Personality and Individual Differences 220 (2024) 112524

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

No modulation effects of depressive traits on the self-face advantage

Jasmine K.W. Lee [a,b,*], Steve M.J. Janssen [b], Alejandro J. Estudillo [b,c]

[a] University of Reading Malaysia, Malaysia
[b] University of Nottingham Malaysia, Malaysia
[c] Bournemouth University, United Kingdom

ARTICLE INFO

Keywords:
Self-face advantage
Visual search
Depressive traits
Negative self-concept attentional advantage

ABSTRACT

The self-face advantage (SFA) is reflected through a faster recognition of a self-face compared to other faces. It has been suggested that this effect is prompted by one's positive self-evaluations. However, it is unclear whether negative self-concepts (depressive traits) also affect the SFA. The present study explored this possibility using a visual-search task. In Experiment 1, participants with low and high depressive traits were asked to search for frontal view images of self and unfamiliar faces among arrays of unfamiliar faces. Regardless of group, participants were better and faster in searching for the own face compared to the unfamiliar face. Similar findings were observed in Experiment 2, but the participants were more accurate when searching for their happy self-face compared to their sad and neutral faces. These results suggest that SFA is not modulated by depressive traits (i.e., negative self-concepts) and that familiarity effects for the own face could be implicated as an underlying factor for an attentional prioritization of the own face.

1. Introduction

Self-processing involves the perceptions and memories of oneself (Liu et al., 2022) and is modulated by one's self-concept (e.g., Morin, 2006). Self-concept is generally understood as the way in which people perceive and evaluate themselves (Markus & Kitayama, 1991). An individual's self-concept influences a range of cognitive processes, such that when a stimulus is perceived as self-relevant, self-concept would guide the perception and interpretation of the self-referent information, resulting in a systematic self-processing bias across domains of attention (Alzueta et al., 2019; Lee et al., 2022; Wójcik et al., 2019) and perception (Cunningham et al., 2008; Sui & Humphreys, 2015).

Most importantly, it is theorized that an individual needs to have a self-concept to be able to recognize their face (Gallup, 1970), and likewise, the ability to recognize one's face in the mirror is often asserted to be fundamental in maintaining a coherent identity of the self (Estudillo & Bindemann, 2017; Rochat & Zahavi, 2011). Self-face processing is considered as a fundamental modality of self-processing such that the self-face receives attentional priority and is processed faster compared to other faces (for a review, see Bortolon & Raffard, 2018). This self-face advantage (SFA) is reflected through individuals showing faster recognition for their own faces compared to other people's faces (e.g., Lee et al., 2022; Liu et al., 2016; Tong & Nakayama, 1999).

There has been considerable debate over how self-faces gain attentional priority. One of the arguments is that SFA is promoted by positive self-biases and self-evaluations (Greenwald, 1980; Watson et al., 2007), as self-face recognition is generally associated with positive self-perceptions (Blackwood et al., 2003). For instance, Epley and Whitchurch (2008) showed that when they morphed photographs of participants' faces with attractive and unattractive faces, participants were more likely to identify the attractive morphs as the own face compared to their actual face or the unattractive morphs. DeBruine (2005) also observed that individuals rated morphs of their faces as more trustworthy compared to morphs of other faces, suggesting that people evaluate unfamiliar faces that resembled the self, more favorably.

Correspondingly, Ma and Han (2010) had put forward the implicit positive associations theory to elucidate the SFA from a social cognitive perspective. This theory stems from studies showing that individuals generally respond faster to positive stimuli compared to negative stimuli (e.g., Feyereisen et al., 1986; Ma & Han, 2010). When postulating the implicit positive associations theory, Ma and Han (2010) argued that when viewing the own face, implicit positive self-attributes are activated, which in turn facilitate the behavioural responses to the own face. In other words, positive emotion may be implicated as an underlying

* Corresponding author at: University of Reading Malaysia, School of Psychology & Clinical Language Sciences, Persiaran Graduan, Kota Ilmu, Educity, Iskandar Puteri 79200, Johor, Malaysia.
E-mail address: j.k.lee@reading.edu.my (J.K.W. Lee).

https://doi.org/10.1016/j.paid.2023.112524
Received 22 June 2023; Received in revised form 7 November 2023; Accepted 14 December 2023
Available online 30 December 2023
0191-8869/

factor for an attentional prioritization of the self-face.

1.1. Negative self-concept and self-referential processing

Whereas it is generally observed that people tend to have a self-positivity bias (Greenwald, 1980), such that they view and evaluate themselves in a favourable and positive manner (e.g., Koole & DeHart, 2007), individuals with depression tend to have negatively biased self-processing. Beck (1976) proposed a cognitive model on depression which theorized that depressed individuals have a negative view of the self, the world, and the future, and he further proposed that this "negative triad" would result in a systematic and automatic negative bias in information processing (Beck, 2008). Based on this theory, depressed individuals possess a negative self-concept, built upon themes of inadequacy and failures. This negative self-concept would then influence the perception and interpretation of self-related information as negatively biased (Beck, 1976, 2008).

Indeed, studies using a wide range of experimental paradigms have presented evidence that depression is associated with negative associations about the self (for a review, see Wisco, 2009). For instance, compared to non-depressed individuals, depressed individuals recall more negative self-traits (e.g., Burke et al., 2015), choose more negative words to describe themselves (e.g., Derry & Kuiper, 1981; Rude et al., 1988), report more negative views of themselves on self-report measures (e.g., Beckham et al., 1986), and respond faster to negative self-related stimuli (i.e., sad self-face; Fritzsche et al., 2010). There is also considerable evidence (e.g., Gotlib et al., 2004; Hankin et al., 2010) showing that depressed (or depression prone) individuals show a greater avoidance to positive facial stimuli and are less likely to correctly recall positive self-referential information compared to non-depressed individuals. Taken together, these studies seem to suggest that self-relevant information is associated with more negative thinking in depression.

Recent studies have put forth evidence that the effects of having a negative self-concept can be extended to the processing for the own face. For instance, Ma and Han (2010) reported that participants who were primed with negative adjectives to describe the self (i.e., low levels of positive self-evaluation) showed a reduced preferential bias for the own face (i.e., a weaker SFA) compared to those with higher levels of positive self-evaluations. This finding implicated that the observed SFA may be driven by the implicit positive associations to self-related stimuli. Furthermore, in a brain imaging study, Quevedo et al. (2016) observed that depressed youth with high suicidality showed lower activity in the midline cortical structures (i.e., medial prefrontal cortex, anterior cingular cortex, and posterior cingulate cortex) implicated for self-processing (e.g., Sugiura et al., 2005). The authors also reported a significantly reduced neural activity in the limbic structures (i.e., hippocampus and amygdala) when viewing the own face with a happy expression compared to an unfamiliar face with a happy expression. In other words, suicidal depressed youth showed a reduced activity in the neural circuitry for self-face processing when asked to recognize positive self-expression. These findings seem to be in parallel with the cognitive theories associating depression with negative biases in self-processing (e.g., Beck, 1976; Fritzsche et al., 2010; Gotlib et al., 2004; Hankin et al., 2010).

On a different note, extending from Beck's (1976) negative self-concept theory, the specific preference for negative stimuli in depressive individuals could also be accounted for by the mood-congruency hypothesis (e.g., Bower, 1981; Dalgleish & Watts, 1990). Specifically, negatively valenced stimuli may correspond closely to a depressed individual's negative affective state (Cavanagh & Geisler, 2006; Ilardi et al., 2007), hence promoting an attentional bias to negative stimuli. While existing sources of evidence are largely consistent with the mood-congruency hypothesis, some research has explored the combined effect of self-perception and emotion in depressive disorders. Caudek and Monni (2013) showed that after a negative mood induction procedure to activate a distressed mood state, non-depressed individuals with a negative cognitive style showed a negative self-referential memory bias. Specifically, these individuals showed a better head-pose recognition for one's own sad face compared to one's own happy face, However, participants who were not distressed but had a negative cognitive style did not show a negative self-referential bias. This finding seems to suggest that negative self-concepts would only be activated in negative mood states (Ingram, 1984; Joormann & Gotlib, 2007).

In a recent study, McIvor et al. (2021) examined the influence of self-perception on the salience of emotional stimuli in depressive individuals using a perceptual-matching task. In the study, participants had to associate geometric shapes with personal labels ("self" or "others") and each shape had a happy, neutral, or sad line drawing of a face. Participants had to decide whether the shape-label pairs matched while the facial emotion was deemed task irrelevant. The authors reported a SFA regardless of facial emotion across both control and depressed participants. Interestingly, they observed that depressed individuals showed reduced happy and sad emotional biases regardless of the self-relevance of the stimulus and hence suggested that depressed individuals may instead show a general blunted response to emotion (Rottenberg et al., 2005). These findings, however, contradict Beck's (1976) cognitive theory of depression which emphasizes that the bias to negative stimuli is due to negative self-perceptions. The emerging picture from the evidence discussed above seems to suggest the possibility that the mood-congruency hypothesis may be implicated as an underlying factor for the negative processing biases in depressed individuals.

Depression is also associated with altered reward and punishment sensitivity that are potentially linked to self-processing. For instance, brain regions for self-relevant and reward processing overlap (Northoff & Hayes, 2011; Ota & Nakano, 2021). In Hobbs et al.'s (2023) cognitive tasks, isolated self-processing showed no self-prioritization changes in those with greater depression. However, combining self-processing with emotion processing revealed a positive bias towards others in individuals with depression. This suggests that depression leads to not only negative self-perception but also a tendency to view others more positively (Kuiper et al., 1982).

1.2. The current study

To date, it is unknown whether depressive traits in neurotypical samples modulate self-face processing. Answering this question is important as assessing the relationship between depressive traits features and self-processing, specifically how self-relevant information is prioritized, in the general population provides a platform for follow-up investigations in clinically diagnosed depressed individuals (i.e., Robinson et al., 2011). Therefore, Experiment 1 explored the modulation effects of depressive traits on the attentional prioritization of the own face in a sample of people who have not been diagnosed with depression. Considering the mood congruency hypothesis (e.g., Dalgleish & Watts, 1990), Experiment 2 was conducted to further explore the modulation effects of depressive traits on SFA while considering the role of emotional valence of stimuli.

2. Experiment 1

Experiment 1 aimed to explore the modulation effects of depressive traits on an SFA in a neurotypical sample. In this study, depressive traits were measured using the Center for Epidemiologic Studies Depression Scale (CES—D; Radloff, 1977). Based on the theory of implicit positive associations with the self (Ma & Han, 2010) and the self-positivity bias (Greenwald, 1980), the own face may be treated and processed as an emotionally positive face (i.e., a happy face) and positive emotion may be implicated as an underlying factor for the SFA. However, based on the negative self-concept theory (Beck, 1976), evidence has shown that depressed individuals are less likely to accurately identify positive self-referential information due to having low levels of positive self-evaluations (e.g., Ma & Han, 2010).

Following this line of thought, individuals with more depressive traits were expected to show longer search times and lower search accuracy for the own face (i.e., a weakened SFA) compared to those with lesser depressive traits. On the other hand, individuals across the low and high depressive traits were expected to perform comparably for the search time and search accuracy for an unfamiliar face. To test these hypotheses, Experiment 1 compared the search times and search accuracy for frontal view images of self and unfamiliar faces among an array of unfamiliar distractor faces across individuals with low or high depressive traits.

2.1. Method

2.1.1. Participants

One-hundred ten Chinese Malaysian participants (34 males) were recruited from the University of Nottingham Malaysia. A power analysis performed in G*Power 3.1.9.7 (Faul et al., 2007) with an effect size of 0.15 and alpha of 0.025 gives a required sample of 110 participants to achieve 80 % power in a 2 × 2 mixed-design ANOVA. Participants' age ranged from 19 to 30 years old ($M = 22.48$, $SD = 2.39$ years old). Participants were either awarded with course credits or compensated financially for their participation. Participants provided informed consent and were debriefed at the end of the study. Ethics approval for this study was obtained from the Science and Engineering Research Ethics Committee of the University of Nottingham Malaysia.

2.1.2. Design

This experiment used a 2 × 2 mixed design. The between-subjects variable was group (low depressive traits or high depressive traits). The within-subjects variable was target identity (self or unfamiliar). The dependent variables were the median reaction time and accuracy to search for the self and unfamiliar face.

As Experiment 1 aimed to explore the self-face advantage (SFA) across the lower and higher end of depressive traits. However, using a cut-off score would result in an unequal sample size across those of low and high depressive traits groups. Hence, to ensure a rather equal sample size across the groups, participants were grouped into four quartiles following their scores on the CES-D questionnaire (see Table 1). Following this method, two participants with the same score in the CES-D questionnaire would always be included in the same quartile. Since the experiment aimed to exclusively investigate SFA among individuals with low and high levels of depressive traits, subsequent statistical analyses were carried out using data from the lowest quartile (low group; $N = 28$) and the highest quartile (high group; $N = 26$). Importantly, a median split analysis including the entire sample revealed similar results (see Appendix A).

2.1.3. Stimuli

Photograph stimuli were individually tailored to each participant. Each participant was photographed under similar conditions (i.e., constant lighting), in a frontal position while assuming a neutral and happy expression and while articulating three different speech sounds (e.g., A, O, and E; see Fig. 1). Different images were used for each identity to reduce image-specific learning. Five different images were used as "self-face" for the participant themselves. Fourteen separate Chinese Malaysians individuals (7 males and 7 females) matched in age were photographed under same conditions to be used as unfamiliar targets and distractor faces. All images were collected and processed at least one week prior to the experimental session.

Table 1
CES-D scores of participants in Experiment 1 for the total sample and across each quartile.

CES-D quartile	*N*	Mean	*SD*	Range
Q1	28	8.32	2.36	4–11
Q2	28	14.71	1.78	12–17
Q3	28	20.50	2.19	18–24
Q4	26	32.69	6.42	25–50
Total	110	18.81	9.60	4–50

Fig. 1. Example of face stimuli.
Note. The five different images for each identity that were presented throughout the study. From left to right, top row: neutral, happy. From left to right, bottom row: "A", "O", and "E".

Using Photoshop™, all photographs were rotated to ensure eyes were horizontal and were cropped to 113 × 126 pixels, corresponding to an approximate visual angle of 2.9° × 3.4° at a viewing distance of 70 cm. All photographs were cropped based on their individual contours and external features (i.e., hairs and ears were removed). All face images were also converted to greyscale. These transformations would minimize differences in non-facial cues. "Self-face" images were presented in a mirror-reversed orientation (i.e., the view in which people generally view their own face), whereas the "unfamiliar" images were presented in normal orientation. Each participant's stimuli set consisted of three sets of images: one target self-face set (with five different images), one target unfamiliar face set (with five different images), and six distractor faces sets (each with five different images). Fig. 1 shows example of face stimuli that were presented in the study.

The Center for Epidemiologic Studies Depression Scale (CES—D) scale measures the current level of depressive symptomatology among the general population (Radloff, 1977). Participants were required to indicate how often the symptoms occurred in the week prior to the experiment with response options from 0 = 'rarely' to 3 = 'most or all of the time'. The score ranges from 0 to 60, and the total depression score is calculated by adding all items together, in which a higher total represents a higher presence of depressive symptoms. Using Cronbach's alpha, previous research reported that the internal consistency of the scale ranged between 0.45 and 0.70 (Campo-Arias et al., 2007; Cosco et al., 2017).

2.1.4. Procedure

The self and unfamiliar face conditions were presented in separate blocks of trials (self-block and unfamiliar block), with each identity block presented twice. The presentation of these blocks was counterbalanced for target identity across participants. Each block consisted of a total of 80 trials with target faces appearing in only 50 % of the trials (i.e., target present condition): 40 (5 different target images × 8 repetitions). The remaining 50 % of the trials consisted of display of only unfamiliar distractor faces (i.e., target absent condition). The order of trials within each block was also randomized. The distractor faces were randomly selected among the set of six distractors with no two identical faces presented with the same trial. For each trial, participants' set of stimuli (self, unfamiliar, and distractor faces) would always consist of the same expression and gender. At the start of the study, participants performed a familiarisation phase: 36 practice trials with the same unfamiliar target during the practice trials as during the subsequent test trials. The familiarisation phase was included to reduce the influence of self-face familiarity while participants are still learning to learn the unfamiliar face.

During the experiment, participants were seated 70 cm from the screen. The screen measured horizontally 51 cm and vertically 28.5 cm. Participants were then instructed to search for a given target identity among an array of distractor faces. At the start of each block, participants were cued with a target image (i.e., self-face or unfamiliar face). With a key press by the participants, each trial was initiated with a central fixation cross appearing for 500 ms. Participants were asked to fixate the cross until an array of six faces was presented. All face stimuli (i.e., target face and distractor faces) were randomly positioned to one of the six possible locations to form a hexagon around a fixation cross subtending to a visual angle of 10.1° × 7.7° (see Fig. 2). The display remained on the screen for 3 s or until participants made a response. The target face was present in 50 % of the trials, and to respond, participants pressed the "/" key when the target was present and the "z" key when the target was absent. Participants were asked to respond as quickly and as accurately as possible, and visual feedback was provided when participants did not respond within 3 s.

Participants were also asked to complete the CES-D questionnaire after performing the visual-search task. The study took approximately 40 min to complete.

2.1.5. Data analyses

Data analysis was performed on the median search reaction times (RTs) and mean search accuracies for correct responses. The median of RTs was used instead of the mean RTs to remove the influence of extreme values. For supplementary analyses on hit rates, false alarms rates, and d' scores, see Appendix C.

Additionally, a normalization procedure was adopted to quantify the SFA, such that the SFA on RTs was calculated as a ratio (SF − UF) / (SF + UF), where SF and UF were the median search RTs for the self-face and unfamiliar face, respectively (see Qian et al., 2017, for a similar normalization procedure). Furthermore, to examine whether the normalized SFA effects correlate with the depressive traits of participants, a Pearson's correlational analysis was conducted with scores from the CES—D. It should be noted that the correlation analysis was performed using the full sample.

2.2. Results

Repeated-measures analyses of variance (ANOVAs) were performed on the search accuracy, median reaction time (RTs) for correct responses, and a normalized SFA effect. The ANOVA analyses were complemented with Bayesian analysis methods and estimating a Bayes factor using JASP (Version 0.17.3, JASP Team, 2023), comparing the fit of the data under the alternative hypothesis (H_1) over the fit of the data under the null hypothesis (H_0). The Bayes factors were interpreted according to Lee and Wagenmakers (2014). BF_{10} values between 1 and 3 suggest anecdotal support for H_1, 3–10 implies moderate evidence, 10–30 implies strong evidence, and 30–100 and over 100 implies very strong and extreme support for the alternative model. For H_0, BF10 between 0.33 and 1 suggests anecdotal support, 0.1–0.33 implies moderate evidence, 0.03–0.1 indicates strong evidence, and 0.01–0.03 and <0.01 indicate very strong to extreme evidence for the null model.

The between-subjects variable was depressive traits group (low vs. high depressive traits), and the within-subjects variable was target identity (self vs. unfamiliar face). Table 2 shows the descriptive statistics for search accuracy and median RTs across each variable.

2.2.1. Median RT

Fig. 3 shows the median RTs for each face identity across the low and high depressive traits group. The analysis revealed a main effect of target identity, $F(1, 52) = 25.02, p < .001, \eta_p^2 = 0.325$, $BF_{10} = 13{,}237.45$,

Table 2
Mean accuracies and median RT(s) across low and high depressive traits groups.

Target identity	Group	Accuracy	RT
Self	Low	0.892 (0.142)	1.311 (0.39)
	High	0.934 (0.081)	1.350 (0.38)
Unfamiliar	Low	0.673 (0.152)	1.632 (0.30)
	High	0.640 (0.186)	1.675 (0.35)

Note. Numbers in parentheses are *SD*s.

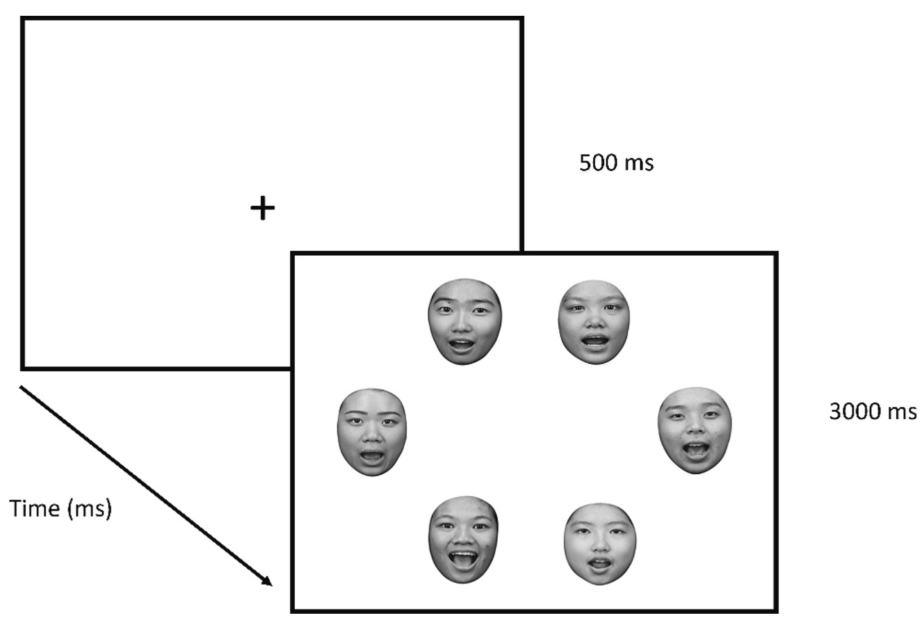

Fig. 2. The experimental paradigm.
Note. On each trial, a central fixation cross was presented for 500 ms followed by an array of six faces for a maximum of 3000 ms.

Fig. 3. The search time of low and high depressive traits group.
Note. Median RT per participant for self and unfamiliar faces condition across high and low depressive traits group. Red squares denote the group means, with 95 % confidence intervals denoted by the whiskers.

with shorter RTs for the self than the unfamiliar face. The analysis further revealed no significant main effect of depressive traits group, $F(1, 52) = 0.29$, $p = .590$, $\eta_p^2 = 0.006$, $BF_{10} = 0.27$. There is also no significant interaction effect between target identity and depressive traits group, $F(1, 52) = 0.00$, $p = .979$, $\eta_p^2 = 0.000$, $BF_{10} = 0.28$.

2.2.2. Search accuracy

Fig. 4 shows the performance accuracy for each face identity across the low and high depressive traits groups. A significant main effect of target identity was reported, $F(1, 52) = 102.18$, $p < .001$, $\eta_p^2 = 0.663$, $BF_{10} = 1.10 \times 10^{14}$, with a higher mean accuracy reported for the self than the unfamiliar face. The analysis further revealed no significant main effect of depressive traits group, $F(1, 52) = 0.02$, $p = .878$, $\eta_p^2 = 0.000$, $BF_{10} = 0.23$. There is also no significant interaction effect between target identity and depressive traits group, $F(1, 52) = 2.13$, $p = .151$, $\eta_p^2 = 0.039$, $BF_{10} = 0.69$.

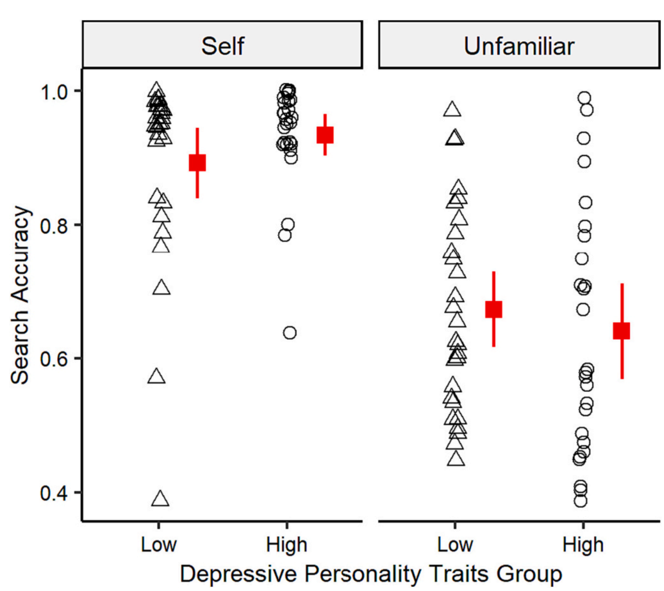

Fig. 4. The search accuracy of low and high depressive traits group.
Note. The mean accuracy scores per participant for self and unfamiliar faces conditions across high and low depressive traits group. Red squares denote the group means, with 95 % confidence intervals denoted by the whiskers.

2.2.3. Normalized self-face advantage (SFA)

As aforementioned, a normalization procedure was adopted to quantify the processing advantages of self-face, where negative values represent faster responses to self-face. Fig. 5 shows the normalized SFA across the low and high depressive traits group. An independent-samples *t*-test on the normalized SFA showed no significant difference between the low and high depressive traits groups, $t(52) = -0.24$, $p = .814$, $BF_{10} = 0.28$.

2.2.4. Normalized SFA effect and CES-D scores

A Pearson's correlation test was conducted using the normalized SFA effect scores and the scores on the CES-D scale of all participants. Findings showed that the normalized SFA effect did not correlate significantly with the scores on the CES-D scale, $r(108) = -0.015$, $p = .877$, 95 % CI = [−0.202, 0.173].

2.3. Discussion

Experiment 1 explored SFA across individuals with low and high depressive traits using a visual-search paradigm wherein participants searched for the own face and a stranger's face. Based on the negative self-concept (e.g., Beck, 1976, 2008) and the implicit positive association theory (e.g., Ma & Han, 2010), depressive individuals are more likely to avoid their face (i.e., a positive self-referential stimulus) due to low levels of positive self-evaluations. Hence, participants with higher

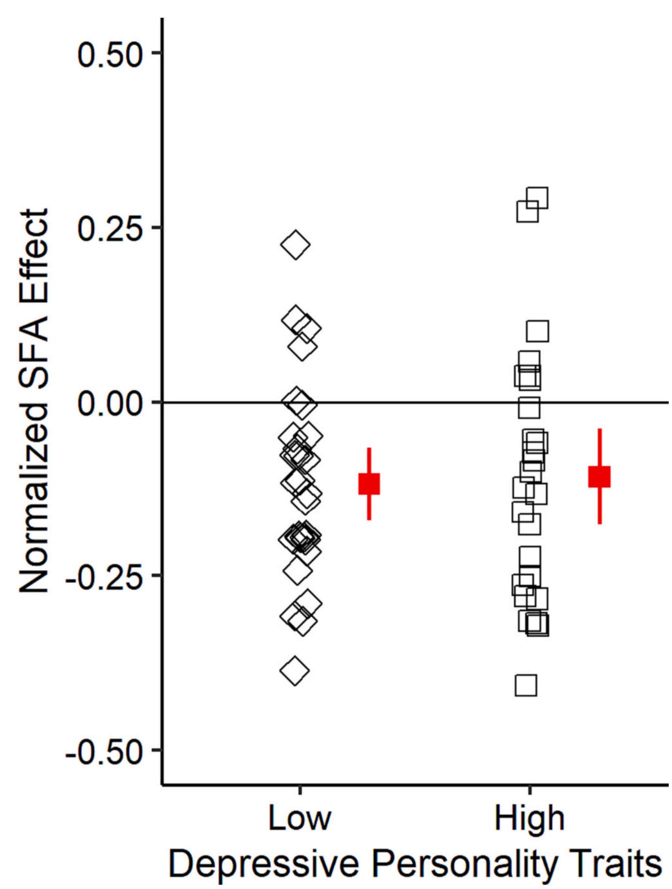

Fig. 5. The normalized SFA effect across low and high depressive traits groups.
Note. Normalized SFA effect per participant across high and low depressive traits groups. Red squares denote the group means, with 95 % confidence interval denoted by the whiskers.

depressive traits were expected to show a reduced SFA (i.e., slower RT and lower accuracy) when searching the own face compared to those with lesser depressive traits.

However, contradicting the hypothesis, our findings suggest that both groups of participants demonstrated a preference for the self-face. Specifically, across both the low and high depressive traits groups, the own face was consistently searched faster and more accurately compared to an unfamiliar face. There were also no significant differences in terms of the normalized SFA effect shown by both groups. Additionally, there was no significant correlation between the SFA and depressive traits (i.e., scores from the CES-D scale). Findings also showed that there were no differences when searching for a stranger's face between the high and low depressive traits groups. Altogether, these findings seem to suggest that the SFA is not modulated by depressive traits, at least in a visual-search paradigm.

One possible explanation for such a finding could be that, rather than showing a lesser preference to the own face (i.e., an emotionally positive face), depressive individuals might instead show a processing bias to a negatively valenced own face (i.e., a sad self-face) that is congruent with their negative affective states (i.e., sadness). It is worth noting that Beck's (1976) negative self-concept theory stipulates that the negative self-representation of a depressed individual would bias the perception and interpretation of self-related information negatively. In fact, studies have presented evidence wherein depressive individuals are more prone to selectively process information that is congruent with their affective states (e.g., sadness). For example, compared to non-depressed individuals, depressive individuals are more likely to show biases to negatively valenced information (e.g., Clark & Teasdale, 1982; Gotlib et al., 2004).

This attentional bias may be interpreted as a mood-congruent bias – "an enhanced coding or retrieval of positive or negative stimuli" corresponding with the individual's mood or affective state (Dalgleish & Watts, 1990). Indeed, there is considerable evidence for a mood-congruency bias in the context of self-referential processing among depressed individuals. For instance, depressive individuals recalled more negative autobiographical memories (e.g., Lloyd & Lishman, 1975; Rottenberg et al., 2005) and negative self-traits (e.g., Burke et al., 2015) and showed better head-pose recognition and increased brain activity to a sad self-face compared to a happy self-face (e.g., Caudek & Monni, 2013; Quevedo et al., 2016). Findings from these studies seem to suggest that depressive individuals exhibit a mood-congruent bias such that, compared to a neutral or positive self-referential stimulus, they are more likely to show biases to negative self-referential stimuli that are congruent with their affective states.

The evidence reviewed in the previous section converges on the idea that the mood-congruency hypothesis may account for the negative processing biases in depressed individuals. Specifically, negatively valenced self-referential stimuli would be more congruent with the negative self-perception of a depressed individual. Taking this account into consideration, Experiment 2 was conducted to further examine the role of a mood-congruent bias on the modulation effects of depressive traits on a SFA in a general population.

3. Experiment 2

Experiment 2 further explored the modulation effects of depressive traits on SFA while introducing the role of emotional valence of the stimuli by presenting the own and unfamiliar face with a neutral, happy, or sad emotion. Participants had to search for target faces among an array of distractor faces while the facial emotion was task irrelevant. According to the mood-congruency hypothesis, participants with more depressive traits are expected to be slower and less accurate in detecting their own face but only when the self-face expression is incongruent with their affective state (i.e., their happy/neutral face) compared to those with lower depressive traits.

However, the congruency of mood and sad expression in those with higher depressive traits might also 'benefit' the processing of sad unfamiliar faces compared to a happy or neutral unfamiliar face. In other words, those with higher depressive traits would search sad faces, regardless of identity, faster and better compared to other emotional expressions (i.e., no/reduced SFA for sad expressions). If, however, those with depressive traits search the sad self-face faster and better than a sad unfamiliar face (i.e., SFA for sad expressions), this finding would then suggest a depressive-specific emotion related attentional bias to a *self-relevant* stimulus due to mood-congruency.

3.1. Method

3.1.1. Participants

Sixty-eight Chinese Malaysians participants (19 males) were recruited from the University of Nottingham Malaysia. A power analysis performed in G*Power 3.1.9.7 (Faul et al., 2007) with an effect size of 0.15 and alpha of 0.025 gives a required sample of 58 participants to achieve 80 % power in a 2 × 2 × 3 mixed-design ANOVA analysis. Participants' age ranged from 18 to 26 years old ($M = 21.0$, $SD = 1.55$ years old). Participants were either rewarded with course credits or compensated financially for their participation. Participants provided informed consent and were debriefed at the end of the study. Ethics approval for this study was obtained from the Science and Engineering Research Ethics Committee of the University of Nottingham Malaysia.

3.1.2. Design

This experiment used a mixed design. The between-subjects variable was group (low depressive traits or high depressive traits), and the within-subjects variables were target identity (self or unfamiliar) and emotional valence (neutral, happy, or sad).

Similar to Experiment 1, participants were grouped into four quartiles following their scores on the CES-D questionnaire (see Table 3). Following this method, two participants with the same scores in the CES-D questionnaire would always be included to the same quartile. As this experiment is only interested in only exploring the SFA across individuals in the lower and higher end of depressive traits, all further statistical analyses were conducted using scores from the first quartile (i.e., low group; $N = 20$) and from the fourth quartile (i.e., high group; $N = 17$; see *Appendix A* for median-split analyses using the entire sample).

3.1.3. Stimuli

The stimuli were collected and processed in an almost similar manner to Experiment 1, except that participants were photographed while displaying neutral, happy, and sad expressions rather than articulating three different speech sounds as in Experiment 1. Fig. 6 shows an example of the face stimuli being presented to a participant.

3.1.4. Procedure

The experiment was conducted in a similar manner as Experiment 1 where participants were required to indicate the presence or absence of a target face (regardless of the emotion valence) by pressing a key on the keyboard. The self and unfamiliar face conditions were presented in separate blocks of trials (self-block and unfamiliar block), with each identity block presented twice and counterbalanced across participants. Each block consisted of 180 trials with target faces appearing in only 50

Table 3
CES-D scores of participants in Experiment 2 for the total sample and across each quartile.

CES-D quartile	*N*	Mean	*SD*	Range
Q1	20	8.45	1.23	6–10
Q2	16	15.50	2.45	12–20
Q3	15	23.80	1.97	21–26
Q4	17	33.35	5.49	28–43
Total	68	19.72	10.14	6–43

Fig. 6. Example of the face stimuli used in Experiment 2.
Note. An example of three different emotion valence for each target identity. From left: "neutral", "happy", and "sad" expression. All images were cropped based on its individual contours and converted to grayscale.

% of the trials (i.e., target present condition): 90 (3 different emotion valence × 30 repetitions). At the start of the study, participants performed a familiarisation phase: 36 practice trials with the same unfamiliar target during practice trials as during the subsequent test trials. Participants were then asked to complete the CES-D questionnaire. The study took approximately 40 min to complete.

3.2. Results

Similar to Experiment 1, repeated-measures analyses of variance (ANOVA) and Bayesian analyses were then performed on the mean search accuracy, median reaction time (RTs) for correct responses, and the normalized SFA effect, respectively. Additional analyses were performed on the hit rates, false alarm rates, and d' scores (see Appendix C). The between-subject variable was depressive traits groups (low vs. high depressive traits). The within-subject variables were target identity (self vs. unfamiliar face) and emotion valence (neutral vs. happy vs. sad). Table 4 shows the descriptive statistics for search accuracy and median RTs across each variable.

3.2.1. Median RT

Fig. 7 shows the median RT for each face identity across the different emotion valence and depressive traits groups. The corresponding analysis revealed a significant main effect for target identity, $F(1, 35) = 19.91$, $p < .001$, $\eta_p^2 = 0.363$, $BF_{10} = 1.95 \times 10^{18}$, with shorter search RTs reported for the self-face than for the unfamiliar face. Next, a significant main effect of depressive traits group was reported, $F(1, 35) = 7.11$, $p = .012$, $\eta_p^2 = 0.169$, $BF_{10} = 1.62$, with participants from the high depressive traits group showing shorter search RTs compared to the low depressive traits group. The analysis further revealed no significant interaction effects between target identity and depressive traits group, $F(1, 35) = 0.00$, $p = .967$, $\eta_p^2 = 0.000$; $BF_{10} = 0.36$. The analysis revealed no significant main effect of emotion, $F(2, 70) = 0.80$, $p = .454$, $\eta_p^2 = 0.022$, $BF_{10} = 0.05$, and no significant interaction effects between target identity and depressive traits group, $F(1, 35) = 0.00$, $p = .967$, $\eta_p^2 = 0.000$, $BF_{10} = 0.12$.

However, the analysis showed an interaction effect between target identity and emotion, $F(2, 70) = 3.26$, $p = .044$, $\eta_p^2 = 0.085$, $BF_{10} = 9.57 \times 10^{15}$. To understand this interaction further, ANOVAs were performed on the median RTs for self and unfamiliar separately. An ANOVA on the median RTs for "self" faces showed a significant main effect of emotion, $F(2, 72) = 4.26$, $p = .018$, $\eta_p^2 = 0.106$. Holm-Bonferroni post-hoc comparisons revealed that participants showed a longer search time for sad compared to neutral emotions ($p = .018$, Cohen's $d = -0.47$) whereas there were no significant differences between neutral and happy emotions ($p = 1.00$, Cohen's $d = -0.13$) and happy and sad emotions ($p = .138$, Cohen's $d = -0.33$). An ANOVA on the median RTs data for "unfamiliar" faces, however, showed no significant main effect of emotion, $F(2, 72) = 0.99$, $p = .377$, $\eta_p^2 = 0.027$. Lastly, the analysis revealed no significant three-way interaction effect between target identity, emotion valence, and depressive traits group, $F(2, 70) = 0.31$, $p = .733$, $\eta_p^2 = 0.009$, $BF_{10} = 0.20$.

Table 4
Mean accuracies and median RT(s) across different emotions and depressive traits group.

Target identity	Group	Emotion	Accuracy	RT
Self	Low	Neutral	0.958 (0.04)	1.516 (0.34)
		Happy	0.966 (0.04)	1.512 (0.34)
		Sad	0.949 (0.60)	1.557 (0.37)
	High	Neutral	0.961 (0.06)	1.277 (0.33)
		Happy	0.968 (0.03)	1.316 (0.35)
		Sad	0.946 (0.08)	1.350 (0.35)
Unfamiliar	Low	Neutral	0.670 (0.19)	1.895 (0.38)
		Happy	0.642 (0.18)	1.877 (0.40)
		Sad	0.631 (0.20)	1.862 (0.37)
	High	Neutral	0.734 (0.17)	1.648 (0.26)
		Happy	0.658 (0.19)	1.721 (0.35)
		Sad	0.665 (0.19)	1.641 (0.36)

Note. Numbers in parentheses are *SDs*.

3.2.2. Search accuracy

Fig. 8 shows the performance accuracy for each face identity with different emotion valences across the low and high depressive traits groups. The analysis revealed a significant main effect for target identity, $F(1, 35) = 110.66$, $p < .001$, $\eta_p^2 = 0.760$, $BF_{10} = 5.75 \times 10^{47}$, with higher mean accuracy reported for the self-face than the unfamiliar face. Next, a significant main effect of emotion valence was reported, $F(2, 70) = 7.36$, $p = .001$, $\eta_p^2 = 0.174$, $BF_{10} = 1.08$. Holm-Bonferroni post-hoc comparisons indicated a higher accuracy for neutral emotion compared to both happy ($p = .013$, Cohen's $d = 0.42$) and sad ($p = .002$, Cohen's $d = 0.62$) emotions, whereas there was no significant difference between sad and happy emotions ($p = .914$, Cohen's $d = 0.20$). The analysis revealed no significant main effect of depressive traits group, $F(1, 35) = 0.56$, $p = .671$, $\eta_p^2 = 0.010$, $BF_{10} = 0.23$, and no significant interaction between target identity and depressive traits group, $F(1, 35) = 0.47$, $p = .497$, $\eta_p^2 = 0.013$, $BF_{10} = 0.47$, and no significant interaction between emotion and depressive traits group, $F(2, 70) = 1.077$, $p = .342$, $\eta_p^2 = 0.030$, $BF_{10} = 0.11$.

Nevertheless, the analysis revealed an interaction effect between target identity and emotion, $F(2, 70) = 5.76$, $p = .005$, $\eta_p^2 = 0.041$, $BF_{10} = 3.91 \times 10^{46}$. To understand this interaction further, ANOVAs were performed on the accuracy data for self and unfamiliar faces separately. An ANOVA on the accuracy data for the "self" face showed a significant main effect of emotion, $F(1.52, 54.77) = 2.58$, $p = .014$, $\eta_p^2 = 0.10$ (Huynh-Feldt corrected). Holm-Bonferroni post-hoc comparisons revealed that participants showed a higher accuracy for happy

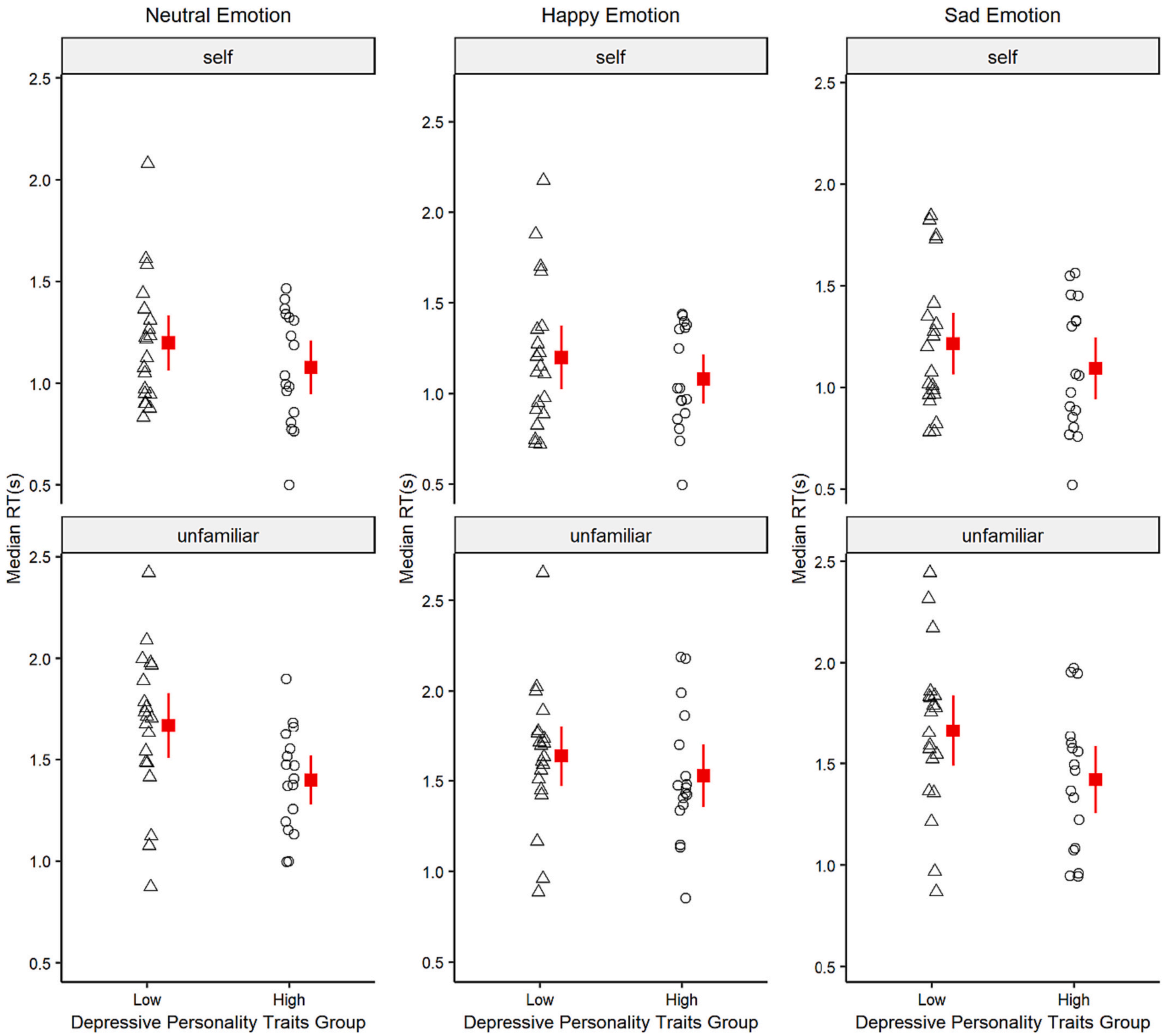

Fig. 7. The search time for different emotion valence across low and high depressive traits group.
Note. Median RT per participant across three emotion conditions for self and unfamiliar faces condition across low and high depressive traits group. Red squares denote the group means with 95 % confidence intervals denoted by the whiskers.

compared to sad emotions (p = .037, Cohen's $d = 0.37$), whereas there were no significant differences between neutral and happy emotions (p = .129, Cohen's $d = -0.14$) and neutral and sad emotions (p = .129, Cohen's $d = 0.23$).

Next, an ANOVA on the accuracy data for the "unfamiliar" faces also showed a significant main effect of emotion, $F(2, 72) = 7.27$, $p < .001$, $\eta_p^2 = 0.168$. Holm-Bonferroni post-hoc comparisons indicated a higher accuracy for neutral emotion compared to both happy (p = .006, Cohen's $d = 0.53$) and sad emotions (p = .003, Cohen's $d = 0.56$), whereas there was no significant difference between happy and sad emotion ($p = 1.00$, Cohen's $d = 0.03$). Lastly, the analysis revealed no significant three-way interaction effect between target identity, emotion valence, and depressive traits group, $F(2, 70) = 0.91$, p = .408, η_p^2 = 0.025, $BF_{10} = 0.16$.

3.2.3. Normalized self-face advantage (SFA) effect

Fig. 9 shows the normalized SFA across different emotion valence across the low and high depressive traits group. An ANOVA on the normalized SFA effect revealed no significant main effect of group, $F(1, 35) = 0.18$, p = .671, $\eta_p^2 = 0.005$, $BF_{10} = 0.56$, but there was a significant main effect for emotional valence, $F(1.80, 63.04) = 3.51$, p = .040, η_p^2 = 0.091 (Huynh-Feldt corrected), $BF_{10} = 0.51$. However, Holm-Bonferroni post-hoc comparisons indicated no significant differences between neutral and happy emotions (p = .851, Cohen's $d = -0.03$), neutral and sad emotions (p = .060, Cohen's $d = -0.39$), and sad and happy emotions (p = .063, Cohen's $d = -0.36$). The analysis further revealed no interaction effect between depressive traits group and emotion valence, $F(1.80, 63.04) = 0.50$, p = .588, $\eta_p^2 = 0.014$ (Huynh-Feldt corrected), $BF_{10} = 0.26$.

3.2.4. Normalized SFA effect and CES-D scores

Three Pearson's correlational tests were conducted with the normalized SFA effect across three emotion valence conditions and the scores on the CES-D scale. All correlational analyses were performed

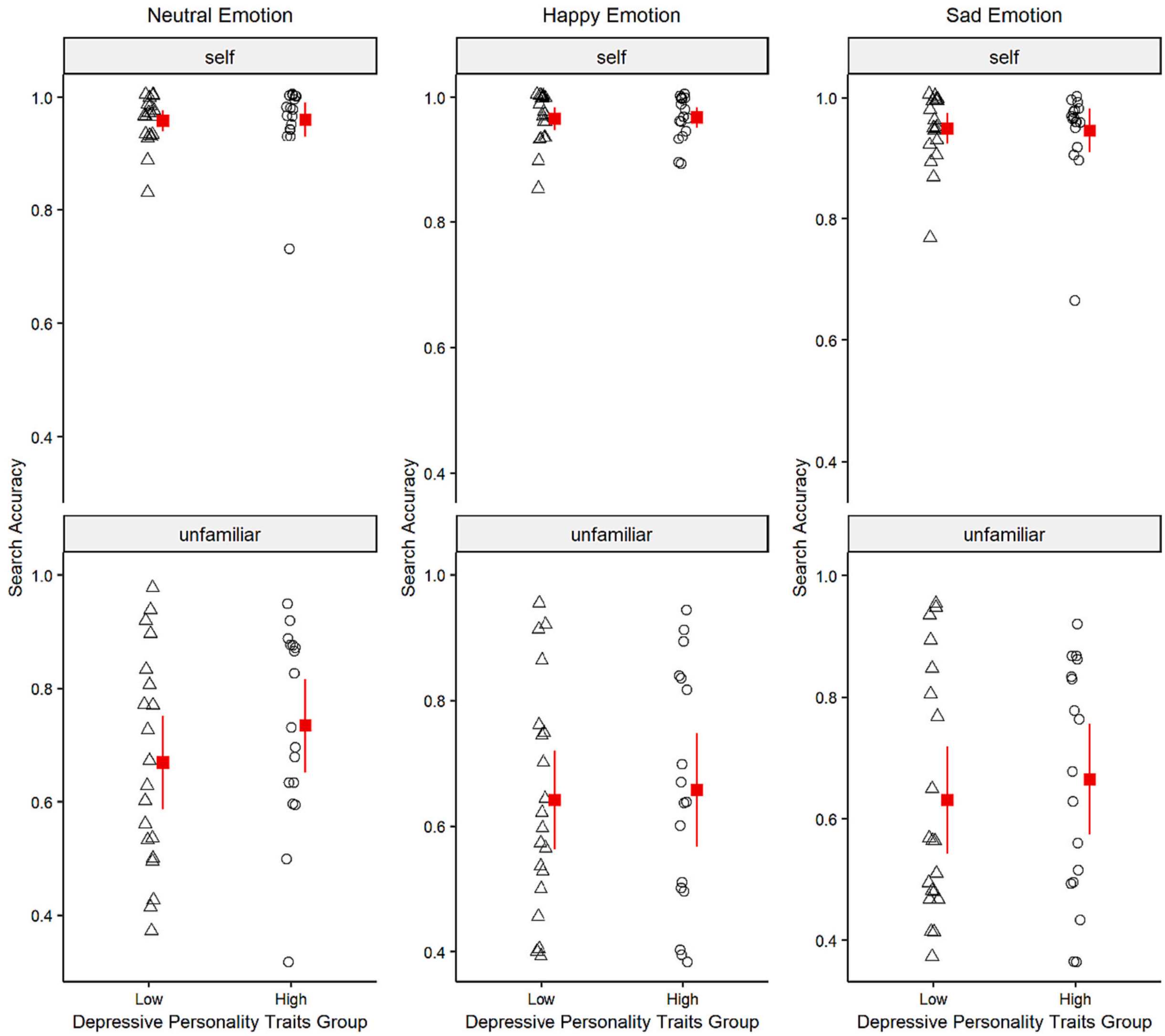

Fig. 8. The search accuracy scores for different emotion valence across low and high depressive traits group.
Note. The mean accuracy scores per participant across three emotion conditions for self and unfamiliar faces condition across low and high depressive traits group. Red squares denote the group means, with 95 % confidence intervals denoted by the whiskers.

using the full sample. Findings showed that scores on the CES-D scale did not correlate significantly with a normalized SFA effect for neutral (r(66) = 0.034, p = .782, 95 % CI [−0.21, 0.27]), happy (r(66) = 0.010, p = .937, 95 % CI [−0.23, 0.25]), or sad faces (r(66) = 0.034, p = .781, 95 % CI [−0.21, 0.27]).

3.3. Discussion

Experiment 2 investigated the modulation effects of depressive traits on SFA while considering the role of emotional valence of the face stimuli. Based on the mood-congruency hypothesis (Dalgleish & Watts, 1990), it was expected that participants with more depressive symptoms would be slower in detecting their own face but only when the self-face expression would be incongruent with their affective state (i.e., their happy face or neutral face) compared to those with lower depressive traits.

Findings from Experiment 2 show that participants demonstrated a significant processing bias for the own face compared to an unfamiliar face, regardless of their group and emotional valence condition. Furthermore, the results also show that the normalized SFA effect was similar across groups and emotions. These findings therefore do not conform to Beck's (1976) negative self-concept theory or the mood-congruency hypothesis. In other words, Experiment 2 did not find evidence of a relationship between an attenuated self-bias for the own face and specific emotion biases in individuals with more depressive traits.

Nevertheless, we reported that individuals have a positivity bias to the own face (i.e., self-positivity bias). Specifically, both groups showed a higher accuracy when searching for their happy self-face compared to their sad and neutral self-faces, whereas they performed comparably for their sad and neutral self-faces. Although it should be noted that, compared to the SFA (η_p^2 = 0.760), the facial expression effects were relatively small (η_p^2 = 0.041). We also showed that participants took a longer time to search for sad self-face compared to both happy and neutral self-faces. Interestingly, this positivity bias was not observed for unfamiliar faces, such that participants showed a higher search accuracy for a neutral unfamiliar face compared to both happy and sad unfamiliar faces. This finding is discussed further in General discussion.

Lastly, individuals with higher depressive traits showed faster searching for all face conditions, regardless of their identity and emotion, aligning with Wu et al.'s (2012) findings of quicker verbal labelling of emotional facial expression. This may result from a global hypersensitivity to emotional facial expressions due to depression-related negative schemas (e.g., Harkness et al., 2010), leading to quicker responses to minimize exposure to facial expressions and

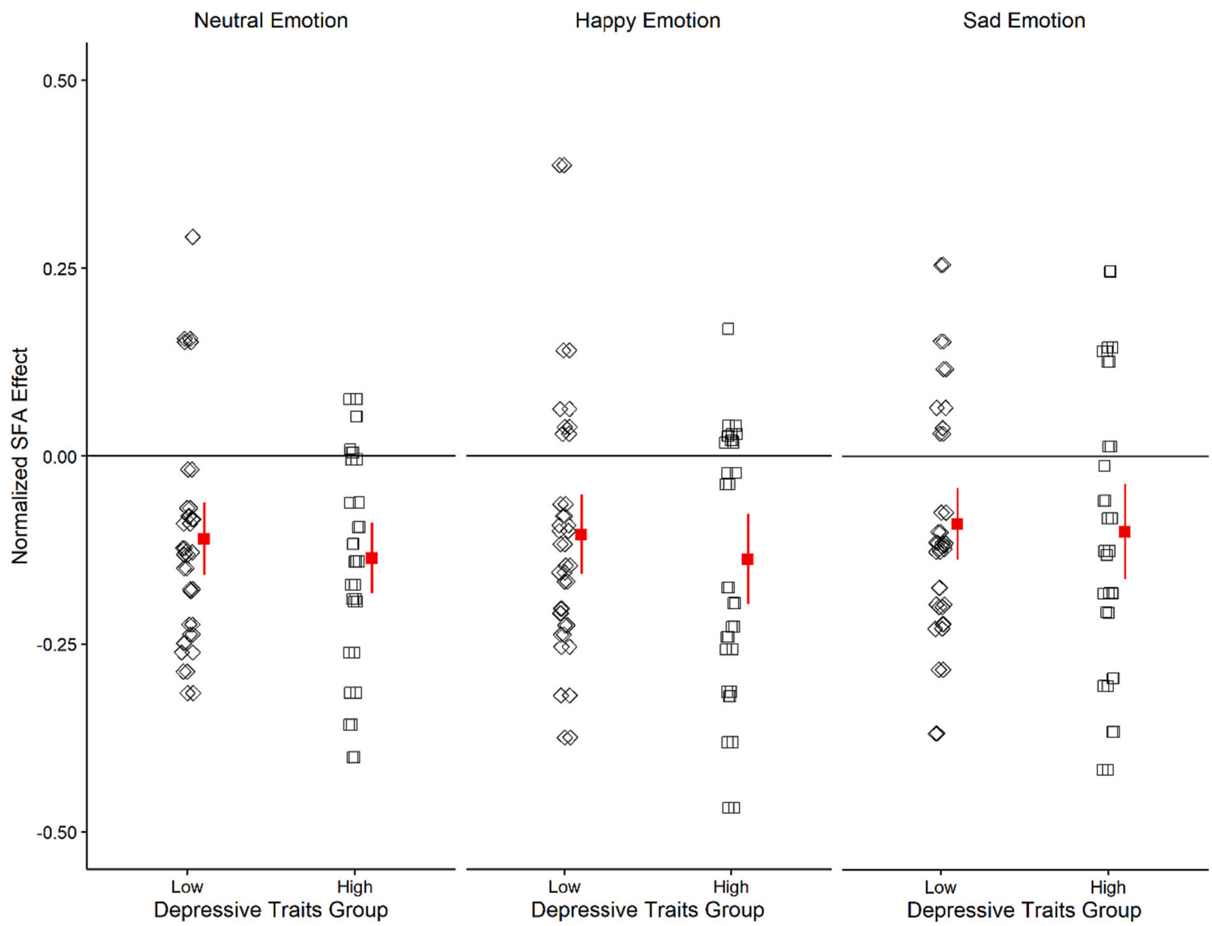

Fig. 9. The normalized SFA effect for different emotion valence across low and high depressive traits group.
Note. Normalized SFA effect per participant across three emotion conditions for low and high depressive traits group. Red squares denote the group means and 95 % confidence interval are denoted by the whiskers.

distress triggered by the presence of other's facial expression (Persad & Polivy, 1993). Nevertheless, we cannot establish if 'high depressive traits' participants were simply more engaged with the task or whether, compared 'low depressive traits' group, they were more motivated to complete the searching task faster. Future studies could explore this by introducing a control condition where both group of participants search for face and non-face stimuli (e.g., shapes).

4. General discussion

This study explored the modulation effects of negative self-concepts (i.e., depressive traits) on the attentional advantage to the own face compared to other faces using a visual-search paradigm. Experiment 1 explored the SFA across individuals in the lower end and higher end of depressive traits by asking participants to search for their face and an unfamiliar face among other distractor faces. Considering the mood-congruency hypothesis, Experiment 2 explored the modulation effects of depressive traits on SFA while considering the role of emotional valence of the stimuli by having participants search for their own face and an unfamiliar face presented in neutral, happy, or sad expressions.

In general, research seems to point towards the direction that depressed individuals tend to show a preference for negative stimuli (e.g., Krompinger & Simons, 2009) and/or show an avoidance of positive stimuli (e.g., Hankin et al., 2010). As the self-face is generally deemed as an emotionally positive stimuli (Ma & Han, 2010), it was hypothesized in Experiment 1 that individuals with higher depressive traits (or negative self-concept) would show an attenuated self-bias (i.e., absent or reduced SFA). However, contradicting this hypothesis, both groups showed an attentional prioritization to self-face compared to an unfamiliar face (i.e., an SFA). One possibility could be that individuals with higher depressive traits would only show a reduced positive self-bias in social situations. For instance, Hobbs et al. (2023) reported that when self-processing was isolated from emotion and reward processing, there were no changes to self-prioritization with higher depressive levels. However, participants with higher depressive levels showed a reduced positive bias when learning social evaluations about the self in a social evaluation task. Nevertheless, it should be noted that Hobbs et al. (2023) study did not use self-face/unfamiliar faces as experimental stimuli.

Another possibility could be that individuals with higher depressive traits would be slower in searching their face only when the self-face expression is incongruent with their affective state (i.e., their happy or neutral face). This is in accordance to the mood-congruency hypothesis which suggests that emotionally negative stimuli are more congruent with the depressed individual's self-concept and self-perception, prompting an attentional bias to negative stimuli. This hypothesis was directly tested in Experiment 2. We found that regardless of the emotion and depressive traits condition, both groups of participants searched their face faster and more accurately compared to an unfamiliar face. In line with McIvor et al.'s (2021) findings, we observed self-prioritization with no evidence of specific emotion-related attentional bias in the context of depression.

If there is a relationship between self-processing and positive emotions and given the central role of negative self-perception in depression (Beck, 2008), one could reasonably argue that a reduced self-bias would be expected in those with depressive traits. However, a reduced self-bias was not observed in the current study. Our findings seem to support

Stolte et al.'s (2017) notion of independent processing of self and positive emotion biases. Brain research also suggests separate processing in the ventral anterior cingulate cortex for emotional processing and medial prefrontal cortex for self-relevant stimuli (Moran et al., 2006). In sum, evidence points to separate processing of self and emotional valence.

In addition, rather than assuming depression-specific cognitive biases persist in all mood states, it is plausible that negative self-concepts in depressed individuals activate in distressing situations (Ingram, 1984). For instance, Caudek and Monni (2013) found negative self-bias in distressed individuals with negative thinking styles, but not in non-distressed individuals. This account, however, contradicts the notion that depression-specific biases persist regardless of mood state (see Joormann & Gotlib, 2007). Consequently, this suggests that mood-congruency effects might require triggering a negative affective state for such biases to be activated. Future studies could induce sadness before tasks to further explore the mood-congruency hypothesis.

In Experiment 2, we also reported that individuals showed a preference for a happy self-face compared to a neutral and sad self-face, and interestingly, this preference was not observed for the unfamiliar face. While the findings could suggest a self-positivity bias, consistent with the notion of the self being treated as an emotionally positive stimulus (e.g., Ma & Han, 2010), caution is needed in linking self-perception to positive emotions. Instead, familiarity effects may explain the preference for the happy self-face due to a greater exposure to one's smiling face in photos. Supporting this, the absence of the positivity bias for an unfamiliar face, with faster searching for the neutral face, could be attributed to participants' familiarity with the neutral unfamiliar face during the familiarisation phase.

Indeed, one could argue that as one's own face is overlearned compared to unfamiliar faces, participants find it easier to search for their own face. To reduce the influence of self-face familiarity, participants practiced with the same unfamiliar target as during the subsequent test trials, preventing large artificial differences between self and unfamiliar face target while participants learn to recognize the latter. Arguably, participants are also likely inexperienced at searching for their own face, especially a small grey scaled image of their face, among distractor faces. We did not control for familiarity as the primary aim for this study was to explore the own face's association with positive or negative valences (i.e., Ma & Han, 2010) depending on participant's depressive traits. Nevertheless, we do not dismiss the possibility that the SFA across both experiments are driven by familiarity effects: due to extensive exposure, the own face is an overlearned and highly familiar stimuli, hence the better and faster search performance for the own face in this study might be better explained by a familiarity effect (e.g., Lee et al., 2022).

An anonymous reviewer also raised the possibility that if SFA is indeed driven by familiarity effects, it is plausible that individuals with stronger face recognition and learning skills may demonstrate a smaller SFA, as they are faster and better in forming face representations of the pre-experimentally unfamiliar faces. Future studies should explore how individual differences in face recognition abilities impact SFA magnitude. Lastly, contrary to prior research noting a reduced SFA in non-Western samples (e.g., Bortolon & Raffard, 2018; Liew et al., 2011), our study with Malaysian Chinese participants revealed a substantial SFA and this finding is further discussed in Appendix D.

One of the limitations of this study is that it focuses on depression levels as a continuum wherein individuals were distributed into low and high depression groups based on their depression scores using a quartile method, instead of using cut-offs for clinical levels of depression. Another point worth considering is that achieving a threshold level on an administered questionnaire (i.e., cut-off scores used in CES—D) is different from getting a clinical diagnosis of depression. Therefore, it is unclear whether these findings would vary in a clinically depressed population. In addition, factors, such as stress levels and current mood of participants, were not controlled for; hence, our data needs to be treated with caution as it is unclear if these factors influenced or contributed to the findings in Experiments 1 and 2.

It is also important to acknowledge that the presence of an SFA is affected by the task used. Bortolon and Raffard's (2018) meta-analysis highlighted SFA in memory and perception tasks but not in attention-based tasks (but see Humphreys & Sui, 2016; Sui & Rotshtein, 2019). This led the authors to suggest that all faces are detected similarly in attention-demanding tasks, implying also that advantages of self-relevant information may not affect early perceptual stages but could influence later stages like memory encoding and response selection (e.g., Firestone & Scholl, 2015). In our visual search task, we postulate that participants likely relied on attention resources to find a target face, either by shifting their attention across visual space (Treisman & Gelade, 1980) or through parallel processing (Duncan & Humphreys, 1989). Additionally, they may have prioritized pictorial and perceptual information (static pose) over semantic details (face identity/familiarity; Bortolon & Raffard, 2018). Nevertheless, the visual-search task paradigm allows one to mimic a demanding real-world task similar to searching for someone in a crowd with the presence of heterogenous face images (i.e., distractor faces). Future studies could also take into consideration of the different type of tasks that are used when exploring for the SFA.

5. Conclusions

In conclusion, our work here seems to indicate that self-face advantage is not modulated by one's level of depressive traits, at least in a visual-search paradigm. Our work also highlighted that self-face familiarity may be implicated as an underlying factor for an attentional prioritization of the own face.

CRediT authorship contribution statement

Jasmine Lee: Conceptualization, Methodology, Investigation, Software, Data curation, Formal Analysis, Writing – Original draft preparation, Visualisation

Steve Janssen, Alejandro Estudillo: Supervision, Writing – Reviewing & Editing

Declaration of competing interest

None.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2023.112524.

References

Alzueta, E., Melcón, M., Poch, C., & Capilla, A. (2019). Is your own face more than a highly familiar face? *Biological Psychology, 142*, 100–107. https://doi.org/10.1016/j.biopsycho.2019.01.018

Beck, A. T. (1976). *Cognitive therapy and the emotional disorders*. New York: New American Library.

Beck, A. T. (2008). The evolution of the cognitive model of depression and its neurobiological correlates. *American Journal of Psychiatry, 165*(8), 969–977. https://doi.org/10.1176/appi.ajp.2008.08050721

Beckham, E. E., Leber, W. R., Watkins, J. T., Boyer, J. L., & Cook, J. B. (1986). Development of an instrument to measure Beck's cognitive triad: The cognitive triad inventory. *Journal of Consulting and Clinical Psychology, 54*(4), 566–567. https://doi.org/10.1037/0022-006X.54.4.566

Blackwood, N. J., Bentall, R. P., Simmons, A., Murray, R. M., & Howard, R. J. (2003). Self-responsibility and the self-serving bias: An fMRI investigation of causal attributions. *NeuroImage, 20*(2), 1076–1085. https://doi.org/10.1016/S1053-8119(03)00331-8

Bortolon, C., & Raffard, S. (2018). Self-face advantage over familiar and unfamiliar faces: A three-level meta-analytic approach. *Psychonomic Bulletin & Review, 25*(4), 1287–1300. https://doi.org/10.3758/s13423-018-1487-9

Bower, G. H. (1981). Mood and memory. *American Psychologist, 36*(2), 129–148. https://doi.org/10.1037/0003-066X.36.2.129

Burke, T. A., Connolly, S. L., Hamilton, J. L., Stange, J. P., Abramson, L. Y., & Alloy, L. B. (2015). Cognitive risk and protective factors for suicidal ideation: A two-year longitudinal study in adolescence. *Journal of Abnormal Child Psychology, 44*(6), 1145–1160. https://doi.org/10.1007/s10802-015-0104-x

Campo-Arias, A., Díaz-Martínez, L. A., Rueda-Jaimes, G. E., Cadena-Afanador, L. D. P., & Hernández, N. L. (2007). Psychometric properties of the CES-D scale among Colombian adults from the general population. *Revista Colombiana de Psiquiatría, 36*(4), 664–674.

Caudek, C., & Monni, A. (2013). Do you remember your sad face? The roles of negative cognitive style and sad mood. *Memory, 21*(8), 891–903. https://doi.org/10.1080/09658211.2013.765893

Cavanagh, J., & Geisler, M. W. (2006). Mood effects on the ERP processing of emotional intensity in faces: A P3 investigation with depressed students. *International Journal of Psychophysiology, 60*, 27–33. https://doi.org/10.1016/j.ijpsycho.2005.04.005

Clark, D. M., & Teasdale, J. D. (1982). Diurnal variation in clinical depression and accessibility of memories of positive and negative experiences. *Journal of Abnormal Psychology, 91*(2), 87–95. https://doi.org/10.1037/0021-843X.91.2.87

Cosco, T. D., Prina, M., Stubbs, B., & Wu, Y. T. (2017). Reliability and validity of the Center for Epidemiologic Studies Depression Scale in a population-based cohort of middle-aged U.S. adults. *Journal of Nursing Measurement, 25*(3), 476–485. https://doi.org/10.1891/1061-3749.25.3.476

Cunningham, S. J., Turk, D. J., Macdonald, L. M., & Macrae, C. N. (2008). Yours or mine? Ownership and memory. *Consciousness and Cognition, 17*(1), 312–318. https://doi.org/10.1016/j.concog.2007.04.003

Dalgleish, T., & Watts, F. N. (1990). Biases of attention and memory in disorders of anxiety and depression. *Clinical Psychology Review, 10*(5), 589–604. https://doi.org/10.1016/0272-7358(90)90098-U

DeBruine, L. M. (2005). Trustworthy but not lust-worthy: Context-specific effects of facial resemblance. *Proceedings of the Royal Society B: Biological Sciences, 272*(1566), 919–922. https://doi.org/10.1098/rspb.2004.3003

Derry, P. A., & Kuiper, N. A. (1981). Schematic processing and self-reference in clinical depression. *Journal of Abnormal Psychology, 90*(4), 286–297. https://doi.org/10.1037/0021-843X.90.4.286

Duncan, J., & Humphreys, G. W. (1989). Visual search and stimulus similarity. *Psychological Review, 96*(3), 433–458. https://doi.org/10.1037/0033-295X.96.3.433

Epley, N., & Whitchurch, E. (2008). Mirror, mirror on the wall: Enhancement in self-recognition. *Personality and Social Psychology Bulletin, 34*(9), 1159–1170. https://doi.org/10.1177/0146167208318601

Estudillo, A. J., & Bindemann, M. (2017). Can gaze-contingent mirror-feedback from unfamiliar faces alter self-recognition? *The Quarterly Journal of Experimental Psychology, 70*(5), 944–958. https://doi.org/10.1080/17470218.2016.1166253

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175–191. https://doi.org/10.3758/BF03193146

Feyereisen, P., Malet, C., & Martin, Y. (1986). Is the faster processing of expressions of happiness modality-specific? In H. D. Ellis, M. A. Jeeves, F. Newcombe, & A. Young (Eds.), *Aspects of Face Processing* (pp. 349–355). Boston: Martinus Nijhoff.

Firestone, C., & Scholl, B. J. (2015). Cognition does not affect perception: Evaluating the evidence for "top-down" effects. *Behavioral and Brain Sciences, 39*, Article e229. https://doi.org/10.1017/S0140525X15000965

Fritzsche, A., Dahme, B., Gotlib, I., Joormann, J., Magnussen, H., Watz, H., … von Leupoldt, A. (2010). Specificity of cognitive biases in patients with current depression and remitted depression and in patients with asthma. *Psychological Medicine, 40*(5), 815–826. https://doi.org/10.1017/S0033291709990948

Gallup, G. G. (1970). Chimpanzees: Self-recognition. *Science, 167*(3914), 86–87. https://doi.org/10.1126/science.167.3914.86

Gotlib, I. H., Krasnoperova, E., Yue, D. N., & Joormann, J. (2004). Attentional biases for negative interpersonal stimuli in clinical depression. *Journal of Abnormal Psychology, 113*(1), 121–135. https://doi.org/10.1037/0021-843X.113.1.121

Greenwald, A. G. (1980). The totalitarian ego: Fabrication and revision of personal history. *American Psychologist, 35*(7), 603–618. https://doi.org/10.1037/0003-066X.35.7.603

Hankin, B. L., Gibb, B. E., Abela, J. R., & Flory, K. (2010). Selective attention to affective stimuli and clinical depression among youths: Role of anxiety and specificity of emotion. *Journal of Abnormal Psychology, 119*(3), 491–501. https://doi.org/10.1037/a0019609

Harkness, K. L., Jacobson, J. A., Duong, D., & Sabbagh, M. A. (2010). Mental state decoding in past major depression: Effect of sad versus happy mood induction. *Cognition and Emotion, 24*(3), 497–513. https://doi.org/10.1080/02699930902750249

Hobbs, C., Sui, J., Kessler, D., Munafò, M., & Button, K. (2023). Self-processing in relation to emotion and reward processing in depression. *Psychological Medicine, 53*(5), 1924–1936. https://doi.org/10.1017/S0033291721003597

Humphreys, G. W., & Sui, J. (2016). Attentional control and the self: The self-attention network (SAN). *Cognitive Neuroscience, 7*(1–4), 5–17. https://doi.org/10.1080/17588928.2015.1044427

Ilardi, S., Atchley, R., Enloe, A., Kwansy, K., & Garratt, G. (2007). Disentangling attentional biases and attentional deficits in depression: An event-related potential P300 analysis. *Cognitive Therapy and Research, 31*(2), 175–187. https://doi.org/10.1007/s1060 8-006-9113-y

Ingram, R. E. (1984). Information processing and feedback: Effects of mood and information favorability on the cognitive processing of personally relevant information. *Cognitive Therapy and Research, 8*(4), 371–385. https://doi.org/10.1007/BF01173312

JASP Team. (2023). *JASP (Version 0.17.3) [Computer software]*.

Joormann, J., & Gotlib, I. H. (2007). Selective attention to emotional faces following recovery from depression. *Journal of Abnormal Psychology, 116*(1), 80–85. https://doi.org/10.1037/0021-843X.116.1.80

Koole, S. L., & DeHart, T. (2007). Self-affection without self-reflection: Origins, models, and consequences of implicit self-esteem. In C. Sedikides, & S. Spencer (Eds.), *The self in social psychology* (pp. 36–86). New York: Psychology Press.

Krompinger, J. W., & Simons, R. F. (2009). Electrophysiological indicators of emotion processing biases in depressed undergraduates. *Biological Psychology, 81*(3), 153–163. https://doi.org/10.1016/j.biops ycho.2009.03.007

Kuiper, N. A., Derry, P. A., & MacDonald, M. R. (1982). Self-reference and person perception in depression: A social cognition perspective. In G. Weary, H. L. Mirels, & H. Mirels (Eds.), *Integrations of clinical and social psychology* (pp. 79–2103). Oxford, UK: Oxford University Press.

Lee, J. K. W., Gregson, C., Janssen, S. M. J., & Estudillo, A. J. (2022). Cultural modulation effects on the self-face advantage: Do Caucasians find their own faces faster than Chinese? *The Quarterly Journal of Experimental Psychology, 76*(8), 1724–1739. https://doi.org/10.1177/17470218221142158

Lee, M. D., & Wagenmakers, E. J. (2014). *Bayesian cognitive modeling: A practical course*. Cambridge University Press.

Liew, S. L., Ma, Y., Han, S., & Aziz-Zadeh, L. (2011). Who's afraid of the boss: Cultural differences in social hierarchies modulate self-face recognition in Chinese and Americans. *PLoS ONE, 6*(2), Article e16901. https://doi.org/10.1371/journal.pone.0016901

Liu, G., Zhang, N., Teoh, J. Y., Egan, C., Zeffiro, T. A., Davidson, R. J., & Quevedo, K. (2022). Self-compassion and dorsolateral prefrontal cortex activity during sad self-face recognition in depressed adolescents. *Psychological Medicine, 52*(5), 864–873. https://doi.org/10.1017/S0033291720002482

Liu, M., He, X., Rotshtein, P., & Sui, J. (2016). Dynamically orienting your own face facilitates the automatic attraction of attention. *Cognitive Neuroscience, 7*(1–4), 37–44. https://doi.org/10.1080/17588928.2015.1044428

Lloyd, G. G., & Lishman, W. A. (1975). Effect of depression on the speed of recall of pleasant and unpleasant experiences. *Psychological Medicine, 5*(2), 173–180. https://doi.org/10.1017/S0033291700056440

Ma, Y., & Han, S. (2010). Why we respond faster to the self than to others? An implicit positive association theory of self-advantage during implicit face recognition. *Journal of Experimental Psychology: Human Perception and Performance, 36*(3), 619–633. https://doi.org/10.1037/a0015797

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98*(2), 224–253. https://doi.org/10.1037/0033-295X.98.2.224

McIvor, L., Sui, J., Malhotra, T., Drury, D., & Kumar, S. (2021). Self-referential processing and emotion context insensitivity in major depressive disorder. *European Journal of Neuroscience, 53*(1), 311–329. https://doi.org/10.1111/ejn.14782

Moran, J. M., Macrae, C. N., Heatherton, T. F., Wyland, C. L., & Kelly, W. M. (2006). Distinct cognitive and affective components of self. *Journal of Cognitive Neuroscience, 18*, 1586–1594. https://doi.org/10.1162/jocn.2006.18.9.1586

Morin, A. (2006). Levels of consciousness and self-awareness: A comparison and integration of various neurocognitive views. *Consciousness and Cognition, 15*(2), 358–371. https://doi.org/10.1016/j.concog.2005.09.006

Northoff, G., & Hayes, D. J. (2011). Is our self nothing but reward? *Biological Psychiatry, 69*(11), 1019–1025. https://doi.org/10.1016/j.biopsych.2010.12.014

Ota, C., & Nakano, T. (2021). Self-face activates the dopamine reward pathway without awareness. *Cerebral Cortex, 31*(10), 4420–4426. https://doi.org/10.1093/cercor/bhab096

Persad, S. M., & Polivy, J. (1993). Differences between depressed and nondepressed individuals in the recognition of and response to facial emotional cues. *Journal of Abnormal Psychology, 102*(3), 358–368. https://doi.org/10.1037/0021-843X.102.3.358

Qian, H., Wang, Z., Yan, L., & Gao, X. (2017). Aging strikes the self-face advantage in featural processing. *Experimental Aging Research, 43*(4), 379–390. https://doi.org/10.1080/0361073X.2017.1333834

Quevedo, K., Ng, R., Scott, H., Martin, J., Smyda, G., Keener, M., & Oppenheimer, C. W. (2016). The neurobiology of self-face recognition in depressed adolescents with low or high suicidality. *Journal of Abnormal Psychology, 125*(8). https://doi.org/10.1037/abn0000200 (1185–1120).

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*(3), 385–401. https://doi.org/10.1177/014662167700100306

Robinson, E. B., Koenen, K. C., McCormick, M. C., Munir, K., Hallett, V., Happé, F., … Ronald, A. (2011). Evidence that autistic traits show the same etiology in the general population and at the quantitative extremes (5%, 2.5%, and 1%). *Archives of General Psychiatry, 68*(11), 1113–1121. https://doi.org/10.1001/archgenpsychiatry.2011.119

Rochat, P., & Zahavi, D. (2011). The uncanny mirror: A re-framing of mirror self-experience. *Consciousness and Cognition, 20*(2), 204–213. https://doi.org/10.1016/j.concog.2010.06.007

Rottenberg, J., Gross, J. J., & Gotlib, I. H. (2005). Emotion context insensitivity in major depressive disorder. *Journal of Abnormal Psychology, 114*(4), 627–639. https://doi.org/10.1037/0021-843X.114.4.627

Rude, S. S., Krantz, S. E., & Rosenhan, D. L. (1988). Distinguishing the dimensions of valence and belief consistency in depressive and nondepressive information processing. *Cognitive Therapy and Research, 12*(4), 391–407. https://doi.org/10.1007/BF01173306

Stolte, M., Humphreys, G., Yankouskaya, A., & Sui, J. (2017). Dissociating biases towards the self and positive emotion. *The Quarterly Journal of Experimental Psychology, 70*(6), 1011–1022. https://doi.org/10.1080/17470218.2015.1101477

Sugiura, M., Watanabe, J., Maeda, Y., Matsue, Y., Fukuda, H., & Kawashima, R. (2005). Cortical mechanisms of visual self-recognition. *NeuroImage, 24*(1), 143–149. https://doi.org/10.1016/j.neuroimage.2004.07.063

Sui, J., & Humphreys, G. W. (2015). The integrative self: How self-reference integrates perception and memory. *Trends in Cognitive Sciences, 19*(12), 719–728. https://doi.org/10.1016/j.tics.2015.08.015

Sui, J., & Rotshtein, P. (2019). Self-prioritization and the attentional systems. *Current Opinion in Psychology, 29*, 148–152. https://doi.org/10.1016/j.copsyc.2019.02.010

Tong, F., & Nakayama, K. (1999). Robust representations for faces: Evidence from visual search. *Journal of Experimental Psychology: Human Perception and Performance, 25*(4), 1016–1035. https://doi.org/10.1037/0096-1523.25.4.1016

Treisman, A. M., & Gelade, G. (1980). A feature-integration theory of attention. *Cognitive Psychology, 12*(1), 97–136. https://doi.org/10.1016/0010-0285(80)90005-5

Watson, L. A., Dritschel, B., Obonsawin, M. C., & Jentzsch, I. (2007). Seeing yourself in a positive light: Brain correlates of the self-positivity bias. *Brain Research, 1152*, 106–110. https://doi.org/10.1016/j.brainres.2007.03.049

Wisco, B. E. (2009). Depressive cognition: Self-reference and depth of processing. *Clinical Psychology Review, 29*(4), 382–392. https://doi.org/10.1016/j.cpr.2009.03.003

Wójcik, M. J., Nowicka, M. M., Bola, M., & Nowicka, A. (2019). Unconscious detection of one's own image. *Psychological Science, 30*(4), 471–480. https://doi.org/10.1177/0956797618822971

Wu, L., Pu, J., Allen, J. J., & Pauli, P. (2012). Recognition of facial expressions in individuals with elevated levels of depressive symptoms: An eye-movement study. *Depression Research and Treatment, 2012*, Article e249030. https://doi.org/10.1155/2012/249030