1. Introduction

Theory of Mind (ToM), also referred to as mentalization or mindreading, is the ability to represent self and others' mental states, allowing intentions, dispositions, and/or beliefs to be inferred (Green et al., 2008). Deficits in ToM are well-established in individuals with schizophrenia (Sprong et al., 2007). These and other impairments in domains of social cognition, are specifically related to impaired social functioning (Fett et al., 2011) and are a disabling feature of the illness (Velthorst et al., 2017).

ToM impairment has both state and trait characteristics. Research shows that it is more pronounced in acute psychotic episodes and it is correlated with both positive and negative symptoms (Ventura et al., 2013). However, the trait notion is supported by evidence which demonstrates that deficits persist in an attenuated form even after symptom remission (Bora et al., 2009); are also evident in individuals at ultra-high-risk, first psychotic episode samples; and in first-degree relatives (Bora & Pantelis, 2013). ToM deficits occur along a psychosis continuum, ranging from at-risk states (e.g., unaffected relatives who share genetic risk factors) to severe psychotic disorders; suggesting that ToM may represent an intermediate phenotype (or endophenotype), with a partly genetic origin (Abu-Akel & Shamay-Tsoory, 2013). In this regard, there is evidence showing that both individuals with psychosis and their parents perform worse in neurocognitive and ToM tasks when compared to controls and parents. However, neurocognition predicted poorer ToM performance only for individuals with psychosis, explaining around a third of the variance suggestive of other

contributing factors (Anselmetti et al., 2009). Indeed, ToM has also been considered a “developmental achievement”, where optimal maturation may depend on establishing good quality early attachments to others (Luyten & Fonagy, 2015). In support of this, the quality of attachment has been shown to be intrinsically related to the processing of social information (Chris Fraley et al., 2006; Dykas & Cassidy, 2011).

Attachment theory (Bowlby, 1969) proposes that there is an innate human disposition for seeking proximity and support from others in times of need in order to feel safe and secure (Mikulincer & Shaver, 2016). Attachment is conceived as a behavioural system that is activated by distress or perceived threat and then deactivated by feeling secure, thus promoting optimal social development (Mikulincer & Shaver, 2012). Consistency in early experiences of care and social relationships are related to the formation of internal working models of self and others, which form the basis of adult attachment styles. These models entail knowledge, expectations, and insecurities that people hold about themselves and their relationships (Fraley & Roisman, 2019). Attachment styles can be generally classified as secure and insecure. Secure attachment is characterized by models of the self and others in which close relationships are highly valued and associated with positive personal development. Insecure attachment constitutes two main dimensions: anxiety and avoidance. Attachment anxiety (also referred to as preoccupied attachment style), refers to a negative model of self and a positive model of others, and is characterized by low self-worth, fear of abandonment and rejection, continuous vigilance of threat-related

cues and reduced capacity to regulate negative emotions. Attachment avoidance (also referred to as dismissing attachment style) is characterized by a positive self-view and excessive self-reliance, allied to a negative view of others that is expressed in reduced emotional reactivity and expressiveness and intimacy with others (Mikulincer & Shaver, 2016). Importantly, although attachment styles are generally stable, it is accepted that they can change under normative influences and also in stressful contexts, including the experience of psychopathology (Fraley, 2019).

Insecure attachment is twice as high in psychosis samples compared to non-clinical samples (Carr et al., 2018; Gumley et al., 2014; Korver-Nieberg et al., 2014; Palmier-Claus et al., 2019) and has been associated with early traumatic experiences (Bucci et al., 2017) and severity of positive psychotic symptoms. Research showed that attachment anxiety is strongly associated with paranoia, potentially mediated by elevated hypervigilance for threat and negative beliefs about the self (Carr et al., 2018; Lavin et al., 2019).

Attachment styles also seem to play a role in social cognitive impairments in psychosis. Insecure attachment may lead to withdrawal from social contact and thus reduced opportunities to learn social cognitive skills throughout childhood and adolescence. There is evidence from the healthy adolescent population suggesting that attachment styles are differentially associated with ToM abilities. Specifically, attachment anxiety was found to be associated with less accurate ToM. However, some evidence shows that this effect was present only in the domain of relationship with the mother, and that it was stronger in younger

adolescents, suggesting a complex relationship between attachment styles and ToM (Hünefeldt et al., 2013). Studying the relationship between attachment and social cognition can provide valuable insights into how attachment impacts social functioning in psychosis. The first study to explore this relationship (MacBeth et al. 2011) was conducted in a sample of 34 individuals with a first episode of psychosis (FEP) assessed with the Attachment Assessment Interview (AAI). This semi-structured interview is transcribed and coded for analysis of coherence between the narrative of attachment experiences and how those memories are currently appraised. Attachment was categorized as secure, preoccupied (anxious) or dismissing (avoidant). ToM, operationalized as 'reflective function', was also derived from the interview's transcript. The authors found that those classified as anxious had higher ToM abilities compared to those classified as avoidant. Additionally, there was no association between attachment classifications and psychotic symptoms, as measured by the Positive and Negative Syndrome Scale (PANSS). However, there was the limitation of a relatively small sample size. A second study (Korver-Nieberg et al., 2013) was conducted in a sample of 32 individuals with early psychosis and 78 healthy controls. Attachment was assessed with the self-reported questionnaire Psychosis Attachment Measure (PAM) and ToM was operationalized as 'perspective taking' and assessed with a visual Perspective Taking task. Patients showed higher attachment anxiety and avoidance, but they performed similar on the Perspective Taking task and no associations were found between anxious or avoidant attachment and performance on the task. Attachment avoidance had a

medium sized correlation with persecutory ideation. The authors attributed their findings to the fact that a more cognitive aspect of ToM was measured with their task, and attachment may be more relevant to the emotional, affective components of ToM. The third study (Pos et al., 2015), was conducted with a sample of 111 individuals with diagnosis of schizophrenia spectrum disorders, 106 unaffected siblings and 63 controls. Attachment was assessed with the PAM and both cognitive and affective aspects of ToM were assessed with the Conflicting Beliefs and Emotions task, evaluating first order skills (inferring thoughts/emotions of another person) and second order skills (inferring what another person thinks about another person's thoughts and emotions). Additional assessments of psychotic like experiences and trauma were conducted. They found that out of the three groups, patients with a schizophrenia spectrum disorder showed the highest attachment anxiety and avoidance and the lowest ToM. There were no differences between siblings and controls in either attachment domain or ToM. Patients' attachment anxiety showed a negative linear association with cognitive ToM, while attachment avoidance showed U-shaped associations with cognitive and affective ToM, where both lower and higher scores on attachment avoidance were associated with better ToM performance. The authors suggested that attachment styles might moderate ToM and that the diagnoses of a psychotic disorder could potentially contribute to this association.

In the present study, we aimed to explore the interaction effect between attachment styles (avoidant and anxious) and ToM in three groups across the of

the psychosis continuum, i.e., individuals with a non-affective psychotic disorder, unaffected first-degree relatives, and controls. First-degree relatives share genetic and environmental factors with patients, but who do not present the clinical disorder, thus offering an intermediate phenotype. Specifically, we aimed: 1) to investigate the interaction between group (patients with chronic non-affective psychosis, their healthy first-degree relatives, and healthy controls) and attachment insecurity (anxiety and avoidance) and ToM ability; and 2) to explore the relationship between symptoms and attachment insecurity (anxiety and avoidance) in patients. We hypothesized that: 1) higher attachment insecurity in both domains would be present in patients followed by relatives and controls; 3) lowest levels of ToM performance would be evident in patients, followed by relatives and controls; 4) attachment insecurity would moderate group differences in ToM performance; and (5) higher symptom levels would be associated with poorer ToM performance and higher scores on the two dimensions of the insecure attachment styles in patients.

Methods

Participants

The sample consisted of 51 patients, 23 first-degree relatives and 49 controls. Inclusion criteria were (1) age between 18 and 65 (2) sufficient understanding of English to understand the study information, consent form and questionnaires; and (3) an estimated IQ > 70. Additionally, for patients, a diagnosis of non-affective psychosis within the ICD-10 (World Health Organization, 1992) and a

stable status on atypical antipsychotics treatment during the testing period were required. Relatives were only included if they had no personal history of a mental disorder. Controls were only included if they had no personal or family history of a mental disorder. Exclusion criteria included a documented or known history of neurological conditions; any history of alcohol/drug abuse or dependence within six months of the study screening. All participants gave a written informed consent.

Measures

Positive and Negative Syndrome Scale (PANSS)

The PANSS (Kay et al., 1987) is a clinician administered scale and was used to assess clinical symptoms in three subscales: positive (7 items), negative (7 items) and general psychopathology (16 items). Each item is rated on a Likert scale ranging from 1 (absence) to 7 (extreme). Sum scores for all items can range from 30 (no symptoms) to 210. Only the patient group was assessed with the PANSS. The Cronbach's alpha in our sample was 0.79, indicating good internal consistency.

Psychosis Attachment Measure (PAM)

The PAM (Berry et al., 2006, 2007) is the most widely used measure to assess attachment in individuals with diagnosis of psychosis. A distinctive feature, compared to other scales, is the exclusion of items about romantic relationships which tend to be infrequent or unstable in this group of individuals. It is a self-report, 16 item measure, with eight items for attachment anxiety and eight for

attachment avoidance. Each item describes a characteristic about current relationships with significant others (i.e., "*I worry that key people in my life won't be around in the future*"). Items are rated on a four-point Likert scale that assesses the extent to which a certain characteristic is present, ranging from 1 = 'not at all' to 4 = 'very much'. Three items of the avoidance dimension are reverse scored. Total scores are calculated for each dimension by averaging item scores, with higher scores reflecting greater anxiety and avoidance. The Cronbach's alpha in our sample was 0.8, indicating good internal consistency.

Reading the mind in the eyes task (RMET)

The RMET (Baron-Cohen et al., 2001) assesses the integration of cognitive and affective knowledge about others' mental states through direct visual perception (Bateman & Fonagy, 2012) from expressions in the eye region of the face. All participants were presented with the same set of thirty-six photos of different eye-region expressions, each with four answer options indicating different complex emotions. Participants had to choose the most representative option for each picture with aid of a list of all emotions used in the test with the corresponding meaning. The number of correct responses ranged from 0 to 36. The Social Cognition Psychometric Evaluation (SCOPE) study, aimed at identifying and improving assessment tools for conducting treatment studies in social cognition in schizophrenia, concluded that the psychometric properties of the RMET were acceptable and recommended its use (Pinkham et al., 2017). The Cronbach's alpha in our sample was 0.8, indicating good internal consistency.

General cognitive ability

The vocabulary and matrix reasoning subtests of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) were used as indicator of general estimated cognitive ability to control for the effect of IQ on ToM performance. This version has shown to provide reliable and valid estimates of Full-Scale IQ in individuals with schizophrenia (Velthorst et al., 2013)

Procedures

Testing was carried out by trained MSc level researchers. Participants received a detailed information sheet and gave written informed consent before the study. The researchers explained the testing procedure and informed participants about their rights to withdraw from the study at any point. Participants completed a demographic questionnaire and were assessed on the PANSS (patients only), PAM, RMET and the vocabulary and matrix reasoning subtests of the WASI. They also completed additional tasks, which are not within the scope of the current analysis. At the end of the study, participants received payment for their participation.

Data analysis

Descriptive statistics

Analyses were conducted using SPSS 24 (IBM Corp., 2016). Descriptive statistics were compared with Analysis of Variance (ANOVA) for continuous

variables, along with Bonferroni correction for multiple testing and Tukey Post hoc analysis when statistically significant differences were found. Chi-square tests were used for comparing categorical variables.

Moderation analysis

For testing the hypotheses of moderation effects, we followed the procedure described by Hayes & Montoya (Hayes & Montoya, 2017) using the PROCESS macro for SPSS (version 2.16), model 1 (Hayes, 2013). The first part consisted of testing for the presence of an overall interaction effect between predictors (group and attachment) and the outcome variable (ToM). Gender and general cognitive ability differed significantly between groups. We added the two factors as covariates to the analyses, as they have been suggested to impact on social cognitive performance and might impact on attachment (Del Giudice, 2019; Savla et al., 2013). The three groups (patients, relatives, controls) were represented as two dummy variables with the control group defined as reference category: D1 (controls vs. relatives) and D2 (controls vs. patients). A hierarchical multiple regression was conducted with the RMET score as the dependent variable. Independent variables for the first step were group (D1 and D2) and attachment anxiety. In the second step, interaction terms between independent variables were added to the model. The PROCESS macro reports the results of this model with unstandardized coefficients which are reported here. A statistically significant increase in R^2 when the interaction terms were included was considered as evidence for an overall moderation effect. The same procedure

was conducted separately for attachment avoidance. We repeated all analyses with the patient group as reference category to examine the difference between patients and relatives.

The second part of the analysis was conducted when evidence of an overall moderation effect was found, to determine at what level of the moderator's distribution (attachment in this case) the interaction was statistically significant. For this purpose, a simple slope analysis was conducted testing the interaction at three points in the distribution of the moderator (mean, - 1 and + 1 standard deviations). Complementary to the simple slope analysis, the Johnson-Neyman technique was used to establish the exact value in the distribution of the moderator at which the interaction becomes statistically significant. For the Johnson-Neyman technique we used the OGRS macro for SPSS (version 1.2) (Montoya, 2016). Finally, for the patient group, the same procedure for testing interaction between symptoms and attachment over ToM was conducted.

Results

Descriptive statistics

Sample characteristics and statistical analyses are displayed in Table 1. The total sample consisted of 123 participants (66% male). About 80% of participants in our sample were British and had English as their first language. Both the patient and control group had a higher proportion of males (82.4 % and 67.3%, respectively), while relatives had a higher proportion of females (74% female vs. 26% male). Gender differences between groups reached statistical significance

($\chi 2$ = 24.17, df = 2, p < 0.001). Patients had lower educational status ($\chi 2$ = 36.30, df =10, p < 0.001) and a higher proportion of them lived alone ($\chi 2$ = 32.19, df = 4, p < 0.001) and were unemployed ($\chi 2$ = 54.35, df = 6, p < 0.001). No differences in age were found between groups. Regarding attachment styles, no differences were found for either PAM total score or attachment anxiety. Although attachment avoidance differences reached statistical significance (F (2, 120) = 3.0, p = 0.05) they did not survive post-hoc correction. Statistically significant group differences were found for ToM (F (2, 120) = 18.93, p < 0.001) and estimated cognitive ability (F (2, 120) = 18.34, p < 0.001) with lowest scores for patients as compared to controls and relatives, who did not differ from each other significantly.

----------Table 1 about here----------

Bivariate correlations

ToM performance was significantly correlated with estimated cognitive ability at group level (r = 0.61, p < 0.001). For each group, ToM and estimated cognitive ability was significantly correlated at the 0.01 level: patients (r = 0.51), relatives (r = 0.54) and controls (r = 0.52). For patients, symptom severity was only correlated with attachment anxiety (Table S1).

Moderation analyses

Tables 2 and 3 show the results of the hierarchical multiple linear regression conducted to test the hypothesis that attachment styles interact with groups over ToM, controlling for gender and estimated cognitive ability.

Attachment anxiety

In the first model (Table 2) ToM performance was negatively predicted by attachment anxiety (b= -1.64, p = 0.007) and D2 (controls vs patients) (b= -2.49, p = 0.02). This model accounted for 47% of the variance in ToM. In the second model, only the interaction between D2 and attachment anxiety was statistically significant (b= -3.36, p = 0.02) (Table 2 and S1). The addition of the interaction term to the model led to a statistically significant increase in R^2 from 47% to 50% of the variance in ToM (ΔR^2 = 0.03, F(2, 114) = 3.17, p = 0.046), and therefore an overall interaction effect was confirmed.

To determine if the interaction exists along the whole distribution of attachment anxiety, an analysis of simple slopes was conducted (see Figure 1 and Table 4). The interaction was tested at three points: the mean value of attachment anxiety (1.92) at -1 SD and at +1 SD. The analysis showed that throughout the distribution of attachment anxiety, the interaction was statistically significant only at the mean and at +1SD. At -1SD, the interaction did not reach significance. To further identify the exact value in the distribution of attachment anxiety at which the interaction reaches significance, the Johnson – Neyman technique was conducted. The analysis showed that the interaction was statistically significant

at attachment anxiety values above 1.78 (p = 0.05). Translated to the scores of the PAM scale this value would broadly correspond to the transition between the absence of the trait (1 = “not at all”) mild presence of it (2 = “a little”).

Attachment avoidance

In the first model (Table 3 and S2), no association between attachment avoidance and ToM was found. ToM performance was negatively associated with D2 (controls vs patients) (b= -2.88, p = 0.01). This model accounted for 44% of the variance in ToM. In the second model, none of the predictors was significantly associated with ToM. The addition of the interaction terms did not lead to a statistically significant increase in R^2 (ΔR^2 = 0.02, F(2, 114) = 2.07, p = 0.13). The results contradicted the presence of an overall interaction effect. We therefore did not proceed with further analyses (Hayes & Montoya, 2017).

----------Tables 2, 3 and 4 about here----------

Symptoms of psychosis

To explore the hypothesis that symptoms would interact with attachment anxiety over ToM performance in patients, positive and negative symptoms were examined independently as moderators of the relationship between attachment

anxiety and ToM (Table 5 and 6). In both analyses, only attachment anxiety showed statistically significant associations with ToM. Also, for both analyses, the addition of the interaction terms did not increase the explained variance at a statistically significant level. Therefore, no further analyses were conducted.

----------Tables 5 and 6 about here----------

Discussion

This study aimed to explore the interaction between attachment styles (avoidant and anxious) and psychosis risk, operationalised in terms of three groups of the psychosis continuum, over ToM performance. The sample comprised of individuals with non-affective psychosis, their healthy first-degree relatives, and controls. Patients had a poorer performance in ToM compared to controls and relatives, whereas relatives and controls did not differ significantly, suggesting that ToM, as measured by the RMET, does not reflect an endophenotype. Regarding attachment styles, no differences were found between the three groups.

Although we did not find differences in attachments styles, our main finding was that attachment anxiety moderated group differences in ToM performance between patients and controls. Interestingly, these differences were only present at mean and high scores of attachment anxiety; i.e., increasing attachment anxiety scores were associated with worse ToM performance in

patients (*b* = - 3.36), whereas performance in controls improved slightly but non-significantly. This moderation effect was not statistically significant at the lower end of attachment anxiety distribution, where patient's ToM performance was similar to the performance of relatives and controls. This finding is in line with previous research in individuals with chronic psychosis, which showed that anxious attachment is related to poorer (cognitive) ToM performance in patients only (Pos et al., 2015). One possible interpretation of this finding is suggested by Fonagy and Lyuten (2015); individuals with higher attachment anxiety are more vulnerable to stress and have lower thresholds to switch from cortical to subcortical processing of social information, making them vulnerable to bias and error (Luyten & Fonagy, 2015). Individuals with a diagnosis of non-affective psychosis have higher baseline levels of stress and greater sensitivity to stress than the general population (Howes & Murray, 2014). The previously described vulnerability mechanism might therefore be amplified and lead to a decrease in ToM performance associated with higher levels of attachment anxiety. Alternatively, ToM impairment might lead to attachment anxiety once a psychotic disorder has been developed. Such an interpretation that suggests that the association is influenced by factors that are related to the chronicity of the disorder is supported by previous work, which showed that the association between attachment anxiety and poorer ToM performance was absent in individuals in the early stages of a psychotic disorder (MacBeth et al., 2011; Korver-Nieberg et al., 2013). Importantly, symptom severity in our sample did not moderate the relationship between attachment anxiety and ToM in patients.

Thus, the positive association between high attachment anxiety and poorer ToM was not due to severity of illness. Longitudinal data will be necessary to gain insights into the causal direction of the association and also into factors that may moderate or mediate this phenomenon.

No differences in attachment avoidance and no interaction effect between attachment avoidance and group on ToM was found. This result is in contrast with previous research (Pos et al., 2015), which found differences between patients and relatives and controls and which indicated that patients had better first order affective ToM performance at lower and higher levels of attachment avoidance. Attachment was measured with the same instrument (PAM) as in the current study. Possibly the difference in associations between ToM and attachment avoidance might be explained by the differential way in how ToM was assessed. Pos et al. (2015) used a narrative task, which differentiates first and second order cognitive and affective ToM, while we used a first order ToM task that was based on visual stimuli that rely on emotion recognition and affective ToM (Warrier et al., 2017).

Attachment avoidance is characterized by a positive self-view with excessive self-reliance and a negative view of others, expressed in discomfort with closeness along with reduced emotional reactivity and expressiveness (Mikulincer & Shaver, 2016). According to Fonagy and Luyten, in attachment avoidance, the element of reduced emotional reactivity might be related with a higher tolerance to stress and a higher threshold for switching from cortical to subcortical processing of social information, therefore maintaining a more stable

functioning of ToM (Luyten & Fonagy, 2015). Future research could assess the association between ToM performance and attachment avoidance while manipulating the levels of stress in social situations to explore such mechanisms further in individuals with psychotic disorders.

As Pos et al. (2015), we did not find differences between relatives and controls in either ToM or attachment styles, suggesting that these factors are related to characteristics that are unique to the individuals with a psychotic disorder. However, the relatives' group was 50% smaller in the current study than the other two groups, this could have led us to fail to detect subtle effects. Though the study by Pos et al. (2015) was large and well-powered to detect such effects. Finally, the current results differed from Korver-Nieberg et al.'s (2013) study on adolescent psychosis, which did not show an association between performance on a more cognitive ToM measure and the two dimensions of attachment insecurity. Several explanations for the absence of an effect in the younger sample are possible. Social cognitive abilities are still in development in the transition period of adolescence (Blakemore, 2008) and also attachment might be more likely to fluctuate (Carr et al., 2018). The individuals were in the very early stages of the psychotic disorder and observed associations in more chronic patients might be due to illness related factors, such as for instance disruptive social experiences (Velthorst et al., 2017), physiological (Debbané et al., 2016) and/or cognitive changes (Fett et al., 2019).

Strengths and limitations

To the best of our knowledge, our study is the first to formally test the hypothesis that attachment styles interact in different ways with groups of the psychosis continuum – specifically with patients. These findings are a contribution to the idea that social-emotional states play an important role in the psychopathology of psychotic disorders (MacBeth et al., 2011; Ciompi, 2015). However, some limitations must be considered in the interpretation of our results. First, the relatives' group differed from the other two as it was not only smaller, but also had a greater proportion of females. The smaller sample size of the relatives' group could have led to low power to detect subtle differences in attachment or possible interactions with group status on ToM (Type II error). Due to the small sample we also could not stratify the relatives group in type of relative (i.e., parents or siblings) in order to explore associations, as described in previous research (Anselmetti et al., 2009; Hünefeldt et al., 2013). Our findings highlight that it is important for future research to establish effective recruitment initiatives that include sufficient male first-degree relatives. Second, we used the original version of the PAM which only assess the dimensions of attachment avoidance and anxiety. However, there is theoretical and empirical evidence suggesting that the dimension of disorganized attachment – high scores on both avoidance and anxiety – is closely linked to the vulnerability to psychosis (Berry et al., 2017; Bucci et al., 2017). This relevant factor was recently taken into account in the development of a revised version of the PAM which assesses disorganized

attachment (Pollard et al., 2020). Further research will be necessary to evaluate the relationship of this dimension with ToM in individuals with psychosis. Third, although the psychometric properties of the RMET have been qualified as acceptable by the SCOPE study panel (Pinkham et al., 2017) it is highly demanding on vocabulary skills, and it partially relies on facial recognition. Future research on the associations between ToM and attachment could usefully include a wider battery of ToM measures to scrutinize these effects and associations between more cognitive and affective aspects of ToM in more detail. Finally, the cross-sectional design of this study does not allow for causal inferences about whether ToM influences attachment insecurity, or whether attachment insecurity influences ToM or whether a bi-directional relationship exists. Longitudinal research will be necessary to answer such questions.

Future research and clinical implications

Further research is required to shed light on several issues. First, our results need to be replicated in bigger samples to minimize the risk of Type II error. Future research should include longitudinal assessments to capture temporal development of attachment styles in individuals with non-affective psychosis. Also, as attachment styles are related to specific relationships with significant others (parents, siblings, couples) (Hünefeldt et al., 2013), future studies might assess ToM performance in each of these specific relationship contexts. Finally, other areas of social cognition should be assessed to explore the extent to which they are related to attachment insecurity.

The clinical implications of our study are related to the potential benefits of assessing the attachment styles of patients and to understanding their impact on processing of social information. This could be especially relevant at the beginning of the relationship between patient and clinical team, as attachment styles are related with service engagement (Gumley et al., 2014). Moreover, as social cognition has a substantial role in functional outcomes in individuals with psychosis (Fett et al., 2011; Halverson et al., 2019), strategies that promote secure attachment and that reduce interpersonal threat (Phillips et al., 2009) could potentially improve ToM functioning and may thus contribute to the recovery process in patients.

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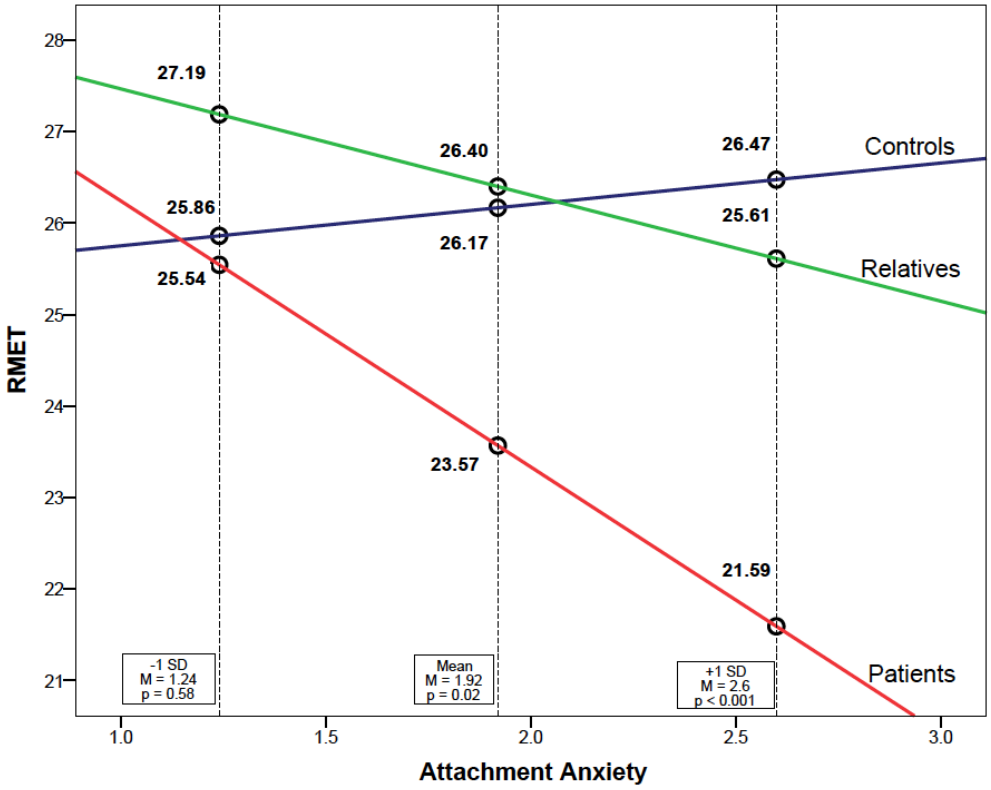

Figure 1. Visualization of the interaction between Attachment anxiety and Reading the Mind in the Eyes Test (RMET)

Table 1. Socio-demographic and clinical characteristics of the sample

	Patients (n = 51)		Relatives (n = 23)		Controls (n = 49)		Analysis
	n	%	*n*	%	*n*	%	
Gender Male	42	82.4	6	26.1	33	67.3	$\chi 2$ = 24.17, df = 2, p < 0.001
Education							
None	4	8.0	1	4.3			
Primary	3	6.0			2	4.1	
Secondary	10	20.0			16	32.7	$\chi 2$ = 36.30, df =10, p < 0.001
College	22	44.0	6	26.1	7	14.3	
University	9	18.0	13	56.5	24	49.0	
Other	2	4.0	3	13.0			
Living status							
Alone	38	74.5	4	17.4	17	34.7	
With family / partner	13	25.5	15	65.2	20	40.8	$\chi 2$ = 32.19, df = 4, p < 0.001
Other			4	17.4	12	24.5	
Employment Status							
Unemployed	38	74.5	3	13.0	6	12.2	
Student	4	7.8	4	17.4	14	28.6	$\chi 2$ = 54.35, df = 6, p < 0.001
Employed	7	13.7	15	65.2	29	59.2	
Missing	2	3.9	1	4.3			
ICD - 10 Diagnosis							
Schizophrenia	42	84.0					
ATPD	1	2.0					
Schizoaffective disorder	7	14.0					
	Mean	SD	Mean	SD	Mean	SD	
Age	35*[a]	10	37[a]	13	34[a]	10	F (2, 120) = 0.796, p = 0.5
Attachment Total Score	2.40*[a]	0.46	2.29[a]	0.55	2.25[a]	0.37	F (2, 120) = 1.46, p = 0.24
Attachment anxiety	1.95	0.75	1.98	0.75	1.86	0.56	F (2, 120) = 0.32, p = 0.73
Attachment avoidance	2.85*[a]	0.49	2.59[a]	0.62	2.64[a]	0.49	F (2, 120) = 3.0, p = 0.05
RMET	21.70[a]	5.85	26.91[b]	4.48	27.69[b]	4.51	F (2, 120) = 18.93, p < 0.001
Estimated cognitive ability	37.67*[a]	7.41	42.13[b]	8.04	45.51[b]	4.31	F (2, 120) = 18.34, p < 0.001
PANSS Total	56.73	12.00					
PANSS Positive	13.24	4.38					
PANSS Negative	15.04	5.05					
PANSS General	28.39	5.59					
Duration of illness (years)	11.44	8.88					

*: Tukey Post hoc analysis. Same letter represents no statistically significant difference. ATPD: Acute and transient psychotic disorder; RMET: Reading the Mind in the Eyes Test; PANSS: Positive and Negative Symptom scale.

Table 2. Moderation analysis: Attachment Anxiety x Group. Dependent variable: RMET

	Step 1			Step 2		
	b	*SE*	*p*	*b*	*SE*	*p*
Attachment Anxiety	-1.64	0.60	0.007	0.45	1.11	0.69
D1	0.32	1.17	0.78	3.33	3.39	0.33
D2	-2.49	1.01	0.02	3.85	2.74	0.16
D1 x Attachment Anxiety				-1.61	1.64	0.33
D2 x Attachment Anxiety				-3.36	1.40	0.02
R^2	0.47			0.5		
$\Delta R^2 = 0.03$, $F(2, 114) = 3.17$, $p = 0.046$						

D1: controls vs relatives. D2 controls vs patients. RMET: Reading the mind in the eyes test. Analysis controlled for gender and cognitive ability.

Table 3. Moderation analysis: Attachment Avoidance x Group. Dependent variable: RMET

	Step 1			Step 2		
	b	*SE*	*p*	*b*	*SE*	*p*
Attachment Avoidance	0.27	0.80	0.74	0.02	1.33	0.99
D1	0.32	1.21	0.80	5.52	5.40	0.31
D2	-2.88	1.03	0.01	-8.85	5.30	0.10
D1 x Attachment Avoidance				-2.00	2.01	0.32
D2 x Attachment Avoidance				2.07	1.87	0.27
R^2		0.44			0.46	
$\Delta R^2 = 0.02$, $F(2, 114) = 2.07$, $p = 0.13$						

D1: controls vs relatives. D2: controls vs patients. RMET: Reading the mind in the eyes test. Analysis controlled for gender and cognitive ability.

Table 4. Analysis of simple slopes for attachment anxiety

	-1SD AX = 1.24			Mean AX = 1.92			+1SD AX = 2.6		
	b	*SE*	*p*	*b*	*SE*	*p*	*b*	*SE*	*p*
D1	1.33	1.64	0.42	0.23	1.15	0.84	-0.86	1.56	0.58
D2	-0.32	1.32	0.81	-2.60	0.99	0.01	-4.88	1.38	<0.001
ΔR^2		0.00			0.04			0.06	
F (2, 114)		0.54			4.24			7.04	
p		0.58			0.02			<0.001	

D1: controls vs relatives. D2: controls vs patients. AX: Attachment anxiety.

Table 5. Test of interaction between attachment anxiety and PANSS positive. Dependent variable: RMET

	Step 1			Step 2		
	b	*SE*	*p*	*b*	*SE*	*p*
Attachment anxiety	-2.48	1.09	0.03	-0.57	3.76	0.88
PANSS positive	-0.11	0.19	0.55	0.14	0.52	0.77
Attachment anxiety x PANSS positive				-0.13	0.25	0.6
R^2		0.128			0.134	
$\Delta R^2 = 0.006$, $F(1,45) = 0.29$, $p = 0.6$						

PANSS: Positive and Negative Symptom Scale. RMET: Reading the mind in the eyes test

Table 6. Test of interaction between attachment anxiety and PANSS negative. Dependent variable: RMET

	Step 1			Step 2		
	b	*SE*	*p*	*b*	*SE*	*p*
Attachment anxiety	-2.19	1.09	0.05	1.53	3.7	0.7
PANSS negative	-0.02	0.16	0.2	0.35	0.57	0.5
Attachment anxiety x PANSS negative				-0.25	0.24	0.3
R^2		0.154			0.174	
$\Delta R^2 = 0.002$, $F(1,45) = 1.09$, $p = 0.3$						

PANSS: Positive and Negative Symptom Scale. RMET: Reading the mind in the eyes test