Distinct Profiles of Social Skill in Adults with Autism Spectrum Disorder and Schizophrenia

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Overlapping social impairments in Autism Spectrum Disorder (ASD) and Schizophrenia (SCZ) contributed to decades of diagnostic confusion that continues to this day in some clinical settings. The current study provides the first direct and detailed comparison of social behavior in the two disorders by identifying profiles of social skill in adults with ASD ($n = 54$), SCZ ($n = 54$), and typically developing (TD) controls ($n = 56$) during a real-world social interaction. ASD and SCZ groups exhibited poorer social skill, both overall and on most discrete abilities, relative to the TD group. Direct comparison of ASD to SCZ revealed distinct behavioral profiles, with ASD uniquely characterized by fewer interactive behaviors, and SCZ characterized by greater impaired gaze and flat/inappropriate affective responses. Additionally, IQ was associated with both overall social skill and many discrete social skills in SCZ, but was largely unrelated to social skill in ASD. These results indicate that overlapping social deficits in ASD and SCZ are comprised of both shared and distinct social skill impairments. The largest distinctions—reduced social reciprocity but better expressivity in ASD relative to SCZ, and a greater role of IQ in social skill for SCZ than ASD—highlight disorder-specific features that can improve etiological understanding, diagnostic differentiation, and treatment strategies. ***Autism Res*** *2017, 10: 878–887*. © 2016 International Society for Autism Research, Wiley Periodicals, Inc.

Keywords: social skills; social interaction; social cognition; social behavior

Introduction

Adults with Autism Spectrum Disorder (ASD) and Schizophrenia (SCZ) are both characterized by social dysfunction, a broad term for maladaptive behaviors that hinder optimal functioning in social contexts [Bellack, Morrison, Wixted, & Mueser, 1990; Klin, Volkmar, & Sparrow, 1992]. Social impairments in ASD and SCZ are associated with occupational challenges [Marwaha & Johnson, 2004; Taylor, Henninger, & Mailick, 2015], interpersonal difficulties [Horan, Subotnik, Snyder, & Nuechterlein, 2006; Howlin, Goode, Hutton, & Rutter, 2004] (e.g., small social networks, low rates of friendship), and a reduced quality of life [Barneveld, Swaab, Fagel, van Engeland, & de Sonneville, 2014; Eack & Newhill, 2007]. These outcomes are present in adults with "high-functioning" ASD, who despite being intellectually capable, still struggle with the social demands of adult responsibilities [Seltzer, Shattuck, Abbeduto, & Greenberg, 2004]. Similarly, social dysfunction in individuals with SCZ persists even when pharmacological treatment improves symptom presentation in other domains [Pinkham, et al., 2012]. For both groups, psychosocial treatments have yielded some gains in social functioning [Bishop-Fitzpatrick, Minshew, & Eack, 2014; Wykes, Steel, Everitt, & Tarrier, 2008], but the extent of improvement and generalization to real-world outcomes are often limited.

Similarities in the social features of ASD and SCZ contributed to decades of diagnostic confusion [Sasson, Pinkham, Carpenter, & Belger, 2011] that continue to this day in some clinical settings [Mandell et al., 2012]. ASD and SCZ do share some behavioral, genetic, and neurobiological characteristics [American Psychiatric Association, 2013; Crespi, Stead, & Elliot, 2010; Pinkham, Hopfinger, Pelphrey, Piven, & Penn, 2008; Rapoport, Chavez, Greenstein, Addington, & Gogtay, 2009; Sullivan et al., 2012], yet they have distinct developmental trajectories [Sasson et al., 2011], prominent nonshared features (e.g., positive symptoms in SCZ and restricted interests in ASD) [Leifker, Bowie, & Harvey, 2009; Nadig, Lee, Singh, Bosshart, & Ozonoff, 2010], and respond differently to psychosocial treatment [Turner-Brown, Perry, Dichter, Bodfish, & Penn, 2008].

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These distinctions suggest that the nature and mechanisms of social impairment in the two disorders may differ, but their identification has been hindered by a lack of direct comparisons of ASD and SCZ using systematically matched designs. Direct comparisons can reveal disorder-specific aspects of social impairment missed when using the traditional approach of comparing each clinical group to typically developing (TD) controls [Sasson et al., 2011].

Indeed, previous direct comparisons between ASD and SCZ suggest that the two disorders share general impairments in social cognition and emotional understanding (Couture et al., 2010; Craig, Hatton, Craig, & Bentall, 2004; Konstantareas & Hewitt, 2001), yet the processes underlying these impairments may differ [Sasson et al., 2011; Pinkham et al., 2012]. For instance, individuals with ASD demonstrate greater impairments in orienting to relevant social and emotional information [Sasson et al., 2007; Sasson, Pinkham, Weittenhiller, Faso, & Simpson, 2015] whereas individuals with SCZ may exhibit a greater tendency to "jump to conclusions" in social situations [Freeman, 2007]. Some evidence also suggests that social impairments in the two disorders may manifest in divergent ways, with ASD characterized more by hyposociality and undermentalizing, but SCZ—at least in its paranoid variant—characterized more by hypersociality and overmentalizing [Crespi et al., 2010; Crespi & Badcock, 2008]. Further, although IQ is positively associated with social outcomes for both groups [Green, Kern, & Heaton, 2004; Eaves & Ho, 2008; Howlin et al., 2004], general intellectual ability may be more central in SCZ than ASD for both social cognitive skill [Sasson et al., 2015] and social functioning [Green et al., 2004; Saulnier & Klin, 2007]. A large portion of the variance in functional outcome is attributable to general intelligence in SCZ [Green et al., 2004] whereas social disability and poor functional outcomes persist in ASD even in individuals with average to above-average intellectual ability [Klin, 2000; Nicpon, Doobay, & Assouline, 2010; Saulnier & Klin, 2007]. Ultimately, refined understanding of these and other distinctions in social cognition and behavior in the two disorders can be used to improve diagnostic practices, inform etiological understanding, and guide targeted treatment approaches.

A primary component of social behavior is social skill, defined as the set of behaviors employed to achieve social goals in different contexts and environments [Mueser & Bellack, 1998]. Social skill is impaired in ASD and SCZ relative to TD controls, both globally [Constantino, Przybeck, Friesen, & Todd, 2000; Pinkham & Penn, 2006] and in more discrete social behaviors such as pragmatic language usage and nonverbal skills [Bishop, 1998; Patterson, Moscona, McKibbin, Davidson, & Jeste, 2001]. However, studies of social skill in ASD and SCZ have to this point been conducted independently, and large differences in sample characteristics—mostly children in ASD but adults in SCZ—and methodological distinctions between studies prevent the ability to identify patterns of social skill convergence and divergence in ASD and SCZ.

The current study compares social skills between ASD and SCZ, both relative to TD adults and to each other, using systematic direct observation of social behaviors during a real-world social situation common to adult daily functioning. We hypothesized that relative to TD controls, the two clinical groups would exhibit reduced social skill, both overall and across most discrete social behaviors [Mueser, Bellack, Morrison, & Wixted, 1990; Nadig et al., 2010; Paul, Orlovski, Marcinko, & Volkmar, 2009; Verhoeven, Smeekens, & Didden, 2013]. However, based upon social aspects emphasized in prior research and clinical reports, we predicted several differences between the two clinical groups: whereas the SCZ group would be characterized by inappropriate affective behaviors and more impaired paralinguistic behaviors (i.e., how words are spoken), including verbal clarity and fluency [Bellack et al., 1990; Verhoeven et al., 2013], the ASD group was expected to demonstrate less reciprocity [Paul et al., 2009], and more repetitive verbal content and movement [Bodfish, Symons, Parker, & Lewis, 2000]. Further, given prior research indicating a greater role of general cognition to social impairment in SCZ relative to ASD [Sasson et al., 2015], intellectual ability was predicted to correlate with social skills in SCZ but not ASD. Finally, discriminant function analysis explored the constellation of social skills that best distinguished the groups. Collectively, these analyses sought to identify distinctions in social behavior in ASD and SCZ that can improve clinical differentiation and inform treatment.

Method

Participants

Participants ($N = 164$) were drawn from a multisite study assessing social cognition and functioning in ASD and SCZ. The three groups (ASD $n = 54$, SCZ $n = 54$, TD controls $n = 56$) were matched on gender and comparable on age, ethnicity, years of education completed, and IQ as estimated by the verbal section of the WRAT-3 [Wilkinson, 1993] (see Table 1), a common measure of premorbid IQ in schizophrenia. All participants were between 18 and 65, had an estimated IQ over 70, and had no substance abuse or dependence in the previous six months. Using G Power, we found that with a value = .80 and alpha = .05 sample sizes of 31 participants per group would be sufficient to detect medium sized effects (e.g., F-squared = .15). Thus, we recruited over 50

Table 1. Sample Characteristics

	ASD ($n = 54$) *n* (%)	SCZ ($n = 54$) *n* (%)	TD ($n = 56$)* *n* (%)	X^2	*p*
Gender				–	–
Male	47 (87%)	47 (87%)	49 (88%)		
Ethnicity				10.11	.120
Caucasian	48 (89%)	43 (80%)	51 (91%)		
African American	1 (2%)	6 (11%)	2 (4%)		
Asian	5 (9%)	3 (5%)	3 (5%)		
Other	–	2 (4%)	–		
Medication				49.31	<.001
Atypical only	11 (20%)	41 (76%)	–		
Typical only	1 (2%)	3 (6%)	–		
Both	–	4 (7%)	–		
	Mean (SD)	Mean (SD)	Mean (SD)	*F*	*p*
Age	25.67 (7.17)	28.67 (10.11)	26.89 (9.23)	1.53	.221
Education (years)	13.89*1.78)	13.46 (1.99)	13.80 (1.68)	0.83	.439
WRAT IQ	106.02 (12.83)	103.32 (10.98)	105.34 (11.10)	0.79	.457
PANSS					
Positive total	8.94 (3.16)	15.59 (4.99)	–	68.45	<.001
Negative total	11.07 (4.35)	14.50 (4.60)	–	15.82	<.001
General total	24.02 (5.46)	33.00 (6.99)	–	55.33	<.001

*TD controls did not complete PANSS and were not taking any psychotropic medications.
Abbreviations: SD = Standard deviation; WRAT = Wide Range Achievement Test; PANSS = Positive and Negative Syndrome Scale.

individuals per group to enhance our ability to detect smaller effects.

Adults with ASD were recruited from the UT-Dallas Autism Research Collaborative, a registry of local adults with a confirmed diagnosis of ASD via the Autism Diagnostic Observation Schedule (ADOS) [Lord et al., 2000]. Participants with SCZ were recruited from Metrocare Services, a nonprofit mental health services provider in Dallas, TX and from the Outreach and Support Intervention Services (OASIS) program affiliated with the University of North Carolina at Chapel Hill (UNC-CH). All SCZ diagnoses were confirmed with the Structured Clinical Interview for DSM-IV. The SCZ group exhibited more positive and negative symptoms than the ASD group on the Positive and Negative Syndrome Scale [PANSS; Kay, Flszbein, & Opfer, 1987], and had higher rates of antipsychotic medication usage (see Table 1). TD adults reporting no developmental disabilities or mental illnesses were recruited from the local community in Dallas, TX, and Chapel Hill, NC. All participants completed the study at university facilities between October 2012 and October 2015, provided written informed consent, and received compensation. The Institutional Review Boards of UT-Dallas and UNC-CH approved this protocol.

Procedure

Participants completed scene 1 of the Social Skills Performance Assessment (SSPA) [Patterson et al., 2001], a three-minute role-play in which individuals initiate and maintain a conversation within the context of meeting a new neighbor, played by the experimenter. Role-plays were videotaped, and social skills were coded using scoring criteria from the Conversation Probe (CP) [Pinkham & Penn, 2006], a related social skills role-playing paradigm used previously with adults with SCZ and with individuals exhibiting the Broad Autism Phenotype [Sasson, Nowlin, & Pinkham, 2013] that, like the SSPA, also assesses social behavior upon meeting somebody for the first time. Although, the CP has not previously been applied to the SSPA, it was used here because it is largely redundant with the SSPA in the behaviors it captures and their coding criteria, but is more comprehensive in that it assesses additional discrete social behaviors (e.g., separate codes for flat and appropriate affect) and allows for greater sensitivity (i.e., a nine-point scale vs. the five-point scale of the SSPA).

Coded behaviors include: *clarity* (easily understood speech); *fluency* (ease of speech production); *meshing* (ease of conversational turn-taking); *gaze* (frequency and duration of appropriate eye contact); *flat affect* (nonverbal emotional expressivity); *appropriate affect* (expression of suitable emotion); *involvement* (interest and investment in the conversation); *asks questions* (number of questions asked by the participant); *verbal content* (topics discussed are appropriate to the situation); *social anxiety* (behavioral indicators of anxiousness); and *overall social skill* (a global measure of the

participant's ability to interact and communicate effectively). Because the SSPA was initially developed for capturing social skills relevant to SCZ, three additional behaviors known to affect social interaction quality in ASD were also measured: *repetitive verbal content* (repeating phrases or topics), *repetitive movement* (presence of motor or sensory stereotypies), and *verbosity* (total amount of speech). Repetitive behaviors, although often conceptualized as nonsocial behaviors, are related to social deficits in ASD [Lam, Bodfish, & Piven, 2008] and impact social interaction quality [Nadig et al., 2010; Paul et al., 2009], and verbosity (e.g., the tendency to monologue) is common in cognitively-able adults with ASD [Laugeson & Ellingsen, 2014].

Two coders were trained to reliability at the beginning of the study, and reliability was also assessed at the study mid-point and study end (ICCs > .66 for all behaviors; see Table 3). Coders were blind to group membership and rated the 164 videos independently. The average of both coders' ratings constituted the final scores.

Statistical Analysis

Groups were compared on social skills using MANOVA with follow-up two-tailed univariate tests corrected for multiple comparisons ($\alpha_{pc} = 0.0036$) using SPSS version 23 (IBM). Significant univariate results were followed up with post-hoc Tukey tests. Data used in the MANOVA did not violate assumptions of normality, and variances did not differ between compared groups.

Discriminant function analysis (DFA) was also used to determine the constellation of social skills that together best characterize group membership. DFA is a multivariate technique that predicts group membership based on an optimally weighted linear combination of variables. When predicting three groups, DFA plots the groups along two orthogonal functions (i.e., factors or components) according to the linear combination of behaviors. The distance between the multivariate group means on each function describes how the groups are separated; therefore, functions describe how one group is uniquely characterized relative to the other groups. The contribution of each social skill to group discrimination is determined by examining the magnitude and direction of the standardized coefficients of the linear combination of social skills separating the groups. To focus on profiles of discrete behaviors, the global behaviors (overall social skill and social anxiety) were excluded from this analysis. Because tolerance values for the remaining social skills indicated that the DFA assumption of noncolinearity was violated [Tabachnick & Fidell, 2007], colinearity was reduced by condensing the number of discrete behaviors with a factor analysis. Four factors accounting for 62% of the variance (see Table 2) emerged that align with prior factor analyses of social skill [Mueser & Bellack, 1998]: paralinguistic (clarity, fluency, and meshing), interactive (asks questions and involvement), nonverbal (gaze, appropriate affect, and flat affect), and verbal content behaviors. These four factors and the three ASD-related behaviors were included in the DFA analysis.

Table 2. Factor Analysis Pattern Matrix for Verbal Content, Nonverbal, Paralinguistic, and Interactive Measures of Social Behavior*

Social behavior	Factor 1 Paralinguistic	Factor 2 Nonverbal	Factor 3 Interactive	Factor 4 Verbal content
Meshing	**.86**	.12	−.12	−.08
Fluency	**.68**	−.12	.05	.13
Clarity	**.45**	.07	.08	.10
Flat Affect	.06	**.89**	−.08	−.18
Appropriate Affect	−.11	**.67**	−.05	.33
Gaze	.06	**.47**	.08	.17
Asks Questions	−.05	−.10	**.96**	−.02
Involvement	.16	.35	**.49**	−.03
Verbal Content	.07	−.06	−.03	**.90**

Coefficients greater than .40, shown in bold, significantly load onto the factor.

*$N = 164$. Principal Axis Factoring with Promax rotation.

We also examined the bivariate correlations of IQ with social skills for each group. Further, as symptom severity differed between the clinical groups, we examined the correlations between positive, negative, and general symptoms and overall social skill. Only negative symptom severity was significantly correlated with overall social skill in the SCZ group ($r = -.56$, $P < .001$, all other correlations below −.27). Because the clinical groups also differed in antipsychotic medication usage, we used a MANCOVA with negative symptoms and medication usage as a covariate to explore whether any reported group effects would remain when controlling for these differences between the groups.

Results

Group Differences in Social Skills

Table 3 displays group means for all social behaviors. MANOVA results indicated group differences across all social skills, $\lambda = .488$, $F(28, 296) = 4.56$, $P < .001$. The groups significantly differed on overall social skill, verbal content, fluency, gaze, involvement, asks questions, appropriate affect, social anxiety, and repetitive movement ($P's < .003$; univariate tests displayed in Table 3). Groups did not significantly differ on flat affect, meshing, clarity, repetitive verbal content, and verbosity ($P's > .009$). Post hoc tests demonstrated that the ASD and SCZ groups each scored lower than the TD group on overall social skill, verbal content, fluency, gaze, asks questions, appropriate affect, and social anxiety ($P's < .003$), and the ASD group, but not the SCZ group,

Table 3. Reliability Coefficients, and Univariate Tests for Social Behaviors, and Cohen's D for Group Comparisons

Social behavior	ICC ($n = 30$)	TD ($n = 56$)		SCZ ($n = 54$)		ASD ($n = 54$)		F (2, 161)	P	TD vs. SCZ d	TD vs. ASD d	ASD vs. SCZ d
		M	SD	M	SD	M	SD					
Verbal content	.87	7.01	0.74	6.28	1.37	6.04	1.18	11.27*	<.001	0.99**	1.31**	−0.32
Clarity	.84	6.24	1.12	5.54	1.15	5.86	1.27	4.92	.008	0.63	0.34	0.29
Fluency	.84	6.18	1.16	5.27	1.14	4.97	1.49	13.53*	<.001	0.78**	1.04**	−0.26
Meshing	.92	5.70	1.37	5.29	1.39	5.23	1.56	1.72	.183	0.30	0.34	−0.04
Gaze	.95	7.22	1.32	6.03	1.59	5.94	1,83	11.17*	<.001	0.90**	0.97**	−0.07
Involvement	.93	6.64	1.17	6.07	1.35	5.58	1.51	8.53*	<.001	0.49	0.91**	−0.42
Asks questions	.99	5.61	2.94	4.29	2.77	2.94	1.97	14.50*	<.001	0.45**	0.91**	−0.46**
Appropriate affect	.66	7.09	0.55	6.78	0.66	6.65	0.83	6.04*	<.003	0.56**	0.80**	−0.24
Flat affect	.88	6.70	0.77	6.16	1.05	6.34	0.95	4.84	.009	0.70	0.47	0.23
Social anxiety	.74	6.24	1.30	5.38	1.18	5.07	1.43	11.86*	<.001	0.66**	0.90**	−0.24
Repetitive verbal content	.80	7.21	0.74	6.88	1.03	6.65	0.98	5.22	.006	0.45	0.76	−0.31
Repetitive movement	.84	7.68	1.01	7.51	1.16	6.69	1.33	11.26*	<.001	0.17	0.98**	−0.81**
Verbosity	.96	5.30	1.6	4.52	1.69	4.63	1.42	4.02	.020	0.49	0.42	0.07
Overall social skill	.95	6.70	1.07	5.65	1.58	5.14	1.59	17.01*	<.001	0.98**	1.46**	−0.48

Note. Cohen's *d* calculated with the standard deviation of the TD group used as the standardizer. Repetitive Verbal Content and Repetitive Movement have been reversed coded for consistency.

ICC = Intra-class correlation coefficient; d = Cohen's d; M = Mean; SD = Standard deviation.

*Significant at Bonferroni corrected alpha, $P < 0.0035$.

**Tukey post hoc test significant at $P < .05$.

scored lower than the TD group on involvement (ASD $P < .001$, SCZ $P = .072$) and higher on repetitive movement (ASD $P < .001$, SCZ $P = .728$).

When the clinical groups were directly compared to each other, the ASD group demonstrated significantly more repetitive movement ($P < .001$) and asked significantly fewer questions ($P = .021$) than the SCZ group. The ASD group was also rated as more impaired, scoring lower than the SCZ group at the mean level across all social skills except clarity and flat affect, where SCZ showed greater impairment than ASD, and verbosity, where the groups appeared comparable (comparisons and Cohen's *d* values are displayed in Table 3). Other moderate effect size differences favoring the SCZ group over the ASD group (Cohen's *ds* between .31 and .48; see Table 3) emerged for verbal content, involvement, repetitive verbal content, and overall social skill, but these did not reach statistical significance.

Discriminant Function Analysis

The DFA resulted in one function separating the ASD group from the SCZ and TD groups that accounted for 84% of the variance, $\lambda(14) = .632$, $P < .001$, canonical $R^2 = .560$, 95% confidence interval (CI) [0.42, 0.64]. A second function was also significant, separating the SCZ group from the ASD and TD groups, $\lambda(6) = .920$, $P = .041$, canonical $R^2 = .283$, 95% CI [0.13, 0.37]. Figure 1 displays the discriminant function plot. The pattern of the standardized coefficients (see Table 4) suggests that the ASD group is best differentiated from the SCZ and TD groups by a profile of more repetitive movement, less appropriate verbal content, and fewer interactive behaviors (i.e., involvement and asking questions), whereas the SCZ group is best separated from the ASD and TD groups by a profile of less appropriate nonverbal behaviors (e.g., appropriate gaze and affect), less repetitive moment, and more interactive behaviors.

Correlation of IQ with Social Skills

As shown in Table 5, IQ was positively associated with verbal content, clarity, fluency, meshing, involvement, social anxiety, and overall social skill for the SCZ group, and involvement, asks questions, appropriate affect, verbosity, and overall social skill in the TD group, but only verbosity in the ASD group. To support that IQ significantly correlated across social skills in SCZ but not ASD, we used the randomization test procedure [Sherman & Funder, 2009] in the R programming environment to determine whether the number of correlations observed for each group was significant compared to the number of correlations that would be observed by chance alone. The pattern of the correlations between IQ and social skills was significant for the SCZ ($P < .01$) and TD groups ($P = .02$) but not the ASD group ($P = .40$).

Post hoc Examination of Negative Symptoms and Medication Usage

Finally, we repeated the MANOVA with negative symptoms and antipsychotic medication usage as a covariate, and results changed only minimally. The overall

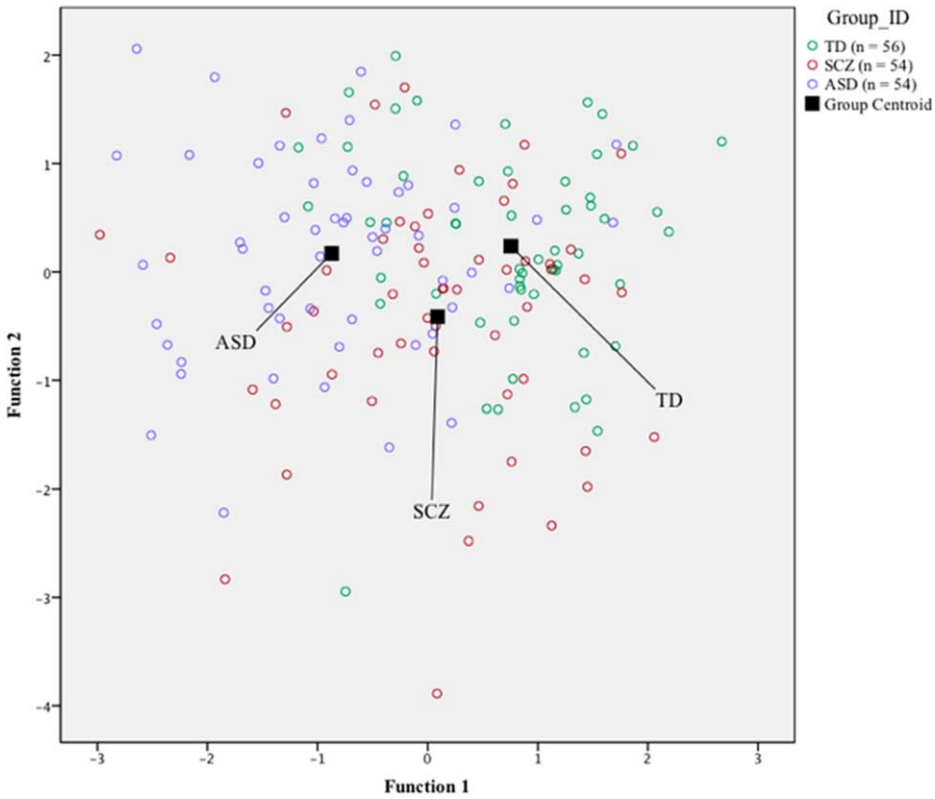

Figure 1. Discriminant Function Plot. Group centroids (squares; mean linear combinations) and the linear combination for each participant (circles) are plotted. Two functions separate groups: Function 1 (*x*-axis) best separates ASD from TD and SCZ, and Function 2 (*y*-axis) separates SCZ from TD and ASD.

MANCOVA was still significant, $\lambda = .705$, $F(14, 91) = 2.732$, $P = .002$, with the ASD group continuing to score significantly lower than the SCZ group on repetitive movement, but interactive behaviors no longer survived correction ($P = .02$). However, now the ASD group also demonstrated worse overall social skill ($P < .001$) than the SCZ group, and also approached the corrected alpha on demonstrating poorer involvement ($P = .004$) and appropriate affect ($P = .004$).

Discussion

This study compared social skill profiles of adults with ASD, SCZ, and TD controls. Consistent with prior work [Patterson et al., 2001; Verhoeven et al., 2013], the ASD and SCZ groups demonstrated poorer social skill than TD controls during a real-world social interaction, both overall and on most specific behaviors, with the ASD but not the SCZ group less socially involved and demonstrating more repetitive movement. Although these results provide further confirmation that ASD and SCZ share broad social impairments relative to TD controls, several notable differences between the clinical groups emerged when they were directly compared.

First, the ASD group asked significantly fewer questions of their conversation partner than did the SCZ group. This deficit in reciprocity is consistent with prior studies of ASD [Paul et al., 2009; Verhoeven et al., 2013], and is particularly salient given that participants were specifically tasked with "getting to know" a new neighbor. Further, given that the three groups did not differ in the amount of speech (i.e., verbosity) used during the task, the low rate of questions asked by the ASD group cannot be explained by lower rates of talking generally. Instead, it suggests that the function of the interaction differed for those with ASD, with a greater focus on providing information and discussing personal interests rather than attempting to learn more about their conversational partner. In contrast, the higher rate of questions by the SCZ group suggests that their social impairments are less related to deficits in social reciprocity. Additionally, when controlling for the higher negative symptoms and greater medication use of the SCZ group in post hoc analyses, not only did patterns largely remain similar, but overall social skill also emerged as significantly worse in ASD compared to SCZ. Collectively, the size and consistent direction of effects favoring the SCZ group over the ASD group highlights the significant social disability experienced

Table 4. Standardized Coefficients for Social Behaviors for Discriminant Functions 1 and 2

	Discriminant function	
	1	2
Interactive	**.75**	**−.48**
Repetitive movement	**.64**	**−.46**
Verbal content	**.54**	.14
Nonverbal	−.09	**.71**
Paralinguistic	−.19	.30
Verbosity	<.01	.35
Repetitive verbal content	.03	−.11

Note. Repetitive Verbal Content and Repetitive Movement have been reversed coded for consistency.

Coefficients greater than .40, shown in bold, load onto the function.

Table 5. Bivariate Correlations of Social Behaviors with IQ for Each Group

Social behavior	ASD ($n = 54$) *r*	SCZ ($n = 54$) *r*	TD ($n = 56$) *r*
Verbal content	.02	.33*	.02
Clarity	.25	.39**	.25
Fluency	−.13	.35*	.04
Meshing	.03	.29*	.04
Gaze	.02	.24	.17
Involvement	.26	.33*	.32*
Asks questions	.18	.17	.47**
Appropriate affect	.16	.15	.29*
Flat affect	.22	.12	.13
Social anxiety	.01	.31*	.20
Repetitive verbal content	.15	.12	.06
Repetitive movement	−.12	−.25	.06
Verbosity	.37**	.25	.35**
Overall social skill	.23	.42**	.27*

Note. Repetitive verbal content and repetitive movement have been reversed coded for consistency.

*$P < .05$; **$P < .01$.

by adults with ASD, and underscores the tremendous need for increasing research and services directed towards adults within a population that historically has focused on children.

DFA analyses revealed that ASD was uniquely characterized by a profile of reduced interactive behaviors and increased repetitive movement and inappropriate conversational content, a combination that corresponds with the ASD phenotype [American Psychiatric Association, 2013]. Collectively, this profile is consistent with prior research indicating that individuals with ASD demonstrate reduced social motivation [Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012], a greater tendency to monologue [Laugeson & Ellingson, 2014], and a penchant for directing conversation toward the self and personal interests [Nadig et al., 2010]. In contrast, the SCZ group was uniquely characterized by poor nonverbal behavior (i.e., presence of poorly modulated eye gaze and affective responses) along with relatively higher levels of interactive behaviors. Taken together, these findings hint at a discrepancy in the two groups between social motivation and social expressivity, with the SCZ group demonstrating an interest in getting to know their social partner but reduced expressive competency while doing so, whereas the ASD group exhibited the reverse pattern. Given the history of diagnostic overlap and social functioning similarities in ASD and SCZ [Sasson et al., 2011], particularly when symptoms seemingly overlap (e.g., negative symptoms), these discrepant social skill patterns may offer clinical value for diagnostic differentiation. The predictive accuracy of DFA can be evaluated statistically [Tabachnick & Fidell, 2007], suggesting that DFA offers promise as a tool for diagnostically classifying individuals based on their social skill profiles.

Our results also have implications for treatment. Developing targeted social skills interventions for ASD and SCZ may prove more beneficial than employing a "one size fits all" approach or administering treatments developed for one disorder on the other [Turner-Brown et al., 2008]. Rather, results here suggest that social skill programs should differ between the two disorders by emphasizing reciprocity in ASD, but affective responses and neurocognitive remediation in SCZ. IQ was significantly related to overall social skill and many discrete social skills in SCZ, but largely unrelated to social skill in ASD. This finding is consistent with studies suggesting that general cognitive ability accounts for a large portion of the variance in social and functional outcomes in SCZ [Green et al., 2004], whereas social deficits in ASD persist even in the intellectually-gifted [Nicpon et al., 2010]. Future work is encouraged to explore whether general cognitive remediation may produce downstream effects for improving social skills in SCZ more so than ASD and examine comprehensively how general cognitive ability relates to broader social disability in each disorder.

Our results should be interpreted in the context of several limitations. First, the SSPA task is a structured role-play that mimics a real-world scenario but may not fully capture naturally occurring social behavior. The SSPA requires the participant to take on a specific role (e.g., a neighbor) and engage in a social interaction with an explicit goal in mind (e.g., introducing themselves). These task demands may not translate to real world situations, especially for the clinical groups, who may be less inclined to initiate or maintain a social interaction with an unfamiliar social partner. The task demands used here assume that social interaction would occur, which may not be the case. It is unclear whether results would differ if the nature of the social task were changed. Second, although the SSPA and CP

code for a wide range of social skills, these codes are not exhaustive and may have missed other relevant social skills for the group comparison. Third, although the sample used here is larger and better matched than previous direct comparisons of ASD and SCZ, it was not possible to match the groups on medication use and the presence of positive, negative, and general symptoms. However, performance was generally better in SCZ than in ASD despite their greater medication use and symptoms, and this pattern only strengthened when negative symptoms were covaried in analyses. Thus, the lower social skill exhibited by the ASD group despite lower levels of medication and symptoms suggest that their performance may be a conservative estimate of their social skill impairment. Finally, although the current findings suggest both similarities and discrepancies in social behavior between ASD and SCZ, they cannot address what cognitive, neural, or developmental mechanisms may be driving these patterns. ASD and SCZ do share many behavioral, genetic, and neurobiological features [Crespi et al., 2010; Pinkham et al., 2008; Rapoport et al., 2009; Sasson et al., 2011; Sullivan et al., 2012], and continued direct comparisons are needed to further refine our understanding of shared and divergent aspects of pathophysiology in the two disorders.

Notwithstanding these limitations, the current study highlights distinct social skill impairments in SCZ and ASD. Using a large, well-matched sample of ASD, SCZ, and TD adults on a task of real-world social behavior, we found that overall social skill impairments in ASD and SCZ are subserved by unique constellations of social skills. Whereas the ASD group demonstrated the largest social skill deficits and a distinct deficit in social reciprocity, the SCZ group was differentiated by impaired affective and nonverbal behaviors. These differences, along with the differential relationship of IQ and social skills for each group, have important implications for treating social reciprocity in ASD and social expressivity in SCZ. Future work is encouraged to examine how these patterns of social skills relate to real-world outcomes, as well as explore the cognitive and neurobiological mechanisms underlying social skill deficits in ASD and SCZ.

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Conflict of Interest Disclosure

None reported.

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