

**CBT and positive psychology interventions for clinical depression promote healthy attentional biases: An eye-tracking study**

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8 CBT and positive psychology interventions for clinical depression promote healthy  
9 attentional biases: An eye-tracking study  
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## Abstract

**Background:** Although there is a growing interest in the role of attentional biases in depression, there are no studies assessing changes in these biases after psychotherapeutic interventions.

**Methods:** We used a validated eye-tracking procedure to assess pre-post therapy changes in attentional biases towards emotional information (i.e., happy, sad and angry faces) when presented with neutral information (i.e., neutral faces). The sample consisted of 75 participants with major depression or dysthymia. Participants were blindly assigned to one of two 10 weekly sessions of group therapy: a CBT intervention (N=41) and a Positive Psychology Intervention (N=34).

**Results:** Both treatments were equally efficacious in improving depressive symptoms ( $p = .0001$ ,  $\eta^2 = .68$ ). A significant change in attentional performance after therapy was observed irrespective of the intervention modality. Comparison of pre-post attentional measures revealed a significant reduction in the total time of fixations (TTF) looking at negative information (i.e., sad and angry faces) and a significant increase in the TTF looking at positive information (i.e., happy faces) -all  $p$ -values  $>.02$ .

**Conclusions:** Findings reveal for the first time that psychotherapeutic interventions are associated with a significant change in attentional biases as assessed by a direct measure of attention. Furthermore, these changes seem to operate in the same direction typically found in healthy populations (i.e., a bias away from negative information and a parallel bias towards positive information). These findings illustrate the importance of considering attentional biases as clinical markers of depression and suggest the viability of modifying these biases as a potential tool for clinical change.

## 1. Introduction

The role that attentional biases play in depression has received increased attention in theoretical models of the disorder (Disner, Beevers, Haigh & Beck, 2011). These biases have been investigated across various experimental paradigms. Using the emotional Stroop task, it has been observed that depressed participants show interference effects for both negative and positive words (Epp, Dobson, Dozois, & Frewen, 2012; Peckham, McHugh & Otto, 2010). Likewise, dot-probe tasks have demonstrated that depressed patients show a consistent attentional bias toward negative words (Donaldson, Lam & Mathews, 2007) and negative pictures (Fritzsche et al., 2010) as well as a bias away from positive stimuli (Winer & Salem, 2016).

Yet, standard assessment procedures of proxy measures of attention based on reaction times, such as those indexed in the Stroop task or the dot-probe, have been criticized because they do not allow investigators to explore the unique mechanisms underlying different stages of attentional processing (Yiend & Mathews, 2004). Moreover, their reliability has also been questioned (Waechter, Nelson, Wright, Hyatt, & Oakman, 2014; Vazquez, Blanco, Sanchez, & McNally, 2016). An alternative to these procedures is eye-tracking methodologies. Using this approach, researchers have found that depressed participants fixate their gaze longer on negative stimuli than control participants (Caseras, Garner, Bradley & Mogg, 2007; Leyman, De Raedt, Vaeyens, & Phillipaerts, 2011). Interestingly, these biases have only been observed in the late and controlled components of attention (e.g., total fixation time), but not in early and automatic components (e.g., direction of initial gaze) - Armstrong & Olatunji (2012). In other words, it seems depressed individuals have difficulties disengaging their gaze from negative stimuli once the negative stimuli have captured their attention.

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4 Additionally, depressed individuals also have difficulties engaging their attention  
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6 towards positive information (Duque & Vazquez (2015)).  
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10 Most of the extant evidence on attentional biases in clinical depression is limited  
11 to cross-sectional studies. Therefore, research focused on analyzing changes in  
12 attentional biases after treatments for depression may clarify whether or not these biases  
13 are a stable characteristic associated with the disorder as well as their relationship with  
14 depression symptoms. Some studies have analyzed changes in attentional performance  
15 before and after cognitive therapy for depression using reaction time tasks or clinical  
16 neuropsychological tests (Segal & Gemar, 1997; Groves et al., 2015). However, at  
17 present, there are no studies in which attentional patterns to emotional information have  
18 been directly assessed using an eye-tracking paradigm following psychological  
19 interventions for clinical depression. In the current study, we explored changes in  
20 attentional patterns to emotional information (i.e. emotional faces) in a sample of  
21 clinically depressed patients under one of two different treatments for depression: CBT  
22 vs. positive psychology interventions (PPI).  
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37 CBT is the most widely researched psychological treatment for depression  
38 (Hofmann, Asmundson & Beck, 2013). It is recommended in treatment guidelines and  
39 the evidence supporting its efficacy for treating depression is strong (Cuijpers et al.,  
40 2011; Moriana, Gálvez-Lara & Corpas, 2017). The main objective of CBT for  
41 depression is to challenge the content of negative thoughts, address cognitive biases in  
42 the processing of emotional information, and alleviate depressive symptoms and  
43 deficits.  
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52 PPI are a theoretically-grounded and empirically-based promising approach to  
53 increase positive emotions and psychological well-being (Lomas, Hefferon & Ivtzan,  
54 2016) which are considered critical psychopathological features of depression (Watson  
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4 & Naragon-Gainey, 2010). Meta-analytic evidence has shown that PPI are effective at  
5 decreasing depressive symptoms and increasing well-being (Bolier et al., 2013; Sin &  
6 Lyubomirsky, 2009).  
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10 The main objective of our study was to explore changes in attentional patterns to  
11 emotional stimuli (i.e., happy, sad and angry faces) in clinically depressed individuals  
12 by comparing their attentional performance before and after receiving CBT or PPI to  
13 treat their depression. Previous research comparing the effects of CBT and PPI for  
14 depressed patients has shown significant changes in self-reported cognitive and well-  
15 being variables following both interventions (Chaves, Lopez-Gomez, Hervas &  
16 Vazquez, 2017).  
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25 Our hypotheses were based on previous literature that has shown attentional  
26 biases are observed only in the late and controlled components of attention (i.e., total  
27 fixation time - Kellough, Beevers, Ellis & Wells, 2008). The first hypothesis was that  
28 pre-post changes in attentional patterns associated with CBT or PPI would be  
29 significant in the maintenance of gaze index but not in the orienting index. Our second  
30 hypothesis was that, compared to pre-treatment assessment, depressed patients would  
31 show a significant reduction of maintenance of attention on negative stimuli (i.e., sad  
32 and angry faces) after CBT and PPI. Our third hypothesis was that, compared to pre-  
33 treatment assessment, depressed patients would show an increase of maintenance of  
34 attention towards positive stimuli (i.e., happy faces) after CBT and PPI. Finally, we  
35 hypothesized that CBT would be more effective than PPI in reducing an attentional bias  
36 towards negative stimuli whereas PPI would more effective than CBT in increasing a  
37 bias towards positive stimuli.  
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## 2. Materials and Methods

### 2.1. Participants

One hundred and twenty-eight depressed women who sought psychological treatment in a women's community center were included in the study (Lopez-Gomez, Chaves, Hervas & Vazquez, 2017). Participants were blindly assigned to one of the interventions and assessors were not informed of each participant's treatment assignment. The flow chart provided in Figure 1 illustrates the study design. The final sample was composed of seventy-five women with a DSM-IV-TR diagnosis of major depressive disorder or dysthymia (APA, 2000). In the end, the CBT group consisted of 41 women, while the PPI group was composed of 34 women. The mean age of the sample was 51.08 ( $SD = 9.68$ ). Exclusion criteria for the study were: substance abuse or dependence disorder (present), manic or hypomanic episodes (past or present), psychotic disorder (past or present), and a cognitive status (e.g., dementia or intellectual disability) that might prevent participants from following the interventions appropriately. All participants had normal or corrected vision through glasses or contact lenses.

### 2.2. Intervention groups for depression

Both intervention options consisted of 10 weekly, 2 hour sessions in a group format. Five groups for each condition, with a maximum of 15 participants per group, were included in the study. Two clinical psychologists administered both forms of intervention. Each session of the PPI and CBT programs had the same structure. They would begin with a review of the prior session's homework that was followed by an introduction of the topic of the day. Participants received guidance on how to carry out

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4 in-session exercises and therapists then provided the homework assignment for the next  
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6 session.

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8 The CBT intervention was an adaptation of the Group Therapy Manual for  
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10 Cognitive-Behavioral Treatment of Depression (Muñoz, Aguilar-Gaxiola & Guzman,  
11  
12 1995), based on the Coping with Depression course (Lewinsohn, Antonuccio,  
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14 Breckenridge & Teri, 1984). The PPI were a manualized protocol composed of  
15  
16 empirically-validated positive psychology interventions for depression called  
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18 Integrative Positive Psychological Intervention for Depression (IPPI-D) - (Chaves et al.,  
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20 2017). None of the modules found in the intervention packages were aimed at  
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22 modifying the focus of attention nor did they provide any kind of attentional training.  
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### 28 *2.3 Clinical Measures*

29  
30 *Structured Clinical Interview for DSM-IV* (SCID-I, First, Spitzer, Gibbon, &  
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32 Williams, 1995). The SCID was used to assess the presence of major depressive  
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34 disorder or dysthymia. The instrument was administered by trained clinical  
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36 psychologists with extensive experience in structured diagnostic interviews.  
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39 *Beck Depression Inventory-II* (BDI-II; Beck, Steer, & Brown, 1996). This is a  
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41 21-item self-report measure assessing depressive symptomatology. Each item consists  
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43 of 4 statements which are ranked from 0 to 3 indicating symptom severity. The  
44  
45 reliability in our study was high ( $\alpha$  pre-treatment = .88;  $\alpha$  post-treatment = .93).  
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### 49 *2.4 Eye-tracking paradigm*

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51 *Stimuli.* The stimuli were pairs of photographs, from the Karolinska Directed  
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53 Emotional Faces (KDEF, Lundqvist, Flykt & Öhman, 1998), with an actor/actress  
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55 displaying different frontal view facial expressions in an emotional-neutral expression  
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4 combination. A set of 28 faces (14 women, 14 men) were drawn for each emotional  
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6 category: happiness, anger and sadness. Facial expressions were transformed into  
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8 grayscale and framed with an oval window removing neck and hair from the original  
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10 pictures (Calvo & Lunqvist, 2008).

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12 *Equipment.* A Tobii T120 eye tracker was used to measure the coordinates of  
13  
14 participants' eye position every 16.7 ms (60 hertz). Ocular movements lasting more  
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16 than 100 milliseconds (ms) within a visual angle of 1° degree were classified as  
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18 fixations. Tobii Studio 2.0.6 software was used for the presentation of the stimuli and  
19  
20 collection of the attentional data. Two areas of interest (AOI) were defined for each  
21  
22 trial. They corresponded to the total surface area for the emotional and neutral faces.  
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24 This attention task has been previously used in similar studies (e.g., Sanchez, Vazquez,  
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26 Gomez, & Joormann, 2014).  
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### 32 *2.5 Procedure*

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34 Once participants gave their written consent, the SCID diagnostic interview was  
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36 administered. Participants who met inclusion criteria were selected for the study and  
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38 assigned to one of the two treatment groups. One week before treatment started,  
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40 participants completed the BDI-II and the attentional task.  
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43 The attentional task consisted of 84 trials, 28 trials for each emotional category:  
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45 happiness, anger and sadness. Pairs of faces were shown in a 53 cm (width) x 30 cm  
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47 (high) computer screen. The location in the screen of each facial expression (emotional  
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49 and neutral) was counterbalanced and all were presented equally as often on the left as  
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51 on the right side of the screen. Participants were seated in an anatomic chair at 73 cm  
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53 from the screen, representing a horizontal visual angle of 14° between the two pictures.  
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4 Each trial started with a black screen for 500 ms. Then, a white fixation cross  
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6 was presented on the center of the screen for 500 ms. After that, a random number  
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8 between 1 and 9 appeared in the same central position for 1000 ms. Participants were  
9  
10 instructed to pronounce it aloud as quick as possible. This procedure has been used in  
11  
12 previous studies (Calvo & Avero, 2005; Vazquez et al., 2016) with the aim of ensuring  
13  
14 the central position of the gaze before the appearance of the target stimuli. Immediately  
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16 afterwards, a couple of facial expressions (happy vs. neutral, anger vs. neutral, sad vs.  
17  
18 neutral) were presented for 3500 ms. Participants were instructed to view the images  
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20 naturally, with no further requirements. This free-viewing attentional task took  
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22 approximately 10 minutes. To conclude this experimental session, each participant  
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24 completed the BDI-II.  
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28 An identical experimental session was repeated one week after completion of  
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30 each treatment program (10 sessions over the span of 2.5 months, approximately), as  
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32 well as the diagnostic interview and the completion of the BDI-II.  
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### 36 *2.6 Dependent variables*

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38 Two attentional indices were extracted for each participant. Direction of initial  
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40 gaze (orienting index) is faster and automatic, as it reflects the early stages of visual  
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42 attention processing, while total fixation time (maintenance index) is considered more  
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44 controlled and to occur later in time.  
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- 47 a) *Direction of initial gaze* (i.e. location of the first fixation on one of the two facial  
48 expressions).
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50 b) *Total fixation time* (i.e. total time that each subject fixated on each of the two  
51 facial expressions).
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4 Following the Shane and Peterson (2007) guideline, relative bias scores were  
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6 calculated for each emotional category (happiness, anger and sadness). For direction of  
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8 initial gaze index, we calculated the percentage of trials in which each participant  
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10 initially fixated first on the emotional expression instead of the neutral one. The values  
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12 obtained above 50% indicated the presence of a bias towards the emotional face (in the  
13  
14 corresponding emotional category), while the values below 50% indicated the presence  
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16 of a bias toward the neutral one. Regarding total fixation time, relative bias scores were  
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18 calculated by subtracting the obtained value of the neutral facial expression from the  
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20 corresponding emotional expression value. Thereby, positive scores (greater than 0)  
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22 were interpreted as the presence of bias towards emotional expressions. Conversely,  
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24 negative scores (lower than 0) reflected a bias towards neutral expressions.  
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### 30 *2.7 Data analysis plan*

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32 A 2 (Group: CBT, PPI)  $\times$  2 (Time: pre-treatment, post-treatment) mixed-model  
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34 analysis of variance (ANOVA) was conducted to analyze the effect of both treatments  
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36 on depressive symptoms. Bonferroni follow-up tests were used to further analyze  
37  
38 significant interactions.  
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40  
41 Then, a series of 2 (Group: CBT, PPI)  $\times$  2 (Time: pre-treatment, post-treatment)  
42  
43  $\times$  3 (Emotional category: happy, angry, sad) mixed-model analysis of variance  
44  
45 (ANOVA) was conducted to explore the effect of both treatments on attentional indices  
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47 to emotional information. Bonferroni follow-up tests were used to further analyze  
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49 significant interactions. Correlation analyses were performed to analyze the associations  
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51 between severity of depression and attentional indexes.  
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## 56 **3. Results**

### 3.1. Group characteristics

As shown in Table 1, there were no significant differences between groups neither in demographic nor clinical characteristics.

### 3.2. Changes in depressive symptoms severity

Analysis showed a non-significant group  $\times$  time interaction,  $F(1, 73) = 1.26, p = .26, \eta^2 = .017$ . Nonetheless, a significant main effect of Time  $F(1, 73) = 152.98, p = .0001, \eta^2 = .68$  emerged (which indicated a large size effect associated with the interventions). Analyses revealed that both groups reported a significant decrease of depressive symptoms after treatment (Figure 2). Furthermore, there were no differences between treatments in regard to the clinical significance of changes as, at the end of the trial, only 21.9% of participants in the CBT group and 23.5% of participants in the PPI group still fulfilled diagnostic criteria of dysthymia or major depressive disorder,  $X^2(1, n = 75) = .03, p = .87$ .

### 3.3 Changes in attentional processing of emotional information

*a) Direction of initial gaze.* Analyses showed a non-significant three-way interaction,  $F(2, 72) = .68, p = .51, \eta^2 = .02$ . However, a significant main effect of emotional category emerged,  $F(2, 72) = 34.68, p \leq .001, \eta^2 = .49$ , which was qualified by a significant two-way interaction, group  $\times$  emotional category,  $F(2, 72) = 5.57, p = .006, \eta^2 = .13$ . Bonferroni post-hoc analyses revealed that both groups showed a greater initial frequency of directing their first fixation to happy faces than to sad (both  $p < .001$ ) or angry faces (both  $p < .004$ ). Additionally, the CBT group, but not the PPI group, showed a greater tendency to fixate on angry faces than on sad ones ( $p = .03$ ). Regarding differences between groups, analyses revealed that, in comparison with the CBT group, PPI patients showed a higher tendency to fixate on sad faces ( $p = .02$ ). To explore this difference between groups we compared sad faces bias scores of each group

with a no-bias criterion (50%). Analyses showed a significant bias to sad faces in the PPI group,  $t(33) = 2.67, p = .01, d = .46$ , but not in the CBT group  $t(40) = -.60, p = .55, d = .09$ . Finally, no effect of treatment was found in the direction of initial gaze index.

*b) Total fixation time.* Analysis showed a non-significant three-way interaction,  $F(2, 72) = .31, p = .73, \eta^2 = .01$ . However, a significant main effect of emotional category,  $F(2, 72) = 7.58, p = .001, \eta^2 = .17$ , and a significant main effect of time,  $F(1, 73) = 7.29, p = .009, \eta^2 = .09$ , emerged. These main effects were qualified by a significant emotional category  $\times$  time interaction,  $F(2, 72) = 3.31, p = .04, \eta^2 = .08$ . Bonferroni post-hoc analyses revealed significant changes in the processing of emotional faces after treatment in both groups. Participants of both groups showed a significant decrease in the total time that they spent looking at angry ( $p = .02$ ) and sad faces ( $p = .003$ ; Figure 3). Furthermore, after treatment both groups spent significantly more time looking at happy faces than looking at angry ( $p < .001$ ) and sad faces ( $p < .001$ ). To identify the existence of objective attentional biases, apart from group differences, we compared the attentional bias scores to happy, sad and angry faces with a no-bias criterion (zero). Our results revealed a significant attentional bias towards happy faces after the treatment,  $t(74) = 5.62, p < .001, d = .65$ , and a significant attentional bias away from angry,  $t(74) = -2.48, p = .01, d = .29$ , and sad expressions,  $t(74) = -2.04, p = .04, d = .24$ , after the treatment.

#### *3.4 Attentional biases and changes in depressive symptoms*

A series of bivariate correlation analyses were conducted to explore whether changes in attentional bias were associated with changes in the severity of depressive symptoms. Table 3 shows the zero-order correlation coefficients. Analyses revealed that improvement in depressive symptoms was significantly correlated with attentional

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4 changes consisting of spending more time looking at happy faces and less time looking  
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6 at angry and sad faces. Duration of initial fixations were not found to be significantly  
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8 associated with clinical changes.  
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#### 12 **4. Discussion**

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15 There are few studies that have analyzed attentional biases in clinically  
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17 depressed participants using eye-tracking methodologies (Armstrong & Olatunji, 2012;  
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19 Peckham et al., 2010). As far as we know, there is no previous study that has explored  
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21 pre-post therapy changes in attentional patterns using this methodology in a clinical  
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23 sample.  
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26 Regarding the first hypothesis, we expected that changes in attentional biases  
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28 would be significant in relation to maintenance of gaze but not in orienting of attention.  
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30 In line with this hypothesis, direction of initial gaze did not show significant changes  
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32 associated solely with the time of assessment (i.e., pre- and post-intervention  
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34 assessments) nor in its interaction with the intervention modality. Yet, there was a  
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36 significant group x emotional category interaction. Participants in the PPI group,  
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38 compared to participants in the CBT group, showed a significantly higher tendency to  
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40 look first at sad faces when presented with neutral ones. As there were no time-based  
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42 changes associated with this pattern, the results do not seem to be linked to the effects  
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44 of the therapies. In fact, the tendency to look at sad faces vs. neutral faces was  
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46 significantly larger in the PPI group than in the CBT group before the therapy and it  
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48 remained the same after the intervention.  
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52 The results of the study fully confirmed our second and third hypotheses, which  
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54 were related to maintenance index. Our second hypothesis was that, after interventions,  
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56 participants would show a decrease of attention towards negative information (i.e., sad  
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4 and angry faces) whereas the third hypothesis was that participants would exhibit an  
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6 increase in attention towards positive information (i.e., happy faces) following  
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8 treatment. As it is shown in Figure 3, both interventions significantly reduced the  
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10 amount of time that participants spent looking at negative faces and increased the  
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12 amount of time they engaged with positive faces. Therefore, the interventions were  
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14 effective at changing the double attentional biases to emotional information that are  
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16 typically found in people with depression (Duque & Vazquez, 2015) in a direction  
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18 similar to the “protective biases” that have been consistently observed in healthy  
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20 participants (Hilt & Pollak, 2013; McCabe, Gotlib & Martin, 2000) helping them to  
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22 regulate negative emotions (Sanchez, Joormann, Gomez & Vazquez, 2014). This  
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24 finding provides support for the need of incorporating positive aspects of functioning in  
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26 the research of psychopathology (Vazquez, 2017) and supports the principle idea of  
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28 anhedonia theories that depression must be characterized not only by the presence of  
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30 negative emotions and cognitions but also by difficulties in experiencing or maintaining  
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32 positive emotional states (Rømer Thomsen, Whybrow & Kringelbach, 2015; Watson &  
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34 Naragon-Gainey, 2010).

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39 Changes in patterns of maintenance of gaze towards positive and negative  
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41 stimuli were not significantly affected by the modality of intervention, which  
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43 disconfirmed our fourth hypothesis. Although CBT and PPI have both been shown to be  
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45 efficacious at treating depression (Chaves et al., 2017), given their large differences in  
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47 content and focus of the interventions, we expected that they might affect patients’  
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49 attentional performance in a different manner (i.e., CBT would reduce the bias towards  
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51 negative information more than PPI, whereas PPI would increase a bias towards  
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53 positive information more than CBT). More research is clearly needed, but it is  
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55 possible that attentional changes are an intermediate mechanism of some other  
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4 underlying processes (e.g., improvements in executive functioning) that may take place  
5 during treatment (DeRubeis, Siegle & Hollon, 2008; Roiser, Elliott & Sahakian, 2012).;

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8 Our study has some strengths and limitations. Regarding its strengths, this is the  
9 first study of clinical depression directly measuring attention by using eye-tracking  
10 methodology and a robust experimental paradigm to assess cognitive biases in  
11 depression (Duque & Vazquez, 2015; Sanchez et al., 2013). Also, the study includes  
12 participants with a clinical diagnosis of depression or dysthymia who have mean scores  
13 of depression in the range of 'severe depression'.  
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21 The study also has some limitations. The study did not assess any other type of  
22 cognitive performance (e.g., memory, interpretation, etc.) that may also be associated  
23 with changes in attention (Everaert, Koster & Derakshan, 2012). Furthermore, all  
24 participants were women and the study did not include follow-up data, which might  
25 have been relevant to know if attentional changes persist over time. Furthermore,  
26 systematic differences between dysthymia and major depression should be explored in  
27 future studies (such as differences in length or intensity of depressive symptoms) as  
28 they may affect attentional performance..  
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38 Finally, our results offer relevant contributions that may help the field better  
39 understand the nature of cognitive changes in therapeutic interventions (Cristea et al.,  
40 2015; Lorenzo-Luaces, German & DeRubeis, 2015). The fact that significant clinical  
41 changes were accompanied by significant changes in attentional biases may reflect that  
42 attentional processes are a key ingredient of change. However, the precise role of  
43 attentional processes and how they influence and interact with other cognitive  
44 processes, symptoms, and neurobiological factors is still not well known (Disner et al.,  
45 2011; Roiser et al., 2012). As Zinbarg et al. (2010) stated, research on the correlates and  
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mechanisms of successful treatments is still in its infancy. We hope that our study sheds light on the attentional mechanisms involved in symptom changes in depression.

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Table 1. *Demographic and clinical characteristics*

	CBT (N = 41)	PPI (N = 34)	<i>p</i> value
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	
Age	49.51 (10.16)	52.97 (8.84)	.12
Education level (%)			
No studies	0	2.94	
Primary studies	53.66	44.12	.61
Secondary studies	36.58	44.12	
University studies	9.75	8.82	
Marital status (%)			
Single	7.32	2.94	.68
Married	70.73	67.65	
Divorced	12.19	20.59	
Widower	9.76	8.82	
Employment status (%)			
Currently employed	17.07	17.65	.09
Unemployed	34.15	20.59	
Homemaker	34.15	38.23	
Retired	2.44	11.76	
Incapacitated	9.76	11.76	
BDI-II pre-intervention	35.47 (11.00)	34.09 (10.29)	.58
BDI-II post-intervention	20.83 (13.63)	16.51 (10.99)	.14
Dysthymic diagnosis pre-intervention (%)	24.4	20.6	.69
Medication (%)			
Antidepressant	14.6	14.7	.67
Anxiolytic	12.2	17.6	
Both	43.9	50	
None	29.3	17.7	

*Note.* CBT = Cognitive-Behavioral Therapy; PPI = Positive Psychology Interventions; M = Mean; SD = Standard Deviation; BDI-II = Beck Depression Inventory-II.

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Table 2. Means and standard deviations of the attentional indexes measured in all participants under two treatment condition for all experimental conditions (i.e., pairs of Happy-Neutral, Sad-Neutral, and Angry-Neutral faces).

	Happy-Neutral trials				Sad-Neutral trials				Angry-Neutral trials			
	Happy face		Neutral face		Sad face		Neutral face		Angry face		Neutral face	
	Pre (SD)	Post (SD)	Pre (SD)	Post (SD)	Pre (SD)	Post (SD)	Pre (SD)	Post (SD)	Pre (SD)	Post (SD)	Pre (SD)	Post (SD)
<i>Direction of initial gaze (%)</i>												
CBT	57.52 (11.80)	58.45 (8.93)	42.48 (11.80)	41.55 (8.93)	48.58 (7.05)	50.38 (9.55)	51.42 (7.05)	49.62 (9.55)	52.19 (8.17)	52.95 (10.90)	47.81 (8.17)	47.05 (10.90)
PPI	59.90 (10.58)	59.92 (8.80)	40.10 (10.58)	40.08 (8.80)	52.18 (6.97)	52.53 (8.21)	47.82 (6.97)	47.47 (8.21)	47.89 (7.71)	51.42 (7.44)	52.11 (7.71)	48.58 (7.44)
<i>Total fixation time (msec.)</i>												
CBT	1467 (492)	1537 (488)	1231 (426)	1140 (357)	1385 (418)	1258 (397)	1307 (417)	1417 (487)	1332 (422)	1227 (437)	1365 (468)	1431 (555)
PPI	1526 (305)	1527 (443)	1251 (313)	1067 (369)	1425 (300)	1250 (367)	1316 (285)	1418 (453)	1401 (334)	1199 (370)	1374 (349)	1464 (539)

Note. CBT = Cognitive-Behavioral Therapy; PPI = Positive Psychology Interventions; SD = Standard Deviation

Table 3. Bivariate correlations between changes in attentional bias towards the emotional faces (i.e., happy, angry, sad) and changes in depressive symptoms before and after the interventions.

Changes in attentional indexes (Pre-post interventions)	Changes in BDI-II (Pre-post interventions)
Direction of initial gaze-Happy	-.075
Direction of initial gaze-Angry	.005
Direction of initial gaze-Sad	-.014
Total fixation time-Happy	-.364**
Total fixation time-Angry	.250*
Total fixation time-Sad	.266*

Note. \* $p < .05$ ; \*\* $p < .01$ . BDI-II = Beck Depression Inventory-II.

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**Figure legends**

Figure 1. *Flow chart of the study design*

Figure 2. *Changes in depressive symptoms from pre-treatment to post-treatment.*

Figure 3. *Total fixation time changes from pre-treatment to post-treatment*

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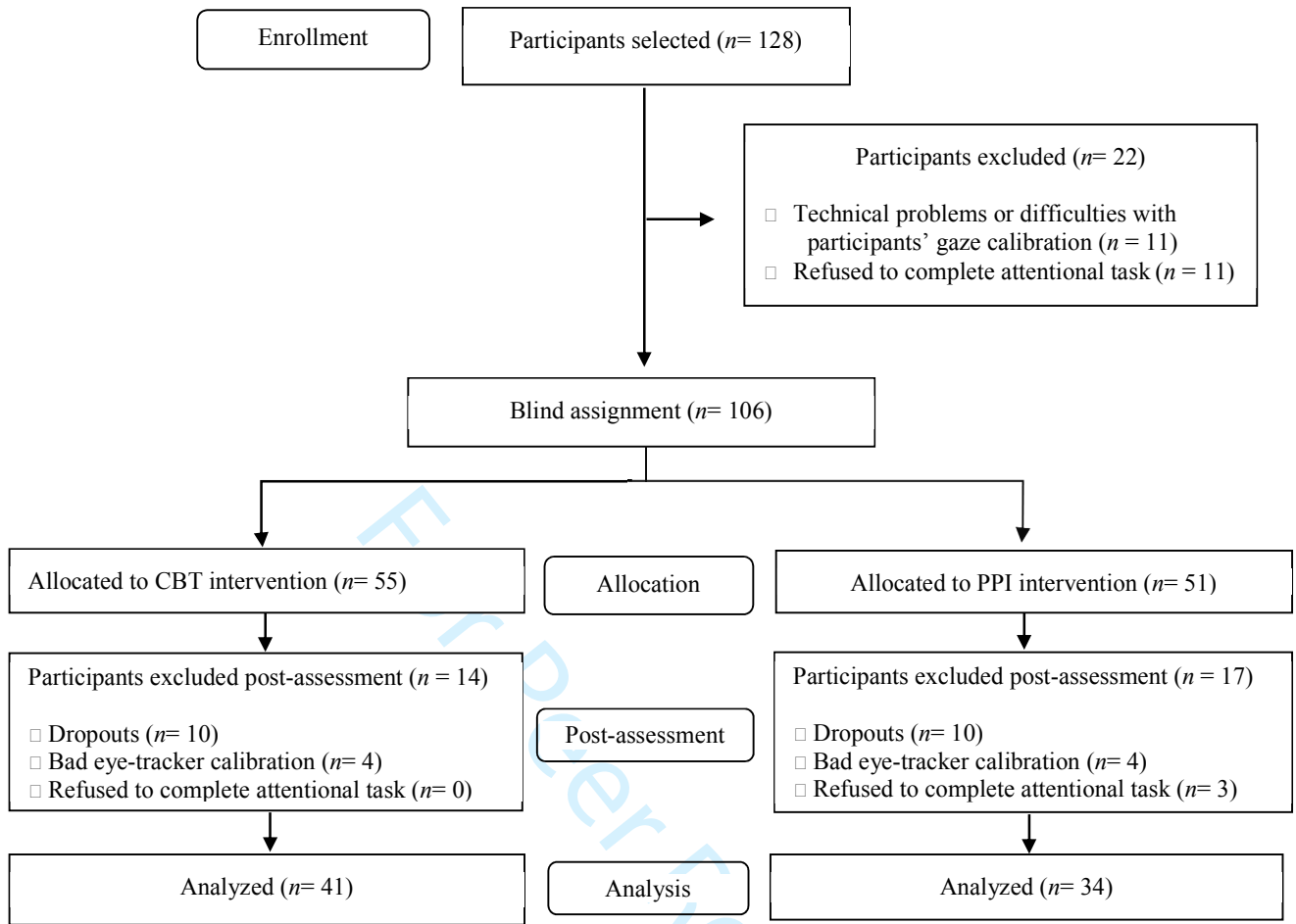
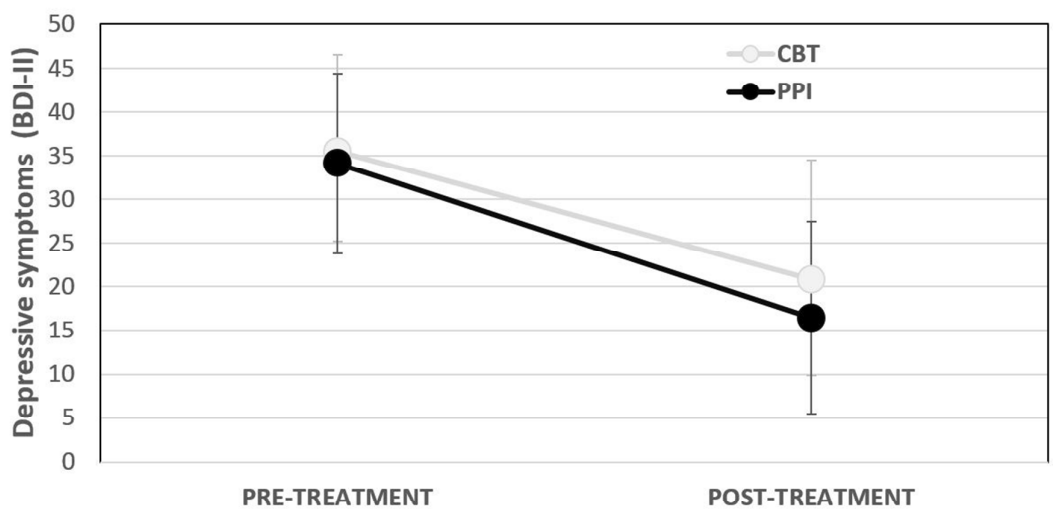


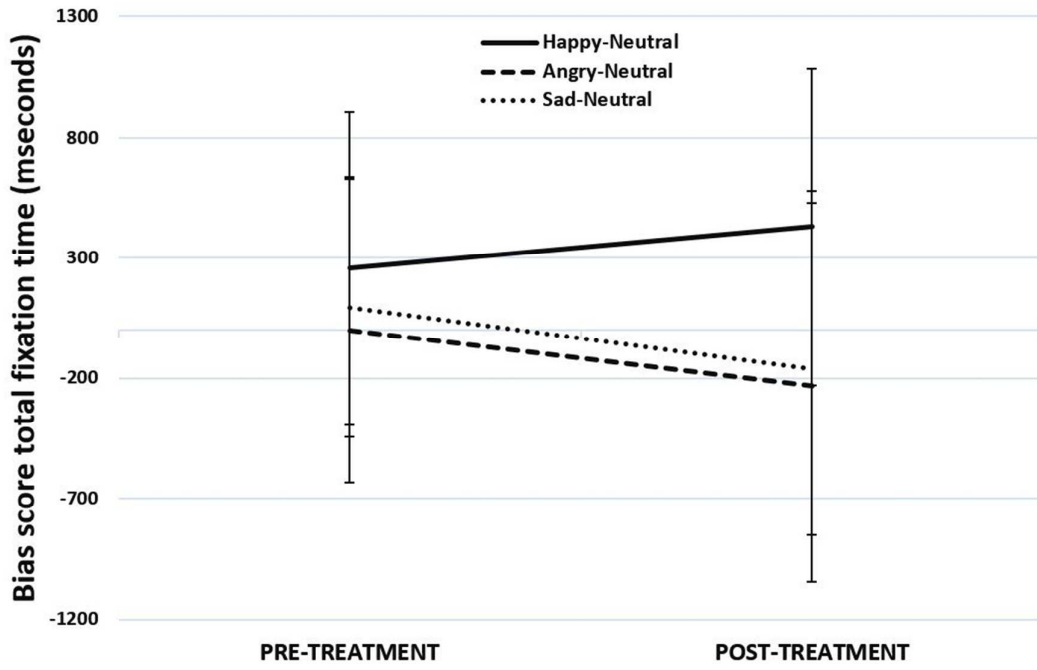
Figure 1. Flowchart of participants. CBT: cognitive-behavioral therapy, PPI: positive psychology intervention.

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**Note:** CBT = Cognitive behavioral therapy; PPI = Positive psychology interventions

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