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Negative interpretation of social cue in depression: Evidence from reading mind from eyes test

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ABSTRACT

Background and purpose: A growing number of studies suggest that patients with depression exhibit tendency to interpret ambiguous stimuli in a relatively negative manner. The purpose of the present study is to develop a practical interpretation bias measure relevant to depression using the mental states behind the facial expressions.
Materials and method: In the present cross-sectional study, 45 patients with major depression were compared with 50 healthy subjects. A modified version of reading the mind in the eyes test (RMET) with a new scoring system was used for evaluation. Independent *t*-test and Multi-Factor ANOVA were used for analysis
Results: Findings showed that individuals with major depressive disorder have generally lower performance in the mind reading ($p < 0.001$). Furthermore, they scored lower in reading the positive mind ($p < 0.001$) and the neutral mind ($p < 0.001$), while obtained higher scores in reading the negative mind ($p < 0.05$). Interpretation scores revealed that individuals with depression interpreted minds more negatively than it seems ($p < 0.001$).
Conclusion: As individuals with depression tend to interpret mental states of others worse than they really are, reading the mind in the eyes test is potentially useful to assess the interpretation bias associated with depression.

1. Introduction

Interpretation is defined as the cognitive process of assigning meaning to a situation or stimulus whose valence is unclear (Huppert, Pasupuleti, Foa, & Mathews, 2007). Biased information processing has been considered as a neuropsychological indicator of a negative mood, and has been contributed to the formation of depression and anxiety disorders (Mathews & MacLeod, 2005). A negative interpretation bias refers to the attribution of a negative rather a positive meaning to an ambiguous situation (Berna, Lang, Goodwin, & Holmes, 2011). Studies have shown the association of negative interpretation biases with clinical depression and depressed mood (dysphoria) (Rude, Valdez, Odom, & Ebrahimi, 2003) and reducing it is a main goal of cognitive behavioral therapy (CBT) for depression (Hollon et al. 2005; MacLeod, Koster, & Fox, 2009).

Depression is developed and maintained by negative interpretations through several mechanisms, including support of negative self-beliefs and support of negative memory biases (Hertel, Brozovich, Joormann, & Gotlib, 2008). Furthermore, the attentional bias to negative stimuli in depressed patients provides a sufficient information flow for negative interpretation (White et al., 2011).

Measuring of the interpretation bias is an interesting issue in mood studies and few methods are invented for this purpose. The measures include a physiological test, measuring the magnitude of the human blink reflex which is augmented when elicited during negative rather than neutral imagery. It has been shown that the blink reflex is sensitive to the emotional valence of imagery evoked by interpretations imposed on ambiguous stimuli. Using this method demonstrated that depression is associated with a negative interpretive bias (Lawson, MacLeod, & Hammond, 2002); that is shown by behavioral tests such as Scrambled Sentences Task (Wenzlaff, Wegner, & Pennebaker, 1993) and the Ambiguous Scenario Test (AST) (e.g. Berna et al., 2011; Holmes & Mathews, 2005; Holmes, Mathews, Dalgleish, & Mackintosh, 2006). In the former, participants are asked to make a sentence from a mixed sequence of words (under a cognitive load and constrained time). The words allow for 'unscrambling' into either a negative or a positive sentence, thus providing an indication of bias. In the latter, participants are simply required to rate a series of descriptions. Further, to maximize impact, participants are encouraged to simulate the scenarios using mental imagery to resolve ambiguity (Holmes, Lang, & Shah, 2009; Hoppitt, Mathews, Yiend, & Mackintosh, 2010).

2. The "reading the mind in the eyes" test (RMET)

RMET was designed as a measure of the mental states by Baron-Cohen and his colleagues (e.g., Baron-Cohen, Wheelwright, & Jolliffe,

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1997a; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Baron-Cohen, Wheelwright, & Jolliffe, 1997b).

RMET was developed for the evaluation of the theory of mind (ToM) in autism spectrum disorders and its findings have revealed that individuals with autism have deficit in the ability to attribute mental states to oneself or another person (Baron-Cohen et al., 2001).

In the RMET, subjects must infer the mental states of different individuals from photographs of their eye-region of the face. That is of interest because it demonstrated that normal adults could judge mental states from even minimal cues (expressions around the eye alone) (Baron-Cohen et al., 2001). In recent years, ToM ability has been increasingly investigated in various neurological diseases, and several studies have shown that ToM ability is affected in schizophrenia (Brüne, 2005; Herold, Tényi, Lenard, & Trixler, 2002), depression (Bora, & Berk, 2016; Lai, Wu, & Hou, 2017), bipolar disorder and Parkinson's disease (PD) (Kawamura & Kobayakawa, 2009; Bodden, Dodel, & Kalbe, 2010; Natsuko, Mutsutaka, & Mitsuru, 2010).

3. New usage and new grading method for the RMET

Reading mind in the eyes is the complex mind reading task in which each stimulus should be interpreted into one of the several available choices. One potential of the reading mind from the eyes task is providing a situation in which an individual should match complex ambiguous stimuli with complex mental states. Complex mental states in contrast with basic mental states involve attribution of a belief or intention to the person. Thus, in the present study we proposed this task for measuring the interpretation bias in depressed individuals.

Aforementioned traditional behavioral tasks used as measures of the interpretation biases are very dependent to individuals' previous experiences so that an individual may have a good experience with one scenario while another person may not; and these scenarios typically are social scenes about which individuals should report their opinions. Thus, we proposed the RMET as a measure of the interpretation bias for several reasons; first, faces represent not only a complex class of visual patterns, but also they have social meaning (e.g., Pelphrey, Adolphs, & Morris, 2004). Therefore, face or eyes can be used as a social stimulus versus social scene. Second, in neuropsychological evaluation, measures should be made based on the structure and function of the brain. Perception of faces has a well- known anatomical area in the brain called fusiform gyrus (Weiner & Grill-Spector, 2012). Therefore, faces or eyes can be used as a universal social stimulus.

There is some neuroimaging evidence about common region in theory of mind and emotion recognition. In more detail, neuroimaging study has shown that dorsolateral prefrontal, the left medial frontal cortex, and the left amygdale are involved in the theory of mind task (Blair, 2001). Further, some studies show the posterior superior temporal sulcus and the inferior frontal gyrus are involved in the reading mind from the eyes task (see Adams et al., 2009; Baron-Cohen et al., 1999; Baron-Cohen et al., 2006; Russell et al., 2000). The posterior superior temporal sulcus has an important role in extracting information about goals and intentions from the eyes and faces (e.g., Allison, Puce, & McCarthy, 2000; Carrington & Bailey, 2009; Gallagher & Frith, 2003), also in the detection of social stimuli (Nelson, Leibenluft, McClure, & Pine, 2005). The inferior frontal gyrus is a part of the mirror neuron system and plays an important role in the assessment of facial expression of emotions (e.g., Frith & Frith, 1999; Rizzolatti, & Craighero, 2004; Van Overwalle, 2009).

RMET consists of 36 different mind states presented by the eye-region of different actors and actresses. Four words are provided for each photograph describing what the person in the photograph is thinking or feeling. In the usual grading method there is only one correct response among four descriptive words of each photograph and the sum of the total correct responses to all photographs indicates the score of an individual. Thus, the range of achievable scores extends from 0 to 36. In the new grading method suggested for the purpose of this study, we defined two valences, one valence (positive, negative or neutral) for each photograph plus a valence for its descriptive words. The score of a participant in each question is measured base on the correspondence of these two valences without considering the best answer as the correct response. Table 1 shows interpretation scores based on the accordance of valences of the photograph and its descriptive words.

Table 1
Interpretation grade in RMET.

Answer valence	Photograph Valence		
	Positive	Neutral	Negative
Positive	0	+ 1	+ 2
Neutral	−1	0	+ 1
Negative	−2	−1	0

As shown in Table 1, if an individual selects a descriptive word with the same valence of a given photograph (e.g. a positive word for a positive photograph), his/her score will be zero without considering whether it is the correct answer or not.

The provided score by original grading of RMET indicates the theory of mind ability. Present grading provides several additional scores such as the positive mind reading, the negative mind reading, the neutral mind reading and the interpretation scores. Furthermore, we calculate the capability of mindreading for positive, negative and neutral mental states separately. The present study aims to use RMET for evaluation of mind reading capability in individuals with major depression in different mental states and their interpretation bias based on it.

4. Method

4.1. Participants and measures

Statistical population of this research was all the individuals suffering from major depression disorder at psychiatric hospital, whom met clinical diagnosis according to the DSM-IV (American psychiatric association, 1994. Forty-five outpatients were selected voluntarily and were compared with 50 healthy controls selected among the hospital staff whom have no history of psychiatric disorders. Both groups were matched on variables of age and education. The reading the mind in the eyes test (RMET) was used as a measurement tool.

5. Result

Table 2 shows demographic data of all participants in the two groups. As shown in Table 2, there were not any differences in the age and education between depressed and healthy participants (p-value > 0.05).

Table 3 shows the scores of RMET in depressed and healthy groups. As shown in Table 3, patients with major depressive disorder compared to healthy individuals had lower performance in RMET based on their overall or classic grades ($P < 0.001$). Patients with depression had also lower performance in reading the positive mental states ($P < 0.001$) as well as the neutral mental states ($P < 0.001$). While they obtained higher scores in reading the negative mental states ($P < 0.05$). The Interpretation scores were also significantly different in both groups ($P < 0.001$).

As shown in Table 4, Using Multi-Factor ANOVA showed that there were a significant simple main effect for different grade types of the RMET ($P < 0.01$) as well as a significant simple main effect between healthy and patient groups ($P < 0.01$). There was also a significant interaction effect between groups and the RMET score types.

Post Hoc Tuckey test showed that healthy group did better in reading the positive, the neutral and the negative mental states respectively, while patients with major depression did exactly reversely.

For evaluation of correlation between severity of depression and the