Decoding and Reasoning Mental States in Major Depression and Social Anxiety Disorder

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Abstract

Background and objectives

Major depression (MDD) and social anxiety (SAD) disorders are debilitating psychiatric conditions characterized by disturbed interpersonal relationships. Despite these impairments in social interaction, little research has simultaneously evaluated the dysfunction in two aspects of theory of mind (ToM) in these disorders: Affective ToM or decoding mental states and cognitive ToM or reasoning mental states. Taking this into consideration, the current study attempts to compare both decoding and reasoning abilities in MDD, SAD, and healthy controls (HC).

Methods

Subjects were 37 patients with MDD, 35 patients with SAD, and 35 HCs. ToM was measured with the Reading the Mind in the Eyes Test (RMET) and the Faux Pas Task, which assessed decoding skills and reasoning mental states, respectively.

Results

Results showed that in decoding mental states, both the SAD and MDD groups achieved lower scores than HC group; moreover, there was no significant difference between SAD and MDD groups in decoding mental states. However, in reasoning mental states, SAD and HC groups had higher scores than the MDD group and no differences observed between SAD and HC groups in reasoning ability.

Conclusions

Results of this study are discussed on generalized impairment in ToM or dysfunction in both decoding and reasoning mental states in MDD and only reasoning dysfunction in SAD.

1. Background

Theory of mind (ToM) is considered to be one of the most important dimensions of social cognition. ToM is defined as the ability to discriminate and judge the mental states (i.e., wants, needs, beliefs, knowledge, emotions.) of oneself and others.\(^1\)\(^-\)\(^3\) Researchers have found that in order to modify behavior in accordance with others, it is important to understand others' mental states.\(^4\) ToM ability, a uniquely human skill, plays a vital role in interaction and everyday functioning.\(^5\)\(^-\)\(^7\) In other words, this ability facilitates the social interaction of humans through understanding the mental and
emotional states of others. Many studies have found ToM deficits in psychological and neurological disorders such as mood disorders, personality disorders, anxiety disorders, psychotic disorders, and Alzheimer disease.

Theoretical frameworks of ToM categorize this ability into two parts: affective and cognitive. According to Singer, affective ToM refers to the attribution of emotional states to others and cognitive ToM is defined as the realization of the intentions of others. Recent theories have referred to affective and cognitive aspects as social-perceptual and social-cognitive components, respectively. The social-perceptual aspect, also known as the “affective aspect” of ToM, refers to the ability to decode and discriminate mental states of others based on available information, which can be recognized by the observer in the immediate environment. The social-cognitive aspect, known as the “cognitive aspect” of ToM, refers to ability to reason about mental states of others through interpretation or prediction the behavior of others. The neurobiological substrates for the affective aspect (decoding phase) of ToM lay within the amygdala, the medial temporal structures, and the frontal lobe, while the medial frontal area of brain has been identified as the most significant region corresponding with the reasoning phase or cognitive aspect of ToM. In accordance with these differences in the affective and cognitive aspects of ToM, recent studies have simultaneously evaluated dysfunction in both aspects of ToM in psychological disorders (de la Osa et al., 2016; Zabihzadeh et al., 2017; Liu et al., 2017).

Affective disorders are a set of psychiatric conditions such as depression, bipolar, and anxiety disorders. Considering the comorbidity of affective disorders and impaired social interaction, the evaluation of social cognition is prevalent in the literature. Literature has shown that among all affective disorders, ToM in Major Depressive Disorder (MDD) has been researched the most. Social functioning deficits are a common feature of MDD. This dysfunction also contributes to the onset and continuation of depressive symptoms. Considering the importance of ToM in the social
interactions, the evaluation of ToM ability in patients with MDD has been widely used in research.\textsuperscript{9-11,28-31} The results of these studies are consistent to a high extent and represent a dysfunction in ToM ability of depressed patients. Also, these findings have been shown in other psychiatric conditions comorbid with depression. According to Zabihzadeh et al.\textsuperscript{7}, findings showed that patients with borderline personality disorder with comorbid MDD had decreased ToM skills as compared to patients without comorbid MDD. This deficit in ToM abilities in depressed patients correlates strongly with impaired social abilities.\textsuperscript{8,10} Since interpersonal conflict is an integral element in symptom onset of depression,\textsuperscript{29} ToM impairment is a predictor in depression reoccurrence of these patients in their social interactions. Many studies have evaluated ToM in patients with MDD, but only two studies (Wang et al.\textsuperscript{11} and Wolkenstein et al.\textsuperscript{9}) have simultaneously investigated affective and cognitive aspects of ToM in these patients; however, their results are inconsistent. According to Wang et al.\textsuperscript{11}, MDD patients had diminished performance in both affective and cognitive dimensions of ToM as compared to healthy controls. On the other hand, the results of Wolkenstein et al.\textsuperscript{9} indicate that MDD patients have lower performance only in cognitive ToM in comparison to healthy controls, while the performance of these patients in affective ToM was not impaired. Both studies used the Reading in the Mind of the Eyes Test (RMET)\textsuperscript{32} to measure the affective ToM. Considering the inconsistencies, further studies measuring the simultaneous measurement of affective and cognitive aspects of ToM in MDD patients is needed.

Despite the considerable studies on ToM in patients with depression, little research has assessed the ability of ToM in anxiety disorders, a prevalent affective disorder, specifically in social anxiety disorder (SAD). SAD is a psychiatric disorder characterized by persistent, excessive fear, and avoidance of social and performance related situations\textsuperscript{24} and is a chronic and debilitating psychiatric condition, leading to social and interpersonal impairments\textsuperscript{27}. Previous studies have proposed that high levels of social anxiety may partly be attributed to social cognitive deficits, which are manifested toward inaccurate and distorted appraisals of the beliefs and intentions of others during interpersonal
Despite social and interpersonal dysfunction in SAD, only three studies have assessed ToM ability in this disorder. According to Samson et al., the high scores on the social anxiety scale are associated with decreased ToM ability, however, individuals with social anxiety in the non-clinical range. Furthermore, in this study, ToM ability was evaluated only with cartoons that involved the interpretation of others’ mental states. This task is most common in the measurement of cognitive ToM but not for the affective aspect. Hezel & McNally found that SAD patients compared to the healthy control group had lower performance in ToM tasks (within the RMET).

Washburn et al. is the only study that considered ToM ability in the clinical case of SAD patients. The results of this study which compared ToM in SAD and MDD patients with and without comorbid depression, demonstrated that the group of non-comorbid SAD patients had significantly lower performance in comparison to the healthy control and non-comorbid MDD groups. Furthermore, both the comorbid and non-comorbid SAD groups made significantly more ‘excessive’ ToM reasoning errors than the non-comorbid MDD group, suggesting a pattern of over-mentalizing. Though evaluation of ToM ability in both RMET and in the movie for the assessment of cognition (MASC) were used, the main goal of the study was not to differentiate the performance of patients in affective and cognitive aspect of ToM. For this reason, the results of this study were not discussed based on the relationship between the performance of patients in ToM tasks with the affective and cognitive aspects.

Considering the limitations of the previous studies, the major purpose of our study is to simultaneously compare affective and cognitive aspects of ToM in MDD and SAD patients and healthy controls (HC). We hypothesized that the impairment of ToM in MDD is more severe than SAD. Furthermore, we expect the HC group (in both decoding and reasoning mental states) to be better than the MDD and SAD groups.

2. Method
2.1. Participants

The participants included three groups: patients with MDD (n=37, 54.05% females, mean age: 28.17, SD: 2.27), patients with SAD (n=35, 54.28% females, mean age: 27.49, SD: 2.06) and HC group
Patients with MDD and SAD were recruited from four psychological services clinics in Sari, Iran. Patients were diagnosed with MDD or SAD according to the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I). Exclusion criteria for two patient groups were the following: a) any current or past diagnosis of a psychotic disorder, and/or b) autism spectrum or any developmental disorders, and/or c) bipolar disorder and/or d) any neurological diseases such as epilepsy, Parkinson’s disease, or severe head injury. Also, they were excluded if they had any substance abuse issues during the preceding six months. Moreover, patients in the SAD group were excluded if they had any history of major depression.

The healthy control (HC) group was recruited from the Islamic Azad University in Sari, Iran. None of the participants in the HC group had a history of any DSM-IV Axis I or Axis II disorders, a brain injury, neurological diseases, and/or evidence of current or past substance abuse.

All participants satisfied the following criteria: they all were a) at least 20 years old, b) capable of understanding the experimental procedure, and c) had normal visual and auditory senses. The ethics committee of the Faculty of Psychology and Education of Shahid Beheshti University approved the procedure. All of the participants gave written informed consent.

2.2. Clinical assessment

For both patient groups, diagnoses were established by the Persian version of Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I). All participants completed the Persian version of Beck Depression Inventory-II (BDI-II) and the Persian version of the Beck Anxiety Inventory (BAI) to assess the severity of depression and anxiety symptoms, respectively. The BDI is a 21-item self-report measure developed to assess the attitudes and clinical symptoms in both depressed and non-depressed psychiatric patients. The BAI is a 21-item self-report measure, which evaluates the severity of anxiety symptoms and can differentiate between anxiety and depression. In previous studies, the Persian versions of the BDI-II and the BAI had good psychometric properties. We also employed the Wechsler Adult Intelligence Scale-Revised Version (WAIS-R) to assess overall intellectual functioning.
2.3. **TOM tasks**

2.3.1. **Reading in the mind of the eyes Task**

To measure the decoding of mental states (i.e., affective aspect) of ToM, we utilized the Reading in the Mind of the Eyes test (RMET)\(^\text{32}\) translated into Persian\(^\text{44}\). This test consists of 36 black-and-white photographs of the same size (15cm×6cm) from the eyes area of confederate actors. Three mental states are presented (i.e., neutral, negative, and positive), and the participant is asked to select the option which could best represent the mental state of the picture. Moreover, as a control task, volunteers were required to express their opinions on the gender of each picture (i.e., gender recognition). There was no time limit for answering questions. The total score of each participant in the two tasks was calculated based on the total participant’s correct response to each picture; the highest score a participant can acquire is 36. In addition to the two above-mentioned scores, in agreement with the Harkness et al.\(^{45}\) study and the Richman & Unoka\(^{31}\) pattern, three subscales were also calculated based upon the value of each mental state. Following this pattern, the 36 photographs fit into three separate categories depending on the positive, negative, and neutral values of each mental state (i.e., 8 positive, 12 negative, and 16 neutral). Previous studies have indicated the attentional bias to negative stimuli in depressed individuals\(^{46,47}\); therefore, in this study, we used such scoring for accurate differentiation of three groups in discrimination of positive and negative mental states.

2.3.2. **Faux Pas Task**

The faux pas task was used to assess the reasoning mental states (i.e., cognitive aspect) of ToM. This test composed of 20 short stories; half of them included a faux pas while the other half excluded a faux pas, considered as control stories. According to Baron-Cohen et al.\(^{48}\), the Faux Pas occurs when a speaker says something without considering if it is something that the listener might not want to hear or know; it typically has negative consequences that the speaker never intended (See Appendix 1). There were no time limits, and therefore, to understand the story entirely, volunteers could read it repeatedly. At the end of every story, there were two faux pas questions together with two control ones. The faux pas questions were about the main character’s intentions and were designed to assess
the participant’s thorough understanding as to whether or not they could recognize that a faux pas had occurred in the story.

The control questions aimed to check the reader’s full comprehension of the story. In the Faux Pas Task, participants who answered “yes” to the first question (In the story you just read, has there been a faux pas and/or an embarrassing mistake in a social situation?) were required to answer the next faux pas question; meanwhile, in the stories involving a faux pas, one score was saved for each correct response. In case the subject’s answer to the first question was “no”, they were not asked the consequent question; however, all participants were required to answer the two control questions, even if their answers to the first question had been negative. Ultimately, 20 was the maximum score a participant could achieve on the Faux Pas Questions, and 40 on the control ones.

2.4. Statistical analysis

All statistical analyses were performed using SPSS 23. In data analysis, we compared the affective and cognitive dimensions of the theory of mind in the three groups of MDD, SAD, and HC by a Multivariate analysis of variance (MANOVA).

3. Results

3.1 Demographic and clinical data

The demographic characteristics of the three groups can be seen in Table 1. According to the results shown in Table 1, there was no significant difference between the participants of the three groups in mean age, educational level, and IQ; however, when comparing the clinical data and concerning BDI-II scores, the difference between groups was significant ($F(2, 104)= 40.36, p < 0.001$). Post hoc comparison shows that MDD and SAD groups had higher scores than the HC in BDI-II scores. Moreover, the SAD group had lower scores than the MDD group in BDI-II. In BAI, three groups had also significant difference ($F(2, 104)= 38.12, p < 0.001$). Two groups of patients had higher scores than HC in BAI. Also, the MDD group had lower scores than the SAD group in BAI (Table 1).

3.2. Comparisons of Decoding Ability among three groups

Multivariate analysis of variance (MANOVA) revealed a significant difference between the three groups in the total score of ToM ($F(2, 104)= 11.27, p < 0.001$). Tukey posthoc comparisons indicated
that the HC group performed better than the SAD and MDD groups; moreover, there was no significant difference between the SAD and MDD groups in the total score of ToM. In ToM subscales, the difference between the three groups was significant. In positive \((F(2, 104)= 8.19, p <0.001)\) and neutral \((F(2, 104)= 13.71, p < 0.001)\) items, the HC group got higher scores than the SAD and MDD groups. For the negative items, the HC group got lower scores compared to the SAD and MDD groups \((F(2, 104)=7.48, p < 0.001)\). Moreover, there was no significant difference between the two groups of patients in ToM subscales. In gender recognition, no significant difference was found between three groups \((F(2, 104)=0.24, p < 0.84)\) (table 2).

3.3. Comparisons of Reasoning Ability among three groups

Results of the MANOVA indicated significant difference between groups in the Faux pas test. The Tukey Post hoc comparison showed that the SAD group had higher scores than the MDD group \((F(2, 104)=23.16, p < 0.001)\). There was no significant difference between the three groups in the control questions \((F(2, 104)=0.48, p < 0.61)\) (table 2). Figure 1 illustrates the performance of the three groups on the RMET and Faux Pas tests.

| Table 1 | Comparisons of demographic data and clinical data among groups. |
|---------|---------------------------------------------------------------|
|         | HC \((n=35)\) | MDD \((n=37)\) | SAD \((n=35)\) | Statistics |
| Sex ratio (M: F) | 20:17 | 17:20 | 16:19 | \(\chi^2=0.58, P=0.37,\) n.s. |
| Index age (years) | 28.38±3.41 | 28.17±2.27 | 27.49±2.06 | \(F=1.39, P=0.11,\) n.s. |
| Education levels (years) | 16.21±2.09 | 14.78±2.35 | 14.36±1.70 | \(F=1.08, P=0.61,\) n.s. |
| IQ | 110.48±5.80 | 107.29±7.61 | 108.52±5.20 | \(F=1.46, P=0.41,\) n.s. |
| BDI-II | 8.11±3.28 | 38.12±3.84 | 20.36±5.11 | \(F=40.36, P=0.001\) |
| BAI | 7.62±3.39 | 19.71±4.27 | 41.59±6.13 | n.s. |

Notes. HC: Healthy Controls; MDD: Major Depression Disorder; SAD: Social Anxiety Disorder; BDI-II: Beck Depression Inventory; BAI: Beck Depression Inventory; n.s.: not significant difference.
### Table 2
Comparisons of affective and cognitive ToM among groups.

| Measures          | MDD (n=37) | SAD (n=35) | HC (n=35) | F   | P     | Partial |
|-------------------|------------|------------|-----------|-----|-------|---------|
| Total ToM         | M 23.81    | SD 3.29    | M 24.94   | SD 3.11| M 27.60 | SD 3.74 | 11.72   | 0.001 | 0.7 |
| Positive ToM      | 5.32       | 1.49       | 5.71      | 1.21 | 7.37  | 2.09   | 8.19    | 0.001 | 0.7 |
| Negative ToM      | 9.15       | 2.39       | 8.92      | 1.83 | 6.10  | 1.69   | 7.48    | 0.001 | 0.7 |
| Neutral ToM       | 9.34       | 2.54       | 10.31     | 2.47 | 14.13 | 3.28   | 13.71   | 0.001 | 0.7 |
| Gender Recognition| 32.37      | 2.39       | 31.54     | 2.31 | 32.45 | 2.63   | 0.24    | 0.84  | 0.0 |
| Faux pas          | 13.45      | 2.51       | 16.02     | 2.09 | 16.71 | 1.74   | 23.16   | 0.001 | 0.7 |
| Control           | 37.16      | 2.03       | 36.74     | 1.96 | 36.77 | 2.08   | 0.48    | 0.61  | 0.0 |

### 4. Discussion
The current study aimed to compare decoding mental states (i.e., the affective aspect of ToM) and reasoning of mental states (i.e, the cognitive aspect of ToM) in SAD, MDD, and HC groups. A major strength of this study is the parsing of the dimensions of ToM in SAD patients as compared to MDD patients and the HC group. Another strength of this study is the inclusion of clinical cases of SAD, which is not often presented in other studies.

The results regarding the affective aspect of ToM, measured by RMET paradigm, demonstrated that both groups (SAD and MDD) represented lower functioning than the healthy control group, while there weren't significant differences between these two groups of patients otherwise. The decreased functioning of MDD patients in the total score of the RMET is consistent with previous studies.\(^8,10,28-31\) According to results of the current study, the MDD patients not only suffer from deficits in affective ToM, however, in comparison to SAD, patients and healthy groups had lower performance in the cognitive aspect; however, in the cognitive aspect, SAD and the healthy groups had no significant differences. In fact, the decreased functioning of the MDD patients in both decoding and reasoning mental states indicates the general impaired of ToM in these patients. The recent findings are consistent with Wang et al.\(^11\); results demonstrated that the depressed patients are vulnerable to the impairment in affective and cognitive dimensions of ToM. On the other hand, this finding is inconsistent with the results of Wolkenstein et al.\(^9\). Based on Wolkenstein et al.\(^9\), MDD patients, in
comparison to HC, had normal functioning in RMET, however, they demonstrated lower functioning in the MASC test; the findings of healthy functioning in MDD patients in the RMET is inconsistent with other related studies. It seems that this discrepancy originated from methodological limitations of Wolkenstein et al. in which only 24 MDD patients were compared with 20 healthy controls. However, other studies mostly cover more than 30 clinical cases for these comparisons. Furthermore, another reason behind this inconsistency can be related to the difference in the severity of depression in samples of previous studies. In this regard, Lee et al. concluded that without any respect to the level of general depression severity, the presence of specific affective symptoms may represent a clinical subtype of depression and can be associated with compromised mental state decoding. As mentioned above, Wolkenstein et al., found that MDD patients are capable of decoding and distinguishing correct mental state of others, however, they are incapable of dealing with and reasoning about mental states. Results of the current study are inconsistent with Wolkenstein et al., while they are consistent with Lee et al. (2005). Lee et al. indicate that MDD patients widely suffer from ToM impairment in the case of affective and cognitive aspects. In some previous studies, it's been suggested that when depression added to another disorder, dysfunction in ToM would be increased. These results demonstrate that MDD patients undergo the difficulty of reading social interactions, which would be associated with chronicity and functional decline. These difficulties are representations of generalized impairment of ToM in MDD patients, which is highly associated with the dysfunction of social interaction skills. One of the major reasons for this association can be related to the same brain structures engaged in ToM and depression. The literature suggests the crucial role of ToM regions in the pathophysiology of depression. The available studies demonstrate that the prefrontal, orbitofrontal, ventromedial prefrontal cortex are neural underpinnings of ToM. Furthermore, the neuroimaging studies indicated that the prefrontal cortex plays a critical role in the pathophysiology of mood disorders. Some studies have shown that MDD patients have a smaller volume of orbitofrontal cortex in comparison with normal individuals. This finding elucidates the role of this brain region in pathophysiology of MDD. On the other hand, there are some
findings\textsuperscript{56} that have regarded the orbitofrontal cortex as having a role in the recognition of mental states through eye region photographs.

Unlike the generalized impairment of ToM in MDD patients, which involves both affective and cognitive aspects, SAD patients had the only difficulty in decoding mental states or the affective aspect. In other words, in the case of reasoning mental states, SAD patients were similar to healthy individuals. Based on our knowledge, the current study is the first piece of research that has simultaneously differentiated function of SAD patients in both affective and cognitive aspects of ToM. The low function of SAD patients in RMET is consistent with the study of Hezel & McNally\textsuperscript{36} as well as Washborn et al.\textsuperscript{27}. An interesting point of this study is that unlike MDD patients, SAD patients did not have any significant difference with HCs in the faux pas test (i.e., cognitive aspect) of ToM. To make it clearer, it should be noted that SAD is generally preceded by MDD, and the clinical characteristics of MDD are more severe in SAD.\textsuperscript{27} Therefore, it can be expected that the range of impairment of ToM in SAD is more than MDD patients. Longitudinal studies indicated that patients who suffer from SAD who later diagnose MDD are characterized by higher levels of interpersonal over-sensitivity and social impairment than those who do not.\textsuperscript{57,58} According to the result of this study, impairment of ToM in SAD patients is solely representing its affective aspect or the decoding ability of mental states, and these patients are not suffering from the dysfunction in cognitive aspect or reasoning ability. Therefore, the impairment of interpersonal interaction of SAD patients has resulted from their impairment of the affective aspect of ToM. According to attention control theory, anxiety causes impairment in the attention system and would lead to a decrease in the attention control and then excessive attention to threatening stimulants.\textsuperscript{59} Difficulty in inhibition and shifting of attention would probably lead to difficulty in recognition, decoding, and understanding the cognitive realization of others in anxious individuals. It is interesting that the results of the current study in the subscales of RMET in both SAD and MDD patients are aligned with cognitive perspectives in the attentional bias of patients to negative stimuli. In this study, MDD and SAD patients in comparison to the healthy group had lower scores in total ToM but higher scores in the negative subscale. This result is consistent with
the findings of Wolkenstein et al.9 in which the MDD patients represented higher function than HC in recognition of negative mental states. Cognitive models of depression emphasized that depressed individuals tend to negatively interpret the vague stimuli; these biases are crucial in the initiation and persistence of the disorder.60 Depressed individuals tend to interpret social situations negatively and they have a better memory for negative stimuli. This deficit is strongly consistent with the dysfunction of social interaction skills in SAD patients.46 Furthermore, the inability to divert attention from threatening stimuli and to shift it to other stimuli59 can also be regarded as the probable reason for the weakness of the SAD patients in decoding positive and neutral mental states. On the other hand, that inability causes high function in recognition of negative mental states. However in related previous studies27,36 did not demonstrate a distinction between the recognition of negative, positive and neutral mental states in SAD patients. It can be said that this discrepancy is a result of subjects who participated in these studies. In the current research, the clinical case of SAD was studied, while in Hezel & McNally36 relationship between the score of individuals in the self-report scale of the social anxiety evaluated along with their function in RMET. Moreover, in Washborn et al.27 participants chosen from the general population of students.

The first limitation of this study is that we did not evaluate the relationship between the relapse rates of depressive and anxious symptoms and ToM performance. Investigation of this relationship is important. Second, SAD and MDD patients were the ones seeking treatment. It would be better if a wider range of SAD and MDD patients were examined so that a more reliable conclusion can be reached regarding their ToM ability. Third, in this study the possible effects of the use of medication on performance of SAD and MDD patients was not analyzed. In addition, we used a categorical approach for the diagnosis of SAD and MDD, whereas a dimensional model allows for varying degrees of severity that may increase the validity of a diagnosis.24 Finally, we were limited by our small sample size.

Conclusion
Overall, the findings of this study confirmed that the generalized impairment of ToM in MDD patients exists in patients. Though the SAD group only had a deficit in the reasoning aspect of ToM, ToM
impairments can contribute to dysfunction in social communication skills especially in MDD patients and have some important implications for clinicians regarding the implementation and planning of psychotherapeutic interventions.

Abbreviations

BAI: Beck Anxiety Inventory
BDI-II: Beck Depression Inventory-II
HC: healthy controls
MANOVA: Multivariate analyze of variance
MASC: movie for the assessment of cognition
MDD: Major depression
RMET: Reading the Mind in the Eyes Test
SAD: social anxiety disorders
SCID-I: Structure Clinical Interview for DSM-IV Axis I Disorders
ToM: theory of mind
WAIS-R: Wechsler Adult Intelligence Scale-Revised Version

Declarations

Ethics approval and consent to participate

The ethics committee of the Faculty of Psychology and Education of Shahid Beheshti University approved the procedure. All of participants gave written informed consent.

Consent for publication

Not applicable.

Availability of data and materials

The study data is available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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support.

Authors’ contributions

GM and AZ conceived the study aim, analyzed and interpreted the data and drafted the article. MR and ZD conceived the study, contributed to the study design and critically revised the article for important intellectual content and the grammatical errors. FM conceived the study, she was responsible for the study design, acquisition of data and drafting the article. All authors approved the final manuscript.

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References

1. Premack D, Woodruff G. Does the chimpanzee have a theory of mind?. Behav. Brain Sci. 1978;1:515-26.

2. Baron-Cohen S, Leslie AM, Frith U. Does the autistic child have a “theory of mind”? Cognition. 1985;21:37-46.

3. O’Neill A, D’Souza A, Samson AC, Carballedo A, Kerskens C, Frodl T. Dysregulation between emotion and theory of mind networks in borderline personality disorder. Psychiatry Res: Neuroimaging. 2015;231:25-32.

4. De la Osa N, Granero R, Domenech JM, Shamay-Tsoory S, Ezpeleta L. Cognitive and affective components of Theory of Mind in preschoolers with oppositional defiance disorder: Clinical evidence. Psychiatry Res. 2016;241:128-34.

5. Adolphs R. Cognitive neuroscience: Cognitive neuroscience of human social behaviour. Nature Rev Neurosci. 2003;4:165.

6. Herrmann E, Call J, Hernández-Lloreda MV, Hare B, Tomasello M. Humans have evolved specialized skills of social cognition: The cultural intelligence hypothesis. Science. 2007;317:1360-6.

7. Zabihzadeh A, Maleki G, Richman MJ, Hatami A, Alimardani Z, Heidari M. Affective
and cognitive theory of mind in borderline personality disorder: the role of comorbid depression. Psychiatry Res. 2017;257:144-9.

8. Koelkebeck K, Liedtke C, Kohl W, Alferink J, Kret ME. Attachment style moderates theory of mind abilities in depression. J Affect Disord. 2017;213:156-60.

9. Wolkenstein L, Schönenberg M, Schirm E, Hautzinger M. I can see what you feel, but I can't deal with it: Impaired theory of mind in depression. J Affect Disord. 2011;132:104-11.

10. Nejati V, Zabihzadeh A, Maleki G, Tehranchi A. Mind reading and mindfulness deficits in patients with major depression disorder. Procedia Soc Behav Sci. 2012;32:431-7.

11. Wang YG, Wang YQ, Chen SL, Zhu CY, Wang K. Theory of mind disability in major depression with or without psychotic symptoms: a componential view. Psychiatry Res. 2008;161:153-61.

12. Buhlmann U, Wacker R, Dziobek I. Inferring other people's states of mind: Comparison across social anxiety, body dysmorphic, and obsessive-compulsive disorders. J anxiety disorder. 2015;34:107-13.

13. Bora E, Veznedaroğlu B, Vahip S. Theory of mind and executive functions in schizophrenia and bipolar disorder: a cross-diagnostic latent class analysis for identification of neuropsychological subtypes. Schizophr Res. 2016;176:500-5.

14. Vaskinn A, Abu-Akel A. The interactive effect of autism and psychosis severity on theory of mind and functioning in schizophrenia. J Neuropsychol. 2019;33(2):195.

15. Bora E, Walterfang M, Velakoulis D. Theory of mind in behavioural-variant frontotemporal dementia and Alzheimer's disease: a meta-analysis. J Neurol Neurosurg Psychiatry. 2015;86:714-9.

16. Singer T. The neuronal basis and ontogeny of empathy and mind reading: review of literature and implications for future research. Neurosci Biobehav Rev. 2006;30:855-
17. Sabbagh MA. Understanding orbitofrontal contributions to theory-of-mind reasoning: implications for autism. BRAIN COGNITION. 2004;55:209-19.

18. Sabbagh MA, Bowman LC, Evraire LE, Ito JM. Neurodevelopmental correlates of theory of mind in preschool children. Child Dev. 2009;80:1147-62.

19. Tager-Flusberg H, Sullivan K. A componential view of theory of mind: evidence from Williams syndrome. Cognition. 2000;76:59-90.

20. Adolphs R, Baron-Cohen S, Tranel D. Impaired recognition of social emotions following amygdala damage. J Cogn Neurosci. 2002;14:1264-74.

21. Frith U, Frith C. The biological basis of social interaction. Curr. Dir. Psychol. Sci. 2001;10:151-5.

22. Siegal M, Varley R. Neural systems involved in theory of mind'. Nature Rev Neurosci. 2002;3:463.

23. Liu W, Fan J, Gan J, Lei H, Niu C, Chan RC, Zhu X. Disassociation of cognitive and affective aspects of theory of mind in obsessive-compulsive disorder. Psychiatry Res. 2017;255:367-72.

24. American Psychiatric Association. Diagnostic and statistical manual of mental disorders (DSM-5®). American Psychiatric Pub; 2013.

25. Levendosky AA, Okun A, Parker JG. Depression and maltreatment as predictors of social competence and social problem-solving skills in school-age children. CHILD ABUSE NEGLECT. 1995;19:1183-95.

26. Kerr N, Dunbar RI, Bentall RP. Theory of mind deficits in bipolar affective disorder. J Affect Disord. 2003;73:253-9.

27. Washburn D, Wilson G, Roes M, Rnic K, Harkness KL. Theory of mind in social anxiety disorder, depression, and comorbid conditions. J Anxiety Disord. 2016; 37:71-7.
28. Weightman MJ, Air TM, Baune BT. A review of the role of social cognition in major depressive disorder. Front Psychol. 2014; 5:179.

29. Inoue Y, Tonooka Y, Yamada K, Kanba S. Deficiency of theory of mind in patients with remitted mood disorder. J Affect Disord. 2004;82:403-9.

30. Lee L, Harkness KL, Sabbagh MA, Jacobson JA. Mental state decoding abilities in clinical depression. J Affect Disord. 2005;86:247-58.

31. Richman MJ, Unoka Z. Mental state decoding impairment in major depression and borderline personality disorder: meta-analysis. Br. J. Psychiatry. 2015;207:483-9.

32. Baron-Cohen S, Wheelwright S, Hill J, Raste Y, Plumb I. The “Reading the Mind in the Eyes” Test revised version: a study with normal adults, and adults with Asperger syndrome or high-functioning autism. J Child Psychol Psychiatry. 2001;42:241-51.

33. Hirsch CR, Clark DM. Information-processing bias in social phobia. Clin Psychol Rev. 2004;24:799-825.

34. Stopa L, Clark DM. Social phobia and interpretation of social events. BEHAV RES THER. 2000;38:273-83.

35. Samson AC, Lackner HK, Weiss EM, Papousek I. Perception of other people’s mental states affects humor in social anxiety. J Behav Ther Exp Psychiatry. 2012;43:625-31.

36. Hezel DM, McNally RJ. Theory of mind impairments in social anxiety disorder. Behav Ther. 2014;45:530-40.

37. Dziobek I, Fleck S, Kalbe E, Rogers K, Hassenstab J, Brand M, Kessler J, Woike JK, Wolf OT, Convit A. Introducing MASC: a movie for the assessment of social cognition. J Autism Dev Disord. 2006;36:623-36.

38. Sharifi V, Assadi SM, Mohammadi MR, Amini H, Kaviani H, Semnani Y, Shabani A, Shahrivar Z, Davari-Ashtiani R, Shooshtari MH, Seddigh A. A persian translation of the structured clinical interview for diagnostic and statistical manual of mental
disorders: psychometric properties. Compr Psychiatry. 2009;50:86-91.

39. Ghassemzadeh H, Mojtabai R, Karamghadiri N, Ebrahimkhani N. Psychometric properties of a Persian-language version of the Beck Depression Inventory-Second edition: BDI-II-PERSIAN. Depress. Anxiety. 2005;21:185-92.

40. Kaviani H, Mousavi AS. Psychometric properties of the Persian version of Beck Anxiety Inventory (BAI). Tehran Univ Med J. 2008;66:136-40.

41. Beck AT, Steer RA, Brown GK. Beck depression inventory-II. San Antonio. 1996;78:490-8.

42. Beck AT, Steer RA, Carbin MG. Psychometric properties of the Beck Depression Inventory: Twenty-five years of evaluation. Clin Psychol Rev. 1988;8:77-100.

43. Wechsler D. WAIS-R manual: Wechsler adult intelligence scale-revised. Psychological Corporation; 1981.

44. Khorashad BS, Baron-Cohen S, Roshan GM, Kazemian M, Khazai L, Aghili Z, Talaei A, Afkhamizadeh M. The “Reading the Mind in the Eyes” test: investigation of psychometric properties and test-retest reliability of the persian version. J Autism Dev Disord. 2015;45:2651-66.

45. Harkness K, Sabbagh M, Jacobson J, Chowdrey N, Chen T. Enhanced accuracy of mental state decoding in dysphoric college students. Cogn Emot. 2005;19:999-1025.

46. Everaert J, Duyck W, Koster EH. Attention, interpretation, and memory biases in subclinical depression: A proof-of-principle test of the combined cognitive biases hypothesis. Emotion. 2014;14:331.

47. Duque A, Vázquez C. Double attention bias for positive and negative emotional faces in clinical depression: Evidence from an eye-tracking study. J Behav Ther Exp Psychiatry. 2015;46:107-14.

48. Baron-Cohen S, O’riordan M, Stone V, Jones R, Plaisted K. Recognition of faux pas by
normally developing children and children with Asperger syndrome or high-functioning autism. J Autism Dev Disord. 1999;29:407-18.

49. Zobel I, Werden D, Linster H, Dykierek P, Drieling T, Berger M, Schramm E. Theory of mind deficits in chronically depressed patients. Depression and Anxiety. 2010;27:821-8.

50. Lai CH, Wu YT, Hou YM. Functional network-based statistics in depression: Theory of mind subnetwork and importance of parietal region. J Affect Disord. 2017;217:132-7.

51. Brothers L. The social brain: a project for integrating primate behavior and neurophysiology in a new domain. J Psychiatry Neurosci. 2002;367-385.

52. Mayberg HS. Limbic-cortical dysregulation: a proposed model of depression. J Neuropsychiatry Clin Neurosci. 1997; 9, 471-481.

53. Bremner JD, Vythilingam M, Vermetten E, Nazeer A, Adil J, Khan S, Staib LH, Charney DS. Reduced volume of orbitofrontal cortex in major depression. Biol Psychiatry. 2002;51:273-9.

54. Ballmaier M, Toga AW, Blanton RE, Sowell ER, Lavretsky H, Peterson J, Pham D, Kumar A. Anterior cingulate, gyrus rectus, and orbitofrontal abnormalities in elderly depressed patients: an MRI-based parcellation of the prefrontal cortex. Am J Psychiatry. 2004;161:99-108.

55. Lacerda AL, Keshavan MS, Hardan Ay, Yorbik O, Brambilla P, Sassi RB, Nicoletti M, Mallinger AG, Frank E, Kupfer DJ, Soares JC. Anatomic evaluation of the orbitofrontal cortex in major depressive disorder. Biol psychiatry. 2004;55:353-8.

56. Baron-Cohen S. Hey! It was just a joke! Understanding propositions and propositional attitudes by normally developing children and children with autism. Isr J Psychiat Rel. 1997;34:174-8.

57. Katz SJ, Conway CC, Hammen CL, Brennan PA, Najman JM. Childhood social
withdrawal, interpersonal impairment, and young adult depression: a mediational model. J. Abnorm. Child Psychol. 2011;39:1227.

58. Starr LR, Hammen C, Connolly NP, Brennan PA. Does relational dysfunction mediate the association between anxiety disorders and later depression? Testing an interpersonal model of comorbidity. DEPRESS ANXIETY. 2014;31:77-86.

59. Eysenck MW, Derakshan N, Santos R, Calvo MG. Anxiety and cognitive performance: attentional control theory. Emotion. 2007;7:336.

60. Bradley BP, Mogg K, Millar N, White J. Selective processing of negative information: Effects of clinical anxiety, concurrent depression, and awareness. J. Abnorm. Psychol. 1995;104:532.

Appendix 1
Nahid had just moved into a new apartment. Nahid went shopping and bought some new curtains for her bedroom. When she had just finished decorating the apartment, her best friend, Zahra, came over. Nahid gave her a tour of the apartment and asked, "How do you like my bedroom?" "Those curtains are horrible," Zahra said. "I hope you're going to get some new ones!"

Did anyone say something they shouldn't have said or something awkward?

If yes, ask:
Who said something they shouldn't have said or something awkward?

Control question:
In the story, what had Nahid just bought?

How long had Nahid lived in this apartment?

Figures
Figure 1

Mean of accurate responses of RMET and Faux Pas test in three groups. Notes. HC: Healthy Controls; MDD: Major Depression Disorder; SAD: Social Anxiety Disorder.