that emotional faces (for each emotional category) and neutral faces appeared in a ratio of 1:3. Therefore, it is possible that the salience of emotional stimuli may have contributed to the participant’s observed tendency to direct the initial gaze more frequently to emotional rather than to neutral faces.

3.2.2. First fixation latency

A 2 (Group: MDD, ND) × 3 (Emotional category: happy, angry, sad) mixed-model ANOVA showed a non-significant interaction between emotional category and group, F (2, 47) = .01, p = .98, η² = .001, a non-significant main effect for group, F (1, 48) = 1.88, p = .17, η² = .04, and a significant main effect for emotional category, F (2, 47) = 13.16, p < .001, η² = .36. Follow-up comparisons
revealed that participants fixated faster on happy faces than on those with angry ($p = .02$) and sad ($p < .001$) expressions. Comparisons with a no-bias criterion (zero) indicated that participants fixated faster on emotional, rather than neutral facial expressions in the happy, $t (49) = -6.11, p < .001$, angry, $t (49) = -3.94, p < .001$, and sad, $t (49) = -2.89, p = .01$ categories. This bias was also observed to be greater for happy faces. As noted above, these findings are limited by the low ratio of emotional faces in each category, which may have contributed to the observed tendency of participants to fixate faster on emotional than on neutral faces.

### 3.2.3. First fixation duration

A 2 (Group: MDD, ND) $\times$ 3 (Emotional category: happy, angry, sad) mixed-model ANOVA examined whether MDD and ND groups differed in the first fixation duration in each emotional category. Analyses showed a non-significant effect for emotional category, $F (2, 96) = 2.02, p = .14$, $\eta^2 = .04$, and a non-significant main effect for group, $F (1, 48) = .93, p = .34$, $\eta^2 = .02$. There was a significant group $\times$ emotional category interaction, $F (2, 96) = 3.50, p = .03$, $\eta^2 = .07$. Post-hoc analyses indicated that, compared with the ND group, participants with MDD had significantly longer first fixation durations on sad faces ($p = .05$). No differences were found for happy ($p = .25$) and angry expressions ($p = .28$) see Fig. 2. Attentional bias scores to sad faces were compared with a no-bias criterion (zero) for each group in order to reveal whether differences between the MDD and ND groups were attributable to a bias in either one or both of the groups. These analyses showed that participants in the MDD group had an attentional bias which was characterized by longer first fixation duration on sad facial expressions, $t (15) = 3.00, p = .01$, whereas ND participants did not show any attentional bias, $t (33) = -.17, p = .86$.

### 3.2.4. Total fixation time

A 2 (Group: MDD, ND) $\times$ 3 (Emotional category: happy, angry, sad) mixed-model ANOVA was conducted to examine whether MDD and ND groups differed in the total fixation time in each emotional category. Analyses showed a non-significant main effect for group, $F (1, 48) = 1.34, p = .25$, $\eta^2 = .03$, and a significant main effect for emotional category, $F (2, 47) = 4.08, p = .02$, $\eta^2 = .15$. This main effect was qualified by a significant group $\times$ emotional category interaction, $F (2, 47) = 3.24, p = .04$, $\eta^2 = .12$. Post-hoc analyses indicated that patients with MDD spent significantly more time viewing sad faces than those in the ND group ($p = .04$) see Fig. 3. The MDD group also spent marginally less time viewing happy faces compared to the ND group ($p = .06$). No differences were found with respects to angry faces ($p = .13$) Attentional bias scores for sad and happy facial expressions were compared with a no-bias criterion (zero) for each group in order to clarify whether differences between MDD and ND groups were due to a bias in either one or both of the groups. Analyses showed that participants with MDD had an attentional bias to sad faces which was characterized by longer total fixation times, $t (15) = 2.19, p = .04$, whereas ND participants did not show this bias, $t (33) = -.11, p = .27$. Rather, the ND group was shown to have an attentional bias to happy faces, $t (33) = 5.41, p < .001$. The MDD group also showed this bias, $t (15) = 2.22, p = .04$; however, as noted above, it was marginally greater for the ND group.

### 3.3. Relationships between attentional indices and depressive symptoms

A series of bivariate correlation analyses was conducted to explore whether attentional bias scores were associated with severity of depressive symptoms. Table 2 shows the zero-order

### Table 2

<table>
<thead>
<tr>
<th>Attentional bias scores</th>
<th>BDI-II</th>
</tr>
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<tbody>
<tr>
<td>Direction initial gaze-happy</td>
<td>-.04</td>
</tr>
<tr>
<td>Direction initial gaze-angry</td>
<td>.20</td>
</tr>
<tr>
<td>Direction initial gaze-sad</td>
<td>.18</td>
</tr>
<tr>
<td>Latency first fixation-happy</td>
<td>.02</td>
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<tr>
<td>Latency first fixation-angry</td>
<td>-.25</td>
</tr>
<tr>
<td>Latency first fixation-sad</td>
<td>-.22</td>
</tr>
<tr>
<td>First fixation duration-happy</td>
<td>-.13</td>
</tr>
<tr>
<td>First fixation duration-angry</td>
<td>-.12</td>
</tr>
<tr>
<td>First fixation duration-sad</td>
<td>.13</td>
</tr>
<tr>
<td>Total fixation time-happy</td>
<td>-.24</td>
</tr>
<tr>
<td>Total fixation time-angry</td>
<td>.261</td>
</tr>
<tr>
<td>Total fixation time-sad</td>
<td>.361**</td>
</tr>
</tbody>
</table>

Note: **$p < .001$, BDI-II = Beck Depression Inventory--II.
correlation coefficients. Analyses revealed only one significant relationship: symptoms of depression were positively associated with the total time that participants fixated on sad facial expressions. The remaining associations were not found to be significant.

4. Discussion

The current study examined the attentional processing of emotional information, specifically with regards to emotional facial expressions in depression. We also investigated the relationship between the magnitude of attentional biases to emotional information and the severity of depressive symptoms. The present study included clinically depressed patients and never depressed participants. Furthermore, in order to increase the reliability of the results, we analyzed all measures of orienting and maintenance biases using two different indices for each one.

In our first hypothesis, we predicted that participants with MDD would show a specific negative attentional bias to sad faces in the maintenance of gaze, but not in the orienting of gaze, compared with those in the ND group. The results confirmed the first hypothesis: clinically depressed participants demonstrated longer first fixation duration and greater total fixation time on sad facial expressions. However, no group differences were found in the orienting indices (i.e., the direction of initial gaze and first fixation latency). These results are consistent with findings from previous studies that have found that attentional bias to negative information in depressed individuals is mostly present in the later stages of deployment of attention (Gotlib, Krasnoperova, et al., 2004; Kellogg et al., 2008). Furthermore, such findings support the idea that although depression is not characterized by an initial orienting bias toward negative information, individuals with depression have greater difficulties in disengaging their attention from negative information once it is in their attentional focus (Bradley, Mogg, & Lang, 1999).

Problems with inhibiting attention to negative stimuli in MDD have been linked to an ineffective use of mood regulation strategies which contribute to the maintenance of negative affect (Joormann & D'Avanzato, 2010). It should be noted that in our study, attentional biases to negative information were found only toward stimuli related to depression (i.e. sad faces) and not to other kinds of negative information (i.e. angry faces). These results are consistent with other studies that, not using eye-tracking methods, have shown a specific attentional bias to sad, but not angry or threatening, facial expressions in clinically depressed samples (Gotlib, Kasch, et al., 2004; Hankin et al., 2010).

Our second hypothesis with regards to the processing of positive information (i.e. happy faces) was partially supported. Although participants in the MDD group spent less total time viewing faces with happy emotional expressions than ND participants, this effect was found to only reach marginal significance. The greater proportion of negative (sad and angry) than positive stimuli (happy) may have made happy faces more salient for both groups. Thus, it is possible that the observed differences between both groups in the total fixation time to positive stimuli would have been greater without a saliency effect. Nevertheless, this trend is consistent with other eye-tracking studies that have found a robust bias toward happy faces in healthy participants using similar attentional indices (Ellis et al., 2011; Sánchez & Vázquez, 2014). No group differences were found however, in the duration of the first fixation to happy faces. Collectively, these results suggest that attentional bias to positive information in healthy individuals could be explained by greater processing of happy facial expressions across trials rather than by initial engagement as assessed by first fixation (Kellogg et al., 2008). Although no specific prediction was made on orienting indices to happy faces, no differences were found in the direction of initial gaze and first fixation latency.

Attentional deployment to emotional information is considered to play a key role in emotional regulation (Gross, 1998). Attentional deployment is an antecedent-focused regulatory strategy; therefore, it occurs before an emotional response can be fully generated. According to this idea, it could be hypothesized that attending to positive or negative stimuli would improve or worsen an individual's emotional state, respectively. In fact, some preliminary research has shown that difficulty in disengaging focus from negative facial expressions predicts slower recovery from a negative-mood induction procedure in depressed patients (Sánchez et al., 2013). In our study, the trend observed in the ND group to fixate on happy faces versus the MDD group could be interpreted as a cognitive mechanism through which mood is regulated. Interestingly, a previous study has shown, in a nonclinical sample of participants, that an increased focus on happy faces after a negative mood induction is associated to an enhanced mood recovery (Sánchez, Vázquez, Gómez, & Joormann, 2014). Therefore, these overall results suggest that attentional processing of positive information may play a relevant role as a mood repair mechanism.

It is possible that the attentional pattern observed in healthy individuals operates as a protective bias to facilitate or regulate mood in a positive way and to maintain positive emotional balance (McCabe, Gotlib, & Martin, 2000). Along a similar vein, Sánchez et al. (2014) found a preference for happy facial expressions in a sample of university students, suggesting the presence of greater processing of positive information in the general population. This bias toward positive stimuli was also associated with greater life satisfaction and positive emotions. In contrast, the attentional biases (i.e. greater processing of negative stimuli and reduced processing of positive stimuli) observed in our sample of depressed participants may contribute to the exacerbation and maintenance of symptoms of depression.

Over the last few years, Cognitive Bias Modification paradigms, particularly those intended to modify attentional biases, have been implemented to promote better emotional regulation through attentional deployment training. For example, Wells and Beever (2010) observed that repeatedly training attention away from dysphoric stimuli lead to a reduction in symptoms of depression over time. Similarly, Baert, De Raedt, Schacht, and Koster (2010) found that training attention toward positive stimuli alleviated symptom severity in students experiencing mild depressive symptoms. Although further research is necessary to confirm the efficacy of these paradigms in emotional regulation, initial findings suggest that attentional biases to emotional information, such as the ones shown in our sample of clinically depressed participants, are a relevant feature of information processing in depression.

Our third hypothesis with respects to the association between attentional biases and symptoms of depression was partially supported. Severity of depressive symptoms was positively associated with the total fixation time, but not first fixation duration, to sad facial expressions. Although previous eye-tracking studies have considered the first fixation time as an index of maintenance of attention (Caseres et al., 2007), we considered the total fixation time to be a more robust index of sustained attention due to its inclusion of processing across trials. In contrast, the first fixation duration index only offers a snapshot of the beginning of each trial. This difference between the two indices could explain the results obtained in our study in relation to severity of depression. As expected, concordant with the study by Oehlberg et al. (2012), only the bias to depression-related stimuli (i.e. sad faces) was associated with depressive symptom scores. Again, this result suggests that depression is a mood disorder specifically related to processing of emotionally-congruent information rather than overall processing of negative information (Gotlib, Kasch, et al., 2004).
Collectively, the results of the present study are consistent with cognitive models (e.g. Beck, 1976) that have proposed that depressed individuals show a greater tendency to process negative information. Moreover, our study showed that depressed patients prefer those interpersonal cues congruent with their mood. This result may inform our understanding of why depressed persons have interpersonal problems (Gotlib & Hammen, 2002). Yet, our study suggests that, in regard to attention processes, attentional biases appear not in initial stages of information processing but in later ones. Although this adds a significant step in the differentiation of attentional components in clinical depression, we acknowledge some limitations in our study. Since our results are based on cross-sectional data, we are unable to draw conclusions about causality. A further limitation of this study is its relatively small sample size and subsequently, its limited power in detecting differences between the groups. Although this sample size is common in similar studies using eye-tracking methodologies (e.g., Mogg et al., 2000), studies with larger samples of clinical participants and participants characterized by greater severity of symptoms could reveal stronger group differences in attentional biases with regards to positive and negative information.

In summary, our study has confirmed that clinically depressed individuals do not show attentional biases to negative emotional stimuli (i.e., sad and angry faces) in the initial stages of deployment of attention (Mogg et al., 2000). Yet, total fixation times revealed that depressed participants showed a specific maintenance bias toward sad faces. Moreover, the results showed a positive relationship between the magnitude of this attentional bias and the severity of depressive symptoms. Finally, in regard to the processing of positive information, participants with MDD showed reduced processing of happy faces in comparison to those who had never been depressed. These results indicate that depression may be associated with a double bias consisting of sustained attention to negative stimuli and a simultaneous reduced attention to positive stimuli. If these findings are replicated in further studies, future interventions aimed at correcting cognitive biases could be developed to mitigate this bidirectional bias.

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References


