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Intact Implicit Processing of Facial Threat Cues in Schizophrenia

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Abstract

An emerging body of research suggests that people with schizophrenia retain the ability to implicitly perceive facial affect, despite well-documented difficulty explicitly identifying emotional expressions. It remains unclear, however, whether such functional implicit processing extends beyond emotion to other socially relevant facial cues. Here, we constructed two novel versions of the Affect Misattribution Procedure, a paradigm in which affective responses to primes are projected onto neutral targets. The first version included three face primes previously validated to elicit varying inferences of threat from healthy individuals via emotion-independent structural modification (e.g., nose and eye size). The second version included the threat-relevant emotional primes of angry, neutral, and happy faces. Data from 126 participants with schizophrenia and 84 healthy controls revealed that although performing more poorly on an assessment of explicit emotion recognition, patients showed normative implicit threat processing for both non-emotional and emotional facial cues. Collectively, these results support recent hypotheses postulating that the initial perception of salient facial information remains intact in schizophrenia, but that deficits arise at subsequent stages of contextual integration and appraisal. Such a breakdown in the stream of face processing has important implications for mechanistic models of social cognitive impairment in schizophrenia and treatment strategies aiming to improve functional outcome.

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Contributors

Author 1 (J. Shasteen) oversaw and completed all statistical analyses, wrote the first draft of the manuscript, and contributed substantially to all subsequent drafts of the manuscript. Author 2 (A. Pinkham) conceptualized the study, aided in study design, supervised the project, assisted with statistical analysis, and edited all versions of the manuscript. Authors 3 and 4 (S. Kelsven and K. Ludwig) assisted with data collection, data analysis, and edited drafts of the manuscript. Author 5 (B.K. Payne) aided in study design, provided expertise data interpretation, and edited the final version of the manuscript. Author 6 (D. Penn) contributed to study conceptualization, aided in study design, and edited the final version of the manuscript. All authors have approved the final manuscript.

Conflicts of Interest

All authors report no conflicts of interests.

Keywords

implicit vs. explicit processing; threat perception; emotion recognition; affect misattribution

1. Introduction

Impaired affect recognition is well established in schizophrenia (Chan et al., 2010; Kohler et al., 2010) and predicts unique variance in social functioning (Fett et al., 2011; Horan et al., 2013; Lysaker et al., 2013). However, recent evidence indicates that the ability to implicitly process emotion may be retained (Suslow et al., 2003) or even enhanced (Höschel & Irle, 2001) in individuals with the disorder, despite considerable difficulty explicitly processing emotional expressions (Bediou et al., 2005; Green et al., 2008; Li et al., 2010). For instance, using an incidental learning task, van't Wout and colleagues (2007) found that both participants with and without schizophrenia were slower to identify the gender of faces with emotional expressions compared to faces with neutral expressions. Patients have also produced valence-congruent judgments of neutral stimuli after brief exposure to affective expressions through priming (Suslow et al., 2003) and continuous flash suppression (Kring et al., 2014) paradigms. Together, these results suggest that intact low-order mechanisms execute initial stages of emotion perception, but that a breakdown occurs once high-order integration, contextualization, and semantic knowledge are required (Kring et al., 2014).

Whereas this line of work elucidates the presence and importance of implicit facial emotion perception in patients, it is currently unclear whether these preserved capabilities extend to salient, emotion-independent information communicated by faces. For example, emotionless craniofacial features such as larger facial width-to-height ratio correlate strongly with perceptions of greater propensity for aggression (Carré et al., 2009; Stillman et al., 2010), reliably elicit inferences of threat from healthy individuals (Todorov et al., 2013), and account for variance in the amount of aggressive behavior demonstrated by men (Carré & McCormick, 2008). Detecting such latent and static facial signals of threat likely has noteworthy consequences, as appraisal of social threat is believed to facilitate behavioral responses when interacting with others (Bar et al., 2006, Green & Phillips, 2004). Moreover, explicit attribution of hostility to others' intentions (Harris et al., 2014) and faces (Pinkham et al., 2011) seems to vary as a function of paranoid ideation, which suggests that implicit sensitivity to facial threat markers may have important clinical implications as well.

To determine the relative capacities of patients and controls to automatically process facial threat, we constructed two novel versions of the Affect Misattribution Procedure, a validated implicit paradigm wherein affective reactions to primes are projected onto neutral targets (Payne et al., 2005). Our first version, the Structure Cue Task, utilizes three face primes differing on perceived threat via emotion-independent structural manipulation (e.g., nose and jaw size; Oosterhof & Todorov, 2008). It therefore allows examination of the degree to which patients normatively detect threat from unattended craniofacial features. Our second version, the Emotion Cue Task, utilizes three face primes (i.e., angry, neutral, and happy) differing on threat-congruent emotional expressivity, thus serving as an index of threat detection from emotional facial cues. Because prior research concurrently documents operational implicit and impaired explicit perception of facial affect in schizophrenia (e.g., Kring et al., 2014), we anticipated a similar dissociation for facial threat cues. Specifically, we predicted that both patients and controls would exhibit threat-consistent priming effects on the Structure and Emotion Cue tasks, but that patients would show poorer explicit emotion recognition performance as compared to controls. Such findings would support intact automatic processing of subtle social threat in schizophrenia and provide an extension of those studies demonstrating preserved implicit emotion processing.

Our secondary objective was to examine the relationship between interviewer-rated paranoia and the number of threat-related responses on our priming tasks. If elevated levels of paranoia were to strongly correlate with increased threat ratings, then the current or analogous tasks might have prospects as implicit evaluations of paranoia. Such measures could circumvent flaws inherent in self-report, particularly when obtained from those with diminished insight (Gould et al., 2013; Koren et al., 2013) or who may be hesitant to accurately report feelings of suspiciousness (Freeman, 2007; van Os & Verdoux, 2003).

2. Method

2.1 Participants

The study took place at two sites, The University of North Carolina at Chapel Hill (UNC) and The University of Texas at Dallas (UTD). Patients at UNC were recruited from the Outreach and Support Intervention Services (OASIS) program and from Caramore, a structured support program for individuals with severe mental illness. Participants at UTD were recruited from Metrocare Services, a nonprofit mental health services provider in Dallas County, Texas. Healthy controls were recruited through community advertisements. All participants provided written informed consent, and the UNC and UTD Institutional Review Boards approved the study.

Our original sample consisted of 159 individuals with schizophrenia or schizoaffective disorder and 105 healthy controls. Thirty-three patients and twenty-one controls were excluded from analyses for either not completing both experimental tasks (n=22) or providing identical responses for all trials (n=32) suggesting an insincere effort. Hence, 126 patients and 84 healthy controls constituted our final sample. Exclusion criteria for both groups included: 1) presence or history of pervasive developmental disorder or mental retardation (defined as IQ<70) by DSM-IV criteria, 2) presence or history of medical or neurological disorders that may affect brain function (e.g. seizures, CNS tumors, or loss of consciousness for 15 minutes or more), 3) presence of sensory limitation including visual (e.g. blindness, glaucoma, vision uncorrectable to 20/40) or hearing impairments that interfere with assessment, 4) no proficiency in English, 5) presence of substance abuse in the past month, and 6) presence of substance dependence not in remission for the past six months. In addition, healthy controls could not meet criteria for any major DSM-IV Axis I or II disorders. Patients could not have any hospitalizations within the last two months and had to be on a stable medication regimen for a minimum of six weeks, with no dose changes for a minimum of two weeks. Diagnoses were confirmed using the Mini International Neuropsychiatric Interview (Sheehan et al., 1998) and the Structured Clinical Interview for

DSM Disorders Psychosis Module (First et al., 2002), and symptom severity was evaluated with the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1992).

2.2 Stimuli

Priming stimuli were drawn from a database (Oosterhof & Todorov, 2008) of 25 computer-generated facial avatars (FaceGen Modeller, Version 3.1; Singular Inversions, 2005) that were also manipulated to systematically vary on the craniofacial features that relate to perceived threat (i.e. smaller eyes, lower eyebrow ridges, wider noses, more pronounced jaws, and increased facial width-to-height ratio). Manipulations were made in increments of one standard deviation ranging from −3 to +3, thus resulting in seven images for each avatar that ranged from most threatening (−3 SD) to most nonthreatening (+3 SD). All stimuli were color images of bald, Caucasian males with neutral expressions on a black background. We selected 3 faces from each of 24 avatars for use in the current task: the original avatar (henceforth called ‘Neutral’), the most threatening version (henceforth called ‘Threatening’), and the least threatening version (henceforth called ‘Approachable’). As these faces lack explicit displays of emotion, they were employed as primes in the Structure Cue task.

For the Emotion Cue task, the same Neutral face images were used. We also used FaceGen’s emotional expressivity tool to alter the features of the Neutral avatars to create angry and happy expressions. Therefore, primes in the Emotion Cue task were Angry, Neutral, and Happy faces.

In both tasks, target stimuli were emotionally bland and ambiguous Chinese pictographs (Zajonc, 1968) with which no participant in the present study had previous experience. Example face primes and pictograph targets can be viewed in Figure 1.

2.3 Measures

2.3.1 Structure and Emotion Cue Tasks—Experimental tasks were presented using Media Lab and Direct RT and administered by a trained research assistant in a counterbalanced order.

Implicit processing of facial threat without and with emotion was assessed by the Structure and Emotion Cue tasks, respectively. Both were original adaptations of the Affect Misattribution Procedure (Payne et al., 2005), a priming paradigm whose construct validity and ability to discriminate between implicit and explicit attitudes have been thoroughly corroborated (Blaison et al., 2012; Gawronski et al., 2008; Payne et al., 2008). Each task contained 72 trials parsed such that every prime category (i.e., Threatening, Neutral, and Approachable in the Structure Cue task; Angry, Neutral, and Happy in the Emotion Cue task) comprised 24 trials, one for each of the 24 avatars. Beginning each trial, face primes appeared onscreen for 75ms. A blank screen was then displayed for 125ms, followed by a Chinese pictograph for 250ms that was backward-masked by visual noise (i.e., a rectangle with random patterns of gray). Participants were asked to ignore the prime and to indicate whether they considered each pictograph to be ‘More Threatening’ or ‘Less Threatening’ than the average symbol. Participants were encouraged to quickly give an initial reaction, and the next trial began as soon as they responded and briefly viewed a screen with a centered fixation cross. All primes and targets appeared only once within each task in a fully randomized order.

Before each task, participants completed four practice trials to familiarize them with task demands and timing. No feedback was provided during practice or experimental trials.

2.3.2 Penn Emotion Recognition Test (ER-40)—The ER-40 (Kohler et al., 2003) was also administered to assess explicit emotion recognition ability. This forced-choice measure contains 40 color photographs of male and female faces expressing happiness, sadness, anger, fear, or no emotion. Stimuli are displayed onscreen individually along with the five emotion choices, and participants are asked to choose which emotion best describes the facial expression.

2.3.3 Cognitive Performance—Participants also completed a subset of tasks from the MATRICS Consensus Cognitive Battery (Nuechterlein et al., 2008). These included the Trail Making Test – Part A, BACS: Symbol Coding, Animal Naming, Letter-Number Span, and the Hopkins Verbal Learning Test-Revised.

2.4 Statistical Analyses

First, group differences in cognitive performance were assessed with a one-way (group: controls vs. patients) MANOVA with follow-up univariate tests. Second, in order to determine whether our patient sample had difficulty explicitly recognizing emotional expressions, the number of correctly identified items for each expression category on the ER-40 was entered into a repeated measures ANOVA with emotion (happy, sad, anger, fear, and no emotion) as the within-subjects variable and group (controls vs. patients) as the between-subjects variable. Next, to test our hypothesis that patients and controls alike would show threat-congruent priming effects on the Structure and Emotion Cue tasks, we conducted a repeated measures ANOVA for our dependent variable: the percentage of trials perceived as 'More Threatening' for each of the six face primes. This analysis utilized task (*Emotion Cue* vs. *Structure Cue*) and prime (*threatening* [Angry and Threatening] vs. *neutral* [Neutral from Emotion Cue task and Neutral from Structure Cue task] vs. *nonthreatening* [Happy and Approachable]) as within-subjects variables, with group (*patient* vs. c*ontrol*) as the between-subjects variable. For both repeated measures analyses, Greenhouse-Geisser corrections were applied when Mauchly's test indicated violation of the sphericity assumption.

With the secondary aim of investigating paranoia's relationship to automatic threat processing, we calculated Spearman's rank-order correlation coefficients between ratings on the PANSS suspiciousness/persecution item (P6) and 1) threat responses to every face prime and 2) the discrepancies between threat responses to a) Neutral vs. Happy, b) Angry vs. Happy, c) Neutral vs. Approachable, and d) Threatening vs. Approachable primes. These discrepancy scores described facial threat perceptions relative to the least threatening primes in each task. In all four pairs, the former subtracts the latter, so a positive difference denotes comparatively more threat perceptions of the more threatening prime.

3. Results

3.1 Participants

Groups did not differ on gender, $\chi^2(1)=0.06$, $p=.809$, ethnicity, $\chi^2(3)=0.95$, $p=.813$, age, $t(208)=-1.56$, $p=.121$, maternal education, $t(189)=0.57$, $p=.568$, paternal education, $t(174)=-0.17$, $p=.863$, or intellectual ability as estimated by the WRAT-3 reading subscale, $t(208)=1.02$, $p=.309$, though the schizophrenia group completed fewer years of education, $t(208)=3.06$, $p=.002$. Patients reported relatively low levels of symptoms, and the majority were taking atypical antipsychotics. Table 1 displays demographic and clinical characteristics.

3.2 Cognitive Performance

The multivariate effect of group was significant indicating that controls performed better on the cognitive tasks as a whole, Wilks' $\lambda=.782$, $F(5, 204)=11.39$, $p<.001$, $\eta_p^2=.218$). Follow-up univariate analyses revealed that controls scored significantly better than patients on each of the five tasks included here ($p<.001$ for all comparisons). Means and effect sizes for the group difference are presented in Table 2.

3.3 Accuracy on the Explicit Emotion Recognition Task

As hypothesized, our clinical sample showed explicit affect identification impairments on the ER-40 as a whole. The main effect of group was significant indicating that overall, controls accurately identified more stimuli than patients, $F(1, 207)=14.34$, $p<.001$, $\eta_p^2=.062$. The main effect of emotion was also significant, $F(3.35, 692.74)=115.5$, $p<.001$, $\eta_p^2=.358$, such that accuracy for happy was higher than all other emotions ($p<.001$ for all comparisons) and accuracy for anger was lower than all other emotions ($p<.001$ for all comparisons). Importantly, the group by emotion interaction was also significant, $F(3.35, 692.74)=2.99$, $p=.026$, $\eta_p^2=.014$. Follow-up univariate tests revealed that patients only differed from controls for the recognition of sadness, $F(1,208)=9.62$, $p=.002$, fear, $F(1,208)=16.03$, $p<.001$, and no emotion, $F(1,208)=3.98$, $p=.047$. While patients still scored more poorly than controls on recognition of happiness and anger, these performances were not significantly different (Table 2).

3.4 Threat Priming Effects in the Experimental Tasks

The repeated measures ANOVA for threat responses yielded a statistically significant main effect of prime, $F(1.3,161.6)=124.92$, $p<.001$, $\eta_p^2=.375$, such that threatening primes provoked more threat ratings (53.5%) than did neutral primes (33.7%, $p<.001$) and nonthreatening primes (31.6%, $p<.001$), which also significantly differed ($p=.019$). The main effect of task was not statistically significant ($F(1, 208)=0.65$, $p=.422$, $\eta_p^2=.003$), suggesting that overall threat responses were similar for both structural and emotional cues. Nevertheless, these results were qualified by the prime by task interaction, $F(1.4,298.4)=86.46$, $p< .001$, $\eta_p^2=.294$, demonstrating greater differentiation between primes in the Emotion Cue task. Here, Angry primes (62.7%) elicited more threat ratings than did Neutral primes (30.8%; $p<.001$) and Happy primes (27.6%, $p<.001$), which also significantly differed ($p=.009$). In the Structure Cue task, Threatening primes (44.7%)

similarly prompted more threat responses than did Neutral primes (37.6%, $p<.001$) and Approachable primes (36.1%, $p<.001$), although the latter two did not significantly differ ($p=.293$).

Supporting comparable implicit threat processing in patients and controls, no statistically significant group differences emerged (*group main effect*: $F(1,208)=1.86$, $p=.174$, $\eta_p^2=.009$; *group by task interaction*: $F(1,208)=0.15$, $p=.703$, $\eta_p^2=.001$; *group by prime interaction*: $F(1.3,261.6)=0.51$, $p=.512$, $\eta_p^2=.002$; *three-way interaction*: $F(1.4,298.4)=1.51$, $p=.224$, $\eta_p^2=.007$). Means, standard deviations, and corresponding 95% Confidence Intervals for threat responses in both groups are presented in Table 2.

3.5 Correlations between Threat Ratings and Paranoia

Higher PANSS suspiciousness/persecution scores were associated with more threat responses in the Emotion Cue task to Angry primes ($r_s(126)=.184$, $p=.04$) and Angry relative to Happy primes ($r_s(126)=.212$, $p=.017$). However, no other correlations reached statistical significance in either the Structure Cue task (all $r_s \leq .096$, $p \geq .28$) or the Emotion Cue task (all $r_s \leq .149$, $p \geq .09$).

3.6 Post Hoc Analyses

To examine the potential relation between explicit emotion recognition and performance on the threat detection tasks, we calculated Pearson's *r* correlations between recognition accuracy for Happy, Neutral, and Angry expressions on the ER-40 and the amount of discrimination between prime categories for each of the two threat detection tasks. Each of these correlations was minimal (all $r<.089$), and none neared significance (all $p>.20$). We also identified a subgroup of patients (n=40) who performed below the mean for the recognition of both angry and neutral expressions. Ceiling effects for the recognition of happy prevented identification of poor performers in this category. We then repeated our primary analysis of the Structure and Emotion Cue tasks using this subgroup of patients. The results were identical to those of the full sample.

4. Discussion

We examined the ability of individuals with schizophrenia to implicitly perceive threat signaled by the face, without and with emotional expressivity, by analyzing priming effects on two original adaptations of the well-validated Affect Misattribution Procedure. One version utilized primes varying on attributed threat via emotionless structural manipulation; the other utilized angry, neutral, and happy primes. Here, patients and controls similarly exhibited threat-congruent implicit processing on both tasks, whereas patients alone showed deficits in explicit identification of neutral facial expressions and general cognitive performance. Consistent with recent studies reporting intact implicit emotion perception in schizophrenia, these findings demonstrate that such preserved capabilities extend beyond facial affect to the implicit processing of emotion-independent, threat-indicative craniofacial structure. Individuals with schizophrenia thus appear to normatively and accurately sense another's aggressive potential from both subtle, static facial features and overt, dynamic facial expressions of emotion.

Of note, and similar to the findings of Kohler and colleagues (2003), individuals with schizophrenia did not show impairments in the explicit recognition of angry and happy facial expressions. This raises the possibility that intact emotion recognition may have contributed to implicit threat detection abilities. While plausible, this seems unlikely given that 1) patients did show difficulty recognizing neutral expressions, 2) emotion recognition performance was uncorrelated with threat ratings, and 3) even patients who showed poorer emotion recognition performed comparably to controls on both tasks of threat detection. Taken together, these findings suggest that intact implicit threat perception is present in individuals with schizophrenia regardless of explicit emotion recognition abilities.

Functional implicit perception supports models that posit distinct but integrated stages of emotion and face processing: sensation, integration, and evaluation (Haxby et al., 2000; Schirmer & Kotz, 2006). Although disruptions at each stage have been observed in individuals with schizophrenia (Marwick & Hall, 2008), the present results, and those of others (e.g. Kring et al., 2014), suggest that the greatest disruptions likely occur at the stages of integration and evaluation. Intact implicit perception in schizophrenia also potentially implicates social brain networks centered on the amygdala (Pinkham, 2013), a region subserving emotion, salience, and threat processing (Adolphs, 2010). Namely, it lends support to neurocognitive hypotheses of primarily top-down dysfunction (Carter et al., 1998; Weinberger & Berman, 1988), which are bolstered by several studies (Burns et al., 2003; Leitman et al., 2011). Using a facial threat detection task, Leitman and colleagues (2008) found less cortical connectivity in areas recruited for stimulus integration and evaluation, relative to sensation. Furthermore, whereas hypoactivation in the amygdala of patients characterizes explicit and implicit affect perception, functional activity in the fusiform gyrus seems normative during the latter (Li et al., 2010). Thus, although those with schizophrenia have exhibited neural dysfunction at many levels of social information processing (Adolphs, 2004; Chen et al., 2009), comparatively normal functioning earlier in the visual-amygdala-prefrontal system may underlie intact abilities to automatically sense social threat.

The results reported here are additionally relevant to how social perception is measured in the patient population. Considering broad neurocognitive impairments in schizophrenia (Waters, 2007) and their modest links to social cognitive deficiencies (Sergi et al., 2007; Ventura et al., 2013), it is perhaps unsurprising that reducing attentional and mnemonic load on social cognitive assessments lessens or eliminates group differences (Hooker & Park, 2002; Meyer & Lieberman, 2012; Whittaker et al., 2001). Therefore, implicit tasks of social perception that are less cognitively demanding might be more sensitive in detecting retained low-order mechanisms than traditional, performance-based measures (Mathersul et al., 2008). Identification of such intact processes may provide important points of leverage for intervention strategies aimed at improving social cognition. While speculative, patients could be encouraged to trust in their “gut feelings” when evaluating social stimuli on domains known to be intact and then to carefully weigh that information against that gleaned from higher-order processes.

The current study nevertheless has limitations that require consideration. First, contrary to our expectations, threat ratings on our tasks were only minimally associated with interviewer-rated paranoia. These limited associations between implicit perceptions of threat and paranoia support hypotheses that paranoid ideation is driven by distortions in high-order attribution and mentalizing (Freeman, 2007; Penn et al., 2008) that can supersede earlier perception. However, because self-evaluated paranoia is prone to various inaccuracies (Gould et al., 2013; van Os & Verdoux, 2003), further attempts to create implicit measures of paranoia are warranted. Given that our sample consisted of outpatients with relatively low PANSS suspiciousness/persecution scores (*M*=3.07, *SD*=1.53), it might be informative for such investigations to recruit participants with more variation in symptomatology. Second, participants did not explicitly judge our stimuli for threat-relevance. To examine whether craniofacial threat cues are normatively perceived yet inappropriately appraised in schizophrenia, subsequent work could directly compare implicit and explicit threat ratings. Third, we excluded 33 patients and 21 controls for failing to complete both tasks or generating duplicate responses on every trial. Based on experimenter observation at testing, the latter reflected participants' attempts to expedite task completion amid a lengthy, four-hour study battery. Notwithstanding this, generalizability of our findings should be unaffected, as excluded individuals were proportionate between groups and did not differ from included individuals on the measured participant characteristics.

In conclusion, we demonstrated the preservation of implicit facial threat processing, both emotional and non-emotional, in schizophrenia. These findings further illuminate the nature of face processing in individuals with schizophrenia by demonstrating that intact abilities extend to the perception of subtle, non-emotional indices of facial threat. Moreover, the present results support emerging hypotheses of intact facial cue perception but impaired integration of the transmitted information and appraisal of its social salience.

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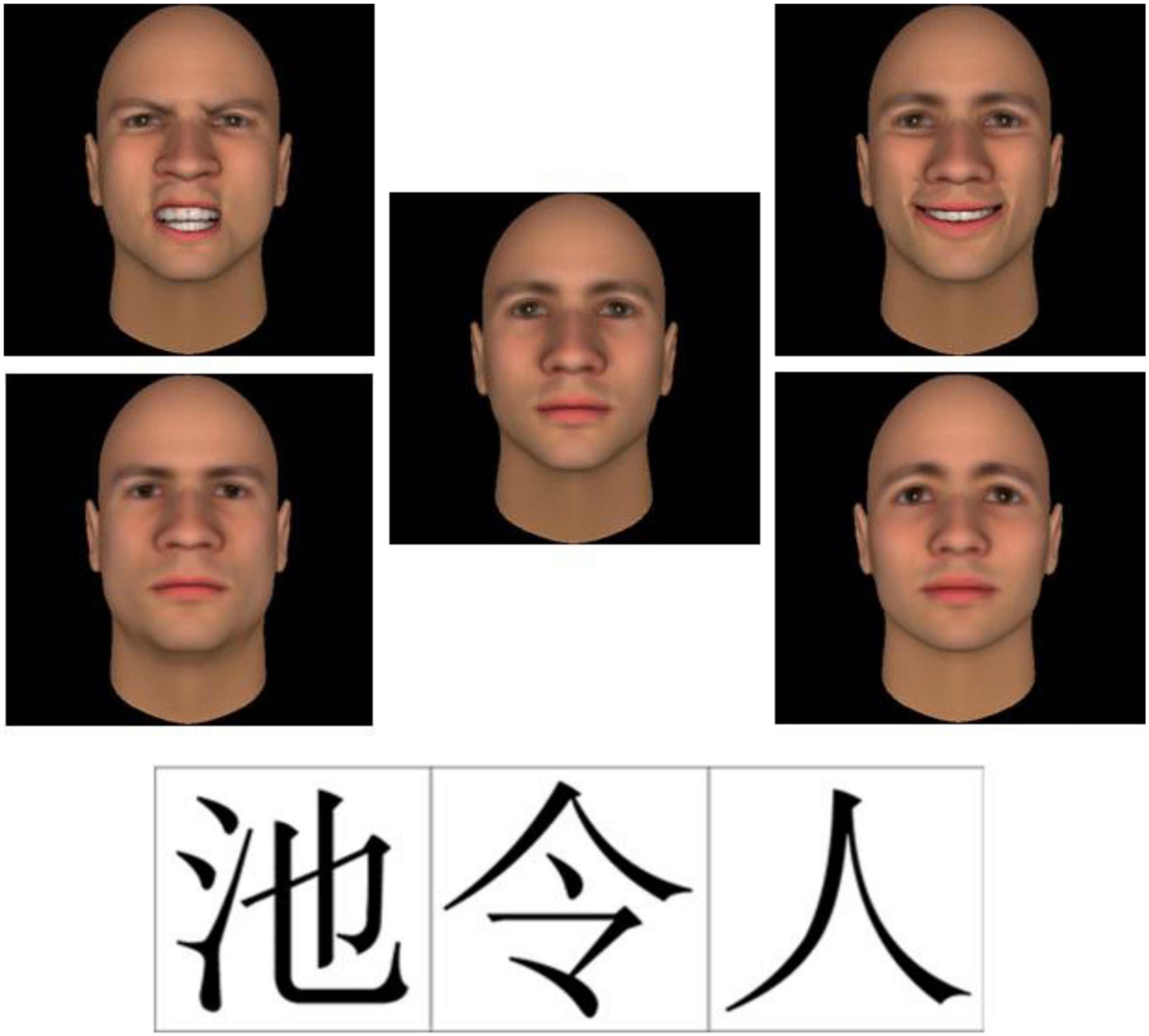

Figure 1.

One example avatar across the face categories and three example Chinese pictographs. *Top left*: Angry prime. *Top right*: Happy prime. *Bottom right*: Approachable prime. *Bottom left*: Threatening prime. *Center*: Neutral prime.

Table 1

Demographic and Clinical Information

	Healthy Control (*n*=84)		**Schizophrenia (*n*=126)**	
	n	%	*n*	%
SCZ Diagnosis				
Schizophrenia			54	42.9
Schizoaffective Disorder			72	57.1
Medication Information [a]				
Typical antipsychotics			20	15.9
Atypical antipsychotics			94	74.6
Typical and atypical antipsychotics			2	1.6
No antipsychotics			7	5.6
Gender				
Male	58	69.0	85	67.5
Female	26	31.0	41	32.5
Ethnicity				
Caucasian	40	47.6	62	49.2
African American	37	44.0	57	45.2
Other	7	8.3	7	5.6
	Mean	*SD*	Mean	*SD*
Symptom severity				
Positive			16.93	5.37
Negative			13.18	4.53
General			31.95	7.26
Age (years)	34.68	11.90	37.34	12.31
Education (years) [+]	13.96	1.84	13.09	2.14
Maternal education (years) [b]	13.68	2.28	13.42	3.61
Paternal education (years) [c]	14.18	2.94	14.27	4.11
Estimated IQ	98.32	12.94	96.23	15.55

Note. Symptom severity is presented as the sum of PANSS items for positive, negative and general symptom clusters. Estimated IQ is presented as a standard score from the reading subscale of the WRAT-3.

[+] Group difference statistically significant at p = .002

[a] Data unavailable for three patients.

[b] Data unavailable for sixteen patients and three controls.

[c] Data unavailable for thirty-one patients and three controls.

Table 2

Descriptive Statistics for Cognitive Performance and Explicit Emotion Recognition

	Healthy Control (n=84)		Schizophrenia (n=126)		
	Mean	**SD**	**Mean**	**SD**	**Cohen's d**
Cognition					
Trails A (seconds)**	29.83	10.74	38.72	16.3	−.64
Symbol Coding**	55.50	13.32	45.82	12.42	.75
Animal Naming**	24.33	6.46	19.44	5.81	.80
Letter-Number**	15.14	3.60	12.84	4.37	.57
Verbal Learning**	27.26	4.83	22.63	5.47	.90
ER-40					
Happy	7.83	0.37	7.72	0.56	.23
Sad**	7.13	1.19	6.55	1.40	.45
Anger	5.30	1.33	5.12	1.52	.13
Fear**	7.10	1.18	6.26	1.71	.57
No Emotion*	6.62	1.47	6.16	1.82	.28

Note: With the exception of Trails A, all scores are provided as total number correct.

* p<.05,

** <.01

Table 3

Means, Standard Deviations, and 95% Confidence Intervals for 'More Threatening' Responses

	Healthy Control (n=84)		**Schizophrenia (n=126)**	
	Mean (*SD*) (%)	**[95% CI] (%)**	**Mean (*SD*) (%)**	**[95% CI] (%)**
Structure Cue Task				
Threatening	45.1 (19.2)	[41.0, 49.2]	44.4 (21.8)	[39.7, 49.1]
Neutral	35.0 (18.1)	[31.1, 38.9]	39.4 (22.2)	[34.7, 44.2]
Approachable	34.0 (19.7)	[29.8, 38.2]	37.4 (23.7)	[32.3, 42.5]
Emotion Cue Task				
Angry	60.2 (26.1)	[54.6, 65.8]	64.4 (28.1)	[58.4, 70.4]
Neutral	28.0 (19.3)	[23.9, 32.1]	32.6 (21.7)	[28.0, 37.2]
Happy	27.2 (20.4)	[22.8, 31.6]	27.8 (21.6)	[23.2, 32.4]

Note. Main effect of group (p=.174) and interactions with group (all p≥.224) not significant.