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Attentional Biases to Emotional Faces Among Women with a History of Single Episode versus Recurrent Major Depression

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Abstract

Major depressive disorder (MDD) is a highly prevalent psychiatric disorder, and recurrent depression is associated with severe and chronic impairment. Identifying markers of risk is imperative to improve our ability to predict which individuals are likely to experience a recurrence. According to cognitive theories, biases in attention for affectively-salient information may serve as one mechanism of risk. Existing research has combined participants with a single episode (sMDD) and those with recurrent MDD (rMDD); therefore, little is known about whether these biases track the severity of disease course. The current study examined attentional biases to facial displays of emotion among 115 women with a history of rMDD, sMDD, or no history of psychopathology using a passive viewing eye-tracking task. Women with rMDD exhibited significantly lower sustained attention to happy faces compared to both healthy controls and sMDD women. These results extend previous research on the presence of attentional avoidance of positive stimuli in individuals with a history of MDD and provide preliminary evidence that this bias is strongest among individuals with a history of rMDD.

Keywords

attention bias; recurrent depression; eye tracking

Introduction

Major depressive disorder (MDD) is one of the most prevalent psychiatric disorders, with approximately 32 – 35 million adults experiencing at least one lifetime MDD episode within

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On average, participants attended to the faces for 70.91% (SD = 1.83%) of the total trial time. There were no group differences in time spent not attending to the faces.

The larger study examined correlates of depression and anxiety among parents and children recruited from the community. The only inclusion criteria for parents was being the biological parent of a 7 to 11-year-old. The only previous publication from this study using the passive viewing task focused on attentional biases associated with brooding rumination in currently nondepressed adults (Owens & Gibb, 2007).

Although no *a priori* power analyses were conducted, the observed power for the MDD history × Emotion and MDD history × Emotion × Epoch interactions were .91 and .96, respectively, suggesting adequate power for the analyses of interest.

the United States (Kessler et al., 2002). Women are at nearly twice the risk for depression as men, with an estimated lifetime prevalence rate of 26% (Hasin et al., 2018). Importantly, depression is a highly recurrent disorder with approximately 50% of individuals relapsing following an initial MDD episode (Keller et al., 1992) and approximately 80% following a second episode (Bulloch, Williams, Lavorato, & Patten, 2014). According to cognitive theories (e.g., Clark & Beck, 1999), biases in attention for affectively-salient information may serve as one mechanism of risk for the development, maintenance, and recurrence of depression. Supporting the role of attentional biases in depression risk, depressed adults exhibit preferential attention toward depression-relevant stimuli (e.g. sad facial expressions) and reduced attention toward positive stimuli (e.g. happy facial expressions) compared to individuals with no history of depression (Armstrong & Olatunji, 2012; Peckham, McHugh, & Otto, 2010). Importantly, there is evidence that attention biases persist following remission of the depressive episode (Joormann & Gotlib, 2007; Peckham et al., 2010), suggesting they are not merely correlates of current depression.

Despite considerable evidence for the role of attentional biases in depression, relatively little is known about whether these biases track the severity of disease course. Existing research has combined participants with a single episode (sMDD) and those with recurrent MDD (rMDD), which may mask risk factors that differentiate individuals at risk for recurrence (Monroe & Harkness, 2011). Previous studies have found that attentional biases are positively associated with depression symptom severity (Duque & Vázquez, 2015) and predict prospective change in symptoms (Joormann & Gotlib, 2007). Importantly, rMDD is associated with more severe impairment, and each additional episode is associated with increased risk for future recurrence (Bulloch et al., 2014). This, together with evidence for differential predictors for onset of the first versus recurrent episodes (Monroe & Harkness, 2011), suggests potentially different mechanisms of risk. A key question, then, is whether attentional biases differ for individuals with rMDD versus sMDD. Although not focusing on attentional biases, there is evidence for differences in neural reactivity to affectively-salient stimuli; individuals with a history of rMDD exhibited increased N170 amplitudes to sad faces and decreased N170 amplitudes to happy faces compared to individuals with histories of no MDD or sMDD (Chen et al., 2014). Increased neural reactivity to sad faces, specifically, positively correlated with number of prior MDD episodes. Although examination of risk unique to rMDD and sMDD has been identified as a critical gap in extant literature (Monroe & Harkness, 2011), Chen and colleagues' study is the first to our knowledge to examine differential responses to emotional faces among rMDD and sMDD.

In the current study, we examined attentional biases to facial displays of emotion among women with a history of rMDD, sMDD, and healthy controls (HCs). Provided evidence for attentional biases in other forms of psychopathology (e.g. Aspen, Darcy, & Lock, 2013; Cisler & Koster, 2010), HCs had no history of psychopathology. We focused on women given that they are at particularly heightened risk for MDD compared to men (Hasin et al., 2018). We predicted that women with a history of MDD would exhibit greater sustained attention to sad faces and less sustained attention to happy faces compared to HCs. Provided the heightened severity and cumulative risk associated with rMDD, we predicted that these effects would be stronger for women with rMDD than sMDD.

Materials and Methods

Participants

Participants were 115 women recruited from the community. Participants' average age was 37.23 years (*SD* = 7.40) and the majority were Caucasian (80.87%) followed by African American (13.91%), biracial (2.61%) and Asian/Pacific Islander (1.74%). The three groups did not differ in age or race (*ps* > .07). Although the possibility cannot be ruled out that women with sMDD or HCs might go on to develop an(other) episode, the absence of group differences in age suggests that the rMDD women did not simply have more time to develop MDD.

Measures

Diagnostic history.—The Structured Clinical Interview for DSM-IV Axis I Disorders (First, Spitzer, Gibbon, & Williams, 1995) was used to assess for current and lifetime Axis I disorders. Inter-rater reliability for MDD diagnoses was good (κ = 0.89). Exclusion criteria for all groups included the presence of any current DSM-IV Axis I disorder and any past Axis I disorder for the HC group. The final sample included 30 women with rMDD, 38 with sMDD, and 50 HCs. Eighteen women from the sMDD group and 19 from the rMDD group met criteria for a past history of one or more additional disorders. There were no significant differences between the MDD groups in prevalence of any of the diagnoses assessed (all *p*s > .10).

For those who met criteria for MDD, interviewers also coded age at first onset, recency of the last episode, duration of time depressed, and total number of episodes. Some women reported episodes that were too prolonged or frequent to estimate number of distinct episodes or lifetime duration and were therefore coded as "Too long/many to estimate." Descriptive statistics for age at first onset and recency of the last episode are in Table 1. Women in the sMDD group reported a median duration of 3.5 months depressed (mode = 12 months, range = 1 month to "Too long to estimate"). Women in the rMDD group reported a median number of 2.5 episodes (mode = 2, range = 2 to "Too many to estimate"), and median duration of 17 months depressed (mode = "Too long to estimate," range = 2 months to "Too long to estimate).

Symptoms.—Participants' symptoms of anxiety and depression were assessed using the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988) and the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996), respectively. Prior studies have supported the reliability and validity of these measures (Beck et al., 1988, 1996) and both demonstrated excellent internal consistency in this study (BAI: α = .87; BAI: α = .90).

Attentional biases.—Participants completed a passive viewing eye-tracking task to assess attentional biases for facial displays of emotion. Trials consisted of images of four faces from the same actor arranged in a 2 × 2 grid, representing angry, happy, sad, and neutral facial expressions. The task consisted of sixteen 20 s trials, with each emotion type occurring with equal frequency in all four quadrants. Stimuli were images of 8 female and 8 male Caucasian actors drawn from the Karolinska Directed Emotional Faces stimulus set

(KDEF; Lundqvist, Flykt, & Öhman, 1998), presented in their original color with non-facial features (e.g. hair, neck, and shoulders) removed via an oval mask, on a Tobii T60XL eye-tracking monitor (60 Hz; 1920 × 1200 pixels). Participants sat 65 cm from the display and each stimulus was 13 cm high and 12 cm wide, with 20 cm between the center of each stimulus horizontally and 16 cm vertically. Participants were instructed to view the images as though they were watching TV or viewing a photo album. Trials were divided into five 4 s epochs, allowing examination of potential changes in attentional allocation across the duration of each trial. Sustained attention was indexed by the total duration of gaze in ms to each emotion type, within each epoch[1]. This task has demonstrated good validity in previous research (Harrison & Gibb, 2015; Owens & Gibb, 2017) and, in this study, the split-half reliability for gaze duration to each emotion across the task was good (.73, .71, .89, and .90, for angry, sad, happy and neutral faces, respectively). Trials were deemed usable if participants exhibited at least one fixation to a face lasting at least 100 ms. Three participants (2 HC, 1 sMDD) had fewer than 15 usable trials and were excluded. There was no significant difference in number of usable trials across groups ($p = .56$). Mean proportion of gaze duration to each emotion type are listed in Table 1.

Procedure

Participants were recruited from the community as part of a larger study.[2] After providing informed consent, women completed the SCID-I with a trained interviewer, followed by the passive viewing eye-tracking task. The University's Institutional Review Board approved all procedures.

Results

Prior to analysis, variables with significant skew were transformed and these transformations adequately reduced within-group skew and kurtosis ($zs < 2.57$). Preliminary analyses showed no group differences in current levels of anxiety, $F(2, 113) = 1.96$, $p = .15$, $\eta_p^2 = .03$, and the two MDD groups did not differ in recency of their last MDD episode, $F(1, 65) = 1.60$, $p = .21$, $\eta_p^2 = .03$. There was a significant group difference in current depressive symptoms, $F(2, 113) = 4.96$, $p < .01$, $\eta_p^2 = .08$, with HCs reporting lower BDI-II scores than the sMDD ($p = .02$) and rMDD ($p < .01$) groups, and the two MDD groups not differing ($p = .49$). Finally, the rMDD group reported a significantly younger age at first MDD onset than the sMDD group, $F(1, 65) = 13.54$, $p < .001$, $\eta_p^2 = .18$.

We then examined group differences in sustained attention to each emotion type by conducting a 3 (Group: rMDD, sMDD, HC) × 4 (Emotion: Angry, Sad, Happy, Neutral) × 5 (Epoch) repeated measures ANOVA with gaze duration serving as the dependent variable. There were significant main effects of Emotion, $F(3, 336) = 58.00$, $p < .001$, $\eta_p^2 = .34$, and Epoch, $F(4, 448) = 44.37$, $p < .001$, $\eta_p^2 = .28$, which were qualified by significant Emotion × Epoch, $F(12, 1344) = 9.41$, $p < .001$, $\eta_p^2 = .08$, and MDD history × Emotion, $F(6, 336) = 3.03$, $p < .01$, $\eta_p^2 = .05$, interactions. No other main effects or interactions were significant (lowest $p = .07$).[3]

To determine the form of the significant Emotion × Epoch interaction, we examined the main effect of epoch within each emotion type, collapsing across groups. There was a

significant effect of epoch for angry, $F(4, 112) = 39.98$, $p < .001$, $\eta_p^2 = .26$, sad, $F(4, 112) = 20.17$, $p < .001$, $\eta_p^2 = .15$, happy, $F(4, 112) = 2.98$, $p = .02$, $\eta_p^2 = .03$, and neutral, $F(4, 112) = 5.57$, $p < .001$, $\eta_p^2 = .05$, faces. We found an overall pattern of greater attention to negative emotions (i.e. angry and sad) in earlier epochs, and greater attention to positive emotion (i.e. happy) in later epochs. The pattern of gaze to neutral faces was more complicated, with no stable increase or decrease in attention across the task. Pairwise comparisons between epochs for each emotion are presented in Table 2.

To determine the form of the significant MDD history × Emotion interaction, we examined the main effect of MDD history within each emotion type, collapsing across epochs. The main effect of MDD history was significant for happy faces, $F(2, 112) = 4.06$, $p = .02$, $\eta_p^2 = .07$, but not angry, $F(2, 112) = 0.02$, $p = .98$, $\eta_p^2 < .001$, sad, $F(2, 112) = 0.01$, $p = .99$, $\eta_p^2 < .001$, or neutral, $F(2, 112) = 0.55$, $p = .58$, $\eta_p^2 = .01$, faces. Posthoc tests revealed that the rMDD group exhibited significantly lower sustained attention to happy faces compared to both the HC ($p = .02$) and sMDD ($p < .01$) groups, while the HC and sMDD groups did not differ ($p = .56$). Given the significant group difference in age at first MDD onset, we should note that the rMDD group continued to exhibit significantly lower sustained attention to happy faces compared to the sMDD group after statistically controlling for the influence of age at first onset, $F(1, 63) = 4.30$, $p = .042$, , $\eta_p^2 = .06$.

Finally, we conducted a series of exploratory analyses to determine whether attentional biases were related to characteristics of women's MDD history (age at first onset, recency of last episode, duration of time depressed, and, for the rMDD group, total number of MDD episodes). Two significant relations emerged. First, duration of attention to happy faces was significantly correlated with age at first onset, $r(66) = .25$, $p = .05$. Given the significant group difference in age at onset, we examined the relation separately by group and found it was not significant for the sMDD, $r(36) = .27$, $p = .11$, nor the rMDD group, $r(30) = -.10$, $p = .62$, suggesting that the effect was driven by rMDD versus sMDD differences. Second, recency of the last episode was significantly correlated with attention to sad faces, $r(66) = -.26$, $p = .04$, with longer periods of remission associated with lower sustained attention to sad faces. None of the other analyses were significant (lowest $p = .11$).

Discussion

The primary goal of this study was to examine attentional biases to facial displays of emotion among women with a history of rMDD, sMDD, or no psychopathology. Across groups, we found an overall pattern of greater attention to negative emotions (i.e. angry and sad) in earlier epochs, and greater attention to positive emotion (i.e. happy) in later epochs. This was moderated by MDD history, as women with a history of rMDD, compared to those in the other two groups, exhibited significantly lower sustained attention to happy faces across all epochs. This relation appears at least partly independent of current disorder as the rMDD and sMDD groups did not differ in recency of the last MDD episode, or current depression or anxiety symptom levels. Although the two MDD groups did differ in age at first MDD onset, the difference in attention to happy faces was maintained even after statistically controlling for age at onset.

These findings are consistent with previous research demonstrating that currently depressed and at-risk individuals exhibit reduced attention to positive stimuli (Armstrong & Olatunji, 2012; Disner, Beevers, Haigh, & Beck, 2011), as well as blunted striatal activation response to both happy faces and socially rewarding stimuli (e.g. praise; Eshel & Roiser, 2010; Keren et al, 2018). The current study is the first to suggest that biases in the processing of positive stimuli may be specific to rMDD rather than sMDD, at least among remitted depressed individuals. Given there is heterogeneity in attention to positive stimuli even in the sMDD group, the current results pave the way for future research to examine whether reduced sustained attention to positive stimuli might help to predict which individuals with a history of sMDD might be at heightened risk for relapse and would benefit most from preventative interventions.

Contrary to our initial hypotheses, there were no significant group differences in sustained attention to sad faces. We initially predicted that, compared to HCs, women with a history of MDD would exhibit greater sustained attention to sad faces, and that this effect would be strongest among women with a history of rMDD. Although previous research found evidence that individuals with current MDD (Armstrong & Olatunji, 2012; Gibb, McGeary, & Beevers, 2016) or remitted MDD (Joormann & Gotlib 2007; Peckham et al., 2010) exhibit preferential attention toward sad faces, the majority of these studies have utilized the dot probe task in which emotional faces are paired with neutral stimuli, rather than other emotional expressions such as in the passive viewing paradigm. Therefore, the dot probe paradigm does not allow for an examination of competition effects between happy and sad stimuli. This said, there is evidence from previous studies that adults with current MDD exhibit preferential attention toward depression-relevant stimuli using a passive viewing paradigm similar to ours (Kellough et al., 2008), though it focused on adults with current MDD and utilized images of dysphoric scenes rather than facial expressions. We should note that exploratory analyses revealed women who have more recently experienced remission of their MDD exhibited greater sustained attention to sad faces, suggesting that biases toward sad faces may be more strongly associated with recent or current MDD. Unfortunately, the number of currently depressed women in our original sample was too small to include in the current study. Future research is needed to determine whether attentional bias toward sad stimuli may be more likely in the presence of current MDD and/or in the absence of competing affective stimuli.

The current study had several strengths including the use of eye tracking to assess attentional allocation, and the relatively large, well-characterized sample. That said, there were limitations which provide important areas for future research. First, it is possible that some of the women in the sMDD group will go on to develop additional episodes of MDD. To the extent that this is true, the current results may underestimate group differences in attention between sMDD and rMDD. Second, the cross-sectional design of this study did not allow us to examine whether these biases reflected “scarring effects” of previous episodes or whether variation in gaze duration to happy faces may help to identify which women with sMDD are at greatest risk for future recurrence. This type of research will be important because, if the predictive validity of gaze duration to happy faces is supported, it could highlight potential targets of intervention to reduce risk of recurrence. Finally, future studies should examine whether these results generalize to genders besides women (e.g., men, non-binary).

Our study adds to a growing body of research supporting the link between a history of MDD and attentional bias for affectively-salient stimuli. Our results suggest that these biases, specifically reduced sustained attention to positively-valenced stimuli, may be strongest in individuals with a history of recurrent MDD. These results are consistent with previous research suggesting reduced reactivity to positive stimuli in individuals with MDD, particularly those with a history of recurrent MDD (Chen et al., 2014). Importantly, our results suggest that depression-related attention bias may track the severity and recurrence of disease course, even in the absence of current MDD. Future research should focus on examining prospective relations between attentional biases and MDD recurrence. This line of research could improve our identification of individuals at risk for relapse and identify additional targets for intervention to reduce the high rates of MDD recurrence.

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Table 1.

Descriptive Statistics for Study Measures.

	Healthy Control (*n* = 48)	sMDD (*n* = 37)	rMDD (*n* = 30)	F/χ^2
Age (Years)	38.00[a] (7.34)	35.61[a] (7.22)	38.1[a] (7.12)	2.66
Age at First MDD Onset (Years)	–	27.14[a] (7.78)	19.69[b] (8.62)	13.54**
Recency of Last MDD Episode (Months)	–	93.31[a] (59.93)	69.77[a] (90.31)	1.60
Past Alcohol Use Disorder	–	29.72%	43.33%	1.33
Past Anorexia Nervosa	–	0.00%	3.33%	1.25
Past Generalized Anxiety Disorder	–	5.41%	3.33%	0.17
Past Obsessive Compulsive Disorder	–	0.00%	3.33%	1.25
Past Panic Disorder	–	0.00%	6.67%	2.54
Past Posttraumatic Stress Disorder	–	8.11%	16.67%	1.15
Past Social Phobia	–	8.11%	10.00%	0.07
Past Substance Use Disorder	–	13.51%	20.00%	0.51
BDI-II	3.87[a] (4.17)	6.87[b] (6.27)	9.56[b] (10.22)	5.44**
BAI	3.07[a] (4.94)	4.76[a] (7.50)	3.90[a] (4.10)	1.96
Gaze to Angry (% across epochs)	19.29[a] (6.60)	18.76[a] (6.54)	20.79[a] (4.74)	0.02
Gaze to Sad (% across epochs)	19.79[a] (7.23)	19.42[a] (5.47)	21.49[a] (5.96)	0.01
Gaze to Happy (% across epochs)	37.0[a] (16.11)	37.18[a] (13.76)	29.99[b] (7.89)	4.06*
Gaze to Neutral (% across epochs)	23.91[a] (8.84)	24.64[a] (6.82)	27.73[a] (6.24)	0.55

Note: sMDD = single episode of major depressive disorder (MDD); rMDD = recurrent MDD; BDI-II = Beck Depression Inventory-II; BAI = Beck Anxiety Inventory. Means with different superscripts differ significantly

* $p < .05$,

** $p < .01$.

Table 2.

Mean Gaze Duration by Epoch.

Emotion Type	Epoch 1	Epoch 2	Epoch 3	Epoch 4	Epoch 5	*F*
Angry	672.60[a]	611.85[b]	560.29[c]	462.47[d]	426.40[d,e]	39.98**
Happy	909.67[a]	977.46[a,b]	1001.34[b]	1018.83[b]	1013.49[b]	2.98*
Sad	631.17[a]	629.82[a,b]	562.45[c]	530.36[c,d]	457.52[e]	20.17**
Neutral	680.71[a]	765.93[b]	695.90[a]	713.54[a,c]	656.62[a,d]	5.57**

Note: Means with different superscripts differ significantly

* $p < .05$,

** $p < .01$