Neighborhood socioeconomic status and racial disparities in schizophrenia: An exploration of domains of functioning

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ABSTRACT

Black Americans are disproportionately diagnosed with schizophrenia and experience worse objective functional outcomes (e.g., hospitalizations) than their White counterparts. However, we have a limited understanding of the psychological pathways through which Black Americans with schizophrenia reach worse outcomes. This study assessed race and domains of functioning (e.g., neurocognition, functional capacity) known to be associated with objective outcomes in a sample of 108 non-Hispanic Black and 61 non-Hispanic White individuals with schizophrenia-spectrum disorders from the Social Cognition Psychometric Evaluation (SCOPE) study. Three primary findings emerged: First, Black participants showed lower scores than White participants on measures of neurocognition(NC), social cognition(SC), and everyday living skills, but not social skills or community functioning. Second, neighborhood socioeconomic status (SES) explained 21% of the relationship between race and NC but did not mediate the relationship between race and SC or everyday living skills. Finally, prior research has established that NC, SC, social skills, and everyday living skills predict community functioning in individuals. Finally, prior research has established that NC, SC, social skills, and everyday living skills predict community functioning in individuals with schizophrenia. In our sample, after controlling for neighborhood SES, race did not moderate the relationships of NC, SC, social skills, or everyday living skills to community functioning. This indicates that relationships between these domains are comparably strong across Black and White Americans. Taken together, these findings show that NC, SC, and everyday living skills may be important areas to explore in regards to racial disparities in schizophrenia. More research, especially incorporating nuanced race- and SES-related variables, is needed to understand how to best intervene and improve real-world outcomes for Black Americans with schizophrenia.

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1. Introduction

A recent meta-analysis of 55 studies found that Black Americans are 2.4 times more likely to be diagnosed with schizophrenia than their White counterparts (Olbert et al., 2018). Moreover, large-scale studies of objective real-world outcomes in schizophrenia demonstrate that Black Americans are more likely than White individuals to be hospitalized (Rost et al., 2011), homeless (Folsom et al., 2005), and incarcerated (Baillargeon et al., 2009; Prince et al., 2007), as well as less likely to obtain competitive employment (Rosenheck et al., 2006; Salkever et al., 2007). These findings highlight that Black Americans are disproportionately impacted by schizophrenia. However, we have a limited understanding of the pathways through which Black Americans with schizophrenia reach worse objective outcomes. This knowledge is necessary in order to develop effective and targeted interventions for this group.

One promising strategy that may illuminate why Black Americans experience psychosocial challenges after diagnosis is to evaluate domains of functioning known to be associated with long-term outcomes, including (a) social and community functioning (e.g., interpersonal relationships, work skills); (b) neurocognition (NC); (c) social cognition

(SC); (d) social skills; and (e) everyday living skills (i.e., "functional capacity"). These domains have received a wealth of attention in schizophrenia research, as they might be more amenable to direct intervention than broad, objective outcomes such as hospitalization and incarceration (Fett et al., 2011; Halverson et al., 2019; Harvey et al., 2011; Turner et al., 2014; Vaskinn and Horan, 2020).

However, research on associations between race and domains of functioning is sparse and fragmented. Prior studies have indicated that Black Americans tend to obtain lower scores on measures of NC (Nagendra et al., 2018a; Sabbag et al., 2015) and SC (Brekke et al., 2005; Pinkham et al., 2017). However, the only known study that has evaluated everyday living skills, as well as social and community functioning, did not find significant racial differences (Sabbag et al., 2015). Additionally, we are not aware of recent studies that have evaluated the relationship between race and social skills performance. The dearth of systematic research across domains of functioning amounts to a sizeable gap in our conceptualization of why Black Americans with schizophrenia experience such negative objective outcomes. Thus, the current study has three aims, which are intended to elucidate relationships between race and domains of functioning.

First, we evaluated whether there are Black-White racial differences in measures of NC, SC, social skills, social and community functioning, and everyday living skills. These analyses quantify the presence and magnitude of racial disparities across domains. Second, we assessed the extent to which socioeconomic status (SES) explains observed relationships between race and functioning, given the strong overlap between Black race and low SES in schizophrenia (e.g., Nagendra et al., 2018b; Rosenheck et al., 2006). SES was evaluated at two levels: individual (i.e., participant education[1]) and area (e.g., neighborhood education). Prior research on healthy individuals has demonstrated that individual- and area-level SES may impact functioning through complementary pathways. There is a well-established relationship between individual education and cognitive performance (Guerra-Carrillo et al., 2017). Additionally, research demonstrates that a variety of socioeconomic and environmental characteristics can impact cognitive scores (Cassarino and Setti, 2015; Clarke et al., 2015; Wu et al., 2015). For example, studies suggest that living in a neighborhood with increased community resources (e.g., public transportation, community centers) may protect against cognitive decline over time (Cassarino and Setti, 2015; Clarke et al., 2015). Similarly, individuals with low levels of formalized education who live in neighborhoods that facilitate social and mental stimulation may show improvements in social and cognitive functioning over time. Thus, the present study will evaluate the extent to which area-level SES mediates the relationship between race and domains of functioning, while controlling for individual level SES.

Finally, this study evaluated whether NC, SC, social skills, and everyday living skills predict community functioning comparably across Black and White Americans. An important part of schizophrenia research is to identify and address predictors of real-world impairment in the illness (Bowie et al., 2010; Gold, 2004). However, at present, research has not demonstrated that these predictors of outcome function similarly in Black and White Americans. This is a crucial oversight, as cross-cultural psychology has demonstrated that even well-established constructs may not function in the same way across races (e.g., Chen, 2008). For example, expressed emotion (EE) – the tendency for family members to exhibit critical, hostile, or emotionally-overinvolved statements - is considered a robust predictor of relapse in schizophrenia (Goldstein, 1995; Hooley, 2007). However, studies suggest that for Black individuals with schizophrenia, higher EE may actually be associated with *better* outcomes (Gurak and Weisman de Mamani, 2017; Rosenfarb et al., 2006). Moreover, a recent meta-analysis revealed that the relationship between NC and functional

outcomes is weaker in non-White versus White individuals (Halverson et al., 2019). Given the centrality of NC, SC, social skills, and everyday living skills to our current conceptualization of impairment and outcomes in schizophrenia, it is important to assess if these factors show predictive validity in Black as well as White Americans.

2. Methods

2.1. Sample

Participants were 108 non-Hispanic Black and 61 non-Hispanic White Americans with schizophrenia-spectrum illnesses from the two data collection phases of the NIMH-funded Social Cognition Psychometric Evaluation (SCOPE) study (Pinkham et al., 2014, 2016, 2018). Participants in the SCOPE study were recruited from mental health clinics, hospitals, and medical centers in Florida, Texas, and North Carolina. However, addresses necessary for neighborhood-level SES analyses were not collected from participants in North Carolina. Thus, the sample for this study consists only of individuals from Florida and Texas with complete addresses. All duplicates between the two phases were removed, and data from the first of two visits was used.

Demographic, diagnostic, and clinical information for the sample included in the current study is provided in Table 1 (information for the full SCOPE non-Hispanic Black and White Americans sample is provided in Supplementary Table 1). Diagnoses were assessed via chart review (N = 84) and the Structured Clinical Interview for DSM-IV Axis I Disorders (N = 86). Black participants were more likely to be diagnosed with schizophrenia than schizoaffective disorder ($\chi2 = 12.59$, $p < .01$). There were no differences in method of diagnosis (i.e., chart review or SCID), or on the PANSS total score between White and Black participants (see Supplementary Table 2). Further sensitivity analyses examining differences in clinical and demographic characteristics between White and Black participants and diagnostic groups and results are presented in Supplementary Tables 3 and 4.

2.2. Measures

2.2.1. Demographic measures

Race and ethnicity were assessed via self-report. Individual-level SES was measured as years of participant education. While other metrics have been used to measure individual-level SES (e.g., income; Braveman et al., 2005), the data available for participants in the SCOPE study for these variables was often missing (e.g., 30% of data on

Table 1
Sample description and group comparisons.

	Black (N = 108)	White (N = 61)
Age, M (SD)	43.27 (11.62)	41.33 (12.51)
Gender, % male (N)	56 (61)	69 (42)
Diagnosis, % (N)[**]		
Schizophrenia	57 (62)	30 (18)
Schizoaffective	42 (45)	70 (43)
Other	<1 (1)	0
Mean PANSS[a] total	61.53 (15.13)	61.18 (13.24)
Participant education years, M (SD)	12.39 (1.88)	12.80 (2.38)
Neighborhood % with < college education[**]	80.18 (15.89)	72.62 (18.27)
Neighborhood % at ≤ 200% poverty	53.49 (17.51)	48.43 (19.67)
Neighboorhood % unemployed[**]	10.17 (5.30)	6.62 (3.92)
Neighborhood composite SES z-score[**]	0.16 (0.82)	−0.30 (0.84)
Neurocognition composite t-score[**]	34.88 (6.82)	38.93 (7.42)
Social cognition composite z-score[**]	−0.18 (0.77)	0.34 (0.75)
UPSA-B z-score[**]	−0.26 (0.99)	0.45 (0.85)
SSPA z-score	0.05 (0.98)	−0.09 (1.04)
SLOF-informant z-score	−0.07 (0.98)	0.13 (1.03)

Note.
[**] Indicates significant group differences, $p < .01$.
[a] PANSS = Positive and Negative Syndrome Scale.

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[1] Ideally, a variety of possible metrics of socioeconomic status would be considered for analyses (Shavers, 2007). However, there were limitations on available data in the SCOPE study. More details are provided in the Methods section.

maternal education was not available), or less useful in this cohort (e.g., not all participants had consistent employment).

For neighborhood SES, census tract designations were geocoded using participant addresses via the program ArcGIS, then linked to five-year data from the 2013–2017 American Community Survey (U.S. Census Bureau, 2018). Census tracts are roughly equivalent to "neighborhoods" (averaging around 4000 individuals) and are considered to be generally homogeneous units in regards to population characteristics, economic status, and living conditions (Krieger et al., 2002). No clear consensus exists on the key variables to include in a composite neighborhood SES score, although economic measures have demonstrated the clearest relationship with physical health problems (Krieger et al., 2002). Given that domains of functioning are closely linked to cognitive scores, we also included neighborhood education level in our composite score. Thus, neighborhood SES was calculated as the mean z-scores of the percentage of people in a census tract, a) with less than a college degree; b) who were unemployed; and c) lived below 200% of the poverty line. Higher scores on the neighborhood SES composite indicate residence in a lower SES neighborhood.

Analyses showed that there were no significant differences between racial groups in years of participant education, $t(167) = 1.23$, $p = .22$; thus, individual SES was excluded from further analyses. However, Black participants lived in lower SES neighborhoods than their White counterparts, $t(167) = 3.53$, $p < .01$.

2.2.2. Measures of functioning

NC was measured with a subset of five tasks from the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) neurocognitive battery, which shows robust psychometric properties (Green et al., 2014; Kern et al., 2008; Nuechterlein et al., 2008). Processing speed was assessed through the Trail Making Test – Part A, Symbol Coding, and Animal Fluency. Working memory was evaluated through the Letter-Number Test. Verbal Learning was assessed through the Hopkins Verbal Learning Test. All tasks in the MATRICS battery have strong psychometric properties and are expected to load onto one factor (Green et al., 2014). Thus, in the current study, age- and gender-corrected participant T-score totals for each task were averaged for a NC composite score exhibiting good reliability (Cronbach's $\alpha = 0.69$). Comparable reliability was observed for Black Americans (Cronbach's $\alpha = 0.65$) and White Americans (Cronbach's $\alpha = 0.70$).

Four SC tasks were used in the current analyses, all of which show adequate psychometric properties (Pinkham et al., 2016, 2018). Emotion perception was measured with the Penn Emotion Recognition Task (ER-40; Kohler et al., 2003) and the Bell-Lysaker Emotion Recognition Task (BLERT; Bryson et al., 1997). Two tasks were used to measure theory of mind, the ability to infer the mental states of others: The Reading the Mind in the Eyes Task (Eyes Task; Baron-Cohen et al., 2001) and Part III of The Awareness of Social Inferences Task (TASIT; Mcdonald et al., 2003). Based on prior research, the four tasks were expected to load onto one latent factor (Browne et al., 2016; Ludwig et al., 2017), which was tested via confirmatory factor analysis. Overall model fit was evaluated using recommendations from Hu and Bentler (1999) and Bentler (2007), and the model demonstrated good fit to the data. Standardized loadings and model fit indices are displayed in Supplementary Table 2. Thus, a SC composite was calculated, consisting of the averaged z-scores of the ER-40, BLERT, TASIT, and Eyes Task (Cronbach's $\alpha = 0.82$). Comparable reliability was observed for Black Americans (Cronbach's $\alpha = 0.78$) and White Americans (Cronbach's $\alpha = 0.77$).

Social skills were measured with the Social Skills Performance Assessment (SSPA), which shows adequate psychometric properties (Patterson et al., 2001). The SSPA measures social skills via roleplay exercises that mimic two real life situations: (a) a tenant greeting a new neighbor; and (b) persuading a landlord to fix a leak as soon as possible. Dimensions of social skills are rated on a 5-point Likert scale by trained observers, and include interest, fluency, clarity, focus, affect, grooming,

social appropriateness, negotiation ability, persistence, and overall conversation/argument. Ratings from two scenes were collapsed into an overall composite social skill scale with a range from 16 to 80, with higher scores signifying greater skill. Ratings were converted to z-scores prior to data analysis and exhibited good reliability (Cronbach's $\alpha = 0.88$). Comparable reliability was observed for Black Americans (Cronbach's $\alpha = 0.89$) and White Americans (Cronbach's $\alpha = 0.89$).

Real-world functioning was assessed with the Specific Levels of Functioning Scale (SLOF; Harvey et al., 2011; Schneider and Streuning, 1983). The SLOF is a 30-item, five point-scale, informant-rated measure of a participant's behavior and functioning in four domains: interpersonal relationships (e.g., social contacts, effective communication), social acceptability (e.g., verbal and physical abuse, repetitive behaviors), participation in community activities (e.g., using the telephone, paying bills, leisure time), and work skills (e.g., employable skills, level of supervision needed). In the current study, ratings were provided by "high quality informants" (i.e., high contact clinicians, family members, or close friends identified by participants). Scores on the SLOF range from 30 to 150, with higher scores indicating better social and community functioning. For analyses, SLOF totals were converted to z-scores. The SLOF exhibited good reliability in the total sample (Cronbach's $\alpha = 0.92$) and in Black Americans (Cronbach's $\alpha = 0.93$) as well as White Americans (Cronbach's $\alpha = 0.92$).

Everyday living skills were assessed via the UCSD Performance-Based Skills Assessment – Brief Version (UPSA-B; Patterson et al., 2006). This measure assesses capacity in domains of everyday functioning through standardized skills performance situations (e.g., counting out money, filling out a check, making a doctor's appointment). For the purposes of these analyses, the UPSA-B total scaled score from both domains (comprehension/planning and financial skills) was used. Scores range from 0 to 100, with higher scores indicating better everyday living skills. For analyses, the UPSA-B totals were converted to z-scores. The UPSA-B exhibited good reliability in the total sample (Cronbach's $\alpha = 0.89$) and in Black Americans (Cronbach's $\alpha = 0.83$) as well as White Americans (Cronbach's $\alpha = 0.96$).

2.3. Data analytic plan

Correlations between domains of functioning, across races, were conducted to ensure that they were positively and significantly associated with each other.

Our first aim was to evaluate whether there were Black-White racial differences in measures of functioning. To assess this, a one-way multivariate analysis of variance (MANOVA) was conducted to compare Black and White Americans on the NC composite, SC composite, SSPA total score, UPSA-B total score, and SLOF total score.

Our second aim was to assess the extent to which socioeconomic status (SES) indicators may explain any observed relationships between race and functioning. Using the *mediation* package for R (Tingley et al., 2014), race was entered as the predictor variable and any domains that showed significant racial differences in Aim 1 were entered as dependent variables (each modeled separately). Next, the composite neighborhood SES score was entered as a mediator. The significance of indirect effects was tested using a bootstrap estimation approach with 10,000 samples.

Our third aim was to evaluate whether neurocognition, social cognition, social skills, and everyday living skills predict community functioning comparably across Black and White Americans. Moderation analyses were conducted to assess if the NC composite, SC composite, SSPA total score, and UPSA-B total score (each modeled separately) predicted SLOF informant scores comparably across Black and White individuals. Each predictor variable (e.g., NC composite), the moderator variable (Black/White race), and the covariate (neighborhood SES) were entered into the PROCESS macro for SPSS (Hayes, 2017) which automatically centered the predictor and moderator variables and calculated the interaction terms. Moderation effects were evaluated via

Table 2
Correlations between NC, SC, SSPA, UPSA-B, and SLOF scores.

	NC composite[a]	SC composite[b]	UPSA-B[c]	SSPA[d]
SC composite[b]	0.56**			
UPSA-B[c]	0.50**	0.44**		
SSPA[d]	0.41**	0.37**	0.43**	
SLOF-inf[e]	0.28**	0.25**	0.19*	0.23**

Note.
[a] Neurocognition.
[b] Social cognition.
[c] UCSD Performance-Based Skills Assessment – Brief.
[d] Social Skills Performance Assessment.
[e] Specific Levels of Functioning Scale – informant ratings.
* $p < .05$.
** $p < .01$.

statistically significant interaction effects and change in R^2. Significant interaction effects were probed via plots.

3. Results

Correlations between domains of functioning are presented in Table 2. As expected, all five domains were strongly positively correlated with each other, ranging in strength from $r = 0.19$ to $r = 0.56$. Correlations between NC, SC, and functional outcome scores were also evaluated separately by race (see Supplementary Tables 3 and 4).

Our first aim was to evaluate racial group differences on domains of functioning. Multivariate tests indicated there were statistically significant differences across domains of functioning based on race, $F(5,136) = 9.33$, $p < .01$, such that Black individuals scored lower than their White counterparts. Univariate tests with a Bonferroni adjustment for multiple comparisons revealed that there were significant differences on the NC composite $F(1,140) = 10.12$, $p < .01$, SC composite $F(1,140) = 20.40$, $p < .01$, and everyday living skills $F(1,140) = 23.27$, $p < .01$. No racial group differences were found in community functioning (SLOF scores), or social skills (SSPA scores).

Our second aim was to use mediation analyses to test the extent to which neighborhood SES indicators may explain significant relationships between race and functioning. Three separate sets of analyses were conducted with race as a predictor, neighborhood SES status as a mediator, and each of the three variables that showed racial group differences as outcomes (i.e., NC composite, SC composite, and everyday living skills). Analyses showed that the relationship between race and NC was mediated by neighborhood SES (see Fig. 1). The bootstrapped unstandardized indirect effect was −0.12, and the 95% confidence interval ranged from −0.23 to −0.03. Thus, the indirect effect was statistically significant. Based on the ratio of the indirect to the total effect, neighborhood SES accounted for 21% of the relationship between race and NC. A trend-level mediation effect ($p = .09$) for neighborhood SES

Table 3
Results of moderation analyses.

Model	β [95% CI]	p	ΔR²	Overall model
Predictor				
Neurocognition				$F(4, 107)$ = 1.09 $R^2 = 0.04$
NC composite	0.03 [−0.01, 0.05]	0.08		
Race	−0.03 [−0.42, 0.37]	0.89		
NC Composite x Race	−0.01 [−0.07, 0.04]	0.67	<0.01	
Social cognition				$F(4, 107)$ = 2.84 $R^2 = 0.10$
SC composite	0.32 [0.10, 0.55]	<0.01		
Race	0.12 [−0.29, 0.53]	0.56		
SC Composite × Race	−0.39 [−0.87, −0.09]	0.11	0.02	
Social skills				$F(4, 108)$ = 2.57 $R^2 = 0.09$
SSPA	0.25 [0.08, 0.43]	<0.01		
Race	−0.15 [−0.52, 0.23]	0.45		
SSPA × Race	0.16 [−0.19, 0.52]	0.36	<0.01	
Everyday living				$F(4, 107)$ = 1.88 $R^2 = 0.07$
UPSA-D	0.22 [0.02, 0.43]	0.03		
Race	0.05 [−0.39, 0.48]	0.84		
UPSA-D × Race	0.17 [−0.29, 0.63]	0.47	<0.01	

Note: Community living outcome = Specific Levels of Functioning – informant report.

was observed between race and SC, but neighborhood SES did not significantly mediate the relationship between race and everyday skills.

Our third aim was to evaluate whether NC, SC, social skills, and everyday living skills predict community functioning comparably across races. Results of moderation analyses are presented in Table 3. Analyses examined whether race moderates the relationship between NC, SC, social skills, everyday living skills, and functional outcome when covarying for neighborhood SES. β values indicate relationships between predictors (i.e., NC, SC, social skills, everyday living), the moderator (i.e., race), and community functioning. A significant interaction between a predictor and moderator (e.g., NC and race) indicates race significantly moderates the relationship between the predictor and community functioning. Race did not significantly moderate the relationship between NC, SC, UPSA-B, or SSPA scores and SLOF scores when covarying for neighborhood SES.

4. Discussion

This study examined race in five domains of functioning known to be associated with objective outcomes in schizophrenia. Results revealed
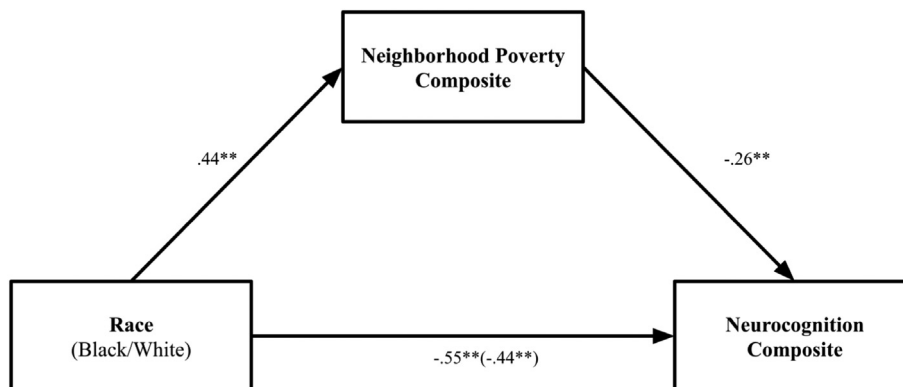

Fig. 1. Neighborhood SES mediates the relationship between race and cognitive functioning. *Note:* Race coded with White as the reference (i.e., Black coded as 1 and White coded as 0); estimate in parentheses indicates c′; **$p < .01$.

that Black individuals had lower scores than White participants in three domains: NC, SC, and everyday living skills. Additionally, a composite index of neighborhood SES partially mediated the relationship between race and NC performance, but not SC or everyday living skills. Lastly, race did not moderate the effects of NC, SC, social skills, and everyday living skills on functional outcomes.

Our results replicate previous findings that Black Americans with schizophrenia obtain lower scores on NC measures (Nagendra et al., 2018b; Sabbag et al., 2015). This disparity mirrors extensive research showing racial differences in cognitive scores in nonclinical populations, a phenomenon that has implicated bias in assessments (Berry et al., 2011) as well as structural factors such as socioeconomic inequity (Lyu and Burr, 2016; Zahodne et al., 2017). Based on our findings, neighborhood SES may explain about one-fifth (21%) of the relationship between race and NC performance in people with schizophrenia. The mediation effect of neighborhood SES is consistent with prior research on nonclinical populations showing that increased community resources in a neighborhood (e.g., community centers; Clarke et al., 2015) may foster cognitive stimulation, which in turn may improve cognitive performance (Cassarino and Setti, 2015; Clarke et al., 2015; Wu et al., 2015). Alternatively, it is possible that individuals with lower cognitive abilities migrate to lower SES neighborhoods. This explanation would be consistent with the social drift hypothesis of schizophrenia, which suggests that developing the illness is associated with residence in increasingly lower SES neighborhoods (Sariaslan et al., 2016). Longitudinal data would clarify the directionality of the relationship between NC and neighborhood SES in Black Americans with schizophrenia.

Even after considering individual education, and accounting for neighborhood income, employment, and education, the majority of the relationship between race and NC remained unexplained. Moreover, neighborhood SES did not mediate the relationship between race and SC or everyday living skills. Thus, other race- and SES-related mechanisms likely underlie the relationship between race and domains of functioning. On an individual level, racial and socioeconomic stress may negatively impact cognitive performance in Black individuals with schizophrenia. For example, higher levels of perceived racism in nonclinical Black participants can deplete cognitive performance (Barnes et al., 2012; Salvatore and Shelton, 2007). Furthermore, experimentally-induced thoughts about finances may reduce cognitive performance in lower-earning individuals (Mani et al., 2013). For example, healthy Black individuals may perform better on social cognitive tasks used in schizophrenia research when they are tested by same-race experimenters (Nagendra et al., 2018b) and Black Americans with schizophrenia may perform better on social cognitive tasks that use racially diverse stimuli (Pinkham et al., 2017). Less research has examined the relationship between domains of functioning and neighborhood quality. However, extant studies across a variety of racial/ethnic groups have demonstrated that better psychological wellbeing is associated with increased neighborhood social cohesion (Gapen et al., 2011; Hong et al., 2014) as well as less urbanicity (Krabbendam and van Os, 2005). Consequently, these may be valuable constructs to study when considering predictors of functional outcomes in Black Americans.

Despite differences observed between Black and White participants on NC and SC, no differences were observed on the informant-rated measure of community functioning (i.e., the SLOF). Since NC, SC, and community functioning are closely related (e.g., Fett et al., 2011; Halverson et al., 2019), this result is surprising. One potential explanation is that Black Americans may have been more likely to identify family members or close friends as informants for the SLOF rather than high-contact clinicians, which may have resulted in culturally attuned ratings for community functioning and minimized any group differences due to racial bias. Another explanation for that this null finding is that participants in this sample tended to receive ratings indicating higher community functioning. Even though SLOF scores were approximately normally distributed, they showed a slight negative skew. This reduced variability may have limited our power to detect expected

relationships between NC and SC and community functioning. Future research could examine whether race moderates observer type on the SLOF and how this may impact ratings of functioning, as well as make a concerted effort to recruit participants who may represent a wider range of community functioning.

In the current study we found that SC, but not NC, predicted community functioning, as measured by the SLOF. Although NC exhibited a trend-level effect for predicting community functioning, this result differs from meta-analyses that demonstrate *both* NC and SC are significant predictors of functional outcome (Fett et al., 2011; Halverson et al., 2019). One possible explanation for this null finding may lie within our measurements of NC and community functioning as composite scores, rather than individual task scores. Only a minority of NC measures within the full SCOPE sample were predictive of community functioning (Pinkham et al., 2018), and prior studies have found that NC is linked to specific subdomains within the SLOF (e.g., Helldin et al., 2020; Holshausen et al., 2014; Strassnig et al., 2015). Thus, the use of composite scores may have obscured relationships between measures of NC and community functioning. Future studies could examine individual tasks and subscales within established assessments for SC, NC, and community functioning to more thoroughly illuminate the relationships between racer and domains of functioning.

Moderation analyses indicated that NC, SC, everyday living skills, and social skills predict functional outcomes comparably in Black and White Americans. These findings further highlight the importance of understanding why Black Americans perform more poorly on SC and NC assessments (Brekke et al., 2005; Nagendra et al., 2018b; Pinkham et al., 2008, 2017; Sabbag et al., 2015). Notably, the present findings differ from meta-analysis results by Halverson et al. (2019), which revealed that the strength of the relationship between NC and functional outcomes was weaker for racial/ethnic minority groups. However, in Halverson et al. (2019), race was dichotomized as Caucasian/Non-Caucasian, and included international samples. Thus, the two studies may not be directly comparable.

This study also revealed substantial diagnostic differences by race, such that Black Americans were more likely than White Americans to receive diagnoses of schizophrenia over schizoaffective disorder. This finding mirrors a robust body of research that shows schizophrenia is disproportionately diagnosed in Black Americans (Olbert et al., 2018), a phenomenon that is least partially due to assessment bias (Schwartz and Blankenship, 2014). In parallel, there is a well-documented relationship between symptomatology and functional outcomes (e.g., Eack and Newhill, 2007; Ventura et al., 2009), and an especially strong relationship between negative symptoms and social functioning (e.g., Galderisi et al., 2014; Kalin et al., 2015; Robertson et al., 2014; Strassnig et al., 2015). Thus, an important direction for future studies is to disentangle cross-cultural assessment bias in diagnostic and symptom measures from factors that may genuinely explain racial differences in functional outcomes.

Lastly, it should be noted that our study used a subsample of the overall SCOPE project, as it included only individuals from whom addresses were collected. In the overall sample, Black Americans had significantly fewer years of education. However, group differences in education were not observed in our primary analyses. Formal education levels have generally been shown to be lower in Black Americans with schizophrenia-spectrum disorders (e.g., Nagendra et al., 2018b), as well as in healthy individuals (e.g., Fontenot et al., 2017). Consequently, the generalizability of the findings from the current study needs to be replicated.

Taken together, this study suggests that domains of functioning – especially neurocognition, social cognition, and everyday living skills – are important to study in order to understand and improve real-world outcomes in Black Americans with schizophrenia. Future research should examine nuanced race- and socioeconomic-related factors within these domains in order to understand the mechanisms that contribute to racial disparities. In turn, these studies may suggest potential

intervention targets to improve real-world outcomes for Black Americans with schizophrenia.

CRediT authorship contribution statement

AN conceptualized and designed this paper, wrote the first draft, and geocoded the socioeconomic status data. TH analyzed and presented the data, and certifies the accuracy of the results. AEP, PDH, and DLP were the PIs on the SCOPE study, from which the data for this study was derived. LFJ provided consultation regarding interpretation of the cognitive aspects of this study. AWdM provided consultation regarding the cultural aspects of this study. DLP was AN's primary advisor and provided consultation at all stages of the project. All authors provided edits and revisions to the manuscript and are in agreement with the final version.

Declaration of competing interest

Dr. Harvey serves as a consultant/advisory board member for Boeheringer Ingelheim, Lundbeck, Otsuka Digital Heath, Roche, Sanofi, Sunovion, and Takeda. The other authors report no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.schres.2020.09.020.

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