Title:

Can Compassion-Focused Imagery be used as an Attention Bias Modification Treatment?

Isabelle Leboeuf[1], Kirsten McEwan[2], Stéphane Rusinek[3], Eva Andreotti[1] and Pascal Antoine[1]

[1] Sciences Cognitives et Sciences Affectives (SCALab), Université de Lille Nord De France

[2] University of Derby, Derby, U.K.

[3] Psychologie: Interactions Temps Émotions Cognitions (PSITEC), Université de Lille Nord De France

Running title: Can CFI be used as an ABMT?

Correspondence concerning this manuscript should be addressed to:
Isabelle Leboeuf
https://orcid.org/0000-0001-8465-982X
Laboratoire SCALab UMR CNRS 9193
Université Lille Nord de France
BP 60149
59653 Villeneuve d'Ascq Cedex
TEL / FAX: (+33) (0)3-20-41-60-32 / (+33)(0)3-20-41-60-36
Université de Lille Nord de France
France
Email: isabelle.leboeuf.lanthoen@gmail.com

Funding: The authors have no support or funding to report.
Conflict of Interest: The authors declare that they have no conflicts of interest.

Author Contributions

IL designed and executed the study, performed the data analyses and wrote the paper.

KM collaborated in the design and the data analyses of the results and wrote the paper.

SR collaborated in the design and implementation of the study.

EA collaborated in the data analyses and the discussion of the results and wrote the paper.

PA collaborated in the data analyses and the discussion of the results and wrote the paper.

Abstract

Introduction: Compassion focused-imagery (CFI), one of the psychological interventions of compassion-focused therapy, is receiving increasing attention. It is a therapeutic tool that targets the process of self-criticism by prompting individuals to imagine themselves as compassionate or to imagine receiving compassion from an ideal compassionate other. This research examines the role of self-criticism in the attentional processing of emotional stimuli, namely, critical and compassionate facial expressions. It is hypothesized that the activation of positive social emotions through CFI plays a role in broadening attention in the processing of emotional stimuli. **Method:** The McEwan Faces stimulus set, which includes critical, neutral and compassionate faces, was used to create an attentional bias task called the dot probe task. The processing of emotional faces was assessed before and after exposure to either CFI or neutral imagery, controlling for the process of sensory integration (n = 80). A between-subject analysis was used to test the hypothesis. **Results:** Before the imagery task, participants tended to look away from critical faces, and their level of self-criticism played a role. Both types of imagery significantly reduced the bias away from critical faces when the stimuli were presented for 1200 ms. This effect was reversed in the neutral condition for participants with high levels of self-criticism but not in the CFI condition. **Discussion:** Interestingly, self-criticism impacts the attentional treatment of critical faces and the effect of imagery entailing sensory integration on this treatment. CFI seems to preserve this effect for participants with high levels of self-criticism, possibly due to the activation of positive social emotions.
Keywords: compassion-focused imagery, positive social emotions, self-criticism, attention bias modification.

Can CFI be used as an ABMT?

Compassion-focused imagery (CFI) is one of the therapeutic strategies used in compassion-focused therapy (Gilbert, 2000, 2006, 2007; Gilbert & Irons, 2004). This very promising form of therapy created by Paul Gilbert is based on an integrative model and is designed to help people with high levels of self-criticism benefit from the compassion inherent to the therapeutic process. Indeed, compassion, defined as "a sensitivity to suffering in self and others with a motivation to try to alleviate and prevent it" (Gilbert, 2014), can be difficult to access when self-criticism is high.

Self-criticism is a defensive behavioral adjustment to unexpected events. It is described as facilitating avoidance of aversive events through behavioral inhibition (Longe et al., 2010) or by obtaining validation and social support (Powers & Zuroff, 1988). The study of self-criticism, as a trait of the relation to self, is critical in therapy because it has a negative impact on the evolution and maintenance of emotional disorders (Shahar, Doron & Szepsenwol, 2015; Zuroff et al., 2005). In contrast, an increasing number of studies, as reviewed in the meta-analyze from Kirby (2016), show that activating compassion has beneficial effects on psychological outcomes (Fredrickson, Cohn, Coffey, Pek & Finkel, 2008; Hofmann, Grossman & Hinton, 2011; Jazaieri et al., 2013; Keltner, Kogan, Piff & Saturn, 2014; Kirby, 2016). As Gilbert (2014) explains, CFT activates compassion as a motivation based on the care-giving motivation considered by evolutionary psychology to be central to the survival of mammalians.

In compassion-focused therapy, self-criticism is thought to develop when the career does not provide the infant with a secure base and a safe haven (Mikulincer & Shaver, 2007). The activation of positive social emotions is practiced during therapy and is therefore considered a secondary but important process that facilitates the integration of positive social information. Indeed, as a process impacting the relation to self and others, self-criticism is expected to play a role in the response to critical and compassionate faces and to create biases. This study questions the role of attention in self-criticism and the possible existence of attention biases in the treatment of emotional faces, which has yet to be demonstrated. This research also tests the idea that positive social emotions may play a central role in the treatment of attention and, more specifically, may lead to attention bias modification (ABM) from the very first imagery session. This research will therefore be based on a single trial of CFI.

ABM is a promising field of research, especially for emotional pathology (Amir et al., 2008; Bar-Haim et al., 2007, 2010; Eldar & Bar-Haim 2010; Hakatama et al., 2010; Klumpp & Amir, 2010; Lang et al. 2012; Li et al., 2008; MacLeod et al. 2002, MacLeod, Clarke, 2013; MacLeod, Clarke & Mathews 2002; MacLeod & Mathews, 2012; Mathews & MacLeod, 2002; Schmidt, 2009; Waters, 2013). Research conducted within the general paradigm of ABM reveals that emotional biases in attention are not merely associated with emotional disorders but contribute to their development and maintenance (Hertel & Mathews, 2011). ABM has also been researched in association with visual imagery (Blackwell et al., 2015; Browning, Blackwell & Holmes, 2013; Torkan et al., 2014). After more than two decades of experimental psychotherapy research into ABM, there have been few clinical applications (Clarke, Notebaert, & MacLeod, 2014).

Can CFI be used as an ABMT?

ABM training has been shown to be an effective method of inducing biased attentional responses to emotionally toned information among anxious individuals (MacLeod, Clarke & Mathews, 2002). Classically, participants were trained to find a probe behind a neutral stimulus (a word or face, see Hakamata et al., 2010 for a review and meta-analysis). Only a few studies (Li et al., 2008) focused on training attention specifically toward positive faces. In Li's research, socially anxious participants with bias toward negative faces were trained for seven days to focus on images of positive faces with the dot probe paradigm. The training was effective in changing attentional bias and levels of social anxiety.

CFI, which involves visualizing compassion toward oneself or imagining people directing compassion toward the self, is proposed to activate the attachment system and the physiological systems related to feeling soothed and calm via the parasympathetic nervous system, as evidenced through physiological measures such as increased heart rate variability and reduced cortisol levels (Rockliff, Gilbert, McEwan, Lightman, & Glove, 2008). Single trials in non-clinical populations have been shown to reduce negative emotions, increase self-esteem, and produce physiological changes associated with the attenuation of threat-defensive behaviors (Lincoln, Hohenhaus & Hartmann, 2013, Rockliff, Gilbert, McEwan, Lightman, & Glove, 2008), and regular practice of CFI has produced improvement in clinical and non-clinical populations (Matos et al., 2017; McEwan & Gilbert, 2016; Naismith, Mwale, & Feigenbaum, 2019). Receiving kindness and support from others has been linked to a specific "affiliative" type of positive affect regulation system (Depue & Morrone-Strupinsky, 2005, Wang, 2005) that can reduce the activation linked to socially threatening information.

We used a brief validated CFI (McEwan, Gilbert, 2016). Compassion practice begins with soothing rhythmic breathing, which involves slowing and deepening the breath and focusing attention on the sensations of breathing in one's own body. The participant is then prompted to imagine a compassionate other who is focused on caring about the participant's well-being. Some research has shown that individuals scoring higher in self-criticism may show adverse responses after a single episode of CFI (Rockliff, Gilbert, McEwan, Lightman, & Glover, 2008, Rockliff et al., 2011). To avoid this negative effect, we modified the imagery task by asking participants to focus on social connection cues to activate more intensely the positive feelings of connection (e.g., visual cues such as a smile, the inner smile and feeling of warmth, energy, the general feeling of connection). We called the emotion activated 'social joy' and defined it as "the joy of a shared attention or presence". The concept of social joy was previously used by Panksepp (2007) to describe the joy observed during interaction in animals. Narvaez (2014) used the concept to describe the common human need for connection in a transdisciplinary approach. Fredrickson (1998, 2004) has shown in her social-evolutionary model called 'broaden and build' that positive emotions help people broaden their perspective and social bounds (Fredrickson, B., 2013). The aim was to ensure that the imagery would activate a positive feeling of connection and prevent the activation of the threat system. Rockliff, Gilbert, McEwan, Lightman, & Glover (2008) have shown that imagining someone being kind to oneself leads to an increase in heart rate variability (a physiological indicator of appeasement) and a reduction in cortisol (a stress hormone). Social safeness (Gilbert 2008) was found to be a significant variable, but self-criticism was

an inhibitor. Indeed, people with higher levels of self-criticism have been found to have difficulty detecting and responding to signs of compassion from others. Longe et al. (2010) showed via fMRI that individuals with a high level of self-criticism, when asked to reassure themselves in a threatening scenario, showed activation of brain areas associated with threat. Duarte et al. (2014) found that high levels of self-criticism were linked to feeling unsafe and experiencing threat-like physiological reactions to CFI. Consistent with this, Naismith, Zarate, Guerrero, & Feigenbaum (2018) found that self-criticism predicts poorer outcomes in compassion-focused therapy but not after controlling for self-reassurance. To counter this effect, we induced social joy in the imagery task in two different ways: in the imagery itself and in the interaction between the participant and the experimenter through synchronization of breathing (pacing). We considered synchronization to be part of the process of both compassion and social joy activation. For example, Valdesolo and DeSteno (2011) show that movement synchronization, such as two participants tapping their fingers to the same rhythm, increased reported compassion when one participant witnessed the partner being unfairly victimized and led to increased engagement in helping behavior.

Based on Vanlessen's review of the literature (2014), we assumed that activating positive mood would broaden the attention field (Fredrickson, 2001). Whether positive mood broadens attention in the processing of emotional facial information remains an open question in the affective science literature.

This research had two aims.

The first was to test the hypothesis that the positive social emotions induced in CFI (McEwan & Gilbert 2016) would broaden attention, enhance the processing of all stimuli, and reduce potential attention bias present before the imagery exposure.

The second was to test in a non-clinical group the response to two kinds of faces, critical and compassionate, in a new set of faces (McEwan, 2014). This new stimulus set of emotional faces is based on N = 31 actors, whose facial expressions were reliably distinguished as compassionate, critical, and neutral. McEwan showed for the first time with this set of faces that self-criticism could affect the attentional treatment of emotional faces. This study questions the validity of these findings.

In both hypotheses, before the imagery exercise, self-criticism was expected to affect the attentional treatment of critical and compassionate faces. Higher levels of self-criticism were expected to be linked to more attentional bias toward or away from critical faces, and lower levels of self-criticism were expected to be linked to attention biases toward compassionate faces. We explored the time course of the attention treatment. It is known that depression is associated with a demotivated state that could counteract motivation to orient towards stimuli (Foa & Kozak, 1986); hence, some researchers suggest controlling for state depression when exploring attentional biases (Bar-Haim et al. 2007). Therefore, we controlled the effect of depression and social anxiety.

METHODS

MEASURES

Self-Criticism. The Forms of Self-Criticizing/Self-Reassuring Scale *(FSCRS*, Gilbert et al., 2004) was translated into French and validated by Leboeuf (Submitted). The scale is composed of 22 items. Each statement is scored on a 5-point Likert scale from 0 ("not at all like me") to 4 ("just like me"). The FSCRS was designed to measure self-criticism and self-reassurance, with the subscales Inadequate Self and Hated Self measuring self-criticism. It has good internal consistency (between 0.77 and 0.84 for the three subscales).

Depression. The Beck Depression Inventory – Short Form (Beck & Beamesderfer, 1974) was translated into and validated in French by Bourque and Beaudette (1982). Participants rate the degree to which three statements reflect their state of mind on a 4-point scale from 0 (none) to 3 (severe depressive symptoms). The internal consistency in this research was good ($\alpha = 0.88$).

Social anxiety. The Liebowitz Social Anxiety Scale (Liebowitz, 1989) was translated and validated by Heeren, Maurage, Eeckout and Philippot (2012). It comprises eight subscales. Participants rate each of the 24 social situations on a 4-point Likert-type scale, once for intensity of fear (0, None; 1, Mild; 2 Moderate; 3 Severe) and once for frequency of avoidance of the situation (0, Never; 1, Occasionally; 2 Often; 3 Usually). This scale has good internal consistency here ($\alpha = 0.94$).

Effect of the Imagery. The McEwan Mental Imagery Assessment Questionnaire from McEwan and Gilbert (2016) was translated into French for the study. It comprises 10 items assessing the frequency and intensity of the imagery experience and invites written feedback. Six of the items (scored 0–10) ask participants to rate how easy/hard/clear the imagery was and how tense they felt, how moved they were, and how much they resisted the imagery.

PARTICIPANTS

The participants were 80 adults aged 18 and older; the average age was 26.31 (standard deviation of 12.02), with a minimum of 18 and a maximum of 75. Of the participants, 72.5% identified as female and 27.5% as male. They were recruited from the University of Lille, France. If they were in the second year of a degree in psychology at the University of Lille, participation in this experiment was awarded with credit in the framework of the teaching unit "General and Differential Psychology".

PROCEDURE

Ethical approval for this study was received on 15/07/2016 from the Ethical Committee in Behavioral Sciences of the University of Lille (comity number: 2016-1-S45). All the procedures performed in studies involving human participants were in accordance with the ethical standards of the National Research Committee, the 1964 Helsinki Declaration and its later amendments, or comparable ethical standards. Data are available on figshare (Leboeuf, 2020). The procedure flowchart is provided in figure 1. Informed consent was obtained from all participants included in the study.

[Insert Figure 1 here]

Participants were randomly assigned to either a compassionate imagery condition or a control condition (neutral imagery condition matched for duration) according to gender criteria. The characteristics of the participants in the two groups are presented in table 1. They were significantly different in age and meditation practice.

[Insert Table 1 here]

After having completed the scales, all participants were asked to perform the first probe detection task (see figure 2) using the McEwan Faces stimulus set. The set (McEwan 2012-2014) was created with photographs of actors displaying critical, neutral or compassionate facial expressions. The facial stimuli were presented in black and white at a resolution of 72 dpi and 115 mm from the center of the screen. Participants responded by pressing a button to indicate which probe replaced one of the facial stimuli (i.e., ; or : for left or right). Participants started with seven training trials that used joyful faces from the set of faces that were not used in the experiment, followed by 64 experimental trials (16 compassion-neutral pairs and 16 critical-neutral pairs presented twice in each of the left and right fields). Each test began with a fixation dot presented for 500 ms in the center of the screen. This was replaced by a pair of facial stimuli and finally by a probe that replaced one of the stimuli in the pair. The interval between the two presentations varied between 500 ms and 1200 ms in reference to previous research (Iannou, Mogg & Bradley 2003 uses 1250 ms). The task was programmed on Inquisit. The response times and accuracy were recorded.

[Insert Figure 2 here]

Then, participants completed an imagery task that lasted five minutes. For the neutral imagery, they were asked to visualize numbers in a multi-sensorial way (e.g., color, shape, texture) to control for the process of sensory integration that is considered to be the central effect of imagery (Siegel, 2016). For the compassion imagery, participants were asked to first do a breathing exercise for which they had to focus on bodily sensations, slowing down the outbreath, and inflating the belly on the inbreath. Only the compassionate imagery was associated with a breathing exercise. The instructions were given on the participant's outbreath to create synchronization. The participants were then asked to visualize a smiling face of a person that had their well-being at heart. The word compassion was not used specifically, but it was suggested that this person could be friendly. During the following instructions, participants were invited to focus on the sensations associated with the feeling of connection. After the imagery task, they completed the second dot probe task and finally the McEwan Mental Imagery Assessment Questionnaire to assess their engagement with the imagery task.

EXPERIMENTAL RESULTS

DATA ANALYSIS

Data are available on figshare (Leboeuf, 2020). Analyses were conducted using SPSS version 18 software. The analyses were replicated with JASP 0.13.1.0, and the same results were found. The reaction times for the incorrect answers and the times considered outliers (extreme values) were deleted. Outliers correspond to reaction times less than 200 ms or greater than three standard deviations from the average response time.

We used the procedure of MacLeod, Mathews & Tata (1986) to calculate the attentional bias scores for compassionate and critical faces. The attentional bias score for critical faces was calculated by subtracting the reaction time for tests in which the probe replaced the neutral face from the reaction time for tests in which the probe replaced the critical face (i.e., incongruence). Thus, a positive score indicates a preferential allocation of attention to the critical face (i.e., vigilance toward critical faces). A negative score indicates a preferential allocation of attention to the neutral face (i.e., avoidance of critical faces). Finally, a score of zero indicates no attentional preference between the emotional face and the neutral face. The attention bias score (ABS) for compassionate faces was calculated according to the same logic.

DOT PROBE RESULTS:

The two groups in the different imagery conditions (neutral, compassionate imagery) differ at baseline in terms of self-criticism (p= 0,004), depression, and anxiety (p=<001). The means are reported in table 1.

We conducted a repeated measures ANOVA on the ABSs. There were two between-subjects factors—i) type of imagery and ii) level of self-criticism (measured by the Inadequate Self subscale of the FSCRS)—and three within-subject factors—i) time (pre vs post imagery), ii) type of emotional face (compassionate vs critical) and iii) presentation time (500 ms vs 1200 ms).

EFFECT OF THE TYPE OF IMAGERY AND THE INTERACTION WITH SELF-CRITICISM

We conducted a series of ANOVAs (see table 2) that showed that the 5 variables interacted: time X presentation time X type of emotional face X type of imagery X self-criticism, F (14, 593) = 1.8, $p < .03$, ηp^2 =0,041. Both types of imagery had an effect on the attention response but only at a presentation time of 1200 ms and only for critical faces with a three-

way interaction effect of time X type of imagery X self-criticism, F (1, 80) = 3,18, p = <0,001, ηp^2 =0,7. Before the imagery exercise, bias away from critical faces presented for 1200 ms was exhibited. This bias was reduced by the imagery independent of the type of imagery.

[Insert Table 2 here]

To understand more clearly this interaction at the presentation time of 1200 ms, we conducted tertile split analyses in which the Inadequate Self subscale scores were divided into low (0-14), medium (15-21), and high (22-35). We compared the low (n=26) and high (n=28) groups, following the methodology of McEwan (2014) using the same set of faces. The results are presented in figure 3. Though the sampling group approach may induce a loss of power (Preacher, Rucker, MacCallum & Nicewander ,2005), we chose to use it to further clarify the interaction. Both imagery types had the same effect on the participants with low levels of self-criticism, reducing bias away from critical faces. After the imagery exercise, participants answered more quickly when the probe was behind a critical face. The differences in the ABSs before and after the imagery exercise in the group with low self-criticism were different from 0, t (103) = 2.18; p = .003 (d = 0.21) for the compassionate imagery and t (119) = 3.32; p = .001 (d = 0.32) for the neutral imagery. The difference between the two scores was not significant. This effect was significantly different for the participants with high levels of self-criticism in the neutral imagery condition, t (222) = -3.37; p = .001 (d = -0.45). Participants started to look away from critical faces, and the differences became negative. However, the effect was not significantly different for the compassionate imagery, t (206) = -1.41; p = .15 (d = -0.19). The difference remained positive. After exposure to neutral imagery, participants with high levels of self-criticism started to look away from critical faces, but not after exposure to compassionate imagery.

[Insert Figure 3 here]

EFFECT OF THE TYPE OF EMOTIONAL FACE AND THE INTERACTION WITH SELF-CRITICISM

We conducted multivariate ANOVAs and found an effect of the type of emotional face before the imagery task, F (1, 608) = 7.3, p < .007, ηp^2 =0,012, which showed that the set of faces was discriminant. The time course impacted the attentional treatment, with a two-way interaction effect between the type of emotional face variable and the presentation time variable (F (1, 608) = 5.6, p = 0,017, ηp^2 =0,009. This effect was further examined using a paired samples t test. Participants, before the imagery task, looked away from critical faces at both 1200 ms, t (639) = -2.37 (d = 0.08); p = .025, and 500 ms, t (639) = -2.34; p = .019 (d = 0.08). They tended to look toward compassionate faces, but the score did not reach significance. Self-criticism interacted with treatment of the type of face, F (1, 608) = 1.9, p < .005, ηp^2 =0,085. Self-criticism had a significant effect at a presentation time of 1200 ms for both critical and compassionate faces, but the

effect was no longer significant at 500 ms for both face types. Table 3 presents the means, standard deviations and significance of the self-criticism variable effect for each of the four conditions.

[Insert Table 3 here]

We then conducted tertile split analyses, as explained previously. We compared the low and high groups when critical faces were presented for 1200 ms. The groups showed significant differences, t (430) = -2.93; p = .004 (d = -0.28). Then, we compared each group to 0. The group with low levels of self-criticism had a bias away from critical faces, t (207) = -3.08; p = .002 (d = -0.21), but the group with high levels was not significantly different from 0. Participants with higher levels of self-criticism tended to look more toward compassionate faces at 1200 ms, but the statistics did not reach significance. Table 4 presents the means and standard deviations for high and low self-criticism. Notably, the significant effect of self-criticism as a continuous variable on the attentional treatment of compassionate faces is no longer significant with this statistical treatment after the tertile split.

[Insert Table 4 here]

ANALYSIS CONTROLLING FOR DEPRESSION AND SOCIAL ANXIETY

The analyses were repeated while controlling for depression as a covariate. With regards to the ANOVA exploring the bias scores for critical faces and levels of self-criticism, the findings remained unchanged except for the presentation time. We found a significant effect of presentation time when controlling for depression, F(1, 80) = 6.7, p < .001, ηp^2 = 0.011, and an effect of the interaction between the presentation time variable and the BDI variable, F(1, 80) = 5.4, p < .01, η_p^2 = 0.009. We also repeated the analyses while controlling for social anxiety as a covariate. The findings remained unchanged for all the ANOVA results.

DISCUSSION

To our knowledge, this is the first study showing a link between levels of self-criticism and the processing of critical faces. In 2014, McEwan did not find bias in the processing of critical faces in a group of participants with high levels of self-criticism, but the research did show a bias away from compassionate faces for participants with high levels of self-criticism. The different types of faces, critical and compassionate, were treated very differently. Before exposure to the

imagery, participants tended to look away from critical faces presented for both 500 ms and 1200 ms, but the biases appeared to significantly interact with self-criticism only at 1200 ms. Participants with higher levels of self-criticism exhibited less bias away from critical faces.

For Gilbert (2004), self-criticism is the internalization of strategies to protect ourselves from social threats. Here, the participants with lower levels of self-criticism looked away from critical faces and thereby felt safer from social threat. Looking away from critical faces could therefore be a strategy linked to effectively reducing the negative feelings induced by being criticized. This is congruent with the polyvagal theory (Porges, 2003), in which the "social nervous system" is an affiliative neurocircuitry that prompts affiliation, particularly in response to stress.

In our results, participants with higher levels of self-criticism did not show an attention bias away from or toward critical faces. This is a surprising result, as we could have expected, based on previous research, a bias toward critical faces. To explore this issue, further research is needed to explore the orientation of attention in a clinical population with higher levels of self-criticism, as attentional biases are often more pronounced in clinical populations.

There was an effect of the imagery in terms of reducing the bias away from critical faces presented for 1200 ms, but there was no difference between the types of imagery. As the neutral condition controls for the process of sensory integration that is considered the central effect of imagery (Siegel, 2016), we can interpret this effect as inherent to the imagery. There may be an increase in flexibility in the treatment of information, with a possible reduction in the negative feeling of being criticized associated with critical faces—and therefore a reduced need to look away from critical faces. The fact that the imagery had an effect only when it was presented for 1200 ms may indicate a top-down attentional control mechanism (Corbetta & Shulman, 2002, Desimone & Duncan, 1995; Leleu, Douilliez, & Rusinek, 2013). This result is coherent with the motivational dimension of compassion. Bottom-up activation occurs during early preattentive processing and is supposed to be stimulus-driven (for a review, see Theeuwes, Atchley, & Kramer). Top-down processes are thought to be goal-driven and prioritized when the object is in line with the observer's current goals, in other words, when the observer's motivation turns the attention toward the stimuli. Top-down guidance is typically assumed to proceed by either *activation* of features that match those of the target (e.g., Wolfe 1994) or *inhibition* of the features that do not (Treisman and Sato 1990).

There was an effect of the type of imagery, but only in interaction with the level of self-criticism. Indeed, the effect of reducing the bias away from critical faces was reversed for the participants with high levels of self-criticism in the neutral imagery condition but persisted in the compassionate imagery condition. The neutral imagery did not reduce attention bias for participants with high levels of self-criticism. This result may be linked to a different type of emotional reaction in these participants due to the activation of a threat reaction. It has been shown that high levels of self-criticism may be linked to adverse responses after a single episode of compassionate imagery (Rockliff, Gilbert, McEwan, Lightman, &

Glover, 2008, Rockliff et al., 2011). As explained in the introduction, we specifically increased the activation of positive social emotions to reduce this effect.

The results do not contradict the hypotheses that the compassionate imagery, with increased positive social emotions, may allow participants with high levels of self-criticism to benefit from the attentional effect of the imagery.

The data are consistent with our hypothesis that activating positive emotions would broaden attention (Fredrickson, 2001, 2005). A positive internal state seems to enhance the processing of all stimuli in a less selective way. Positive mood can influence the processing of peripheral task-relevant stimuli, for better or worse, providing evidence of the influence of mood on top-down attention control (Grol and De Raedt, 2014; Grolg et al., 2014, Uddenberg and Shim, 2014, Vanlessen et al., 2014). Positive emotions seem to sustain the effect of the imagery for participants with higher levels of self-criticism.

LIMITATATIONS AND FUTURE RESEARCH

The findings in this study should be interpreted in light of several limitations. First, this research is exploratory, with a limited sample of nonclinical participants. An interesting exploration would be into how individuals with high levels of self-criticism and diagnosed emotional disorder treat the information on critical faces. The imagery based on the validated version of compassion-focused imagery was modified to focus more on cues of social connection and was not previously tested in this form. Although the results were congruent with our hypotheses, we notice that we could have expected the compassionate imagery to create an attention bias toward compassionate faces, which is not the case here. The imagery did not create a positive bias. In a longitudinal study, Troller-Renfree et al. (2015, 2016) showed using a large group of children raised in an institution who experienced psychosocial deprivation that high-quality foster care intervention (relative to care-as-usual) affected the attention processing of emotional faces. Over time, the group with high-quality foster care intervention had a bias toward joyful faces. The magnitude of the positive bias was associated with fewer internalizing problems and better coping mechanisms. Within the foster care group, a positive attention bias was related to less blunted cortisol reactivity. Therefore, that the compassion imagery does not induce a positive bias toward compassionate faces is a bit surprising. Testing the possibility that such bias appears over time would be possible with longer exposure to Compassion Focused Imagery. The use of eye-tracking indices could add information on where the participants look when they look away from critical faces and increase the reliability of the measure (see Price et al., 2015 for recommendations). The role of positive emotions in attentional bias modification and in compassion is still inconsistently researched. Research in neurosciences indicate that the activation of compassion induces positive emotions (Engen & Singer, 2015). Further research may question the underling mechanisms and consider negative and positive emotions distinctly.

The difference between the groups is a limitation of this study. Replication with randomization based on levels of anxiety and depression and levels of self-criticism would be interesting.

CONCLUSION

The imagery entailing sensory integration plays a role in the way attention is allocated to integrate emotional faces, specifically critical faces. The study of the time course shows that this effect is linked to longer presentation times and higher processes. This effect is reduced when the levels of self-criticism of the participants are high but is maintained under the compassionate imagery condition. These results are congruent with the expectation that positive emotions broaden attention. CFI enables people with high levels of self-criticism to benefit from the effect of the imagery. The results support the further study of CFI as an ABM treatment, which may be beneficial specifically to populations with higher levels of self-criticism.

Compliance with Ethical Standards

Funding: This study did not receive funding.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the Faculty of Psychology of Lille Nord de France 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 study.

REFERENCES.

Amir, N., Weber, G., Beard, C., Bomyea, J., & Taylor, C.T. (2008). The effect of a single-session attention modification program on response to a public-speaking challenge in socially anxious individuals. *Journal of Abnormal Psychology*, 11, 860–868.
https://dx.doi.org/10.1037/a0013445

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin*, *133*(1), 1-24. https://doi.org/10.1037/0033-2909.133.1.1

Bar-Haim, Y. (2010). Research Review: attention bias modification (ABM): a novel treatment for anxiety disorders: Research Review: Attention bias modification (ABM). *Journal of Child Psychology and Psychiatry,* 51(8), 859-870. https://doi.org/10.1111/j.1469-7610.2010.02251.x

Beck, A. T., & Beamesderfer, A. (1974). *Assessment of depression: The depression inventory.* Karger Publishers.

Blackwell, S. E., Browning, M., Mathews, A., Pictet, A., Welch, J., Davies, J., Holmes, E. A. (2015). Positive Imagery-Based Cognitive Bias Modification as a Web-Based Treatment Tool for Depressed Adults: A Randomized Controlled Trial. *Clinical Psychological Science*, *3*(1), 91-111. https://doi.org/10.1177/2167702614560746

Bourque, P., & Beaudette, D. (1982). Étude psychométrique du questionnaire de dépression de Beck auprès d'un échantillon d'étudiants universitaires francophones. *Canadian Journal of Behavioural Science/Revue Canadienne Des Sciences Du Comportement*, 14(3), 211. http://dx.doi.org/10.1037/h0081254

Browning M, et al: Using attentional bias modification as a cognitive vaccine against depression. *Biol Psychiatry*, 2012, 72(7):572–579.

Browning, M., Blackwell, S. E., & Holmes, E. A. (2013). The Use of Cognitive Bias Modification and Imagery in the Understanding and Treatment of Depression. In P. J. Cowen, T. Sharp, & J. Y. F. Lau (Éd.), *Behavioral Neurobiology of Depression and Its Treatment* (p. 243-260). https://doi.org/10.1007/7854_2012_212

Clarke, P. J., Notebaert, L., & MacLeod, C. (2014). Absence of evidence or evidence of absence: reflecting on therapeutic implementations of attentional bias modification. *BMC Psychiatry*, *14*(1), 8. https://doi.org/10.1186/1471-244X-14-8

Corbetta, M., & Shulman, G. L. (2002). Control of goal-directed and stimulus-driven attention in the brain. *Nature Reviews Neuroscience*, *3*(3), 201-215. https://doi.org/10.1038/nrn755

Depue, R. Morrone-Struppinski, J. (2005). A neurobehavioral model of affiliative bonding: Implications for conceptualizing a human trait of affiliation. *Behavioral and Brain Sciences.* 28, 313–395. https://doi.org/10.1017/S0140525X05350060

Desimone, R., & Duncan, J. (1995). Neural Mechanisms of Selective Visual Attention. *Annual Review of Neuroscience*, *18*(1), 193-222. https://doi.org/10.1146/annurev.ne.18.030195.001205

Duarte, J., McEwan, K., Barnes, C., & Maratos, F. (2014). Imagery focused interventions increase physiological and behavioural indices of threat in high self-critics. *Psychology and Psychotherapy: Theory, Research and Practice,* 88, 270–284. doi:10.1111/papt.12043

Eldar, S., & Bar-Haim, Y. (2010). Neural plasticity in response to attention training in anxiety. *Psychological Medicine,* 40, 667–678. https://doi.org/10.1017/S0033291709990766

Engen, H., Singer, T. (2015). Compassion-based emotion regulation up-regulates experienced positive affect and associated neural networks, *Social Cognitive and Affective Neuroscience*, 10(9), 1291–1301. https://doi.org/10.1093/scan/nsv008

Fredrickson Barbara L, 2001. The role of positive emotions in positive psychology; the broaden-and-build theory of positive emotions. *Am. Psychol.* 56 (3), 218-226, https://doi.org/10.1037/0003-066x.56.3.218.

Fredrickson B. L., Huppert F. A., Baylis N. & Keverne B. (2004). The broaden–and–build theory of positive emotions. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, *359*(1449), 1367-1377. https://doi.org/10.1098/rstb.2004.1512

Fredrickson, B. L. (1998). What Good Are Positive Emotions? *Review of General Psychology*, *2*(3), 300-319. https://doi.org/10.1037/1089-2680.2.3.300

Fredrickson B., Branigan, C. (2005): Positive emotions broaden the scope of attention and thought- action repertoires, *Cognition & Emotion*, 19:3, 313-332. http://dx.doi.org/10.1080/02699930441000238

Fredrickson, B. L., Cohn, M. A., Coffey, K. A., Pek, J., & Finkel, S. M. (2008). Open hearts build lives: Positive emotions, induced through loving-kindness meditation, build consequential personal resources. Journal of Personality and Social Psychology, 95(5), 1045-1062.

Fredrickson, B. L. (2013). Positive Emotions Broaden and Build. In *Advances in Experimental Social Psychology* (Vol. 47, pp. 1–53). https://doi.org/10.1016/B978-0-12-407236-7.00001-2

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. *Psychological Bulletin*, *99*(1), 20-35. https://doi.org/10.1037/0033-2909.99.1.20

Gauthier, J., & Bouchard, S. (1993). Adaptation canadienne-française de la forme révisée du State–Trait Anxiety Inventory de Spielberger. *Canadian Journal of Behavioural Science/Revue Canadienne Des Sciences Du Comportement,* 25(4), 559–578. http://dx.doi.org/10.1037/h0078881.

Gilbert, P. (2000). Social mentalities: Internal 'social' conflicts and the role of inner warmth and compassion in cognitive therapy. In, P. Gilbert & Bailey K.G (eds.) *Genes on the Couch: Explorations in Evolutionary Psychotherapy* (p.118-150). Hove: Brenner-Routledge.

Gilbert P., Clarke M., Hempel S., Miles J.N.V., Irons C. (2004). Criticizing and reassuring oneself: An exploration of forms, styles and reasons in female students. *Brit J Clin Psychol 43*: 31–50. DOI: 10.1348/014466504772812959

Gilbert, P., & Procter, S. (2006). Compassionate mind training for people with high shame and self-criticism: overview and pilot study of a group therapy approach. *Clinical Psychology & Psychotherapy*, *13*(6), 353-379. https://doi.org/10.1002/cpp.507

Gilbert, P. (2007) Introducing Compassion-Focused Therapy, *Advanced in Psychiatric Treatment,* 15-3; 199-208. https://doi.org/10.1192/apt.bp.107.005264

P. Gilbert, K. McEwan, R. Mitra, L. Franks, A. Richter & H. Rockliff (2008) Feeling safe and content: A specific affect regulation system? Relationship to depression, anxiety, stress, and self-criticism, The Journal of Positive Psychology, 3:3, 182-191, DOI: 10.1080/17439760801999461

Gilbert, P. (2014) The origins and nature of compassion Focused Therapy, *British Journal of Clinical Psychology*.53,1: 6-41. https://doi.org/10.1111/bjc.12043

Grol, M., Koster, E. H. W., Bruyneel, L., & De Raedt, R. (2014). Effects of positive mood on attention broadening for self-related information. *Psychological Research, 78*(4), 566-573. https://doi.org/10.1007/s00426-013-0508-6

Grol, M., & Raedt, R. D. (2014). Effects of positive mood on attentional breadth for emotional stimuli. *Frontiers in Psychology*, *5*. https://doi.org/10.3389/fpsyg.2014.01277

Hakamata, Y., Lissek, S., Bar-Haim, Y., Britton, J. C., Fox, N. A., Leibenluft, E., … Pine, D. S. (2010). Attention Bias Modification Treatment: A Meta-Analysis Toward the Establishment of Novel Treatment for Anxiety. *Biological Psychiatry*, 68(11), 982-990. https://doi.org/10.1016/j.biopsych.2010.07.021

Heeren, A., Maurage, P., Rossignol, M., Vanhaelen, M., Peschard, V., Eeckhout, C., & Philippot, P. (2012). Self-report version of the Liebowitz Social Anxiety Scale: Psychometric properties of the French version. *Canadian Journal of Behavioural Science / Revue canadienne des sciences du comportement*, *44*(2), 99-107. https://doi.org/10.1037/a0026249

Hertel, P. T., & Mathews, A. (2011). Cognitive Bias Modification: Past Perspectives, Current Findings, and Future Applications. *Perspectives on Psychological Science*, *6*(6), 521-536. https://doi.org/10.1177/1745691611421205

Hofmann, S. G., Grossman, P., & Hinton D. E. (2011). Loving-kindness and compassion meditation: Potential for psychological intervention. Clinical Psychology Review, 13, 1126–1132. doi:10.1016/j.cpr.2011.07.003

Iannou, M., Mogg, K. & Bradley, B. (2003). Vigilance for threat: effects of anxiety and defensiveness. *Personality and Individual Differences* 36 (2004) 1879–1891 doi:10.1016/j.paid.2003.08.018

Jazaieri, H, McGonigal, K., Jinpa, G. T., Doty, J. , Gross, J., Goldin, P. (2013) A randomized controlled trial of compassion cultivation training: Effects on mindfulness, affect, and emotion regulation. *Motiv Emot* 38:23–35. 10.1007/s11031-013-9368-z

Keltner, D., Kogan, A., Piff, P. K., & Saturn, S. R. (2014). The sociocultural appraisals, values, and emotions (SAVE) framework of prosociality: Core processes from gene to meme. The Annual Review of Psychology, 65, 425–460. doi: 10.1146/annurev-psych-010213-115054

Kirby, J.N. (2016). Compassion interventions: The programs, the evidence, and implications for research and practice. Psychology and Psychotherapy: Theory, Research, and Practice. Advance online publication. doi: 10.1111/papt.12104

Klumpp, H., & Amir, N. (2010). Preliminary study of attention training to threat and neutral faces on anxious reactivity to a social stressor in social anxiety. *Cognitive Therapy and Research*, 34, 263–271 https://doi.org/10.1007/s10608-009-9251-0

Kotsou I., & Leys, C. (2016) Self-Compassion Scale (SCS): Psychometric Properties of The French Translation and Its Relations with Psychological Well-Being, Affect and Depression. *PLoS ONE* 11(4): e0152880. DOI: 10.1371/journal.pone.0152880

Lang TJ, Blackwell SE, Harmer CJ, Davison P, Holmes EA (2012) Cognitive bias modification using mental imagery for depression: developing a novel computerized intervention to change negative thinking styles. *Eur J Pers* 26:145–157 https://doi.org/10.1002/per.855

Leboeuf, I., Mahanga, J., Rusinek, S., Delamillieure, P., Gheysen, F., Andreotti, E., Antoine, P. (2019) Validation of the French versions of the Forms of Self-Criticizing/Attacking and Self-Reassuring Scale (FSCRS), *Stress and Health*, 2009; 1-6. DOI: 10.1002/smi.2909

Leboeuf, I. (2020): Attention-figshare-Datas.xlsx. figshare. Dataset. https://doi.org/10.6084/m9.figshare.12912149.v1

Leleu, V., Douilliez, C., Rusinek, S. (2013) Etude du biais d'attention selective envers les stimuli menaçants et insecurisants dans l'anxiété-trait: considération du décours temporel. *Canadian Journal of Experimental Psychology,12*. DOI: 10.1037/cep0000006

Li, S.W., Tan, J.Q., Qian, M.Y., & Liu, X.H. (2008). Continual training of attentional bias in social anxiety. *Behaviour Research and Therapy*, 46, 905–912. https://doi.org/10.1016/j.brat.2008.04.005

Lincoln, T. M., Hohenhaus, F., & Hartmann, M. (2013). Can Paranoid Thoughts be Reduced by Targeting Negative Emotions and Self-Esteem? An Experimental Investigation of a Brief Compassion-Focused Intervention. *Cognitive Therapy and Research*, *37*(2), 390-402. https://doi.org/10.1007/s10608-012-9470-7

Liebowitz, M. R. (1987). Social phobia. *Modern Problems of Pharmacopsychiatry*, *22*, 141-173. https://doi.org/10.1159/000414022

Longe, O., Maratos, F.A., Gilbert, P., Evans, G., Volker, F., Rockliffe, H., & Rippon, G. (2010). Having a word with yourself: Neural correlates of self-criticism and self-reassurance. *NeuroImage*, *49*, 1849-1856. DOI: 10.1016/j.neuroimage.2009.09.019

MacLeod C, Clarke, PJF., Mathews, A. (2002). Selective attention and emotional vulnerability: assessing the causal basis of their association through the experimental manipulation of attentional bias. *J Abnorm Psychol*, 111(1):107–123. http://dx.doi.org/10.1037/0021-843X.111.1.107

MacLeod C, Mathews A (2012). Cognitive bias modification approaches to anxiety. *Annu Rev Clin Psychol*, 8:189–217. https://doi.org/10.1146/annurev-clinpsy-032511-143052

MacLeod C., Mathews A., Tata P. (1986) Attentional bias in emotional disorders. *J Abnorm Psychol 95*: 15–20. http://dx.doi.org/10.1037/0021-843X.95.1.15

MacLeod, C., Clarke, PJF. (2013) Cognitive Bias Modification: a next frontier in cognition and emotion research. In *Hanbook of cognition and Emotion.* Edited by Robinson MMD, Watkins, ER., Harmon-Jones, E. New-York: Guilford Press: 540-562. ISBN 978-1-4625-0999-7

Mathews, A., & MacLeod, C. (2002). Induced processing biases have causal effects on anxiety. Cognition and Emotion, 16, 331–354. DOI: 10.1080/02699930143000518

Matos, M., Duarte, C., Duarte, J., Pinto-Gouveia, J., Petrocchi, N., Basran, J., & Gilbert, P. (2017). Psychological and Physiological Effects of Compassionate Mind Training: a Pilot Randomised Controlled Study. *Mindfulness*, *8*(6), 1699-1712. https://doi.org/10.1007/s12671-017-0745-7

Preacher KJ, Rucker DD, MacCallum RC, Nicewander WA (2005) Use of the extreme groups approach: A critical reexamination and new recommendations. *Psychol Methods* 10: 178–192. DOI: 10.1037/1082-989X.10.2.178

McEwan, K. (2012), An exploration of the processing of compassionate and critical faces, These, Universtiy of Derby. ISNI: 0000 0004 2742 4524

McEwan, K., Gilbert, P. (2014) Facial expression depicting compassion and critical emotions: The développement and validation of a new emotional face stimulus set, *Plos-one*, *9*, 1-5. doi:10.1371/journal.pone.0088783

McEwan, K., & Gilbert, P. (2016). A pilot feasibility study exploring the practicing of compassionate imagery exercises in a nonclinical population. *Psychology and Psychotherapy: Theory, Research and Practice*, *89*(2), 239-243. https://doi.org/10.1111/papt.12078

Mikulincer, M., Shaver, R. (2007) Boosting Attachment Security to Promote Mental Health, Prosocial Values, and Inter-Group Tolerance, *Psychological Inquiry*, 18:3, 139-156, DOI: 10.1080/10478400701512646

Naismith, I., Zarate Guerrero, S. & Feigenbaum, J. (2019). Abuse, invalidation, and lack of early warmth show distinct relationships with self-criticism, self-compassion, and fear of self-compassion in personality disorder. *Clinical Psychology & Psychotherapy*. *A*dvance online publication. doi: 10.1002/cpp.2357.

Narvaez, D. (2014). *Neurobiology and the Development of Human Morality: Evolution, Culture, and Wisdom* (Norton Series on Interpersonal Neurobiology). W. W. Norton & Company.

Neff, D. K. (2003). The Development and Validation of a Scale to Measure Self-Compassion. *Self and Identity, 2*, 223-250. DOI: 10.1080/15298860309027

Neff, K., Kirkpatrick, K., & Rude, S. (2007). Self-compassion and adaptive psychological functioning. *Journal of Research in Personality, 41,* 139 – 154. DOI: 10.1016/j.jrp.2006.03.004

Powers, T.A, & Zuroff, D.C. (1988). Interpersonal consequences of overt self- criticism: A comparison with neutral and self-enhancing presentations of self. *Journal of Personality and Social Psychology*, *54*(6), 1054-1062. DOI : 10.1037/0022-3514.54.6.1054

Pankseep, J. 2007, Review Neuroevolutionary sources of laughter and social joy: Modeling primal human laughter in laboratory rats. *Biavioral Brain Research,* 182 (2007) 231–244. doi:10.1016/j.bbr.2007.02.015

Porges, S.W. (2003). The polyvagal Theory: phylogenetic contributions to social behavior. *Physiology and behavior*, 79, 502-513 doi:10.1016/S0031-9384(03)00156-2

Price, R. B., Kuckertz, J. M., Siegle, G. J., Ladouceur, C. D., Silk, J. S., Ryan, N. D., Dahl, R. E., & Amir, N. (2015). Empirical recommendations for improving the stability of the dot-probe task in clinical research. *Psychological Assessment, 27*(2), 365–376. https://doi.org/10.1037/pas0000036

Troller-Renfree, S., et al. The beneficial effects of a positive attention bias amongst children with a history of psychosocial deprivation. *Biol. Psychol*. (2016), http://dx.doi.org/10.1016/j.biopsycho.2016.04.008

Troller-Renfree, S., McDermott, J., Nelson, C., Zeanah, C., Fox, N. (2015) The effects of early foster care intervention on attention biases in previously institutionalized children in Romania *Dev. Sci*., 18 (2015), pp. 713-722 DOI: 10.1111/desc.12261

Rockliff, H., Gilbert, P., McEwan, K., Lightman, S., & Glover, D. (2008). A pilot exploration of heart rate variability and salivary cortisol responses to compassion-focused imagery. *Journal of Clinical Neuropsychiatry, 5*, 132–139. http://hdl.handle.net/10545/622861

Rockliff, H., Karl, A., McEwan, K., Gilbert, J., Matos, M., & Gilbert, P. (2011). Effects of intranasal oxytocin on « compassion focused imagery ». *Emotion*, *11*(6), 1388-1396. https://doi.org/10.1037/a0023861

Schmidt NB, et al: Attention training for generalized social anxiety disorder. *J Abnorm Psychol* 2009, 118(1):5–14. http://dx.doi.org/10.1037/a0013643

Shahar, G. (2015). *Erosion: The psychopathology of self-criticism.* In New York: Oxford University Press.

Siegel, D. J. (2016). *Mind: A Journey to the Heart of Being Human (Norton Series on Interpersonal Neurobiology)*. W. W. Norton & Company.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). STAI manual for the state-trait anxiety inventory. Palo Alto, CA: Consulting Psychologists Press.

Theeuwes, J., Atchley, P., & Kramer, A. F. (2000). On the time course of top–down and bottom–up control of visual attention. In S. M. J. Driver (Ed.), Attention & performance, vol. 18. (pp. 105-125). Cambridge: MIT Press.

Torkan, H., Blackwell, S. E., Holmes, E. A., Kalantari, M., Neshat-Doost, H. T., Maroufi, M., & Talebi, H. (2014). Positive Imagery Cognitive Bias Modification in Treatment-Seeking Patients with Major Depression in Iran: A Pilot Study. *Cognitive Therapy and Research*, *38*(2), 132-145. https://doi.org/10.1007/s10608-014-9598-8

Treisman, A., & Sato, S. (1990). Conjunction search revisited. *Journal of Experimental Psychology: Human Perception and Performance, 16*(3), 459–478. https://doi.org/10.1037/0096-1523.16.3.459

Uddenberg, S., & Shim, W. M. (2015). Seeing the world through target-tinted glasses: Positive mood broadens perceptual tuning. *Emotion*, *15*(3), 319-328. https://doi.org/10.1037/emo0000029

Valdesolo, P., DeSteno, D. (2011), Synchrony and the social Tuning of Compassion, *Emotion,* Vol. 11, No. 2, 262-266. http://dx.doi.org/10.1037/emo0000029

Vanlessen, N., Rossi, V., De Raedt, R., & Pourtois, G. (2014). Feeling happy enhances early spatial encoding of peripheral information automatically: electrophysiological time-course and neural sources. *Cognitive, Affective, & Behavioral Neuroscience*, *14*(3), 951-969. https://doi.org/10.3758/s13415-014-0262-2

Vanlessen, N., De readt, R., Koster, E., Pourtois, G. (2016) Happy heart, smiling eyes: A systematic review of positive mood effects on broadening of visuospatial attention, *Neurosciences and Biobehavrioral Reviews,* 68-16. 816-837. https://doi.org/10.1016/j.neubiorev.2016.07.001

Wang, S. (2005). A conceptual framework for integrating research related to the physiology of compassion and the wisdom of Buddhist teachings. In Gilbert P (Ed) *Compassion: Conceptualisations, research and Use in Psychotherapy*. London, Routledge, pp 371-385.

Waters AM, et al: Attention training towards positive stimuli in clinically anxious children. *Dev Cognit Neurosci* 2013, 4:77–84. https://doi.org/10.1016/j.dcn.2012.09.004

Zuroff, D. C., Santor, D. A., & Mongrain, M. (2005). Dependency, self-criticism, and maladjustment. In J. S. Auerbach, K. J. Levy, & C. E. Schaffer (Eds.), *Relatedness, self-definition and mental representation: Essays in honor of Sidney J. Blatt* (pp. 75–90). London: Brunner-Routledge.

Table 1. Participant characteristics

Variable	**Value**	**Neutral group (n = 40)**	**Compassion group (n= 40)**
Sex	Female (%)	29 (72,5)	29 (72,5)
Age	Mean (range)	21,12 (4,30)	26,31 (12,01)
Prior meditation experience	Yes (%)	6 (15)	13(32,5)
Activity professional	Professional (%)	6 (15)	23 (57,5)
	Student (%)	34 (85)	17 (42,5)
Marital status	Divorced (%)	1 (2,5)	5 (12,5)
	Married or civil union (%)	3 (7,5)	14 (35)
	Single (%)	36 (90)	25 (62,5)
BDI	Mean (range)	10,68 (7,3)	15,01(8,74)
STAI T	Mean (range)	47,02 (9,23)	50,83 (11,43)
Self-criticism	Mean (range)	17,67 (6,60)	19,35 (8,17)

Table 2. Summary of interaction effects

Vairables	Df hyp	Df error	F	p	Partial eta-squared
time X presentation time X type of emotional face X type of imagery X self-criticism	14	593	1,8	0,035	0,041
time X type of imagery X self-criticism for critical faces at 1200 ms	14	593	3,18	0,000	0,07
Type of faces X imagery X self-criticism	14	593	1,88	0,026	0,43
Time X type of faces	1	593	5,68	0,017	0,009
	1	608	7,3	0,007	0,012

Type of faces at 1200 ms before imagery					
Self-criticism X type of faces	1	608	1,0	0,05	0,085

	Critical Faces 1200 ms	Critical Faces 500 ms	Compassionate Faces 1200 ms	Compassionate Faces 500 ms
Mean	-15.76	-12.31	5.50	5.20
SD	197.9	139.4	128.2	137.4
F	1.53	0.64	1.54	1.19
p	0.03	0.93	0.03	0.21

Table 3: Mean of the Attention Bias Score, Standard Deviation and ANOVA of the effect of the self-criticism variable (Inadequate Self subscale of the FSCRS) df=31.

	Critical Faces Low Self-criticism	Critical Faces High Self-criticism	Compassionate Faces Low Self-criticism	Compassionate Faces High Self-criticism
Mean	-57.35	2.98	-6.35	12.73
SD	268.1	146.4	140	133

Table 4: Mean of the Attention Bias Score at 1200 ms, Standard Deviation for critical and compassionate faces and for the low and high self-criticism groups (score of the Inadequate Self subscale of the FSCRS)