

Research papers

'Don't look at me in that tone of voice!' Disturbances in the perception of emotion in facial expression and vocal intonation by depressed patients

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ABSTRACT

Background Recurrence is common in depression. Moreover, each new depressive episode increases the risk of further recurrence, though the mechanism for this is unknown. In order to examine this effect further, this study investigated the possibility that depressed patients perceive non-verbal signals (facial expression and vocal intonation) of others in a negative light and that this negative bias is more severe in patients who have had previous episodes of depression, thereby worsening patients' sense of rejection, isolation and vulnerability to relapse.

Method Seventy-nine subjects were studied: 22 patients during their first depressive episode (index group); 27 patients who had experienced at least one previous episode (recurrent group); and 30 subjects with no previous psychiatric history (control group). Outcome measures were: indices of depression (British Depression Index (BDI)) and anxiety (British Anxiety Index (BAI)); subjects' ratings of intensity of positive and negative emotion perceived in ambiguous, schematic (line-drawing) faces; subjects' ability to categorise the emotional (prosodic) tone of voice used by an actress in a series of recorded vocal trials. Patients were tested at presentation to their general practitioner and again after about six weeks' antidepressant treatment.

Results Compared with controls, patients with major depression generally perceived less positive facial emotion (controls: 17% (8-26%) maximum intensity; patients: 8% (4-16%) maximum intensity (median (interquartile range (IQR)), $P = 0.001$) and saw more negative facial emotion (controls: 20% (13-26%) maximum intensity; patients: 28% (23-36%) maximum intensity, $P = 0.001$). They also categorised more vocal trials with a negative emotional bias (controls: 3% (2-7%) trials; patients: 9% (3-16%)

trials, $P = 0.002$), and made more erroneous categorisations of vocal prosody than controls (controls: 12% (9-21%) trials; patients: 18% (14-29) trials, $P = 0.003$). Compared with the index group, the recurrent group perceived significantly less positive emotion in the faces (index: 12% (7-17%) maximum intensity; recurrent: 4% (0-12%) maximum, $P = 0.010$). Recurrent cases also categorised significantly more vocal trials with a negative emotional bias (index: 6% (3-12%) trials; recurrent: 15% (6-18%) trials, $P = 0.040$). After six weeks' treatment with antidepressant there was a generalised improvement in the perceptual disturbances of the cases taken as a whole. There was now no significant difference between index and recurrent groups in any of the outcome measures.

Conclusions The results suggest that depressed patients have negative biases in their perceptions of non-verbal signals (facial expression and vocal tone). These disturbances were particularly severe in those who had experienced one or more previous depressive episodes, and could contribute to the increased vulnerability to recurrence in patients with a history of depression. The improvement in perceptual disturbances which was observed in all the patients after treatment suggests that these negative cognitive biases are not enduring, trait-like qualities, but probably secondary to depressed mood. These findings may find application in the cognitive therapy of depression whereby patients could learn to recognise their faulty perceptions of non-verbal social cues and modify their behaviour accordingly.

Keywords: cognitive behavioural therapy, emotion, facial expression, perception, recurrent depression, vocal intonation

Introduction

Recurrence is a common feature of depression and has been reported to occur in 50–85% of those patients seeking treatment.¹ Moreover, there is evidence that each new episode of depression is associated with a greater risk of future recurrence and an increased risk of development of chronic illness.² The mechanism whereby patients who experience more than one episode of depressive symptoms become more vulnerable to recurrence is not well understood. Therefore in the present study we sought to examine the possibility that cognitive disturbances might occur in the illness and that the severity of these might increase with subsequent depressive episodes.

According to cognitive theory, depressed patients have mood-congruent biases in their perceptions which cause them to view social signals from others in a negative light.³ It has been suggested that these negative perceptual biases may cause the depressed person to misinterpret social cues of others as being rejecting, thereby increasing the patient's sense of isolation and exacerbating and perpetuating depressed mood.⁴ In the present study we have tested the hypothesis that depressed patients exhibit distortions in their perception of the social cues of others and that these are particularly severe in those with a previous depressive history. Since facial expression and vocal intonation are important non-verbal means of interpersonal social signalling, we studied the perception of facial and vocal emotion in patients with recurrent depression, comparing them with those of patients suffering their first (index) episode and with controls.

Methods

Participants

The study was conducted in a six-partner practice, list size of about 10 000, located in a North Hertfordshire market town. Patient recruitment was during an 18-month period in 2001–2002. All the 49 patients (24 male) studied met the DSM IV criteria for major depression.⁵ Those with a history of drug and alcohol abuse were excluded from study, as were those with suicidal intent. Patients with co-existing generalised anxiety disorder were not excluded, in order also to study the effect anxiety might have on patients' perceptions. Patients were recruited randomly at presentation to their general practitioner (GP) and were studied before treatment

began and again at about six weeks (mean six weeks, range 5–8 weeks) into treatment. The treatment consisted of antidepressants \pm counselling, according to the clinical judgement of the patient's own GP. At each test patients completed standard instruments to measure depression (the British Depression Index (BDI)) and anxiety (the British Anxiety Index (BAI)).⁶ Thirty control subjects (13 male) with no psychiatric history were also tested.

Assessment of facial perception

Subjects' perception of facial emotion was assessed using the method described by Bouhuys *et al.*⁷ Three ambiguous, schematic (line-drawing) faces were used whose expressions have been shown to convey, in control subjects, equal amounts of positive and negative emotion.⁷ Subjects judged each face with respect to the primary emotions: fear, happiness, anger, sadness and disgust. Two other categories were included to describe more relational (i.e. self-referent) emotions: rejection and invitation. Subjects were instructed to judge how strongly each facial expression displayed each of the emotional categories at first glance. Using a five-point scale: 0% (not at all), 25% (a little), 50% (moderately), 75% (very much), 100% (very much indeed), they rated the intensity with which they perceived each of the emotions in each of the three faces.

Identification of vocal emotional intonation

The ability of subjects to identify emotional (prosodic) tone in the voice was assessed using the method of Bowers *et al.*⁸ A stimulus audiotape was made consisting of 32 simple declarative sentences recorded by an actress in a happy, sad, angry and neutral tone. The semantic content of the base sentences differed: two conveyed happy messages, two sad, two angry and two neutral messages. On 16 of the 32 trials, the emotional prosody of the sentences was congruent with the emotional message conveyed by its semantic content (e.g. 'the old man held his dying son' stated in a sad tone). In the remaining 16 trials the emotional prosody was incongruent with the emotional message conveyed by its semantic content (e.g. 'the old man held his dying son' stated in a happy tone). The inclusion, within the test, of trials in which there is conflict between the affective tone of the stimulus and its semantic content makes the task of emotional tone identification more difficult and thus increases the sensitivity of the test.⁸ The order of the congruent

and incongruent trials was randomised on the tape, with 10-second inter-trial intervals. The stimulus tape was played on a Panasonic Stereo recorder and binaurally delivered via stereo headphones.

Subjects were asked to listen to each sentence, decide whether the speaker sounded happy, sad, angry, or neutral (indifferent) for each trial, and then during the inter-trial interval indicate their choice on a response card. Subjects were instructed to disregard 'what' the speaker said and to make their decision only on 'how' the sentences were said.

Ethical approval

The study received prior approval by the local regional ethics committee, and each subject gave informed consent before entering it.

Analysis

Patients were subdivided into index and recurrent groups according to whether or not they had documented one or more previous episodes of major depression.

Perception of facial emotion

Happiness and invitation were considered as positive emotions and fear, sadness, anger, disgust and rejection as negative emotions.⁷ Ratings of perceived intensity for the five negative emotions were taken together and averaged over the three faces. The same was done for the two positive emotions. The outcomes thus obtained were skewed so the data are summarised as median (interquartile range (IQR)) of the continuous variable, perceived intensity.

Identification of emotional intonation

Subjects categorised the emotional tone of each trial as happy, angry, neutral or sad. Happy was considered a positive emotional category; angry and sad were considered as negative emotional categories. For analysis, any true-neutral tone mistakenly identified as happy, or any true-angry or sad tone mistakenly identified as neutral or happy was recorded as a categorisation with positively biased emotion. Similarly, any true-neutral tone mistakenly identified as sad or angry, or any true-happy trial mistakenly identified as neutral or sad or angry was recorded as a categorisation with negatively biased emotion. The number of categorisations with positively biased emotion over each of the 32 trials was expressed as a percentage; the same was done for the categorisations with negatively biased emotion. The percentage of erroneous categorisations was calculated as the sum of all the incorrect categorisations made, including those of the same valence (i.e. angry mistaken for sad) expressed as a percentage of the 32 trials. The outcomes thus obtained were skewed, so the data are summarised as median (IQR).

Between-group comparisons were made using the Mann-Whitney test. Pre- and post-treatment outcomes were compared using Wilcoxon signed ranks test. A *P*-value of <0.05 was considered to be statistically significant.

Results

Baseline measures

Table 1 summarises some of the details of the participants. Thirty control subjects (mean age 31.8 ± 10.18 (standard deviation (SD)) years; 13 male) were assessed on all outcomes. Initial assessment

Table 1 Details of participants

	Controls	All cases	Index cases	Recurrent cases
Number studied	30 (13 male)	49 (24 male)	22 (11 male)	27 (13 male)
Age (mean ± SD, years)	31.8 ± 10.18	37.3 ± 12.1	37.7 ± 13.15	36.9 ± 11.2
Antidepressant treatment				
SSRI (%)		74	72	76
Tricyclic (%)		26	28	24

SSRI: Selective serotonin re-uptake inhibitor

Table 2 Baseline outcomes for controls and cases (index and recurrent)

	Outcome (median (IQR))				<i>P</i> -value controls vs. cases	<i>P</i> -value index vs. recurrent
	Controls (<i>n</i> = 30)	Cases (<i>n</i> = 49)	Index cases (<i>n</i> = 22)	Recurrent cases (<i>n</i> = 27)		
BDI	5 (2,8)	28 (22,37)	25 (22,35)	29 (24,37)	0.001	0.295
BAI	4 (2,7)	22 (16,29)	22 (16,28)	22 (16,30)	0.001	0.968
Facial perception						
Positive (% maximum)	17 (8,26)	8 (4,16)	12 (7,17)	4 (0,12)	0.001	0.010
Negative (% maximum)	20 (13,26)	28 (23,36)	26 (22,32)	32 (25,38)	0.001	0.052
Vocal emotion categorisation						
percentage with positive bias	6 (3,12)	9 (6,15)	11 (5,15)	9 (6,15)	0.381	0.959
percentage with negative bias	3 (2,7)	9 (3,16)	6 (3,12)	15 (6,18)	0.002	0.040
percentage erroneous	12 (9,21)	18 (14,29)	18 (12,21)	21 (15,33)	0.003	0.225

was made on 22 patients (mean age 37.7 ± 13.15 (SD) years; 11 male) presenting with depression for the first time (index cases) and 27 patients (mean age 36.9 ± 11.2 (SD) years; 13 male) who presented with a recurrent episode. There was no significant difference between the ages of the index and recurrent cases ($P > 0.05$) but the control subjects were significantly younger than the patients ($P < 0.01$).

Table 2 summarises the baseline scores for all the groups. Perceptions of emotion in facial expression are percentages of a possible maximum intensity rating (100% = 'very much indeed') and are the average responses over the three faces for the positive (happiness and invitation) and negative (fear, anger, sadness, disgust, surprise, and rejection) expressions. Identification of emotion in vocal tone is shown as the percentage of the trials categorised with a positive emotional bias (sad/angry or neutral emotion mistaken for neutral or happy) and with a negative emotional bias (happy or neutral emotion mistaken for neutral or sad/angry). The total of all the erroneous categorisations of vocal emotion are expressed as a percentage of the 32 trials. Figures 1 and 2 show baseline perceptions of facial emotion and identification of vocal prosodic tone graphically.

Measures of depression and anxiety

As shown in Table 2, the BDIs and BAIs of the cases were significantly higher than those of controls (both $P = 0.001$). However, there was no significant difference in BDIs or BAIs between index and recurrent cases ($P = 0.295$ and $P = 0.968$, respectively).

Intensity of perceived emotion (%max)

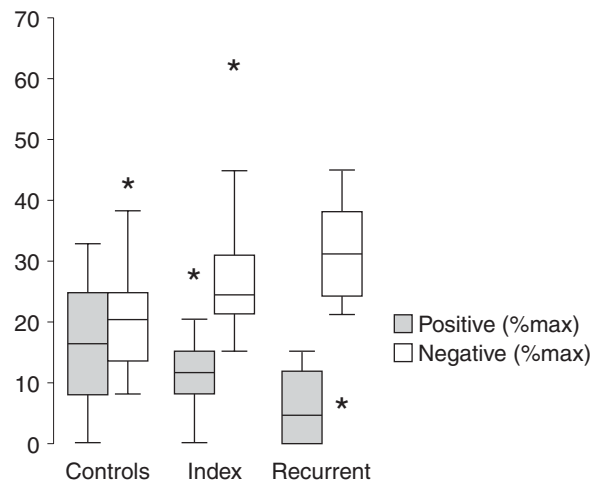


Figure 1 Baseline perceptions of facial emotions. Median (IQR) of continuous variable, intensity of perceived emotion.

*outlier, below the 2.5% or above 97.5 percentiles

Perception of facial emotion

In general, the cases perceived significantly less positive emotion in the facial expressions than controls ($P = 0.001$) and significantly more negative emotion ($P = 0.001$, Figure 1). Significantly, the recurrent cases perceived less positive facial emotion than the index cases ($P = 0.01$). They also saw more negative facial emotion than the index cases but this just failed to reach statistical significance ($P = 0.052$).

Frequency of categorisations with mistaken emotion (%)

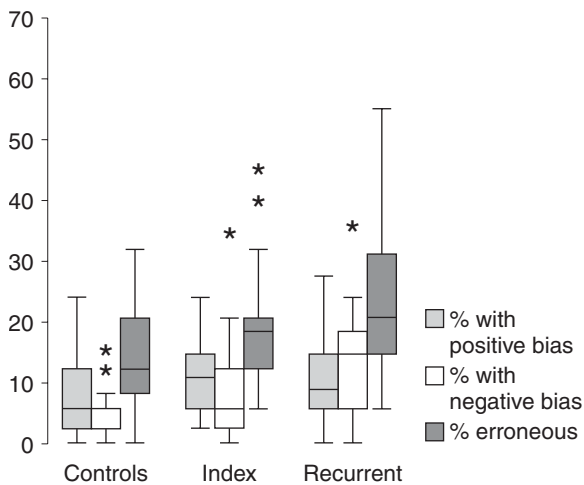


Figure 2 Baseline identification of vocal emotion. Median (IQR) of continuous variable, frequency of categorisations.

*outlier, below the 2.5 or above 97.5 percentiles

Identification of vocal emotion

In general, the cases categorised significantly more of the vocal trials with a negative emotional bias compared with the controls ($P = 0.002$). They also made significantly more errors than controls in identifying vocal emotional tone ($P = 0.003$, Table 2 and Figure 2). Significantly, the recurrent cases categorised more of the vocal trials with a negative emotional bias compared with the index cases ($P = 0.040$). However, there were no differences between recurrent and index groups in the percentage of trials categorised with a positive emotional bias or in the relative number of errors

made in identifying vocal emotional tone ($P = 0.959$ and $P = 0.225$, respectively, Table 2 and Figure 2).

Post-treatment outcomes

Seven patients (five male) withdrew from the study, so post-treatment outcomes were obtained from 42 (86%) of 49 cases. Three of those lost to follow up were index cases. The data are summarised in Table 3.

Measures of depression and anxiety

In both recurrent and index groups, the BDI and BAI were significantly reduced after treatment (both $P < 0.001$); there was again no significant difference between the groups in either of these explanatory variables ($P = 0.586$ and $P = 0.518$, respectively).

Facial perception and identification of vocal prosody

Following treatment there was a global improvement in the perceptual disturbances of the depressed cases taken as a whole. However, these changes only reached statistical significance in the fall in negative facial emotion perceived by the index group and in the reduction in the percentage of vocal trials which the recurrent group categorised with a negative bias ($P = 0.053$ and $P = 0.041$, respectively). There was no significant difference between recurrent and index cases in any of the outcome measures post-treatment.

Table 3 Post-treatment outcomes for index and recurrent cases

	Outcome (median (IQR))		
	Index cases ($n = 19$)	Recurrent cases ($n = 23$)	P -value index vs. recurrent
BDI	11 (9,16)	12 (6,14)	0.586
BAI	8 (6,13)	11 (5,14)	0.518
Facial perception			
Positive (% maximum)	12 (8,21)	12 (0,16)	0.056
Negative (% maximum)	23 (18,27)	28 (18,35)	0.144
Vocal emotion categorisation			
percentage with positive bias	12 (7,5)	9 (6,15)	0.474
percentage with negative bias	3 (3,6)	6 (0,9)	0.479
percentage erroneous	15 (9,24)	15 (9,27)	0.780

Discussion

Facial perception

We chose faces with ambiguous expressions of emotion as the instrument for assessing facial perception because ambiguous situations are supposed to be of paramount significance in cognitive theories of depression.⁹

Patients presenting with symptoms of major depression were found to show evidence of an abnormal negative bias in their perception of facial emotion since they perceived less positive and more negative emotional intensity than controls. Although the patients were significantly older than the control subjects (see Table 1), it seems unlikely that their perceptual disturbances were merely related to age since no significant correlation was detected between these variables within the control subjects themselves.

Our findings are in accordance with evidence from other studies suggesting that there is a disturbance of the processing of emotional information in depressive illness.¹⁰ Thus, a number of authors have studied the ability of depressed patients to discriminate facial affects using tests of recognition of 'standard' facial emotions. Some of these have reported a generalised impairment in the ability of depressed patients to discriminate facial emotion, such that the impaired recognition was not specific to particular affects.¹¹⁻¹³ Others however, have reported a negative bias in patients' performance of happy-sad discrimination tasks. Thus, Gur *et al* found that depressed patients misinterpreted neutral faces as sad, and happy faces as neutral, in accordance with the negative bias in perception of facial emotion reported in the present study.¹⁴

Vocal intonation

We found that patients presenting with depression exhibited an abnormal tendency to categorise vocal trials with a negative emotional bias. Since the cognitive process of categorisation is dependent on the initial stage of perception, our findings suggest that an abnormal negative bias in the perception of vocal emotional prosody also exists in patients with depressive illness. Our findings concur with those of Emerson *et al* who investigated the perception of affective prosody by acutely depressed boys, using the same methodology as that used in the present study.¹⁵ A general impairment was found in the ability of the cases to identify vocal emotion, but this was less marked in their discrimination of sad emotion. Thus, the children with depression were more

accurate in identifying vocal emotion which was congruent with their dysphoric state, suggestive of a negative bias in their perception of affective prosody.

Functional implications

One consequence of the perceptual disturbances reported here might be that depressed patients view social signals from others in an abnormally negative light and misinterpret such cues as being of a rejecting nature. This might lead to withdrawal from social interaction, further compounding the sense of isolation and exacerbating depressed mood. This suggestion is consistent with, and helps to rationalise the findings from another study which showed that depressed subjects reacted with more escape and avoidance and increased negative affect to daily encounters than did non-depressed control subjects.¹⁶ Such maladaptive responses may be the result of faulty appraisals of the meaning of facial and vocal expressions of others. One practical application of these results might be in the cognitive therapy of depressive illness where emphasis should be placed on encouraging patients to recognise their faulty perceptual biases and then to attempt to compensate for them in their behaviour. This approach might improve depressed individuals' social skills and allow them to feel more comfortable when interacting with others.

In addition, our findings may be relevant to the clinical practice of some GPs, specifically in their ability to recognise emotional distress in the non-verbal signals of patients. An excess prevalence of low mood and depression has been reported in GPs, and the presence of negative perceptual biases in those thus affected might lead them to misdiagnose some patients as suffering from a depressive illness.¹⁷ Any future investigation of the factors that may influence the ability of GPs to detect emotional distress and affective disorders should, we suggest, therefore include some measure of the doctor's own affective state.

Comparison of outcomes: index vs. recurrent groups

Patients with a previous depressive history reported seeing significantly less happiness and invitation in facial expressions, and hearing more anger and sadness in vocal tone than those with no previous history of depression (see Figures 1 and 2). These differences in perceptions between the recurrent and index cases cannot be attributed to greater severity of depression and/or anxiety in the recurrent cases, since baseline values for BDI and BAI were

similar in the two groups (see Table 2). Following treatment, depression and anxiety scores of the patients tended towards those of controls and there was a global improvement in the patients' abnormal perceptions. Moreover, no differences in the cognitions of the two patient groups were now apparent (see Table 3). These results support the notion that the negative perceptual biases of depressed patients are not enduring, trait-like qualities but temporary states which revert towards normal with improvement in patients' mood.¹⁸ In studies on healthy individuals, induction of low mood has been shown to be associated with the presence of negative biases in perception of facial emotion.⁶ Taken together these observations suggest a cognitive model to account for the vulnerability of patients with previous depressive histories to recurrence. It is proposed that the onset of dysphoric mood in patients activates negative perceptual biases, and that these are excessive in those who have experienced previous bouts of depression. A possible practical application of this model might be to enable the GP to predict, at the time of initial presentation, those patients most at risk of future recurrence of depression. Thus, those found to display the severest negative perceptual distortions at presentation may be those most at risk of recurrence and merit regular monitoring after remission.

Post-treatment changes in outcomes

Comparison of Tables 2 and 3 shows that BDI and BAI scores fell for both index and recurrent groups of patients post-treatment, but scores of perception of facial expression and vocal tone did not change to a similar extent in the direction of those of the controls. This suggests that improvement in patients' perceptual disturbances with treatment may have lagged behind those of mood. One practical application of this observation may be in the clinical judgement of when to discontinue a course of treatment. Thus, it is recognised that in order to reduce the risk of early relapse, antidepressant treatment should be continued until, as near as possible, there is complete symptom resolution.¹⁹ Monitoring patients' perceptual biases, as described in the present study, might provide a more sensitive index of symptom resolution than those used currently, and serve to usefully indicate when treatment could be discontinued.

Limitations of the study

Several limitations of this study require mention. Thus, the size of the study was modest and based

on patients from a single practice in a North Hertfordshire market town. There was an imbalance of ages between the control subjects and the patients, the former being significantly younger. However, age is unlikely to account for the perceptual disturbances observed, since no correlation was detected between these variables within the control group. Although we did not control for treatment conditions, nevertheless we did not find indications that differences in medication can explain our results. However, one important limitation was in the treatment interval of six weeks allowed before outcomes were measured. At that time the BDI and BAI values were still significantly above those of controls (see Table 3). Thus, it is impossible to know with certainty whether the perceptual disturbances observed would have eventually reverted to normal. This question could only have been resolved by extending the duration of the study and continuing to monitor the outcome measures. Finally, only by following our patients indefinitely beyond remission and retesting those who suffer recurrences, would it have been possible for us to obtain more conclusive support for our suggestion that the negative perceptual biases become more severe with succeeding episodes of depression.

Conclusion

In conclusion, the data we present indicate the presence of negative perceptual biases in patients with major depression, which are more severe in those with a history of previous depressive episodes. These findings may be relevant in explaining patients' increased vulnerability to recurrence with each successive depressive episode.

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CONFLICTS OF INTEREST

None.

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