Empathy and Theory of Mind in Ultra-High Risk for Psychosis: Relations With Schizotypy and Executive Function

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Objective While recent studies have found deficits in theory of mind (ToM) skills in individuals at ultra-high risk (UHR) for psychosis, empathic tendencies in these subjects remain unclear. The presence of high schizotypy and compromised executive functions, which are found in UHR individuals, would affect ToM skills and empathic tendencies. We investigated the ToM skills and empathic tendencies of UHR individuals and examined their relationship with schizotypy and executive function.

Methods This study included 28 UHR individuals and 28 age- and sex-matched healthy controls. All participants completed a self-reported empathic scale (Interpersonal Reactivity Index) and the Wisconsin Schizotypy Scales. Additionally, the ToM Picture Stories Task and Wisconsin Card Sorting Test were conducted.

Results UHR individuals showed a trend toward lower self-reported empathic tendencies; however, there were no differences in ToM skills between the two groups. Of the four subscales of the IRI, only empathic concern showed a significant difference between the two groups. Empathic concern was inversely associated with negative schizotypy.

Conclusion Our findings suggest that UHR individuals show relatively preserved cognitive empathy but compromised emotional empathy. Furthermore, in UHR individuals, the empathic concern subscale of the IRI was associated with negative schizotypy, while ToM skills were related to positive schizotypy and executive function. **Psychiatry Investig 2021;18(11):1109-1116**

Keywords Social cognition; Empathy; Theory of mind; Anhedonia; Magical ideation; Self-other boundary.

INTRODUCTION

Social cognitive deficits are a key feature of individuals with schizophrenia that affect daily functioning and outcomes.[1,2] Theory of mind (ToM) and empathic tendencies are multidimensional domains of social cognition and have been used reciprocally without clear distinction in previous studies.[3] ToM is the ability to infer others' mental states, including intentions and thoughts, and to attribute those states to others, while empathy describes the ability to react to one's own and other people's emotions. According to the empathy models of Shamay-

Tsoory et al.,[4] both ToM and empathic tendencies have two distinct aspects: cognitive and affective.[5,6] Cognitive ToM refers to the ability to infer others' beliefs, intentions, and thoughts, while affective ToM refers to the ability to think about others' feelings. Cognitive empathy is the ability to employ cognitive functions to take other people's perspectives, whereas emotional empathy is the ability to feel emotional reactions when observing other people's experiences. Thus, cognitive ToM is a prerequisite for affective ToM, and affective ToM is related to cognitive empathy, as well as emotional empathy to some extent.[4]

ToM abilities are empirically examined using verbal or visual behavioral tasks such as the Strange Stories Test,[7] the Reading the Mind in the Eyes Test,[8,9] and the ToM Picture Stories Task (ToM-PST).[10] Impairment of ToM in schizophrenia has been consistently reported.[1,11] Unaffected first-degree relatives of schizophrenic patients[12,13] and individuals at ultra-high risk (UHR) for psychosis[13] also show modest ToM deficits. Meanwhile, empathic tendencies are measured using self-reported questionnaires such as the Interpersonal Reactivity Index (IRI).[14]

Empathic tendencies in schizophrenic patients have mostly been investigated using the IRI, which consists of two cognitive (perspective taking and fantasy) and two emotional components (empathic concern and personal distress) of empathy. According to a previous meta-analysis, individuals with schizophrenia reported significant impairments in perspective taking (pooled effect size [ES]=-0.53), empathic concern (pooled ES=-0.28), and fantasy (pooled ES=-0.19), while experiencing more personal distress (pooled ES=0.71).[15] Meanwhile, in one study of the IRI of patients with first-episode schizophrenia with subsequent meta-analytic comparisons with previous studies in patients with chronic schizophrenia,[16,17] first-episode patients showed an increase in personal distress subscale scores at the trend-level while showing comparable levels in other subscales relative to those of normal controls. Moreover, this meta-analytic comparison found that there was a significant difference in perspective-taking and trend-level differences in fantasy between patients with first-episode schizophrenia and those with chronic schizophrenia.[16,17] It was previously proposed that no impairment in perspective taking exists in patients with first-episode schizophrenia.[16,17] In unaffected first-degree relatives of schizophrenic patients, no significant difference in IRI subscales was found compared to normal controls who did not have a family history of schizophrenia.[12] However, little is known about self-reported empathy in UHR individuals. One study[18] on behavioral assessments of empathic tendencies in individuals at UHR for psychosis showed that subjects who later developed overt psychosis were characterized by lower scores in emotional empathy but not in cognitive empathy.

It has been reported that social cognitive deficits are related to the level of schizotypy, executive function, duration of illness, use of psychiatric medications, co-morbidities, and sex.[2,15,19-21] Schizotypy is the risk of psychosis that is continuously distributed in the general population.[22-24] Schizotypy consists of three identifiable dimensions: 1) positive dimension, which is a cognitive-perceptual dimension that includes magical thinking, perceptual aberrations, or ideas of reference; 2) negative dimension, which is an interpersonal dimension and includes constricted affect, social anxiety, and social or physical anhedonia; and 3) disorganized dimension, which includes odd behavior or speech.[25] Regarding the relationship between schizotypy and ToM, it was reported that only positive schizotypy negatively affects ToM performance in psychometrically-defined schizotypy groups.[26] Regarding the relationship of schizotypy with both ToM and empathy, a structural equation modeling study in the general population demonstrated a significant negative relationship only between negative schizotypy and empathy as modeled by the empathic concern, perspective taking, and fantasy subscales of the IRI; however, there were no significant associations between each dimension of schizotypy and ToM.[27]

Executive function plays a role in social cognitive processes; deficits of executive function in schizophrenia may lead to poorer social cognitive processes.[28-30] Executive function is defined as a group of neurocognitive processes that include mental set shifting, inhibition, planning, working memory, and cognitive flexibility.[31] Regarding the relationship between executive function and ToM in UHR individuals, IQ was reported to be positively correlated with ToM performance; additionally, in UHR individuals, lower IQ (<110) was associated with more prominent ToM disabilities when compared to higher IQ (≥110).[32,33] Regarding the relationship of executive function with empathic tendencies, a recent meta-analysis in a mixed sample of healthy volunteers and various clinical groups revealed that empathy, especially cognitive empathy, was positively related to executive function.[34]

The first aim of this study was to investigate the presence of impairment of self-reported empathic tendencies and ToM skills (measured by scores of the sequence and cognitive questionnaire of the ToM-PST[10]) in individuals at UHR for psychosis, who are known to show high levels of schizotypy[35] and compromised executive function.[36-38] The second aim was to examine the relationships of empathic tendencies and ToM skills with schizotypy (measured by anhedonia[39] and magical ideation[40]) and executive function (measured by the Wisconsin Card Sorting Test[41]) in UHR individuals. Based on previous findings, it was hypothesized that, in individuals at UHR for psychosis, both self-rated empathy and ToM skills would be impaired. In addition, we examined whether the domains of empathy and ToM could be associated with schizotypy and executive function in UHR individuals.

METHODS

Participants

Twenty-eight individuals (19 men and 9 women) at UHR for psychosis and 28 age- and sex-matched healthy controls (HC) participated in the present study. From July 2011 to November 2016, UHR participants were recruited from the research clinic FOR YOU at the Severance Hospital of the Yonsei University Health System in Seoul, Republic of Korea. Eligible participants were aged from 15 to 35 years and all of them were assessed using the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-IV).[42,43] Individuals at UHR for psychosis were evaluated according to the Structured Interview for Prodromal Syndromes (SIPS).[44] Each UHR participant met one or more of the following criteria based on the presence and severity of positive symptoms: 1) attenuated positive symptom syndrome (APSS, n=25), 2) brief intermittent psychotic syndrome (BIPS, n=1), and 3) genetic risk and deterioration syndrome (GRDS; n=7). The DSM-IV diagnoses of the UHR

group were as follows: depressive disorder (n=14), anxiety disorder (n=6; social phobia, n=3; obsessive-compulsive disorder, n=1; panic disorder, n=1; post-traumatic stress disorder, n=1), somatoform disorder (n=1), and depersonalization disorder (n=1). Participants were excluded if they have a history of or currently have neurological disorders, traumatic brain injury, or intellectual disability (IQ<70). This study was reviewed and approved by the Institutional Review Board of the Severance Hospital of the Yonsei University Health System (IRB No. 4-2014-0744). All individuals and parents of participants under 18 years of age provided written informed consent.

Measures

Self-report assessment of empathic tendencies

Empathic tendencies were assessed using the Interpersonal Reactivity Index (IRI),[14,45] which is a 28-item self-report questionnaire most widely used for assessing empathy as a multidimensional construct. The IRI consists of four subscales with 7 items under each: 1) empathic concern, the propensity to feel sympathy or compassion for others; 2) perspective taking, the propensity to adopt another's psychological point of view; 3) personal distress, the inclination to experience self-oriented negative feelings when seeing others in distress; and 4) fantasy, the inclination to transpose oneself into feelings and actions of fictitious characters in imaginary situations such as books or movies. The empathic concern and personal distress subscales represent affective aspects, whereas the perspective-taking and fantasy subscales represent the cognitive aspects of empathy. The total score for each subscale ranges from 0 to 28. In the present study, the internal consistency of each subscale (Cronbach's alpha) ranged from 0.71 to 0.79.

Behavioral measurement of ToM skills

ToM skills were evaluated using the ToM Picture Stories Task (ToM-PST),[10] which consists of six cartoon picture sets with four pictures each. The test was carried out in two steps. In the first step, participants were asked to rearrange the shuffled cards into a logical sequence of events. For each trial, participants scored 2 points if the first and last cards were in the correct order and one point each for correctly ordering the second and third cards (ToM-PST, sequence: 0–36 points). In the second step, after the cards were sequenced correctly by the participant or by an examiner, the participant was requested to describe each picture and infer the cognitive and affective mental states of the characters. Cognitive questions were directed towards the false-beliefs and intentions of the cartoon characters, whereas affective questions asked about the emotions and feelings of the characters.[46] In the present study, only the cognitive questionnaires were used since the affective ques-

tionnaires were not available at the author's lab at the start of the study. A point was given in the ToM-PST cognitive questionnaire for logical reasoning and comprehension of first-, second-, and third-order false beliefs (cognitive questionnaires: 0–23 points). There were two missing data for each group.

Assessment of self-reported schizotypy

Psychometric schizotypy was assessed using the self-reported Wisconsin Schizotypy Scales,[47] specifically, the Magical Ideation Scale[40] and the Revised Social Anhedonia Scale.[39] The Magical Ideation Scale is a 30-item true-false scale that assesses unusual beliefs of tendency of causation that are invalid by conventional standards. This scale contains statements that are mainly related to unusual associations between mental processes and external events, occult or fantastic ideas, superstitions, and déjà vu, and also contains a few statements related to delusion-like phenomena such as ideas of reference. The Revised Social Anhedonia Scale assesses anhedonia in hypothetical emotional experiences and consists of 40 true-false items that measure deficits in the ability to experience pleasure from non-physical stimuli such as interpersonal relationships. The Magical Ideation Scale represents the positive aspect of schizotypy, whereas the Revised Social Anhedonia scale represents the negative aspect of schizotypy. We used the Korean version of the Magical Ideation Scale and Social Anhedonia Scale, which is widely used in Korean psychiatric research.[35,48,49] In the present study, the internal consistency (Cronbach's alpha) of the Magical Ideation Scale was 0.76, and that of the Revised Social Anhedonia Scale was 0.93.

Assessment of executive function

The Wisconsin Card Sorting Test[41] was conducted to assess executive function; the total number of errors was used in this study. There was one missing data point in the UHR group.

Statistical analysis

Independent t-tests and χ^2 tests were conducted to analyze the differences in demographic and clinical characteristics between the two groups. The effects of being at UHR for psychosis, sex, and their interactions on IRI and ToM-PST, were tested separately using a multivariate analysis of variance (MANOVA). Post-hoc comparisons between the HC and UHR groups were conducted using one-way analysis of variance (ANOVA) for each IRI and ToM-PST score. In the UHR group, stepwise multiple linear regression analyses were performed to examine the relationships between IRI and ToM-PST with schizotypy and executive function. Each subscale of the IRI and the ToM-PST was analyzed as dependent variables, while the scores from the Magical Ideation Scale and Revised Social Anhedonia Scale, as well as the total errors in WCST, were treated as inde-

pendent variables. Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS 25; IBM Corp., Armonk, NY, USA). The level of significance was defined as a p-value less than 0.05, and a p-value between 0.05 and 0.10 was considered a trend level of significance.

RESULTS

Demographic and clinical characteristics

The demographic and clinical characteristics of all participants are shown in Table 1. There were no significant differences in age, sex, total duration of education, or total errors in WCST between the two groups. The UHR group demonstrated higher scores on the Revised Social Anhedonia scale, but there was no difference in the Magical Ideation Scale between the two groups.

Effect of UHR for psychosis and sex on the empathic tendencies and the ToM skills

For empathic tendencies (Table 2), significant effects at the trend level were observed with the groups [HC vs. UHR; F(4,49)= 2.3, p=0.070] and sex [male vs. female; F(4,49)=2.1, p=0.097]. There were no significant interaction effects between the groups and sex [F(2,47)=1.0, p=0.442]. Post-hoc ANOVAs to compare

Table 1. Demographic and clinical characteristics of healthy controls and individuals at ultra-high risk for psychosis

	HC (N=28)	UHR (N=28)	Statistical parameters
Age (mean years±SD)	20.4±2.9	20.3±3.4	t=0.09, df=54, p=0.932
Sex (male/female)	19/9	19/9	
Education (mean years±SD)	13.6±1.9	13.1±1.7	t=1.12, df=54, p=0.268
PANSS*			
Positive scale	7.1±0.5	13.0±3.9	t=-7.70, df=52, p<0.001
Negative scale	7.1±0.5	17.4±6.1	t=-8.76, df=52, p<0.001
General psychopathology scale	16.2±0.6	34.2±5.7	t=-16.40, df=52, p<0.001
Antipsychotic medications			
Naïve/medicated		21/7	
Chlorpromazine equivalent dose (mg/d)		99.6 (90.5)	
Self-reported schizotypy			
Magical Ideation Scale	8.7±4.2	8.1±5.9	t=0.40, df=54, p=0.692
Revised Social Anhedonia Scale	7.7±4.1	22.0±8.3	t=-8.16, df=54, p<0.001
Executive function			
Total errors of Wisconsin Card Sorting Test[†]	26.1±17.4	19.0±15.8	t=1.58, df=53, p=0.119

*1 missing data in each group; [†]1 missing data in UHR group. HC, healthy controls; UHR, ultra-high risk; PANSS, Positive and Negative Syndrome Scale; SD, standard deviation

Table 2. Empathic tendencies and theory of mind skills of healthy controls and individuals at ultra-high risk for psychosis: MANOVAs and post hoc ANOVAs with subscales of the IRI and ToM-PST as dependent variables

	Group	Sex	Group×sex
MANOVA	F(4,49)=2.319, p=0.070	F(4,49)=2.087, p=0.097	F(4,49)=0.953, p=0.442
Post hoc ANOVA			
Empathic concern of IRI	F(1,52)=4.980, p=0.030	F(1,52)=0.027, p=0.871	F(1,52)=0.345, p=0.560
Perspective taking of IRI	F(1,52)=1.510, p=0.225	F(1,52)=6.569, p=0.013	F(1,52)=3.198, p=0.080
Personal distress of IRI	F(1,52)=2.141, p=0.149	F(1,52)=0.421, p=0.520	F(1,52)=0.097, p=0.757
Fantasy of IRI	F(1,52)=0.083, p=0.774	F(1,52)=0.624, p=0.433	F(1,52)=0.257, p=0.614
MANOVA	F(2,47)=2.378, p=0.104	F(2,47)=2.225, p=0.119	F(2,47)=0.512, p=0.602
Post hoc ANOVA			
ToM-PST sequence	F(1,48)=3.114, p=0.084	F(1,48)=4.284, p=0.044	F(1,48)=0.817, p=0.371
ToM-PST cognitive questionnaire	F(1,48)=4.432, p=0.041	F(1,48)=0.647, p=0.425	F(1,48)=0.845, p=0.363

MANOVA, multivariate analysis of variance; ANOVA, analysis of variance; IRI, interpersonal reactivity index; ToM-PST, theory of mind picture stories task

IRI subscales between UHR individuals and HC, as well as between males and females, were conducted since the main effects of group and sex were at the trend level. Empathic concern (14.5±5.1) in UHR individuals was significantly lower than that (18.0±4.6) in HC [F(1,52)=5.0, p=0.030]. Perspective-taking (13.6±4.6) in women was significantly lower than that (16.9±4.8) in men [F(1,52)=6.6, p=0.013]. There were no significant effects.

For ToM skills (Table 2), there were no significant or trend-level effects by group [F(2,47)=2.4, p=0.104] or sex [F(2,47)=2.2, p=0.119]; furthermore, there were no interaction effects between group and sex [F(2,47)=0.5, p=0.602].

Associations of empathic tendencies and ToM skills with schizotypy and executive function in individuals at UHR for psychosis

Stepwise multiple linear regression analyses were conducted using the Magical Ideation Scale, Revised Social Anhedonia Scale, and total errors in WCST as independent variables. Empathic concern [F(1,25)=5.2, p=0.032, adj. R^2=0.14] and perspective-taking [F(1,25)=6.5, p=0.017, adj. R^2=0.18] were negatively associated with social anhedonia. Personal distress and fantasy were positively related to magical ideation [personal distress: F(1,25)=4.4, p=0.047, adj. R^2=0.12; fantasy: F(1,25)=7.6, p=0.011, adj. R^2=0.20]. For ToM skills, the ToM-PST sequence was negatively associated with total errors in WCST (p=0.001) and magical ideation (p=0.007) [F(2,22)=10.9, p=0.001, adj. R^2=0.45]. The ToM-PST cognitive questionnaire was also negatively related to the total errors in WCST (p=0.012) and magical ideation (p=0.084) [F(2,22)=5.2, p=0.014, adj. R^2= 0.26]. All variance inflation factor (VIF)s were less than 1.1 (Table 3).

DISCUSSION

This study aimed to investigate whether empathic tendencies and ToM skills are impaired in individuals at UHR for psychosis and to examine their relationships with schizotypy and executive function. There was a trend-level difference in self-reported empathic tendencies but there was no difference in the ToM skills between the two groups. The compromised empathic concern of the IRI contributed to the group differences. Empathic concern was solely associated with negative schizotypy, while ToM skills were related to positive schizotypy and executive function in UHR individuals.

Empathic tendencies in individuals at UHR for psychosis

The empathic concern subscale, but not the cognitive empathy subscale, of IRI was found to be compromised in UHR individuals. These results are consistent with the findings of a behaviorally-assessed empathy study which showed that, while emotional empathy in UHR individuals who later developed overt psychosis was poorer compared to HC, cognitive empathy was relatively preserved.[18] Regarding the emotional components of empathic tendency, the impairment of empathic concern in individuals at UHR for psychosis is consistent with our previous finding of reduced current pleasurable response to emotional stimuli in a laboratory setting in UHR individuals.[50] The finding of reduced empathic concern without an increase in personal distress in UHR individuals is inconsistent with previous IRI findings in patients with first-episode schizophrenia that showed intact empathic concern and increased personal distress.[16,17] Regarding cognitive empathy, the relatively intact cognitive empathic tendencies in UHR individuals is consistent with and supports the previous IRI findings

Table 3. Stepwise multiple linear regression analyses of empathic tendencies and theory of mind skills with schizotypy and executive function of individuals at ultra-high risk for psychosis

Dependent variables	Independent variables	B	SE	β	t	p	Model properties
Empathic tendencies							
Empathic concern of IRI	Revised social anhedonia	-0.24	0.11	-0.42	-2.29	0.032	$F_{1,25}$=5.2, p=0.032, R^2=0.17, adj. R^2=0.14
Perspective taking of IRI	Revised social anhedonia	-0.26	0.10	-0.45	-2.55	0.017	$F_{1,25}$=6.5, p=0.017, R^2=0.21, adj. R^2=0.18
Personal distress of IRI	Magical ideation	0.37	0.18	0.39	2.09	0.047	$F_{1,25}$=4.4, p=0.047, R^2=0.15, adj. R^2=0.12
Fantasy of IRI	Magical ideation	0.48	0.17	0.48	2.75	0.011	$F_{1,25}$=7.6, p=0.011, R^2=0.23, adj. R^2=0.20
Theory of mind skills							
ToM-PST sequence	Total errors of WCST	-0.16	0.05	-0.56	-3.68	0.001	$F_{2,22}$=10.9, p=0.001, R^2=0.50, adj. R^2=0.45
	Magical ideation	-0.36	0.12	-0.45	-2.98	0.007	
ToM-PST cognitive questionnaire	Total errors of WCST	-0.10	0.04	-0.48	-2.73	0.012	$F_{2,22}$=5.2, p=0.014, R^2=0.32, adj. R^2=0.26
	Magical ideation	-0.18	0.10	-0.32	-1.81	0.084	

All variance inflation factor (VIF)s were less than 1.1. B, unstandardized coefficient; SE, standard error of unstandardized coefficient; β, standardized coefficient; adj. R^2, adjusted R-square; IRI, interpersonal reactivity index; ToM-PST, theory of mind picture stories task; WCST, Wisconsin Card Sorting Test

of intact perspective taking and fantasy in patients with first-episode schizophrenia.[16,17] Meanwhile, a previous meta-analysis of patients with chronic schizophrenia revealed impaired perspective taking in these patients.[15] Therefore, emotional and cognitive empathic tendencies as a whole may evolve differently depending on the phase and progression of a patient's illness.

ToM skills in individuals at UHR for psychosis

The overall performance of ToM skills in UHR individuals did not differ significantly from that of HC. This finding seems to be incompatible with a previous meta-analysis[51] that reported ToM impairment on verbal ToM tasks in UHR individuals; furthermore, this finding is also incompatible with previous studies that consistently demonstrated impaired ToM performance on false belief tasks in patients with schizophrenia.[11,13] However, previous studies on UHR individuals using false belief tasks as a measure of ToM have shown mixed results.[33,52-54] One study, which divided participants into high- (≥110) and low-IQ groups, revealed that the UHR group with high IQ performed just as well as HC with high IQ on ToM tasks.[33] Therefore, in this study, the results of the ToM-PST could be partly due to the comparable level of performance in the Wisconsin Card Sorting Test in both groups.

Relationship of empathic tendencies and ToM skills with schizotypy and executive function

The empathic concern was exclusively associated with negative schizotypy but not with executive function. Our findings are consistent with a previous study on behaviorally assessed empathy of UHR individuals who later developed overt psychosis; in that study, it was shown that decreased emotional empathy was related to negative symptoms.[18] In addition, this finding is consistent with previous studies that showed a negative correlation between emotional empathy and negative schizotypy in schizophrenic patients[55] and non-clinical participants.[27,56,57] Since social anhedonia, which is a negative schizotypy, is defined as a decrease in pleasure derived from interpersonal sources, decreased empathic concern in UHR individuals may reflect indifference and lower emotional reactivity to other people's experiences.[39,58]

ToM skills were found to be related to both positive schizotypy and executive function in UHR individuals. These findings are consistent with previous findings that showed ToM impairment in the positive schizotypy group but not in the negative group.[26] Since magical ideation is an unusual belief in forms of causation that are invalid by conventional standards and unusual associations between mental processes and external events,[40] UHR individuals with increased magical ideation may not be able to discriminate between their own mental state and that of others; thus, they cannot properly perform the false-belief test. A previous meta-analysis of the general population showed a significant association between schizotypy and poorer ToM performance and demonstrated that various aspects of ToM skills are affected differently by different schizotypy dimensions; furthermore, the researchers suggested that neurocognition might be a potential mediator.[2] As previously demonstrated in schizophrenic patients[11] and in individuals at UHR for psychosis,[33,52,53] ToM skills, but not empathic concern, were shown to be associated with executive function in these individuals. Measurements of ToM skills examine the extent to which a person can match with another person's mental state or emotion; that is, the ability to see from another person's perspective while maintaining one's own stance. However, empathic tendencies that are measured by a self-reported scale may only reflect how much effort one can exert to empathize with others or subjectively experience empathic emotions under given situations. Therefore, the discrepancy in the association of executive function with empathic tendencies and ToM skills in this study might be attributed to differences in the underlying constructs of ToM skills and empathic tendencies. Another possible explanation of this differential relationship of two measures of social cognition with executive function is derived from the methodological differences in evaluating ToM skills and empathic tendencies; that is, the sequencing ability of ToM-PST may also reflect executive function, while self-reported empathic tendencies may be not dependent on executive function. Thus, this differential relationship could just reflect a methodological characteristic of our measures.

Perspective taking is related to social anhedonia. Perspective taking assesses the propensity to adopt another's psychological point of view in an effort to understand and consider the feelings of others. Thus, anhedonia, which is a negative schizotypy, may act as a hindrance to cognitive empathy. Furthermore, it was found that fantasy and personal distress are correlated with magical ideation in UHR individuals. Subjects at UHR for psychosis who have higher levels of magical ideation may not attribute the source of mental states to others and thus show increased empathic tendency to place themselves into hypothetical positions and to direct the distressful emotional states of other people toward themselves.

This study has several limitations. First, the relatively small sample size and the predominance of the male sex in the participants may have influenced the study; thus, the ToM skills of the UHR individuals in this study were not significantly different from those of normal controls. Second, this study was cross-sectional in design; thus, the causal relations of empathy and ToM with schizotypy and executive function cannot be determined. Third, behavioral performances of affective ToM were not examined because the affective questionnaires of ToM-

PST were not available prior to the start of this study. Recent studies found discrepancies in empathy when using behavioral or self-report measurements in schizophrenic patients as these individuals tend to overestimate their empathy compared to what is observed by their caregivers.[59] Therefore, future longitudinal follow-up studies should include behavioral measurements of empathy and comprehensive ToM assessments to elucidate the exact picture of social cognition in UHR individuals.

In conclusion, our findings suggest that individuals at UHR for psychosis experience reduced empathic concern compared to healthy controls, despite their preserved cognitive empathic tendencies and ToM skills. This reduced tendency for empathic concern may be related to stronger negative schizotypy rather than neurocognitive function in UHR individuals.

Availability of Data and Material

The datasets generated or analyzed during the study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Suk Kyoon An. Data curation: all authors. Formal analysis: Wanji Kong, Se Jun Koo, Suk Kyoon An. Funding acquisition: Eun Lee, Suk Kyoon An. Investigation: all authors. Methodology: Wanji Kong, Se Jun Koo. Project administration: Eun Lee, Suk Kyoon An. Resources: Eun Lee, Suk Kyoon An. Software: Wanji Kong, Se Jun Koo. Supervision: Suk Kyoon An. Validation: Suk Kyoon An. Visualization: Wanji Kong. Writing—original draft: Wanji Kong. Writing—review & editing: all authors.

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