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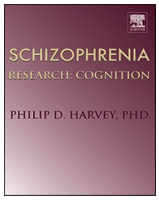

Research Paper

Identity recognition from faces and bodies in schizophrenia spectrum disorders

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ABSTRACT

Deficits in facial identity recognition and its association with poor social functioning are well documented in schizophrenia, but none of these studies have assessed the role of the body in these processes. Recent research in healthy populations shows that the body is also an important source of information in identity recognition, and the current study aimed to thoroughly examine identity recognition from both faces and bodies in schizophrenia. Sixty-five individuals with schizophrenia and forty-nine healthy controls completed three conditions of an identity matching task in which they attempted to match unidentified persons in unedited photos of faces and bodies, edited photos showing faces only, or edited photos showing bodies only. Results revealed global deficits in identity recognition in individuals with schizophrenia ($\eta_p^2 = 0.068$), but both groups showed better recognition from bodies alone as compared to faces alone ($\eta_p^2 = 0.573$), suggesting that the ability to extract useful information from bodies when identifying persons may remain partially preserved in schizophrenia. Further research is necessary to understand the relationship between face/body processing, identity recognition, and functional outcomes in individuals with schizophrenia-spectrum disorders.

1. Introduction

Individuals with schizophrenia show robust deficits across several domains of social cognition when compared to healthy controls. These deficits are comparable to those seen in autism spectrum disorders, and more severe relative to other psychiatric disorders, such as bipolar disorder and social anxiety disorder (Bora and Pantelis, 2016; Fernandes et al., 2018; Pepper et al., 2018). Associations between social cognition and functional outcomes are well-established in schizophrenia, demonstrating that mentalizing and emotional processing can impact community functioning and social skills, and that social cognition mediates the relation between neurocognition and functional outcomes (Halverson et al., 2019).

One of the primary social cognitive domains of inquiry in schizophrenia is emotion perception and recognition (emotional processing) because of its close association to social competence (Irani et al., 2012) and real-world outcomes (Fett et al., 2011; Hajdúk et al., 2020). Facial emotion recognition has been a prominent area of study, detecting significant deficits for individuals with schizophrenia when compared to healthy controls, with large effect sizes (Cohen's d ranging from −0.97 to −0.84; for a review, see Kohler et al., 2010). Healthy siblings of individuals with schizophrenia also show impaired facial emotion recognition, providing evidence that it may be considered as an endophenotype of the illness (Yang et al., 2015).

A large body of work has examined when and why emotion recognition processing in schizophrenia goes awry. Specifically, there are confounding views on whether facial emotion processing depends on identity recognition and/or general abilities for structural encoding of faces (Baudouin et al., 2002; Martin et al., 2005; Turetsky et al., 2007), or if emotion processing at least partially relies on processes that are

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parallel to but interrelated with identity recognition and general perception (Penn et al., 2000; Ramos-Loyo et al., 2009). To investigate this issue, several studies have examined abilities in non-emotional face processing, such as facial identity perception and recognition (for a review, see Bortolon et al., 2015). Across studies, individuals with schizophrenia perform worse than healthy controls on identity recognition tasks, such as the Benton Facial Recognition Task (Benton et al., 1994; for a review, see Bortolon et al., 2015), and this deficit has been found to significantly correlate with tests of emotion recognition and other domains of social cognition (Mueser et al., 1996; Salem et al., 1996). These findings suggest that individuals with schizophrenia present with a generalized deficit in face perception and processing, rather than a specific impairment in emotion recognition (Darke et al., 2013). Additional evidence suggests that this deficit may be related to more fundamental problems in complex object processing and visuo-perceptual abilities (Bauser et al., 2012; Sachse et al., 2014).

Although impaired face processing is well-established in schizophrenia, very little is known about how patients process social stimuli other than the face. Recent work from healthy populations has elucidated the importance of body perception for recognizing both identity and emotion. Evidence suggests that healthy individuals utilize bodily cues more heavily than they are consciously aware, especially in viewing conditions in which facial features are more difficult to detect (de Gelder and Van den Stock, 2011; Rice et al., 2013a), as well as in dynamic (Hahn et al., 2015; O'Toole et al., 2011) or dynamic-related contexts (e.g., due to form-from-motion processes in which seeing a body in motion facilitates processing relative to seeing a body standing still; Simhi and Yovel, 2016). Of particular note, Rice et al. (2013b) selected images of individuals where facial information was not useful for identity recognition and reported that healthy individuals were just as accurate in recognizing identity from bodies alone as they were when processing the whole person. However, when faces were presented in isolation, performance was worse and near chance levels, suggesting a reliance on bodily information for identity recognition. In schizophrenia spectrum populations, there is evidence that patients show deficits in processing emotional body language (e.g. gestures), perceiving biological motion and emotion from bodies depicted using point-light displays (Okruszek and Pilecka, 2017), and configural processing of bodies compared to controls (Bauser et al., 2012; Gupta et al., 2021; Hajdúk et al., 2020; Shasteen et al., 2016; Van den Stock et al., 2011; Walther et al., 2015), but it is currently unknown whether these deficits extend to identity recognition.

These findings highlight an important knowledge gap in our understanding of social information processing in schizophrenia and raise the possibility that individuals with schizophrenia may also struggle with detecting and successfully interpreting identity cues from the body. Therefore, the present study aimed to thoroughly examine the ability of individuals with schizophrenia to perceive identity from both the face and body. Given previous evidence for difficulties processing bodies, we hypothesized that individuals with schizophrenia would be similarly impaired across all conditions of the Rice et al. (2013b) identity recognition task (i.e., photos showing both the face and body, photos showing bodies only, and photos showing faces only) relative to control participants and thus fail to show more accurate recognition when bodily information is present.

2. Methods

2.1. Sample

The sample consisted of sixty-five stable, outpatient individuals diagnosed with schizophrenia or schizoaffective disorder (SCZ) and 49 non-psychiatric healthy controls (HC) between the ages of 18 and 65 (Table 1). Data were collected at two sites, Dallas, USA (45 SCZ and 38 HC), and Bratislava, Slovak Republic (20 SCZ and 11 HC). Psychiatric diagnoses for SCZ participants were confirmed using the Mini International Neuropsychiatric Interview (MINI; Sheehan et al., 1998) and Structured Clinical Interview for DSM Disorders-Psychosis Module (SCID; First et al., 2012). HC participants were group-matched to SCZ participants on ethnicity, age, and gender. Exclusion criteria for both groups were (1) presence or history of pervasive developmental disorder or intellectual disability as indicated by chart review and/or (IQ < 70), (2) presence or history of medical or neurological disorders that may affect brain function (e.g., cardiac or pulmonary disease, CNS tumors, history of seizures or head trauma with unconsciousness >15 min), (3) presence of sensory limitation including visual (e.g., blindness, glaucoma, vision uncorrectable to 20/40) or hearing impairments interfering with assessment, (4) lack of proficiency in English (Dallas site) or Slovak (Bratislava site), and (5) presence of substance abuse (past one month) or dependence not in remission (past 6 months). Additionally, HC individuals could not have 1) presence or history of any Axis I diagnoses according to DSM-5 criteria, confirmed via screening with the SCID or 2) any first-degree relatives with a diagnosis of schizophrenia or schizoaffective disorder. Participants were recruited via study fliers, web-based ads, community mental health clinics, and follow-up contact with previous research participants in the lab who had consented to be contacted for additional studies. All participants provided written informed consent and ethical committees at University of Texas at Dallas and University Hospital Bratislava approved the study.

Table 1
Participant demographics.

	SCZ		HC		
	N/M	SD/%	N/M	SD/%	t/x^2
Gender					
Female	27	41.5	23	46.9	$p = .565$
Male	38	58.5	26	53.1	
Age^{+}	38.58	9.84	39.06	10.25	$p = .802$
Race					
White	46	70.8	32	65.3	$p = .724$
Black/African American	17	26.2	16	32.7	
Other	2	3	1	2	
Years of education	13.27	2.7	14.12	1.81	$p = .058$
EPIQ – WRAT-III^{++}	93.31	13.06	101.68	10.97	$\boldsymbol{p = .002}$**
Ethnicity					
Hispanic	10	15.4	6	12.2	$p = .633$
Non-Hispanic	55	84.6	43	87.8	
Psychopathology					
PANSS – Positive	15.94	5.54			
PANSS – Negative	13.49	5.51			
PANSS – General	31.37	7.70			
PANSS – Total	60.80	13.11			

Note: SCZ = Schizophrenia; HC = Healthy Control; N = Number of participants; M = Mean; SD = Standard Deviation; EPIQ-WRAT-III = Estimated Premorbid Intelligence Quotient as estimated by the Wide Range of Achievement Test III; PANSS = Positive and Negative Syndrome Scale. **$p < .01$. ***$p < .001$. $^{+}$ In SCZ group, actual age range was 19–57 years old. In HC group, actual age range was 19–60 years old. $^{++}$WRAT-3 data are from the UT Dallas sample only (n = 45 SCZ, n = 38 HC).

2.2. Measures

2.2.1. Identity Matching Task (IMT; Rice et al., 2013b)

In the Identity Matching Task developed by Rice et al. (2013b), participants are asked to identify same or different persons from two simultaneously presented photos. The photo pairs used in this task were determined by a face identification algorithm to have poor-quality information for face identification (i.e., either highly dissimilar pairs of images taken on different days showing the same person or highly similar images showing different people; more complete information on this can be found in Rice et al., 2013a), allowing us to isolate and test the influence of bodies in identity recognition decisions. As noted above, in Rice et al.' (2013b) study of healthy individuals, results indicated that individuals performed well above chance level on conditions with

original images (face and body presented together) and images of bodies only (face covered with beige oval) but performed poorly on the face-only condition (covering everything but face with gray background).

In the present study, each participant completed three conditions of a person recognition task in which they attempted to match identities of unknown persons. Conditions included original photos (OR), photos of faces only (FO), and photos of bodies only (BO) (examples shown in Fig. 1). Each condition included 98 trials, or pairs of stimuli, with condition order counterbalanced across participants (Rice et al., 2013a). In each trial, participants viewed side-by-side photos of individuals and were prompted to rate on a 5-point Likert scale how confident they were in whether the two persons were the same or different (1 - *Sure they are the same person*, 2 - *Think they are the same person*; 3 - *Don't know*; 4 - *Think they are different people*; 5 - *Sure they are different people*). This approach allowed for calculation of both signal detection indices (i.e., *d-prime*) and receiver-operator-characteristic (ROC) curves (see Statistical analyses section). Photos remained on screen until participants responded, and response time was not collected.

2.2.2. Estimated Premorbid IQ (EPIQ)

The Wide Range of Achievement Test III (WRAT-III; Snelbaker et al., 2001) Reading subtest was administered at the Dallas site to establish an estimate of premorbid IQ. A reading subtest estimating premorbid IQ was not administered at the Bratislava site because there is no such test created in the Slovak language.

2.2.3. Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987)

The PANSS is a structured clinical interview that assesses severity of positive and negative symptoms in individuals with schizophrenia, as well as severity of general psychopathology, in the past week. Total scores on the positive, negative, and general subscales were used.

2.3. Statistical analyses

Demographic differences between groups were assessed first using *t*-tests or Chi-Square tests (x^2) as appropriate. Performance on the IMT task was then indexed using the same approach as Rice et al. (2013b). Specifically, using signal detection theory (Stanislaw and Todorov, 1999), we calculated the sensitivity index (*d-prime*) for each of the three IMT conditions (original picture, body only, face only). The calculation of *d-prime* (*d'*) was based on the formula reported in the paper by Macmillan (1993) where *d'* = z(Hit Rate) – z(False Alarm Rate). Adjusted Hit Rate and False Alarm Rate according to Macmillan and Kaplan (1985) were used in the calculation to avoid problems of division by zero or result in infinite values of the calculated *d'*. Hits were defined as 'same judgments' (ratings 1 and 2 on 5-point Likert scale) to same-identity pairs, and false alarms were defined as 'same judgments' to different-identity pairs. This measures participants' ability to discriminate same-identity pairs from different-identity pairs, independent of response bias (i.e., tendency to guess 'same' versus 'different' under uncertainty). As in the original Rice et al. (2013b) paper and consistent with our focus on successful recognition, responses of 3, 4, and 5 were considered to be 'different judgments.'[1] Responses of '3 - Don't Know' were interpreted as indicating the participant perceived a potential discrepancy, thus these responses were included in the 'different' category.

IMT task performance was then examined via one-sample *t*-tests to determine whether performance significantly differed from chance levels on each of the three conditions. Next, condition, group, and potential study site effects were analyzed using a repeated measures ANOVA with IMT condition (original vs. bodies only vs. faces only) as the within-subjects factor and group membership (SCZ vs. HC) and site (Dallas vs. Bratislava) as the between-subjects factors with *d-prime* as the dependent variable. ROC curves were also generated from the distribution of ratings for same-identity and different-identity pairs. This approach provides a more comprehensive performance overview compared to a conventional same/different paradigm. Finally, we computed a difference score equal to the absolute value of participants bodies-only and faces-only *d-prime* scores for use in correlation analyses (Pearson's r) between IMT conditions, positive, negative, and general symptom severity, and EPIQ. Analyses were conducted with IBM SPSS v29.

3. Results

3.1. Participants

Groups did not significantly differ on gender ($\chi^2(1,N = 114) = 0.331$, $p = .565$), age ($t(112) = -0.251, p = .802$), years of education ($t(112) = -1.912$, $p = .058$), race ($\chi^2(3,N = 114) = 1.324, p = .724$), and ethnicity ($\chi^2(1,N = 114) = 0.228, p = .633$). As expected, Dallas individuals with SCZ showed lower estimates of EPIQ compared to healthy controls ($t(81) = -3.129, p = .002$).

3.2. Identity recognition from faces and bodies

One-sample *t*-tests revealed that both groups performed well above chance level on original and bodies-only conditions (all *p*-values<.001) and were near chance level on the faces-only condition ($p = .23$ for both groups). Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated in the repeated measures ANOVA, $\chi^2(2) = 6.612, p = .037$, and therefore, a Greenhouse-Geiser correction was used. There was a significant main effect of condition such that performance in both groups decreased across the three conditions ($F(1.889,207.77) = 147.623, p < .001, \eta_p^2 = 0.573$), with performance being best when full bodies and faces were presented together and worst when bodily information was erased and only faces were shown. Performance for bodies alone was intermediary. There was also a significant main effect of group ($F(1,110) = 8.077, p = .005, \eta_p^2 = 0.068$), showing that healthy controls performed significantly better than individuals with schizophrenia across all three conditions. Additionally, there was a significant main effect of site, such that Bratislava participants performed significantly better than Dallas participants across IMT conditions ($F(1,110) = 13.967, p < .001, \eta_p^2 = 0.113$). There was no significant interaction between site and condition ($F(1.889,207.77) = 0.691, p = .502$), showing that the enhanced performance pattern with the presence of bodily information was consistent across individuals at both sites. Importantly, we also did not find a significant interaction between group and condition ($F(1.889,207.770) = 1.731, p = .180$) indicating that the pattern of improved performance when bodily information was present applied equally to both groups. There was no significant interaction between site and group ($F(1.889,207.770) = 0.261, p = .771$).[2]

Post-hoc pairwise comparisons and paired-samples *t*-tests indicated that within the HC group, there was a significant difference in identity recognition *d'* scores between the original condition ($M = 1.35, SD = 0.61$) and bodies only condition ($M = 0.81, SD = 0.42; t(48) = 7.378, p < .001$, Cohen's $d = 1.054$), between the original condition and faces only condition ($M = 0.13, SD = 0.77; t(48) = 15.960, p < .001$, Cohen's $d = 2.280$), and between the faces only condition and bodies only condition ($t(48) = 6.990, p < .001$, Cohen's $d = 0.999$). Similarly, within the SCZ group, there was a significant difference in identity recognition scores between the original condition ($M = 0.99, SD = 0.76$) and bodies only condition ($M = 0.65, SD = 0.47; t(64) = 4.566, p < .001$, Cohen's d =

[1] SCZ and HC groups did not differ significantly in number of "3" response ratings (t (109.35) = 1.170, $p = .244$).

[2] D-prime scores were also calculated with ratings of 3 included in the "same" category, thus dividing the scale between 3 and 4 instead of 2 and 3 as per Rice et al. (2013b). Results were unchanged.

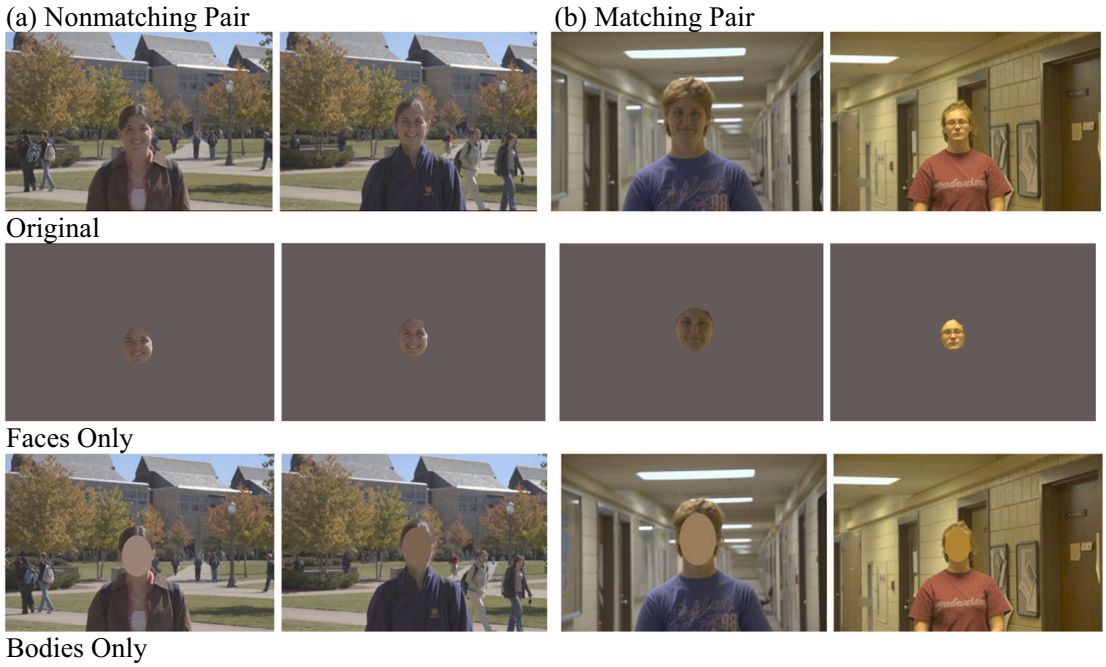

Fig. 1. Identity matching task stimuli examples (Rice et al., 2013a).
Note: Original image source from Ventura et al. (2013).

0.566), between the original condition and faces only condition (M = -0.12,SD = 0.77;t(64) = 14.070,$p < .001$,Cohen's d = 1.745), and between the faces only condition and bodies only condition (t(64) = 9.152, $p < .001$,Cohen's d = 1.135). Mean performances for each group and condition are shown in Figs. 2 and 3 as indicated by ROC curves.

3.3. Identity recognition, symptom severity, and EPIQ

In the SCZ group, performance on the identity recognition task did not correlate with overall interviewer ratings of positive symptoms, negative symptoms, or general psychopathology (all p-values>.06). Within the Dallas site, we did not find a significant relationship between EPIQ and IMT performance in either the SCZ group (all p-values≥.070) or HC group (all p-values≥.463), and covarying for EPIQ when evaluating task performance did not alter any of the results with the exception that the group difference in performance was no longer statistically significant (F(1,80) = 2.526, $p = .116$).

4. Discussion

The goal of this study was to examine the ability of individuals with schizophrenia to recognize identity from the face and body. As anticipated, individuals with schizophrenia performed worse than healthy controls on all three conditions of the IMT task, suggesting global deficits in identity recognition abilities, not only in person identification from faces, but also from bodies. Our finding that facial identity

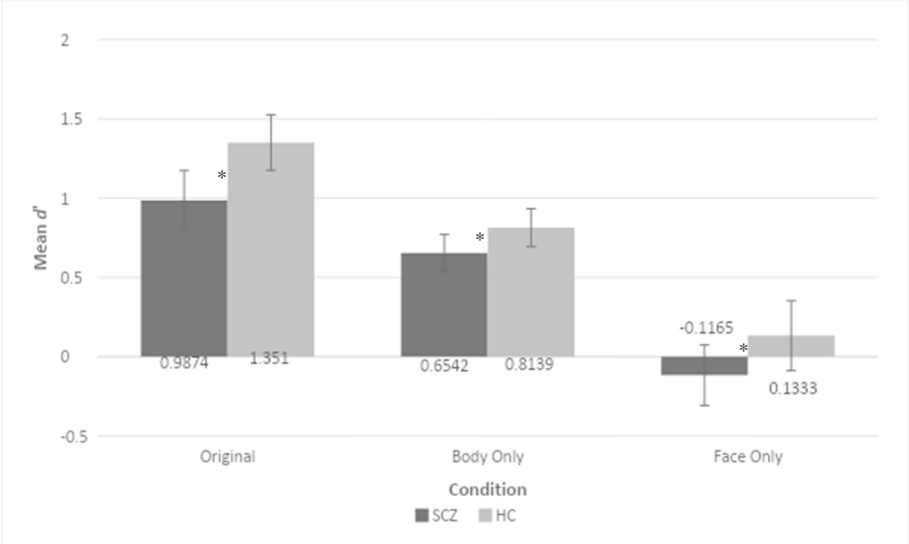

Fig. 2. Identity matching task performance across groups.
Note: Mean performance on the IMT task conditions are shown for each group, as well as significant differences between groups and conditions. SCZ = Schizophrenia; HC = Healthy Control. Error bars represent 95 % confidence interval. *denotes statistically significant difference between groups.

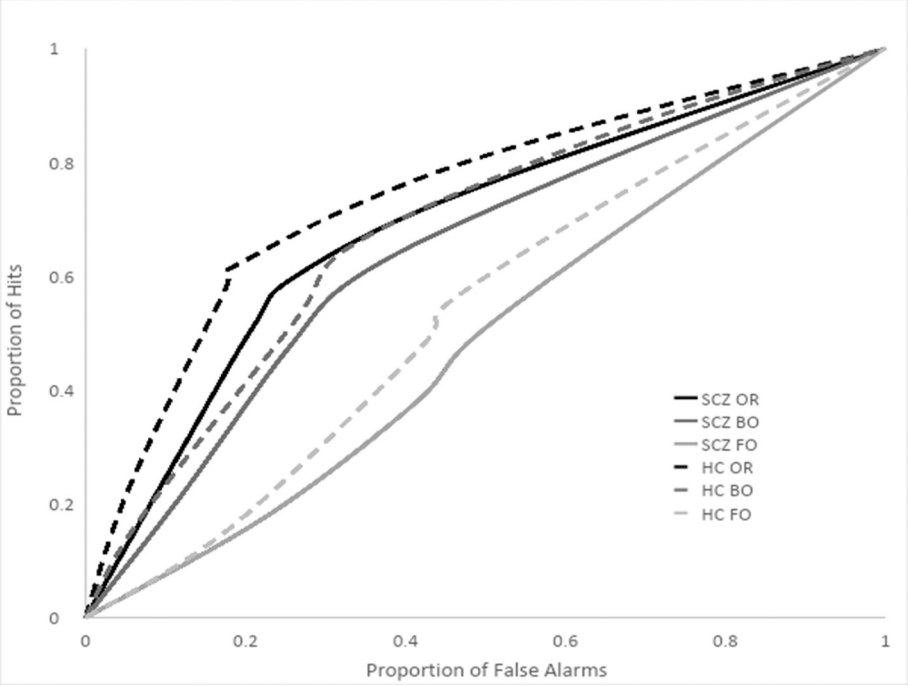

Fig. 3. ROC curve.
Note: The graph shows identification accuracy results using receiver-operator-characteristic (ROC) curves. SCZ = Schizophrenia; HC = Healthy Control; OR = Original Condition; BO = Body Only Condition; FO = Face Only Condition.

recognition was impaired in SCZ compared to HCs is consistent with several previous studies using the Benton Facial Recognition Task in schizophrenia-spectrum populations (Chen et al., 2012; Kucharska-Pietura et al., 2005; Penn et al., 2000); however, demonstration that these impairments extend to body perception have yet to be reported in the literature.

Importantly, given that the images used in the IMT task were chosen because of their lack of identifiable facial information (Rice et al., 2013b), we were able to isolate the effects of body perception on identity recognition in both the absence (body only condition) and presence of facial information (original photo condition wherein facial information was provided but not useful). The pattern of improved performance when bodily information was available relative to when only facial information was provided suggests that individuals with schizophrenia do retain some ability to use bodily information despite their overall recognition deficits and that they do so in a manner similar to healthy individuals who also show an advantage for bodies. These results are consistent with previous studies reporting comparable cortical pathways and processing mechanisms for the perception of face and bodies between SCZ and HC individuals (Bauser et al., 2012; Minnebusch and Daum, 2009). As noted, performance decreased across conditions (OR > BO>FO) in both groups, with performance well above chance levels in original and body only conditions and near chance in face only conditions. This finding indicates that much of the success in the original condition was due to identity cues from the body rather than the face, which is in line with Rice et al.'s (2013a) findings in a healthy population. Given previous findings that bodily emotion perception abilities and configural processing of bodies are related to social deficits (Bauser et al., 2012; Hajdúk et al., 2020; Shasteen et al., 2016; Van den Stock et al., 2011), and the relationship between processing and identification, future research would benefit from additional investigations of how deficits in body perception, processing, and identification relate to one another, as well as their implications for social functioning.

Interestingly, we found a main effect of site location (Bratislava versus Dallas) across all three IMT conditions, such that individuals from Bratislava were significantly better at identifying whether two photos depicted the same individual or a different individual. These findings extend Hajdúk et al.'s (2020) findings of between-site differences in emotion recognition from bodies in samples from Bratislava and Dallas. Future studies should address how potential cultural differences may influence the ability of individuals to recognize identity from faces and bodies. A potential limitation of our findings of site differences is that because EPIQ was collected in only the Dallas sample and not the Bratislava sample, we were unable to examine potential interactions between site and EPIQ. Additionally, site comparisons are somewhat limited due to low statistical power, but other factors, such as potential differences in socio - economic status, may drive differences across sites as well and should be considered in future work.

Consistent with findings from Chen et al. (2012), we did not find EPIQ to be significantly associated with performance on the IMT task in the SCZ or HC group within the Dallas sample. Given known group differences in EPIQ, we conducted a RM ANCOVA to analyze IMT performance while covarying for EPIQ and found no significant changes in results (i.e., pattern across IMT conditions remained) with the exception that the group difference was no longer significant ($p = .114$). However, Cohen's d effect sizes between HC and SCZ groups were comparable when covarying for EPIQ ($d = 0.31$) versus not ($d = 0.47$), suggesting that EPIQ differences do not fully account for the reported group differences in IMT performance. Nevertheless, significant differences in EPIQ scores between groups could still be considered as a potential confounding factor for our findings.

In contrast to previous findings demonstrating links between facial identity recognition and severity of symptoms (Barkhof et al., 2015; Ventura et al., 2013), we did not find any significant relationship between overall positive, negative, or general symptoms and IMT performance. A larger sample size or sample with continuously distributed symptom severity may have allowed us to detect smaller effects of symptom severity with more statistical power.

In addition to a modest sample size and the lack of an EPIQ assessment in the Bratislava sample, one potential limitation of the current work is a lack of social functioning measures that would help elucidate the relationship between bodily identity recognition and functional

outcomes. Similarly, it will be important to examine the relationship between identity recognition and emotion recognition from bodies in SCZ as this would inform the specificity of these processes. Likewise, future research may also consider utilizing imaging techniques to better understand neural processes behind identity recognition, and how these processes may be similar or dissimilar between body processing and face processing in individuals with schizophrenia versus healthy controls.

The current study is the first to demonstrate that while individuals with schizophrenia present with global identity recognition deficits, their ability to use information from bodies when determining identity appears relatively intact. These findings therefore highlight an ability that may be able to be leveraged to improve social perception and social cognition in schizophrenia.

Ethical approval

The ethical committees at the University of Texas at Dallas and University Hospital Bratislava approved the study. The study was performed in accordance with the ethical standards of the institutional committees and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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CRediT authorship contribution statement

Madisen T. Russell: Writing – review & editing, Writing – original draft, Visualization, Formal analysis, Data curation. **Michal Hajdúk:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Cassi R. Springfield:** Writing – review & editing, Investigation. **Hans S. Klein:** Writing – review & editing, Investigation, Data curation. **Emily L. Bass:** Writing – review & editing, Investigation. **Vijay A. Mittal:** Writing – review & editing. **Trevor F. Williams:** Writing – review & editing. **Alice J. O'Toole:** Writing – review & editing, Methodology, Formal analysis, Conceptualization. **Amy E. Pinkham:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization.

Declaration of competing interest

The authors have no relevant financial or non-financial interests to disclose.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.scog.2024.100307.

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