Mental state decoding in past major depression: Effect of sad versus happy mood induction

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First published on: 25 March 2009

To cite this Article

To link to this Article: DOI: 10.1080/02699930902750249
URL: http://dx.doi.org/10.1080/02699930902750249

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Individuals with mild depression show an enhanced ability to read or “decode” others' mental states. The goal of the present study was to investigate whether this pattern of performance is related specifically to the pathology of depression or whether it is simply a feature of the transient dysphoric state. Forty-one undergraduates with a previous episode of major depression and 52 undergraduates with no depression history participated in a mental state decoding task following a sad versus happy mood induction. Previously depressed participants were significantly more accurate in their mental state judgements than were the never-depressed participants, suggesting that enhanced mental state decoding may be a specific feature of depression in remission. Furthermore, previously depressed participants whose positive mood increased in response to the happy mood induction showed a poorer level of performance on the task, similar to that observed in the never-depressed group. Thus, a happy mood may have induced a somewhat less accurate, but perhaps more adaptive, approach to processing social information. These findings were robust after controlling for current level of depression and anxiety symptoms, intensity of response to the mood induction, response times, and performance on a control task.

Keywords: Depression; Theory of mind; Remission; Mood induction.

Unipolar major depression is associated with deficits in social and interpersonal functioning. Depressed individuals have fewer social contacts and less integrated social networks relative to non-depressed individuals (e.g., Billings & Moos, 1984; Gotlib & Lee, 1989), and they report that their social interactions are less enjoyable, less rewarding, and less intimate than those of non-depressed individuals (e.g., Nezlek, Hampton, & Shean, 2000). These factors can lead depressed individuals to withdraw from social contacts (e.g., Rippere, 1980), potentially serving to maintain...
and perpetuate depression. Because the social difficulties of depressed individuals are so pervasive, gaining a deeper understanding of the mechanisms that might underlie these problems is important from both a theoretical and a clinical perspective.

The social deficits associated with other clinical syndromes, such as schizophrenia (Frith, 1996), bipolar disorder (Kerr, Dunbar, & Bentall, 2003), and Asperger’s syndrome (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) recently have been examined within the context of “theory of mind”. Theory of mind (ToM) refers to the everyday ability to ascribe mental states (e.g., beliefs, emotions, intentions, etc.) to others to both understand and predict their behaviour (Wellman, 1990). ToM can be separated into at least two component processes (Baron-Cohen et al., 2001; Sabbagh, 2004): (1) detecting or decoding others’ mental states based on immediately available observable information; and (2) reasoning about those mental states to explain or predict others’ actions. Ordinarily, mental-state decoding and reasoning work together to produce reliable judgements about others’ mental states. However, the distinction between them is important because they each rely primarily on different social-information processing skills. Mental state decoding is a largely inductive process that requires individuals to make probabilistic judgements based upon social information that is obtained from the immediate environment (e.g., facial expression, tone of voice, body posture, etc.). In contrast, mental state reasoning requires one to reason in a deductive manner using additional knowledge about the person and context. For example, to correctly judge that someone is disappointed (mental state decoding), one may attend to observable features such as facial feature positioning, tone of voice, etc. However, to judge that s/he is disappointed about getting a poor mark on an exam (mental state reasoning) one must have the additional contextual information that s/he received a poor mark, and perhaps that s/he had wanted to do well.

Of particular interest in the present study is the relation of depression to the foundational skill of decoding others’ mental states. Several studies have now documented that patients with schizophrenia (Craig, Hatton, Craig, & Bentall, 2004; Kington, Jones, Watt, Hopkin, & Williams, 2000; Oguz, Rita, Miklosne, Szabolcs, & Zoltan, 2003), bipolar disorder in the depressive and euthymic phases (Bora et al., 2005), and Asperger’s syndrome (e.g., Craig et al., 2004), show significant impairments in ToM decoding. All of these studies assessed mental state decoding using the “Reading the mind in the eyes task” (“Eyes task”; Baron-Cohen et al., 2001; see Figure 1 for a sample item). The Eyes task is a test of adult ToM decoding that involves looking at pictures of the eye region of the face and selecting one of four terms (e.g., reflective, irritated, confident, ashamed) that best represents the mental state portrayed by the eyes. The task is challenging. While the eyes carry reliable and important information about others’ mental states (see Kleinke, 1986), this information is quite subtle and difficult to interpret when separated from the additional contextual information that is provided by a whole-face expression (e.g., a smile or a frown; Ekman & Friesen, 1978). It is also important to note that the Eyes task assesses individuals’ accuracy at detecting complex mental states, such as “reflective” or “disappointed”. As such, it assesses a more specific skill than the recognition of basic emotions (happy, sad, etc.). Accurate judgements in this task require a high degree of sensitivity to the subtle features of eye expressions, and require participants to “put themselves into the mind of others” (Baron-Cohen et al., 2001). Healthy adults perform at about 70% accuracy on this task, thus allowing for the detection of subtle group differences. A further important advantage of the Eyes task in assessing mental state decoding is that it is a true recognition task. As such, it does not require free recall or visuospatial discrimination skills, which have been found in basic facial emotion processing studies to be associated with biased or impaired performance by depressed groups, irrespective of their skills in the identification of emotions per se (see Harkness, Sabbagh, Jacobson, Chowdrey, & Chen, 2005).
Two studies to date have examined ToM decoding abilities in unipolar depression (Harkness et al., 2005; Lee, Harkness, Sabbagh, & Jacobson, 2005). First, consistent with the findings of studies investigating other clinical syndromes, women in a current episode of unipolar major depression performed significantly more poorly on the Eyes task than did healthy controls, and this deficit was related specifically to severe depression symptoms of anhedonia, guilt, and psychomotor retardation (Lee et al., 2005). Second, in direct contrast, and in two independent samples, individuals with mild, subthreshold, depression (i.e., dysphoria) performed significantly better on the Eyes task than controls, suggesting an enhanced ToM decoding ability (Harkness et al., 2005). This latter result is consistent with findings from social psychology showing that dysphoric individuals are particularly sensitive to the sort of subtle social information that is required to make judgements about others’ mental states. For example, dysphoric individuals are more likely than non-dysphoric individuals to seek out information about others (Hildebrand-Saints & Weary, 1989), to make more complex attributions about others (Marsh & Weary, 1989), and to use more effortful strategies when analysing social information about others (Edwards & Weary, 1993).

Individuals with subthreshold depression, or dysphoria, are at elevated risk for major depression (Fergusson, Horwood, Ridder, & Beautrais, 2005). Therefore, an important question concerns how to reconcile an enhanced ToM decoding skill in dysphoria with the deficits seen in severe major depression. Are the enhanced ToM decoding abilities seen in dysphoric individuals related in some way to the pathology of major depression? Or, alternatively, are they simply a marker of the transient dysphoric state, irrespective of the stability of that state or its relation to any previous or subsequent episodes of major depression? In the present study we addressed this issue by comparing performance on the Eyes task between a group with a past history of major depression and a group with no depression history, both of which were randomly assigned to a sad or happy mood induction. If enhanced ToM decoding is
related to the pathology of major depression in remission, then when in a dysphoric state following the sad mood induction, the past-depressed group should show superior performance on the Eyes task relative to those in the happy condition, whereas the inductions should make no difference to the performance of the never-depressed group. In contrast, if enhanced ToM decoding skills simply mark a transient dysphoric state, then both the past-depressed and never-depressed groups should show superior performance on the Eyes task in the sad mood induction condition (i.e., when dysphoric) relative to the happy condition.

In the present study we used a mood-induction procedure that combines emotional music and autobiographical recall of a similar valence. This type of induction has been shown to be the most effective in inducing mood (Martin, 1990; Van der Does, 2002). One potential problem with this approach, however, is that although the music is constant within each induction condition, the intensity of participants' recollections cannot be controlled. For example, in the sad condition, some participants may think about a time when they were somewhat down, whereas others might recall an instance in which they were downright miserable. If this variability in the intensity of the induction stimuli is expressed differentially across groups, it could spuriously affect the results of mood-induction studies. In particular, differences in mental state decoding that emerge between previously depressed and never-depressed groups as a result of the mood induction may be related to the fact that the mood-induction conditions are not perfectly matched across the two groups (i.e., the sad induction stimuli may be “sadder” in the previously depressed group and the happy induction stimuli may be “happier” in the never-depressed group) and not because of any fundamental difference in information processing between groups, per se. To account for individual variability both between and within groups in the strength of response to the mood induction, we included a “mood response index” in our models—a continuous score representing the intensity of each participant’s mood response to the induction (see below).

METHOD
Participants
Participants included 93 students recruited from an introductory psychology class and from campus advertisements. Participants received either course credit or $10 for their participation. Participants from the introductory psychology class were contacted on the basis of their “yes” or “no” response to a question that was part of a departmental pre-screening inventory: “Have you ever been diagnosed with depression?” Separate advertisements also specifically requested participants with versus without a past depression. Participants in the past-depressed group had to meet Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994) criteria for a past episode of major depression and not meet criteria for a current major depressive episode. Participants in the never-depressed group had to be free of a current or past major depressive episode.

Among the 101 participants who took part in the study, 7 were excluded because they met full or subthreshold criteria for a current major depressive episode and one was excluded because she was an outlier (>2.5 SDs) on the Eyes task. Thus, the final sample consisted of 93 participants (76 women, 17 men; mean age = 18.90, SD = 1.41), including 41 past-depressed and 52 never-depressed individuals. Forty-eight participants were assigned to the sad mood induction (20 past-depressed, 28 never-depressed) and 45 to the happy induction (21 past-depressed, 24 never-depressed); \( \chi^2(1) = 0.63, \ p = .68 \). Descriptive characteristics are presented in Table 1.

Materials and measures
Diagnostic. Participants were administered the unipolar depression section of the mood disorders
module (Module A) of the Structured Clinical Interview for DSM-IV Axis I Disorders – Patient Edition (SCID-I/P; First, Spitzer, Gibbon, & Williams, 1994). To ensure that none of our participants met even subthreshold criteria for a current episode of major depression, all had to reply “no” to both of the first two criterial symptoms (Criterion A: depressed mood and loss of interest) for current depression status. The reliability and validity of the SCID-I/P has been well documented in the diagnosis of major depression and other Axis I disorders (e.g., Williams et al., 1992). Interviews were conducted by the third author or one of two advanced undergraduate honours students. All had been trained extensively by the first author. This training consisted of sitting in on SCID interviews performed by the first author, and performing SCID interviews with the first author observing. Trainees had to match the first author’s diagnoses on at least three consecutive interviews they performed before they were able to interview independently. The first author provided ongoing supervision throughout the project. Training also included weekly assessment meetings involving comprehensive study of DSM-IV criteria for major depression, in addition to interviewing skills building. Such methods are typically employed to train raters to administer diagnostic interviews (see Grove, Andreasen, McDonald-Scott, Keller, & Shapiro, 1981).

Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996). The 21-item BDI-II was administered to assess the presence and severity of depression symptoms. The standardised internal consistency estimate of the BDI-II in the present sample was .88.

Mood and Anxiety Symptom Questionnaire (MASQ; Watson & Clark, 1991). The 90-item MASQ comprises three dimensions:

1. Anhedonic Depression (AD)—symptoms that distinguish depression from anxiety (e.g., lack of pleasure or interest);
2. Anxious Arousal (AA)—symptoms that distinguish anxiety from depression (e.g., heart palpitations); and
3. General Distress (GD)—symptoms common to both depression and anxiety (e.g., sadness, nervousness).

The standardised internal consistency estimates of the AD, AA, and GD scales in the present sample were .86, .86, and .93, respectively.

Mood induction. Participants were assigned to one of two mood-induction conditions in counter-balanced fashion. In the “sad” condition, participants listened to six minutes of the “Adagio for Strings” by Samuel Barber while recalling a time in their lives when they felt sad. In the “happy” condition, participants listened to six

<table>
<thead>
<tr>
<th>Table 1. Characteristics of the sample by depression group and mood induction condition</th>
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<tr>
<td><strong>Sex (female)</strong></td>
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<tr>
<td><strong>n</strong></td>
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<tr>
<td>Never depressed</td>
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<tr>
<td>Sad condition</td>
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<tr>
<td>Happy condition</td>
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<tr>
<td>Past depressed</td>
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<tr>
<td>Sad condition</td>
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<tr>
<td>Happy condition</td>
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Note: Mean differences between subscripts p < .05.
minutes of the first movement (Allegro) of “Eine Kleine Nachtmusik” by Mozart while recalling a
time when they felt happy. The pieces of music
chosen for the happy and sad mood induction
conditions have been used previously (Scharff &
Nguyen, 2003; Sousou, 1997).

Differential Emotions Scale (DES; adapted by
Cacioppo, Martzke, Petty, & Tassinary, 1988). Four
items from the DES were administered to assess
participants’ immediate affective state both pre-
and post-mood induction: (a) merry/gleeful/
amused; (b) warm-hearted/joyful/elated; (c) sad/
downhearted/blue; and (d) tense/anxious/nervous.
Items were scored on a 7-point scale from 1 = “not
at all” to 7 = “very strongly”. The standardised
internal consistency estimate of the DES in the
present sample was .85.

As explained above, to account for individual
variability both between and within groups in the
strength of response to the mood induction, we
created a “mood response index”. We first reverse-
coded scores on the sad/downhearted/blue and
tense/anxious/nervous items, and then summed
scores across all four items for the pre- and post-
mood induction separately. We then subtracted
the summed pre-mood-induction DES score
from the summed post-mood-induction DES
score. Therefore, negative scores on this index
represent a change in mood in the negative
direction (i.e., more sad or tense, or less merry
or warm-hearted), whereas positive scores repres-
ent a change of mood in the positive direction
(i.e., less sad or tense, or more merry or warm-
hearted). A score of zero represents no change in
mood in response to the induction.

Eyes task. ToM decoding was assessed using the
“Reading the mind in the eyes – revised version”
task (see Figure 1a for a sample item; see Baron-
Cohen et al., 2001, for complete information on
how the stimuli were developed). The task
consists of 36 black-and-white photographs of
the eye region of faces taken from magazines.
Each pair of eyes is standardised to the same size
(15 cm × 6 cm) and edited such that the eye
region is visible from just above the eyebrow
down to midway along the bridge of the nose.
Participants must make a forced choice between
four words (the standardised correct response and
three distracters) that describe what the person in
the photograph might be thinking or feeling. We
presented the stimuli on a computer screen with
the four adjectives placed in the four corners
surrounding the eye picture and equidistant from
the centre of the screen. The location of the
correct answer was counterbalanced across items.
Participants indicated their response by pressing
one of four keys (S, X, K, M), which were spatially
analogous to the location of the adjectives.

The stimuli from the Eyes task have been used
in over 40 published studies involving clinical
samples (e.g., Bora et al., 2005; Kerr et al., 2003;
Kettle, O’Brien-Simpson, & Allen, 2008). In a
previous study using an undergraduate sample
similar to that employed here, researchers vali-
dated the task by determining that the adjectives
chosen as the targets by Baron-Cohen et al.
(2001) were, indeed (a) selected by participants
at higher rates than expected by chance and (b)
the most common selection across participants
(see Harkness et al., 2005).

Control task. We designed and administered a
control task to ensure that any differences
between groups on the Eyes task could be
attributed to differences in mental state decoding.
Specifically, the “Animals task” required partici-
pants to make judgements about the traits of
animals in a format similar to the Eyes task.
Twelve black-and-white pictures of different
animals taken from the Internet were digitally
edited to remove the background, resized to a
screen size of 14.5 cm × 5.5 cm, and surrounded
by four adjectives (see Figure 1b for an example
item). Target adjectives and distracters for the
Animals task were validated in a previous study
(see Harkness et al., 2005). The Animals task
controls for motivation and demands of the task
(e.g., selecting the appropriate adjective from a
4-item array).
Theory of Mind and Past Depression

Procedure
After a complete description of the study, participants provided written informed consent. Participants then completed a paper-and-pencil version of the pre-mood-induction DES, followed by several computer tasks: (a) the sad or happy mood induction; (b) a 10-minute distracter task; (c) the post-mood-induction DES; (d) the Eyes and Animals tasks; (e) a final DES; and (f) the BDI and MASQ. Finally, participants engaged in the SCID Module A interview. A distracter task that required participants to discriminate between phonemes (e.g., “aba” versus “ada”) presented via headphones was inserted following the mood induction because previous research has found that assimilation to the induction occurs only when the material has been removed from conscious awareness; otherwise, participants may contrast their response to the induction stimuli (Bargh & Chartrand, 2000; Herr, 1986). Ten minutes was chosen because in other studies using similar mood-induction procedures this is the minimum length of time before the induction wears off (e.g., Weisenberg, Raz, & Hener, 1998). The experimental tasks were combined such that trials of each task were presented in a single block of 48 randomly ordered trials (36 for the Eyes task and 12 for the Animals task). Participants first completed a practice item from the Eyes task. Participants were instructed to respond as quickly and as accurately as possible. Accuracy was defined as percent correct (i.e., number of trials in which the participant’s answer matched the standardised correct answer divided by the total number of trials). Reaction time was recorded in milliseconds (ms) with measurement error not exceeding 16 ms. Median reaction time was chosen as the measure of central tendency because individual item reaction times within participants were positively skewed.

Results
Preliminary analyses
In the present sample, we achieved an initial reliability for the Eyes task of $\alpha = .58$. Following standard scale development procedures (see Nunnally, 1978), we omitted items that had deleterious effects on the overall scale reliability. Deletion of eight non-reliable items improved reliability to $\alpha = .63$, which is acceptable for a measure used for experimental purposes (Nunnally, 1978). The analyses below are based on this revised 28-item Eyes task.

Eyes-task accuracy was not significantly correlated with age, BDI-II, or AA scores (all $p$s > .23). However, consistent with our previous report (Harkness et al., 2005), better Eyes-task accuracy was significantly related to higher scores on AD ($r = .21, p < .05$) and GD ($r = .21, p < .05$). Also consistent with previous studies, women outperformed men on the Eyes task, although not significantly ($Ms = .68, .63; SEs = .13, .12$); $t(91) = 1.65, p = .10$. In addition, Eyes-task performance was significantly related to performance on the Animals task ($r = .29, p < .005$).

Consistent with our expectations for a control task, we found no differences in Animals task performance between the past-depressed and never-depressed group ($Ms = .73, .77; SDs = .19, .18$); $F(1, 89) = .93, p = .34, \eta^2 = .01$. Participants performed better on the Animals task as a trend in the sad versus happy mood induction condition ($Ms = .79, .72; SDs = .03, .03$); $F(1, 89) = 2.95, p = .09, \eta^2 = .03$; however, there was no significant interaction of group and

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1 The deleted items included (distracter adjectives in brackets): 3. Desiring (joking, convinced, flustered); 6. Fantasising (aghast, impatient, alarmed); 10. Cautious (insisting, bored, aghast); 21. Fantasising (embarrassed, confused, panicked); 25. Interested (panicked, incredulous, despondent); 29. Reflective (impatient, aghast, irritated); and 31. Confident (joking, dispirited, ashamed). We conducted our primary analysis using the full 36-item Eyes task to determine whether deleting the 8 non-reliable items from the Eyes task had an effect on our results. Fully consistent with the results reported below, the model revealed a main effect of Depression Group, $F(1, 81) = 7.84, p < .01, \eta^2 = .09$, and a three-way interaction of Group, Condition, and Mood Response Index, $F(1, 81) = 6.12, p < .05, \eta^2 = .07$.
condition, \(F(1, 89) = 0.86, \ p = .36, \ \eta^2 = .01\). Animals-task accuracy was also not significantly related to sex, age, BDI-II, AA, AD, or GD scores (all \(p s > .30\)).

Descriptive characteristics of the sample by group and condition are presented in Table 1. The past-depressed group (\(n = 41\)) and never-depressed group (\(n = 52\)) did not differ significantly in terms of sex distribution. However, the past-depressed group was significantly younger than the never-depressed group (\(M_s = 18.60, 19.29; SD_s = 1.22, 1.54\)); \(t(91) = 2.43, \ p < .05\), and scored significantly higher on the BDI-II (\(M_s = 81.23; SD_s = 59.63, 50.25\); \(t(91) = 3.67, \ p < .005\), and GD (\(M_s = 93.76, 81.23; SD_s = 19.79, 21.75\)); \(t(91) = 2.87, \ p < .005\). The average age of onset of first depression in the past-depressed group was 14.70 (range = 9–19; \(SD = 2.40\)), the average number of previous episodes was 2.00 (range = 1–8; \(SD = 1.75\)), and the average time since the offset of the most recent previous episode was 46.66 months (range = 1.36–167.97; \(SD = 35.76\)). None of these variables were significantly correlated with Eyes-task performance (all \(p s > .24\)).

Age, and BDI-II, AA, AD, and GD scores were not differentially distributed across the sad (\(n = 48\)) and happy (\(n = 45\)) mood induction conditions. However, in the sad mood induction condition there was a significantly higher proportion of women in the past-depressed group (19/20 women) than in the never-depressed group (20/28 women); \(\chi^2(1) = 4.26, \ p < .05\).

**Manipulation check**

To assess the success of the mood induction in producing a sad or happy mood state we compared participants’ scores on the DES pre- and post-induction. As expected, paired samples \(t\)-tests revealed that participants in the sad mood induction experienced a significant increase in scores on the two negative items, sad: (\(M_s = 2.04, 4.17; SD_s = 1.22, 1.63\)); \(t(47) = 8.43, \ p < .001\); anxious: (\(M_s = 2.69, 3.15; SD_s = 1.52, 1.70\)); \(t(47) = 2.01, \ p < .05\), and a significant decrease in scores on the two positive items, merry: (\(M_s = 4.67, 2.79; SD_s = 0.95, 1.18\)); \(t(47) = -9.32, \ p < .001\); warm-hearted: (\(M_s = 4.67, 2.88; SD_s = 1.14, 1.06\)); \(t(47) = -8.35, \ p < .001\). In contrast, participants in the happy mood induction experienced a significant increase in scores on the two positive items, merry: (\(M_s = 4.44, 4.96; SD_s = 1.39, 1.64\)); \(t(44) = -4.07, \ p < .001\); warm-hearted: (\(M_s = 4.51, 5.00; SD_s = 1.38, 1.78\)); \(t(44) = -2.58, \ p < .05\), and a significant decrease in scores on the tense/anxious/worried item (\(M_s = 2.09, 1.76; SD_s = 1.18, 0.96\)); \(t(44) = 2.62, \ p < .05\), with no significant change on the sad item (\(p = .90\)).

It is important to note that there were no significant differences between the past-depressed and never-depressed groups in scores on the sad (\(M_s = 3.36, 2.98; SD_s = 1.95, 1.82\)); \(t(91) = 0.98, \ p = .33\), merry (\(M_s = 3.53, 4.13; SD_s = 1.76, 1.78\)); \(t(91) = 1.46, \ p = .15\), or warm-hearted (\(M_s = 3.61, 4.13; SD_s = 1.76, 1.78\)); \(t(91) = 1.40, \ p = .16\), items of the DES following the mood induction, although the tense item approached significance (\(M_s = 2.80, 2.21; SD_s = 1.33, 1.80\)); \(t(91) = 1.86, \ p = .07\). Therefore, there is no evidence to suggest that, as a group, the past-depressed participants were significantly more (or less) dysphoric than the never-depressed individuals in their immediate mood state following the mood induction.

As described above, we created a mood response index based on the DES scores to represent variability in response to the mood induction. Scores on this index ranged from -17 to 1 (\(M = -6.25, SD = 4.54\)) in the sad

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\(^2\) Although no one in our sample met even subthreshold criteria for a current major depressive episode based on the SCID interview, both groups reported surprisingly high symptom scores. To statistically address the possibility that high depression symptom scores may have affected performance on the Eyes task differentially for the past-depressed and never-depressed groups, we re-ran all of our main analyses excluding participants with BDI-II scores above 13 (i.e., the stated cut-off for mild depression severity; Beck et al., 1996). Our results were robust. Results of these analyses are available from the first author on request.
mood induction condition and from −4 to 7 (M = 1.36, SD = 2.36) in the happy mood induction condition. A 2 Group (past-depressed vs. never-depressed) × 2 Condition (sad vs. happy) analysis of variance (ANOVA) on mood response index scores revealed a main effect of Condition, F(1, 89) = 47.15, p < .005, η² = .35. In addition, while the two depression groups did not differ significantly on the mood response index overall, F(1, 89) = 2.67, p = .11, η² = .03, the Group by Condition interaction approached significance, F(1, 89) = 3.72, p = .06, η² = .04. The past-depressed group did not differ from the never-depressed group in response to the happy mood induction (Ms = 1.24, 1.46; SEs = 0.78, 0.73), but showed a more extreme response to the sad mood induction (Ms = 7.80, 5.14; SEs = 0.80, 0.67). Thus, as expected, the past-depressed group showed a more intense response to the sad mood induction than the never-depressed group. This result further highlights the importance of including the mood response index in our full models below to control for this individual variability in response.

Accuracy analyses

A 2 Group (+1 = past depressed, −1 = never depressed) by 2 Condition (+1 = happy, −1 = sad) analysis of covariance (ANCOVA) was conducted with accuracy on the Eyes task as the dependent variable and the centred mood response index, Animals task accuracy, sex, age, and BDI-II scores as covariates. A model was specified that included all of the two- and three-way interactions among Group, Condition, and the Mood Response Index.3

The main effect of depression group was significant, F(1, 81) = 8.97, p < .005, η² = .10. Consistent with predictions, those in the past-depressed group performed significantly better on the Eyes task that those in the never-depressed group (Ms = 0.76, 0.60; SEs = 0.03, 0.03). The main effects of Induction Condition (p = .52, η² = .005) and Mood Response Index (p = .77, η² = .001) did not reach significance, nor did the interactions of Depression Group and Mood Induction Condition (p = .45, η² = .007), Depression Group and Mood Response Index (p = .16, η² = .02), or Condition and Mood Response Index (p = .94, η² < .001).

The three-way interaction of Depression Group, Mood Induction Condition, and Mood Response Index was significant, F(1, 81) = 6.17, p < .05, η² = .07. To interpret the interaction we first examined the simple Mood Induction Condition by Mood Response Index interaction separately in the never-depressed versus past-depressed groups. The interaction approached significance in the never-depressed group, F(1, 48) = 3.26, p = .08, η² = .06, and was significant in the past-depressed group, F(1, 37) = 5.07, p < .05, η² = .12. Simple slopes analyses revealed that among those in the never-depressed group, higher scores on the mood response index were associated with superior performance on the Eyes task at a trend level in response to the happy mood induction, B = 0.02, t(50) = 1.80, p = .08, whereas, again, no relation between mood response index and Eyes-task accuracy was obtained in the sad mood induction (p = .69). In contrast, among those in the past-depressed group, higher scores on the mood response index in response to the happy mood induction were associated with worse performance on the Eyes task, B = −0.02, t(39) = 1.96, p < .05, whereas, again, no relation between mood response index and Eyes-task accuracy was obtained in the sad mood induction.

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3 Eyes-task performance was also significantly related to AD and GD scores, and the depression groups differed significantly on these two symptom scales. However, we were unable to include these scales as covariates in our full model with BDI-II scores because the three symptom scales were highly correlated (all r > .62). Therefore, we ran two additional models, controlling, respectively, for AD and GD scores instead of BDI-II scores. The pattern of obtained results in these two additional models were identical to those in the main text. In the model controlling for AD we obtained a main effect of Depression Group, F(1, 81) = 6.97, p < .01, η² = .08, and a three-way interaction of Group, Condition, and Prime Response Index, F(1, 81) = 6.83, p < .05, η² = .08. Similarly, in the model controlling for GD we obtained a main effect of Depression Group, F(1, 81) = 7.94, p < .01, η² = .09, and a three-way interaction of Group, Condition, and Prime Response Index, F(1, 81) = 6.73, p < .05, η² = .08.
The pattern of means in both the sad and happy mood induction conditions is presented in Figure 2a and 2b.

**Reaction time analyses: Speed/accuracy trade-off?**

The effects reported above suggest that past-depressed participants who responded with a happy mood change in the happy condition showed poorer performance on the Eyes task than the rest of the past-depressed participants. One possible interpretation of this effect is that the past-depressed group was speeding through the task when in a positive mood. We examined this possibility by conducting a 2 Group (+1 = past depressed, −1 = never depressed) by 2 Condition (+1 = happy, −1 = sad) analysis of covariance (ANCOVA) with median reaction time on the Eyes task as the dependent variable and the centred mood response index, median reaction time on the Animals task, sex, age, and BDI-II scores as covariates. While the effects of depression group, condition, and prime response index were not significant in this model, the two-way interaction of Depression Group and Mood Induction Condition was significant, \( F(1, 81) = 7.00, p < .05, \eta^2 = .08 \), as was the two-way interaction of Depression Group and Mood Response Index, \( F(1, 81) = 9.47, p < .005, \eta^2 = .10 \). These were both qualified, however, by a significant three-way interaction of Depression Group, Mood Induction Condition, and Mood Response Index, \( F(1, 81) = 6.81, p < .05, \eta^2 = .08 \). Simple slopes analyses revealed that for the never-depressed group, those with a more positive mood change in response to the happy mood induction showed slower response times, \( B = 273.44, t(48) = 2.16, p < .05 \). However, no significant relation between response to the mood induction and response times on the Eyes task was found in the sad mood induction condition \( (p = .34) \), or among those in the past-depressed group in either the happy \( (p = .26) \) or sad \( (p = .18) \) conditions. This pattern is not consistent with a speed/accuracy trade-off as an explanation for our effects for Eyes accuracy.

Further, when we reanalysed the Eyes-accuracy model above while controlling for response times, the main effect of depression group remained robust, \( F(1, 80) = 9.52, p < .005, \eta^2 = .11 \), as did the three-way interaction of Group, Condition, and Mood Response Index, \( F(1, 80) = 6.81, p < .01, \eta^2 = .08 \).

**DISCUSSION**

This study is the first to demonstrate that individuals with a history of major depression, not currently in episode, show enhanced ToM decoding abilities over those with no depression history. Furthermore, this effect was moderated by participants’ responses to an emotional mood induction. Specifically, for individuals with a history of major depression, accuracy on the Eyes task was poorer in those who responded most positively to a happy mood induction. These effects cannot be better accounted for by a higher level of transient dysphoria in the past-depressed group immediately following the induction. Further, these results were robust when controlling for depression symptom severity, intensity of response to the induction in general, performance on the control task, response latencies, sex, and age.

**History of depression is associated with enhanced mental state decoding**

The results of the present study are consistent with previous work demonstrating enhanced mental state decoding abilities in dysphoria (Harkness et al., 2005). Therefore, these two studies are the first to demonstrate that individuals who are vulnerable to depression, either due to a past history of depression or to the presence of subthreshold symptoms, have enhanced ToM decoding abilities.

These findings contrast, however, with studies showing ToM decoding deficits in acute episodes of major depression (Bora et al., 2005; Kerr et al., 2003; Lee et al., 2005). At present, it is unclear why individuals with major depression would
show a deficit in ToM decoding while in episode, yet show superior performance relative to controls upon remission. Differences in participant characteristics may provide one way to reconcile the findings of these two sets of studies. The participants in the present sample represented a young, non-patient, high functioning group, whereas previous studies of major depression have included older patient samples. Therefore, the first step in future research investigating the

Figure 2. Interaction of Mood Induction Condition and Mood Response Index on Eyes-task accuracy in the (a) past-depressed and (b) never-depressed groups.
relation of ToM decoding to the pathology of depression is to replicate the present study in a more representative sample of patients with remitted major depression. In particular, prospective studies are required that follow individuals with major depression from episode to remission to examine the within-individual changes in ToM decoding abilities.

A possible alternative, mechanistic, explanation of the present findings involves the role of motivation. As Weary and colleagues have noted, individuals who are vulnerable to depression (who may include those with dysphoria as well as clinically depressed individuals whose acute episode has lifted) are especially sensitive processors of social information because of a strong motivation to understand others and regain control over their social world (e.g., Weary & Edwards, 1994). ToM decoding may provide a powerful tool in achieving this goal. In particular, by using the information gleaned at the level of mental state decoding, one gains a powerful framework for both explaining and predicting others’ behaviours (Gopnik & Wellman, 1992). However, social motivation may be eclipsed when in a major depressive episode by the amotivational symptoms of the syndrome. Indeed, we found previously that deficits in ToM decoding in depressed outpatients were preferentially related to severe symptoms of anhedonia and retardation (Lee et al., 2005). As such, individuals in an episode of major depression may have “given up” on trying to understand and/or control their social world.

The present study was not designed to test the role of motivation on Eyes-task performance, and individual differences in anhedonic symptoms may not help in addressing this issue in our relatively asymptomatic groups. Indeed, levels of anhedonic depression symptoms were not significantly correlated with Eyes-task performance in our euthymic past-depressed group ($r = .06, p = .69$), and both AD and GD scores were positively correlated with Eyes-task performance in the never-depressed group. Further, our results were robust when controlling for levels of AD and GD.

Previous studies examining other aspects of social cognition have used motivation instructions to experimentally manipulate level of social motivation (e.g., “People who do well on this task tend to have satisfying interpersonal relationships, whereas people who do poorly tend to end up alone. At the end we’ll let you know how you did relative to others”; e.g., Twenge, Baumeister, DeWall, Ciarocco, & Bartels, 2007). The adoption of such procedures to examine the effect of social motivation on Eyes-task performance may allow a more complete determination of the role of social motivation as a mechanism underlying the dissociation in ToM decoding ability between dysphoric and remitted depressed individuals and patients in an acute episode of major depression.

Nevertheless, it is intriguing to note that converging evidence for a dissociation in social intelligence across the depressive spectrum comes from research on related constructs, such as empathy (Baron-Cohen & Wheelwright, 2004; Eslinger, 1998). Specifically, patients with major depression have consistently scored lower on measures of empathy relative to controls (Berthoz et al., 2000; Donges et al., 2005), whereas in general community samples, higher levels of depressive symptoms (i.e., “dysphoria”) have been significantly correlated with higher levels of empathy (Garnowski & Privette, 1997; Schieman & Turner, 2001).

At first blush, the present results also appear to contrast with the large literature reporting negative biases in information processing in depression. It should be noted that previous studies of mental state decoding using the Eyes task failed to find bias in accuracy across eyes that were categorised as positive, negative, or neutral in valence (Harkness et al., 2005; Lee et al., 2005). In the present study, as well, analyses not reported revealed that our observed effects were robust across eyes of a positive, negative, and neutral valence.4 Biases in information processing in depression have been most robust when investigating individuals’

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4 Results of these analyses are available from the first author on request.
recall of, and selective attention to, negative information (e.g., Bradley et al., 1997; Joormann & Gotlib, 2006, 2007). In the present paradigm, however, mental-state judgements were made on the basis of immediately available information and at no point did participants have to recall or selectively attend to a particular kind of information. Of note, recognition studies of basic facial emotions in depression that also use true recognition paradigms have similarly failed to find evidence for a negative bias in depression (e.g., Frewen & Dozois, 2005; Gaebel & Wolwer, 1992; Gessler, Cutting, Frith, & Weinman, 1989; cf. Kan, Mimura, Kamijima, & Kawamura, 2004). Therefore, while negative bias may play a role in depressed individuals’ social-information processing, it may not characterise depressed and dysphoric individuals’ mental state decoding skills independent of other, potentially higher-order, cognitive processes such as selective attention.

Effect of mood prime intensity on mental state decoding

Previously depressed participants who showed a high level of response to the happy mood induction showed lower levels of performance on the Eyes task than those who did not respond as strongly to the induction. In contrast, neither mood induction had a significant effect on the performance of individuals in the past-depressed group. While this was not the pattern we expected, it nevertheless provides further support for the hypothesis that enhanced ToM decoding abilities are related to the pathology of major depression, and are not simply a marker of a transient mood state. The mechanism driving this effect is unclear at present. Related to the previous discussion, perhaps there is an optimum level of sensitivity to social information that preserves, or at least is associated with, emotional health. As such, never-depressed individuals, and past-depressed individuals in a happier mood state, may attend less sensitively than dysphoric and past-depressed individuals to the social information needed to make subtle mental-state judgements as a “protective” bias that helps maintain their non-depressed state. In other words, making previously depressed participants happier may recall adaptive strategies, perhaps learned during the recovery process, that are consistent with a less-sensitive approach to processing social information (see Gotlib, McLachlan, & Katz, 1988; McCabe & Gotlib, 1995; McCabe, Gotlib, & Martin, 2000, for evidence of other protective cognitive mechanisms in depression). As stated above, more research is required to determine whether the pattern observed in the present study is specific to the present sample of undergraduate students, or whether it characterises the major depressive syndrome in remission more generally.

Inclusion of the mood response index in our models allowed us to show that the greater accuracy of social information processing in the previously depressed group could not be better accounted for by the fact that the previously depressed participants experienced a higher intensity of the transient sad mood change induced by the sad induction condition. Furthermore, despite there being no differences between groups in response to the happy mood induction condition, the intensity of response to this condition still moderated Eyes-task performance preferentially in the previously depressed group. We also observed that some individuals in our sample displayed a paradoxical, non-mood-congruent response, especially in the happy condition. The previously depressed group did not differ from the never-depressed group in the tendency to display a paradoxical response and, thus, our results cannot be explained by individual variability in response across groups in this condition. It is unclear why some individuals showed a paradoxical response, although such contrast effects have been found in mood-induction studies using other types of stimuli (e.g., Herr, 1986). What is most important to note is that our inclusion of the mood response index in our analyses allowed us to see that only those who actually got happier in response to the happy mood induction showed the related difference in their ToM decoding abilities. Therefore, we suggest that the mood response index represents a useful tool that may allow future researchers to achieve a more complete
understanding of cognitive-emotional mechanisms in depression.

Study limitations

Because the present sample comprised undergraduate students, the above results are limited in terms of their generalizability. We did not have an indication of the severity of our participants’ previous episode and, thus, it is possible that our current sample represents a less severely depressed group than the samples of patients with major depression in the existing literature. Furthermore, due to the cross-sectional nature of our design, future prospective studies are required to determine whether enhanced ToM decoding is present as a trait prior to the emergence of depression.

A further limitation of the present study is that we did not collect diagnostic information for disorders other than unipolar major depression. Hence, it is possible that some individuals in both our never-depressed and past-depressed groups may have suffered from conditions that could have affected their performance. Anxiety disorders are the most likely candidates in this relatively high-functioning sample. Self-reported scores on the AA scale of the MASQ did not differ significantly between the never-depressed and past-depressed groups. Furthermore, AA scores were not significantly related to Eyes-task performance. Therefore, it is unlikely that individual differences in anxiety symptoms can account for our findings. Nevertheless, replication of our findings in a more rigorously assessed sample is required.

Consistent with previous research, we found that women were more accurate than men in their mental state judgements, although not significantly so. Our results were robust when controlling for gender. Nevertheless, this does not rule out the possibility that gender may moderate the effect of depression on ToM. Therefore, an intriguing future question that would further clarify the role of ToM in the pathology of depression concerns whether the pattern seen here is expressed more strongly in women versus men.

Finally, our study examined only one aspect of ToM judgement—the decoding of mental states based on eye expressions. Therefore, future research is required to examine the hypotheses of the present study in relation to other aspects of ToM decoding (e.g., tone of voice, body posture) and reasoning (e.g., explaining and predicting others’ mental states; Inoue, Tonooka, Yamada, & Kanba, 2004; Inoue, Yamada, & Kanba, 2006).

CONCLUSIONS

The current findings provide compelling preliminary evidence that enhanced ToM decoding skill may be part of the pathology of depression that can be indexed during non-depressed periods. In particular, previously depressed individuals exhibited significantly enhanced mental state decoding abilities versus individuals with no history of depression. Furthermore, increased positive mood following a happy mood induction in the past-depressed group was related to a less sensitive, and perhaps more adaptive, strategy of attending to social information. Although much further research is required in this area, the present results, along with those of previous studies of clinical samples, suggest such that enhanced ToM relative to non-depressed groups may characterise individuals vulnerable to depression, either due to dysphoria or a past history of major depression, whereas this enhanced skill may be eclipsed when in an acute episode of major depression by the severe amotivational symptoms of the syndrome. This distinction has important implications, and tentatively suggests a dissociation of social intelligence across the depressive spectrum.

REFERENCES

Reduced awareness of others’ emotions in unipolar depressed patients. *Journal of Nervous and Mental Disease*, 193, 331–337.


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manuscript, University of Iowa, Department of Psychology, Iowa City.


