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THE EFFECT OF AGE, RACE, AND SEX ON SOCIAL COGNITIVE PERFORMANCE IN INDIVIDUALS WITH SCHIZOPHRENIA

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Abstract

Age, race, and sex are linked to social cognitive performance among healthy individuals, but whether similar effects are evident in schizophrenia is unknown. Data from 170 individuals with schizophrenia or schizoaffective disorder and 98 healthy controls were used to examine relations between these demographic factors and performance across multiple domains and measures of social cognition. Sex was not related to performance on any domain, but older age was related to poorer emotion recognition from dynamic stimuli in both patients and controls. In patients, older age was also associated with better abilities to decipher hints. Both Caucasian patients and controls performed better than African American individuals on emotion recognition and mental state attribution tasks that use only Caucasian individuals as visual stimuli. Findings suggest rather limited influences of demographic factors but do demonstrate normative age and race effects

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Conflicts of Interest

In the last year, Dr. Harvey has served as a consultant to: Acadia Pharma, Boeheringer-Ingelheim, Forum Pharma, Lundbeck, Otsuka Digital Health, Sanofi, Sunovion, and Takeda Pharma. He also has other research support from The Stanley Medical Research Foundation and Takeda. All other authors report no conflicts of interest.

among patients. Findings also highlight important methodological considerations for measurement of social cognition.

Keywords

measurement; emotion recognition; mental state attribution

Introduction

Social cognition broadly refers to how individuals perceive, process, and interpret social information and includes abilities such as identifying facial expressions of emotion and understanding the mental states of others (Adolphs, 2001; Brothers, 1990). A substantial body of literature from healthy populations indicates that the basic demographic factors of age, race, and sex are related to social cognitive performance. Specifically, younger adults tend to be more adept at correctly identifying facial displays of emotion (Ruffman et al., 2008; Sasson et al., 2010) and understanding mental states (Henry et al., 2013) than older adults, and whereas the effect size is somewhat small (d=.19), females display an emotion recognition advantage relative to males (Thompson et al., 2014). Cross-racial effects have also been established for both face perception and emotion identification such that accuracy is better when individuals are processing same- vs. other-race faces (Elfenbein et al., 2002; Meissner et al., 2001). This other-race effect has also recently been replicated in a task that requires both emotion recognition and mental state attribution skills (i.e., the Eyes task) (Adams Jr et al., 2010).

Such findings prompt the question of whether similar patterns are seen among individuals with schizophrenia. As social cognitive impairments are well-established in this disorder, findings supporting demographic differences may highlight potentially important normative processes within the context of overall impairments. For example, previous findings that individuals with schizophrenia show an intact other-race effect for face processing suggest that patients may have normative developmental experiences with faces and that social cognitive abilities may not become maximally impaired until after illness onset (Pinkham et al., 2008).

The literature regarding demographically based differences in social cognitive abilities among individuals with schizophrenia, however, is currently mixed, with reports of significant differences varying across both demographic factors (e.g., sex vs. age) and social cognitive domains (e.g., emotion processing vs. mental state attribution). For example, within emotion recognition, females with schizophrenia do not appear to have an advantage in overall accuracy relative to males (Kohler et al., 2009; Mote et al., 2016), but increased age has been found to be associated with greater impairment (Kohler et al., 2009). The one study that has examined demographic factors and mental state attribution suggests a different pattern in that females did show an advantage, but only minimal relations between mental state attribution abilities and age were evident among patients (Abu-Akel et al., 2013). Thus, whereas the vast majority of this work has focused on emotion recognition, it

appears that some normative processes may be preserved, but only for select social cognitive domains.

The current study aims to test this overarching hypothesis by using data from phase 3 of the Social Cognition Psychometric Evaluation Study (SCOPE)(Pinkham et al., 2014; Pinkham et al., 2015) to examine the relations between demographic factors and performance across multiple domains and measures of social cognition. Based on previous work, we predicted healthy females would show better emotion identification than healthy males, thus demonstrating a relation between sex and emotion recognition abilities. However, among patients, we expected sex to only be related to social cognitive performance within the domain of mental state attribution as indicated by females performing better on these tasks but not on emotion recognition tasks. We also predicted that older age would be associated with poorer social cognitive performance, particularly within the domain of emotion recognition, for both patients and controls. Finally, we predicted that in both groups, race would be associated with performance in social cognitive domains that utilize facial stimuli. These include emotion recognition and mental state attribution but not attributional style or social perception.

Methods

Participants

Data from the first study visit of 170 individuals with schizophrenia or schizoaffective disorder and 98 healthy controls were analyzed. Participants were recruited from two study sites, Southern Methodist University (SMU) and the University of Miami Miller School of Medicine (UM). Patients at the SMU site were recruited from Metrocare Services, a nonprofit mental health services provider for Dallas County, TX, and other area clinics. UM patient recruitment took place at the Miami VA Medical Center and the Jackson Memorial Hospital-University of Miami Medical Center. Healthy controls at both sites were recruited via community advertisements. Inclusion and exclusion criteria have been detailed elsewhere (Pinkham et al., 2016); however for the present analyses, only data from Caucasian and African American participants were analyzed. The larger SCOPE database included an additional 9 patients and 6 controls who self-identified as being from other racial categories. As these groups were not large enough to examine statistically, they were excluded. Diagnoses were confirmed with the Mini International Neuropsychiatric Interview (Sheehan et al., 1998) and Structured Clinical Interview for DSM Disorders Psychosis Module (First et al., 2002). All study procedures were approved by the local site's Institutional Review Board, and all participants provided written informed consent.

Patients and controls did not differ in race (χ^2=.02, p=.90), ethnicity (χ^2=.19, p=.66), age (t(266)=1.53, p=.13), parental education (maternal: t(215)=1.58, p=.12; paternal: t(181)=1.22, p=.22), or IQ as estimated by the WRAT-3 Reading subscale (t(266)=.93, p=.35). The ratio of males to females differed between groups such that there were relatively more males in the patient group (χ^2=.9.46, p=.002), and as expected, controls completed more years of education than patients (t(266)=2.69, p=.008). Demographic and clinical characteristics are presented in Table 1.

Measures

Neurocognition—Cognitive abilities were assessed with a subset of the MATRICS Consensus Cognitive Battery (MCCB) (Nuechterlein et al., 2008) that included the following tests: Trail Making Test, Part A; Brief Assessment of Cognition in Schizophrenia: Symbol Coding; Category Fluency: Animal Naming; Letter-Number Span; and the Hopkins Verbal Learning Test-Revised.

Social Cognition—Full descriptions of the social cognitive measures have been published recently (Pinkham et al., 2016). Briefly, these measures assessed four general domains. Attritional style/bias was evaluated with the Ambiguous Intentions and Hostility Questionnaire (AIHQ) (Combs et al., 2007) which yields scores for a hostility bias, an aggression bias, and a blame score. Emotion recognition was assessed with the Bell Lysaker Emotion Recognition Task (BLERT) (Bryson et al., 1997) and the Penn Emotion Recognition Test (ER-40) (Kohler et al., 2003). Social perception was measured with the Relationships Across Domains test (RAD) (Sergi et al., 2009). Mental state attribution was assessed with the Reading the Mind in the Eyes Test (Eyes) (Baron-Cohen et al., 2001), the Awareness of Social Inferences Test, Part III (TASIT) (McDonald et al., 2003), and the Hinting Task (Hinting) (Corcoran et al., 1995). Participants also completed the Trustworthiness Task (Trust) (Adolphs et al., 1998), which asks participants to make complex social judgments of trustworthiness from facial images but does not fall cleanly into any of the four domains noted above. All of the social cognitive measures are performance-based tasks that are scored for accuracy with the exception of AIHQ and Trust. These latter two tasks assess social cognitive biases and are indexed by average ratings. Higher scores on the AIHQ are indicative of greater bias, and lower scores on Trust indicate more ratings of untrustworthiness.

Statistical Analyses

A multigroup path model was tested to examine the extent to which age, sex, and race predicted social cognitive task performance and whether the effects of these demographic factors differ for patients versus controls. The model was tested using AMOS v. 21, which uses maximum likelihood estimation to account for missing data. To account for anticipated neurocognitive differences between groups and potential influence from normative cognitive ageing (Deary et al., 2009), the model controlled for all five MCCB measures of participants' neurocognitive functioning. Critical ratio tests were used to assess which paths (from the predictors to the outcomes) significantly differed between patients and controls; a critical ratios z-score above 1.96 indicates a significant difference. Due to the number of outcomes in the model, we used the Benjamini-Hochberg false discovery rate correction (Benjamini et al., 1995) to account for multiple tests and to ensure the Type I error rate was not inflated (alpha set to .05).

Results

Figure 1 depicts the results from the multigroup path model for patients and healthy controls, and Table 2 presents the regression coefficients from the path model and the results of the critical ratios tests. Both patients and healthy controls showed age differences on the

BLERT, with older participants in both groups performing worse on this task (Patients: b = −.07, p = .004; Controls: b = −.06, p = .002). Older patients performed significantly better on Hinting than younger patients, b = .09, p < .001, whereas there was no age difference on this task for healthy controls; this group difference between patients and controls was statistically significant, z = 2.58, p < .01. Age was not related to performance on any other tasks.

In regard to race, African Americans in both the patient and control group performed worse on the Eyes Task (Patients: b = −1.92, p = .009; Controls: b = −2.32, p = .009) and the BLERT (Patients: b = −1.42, p = .01; Controls: b = −1.74, p = .001). Among patients, African Americans performed worse on the RAD, b = −2.27, p = .002, whereas African American healthy controls performed worse on the TASIT, b = −2.92, p = .005, as compared to Caucasian participants. The critical ratio tests indicated that these race effects were not statistically different for patients as compared to controls. Race showed no other relations to task performance.

Contrary to our predictions, no significant sex differences in task performance were found for either patients or healthy controls. To compare our data to the established literature, we also calculated the effect sizes for female, relative to male, performance for each group on the two emotion recognition tasks. On the ER-40, the female advantage among healthy controls was small (d=.16), but on par with previous reports using non-verbal stimuli. (Thompson et al., 2014) However, only a very minimal female advantage was evident among patients (d=.02). Results from the BLERT were less clear. Here, both groups showed mean advantages for females; but the size of the effects were very small (control: d=.05; patient: d=.08) and therefore of questionable scientific significance.

Discussion

The demographic factors of age, race, and sex have shown small, but consistent, relations with social cognitive performance in healthy individuals (Elfenbein et al., 2002; Ruffman et al., 2008; Thompson et al., 2014). The current study utilized a large dataset assessing multiple domains and measures of social cognition to examine whether similar relations were evident among individuals with schizophrenia. Overall, demographic factors showed limited relations with social cognitive performance, and those relations that were evident were similar between patients and controls. Sex was not related to performance on any task, but older age was associated with poorer performance on select emotion recognition and mental state attribution tasks. Race predicted performance across the largest number of tasks and spanned the domains of emotion recognition and mental state attribution.

In interpreting these findings, it is noteworthy that sex was not related to emotion recognition performance or to performance in any other social cognitive domain among healthy individuals. As noted previously, a female advantage for emotion recognition has been well-established in the normative literature, but it is a relatively small effect. Examination of the effect sizes from our data show a comparably small effect in healthy controls on the ER-40, suggesting that our sample of healthy individuals was not large enough to detect this difference using our statistical approach and correction method. The

effect size in our larger patient sample; however, was almost zero. This is consistent with several previous reports indicating that individuals with schizophrenia fail to show the normative female advantage in emotion recognition (Kohler et al., 2009; Mote et al., 2016) and may suggest important interactions between sex and diagnosis that should be considered in future attempts to understand the mechanisms underlying emotion recognition impairment. Data from the BLERT failed to show a meaningful sex difference in either patients or controls, but it is important to note that sex differences in recognizing emotion from dynamic stimuli have not been supported among healthy individuals (reviewed in (Kret et al., 2012)). Thus, potential differences between recognition of static and dynamic emotional expressions also requires consideration.

Age also showed relatively few effects; however, increased age was found to be negatively correlated with emotion recognition performance on the BLERT for both patients and healthy controls. Importantly this relationship was found even when controlling for neurocognitive performance. These findings therefore support a normative age effect for emotion recognition in patients and indicates that decreased performance with increased age cannot be explained solely by age-related neurocognitive decline. It is somewhat surprising that age did not show a significant relation with emotion recognition performance on the ER-40; however, this could again be related to differences between the processing of static and dynamic stimuli. The somewhat restricted age range of individuals in this study (18–65) may have also limited our ability to detect age effects, particularly given that previous work using static stimuli demonstrates the greatest impairment in individuals over the age of 65 (Sasson et al., 2010). Increased age among individuals with schizophrenia was also related to greater accuracy discerning the true intention behind a hint. It is possible that older patients may be able to benefit from accrued social experiences when responding to this task.

The greatest number of effects were found for race, which was associated with task performance such that Caucasian patients and healthy controls performed better than African American individuals on the BLERT and the Eyes task. Previous work has demonstrated that African Americans tend to perform worse on neurocognitive tasks when being tested by Caucasian experimenters (Marx et al., 2005; Richeson et al., 2005; Thames et al., 2013), as was the case here, and currently unpublished data from our group shows that this pattern may also extend to social cognitive tasks (Nagendra et al., under review). However, as neurocognitive performance was included as a covariate, race effects were limited to specific tasks, and both the BLERT and the Eyes task use only Caucasian stimuli, these results may best be interpreted while considering the potential impact of an other-race effect. This may have rendered these tasks more difficult for African American individuals due to relatively reduced expertise with Caucasian faces. Such an interpretation is consistent with previous work demonstrating an intact other-race effect among individuals with schizophrenia (Pinkham et al., 2008). African American individuals in the control group also showed poorer performance on the TASIT, another task that includes predominantly Caucasian stimuli. While the relation between race and TASIT performance was not significant in the patient group, the lack of a significant group difference suggests that this relation is not specific to controls and is therefore consistent with the findings regarding the BLERT and Eyes task. Finally, race showed a relation to performance on the RAD in patients; however,

it is important to note that the RAD showed relatively poor psychometric properties in this dataset (Pinkham et al., 2016) and that a large proportion of the patient sample performed only at chance levels. Thus, it would be premature to conclude that race may be related to social perception abilities in schizophrenia.

Beyond identifying the potential influence of demographic factors on social cognitive performance, the present results have implications for the measurement of social cognition and for further understanding the influence of neurocognition on social cognitive performance. First, the minimal relations reported here suggest that the social cognitive tasks utilized in the SCOPE study are widely applicable across individuals. The one notable exception is race, where an argument can be made for a need to develop tasks that include racially diverse stimuli. Only the ER-40 and Trust task include stimuli from various racial categories, and remarkably, these were the only two tasks utilizing human visual stimuli that did not show a relation between participant performance and race. It is possible that including such stimuli may have mitigated the influence of an other-race effect on performance. Thus, inclusion of stimuli from multiple races in social cognitive measures appears necessary in order to prevent systematic bias and erroneous conclusions about differential abilities across subgroups. Second, while neurocognition was not a primary focus, its inclusion in the path model allows for an examination of how neurocognitive performance relates to social cognitive performance. Overall, there were very few significant relations, and only working memory showed a consistent link to social cognitive performance among patients. These findings are consistent with a growing body of literature that suggests the relative independence of neuro- and social cognition (e.g., (Ventura et al., 2011) and reviewed in (Pinkham, 2013)).

Several limitations of the current study should also be considered. First, this is a secondary data analysis, and the study was not designed with the central aim of investigating demographic effects. It is therefore possible that the lack of individuals over the age of 65 may have obscured some age effects. However, schizophrenia patients have been suggested to manifest “accelerated aging” (Kirkpatrick et al., 2008), which might exaggerate age effects in certain domains. Likewise, although the male to female ratio in the control group was approximately equal, the ratio in the patient group was approximately 2:1. Having relatively fewer females in the patient group may have also limited our ability to detect sex effects. The necessity of limiting our analyses to Caucasian and African American individuals also restricts any conclusions about race to those specific groups. Second, it is important to note that our samples were comprised of volunteers living in metropolitan areas surrounding the two study sites, which may limit the generalizability of our findings. And third, many of the demographic effects that are reported in healthy individuals are subtle, and our sample sizes may not have been large enough to find them here, particularly using our conservative correction method. Future efforts may wish to consider pooling data across several studies in order to provide a comprehensive examination. Notwithstanding these limitations, the current study shows no influence of sex on social cognitive performance among individuals with schizophrenia and a limited influence of age on emotion recognition and mental state attribution. Our results also reveal racial disparities in performance on visual tasks that include only Caucasian stimuli and highlight an important methodological limitation in current tasks that assess social cognitive abilities.

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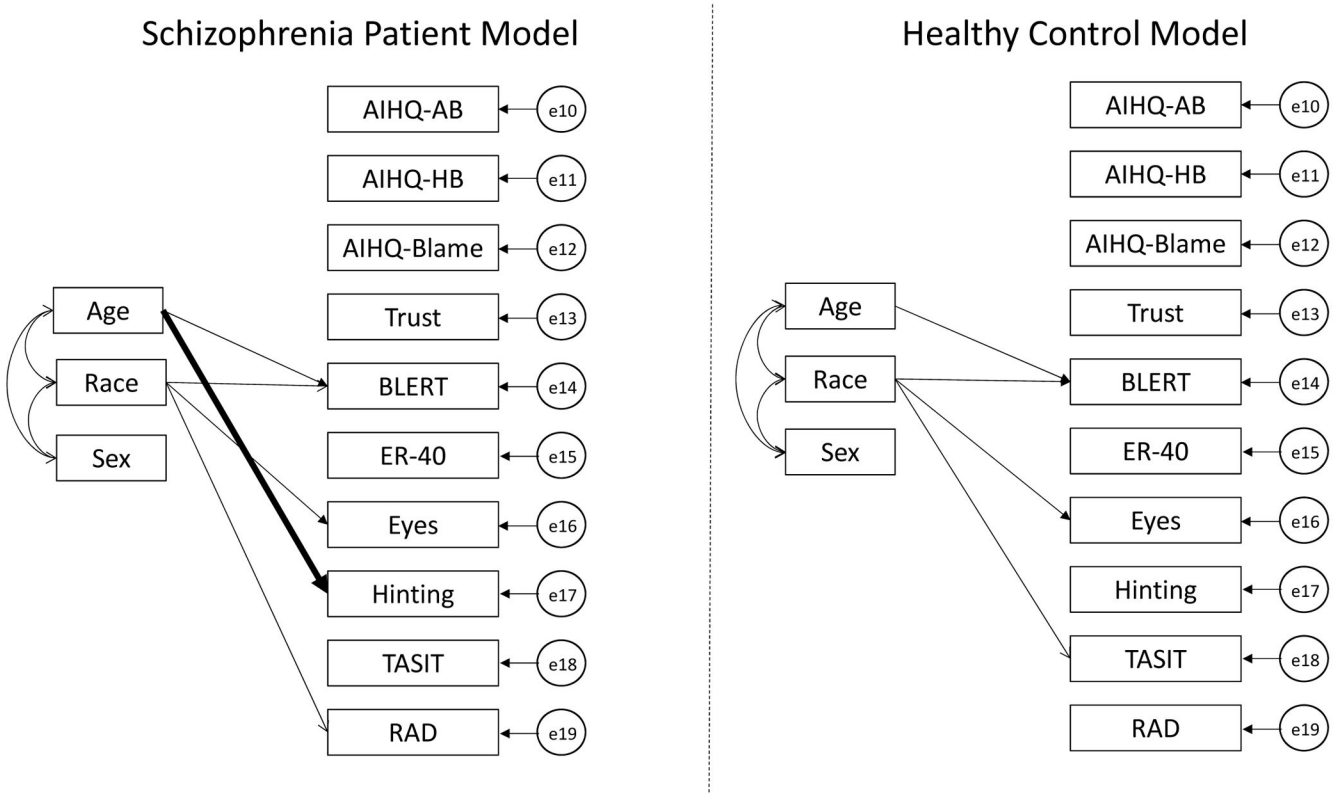

Figure 1.

Results from multigroup path model examining age, race, and sex differences in social cognition for schizophrenia patients and healthy controls.

Note. $N_{patient}$ = 170; $N_{control}$ = 98. Error variances among the 10 social cognition outcomes were allowed to correlate (not depicted in figure). Model controlled for 5 inter-correlated measures of general neurocognitive functioning, which were correlated with the predictors (not depicted in figure). Only significant paths after controlling for multiple tests shown; bold solid line indicates path significantly differed between schizophrenia patients and healthy controls.

Table 1

Participant demographic and clinical characteristics

Characteristic	Patients (n=170)		Controls (n=98)	
	n	n	n	(%)
Male **	114	67%	47	48%
Race				
Caucasian	76	45%	43	44%
African American	94	55%	55	56%
Ethnicity				
Hispanic	35	21%	18	18%
Non-Hispanic	135	79%	80	82%
Diagnosis				
Schizophrenia	92	54%		
Schizoaffective	78	46%		
Medication type [a]				
Typical	25	15%		
Atypical	117	69%		
Combination	3	2%		
	Mean	SD	Mean	SD
Age (years)	42.21	12.40	39.70	13.70
Education (years) **	12.66	2.14	13.33	1.62
Maternal Education (years) [b]	12.48	3.26	13.13	2.55
Paternal Education (years) [c]	12.76	3.73	13.34	2.51
WRAT-3	93.31	15.92	95.08	13.37
PANSS				
Positive Total	16.15	5.84		
Negative Total	13.80	5.38		
General Total	30.88	8.08		
MCCB[d]				
Trails A (seconds) **	41.23	18.98	31.17	12.82
Symbol Coding **	42.27	11.76	53.28	13.94
Animal Naming **	18.52	5.14	21.97	6.39
Letter-Number Span **	11.23	4.08	13.81	3.89
HVLT-R **	20.14	5.39	24.86	4.54

** $p<.01$

[a] Nineteen individuals were not taking antipsychotic medications, and medication information was missing for 6 individuals.

[b] Information was missing for 9 controls and 42 patients.

[c] Information was missing for 20 controls and 65 patients.

[d] Raw scores are provided for each test.

Table 2

Age, Race, and Sex Differences in Social Cognition Task Performance: Regression Coefficients and Critical Ratio Results from Multigroup Path Analysis

	Schizophrenia Patients		Healthy Controls		Critical Ratio Test
	***b* (*SE*)**	***p*-value**	***b* (*SE*)**	***p*-value**	***Z***
Age					
Age → AIHQ-AB	0.002 (0.003)	.44	−0.001 (0.002)	.81	0.76
Age → AIHQ-HB	0.000 (0.004)	.95	−0.01 (0.005)	.28	0.86
Age → AIHQ-Blame	0.02 (0.02)	.33	−0.03 (0.02)	.01	1.81
Age → Trust	0.01 (0.01)	.20	0.005 (0.01)	.36	0.55
Age → BLERT	**−0.07 (0.02)**	**.004**	**−0.06 (0.02)**	**.002**	0.05
Age → ER-40	−0.03 (0.03)	.31	−0.04 (0.03)	.20	0.10
Age → Eyes	0.03 (0.03)	.37	0.04 (0.03)	.24	0.29
Age → Hinting	**0.09 (0.02)**	**<.001**	0.02 (0.02)	.29	**2.58**
Age → TASIT	−0.01 (0.04)	.81	−0.07 (0.04)	.10	0.94
Age → RAD	−0.06 (0.03)	.06	−0.04 (0.04)	.34	0.39
Race					
Race → AIHQ-AB	0.02 (0.07)	.78	−0.01 (0.05)	.85	0.33
Race → AIHQ-HB	0.13 (0.10)	.22	−0.04 (0.12)	.74	1.07
Race → AIHQ-Blame	0.98 (0.47)	.04	0.67 (0.49)	.16	0.44
Race → Trust	0.18 (0.19)	.37	0.02 (0.13)	.87	0.64
Race → BLERT	**−1.42 (0.55)**	**.01**	**−1.74 (0.53)**	**.001**	0.41
Race → ER-40	−0.75 (0.80)	.35	−0.96 (0.76)	.21	0.19
Race → Eyes	**−1.92 (0.74)**	**.009**	**−2.32 (0.89)**	**.009**	0.35
Race → Hinting	−0.50 (0.58)	.39	0.53 (0.44)	.23	1.42
Race → TASIT	−1.71 (1.06)	.11	**−2.92 (1.04)**	**.005**	0.82
Race → RAD	**−2.27 (0.73)**	**.002**	−1.30 (1.03)	.21	0.77
Sex					
Sex → AIHQ-AB	−0.08 (0.07)	.23	−0.10 (0.05)	.06	0.89
Sex → AIHQ-HB	0.14 (0.10)	.18	0.12 (0.12)	.33	0.09
Sex → AIHQ-Blame	0.18 (0.47)	.71	0.42 (0.49)	.39	0.36
Sex → Trust	0.07 (0.19)	.70	0.20 (0.13)	.14	0.53

	Schizophrenia Patients		Healthy Controls		Critical Ratio Test
	***b* (*SE*)**	***p*-value**	***b* (*SE*)**	***p*-value**	***Z***
Sex → BLERT	0.10 (0.56)	.86	−0.53 (0.53)	.32	0.81
Sex → ER-40	−0.26 (0.80)	.75	−0.75 (0.76)	.33	0.44
Sex → Eyes	1.20 (0.75)	.11	0.34 (0.89)	.70	0.74
Sex → Hinting	0.47 (0.58)	.42	0.37 (0.44)	.40	0.13
Sex → TASIT	0.61 (1.07)	.57	−1.69 (1.04)	.10	1.54
Sex → RAD	0.37 (0.73)	.61	1.18 (1.03)	.25	0.64
Covariates					
TRAILS					
TRAILS → AIHQ-AB	0.000 (0.002)	.80	0.01 (0.003)	.04	1.58
TRAILS → AIHQ-HB	0.001 (0.003)	.69	0.01 (0.01)	.11	1.31
TRAILS → AIHQ-Blame	−0.01 (0.01)	.73	00.02 (0.03)	.35	0.98
TRAILS → Trust	−0.001 (0.01)	.86	−.01 (0.01)	.08	1.27
TRAILS → BLERT	−0.001 (0.02)	.97	−0.001 (0.03)	.98	0.01
TRAILS → ER-40	0.01 (0.02)	.64	−0.02 (0.04)	.67	0.60
TRAILS → Eyes	0.02 (0.02)	.46	0.01 (0.05)	.76	0.04
TRAILS → Hinting	−0.002 (0.02)	.89	−0.002 (0.02)	.94	0.02
TRAILS → TASIT	−0.03 (0.03)	.31	−0.07 (0.06)	.19	0.66
TRAILS → RAD	0.03 (0.02)	.18	−0.02 (0.06)	.71	0.83
Symb					
Symb → AIHQ-AB	−0.003 (0.003)	.46	0.01 (0.003)	.044	1.85
Symb → AIHQ-HB	0.002 (0.01)	.77	0.003 (0.01)	.68	0.14
Symb → AIHQ-Blame	0.003 (0.03)	.90	0.01 (0.03)	.71	0.18
Symb → Trust	−0.003 (0.01)	.74	−0.01 (0.01)	.32	0.28
Symb → BLERT	0.04 (0.03)	.14	0.01 (0.03)	.84	0.95
Symb → ER-40	0.08 (0.04)	.05	0.02 (0.04)	.58	1.08
Symb → Eyes	**0.16 (0.04)**	**<.001**	0.09 (0.05)	.05	1.12
Symb → Hinting	0.06 (0.03)	.07	−0.02 (0.02)	.50	1.85
Symb → TASIT	0.12 (0.06)	.033	−0.04 (0.05)	.45	2.06

	Schizophrenia Patients		Healthy Controls		Critical Ratio Test
	***b* (*SE*)**	***p*-value**	***b* (*SE*)**	***p*-value**	***Z***
Symb → RAD	0.06 (0.04)	.15	0.03 (0.05)	.64	0.48
HVLT					
HVLT → AIHQ-AB	−0.01 (0.01)	.33	−0.01 (0.01)	.11	0.51
HVLT → AIHQ-HB	0.02 (0.01)	.028	−0.03 (0.02)	.14	2.42
HVLT → AIHQ-Blame	0.05 (0.05)	.37	−0.08 (0.07)	.21	1.54
HVLT → Trust	0.01 (0.02)	.55	0.04 (0.02)	.02	1.16
HVLT → BLERT	0.07 (0.06)	.23	0.04 (0.07)	.57	0.32
HVLT → ER-40	0.12 (0.09)	.17	0.06 (0.10)	.54	0.40
HVLT → Eyes	0.02 (0.08)	.80	0.09 (0.12)	.48	0.45
HVLT → Hinting	0.13 (0.06)	.035	0.15 (0.06)	.01	0.22
HVLT → TASIT	**0.33 (0.11)**	**.004**	0.13 (0.14)	.37	1.09
HVLT → RAD	**0.25 (0.08)**	**.002**	0.24 (0.14)	.09	0.06
AF					
AF → AIHQ-AB	0.002 (.01)	.79	−0.003 (0.004)	.48	0.62
AF → AIHQ-HB	−0.001 (.01)	.95	0.01 (0.01)	.23	0.91
AF → AIHQ-Blame	−0.06 (.05)	.21	0.05 (0.04)	.22	1.75
AF → Trust	−0.03 (.02)	.11	−0.01 (0.01)	.48	1.00
AF → BLERT	−0.03 (.05)	.62	0.03 (0.04)	.48	0.84
AF → ER-40	0.01 (.08)	.92	0.002 (0.06)	.97	0.06
AF → Eyes	0.01 (.07)	.93	0.06 (0.07)	.45	0.47
AF → Hinting	0.03 (.06)	.55	0.04 (0.04)	.27	0.10
AF → TASIT	0.05 (.10)	.63	0.07 (0.09)	.39	0.17
AF → RAD	0.09 (.07)	.21	−0.004 (0.09)	.96	0.86
LNS					
LNS → AIHQ-AB	0.02 (0.01)	.07	0.02 (0.01)	.05	0.22
LNS → AIHQ-HB	**−0.04 (0.02)**	**.007**	−0.03 (0.02)	.08	0.42
LNS → AIHQ-Blame	−0.09 (0.07)	.21	−0.06 (0.07)	.42	0.34
LNS → Trust	0.02 (0.03)	.43	−0.03 (0.02)	.11	1.54
LNS → BLERT	**0.23 (0.08)**	**.006**	0.13 (0.07)	.07	0.83

	Schizophrenia Patients		Healthy Controls		Critical Ratio Test
	***b* (*SE*)**	***p*-value**	***b* (*SE*)**	***p*-value**	***Z***
LNS → ER-40	**0.67 (0.12)**	**.002**	−0.05 (0.11)	.66	**2.64**
LNS → Eyes	**0.48 (0.11)**	**< .001**	0.25 (0.12)	.04	1.40
LNS → Hinting	**0.24 (0.09)**	**.005**	0.03 (0.06)	.59	1.97
LNS → TASIT	**0.35 (0.16)**	**.023**	0.33 (0.14)	.02	0.14
LNS → RAD	**0.42 (0.11)**	**< .001**	0.19 (0.14)	.19	1.30

Note. Unstandardized regression coefficients and standard errors presented. Bold *p*-value and critical ratio test indicate the path or critical ratio test was significant after applying the Benjamini-Hochberg correction. For race, negative coefficients indicate poorer performance for African American participants relative to Caucasian participants, and for sex, negative coefficients indicate poorer performance for males relative to females. Abbreviations: AIHQ-AB, Ambiguous Intentions and Hostility Questionnaire Aggression Bias; AIHQ-HB, Ambiguous Intentions and Hostility Questionnaire Hostility Bias; BLERT, Bell Lysaker Emotion Recognition Task; ER-40, Penn Emotion Recognition Test; TASIT, The Awareness of Social Inferences Test, Part III; RAD, Relationships Across Domains; Symb, Symbol Coding; HVLT, Hopkins Verbal Learning Test-Revised; AF, Animal Fluency; LNS, Letter-Number Span.