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BRIEF REPORT

Identification of Emotional Facial Expressions Following Recovery From Depression

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This study investigated the identification of facial expressions of emotion in currently nondepressed participants who had a history of recurrent depressive episodes (recurrent major depression; RMD) and never-depressed control participants (CTL). Following a negative mood induction, participants were presented with faces whose expressions slowly changed from neutral to full intensity. Identification of facial expressions was measured by the intensity of the expression at which participants could accurately identify whether faces expressed happiness, sadness, or anger. There were no group differences in the identification of sad or angry expressions. Compared with CTL participants, however, RMD participants required significantly greater emotional intensity in the faces to correctly identify happy expressions. These results indicate that biases in the processing of emotional facial expressions are evident even after individuals have recovered from a depressive episode.

Keywords: depression, vulnerability, cognition, emotion, facial expression

Major depressive disorder (MDD) is a highly recurrent disorder. In fact, 50% of depressed patients relapse within 2 years of recovery; individuals with three or more previous episodes may have a relapse rate as high as 40% within only 12–15 weeks after recovery (Keller et al., 1992). Importantly, the risk of recurrence increases following every depressive episode. Whereas the risk of recurrence is 50%–60% for those who have experienced a single episode, this risk increases to 70% for those who have experienced two past episodes (Kessler et al., 2003). This high rate of recurrence of depressive episodes almost certainly reflects the presence of stable vulnerability factors, which place some individuals at increased risk for experiencing depression repeatedly over the course of their lives.

In this context, cognitive models of depression propose that biased processing of emotional material is a stable vulnerability factor that affects the onset, maintenance, and recurrence of depressive episodes (Beck, 1967). Previous studies have demonstrated that currently depressed individuals preferentially attend to and remember negative material (see Mathews & MacLeod, 2005, for a recent review). Furthermore, research has shown that cognitive biases can also be observed in remitted depressed participants, although they may require the prior activation of dysfunctional schemas through a negative mood induction or some other form of mood priming (see Scher, Ingram, & Segal, 2005, for a review).

Cognitive biases may be especially problematic when they affect the processing of social stimuli. Results from a growing number of studies suggest that deficits in social skills and interpersonal interactions play an important role in vulnerability to depressive episodes (Joiner & Timmons, 2008). Biased processing of social cues, such as misinterpreting facial expressions of emotion, may underlie these impairments. Individuals use facial expressions to monitor emotional reactions, to determine others' opinions, and to adjust their behavior to avoid conflict (e.g., Hess, Kappas, & Scherer, 1988). Thus, the ability to accurately and quickly identify others' emotional facial expressions is of considerable importance in social interactions. Indeed, several investigators have delineated adverse interpersonal consequences of being unable to accurately identify facial expressions (e.g., Carton, Kessler, & Pape, 1999). Although these biases are likely to contribute to social impairments and increased risk for relapse, research to date has examined these biases primarily in individuals who were depressed at the time of the studies.

Indeed, studies have reported that currently depressed individuals exhibit deficits in labeling and recognizing facial expressions (e.g., Feinberg, Rifkin, Schaffer, & Walker, 1986; Persad & Polivy, 1993). Whereas some studies have found MDD participants to exhibit global deficits in emotion processing (e.g., Feinberg et al., 1986), others have reported that MDD participants have difficulty identifying specific emotions (e.g., *happy* but not *sad*). Suslow and colleagues, for example, demonstrated that participants with MDD tended to be slower than were control participants in identifying positive, but not negative or neutral, expressions (Suslow, Klaus, & Volker, 2001). Furthermore, biases in the

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labeling of facial expressions have been associated with symptom severity during a depressive episode, persistence of the depressive symptoms in follow-up (6 and 13 weeks later), and subsequent relapse (Bouhuys, Geerts, & Gordijn, 1999a, 1999b; Hale, 1998). There is also evidence that difficulties processing facial expressions are present in people after remission of a depressive episode (Leppanen, Milders, Bell, Terriere, & Hietanen, 2004). A limitation of these studies is that most have used schematic faces (e.g., Hale, 1998) or static facial expressions at full intensity (Ridout, Astell, Reid, Glen, & O'Carroll, 2003). In everyday life, however, people process a wide range of emotional stimuli, including signals that are far less intense than are the prototypical facial expressions that are contained in standardized picture sets. It is likely, therefore, that responses to the emotions portrayed in these prototypical faces have provided only a limited understanding of the processing of social cues in depression. Assessing the early identification of emotion and of the processing of subtle changes in facial expressions is likely to yield important information regarding depression-associated deficits in interpersonal functioning.

Few studies have examined depression-related difficulties in the identification of subtle expressions of emotion or the processing of subtle changes in emotional expressions. Surguladze et al. (2004) examined depressed and nondepressed participants' ability to identify photographs of happy and sad facial expressions displaying both 100% (full) and 50% emotional expression. Compared with nondepressed participants, depressed participants were less accurate when identifying sad faces presented for short durations and happy faces presented at 50% intensity. Building upon these findings, Joormann and Gotlib (2006) used a finer grained test of emotion identification obtained by morphing pictures of real faces to change from a neutral expression (0%) to a full emotional expression (100%) in 2% increments. Compared with control participants, depressed participants required displays of significantly greater emotional intensity to correctly identify happy facial expressions. These findings suggest that currently depressed individuals exhibit difficulties in identifying subtle expression of happiness. Whether this bias persists beyond the depressive episode, however, has not yet been investigated.

The current study was designed to examine whether carefully screened participants who are not currently depressed but who have a history of recurrent depressive episodes differ from healthy control participants in their identification of subtle expressions of emotion. Given that women are more vulnerable to depression than are men (Kessler et al., 2003) and that sex differences in emotion identification have been identified in previous studies (Bouhuys et al., 1999b; Li, Yuan, & Lin, 2008), we included only women in the current study. We carefully selected women who met criteria for at least two past major depressive episodes but who were not currently depressed (RMD) and control participants (CTL) who had no history of any Axis I disorder. Previous research has found that cognitive biases are present after recovery from a depressive episode but may remain dormant until activated by negative mood (see Scher et al., 2005, for a review). Therefore, we induced a negative mood in all participants before they completed the emotion identification task. In this task, faces were presented that slowly progressed from neutral (0%) to full-intensity (100%) expressions of sadness, anger, or happiness, and individual differences in the intensity required to accurately identify these expressions were assessed. Given previous findings resulting from a similar task with currently depressed participants (Joormann & Gotlib, 2006), we hypothesized that the RMD participants would require greater intensity of emotion than would the CTL participants to correctly identify happy expressions.

Method

Participants

Participants were recruited via advertisements and Internet postings. Women who were fluent in English and between 18 and 60 years of age were screened by phone for initial exclusion/inclusion criteria. Participants were excluded if they had experienced severe head trauma; had learning disabilities, bipolar disorder, or psychotic symptoms; or met *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM–IV*; American Psychiatric Association, 1994) criteria for alcohol or substance abuse within the past 6 months. These phone interviews were also used to identify individuals who were likely to meet criteria for inclusion into one of two groups: (a) individuals with recurrent past major depressive episodes who currently did not meet *DSM–IV* criteria for MDD (RMD) or (b) individuals who did not meet criteria for any past or current Axis I disorder (CTL). Participants who were expected to meet inclusion criteria were invited to participate in the Structured Clinical Interview for the *DSM–IV* (SCID; Spitzer, Gibbon, & Williams, 1995), which was administered by trained and experienced interviewers. On the basis of the SCID, 95 individuals (39 RMD and 56 CTL) were deemed eligible and were included in the study.

Procedure

All participants took part in the phone interview and the SCID, which took approximately 2 hr. Following the SCID, eligible participants were scheduled for their second session within 1 week. In the second session, participants first completed a mood assessment. They then were exposed to a negative mood induction and a second mood measurement before participating in the morphing task.[1]

Mood Induction

The presentation of film clips combined with instructions to "imagine being in the situation" and to "imagine the feelings you would experience in the situation" was found to be most effective in inducing negative mood states (see meta-analysis by Westermann, Spies, Stahl, & Hesse, 1996). Participants were randomly assigned to watch one of three sadness-inducing 6-min film clips (*Stepmom*, Columbus, 1998; *My Girl*, Zieff, 1991; or *Dead Poets Society*, Weir, 1989) and were instructed to imagine being in the

[1] The morphing task was one of three tasks that participants completed. The order of the tasks was counterbalanced. Including order as a factor in our analyses did not change the current findings.

[2] Including film clip as a factor in the analysis did not affect the findings for angry or sad faces. There was a significant main effect of film clip on the intensity needed to correctly identify happy faces. Importantly, however, the main effect of group remained significant, $F(1, 89) = 11.55$, $p < .01$, when film clip was included as a factor, and there was no interaction of group and film clip, $F(2, 89) < 1$, *ns*.

situation presented in the movie.[2] They were then instructed to think for an additional 2 min about how they would feel if they had experienced this situation.

Questionnaires

Participants completed the Beck Depression Inventory—II (BDI–II; Beck, Steer, & Brown, 1996) to assess depressive symptoms. Participants also completed a mood rating before and after the mood induction. As has been done in past studies (e.g., Taylor & Ingram, 1999), ratings were made on a 5-point scale ranging from 1 (*very sad*) to 5 (*very happy*).

Morphing Task

Stimuli. Faces were selected from the Facial Expressions of Emotion: Stimuli and Tests series stimulus set (FEEST; Young, Perrett, Calder, Sprengelmeyer, & Ekman, 2002), in which faces were morphed from a neutral expression to a fully emotive expression in 10% increments. From this set, two actors (one man and one woman) displaying angry, sad, and happy expressions were selected. Images of the same two actors expressing disgust were used for practice trials. In order to create a finer grained progression from neutral to 100% emotion, Morph Studio's Morph Editor software Version 1.0 was used to create 50 intermediate images so that the pictures progressed in 2% increments. Black-and-white, 18.5 × 13-cm photographs were presented in the middle of a high-resolution, 17-in. computer monitor with a black background.

Design. Using E-Prime software Version 1.1, we presented each image for 500 ms in order to create the impression of an animated clip displaying the progression of a facial expression. Moreover, to avoid a perfect correlation between time and percent of emotional expression and to increase the difficulty of the task, we occasionally repeated the same image before progressing to the higher percentage. For example, in some displays, the 50%-emotion image was displayed three times before the 52%-emotion image was presented. Thus, each sequence (e.g., male actor with a progression to a happy face) consisted of 50 unique images but 70 image presentations. Each of the six sequences was presented five times in random order, for a total of 30 sequence presentations.

Participants were instructed to watch the face change from neutral to full emotional expression and to press the space bar as soon as they were able to identify the emotion. Once participants pressed the space bar, a second screen came up, asking them to identify the emotion. The computer recorded the intensity of the emotion expressed when the space bar was pressed and the accuracy of participants' identification.

Results

Participant Characteristics

Demographic and clinical characteristics of the RMD and CTL groups are presented in Table 1. The two groups did not significantly differ in age, $t(93) = -1.55$, *ns*; education, $\chi^2(5, N = 93) = 10.44$, *ns*; or ethnicity, $\chi^2(5, N = 94) = 4.62$, *ns*.[3] There was, however, a significant difference in their BDI scores, $t(93) = 5.17$, $p < .001$, with RMD participants obtaining significantly higher BDI scores than those of CTL participants. At the time of testing, 3 of the RMD participants met *DSM–IV* (American Psychiatric Association, 1994) criteria for an anxiety disorder: 1 with generalized anxiety disorder, 1 with obsessive-compulsive disorder, and 1 with social phobia.[4]

Table 1
Participant Characteristics

Variable	CTL	RMD
N	56	39
Age (years)		
M	44.41	42.62
SD	5.18	6.07
% college educated	84	76
% Caucasian	84	79
BDI score		
M	3.32	11.23
SD	4.42	10.18

Note. CTL = control group; RMD = recurrent past major depression group; BDI = Beck Depression Inventory.

Mood Induction

In order to ensure the effectiveness of the mood induction, a Group (RMD, CTL) × Time (baseline, after mood induction) repeated-measures analysis of variance (ANOVA) was conducted on self-reported mood. As expected, this analysis yielded a significant main effect of time, $F(1, 93) = 296.41$, $p < .001$: Participants endorsed more negative affect after watching the video clip ($M = 1.97$, $SD = 0.92$) than before ($M = 3.85$, $SD = 0.70$). There was no main effect of group, $F(1, 93) < 1$, and no Group × Time interaction, $F(1, 93) = 2.28$, *ns*.

Error Rates

Although the primary hypotheses focused on the percent intensity at which individuals correctly identified an emotion, the percentage of incorrect identifications was examined to ensure that group differences in intensity were not due to differences in accuracy. A Group (RMD, CTL) × Expression (angry, happy, sad) repeated-measures ANOVA was conducted on the percentage of errors. This analysis yielded a significant main effect for group, $F(1, 93) = 4.96$, $p < .05$, and for expression, $F(2, 186) = 25.13$, $p < .001$; the Group × Expression interaction was not significant, $F(2, 186) = 2.11$, $p > .05$. CTL participants ($M = 6.01\%$, $SD = 7.20$) made significantly more errors than did RMD participants ($M = 3.16\%$, $SD = 4.11$). Paired *t* tests were conducted to examine the main effect for expression. These analyses indicated that participants made more errors for angry faces ($M = 8.63\%$, $SD = 11.17$) than they did for happy faces ($M = 0.42\%$, $SD = 2.02$), $t(94) = 7.21$, $p < .001$, or sad faces ($M = 5.47\%$, $SD = 10.19$), $t(94) = 2.81$, $p < .01$. Participants also made more errors

[3] Ethnicity data are missing for 1 RMD participant, and education data are missing for 2 RMD participants.

[4] The interaction of group and expression on percent intensity required to correctly identify the emotion remained significant when the 3 participants with current anxiety disorders were excluded, $F(2, 180) = 3.24$, $p < .05$.

identifying sad faces than identifying happy faces, $t(94) = 4.88$, $p < .001$.

Emotional Intensity

It was hypothesized that RMD participants would require greater emotional intensity than would CTL participants to accurately identify happy faces. Analyses were restricted to trials in which the facial expressions were correctly identified. A Group (RMD, CTL) × Expression (angry, happy, sad) repeated-measures ANOVA was conducted on the percent intensity required to correctly identify the emotion (see Figure 1). The main effect of group was not significant, $F(1, 93) = 2.79$, $p > .05$. The main effect of expression was significant, $F(2, 186) = 3.18$, $p < .05$, but was qualified by the predicted significant Group × Expression interaction, $F(2, 186) = 3.74$, $p < .03$.[5] Follow-up analyses revealed that RMD and CTL participants did not differ in their identification of sad or angry faces, both ts$(93) < 1$. RMD participants required a greater intensity of emotional expression than did CTL participants, however, to correctly identify happy faces, $t(93) = 3.34$, $p < .01$, $d = 0.69$. Covarying BDI scores did not change this finding: The Group × Expression interaction remained significant, $F(1, 92) = 5.88$, $p < .02$.[6]

Discussion

This study was designed to examine whether individuals with a history of recurrent depressive episodes differed from control participants in their identification of subtle expressions of emotion. Whereas no group differences were found in the intensity of emotion required for participants to correctly identify sad or angry facial expressions, RMD participants required greater emotional intensity than did their nondepressed counterparts to correctly identify happy facial expressions. This is the first study to use computer-morphed faces to assess biases in the identification of subtle emotional expressions following a negative mood induction in participants with a history of recurrent depressive episodes. These findings add to previous research investigating whether biased processing of emotional material is evident outside of acute depressive episodes in vulnerable individuals. In fact, other investigators have found cognitive biases in formerly depressed participants following priming of dysfunctional schemas (see Scher et al., 2005, for a review).

Figure 1. Mean percent intensity of emotional expression required to accurately identify emotional facial expressions by participants diagnosed with recurrent past major depressive episodes (RMD) and never-depressed control participants (CTL) as a function of valence of facial expression. Error bars = 1 *SE*.

Although previous studies have reported biased identification of full-intensity emotional expressions in remitted individuals, these data are mixed. Some studies, for example, reported better performance in identifying emotional facial expressions during remission than during a depressive episode (Bouhuys et al., 1999a; Mikhailova, Vladimirova, Iznak, & Tsusulkovskaya, 1996). Because these studies did not include a group of healthy control participants, however, it is unclear whether remitted depressed participants performed at the level of healthy controls or were still impaired in their emotion identification despite an improvement during recovery. In the only study to compare previously depressed individuals with never-disordered controls, remitted individuals demonstrated impaired recognition of briefly presented photographs of neutral faces (Leppanen et al., 2004). It is important to note, however, that remission in this study was operationalized as improvement in participants' BDI scores; nevertheless, the average BDI score (25.8) of the remitted group remained in the clinical range. Finally, these studies examined only full-intensity emotional expressions, and none included a mood induction prior to the emotion identification task. The current results suggest that carefully diagnosed individuals who have experienced multiple past depressive episodes but who do not currently meet *DSM–IV* (American Psychiatric Association, 1994) criteria for MDD exhibit impairment in the identification of happy facial expressions after having been exposed to a negative mood induction.

The finding that remitted depressed participants differed from control participants in the processing of happy faces but not in the processing of negative facial expressions warrants comment. Given that it is generally easier to identify happy than negative facial expressions (e.g., Kirita & Endo, 1995) and given that happiness was the only positive emotion in our task, happy faces should have been easier to identify than angry and sad faces. Whereas the CTL group's performance followed this pattern, as has been previously demonstrated (Joormann & Gotlib, 2006), it is noteworthy that the RMD group's performance did not. Although these results do not support previous findings that suggest that depression is characterized by fast and accurate processing of sad facial expressions (e.g., Gur et al., 1992), they do add to a growing literature indicating that depression is characterized by difficulties in the processing of positive affect, perhaps even more so than by biases in the processing of negative affect (e.g., Deveney & Deldin, 2004; Surguladze et al., 2004). For example, Suslow et al.

[5] Similar results were obtained when overall number of errors was included as a covariate: The interaction of group and expression on percent intensity required to correctly identify the emotion remained significant, $F(2, 184) = 4.02$, $p < .02$. When separated by expression, the RMD and CTL groups differed in the intensity required to correctly identify happy faces after controlling for errors made identifying happy faces, $F(1, 92) = 12.02$, $p < .01$.

[6] A main effect of baseline mood was obtained, $F(1, 92) = 4.20$, $p < .05$, when it was entered as a covariate. Importantly, however, the interaction of group and expression remained significant, $F(2, 184) = 4.56$, $p < .02$. Thus, although baseline mood affected performance on the task, it did not account for the interaction of emotional expression and group.

(2001) found that whereas depressed and control participants did not differ in their response latencies to detect sad faces in a display of schematic faces, depressed participants were significantly slower than were controls to detect happy faces. In an emotion discrimination task, Gur et al. (1992) reported that the tendency to misinterpret happy faces as neutral best discriminated depressed patients from control participants. Similarly, Gilboa-Schechtman, Erhard-Weiss, and Jeczemien (2002) found that depression was associated with decreased memory for happy facial expressions, and Deldin, Deveney, Kim, Casas, and Best (2001) found evidence for decreased N200 event-related brain potential (ERP) in response to positive faces in depression, suggesting decreases in resource allocation to the encoding of these stimuli. Importantly, studies that have investigated the processing of subtle expressions of emotion in depression also have found deficits for positive material. Surguladze et al. (2004), for example, reported that depressed participants were inaccurate at recognizing subtle expressions of happiness. Similarly, Joormann and Gotlib (2006) found that depressed participants' difficulties identifying subtle emotional expressions were specific to happy expressions. Individual differences in identifying less-intense positive facial expressions and subtle changes in these expressions may be especially detrimental to adaptive interpersonal functioning.

We should note a number of limitations of the present study. First, although none of the RMD participants met criteria for a current major depressive episode, they did have higher, though subclinical, BDI scores than did CTL participants. This finding is consistent with previous literature documenting elevated but subclinical levels of depressive symptoms in individuals who have experienced past depressive episodes (e.g., Santesso et al., 2008). Including BDI scores as a covariate, however, did not affect our findings. Second, all participants completed a negative mood induction. Although a negative mood induction is postulated to be necessary when exploring cognitive biases in RMD participants (e.g., Just, Abramson, & Alloy, 2001), future studies should replicate this procedure comparing a negative mood induction group with either a neutral or positive mood induction group. Third, because increased intensity is strongly associated with decreased ambiguity of facial expressions, it is possible that the obtained group differences reflect depression-associated differences in resolving ambiguity. It is important to note, however, that no group differences in identification accuracy for happy faces were obtained, which supports an interpretation of the findings in terms of intensity differences. Nevertheless, future research should attempt to distinguish between these alternative explanations. Furthermore, the design of our study precluded the ability to assess the possibility that the observed impairments were a consequence or a "scar" of having experienced a depressive episode (Just et al., 2001; Lewinsohn, Steinmetz, Larson, & Franklin, 1981). It is interesting, however, that recent studies have found that individuals with an increased familial risk of depression who have not yet experienced a depressive episode exhibit biases in recognizing emotional facial expressions (LeMasurier, Cowen, & Harmer, 2007). It is possible that changes in cognitive processes that occur as a consequence of having been depressed play an important role in the recurrence of depression. For example, investigators have demonstrated that the risk of recurrence increases with each depressive episode that is experienced (Solomon et al., 2000). Thus, assessing cognitive processing in remitted depressed participants should help to identify factors that increase the risk for experiencing recurrent depressive episodes. Future studies should follow at-risk participants to determine whether these processes predict onset and recurrence of depression. Finally, the current design was limited by the use of only three emotional expressions. Future studies should include other facial expressions, in particular other positive expressions such as surprise, to investigate whether RMD participants differ from CTL participants in their processing of arousal or valence.

In sum, the present results suggest that biases in the processing of emotional facial expressions represent a risk factor for the recurrence of depressive episodes. We documented difficulties in the identification of subtle happy facial expressions in currently remitted depressed participants with a history of recurrent depressive episodes following a negative mood induction. The ability to accurately process other people's emotional expressions likely plays an important role in social interactions. Given the importance of social support in preventing depressive episodes (Paykel, 2007), impairments in this area could contribute to the high risk of recurrence observed in MDD.

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