



Facial perception bias in patients with major depression

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ABSTRACT

This study used a morphed categorical perception facial expression task to evaluate whether patients with depression demonstrated deficits in distinguishing boundaries between emotions. Forty-one patients with depression and 41 healthy controls took part in this study. They were administered a standardized set of morphed photographs of facial expressions with varying emotional intensities between 0% and 100% of the emotion, in 10% increments to provide a range of intensities from pleasant (e.g. happy to sad, happy to angry) and approach-avoidance (e.g. angry to fearful). Compared with healthy controls, the patients with depression demonstrated a rapid perception of sad expressions in happy–sad emotional continuum and demonstrated a rapid perception of angry expressions in angry–fearful emotional continuum. In addition, when facial expressions shifted from happy to angry, the depressed patients had a clear demarcation for the happy–angry continuum. Depressed patients had a perceptual bias towards unpleasant versus pleasant expressions and the hypersensitivity to angry facial signals might influence the interaction behaviors between depressed patients and others.

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1. Introduction

Results from a growing number of studies suggest that patients with depression exhibit deficits in labeling and recognizing facial expressions (Gur et al., 1992; Persad and Polivy, 1993; Bouhuys et al., 1999). The difficulties in recognizing facial expressions have been present in children at risk for major depression (Joormann et al., 2009), and still persist even after individuals have recovered from a depressive episode (Leppanen et al., 2004; LeMoult et al., 2009). Importantly, these deficits may lead to decreased social support and are associated with subsequent relapse into depression (Bouhuys et al., 1999). These findings suggest that the bias of emotional recognition plays a significant role in depression development and persistence.

An increased tendency to perceive negative emotional states in others has been reported in depression (Hale, 1998; Milders et al., 2010). Patients with depression were more likely than controls to incorrectly attribute ambiguous faces as negative (Bouhuys et al., 1999), and misinterpreted neutral faces as sad and happy faces as neutral (Gur et al., 1992). Other investigators demonstrated there was a specific impairment in the recognition of positive facial expressions for patients with depression (Suslow et al., 2001; Surguladze et al., 2004). In all, the aforementioned studies suggest there is an

increased vigilance and selective attention towards negative expressions and away from positive expressions in patients with depression.

Most recently, the study of emotional processing in depression has been extended from a simple paradigm of recognition of schematic faces (e.g., (Hale, 1998)) or facial expressions at full intensity (Ridout et al., 2003) to a paradigm of identifying subtle emotional expressions (Surguladze et al., 2004; Joormann and Gotlib, 2006; Joormann et al., 2009; Yoon et al., 2009). This is a more ecologically valid way to examine subtle emotional facial expression processing because people usually process emotional signals that are far less intense than the prototypical facial expressions in standardized picture sets in everyday life. Empirical studies have demonstrated that patients with depression tended to have difficulty in identifying subtle expression of happiness (Surguladze et al., 2004; Joormann and Gotlib, 2006). However, this bias in the processing of positive affect was not found in individuals at high risk for depression (Joormann et al., 2009). Therefore, it is still not clear whether there is a general domain of deficit or emotion-expression specific deficit in facial processing in patients with major depression.

Recently, Kee et al. (2006) developed an alternative categorical perception paradigm which was used to specifically distinguish boundaries between emotions. Unlike those conventional paradigms focusing on the accuracy of recognizing facial expression, this task examines the function in the categorizations of ambiguous stimuli from one emotional category to another. Thus, it provides a pathway to directly address the question of whether patients with depression

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demonstrate a bias for seeking certain emotions more than others. Moreover, this paradigm has been proved to be helpful in clarifying the nature and boundaries of affect perception deficits in schizophrenia (Kee et al., 2006; Huang et al., 2011) and children with histories of severe physical abuse (Pollak and Kistler, 2002).

The purpose of this study was to examine the facial perception in patients with major depression by using the categorical perception paradigm. It was hypothesized that patients with depression would demonstrate typical patterns of categorical perception of facial expressions, for example, clearer discrimination or more ambiguous demarcation in these emotional expressions. Moreover, it was hypothesized that patients with depression would demonstrate a bias toward specific emotions, i.e., a shift in category boundaries towards unpleasant versus pleasant expressions compared to controls.

2. Method

2.1. Participants

Forty-one patients with major depression were recruited to this study. The Structured Clinical Interview for DSM-IV (American Psychiatric Association, 1994) was conducted by an experienced psychiatrist in the local psychiatric hospital to make the clinical diagnoses. Patients with any other concurrent Axis I disorders and current or past psychotic features were excluded from this study. In this sample, 28 patients received antidepressant medications, including selective serotonin re-uptake inhibitors (SSRIs), tricyclic antidepressants, serotonin-noradrenaline re-uptake inhibitors (SNRIs) and other antipsychotic medications.

Forty-one participants without psychiatric or neurologic disorders were recruited from the local community as healthy controls. They were matched to the patient group in terms of gender, age and education level.

The study was approved by the ethics committees of the research institutes involved and informed consent was obtained from all of the participants.

2.2. Morphed emotional stimuli

The facial emotional images were created from a set of black and white photographs of Asian people, developed by Ekman and Friesen (Ekman and Friesen, 1976), which depict differing expressions including happy, sad, fearful and angry. The prototype photographs were morphed to create a linear continuum of 11 facial images between two endpoints (e.g. 100% happy and 100% angry) for three emotional continua (happy to sad, happy to angry, and angry to fearful). Each intermediate image was transformed by a 10% increment. The three emotional continua were chosen because they represented two of the basic emotional dimensions: pleasant-unpleasant (e.g. happy to sad, happy to angry) and avoidance-approach (e.g. angry to fearful). And these emotions might signal potentially social approval and disapproval (e.g., happy to angry).

The morphed emotional stimuli are the same as in a prior study (Huang et al., 2011) and details of the morphing procedure are described elsewhere (Pollak and Kistler, 2002). A linear continuum of facial expressions between the prototypes of 100% happy to 100% angry, 100% happy to 100% sad, 100% angry to 100% fearful were created. The middle faces are ambiguous images that combine features of both ends of the continuum in half signal strength.

2.3. Morphed emotion categorization task

In the task, a facial image was presented in the middle of the screen with two different labels of emotion appearing beneath the image. The participants were required to judge as quickly as possible which one emotion best described the facial expression by pressing 'f' button for the left label and 'j' button for the right label. There were 33 facial stimuli (11 images within each of the 3 continua with 1 poser) that appeared as targets, each presented 8 times in random order, yielding a total of 264 trials. The task lasted about 20 min. For each continuum, the dependent variable was the proportion of correct identifications at each of signal strength from one prototypical facial emotion to the other (signal strengths 1–11). The proportion of correct responses was expected to approach 100% near the two endpoints (e.g., 100% angry and 100% fearful) and 50% of strength along the continuum where the facial expressions "switch" from one category to the other.

2.4. Data analysis

We used the logistic ($y = a + b / (1 + e^{-[(x-c)/d]})$) to fit the emotion categorization data (Pollak and Kistler, 2002). In this equation, y = probability of identification, x = signal strength, a = lower asymptote, b = difference between upper and lower asymptotes, c = signal threshold at midpoint, d = slope, and e = exponential function. The "shift point" (c , signal threshold at midpoint) and the slope (d) was the parameter to characterize the emotion perception performance in the analysis. The "shift point" is the point in the signal strength continuum at which the most likely choice of emotion shifts from one emotional pole to the other. The response slope indicates how rapidly

this change happens. A greater response slope indicates the clearer demarcation and the greater sensitivity towards the increasing intensity of facial expressions, and a higher categorization threshold (shift point) indicates the 'late' perception of the increasing intensity of facial expression in the emotion continuum.

The data were analyzed using the procedure described elsewhere (Pollak and Kistler, 2002). In brief, a separate logistic function model for each individual participant was used, which derived estimates of category shift points and slopes for each individual in each emotion continuum. Because these logistic functions produced parameter values of 14 patients and 4 controls that fell outside the range of possible scores, these data were excluded. Data from 27 patients and 37 controls were utilized for analyses. There were no significant differences between the retained patients and the excluded patients on clinical information. Demographic, emotional and clinical information of the patients with depression and healthy controls are presented in Table 1. They were matched in terms of gender, age and education level.

Analyses of variance (ANOVAs) with Emotion Continuum (angry-fearful, happy-angry, happy-sad) as repeated measures and Group (depressed group, healthy controls) as the between-subject factor were performed for the category shift points and slopes. The Greenhouse-Geisser correction was used for the ANOVAs where applicable and post hoc least significant difference (LSD) tests were performed in cases of significant ANOVA effects.

3. Results

Table 2 shows the means and standard deviations of category shift points and slopes for the two groups. For the category shift point, ANOVA analyses showed that the main effect of Continuum was significant ($F(2,124) = 123.399, p < 0.001$, partial $\eta^2 = 0.667$), with a higher shift point in the happy-sad continuum (7.56 ± 0.11) compared with the happy-angry (6.55 ± 0.07) and the angry-fearful (5.16 ± 0.16) continua and a higher shift point in the happy-angry continuum compared with the angry-fearful continuum (all p 's < 0.001). Further, the interaction effect of Continuum \times Group ($F(2,124) = 10.519, p = 0.001$, partial $\eta^2 = 0.145$) was significant, with a higher shift point in the angry-fearful continuum and a lower shift point in the happy-sad continuum for the clinical patients (angry-fearful: 5.56 ± 0.99 ; happy-sad: 7.27 ± 0.71) compared with the healthy controls (angry-fearful: 4.75 ± 1.43 ; happy-sad: 7.84 ± 0.90) (all p 's < 0.014).

For the response slope, the main effect of Continuum was significant ($F(2,124) = 52.711, p < 0.001$, partial $\eta^2 = 0.46$), with a greater response slope in the happy-angry continuum (-0.45 ± 0.04) compared with the happy-sad (-0.58 ± 0.03) and angry-fearful (-1.12 ± 0.08) continua and a greater response slope in the happy-sad continuum compared with the angry-fearful continuum (all p 's < 0.01). In addition, the interaction effect of Continuum \times Group ($F(2,124) = 6.359, p = 0.005$, partial $\eta^2 = 0.095$) was significant, with a greater response slope in the happy-angry continuum for the clinical patients (-0.21 ± 0.22) compared with the healthy controls (-0.68 ± 0.39) ($p < 0.001$).

Table 1

Demographic and clinical descriptions for patients with depression and healthy controls.

	Patients with depression ($N = 27$)	Healthy controls ($N = 37$)	Statistics
Demographic characteristics			
Gender (M/F)	11/16	13/24	$X = 0.21, p > 0.05$
Age (years)	28.51 ± 8.88	27.89 ± 6.90	$t(62) = 0.32, p = 0.75$
Education (years)	13.29 ± 3.02	14.18 ± 3.34	$t(62) = -1.08, p = 0.28$
Estimated I.Q. (WASI)	107.22 ± 15.37	104.35 ± 14.23	$t(62) = 0.77, p = 0.44$
BDI (0–63)	18.93 ± 11.23	3.97 ± 3.12	$t(62) = 7.72, p < 0.001$
Clinical characteristics			
Duration of illness (years)	2.89 ± 4.18		
Cumulative episodes treated (months)	7.90 ± 11.42		
HDRS-baseline(0–64)	16.33 ± 11.14		

Data are presented as n or mean \pm SD.

BDI: Beck Depression Inventory; HDRS: Hamilton Depression Rating Scale. WASI, Wechsler Abbreviated Scale of Intelligence.

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