



Affect recognition in people at clinical high risk of psychosis

Jean Addington ^{a,*}, Danijela Piskulic ^a, Diana Perkins ^b, Scott W. Woods ^c, Lu Liu ^a, David L. Penn ^d

^a Department of Psychiatry, Faculty of Medicine, University of Calgary, Calgary AB, Canada

^b Department of Psychiatry, University of North Carolina at Chapel Hill, Chapel Hill NC, United States

^c Department of Psychiatry, Yale University, New Haven, CT, USA

^d Department of Psychology, University of North Carolina at Chapel Hill, Chapel Hill NC, United States

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ABSTRACT

Individuals with schizophrenia demonstrate stable deficits in affect recognition. Similar deficits in affect recognition have been observed in those who are at clinical high risk (CHR) of developing psychosis. The current project aimed to longitudinally examine affect processing in CHR individuals, to determine if affect processing predicted later conversion to psychosis and if affect processing deficits were unique to those who met established criteria for prodromal syndromes. The sample consisted of 172 CHR and 100 help-seeking individuals (HS) who were followed for up to 24 months. All CHR individuals met the Criteria of Prodromal Syndromes (COPS) based on the Structured Interview for Prodromal Symptoms (SIPS). The SIPS was used to determine conversion to psychosis. Affect recognition was assessed using two facial affect recognition tasks and a measure of affective prosody. In comparison to previously published data from non-psychiatric controls, both CHR and HS groups demonstrated deficits in affect recognition. By 2 years 25 CHR participants converted to psychosis. Interestingly, there were no differences between converters and non-converters on any affect recognition tasks. This is one of the first studies to longitudinally examine affect processing and its relationship to later conversion to psychosis in individuals at-risk for psychosis. While poorer affect recognition may be associated with vulnerability for psychosis, the current results suggest that it may not be a marker of developing a psychotic illness.

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1. Introduction

There is a growing interest in social cognition in schizophrenia, mainly due to its association with poor social functioning (Fett et al., 2011). One of the most studied domains of social cognition is affect recognition. It has been well established that individuals with schizophrenia demonstrate stable deficits in both discrimination and identification of affect irrespective of modality, facial (Addington et al., 2006; Pinkham et al., 2007; Horan et al., in press) or prosodic (Edwards et al., 2001; Kucharska-Pietura et al., 2005), and across all stages of illness (Green et al., in press). Similar deficits in affect recognition have been observed in individuals who are putatively prodromal for psychosis, i.e., at clinical high risk (CHR) of developing a psychotic disorder. CHR individuals, relative to healthy controls, have demonstrated impaired performance on facial affect identification comparable to the performance of individuals with a first episode of psychosis and those who have a more chronic course of psychosis (Addington et al., 2008; Green et al., in press). Amminger et al. (in press), using both a facial affect task as

well as a measure of affective prosody, reported similar results relative to healthy controls and first episode patients; CHR individuals exhibited deficits in the recognition of fear and sadness across both face and voice modalities compared to non-psychiatric controls.

Although these studies suggest that affect recognition deficits may be a trait-characteristic, there are no longitudinal studies testing the stability of affect recognition in those at clinical high risk or examining its relationship to conversion to psychosis. The aim of this project was to examine longitudinally affect processing in a large sample of individuals at CHR of psychosis, to determine if affect processing was a predictor of later conversion to psychosis and to determine if deficits in affect processing were unique to those who met established criteria for a prodromal syndrome.

2. Method

2.1. Sample

The overall sample consisted of 172 individuals (98 males, 74 females) at CHR of psychosis with a mean age of 19.8 (SD = 4.5) years and 100 help-seeking individuals, the help-seeking controls (HSC) (56 males, 44 females) with a mean age of 19.4 (SD = 3.9) years. All were participants in the PREDICT study that was conducted at the Universities of Toronto (70 CHR, 45 HSC), North Carolina (62 CHR, 31 HSC) and Yale (40 CHR,

* Corresponding author at: Department of Psychiatry, 3280 Hospital Drive NW, Calgary AB T2N 4Z6, Canada. Tel.: +1 403 201 6379; fax: +1 403 210 9182.

E-mail addresses: jmadding@ucalgary.ca (J. Addington), dpiskuli@ucalgary.ca (D. Piskulic), diana_perkins@unc.edu (D. Perkins), scott.woods@yale.edu (S.W. Woods), luliu@ucalgary.ca (L. Liu), dpenn@email.unc.edu (D.L. Penn).

24 HSC). PREDICT was designed to determine predictors of conversion to psychosis. All CHR individuals met the Criteria of Prodromal Syndromes (COPS) based on the Structured Interview for Prodromal Symptoms (SIPS) (McGlashan et al., 2010). Participants were excluded if they were using antipsychotics at baseline. Furthermore, antipsychotics were not used at any later points in this study. One hundred and sixty-eight CHR participants met attenuated positive symptom syndrome (APSS) criteria, which include the emergence or worsening of a non-psychotic level disturbance in thought content, thought process or perceptual abnormality over the past year. Four participants met criteria for genetic risk and deterioration (GRD), which required either a first degree relative with a psychotic disorder or the subject having schizotypal personality disorder (SPD) plus at least a 30% drop in functioning on the General Assessment of Functioning (GAF) scale in the past 12 months. The HSC group were individuals who had (i) responded to recruitment efforts for the CHR sample, and (ii) on a phone screen appeared likely to meet prodromal criteria but after the initial comprehensive interview did not. The HSC group consisted of the following groups: (i) family high risk but no decline in functioning ($n = 17$), (ii) long standing symptoms i.e. attenuated positive symptoms had been present for more than one year ($n = 47$), current prodromal symptoms but symptoms were clearly due to another disorder ($n = 2$), (iii) only had negative symptoms ($n = 4$) and (iv) the remaining group reported vague symptoms that neither met severity nor frequency ($n = 30$). Those with longstanding symptoms were individuals who had attenuated psychotic symptoms that had begun or worsened more than a year before and were rated 3–5 on severity on the Scale of Prodromal Symptoms (SOPS). This severity is within the prodromal range, but to meet prodromal criteria attenuated symptoms have to have begun or worsened in the past year.

The Structured Clinical Interview for DSM-IV (SCID-I) (First et al., 1995) was used to determine the presence of any axis I disorders. Participants were excluded if they met criteria for any current or lifetime axis I psychotic disorder, prior history of treatment with an antipsychotic, or past or current history of a clinically significant central nervous system disorder which may confound or contribute to clinical high risk symptoms. A comprehensive clinical assessment was conducted by the PI or clinical psychiatrist or psychologist at each site to determine if entry criteria were met. Only 146 of the CHR participants and 85 of the HSC completed the affect recognition tasks. In addition, since this longitudinal study lasted for four years, the first person recruited could have had four years of follow-up whereas the last person may have only had 3 months. Therefore at each follow-up, missing subjects are accounted for either by conversion to psychosis, missing the assessment, dropping out of the study or not being in the study long enough to reach that particular follow-up. See Table 1.

2.2. Measures

Criteria for a prodromal syndrome and criteria for conversion to psychosis were determined using the Structured Interview for Prodromal Syndromes (SIPS) (McGlashan et al., 2010). Conversion meant that at least one of the five attenuated positive symptoms reached a psychotic level of intensity (rated 6) for a frequency of ≥ 1 h/day for 4 days/week during the past month or that symptoms seriously impacted functioning

(e.g. severely disorganized or dangerous to self or others) (McGlashan et al., 2010). Symptoms were assessed with the Scale of Prodromal Symptoms (SOPS), which consists of 19 items in 4 symptom domains: positive, negative, general and disorganized. Intelligence was assessed using the Block design, Arithmetic, Digit Symbol/Coding, Vocabulary and Information subtests from the Wechsler Adult Intelligence Test (WAIS)/Wechsler Intelligence Scale for Children-III (WISC-III) (Blyler et al., 2000).

Facial affect recognition was assessed with the Facial Emotion Identification Test (FEIT) and the Facial Emotion Discrimination Test (FEDT) (Kerr and Neale, 1993). These measures have been described in detail elsewhere (Addington et al., 2008). Affective prosody (AP) was assessed using a task developed by Edwards and colleagues (Edwards et al., 2001) and used in the Amminger study (Amminger et al., in press). The task involves audio recordings of 4 simple sentences (i.e. “he will come soon”, “they must stay here”, “she will drive fast” and “we must go there”) spoken by three professional actors displaying following emotions: fear, sadness, anger, surprise and neutral resulting in a total of 60 items. Based on sentence recordings participants were required to indicate which emotion was expressed. For each actor, there were 3 practice and 20 target items, with eight seconds of silence between each item. Published reliability coefficients (Chronbach’s alpha) for AP is 0.85 (Edwards et al., 2001), for FEDT is 0.68, (Pinkham and Penn, 2006) and FEIT is 0.50 (Pinkham and Penn, 2006).

2.3. Procedures

This was a longitudinal study of predictors of conversion to psychosis whereby all three sites recruited CHR and HS individuals. Raters were experienced research clinicians who demonstrated adequate reliability at routine reliability checks. Gold standard post-training agreement on the distinction between high risk and psychotic levels of intensity on the positive symptom items (i.e., the critical threshold for determining initial eligibility and subsequent conversion status) was excellent ($\kappa = 0.90$). The DSM-IV diagnoses were made using the SCID-I. Interrater reliability was determined at the start of the study and annually by 100% agreement on the diagnosis and at least 80% agreement for symptom presence. JA chaired weekly conference calls to review criteria for all individuals admitted to the study. Affect processing assessments were conducted by trained research assistants trained by DLP. The study protocols and informed consents were reviewed and approved by the ethical review boards of all three study sites.

2.4. Statistical analyses

All analyses were performed with the use of IBM SPSS version 19 and SAS version 9.2. The Student *t*-test and chi-square test were used to compare baseline differences between the CHR group and the HS group and between the converters and the non-converters. Mann-Whitney *U* test was used to compare converters and non-converters given the unequal sample sizes in the two groups. Spearman correlations were used to determine associations amongst measures. To accommodate missing data and account for intra-participant correlation over time, generalized linear mixed model for repeated measures was used to examine changes over time (baseline, 6 months, 12 months, 18 months and 24 months) and group differences for ratings on the three affect recognition measures.

3. Results

3.1. Sample characteristics

There were no demographic differences between the CHR and HSC groups. Within the CHR group there were no differences between those who converted and those who did not convert within the time of the study. These results are presented in Table 2. The CHR group had significantly higher ratings on attenuated positive symptoms and on

Table 1
Reasons for missing data.

	Clinical-high risk assessment (years)				Help-seeking controls assessment (years)			
	0.5	1	1.5	2	0.5	1	1.5	2
Completed	79	50	35	25	48	46	32	24
Missed because study ended	3	24	45	67	0	8	15	26
No show	52	55	43	28	36	29	35	32
Converted	12	17	23	26	1	2	3	3
Total	146	146	146	146	85	85	85	85

general symptoms on the SOPS compared to the HSC. These results are presented in Table 3. The groups were also compared on IQ. There were no group differences (CHR, M = 111.65, SD = 17.13; HSC, M = 110.75, SD = 19.99, $t = -0.32$).

Since there were a number of dropouts in this study, we compared those who dropped out on demographics, IQ, three affect recognition tasks and symptoms. There were no differences at any time between HSC who completed assessments and those who did not complete. For the CHR participants who dropped out before one year those who dropped out had significantly higher scores on the facial identification task ($t = 2.06, p < 0.05$). For those who completed one year but not two years ($n = 8$) compared to those who completed beyond one year those who dropped out after one year had lower scores on facial affect discrimination ($t = 3.56, p < 0.01$), less negative symptoms ($t = 2.65, p < 0.1$).

3.2. Affect recognition

In the HSC group, all three affect recognition tasks were significantly associated with one another (Pearson's correlation coefficient r ranged from 0.31 to 0.35, all $p < 0.001$). In the CHR group, the facial affect identification and discrimination tasks were associated ($r = 0.2, p < 0.05$) and the facial affect identification task was significantly related to the prosody task ($r = 0.36, p < 0.001$). There were some associations amongst the affect recognition tasks and symptoms. Interestingly, none of the

Table 3
SOPS symptom ratings for clinical high risk and help-seeking control groups.

Symptom subscores	CHR (N = 172) M (SD)	HSC (N = 100) M (SD)	t-value
Positive	11.02 (3.20)	6.53 (4.15)	-9.31***
Negative	8.61 (5.66)	8.38 (6.30)	-0.30
Disorganized	4.11 (2.75)	3.68 (3.16)	-1.18
General	7.02 (3.91)	5.19 (4.11)	-3.64***

*** $p \leq 0.001$

tasks were associated with positive symptoms in either group. See Table 4. Table 5 presents the means and SDs for each affect task for each group. In this table we have also presented means from healthy control groups published in the literature (Mueser et al., 1996; Salem et al., 1996; Edwards et al., 2001; Kee et al., 2004; Addington et al., 2006; Pinkham and Penn, 2006).

Results of the mixed effects modelling demonstrated that there were no differences between the CHR and the HSC group on affect recognition tasks at baseline or any of the follow-up assessments. However, for the HSC group, there was a significant improvement on all affect tasks by 24 months. For the CHR group, improvement occurred on two of the tasks by 6 months and on one task again at 24 months. However, since there is a significant loss of data at 18 and 24 months we tested these results running the mixed effects model up to 12 months only. The only change was that for the CHR group there was a significant

Table 2
Baseline characteristics.

Variable	CHR (N = 171)	HS control (N = 100)	Test statistic	Converters (N = 29)	Non-converters (N = 143)	Test statistics
Age, M (SD)	19.76 (4.50)	19.35 (3.87)	$t(270) = -0.76$	19.67 (4.62)	19.78 (5.50)	MWU = 2013.5
Sex, n (%)			$\chi^2 = 0.04$ (df = 1)			$\chi^2 = 1.07$ (df = 1)
Male	98 (57.3%)	56 (56.0%)		14	84	
Female	73 (42.7%)	44 (44.0%)		15	59	
Race, n (%)			$\chi^2 = 2.62$ (df = 4)			$\chi^2 = 3.59$ (df = 4)
White	132 (77.6%)	74 (74.0%)		19	114	
Black or African American	18 (10.6%)	12 (12.0%)		5	13	
Canadian Aboriginal/American Indian or Alaskan Native	0 (0%)	0 (0%)				
Asian	12 (7.1%)	6 (6.0%)		3	9	
Pacific Islander	1 (0.6%)	0 (0%)		0	1	
Mixed	7 (4.1%)	8 (8.0%)		2	5	
Spanish/Hispanic/Latino, n (%)			$\chi^2 = 2.49$ (df = 1)			$\chi^2 = 1.22$ (df = 1)
Yes	15 (8.8%)	15 (15.0%)		1	14	
No	156 (91.2%)	85 (85%)		28	129	
Current marital status, n (%)			$\chi^2 = 1.66$ (df = 2)			$\chi^2 = 0.78$ (df = 2)
Common law or legal married	8 (4.7%)	3 (3.0%)		2	6	
Widowed	0 (0%)	0 (0%)		0	0	
Divorced	0 (0%)	0 (0%)		0	0	
Separated	2 (1.2%)	0 (0%)		0	2	
Never married	161 (94.2%)	97 (97%)		27	135	
Currently living with a significant other, n (%)			$\chi^2 = 0.94$ (df = 1)			$\chi^2 = 0.01$ (df = 1)
Yes	18 (10.5%)	7 (7.0%)		3	15	
No	153 (89.5%)	93 (93.0%)		26	128	
Education, n (%)			$\chi^2 = 3.10$ (df = 8)			$\chi^2 = 5.08$ (df = 7)
Did not complete High School n (%)	74 (43.3%)	47 (47%)		13	62	
GED/High School diploma, n (%)	2 (1.2%)	1 (1.0%)		1	1	
Some college, did not graduate, n (%)	17 (9.9%)	11 (11.0%)		3	14	
Community college or Technical School Degree, n (%)	59 (34.5%)	31 (31%)		7	52	
College graduate, n (%)	7 (4.1%)	3 (3.0%)		2	5	
College graduate and some Master's level courses, n (%)	6 (3.5%)	4 (4.0%)		2	4	
Master's degree completed, n (%)	4 (2.3%)	1 (1.0%)		1	3	
Advanced degree courses, not graduated, n (%)	2 (1.2%)	1 (1.0%)		0	2	
Advanced degree completed, n (%)	0 (0%)	1 (1.0%)		0	0	
If you did not complete High School or obtain GED, indicate # of years of education: M (SD)	8.97 (1.86)	8.98 (1.95)	$t = 0.02$ (df = 119)			

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$.

Table 4
Correlations between SOPS symptoms and affect recognition at baseline.

	Clinical high risk			
	Positive	Negative	Disorganized	General
FEDT	0.11	0.02	−0.03	−0.01
FEIT	−0.01	−0.27**	−0.17	−0.14
AP	−0.09	−0.22**	−0.12	−0.01
<i>Help-seeking controls</i>				
FEDT	−0.13	−0.07	−0.13	−0.07
FEIT	−0.03	−0.11	−0.03	−0.02
AP	−0.08	−0.38**	−0.33**	0.01

Note: all correlations are Spearman's rho coefficients; ** $p < 0.007$ following Bonferroni correction.

FEIT = Facial Affect Identification Test; FEDT = Facial Affect Discrimination Test; AP = Affect Prosody.

change in the FEIT from baseline to 6 months ($p = 0.22$) where as previously this had not been significant ($p = 0.057$). These results are presented in Table 6.

At baseline we examined the differences between the CHR and HSC groups on the individual emotions within the prosody task and there were no significant differences.

Within the first 2 years of the study 25 participants in the CHR group, 13 males and 12 females, converted to psychosis. There were no differences between those who converted and those who did not convert to psychosis on any of the three affect recognition tasks at

baseline. For those who converted there were no changes over time on any of the affect recognition tasks.

4. Discussion

This is one of the first studies to longitudinally examine affect processing and its relationship to later conversion to psychosis in a group of people at high risk of developing psychosis. In this study, we did not have a healthy control group, thus we cannot definitely say that our CHR sample demonstrated affect recognition deficits relative to healthy controls. However, an earlier publication (Addington et al., 2008) demonstrated that a subsample of 85 CHR individuals had significant deficits relative to healthy controls on the facial affect identification task and performed similarly to those with an established psychotic illness. With respect to the prosody task, our samples had scores that fell in the same range as those of clinical samples with schizophrenia and other psychoses in Edwards et al's (2001) study. We have reported results from other studies which suggest that our sample of individuals at CHR of psychosis most likely have deficits in affect processing with respect to facial affect identification and affective prosody. Interestingly, the performance of the HSC group was indistinguishable from those at CHR. There was no difference in performance on the three measures at baseline between those who did and did not develop psychosis. Those at CHR showed some improvement at 6 months and for those who remained in the study at 24 months there was some evidence of improved performance.

There are some limitations to this study. The follow-up sample is small due to the time line of the study. The number of conversions

Table 5
Comparison of clinical high risk and help-seeking controls with healthy volunteers and schizophrenia patients from the literature.

Affect recognition measures	CHR M (SD)	HSC M (SD)	Healthy volunteers M (SD) range	SCZ M (SD) range
Affect Prosody	44.25 (0.56)	45.03 (0.75)	49.46 (6.27)	45.34 (7.59)
FEIT	12.70 (0.20)	12.78 (0.27)	12.32 (2.25)–14.10 (2.39)	10.70 (3.62)–12.43 (2.89)
FEDT	25.73 (0.16)	25.44 (0.21)	24.53 (2.92)–26.47 (2.30)	20.84 (4.60)–24.80 (2.70)

Note: FEIT = Facial Affect Identification Test; FEDT = Facial Affect Discrimination Test; CHR = clinical high risk; HSC = help-seeking controls; SCZ = patients with schizophrenia.

Table 6
Change over time in facial affect tasks.

	Clinical high risk				
	Baseline (n = 146) M* (SE)	6 m (n = 79) M* (SE)	12 m (n = 50) M* (SE)	18 m (n = 35) M* (SE)	24 m (n = 25) M* (SE)
FEIT	12.70 (0.20)	13.46 (0.25) ^{d,*}	13.46 (0.33)	13.77 (0.35)	14.21 (0.32) ^{a,***}
FEDT	25.73 (0.16)	26.43 (0.21) ^{a,*}	26.29 (0.24)	26.08 (0.30)	26.66 (0.29)
AP	44.25 (0.56)	46.84 (0.68) ^{a,***}	45.48 (0.74)	46.43 (0.91)	46.33 (0.76)
<i>Help-seekers</i>					
	Baseline (n = 85) M* (SE)	6 m (n = 48) M* (SE)	12 m (n = 46) M* (SE)	18 m (n = 32) M* (SE)	24 m (n = 24) M* (SE)
FEIT	12.78 (0.27)	13.22 (0.32)	13.12 (0.36)	13.90 (0.39)	14.36 (0.33) ^{a,***,b,*,c,****}
FEDT	25.44 (0.21)	25.86 (0.27)	25.94 (0.26)	26.05 (0.33)	26.57 (0.29) ^{a,**}
AP	45.03 (0.75)	44.74 (0.86)	46.62 (0.85)	46.89 (1.02)	47.99 (0.82) ^{a,b,***}

M* = represents the least squares means estimated by the generalized linear mixed models.

FEIT = Facial Affect Identification Test; FEDT = Facial Affect Discrimination Test; AP = Affect Prosody

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

**** $p < 0.0001$.

^a Significantly different from baseline.

^b Significantly different from 6 months.

^c Significantly different from 12 months.

^d Significantly different from baseline when the mixed model is conducted only for the first 12 months.

is approximately 17% by 2 years which is an average of what has been reported in the literature (Yung et al., 2008) and since all participants did not reach the one year mark, there may be more potential converters. Our assessment of social cognition was limited to affect processing and it may be that an assessment of other domains of social cognition would have had different results. However, with respect to psychotic disorders, affect processing is one of the best studied and robust of the domains of social cognition (Hoekert et al., 2007; Kohler et al., 2010). We did not observe any differences between the groups on individual emotions nor did any of the individual emotions predict conversion to psychosis. The strengths of the current study are its longitudinal, prospective design, large initial sample, examination of two modalities of affect processing as a predictor to later conversion to psychosis and the fact that the sample was free of antipsychotics.

Thus, our results suggest that poorer performance on social cognition may be indicative of being potentially vulnerable to developing psychosis but not necessarily a marker of developing a full blown psychotic illness. This fits with the suggestion that there is a continuum of psychosis from psychotic-like-experiences to subclinical psychotic symptoms to psychosis (van Os et al., 2009). Thus, difficulties in processing affect information may be a problem for those who report psychotic-like-experiences or fluctuating subclinical psychotic symptoms, or subthreshold symptoms regardless of whether they meet criteria for a putative prodrome experience. In fact a recent internet-based, general population study demonstrated that individual differences in psychosis-proneness were associated with the ability to process facial affect (Germine and Hooker, 2011). Germine et al. (2011) further demonstrated that in individuals who rated high on social anhedonia, there was less neural activity in brain regions thought to be implicated in facial emotion processing. In addition there is evidence of deficits in affect recognition in those who are at family high risk (Kee et al., 2004).

However, we cannot entirely rule out the predictive role of affect processing for conversion to psychosis. The number of converters was small and approximately half of the conversions occurred in the first 6 months of the study. Of those who converted after 6 months and had at least one follow-up pre-conversion, statistically, there was no significant change in their scores over time. Furthermore, a visual examination of their scores revealed that a few had declining scores and a few had scores that varied only by one or two points over time. This is the difficulty when focusing only on average performance.

Thus, it is likely that these individuals at high risk of psychosis, regardless of their level of vulnerability (i.e., meeting criteria for a syndrome), have persistent difficulties with affect processing. For those who do not go on to develop a psychotic illness, there seems to be some improvement over time, but for those who do develop a psychotic illness the difficulties may persist. Since the field of social cognition needs further work, particularly with respect to norms of the many measures that are used, we are unable to determine the level of improvement that may be occurring.

Our results may have important implications for social functioning since the ability to accurately recognize emotion is fundamental to social functioning. Difficulties in affect recognition as well as other aspects of social cognition are consistently associated with poor social functioning (Fett et al., 2011) and have been reported to be the best predictor of social functioning in schizophrenia even when compared with other cognitive tasks (Hooker and Park, 2002). A number of studies of individuals at CHR have reported deficits in functioning (Addington et al., 2008; Cornblatt et al., in press) and that social deficits may be predictive of conversion to later psychosis (Cornblatt et al., in press). Thus, although poor affect processing may exist in CHR samples and does not independently predict conversion, it does relate to functioning, which in turn has been reported to predict conversion.

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Contributors

Drs. Addington, Perkins and Woods were responsible for the design of the whole study and the supervision of all aspects of data collection. Dr. Penn contributed to the design and data collection with respect to the affect processing data. Ms. Liu and Dr. Piskulic were responsible for data analysis. Dr. Addington took the lead on writing the manuscript with the help in writing from Piskulic, Woods, & Perkins. All authors contributed to and approved the final manuscript.

Conflict of interest

There are no conflicts of interest for any of the authors with respect to the data in this paper or for the study.

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