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Facial Emotion Recognition and Its Relationships with Neurocognition and Theory of Mind in Schizophrenia

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The present study aimed at clarifying the relationships among neurocognition (attention/vigilance, working memory, reasoning and problem solving), facial emotion recognition and theory of mind in patients with schizophrenia. Participants were 106 patients with schizophrenia recruited from two medical institutes in north Taiwan. Participants completed the Short Version of Chinese Wechsler Adult Intelligence Scale-III, Conners' Continuous Performance Task-II (CPT-II), the Chinese Wechsler Memory Scale-III, Working Memory Index subtests (WMI), the Wisconsin Card Sorting Test (WCST), the Japanese and Caucasian Facial Expression of Emotion (JACFEE), and the Chinese Theory of Mind Tasks, including Faux Pas, implication stories, and non-verbal task. Structural equation modeling technique with path analyses indicated that, under the control of age and the general intelligence, except for working memory from the WMI, attention/vigilance from the CPT-II and reasoning and problem solving from the WCST respectively influenced facial emotion recognition from the JACFEE, which in turn influenced three tasks of theory of mind. These results can be interpreted as providing evidences to support the hypotheses of this study. The conclusions of this study are attention/vigilance and reasoning and problem solving are important ingredients of facial emotion recognition. In addition, facial emotion recognition is an important ingredient of theory of mind. The practical implication for clinical working is discussed.

Keywords: *facial emotion recognition, neurocognition, schizophrenia, social cognition, theory of mind*

Impairments in facial emotion recognition are a pervasive feature of schizophrenia. Schizophrenic patients find it difficult to scan and explain other people's facial expressions, leading to inaccurate judgments of others' affective reactions. In addition, schizophrenic patients have deficits in theory of mind (ToM). They have limited ability to infer the mental states of others. Impaired emotion recognition and ToM may have adverse effects on psychosocial functioning. Impairments in neurocognitive functioning concerning attention/vigilance, working memory, and reasoning and problem solving are also well established core abnormalities in schizophrenia. However, how facial emotion recognition relates to ToM and neurocognitive functioning in schizophrenia is still unclear.

Purposes

The aim of the present study was to investigate the relationships between attention/vigilance, working memory, reasoning and problem solving, facial emotion recognition and ToM. Earlier empirical studies have indicated that facial emotion recognition requires neurocognitive processes such as attention/vigilance, working memory, reasoning and problem solving. Emotion recognition is also the first step in ToM. The results of a functional magnetic resonance imaging study indicated that the time of response is significantly later in brain regions responsible for mentalizing than regions responsible for emotion recognition. Furthermore, ontogenetic and information processing theories have shown that emotion recognition develops earlier than the ability to mentalize. Thus, this study hypothesized

that attention/vigilance, working memory, reasoning and problem solving influence facial emotion recognition, which in turn influence ToM. Based on this hypothesis, the study established three models based on different ToM tasks-faux pas detection, implication stories and non-verbal tasks. Data were obtained from patients with schizophrenia to test the hypothesized models.

Methods

One hundred and six patients with schizophrenia were recruited from two hospitals in Taiwan. All of the patients were taking antipsychotic medication and their symptoms were stable while participating in the study. The participants completed the Chinese Wechsler Adult Intelligence Scale-III-Short Form (C-WAIS-III-SF), the Scale for the Assessment of Negative Symptoms (SANS), the Conners' Continuous Performance Task-II (CPT-II), the Chinese Wechsler Memory Scale-III-Working Memory Index (C-WMI) subtests, the Wisconsin Card Sorting Test (WCST), the Japanese and Caucasian Facial Expression of Emotion (JACFEE) test and the Chinese Theory of Mind (C-ToM) tasks, including faux pas detection, implication stories, and non-verbal tasks. All of the participants signed written informed consent statements after receiving a full explanation of the test procedures. The study was approved by the Institutional Review Board of the hospitals involved.

Results

Table 1 shows the means and correlations for age and the task measures. The scores in the JACFEE task, the C-ToM faux pas task, the C-ToM implication stories, and the C-ToM non-verbal tasks were quite strongly interrelated. Structural equation modeling analysis indicated that all of the hypothesized models fit the sample data well. As can be seen in Models 1, 2, and 3 in Figure 1, when controlling for age and general intelligence from the C-WAIS-III-SF, attention/vigilance from the CPT-II and reasoning and problem solving from the WCST (but not working memory from the C-WMI) influenced facial emotion recognition from the JACFEE task, which in turn influenced performance in three of the C-ToM tasks. Bootstrapping mediation analysis indicated that JACFEE scores mediated the relationship between performance in the CPT-II and three of the ToM tasks. In addition, JACFEE scores mediated the relationship between WCST scores and performance in three of the ToM tasks. These results can be interpreted as providing evidence to support the hypotheses of this study.

Conclusions/Implications for Practice

The findings of this study indicated that attention/vigilance, working memory, reasoning and problem solving are related to ToM through facial emotion recognition. This implies that attention/vigilance, working memory, reasoning and problem solving are important components of facial emotion recognition. In addition, facial emotion recognition is an important component of ToM. Clarifying the psychopathological mechanisms of the cognitive deficits involved in schizophrenia has direct implications for the treatment of the mental disorder. This study indicated that cognitive deficits in schizophrenia are closely connected. We suggest that practitioners should consider a series of steps when conducting social cognitive interventions for schizophrenia. To enhance ToM, facial emotion recognition must be strengthened. To strengthen facial emotion recognition, attention/vigilance, reasoning and problem solving must be enhanced. The findings of this study provide a theoretical basis for a new social cognitive training program. It is reasonable to hypothesize that the new program will provide more effective cognitive reinforcement for schizophrenic patients.

Limitations

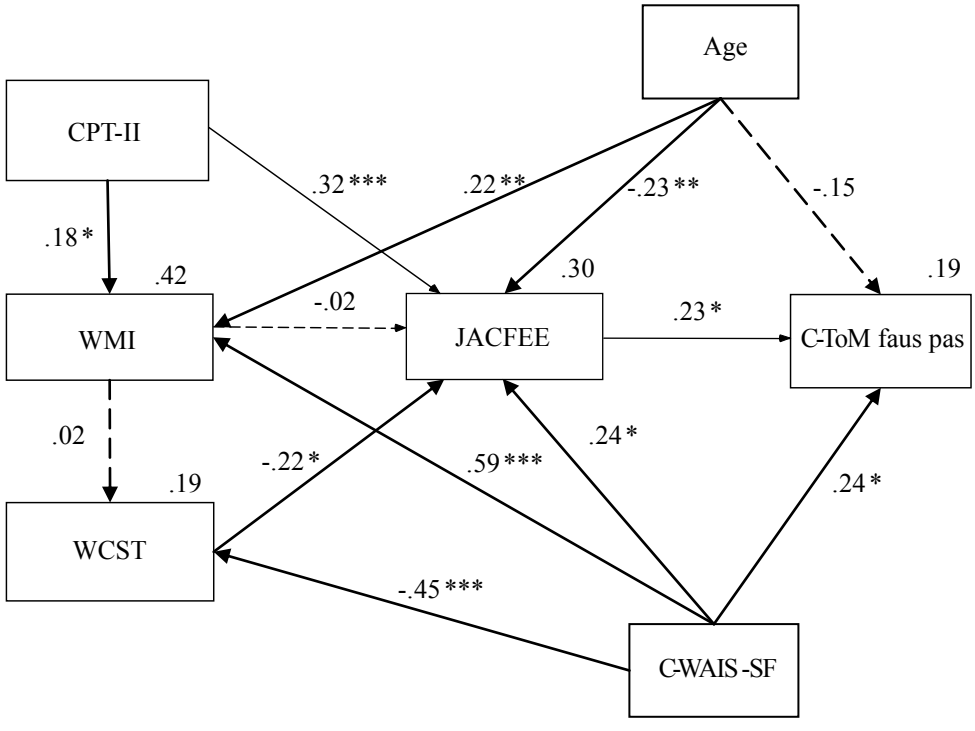
This study has some limitations that should be taken into consideration. First, some aspects of cognitive functioning were measured using only one instrument. For example, attention/vigilance was measured using the CPT-II, and reasoning and problem solving were measured using the WCST. Using just one instrument may have restricted the scope of the measurement of cognitive functioning. This may have limited the generalizability of the findings. Future research could use multiple measures

of cognitive functioning to ensure the comparability of the results. Second, facial emotion recognition may be linked with neurocognitive and social cognitive variables other than those included in this study. The issues are worthy of further exploration.

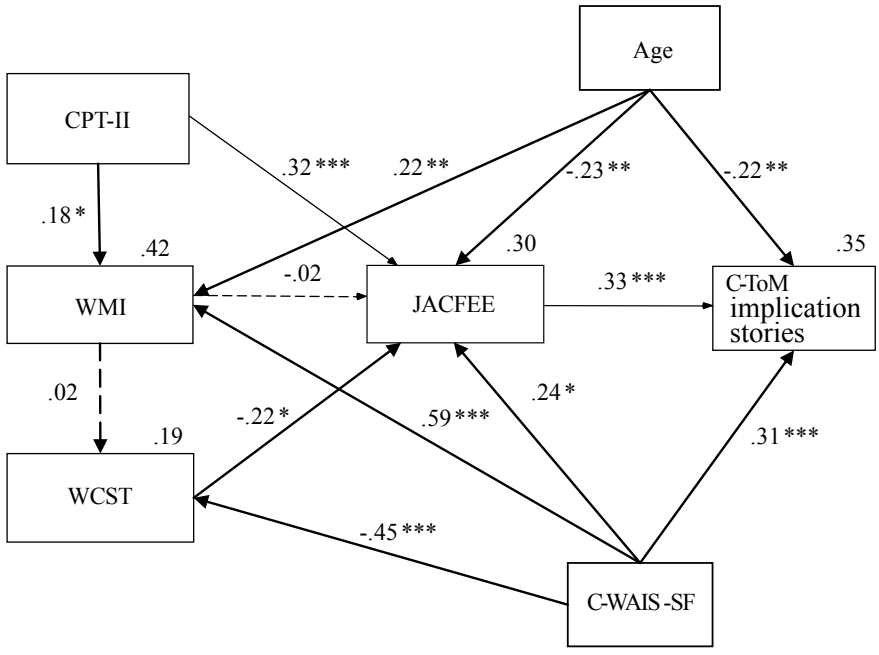
Table 1. **Means and correlations of patients' age and task measures**

	Mean ± *SD*	Age	C-WAIS-SF	SANS	CPT-II	WMI	WCST	JACFEE	C-ToM faux pas	C-ToM implication stories
Age	43.61 ± 8.81									
C-WAIS-SF	84.78 ± 10.15	.13								
SANS	29.03 ± 15.74	.27**	-.10							
CPT-II	.51 ± .18	-.04	.18	-.19						
C-WMI	81.71 ± 11.64	.27**	.63***	-.13	.27**					
WCST	29.88 ± 12.65	.03	-.44***	.22*	-.04	-.26**				
JACFEE	30.63 ± 5.72	-.23*	.35***	-.15	.37***	.21*	-.34***			
C-ToM faux pas	18.32 ± 5.65	-.17	.30**	-.05	.07	.13	-.11	.35***		
C-ToM implication stories	6.28 ± 1.89	-.26*	.40***	-.15	.21*	.26*	-.14	.49***	.53***	
C-ToM non-verbal	8.17 ± 2.96	-.42***	.24*	-.34**	.31**	.24*	-.18	.42***	.29**	.54***

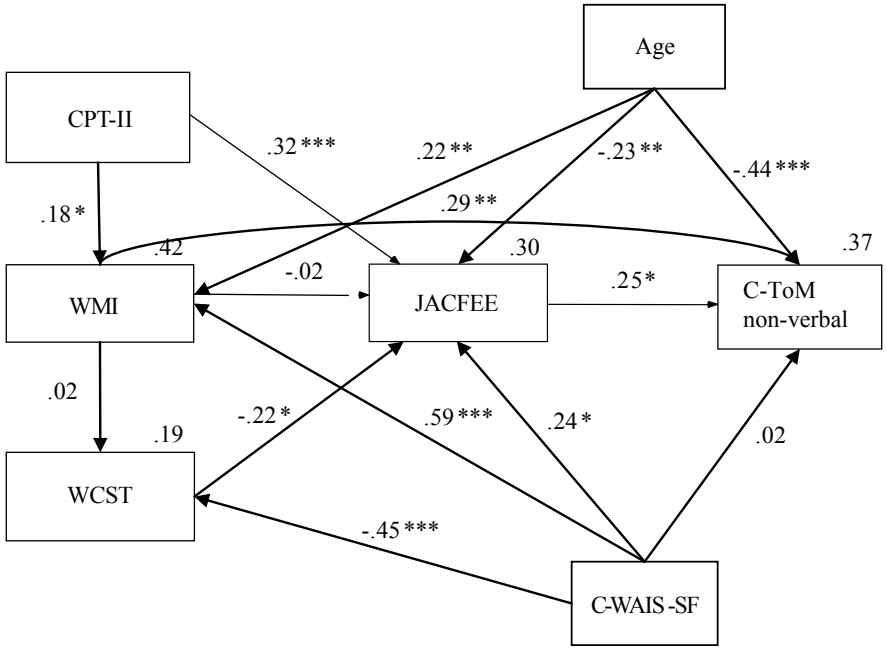
Notes. C-WAIS-SF = Chinese Wechsler Adult Intelligence Scale-III-Short Form, SANS = the Scale for the Assessment of Negative Symptoms, CPT-II = Conners' Continuous Performance Task-II, C-WMI = Chinese Wechsler Memory Scale-III-Working Memory Index subtests, WCST = Wisconsin Card Sorting Test, JACFEE = Japanese and Caucasian Facial Expression of Emotion, C-ToM = Chinese Theory of Mind Tasks.
* $p < .05$, ** $p < .001$, *** $p < .001$.



Model 1 ToM faus pas model



Model 2 ToM implication stories model



Model 3 ToM non-verbal model

Fagure 1. **Standardized regression path estimates for Model 1: ToM Faus Pas model, Model 2: ToM implication stories model, and Model 3: ToM non-verbal model. Dotted lines represent non-significant paths. Squared multiple correlations are shown at the top-right corner of cariables. CPT-II = Conners' Continuous Performance Task-II, C-WMI = Chinese Wechsler Memory Scale-III-Working Memory Index subtests, WCST = Wisconsin Card Sorting Test, JACFEE = Japanese and Caucasian Facial Expression of Emotion, C-ToM = Chinese Theory of Mind Tasks, C-WAIS-SF = Chinese Wechsler Adult Intelligence Scale-III-Short Form. *$p < 0.05$, **$p < 0.01$, ***$p < .001$.**