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The Role of Communication on Social Functioning in Schizophrenia: Verbal and Nonverbal Aspects

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ABSTRACT

Inroduction: Communication skills are vital to social functioning. Patients with schizophrenia, who often exhibit impairments in social functioning, experience difficulties in both verbal and nonverbal communication. This study aimed to compare the influence of nonverbal sensitivity and verbal communication disturbance on the social functioning of schizophrenia patients.

Methods: The study included 38 schizophrenia patients (SCH) and 40 healthy controls (HC). Nonverbal and verbal abilities were assessed using the Mini Profile of Nonverbal Sensitivity (Mini-PONS) and the Communication Disturbance Index (CDI), respectively. Social functioning was measured with the Social Functioning Scale (SFS), and symptom severity was evaluated using the Positive and Negative Syndrome Scale (PANSS).

Results: Schizophrenia patients exhibited significantly lower nonverbal sensitivity and higher verbal communication disturbance compared to healthy controls. Mini-PONS and CDI scores were significantly correlated with SFS scores in the schizophrenia group but not in healthy controls. Regression models revealed that PANSS and Mini-PONS scores significantly predicted social functioning in schizophrenia patients. Furthermore, symptom severity fully mediated the relationship between verbal communication disturbance and social functioning.

Conclusion: Nonverbal communication impairments exert a more pronounced effect on the decline in social functioning among schizophrenia patients. These findings underscore the importance of addressing communication deficits to improve social outcomes in this population.

Keywords: Nonverbal sensitivity, schizophrenia, social functioning, verbal communication disturbances

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INTRODUCTION

Communication encompasses verbal communication, which uses spoken and written language as a tool, and nonverbal communication, which consists of all messages other than words and sentences that people exchange with each other (1). Nonverbal communication; refers to the informative aspects of behavior and appearance, including head, face and body movements, features of speech such as intonation and speed, touch and interpersonal distance (2). The ability to perceive, interpret and respond appropriately to these kinetic, haptic, proxemic and paralinguistic nonverbal cues transmitted between individuals is defined as nonverbal sensitivity (NVS) or interpersonal sensitivity (3). Nonverbal sensitivity constitutes social perception, which is an important component of social cognition (4). The role of social cognitive abilities in social functioning, and even their prominence over neurocognitive abilities, has been established by the findings of significant studies (5). There is a direct correlation between NVS and better psychological and occupational functioning (4), because being able to decipher and realistically appraise others' clues is a precursor to an appropriate social response. This, in turn, contributes to avoiding social rejection and making positive progress in personal development (6). It has been shown

Highlights

- **The CDI and Mini-PONS were used for the first time in modern standard Turkish.**
- **Schizophrenia patients were less sensitive to nonverbal cues.**
- **Schizophrenia patients experienced more difficulties with verbal communication.**
- **Nonverbal communication had a greater impact on social functioning in SCH.**

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that NVS, which has individual differences even among individuals without major mental illness (7), is lower or more problematic in patients with schizophrenia (SCH) compared to the healthy population (8,9). A recent study involving healthcare robots even showed that SCH was less sensitive to detecting the nonverbal cues of robots compared to healthy individuals (10). This difficulty in processing social information in patients with schizophrenia is important, as it can lead to social withdrawal and impairment of daily social functions. As a matter of fact, there are studies showing that low NVS, in other words, low social perception skills are associated with low social functioning (SF) in SCH (4,11).

Disruptions in the other component of communication-verbal communication are common in schizophrenia. Attempts to explain the language use of SCH are grouped around several approaches (12). In this study, the spoken language used by SCH will be investigated from the perspective of the approach focusing on the discourse structure, because this approach is directly related to verbal communication skills and the ability to convey meaning. This approach, evaluating discourse structure, focuses on linking tools that link words to their real-world references and previous references in the text (12). When there is a reference error during the speech, it becomes difficult for the listener to understand the statement; because the reference is ambiguous or not previously introduced to the listener. Docherty et al. (1996) observed that the mentioned reference errors are frequently encountered in the speech of SCH, then introduced the "Communication Disturbance Index" (CDI), which they created based on reference errors (13). Although it is not difficult to predict that speech disturbances in schizophrenia impair social functioning because they make communication difficult with other people, a limited number of studies have aimed to reveal the relationship between verbal communication disturbances (VCD) and SF. However, few studies have shown that disconnected speech and reference errors are associated with poor social outcomes (14,15).

As mentioned above, the effects of verbal communication difficulties, such as disruption in contextuality, and low nonverbal communication skills on social impairments have also been separately studied in previous research. While the impact of NVS and VCD on social functioning has been studied separately, their comparative influence remains underexplored. This study aims to investigate the roles of these two communication dimensions in predicting social outcomes among schizophrenia patients and to compare these findings with healthy controls.

METHODS

Subjects

Data were collected from psychiatry outpatient clinic of Marmara University Pendik Training and Research Hospital between October 2018 and December 2019. Inclusion criteria for the patient's group can be listed as 1) Meeting the diagnostic criteria for schizophrenia of Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), 2) Being between the ages of 18–65, 3) Being clinically stable for at least preceding 3 months. Exclusion criteria were: 1) To be diagnosed with intellectual disability and substance-related disorder, 2) Meeting the diagnostic criteria for moderate to severe depression according to DSM-5, 3) Having visual and hearing loss that prevents compliance with the tests, 4) Having disorganized speech that does not allow to CDI scoring. Participants in the healthy control (HC) group who were diagnosed with any psychiatric disease were excluded from the study. Thirty-eight of 53 patients diagnosed with schizophrenia and 40 of 44 healthy volunteers who met the inclusion criteria were included in the study. Figure 1 presents the flow diagram of participants throughout the study. Demographics and characteristics of the participants are presented in Table 1. The present study was conducted in accordance with Declaration of Helsinki and approved by Marmara University Clinical Research Ethics Committee. Written consent was obtained from all participants.

Clinical Tests

Mini-PONS, which consists of 64 out of 220 two-second videos of the original version (16), were used to measure individual differences in the decoding abilities of nonverbal signs (17). Nonverbal cues were encoded in three sets of channels, which include the video channel (*Body (neck-to-knee), Face*), the audio channel (*Filtered content (FC)* and *Random splicing (RS))* and combined of both channels (*Face+FC, Face+RB*). After watching each scene, the subjects are required to choose one of two possible labels that best reflect their inference from the scene. More correct answers indicate higher NVS.

The CDI was used to evaluate VCD. Communication Disturbances Index is an index created by Docherty et al. (1996) based on the observations of schizophrenic and manic patients' speeches, which has been deemed to assess explicitly the transmission of meaning rather than abnormalities of language structure (13). The index consists of six types of speech errors: Vague references (VG), confused reference (CR), missing information reference (MI), ambiguous word meaning (AW), wrong word reference (WW), and structural unclarities (SU). The subject is asked to talk about a certain topic ("family", in the present study) for 10 minutes. The frequency of each type of these errors per 100 words of narratives was calculated. Word repetitions, false starts, gap-fillers and exclamations were not included in the total word count on the recommendation of linguists involved in this study. Transcripts of recorded speech were rated by a psychiatrist and two linguists who were blind to the subjects. Evaluators, native speakers in modern Turkish, were trained by a reference evaluator. Prior to rating study sample, they assessed a set of pilot speech sample. The pairwise agreement with the reference evaluatoron pilot samples attained an acceptable level. Estimation of intra class correlations (ICC) in study sample indicated good reliability for CDI total score in both groups (0.82 for HC, 0.92 for SCH). It was also shown to be moderate to good reliability for the score of error types in both groups as well (ranging from 0.60 to 0.90 in SCH, ranging from 0.65 to 0.88 in HC).

The SFS was used to evaluate the SF and consists of 7 subscales that provide detailed information on daily functions (18). The score that can be obtained by adding the subscale scores varies between 0 and 210. We calculated corrected versions of the scores as well. A high score indicates better SF.

Procedure

Each participant was assessed in 2 sessions. The Structured Clinical Interview for DSM-5 Disorders (SCID-5-CV) was applied to all participants and then PANSS was applied to SCH in the first session. In the second session, digit span test, the Calgary Depression Scale for Schizophrenia (CDSS) for SCH and the Hamilton Depression Rating Scale (HAM-D) for HC were applied. As in previous studies that have administered PONS to SCH (19), a modified procedure of Mini-PONS was administered to keep patients focused on the task. Then 10-min. speech samples were recorded for CDI assessment. The experimenter asked open-ended questions and made comments when the participants discontinued talking or digressed from the topic. Finally, the participants were asked to fill out the Social Functioning Scale (SFS). The self-report of SCH was confirmed by their relatives.

Data Analysis

A prior analysis of sample size

G*Power 3.1 was used to calculate the required sample size. Separate power analyses were performed on group differences of both Mini-PONS

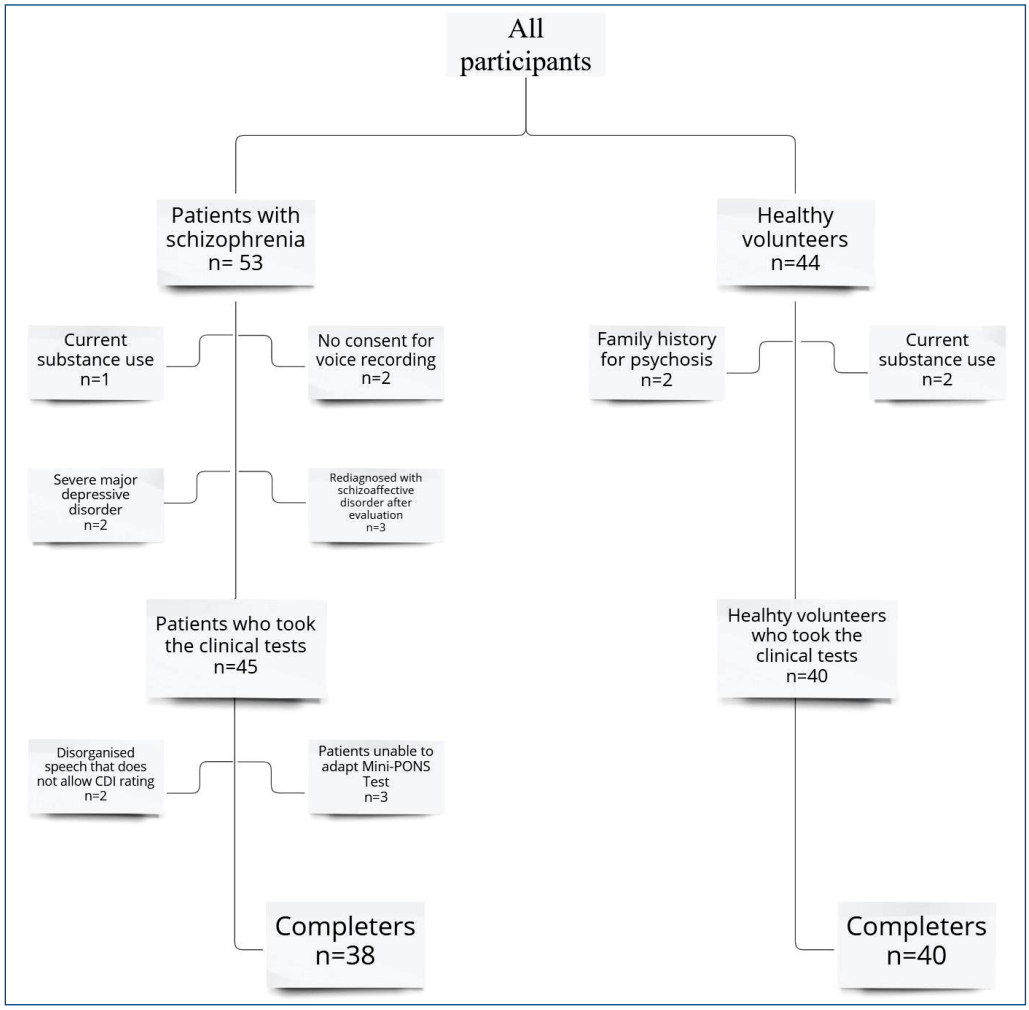

Figure 1. Flow diagram of participants

Table 1. Demographic information from patients with schizophrenia and controls

	Patients with schizophrenia (n=38) n(%)	Healthy controls (n=40) n(%)	df	χ^2	p
Mean age (Mean±SD)	41.58±9.08	37.98±9.15	76	1.745	0.085†
Gender					
Female	11(28.9)	11(27.5)			
Male	27(71.1)	29(72.5)	1	0.20	0.887
Marital status					
Single	24(63.2)[a]	12(30.0)[b]			
Married	9(23.7)[a]	21(52.5)[b]			
Widow	0(0.0)[a]	1(2.5)[a]			
Divorced	5(13.2)[a]	6(15.0)[a]	3	9.768	**0.012***
Education					
Primary school	7(18.4)	2(5.0)			
Secondary school	7(18.4)	6(15.0)			
Highschool	16(42.1)	20(50.0)			
University	8(21.1)	12(30)	4	5.857	0.200*
Occupational status					
Non employee	30(78.9)	5(12.5)			
employee	8(21.1)	35(87.5)	1	34.782	**<0.001**
Immigration					
No	3(7.9)	3(7.5)			
1. Degree	18(47.4)	24(60.0)			
2. Degree	17(44.7)	13(32.5)	2	1.413	0.536*

Chi-square independence test *Fisher-Freeman-Halton **Fisher 's Exact †Student t. The letters "a,b" are used to show the difference in statistical significance between the values in the columns in the same row in the RXC regular table (Bonferroni correction, a=0.05).

and CDI. Using the mean and standard deviation values of prominent studies in line with our hypothesis, effect size was found in the range of 0.52–0.93 for Mini-PONS with each cue type, and 0.61–0.97 for CDI with each error type. We set the effect size to 0.7, which satisfies the reference of both measurements. Sample size was calculated as 34 for each group with a power of 0.80 and a=0.05 at two-tailed level.

Hypothesis testing

IBM Statistical Package for Social Sciences (SPSS) program version 25 was used to test the hypotheses. Logarithmic or square-root transformation was applied to variables that violated the assumption of normal distribution. Group differences of all measurements were analyzed with t test for independent groups, which was confirmed for both total score of Mini-PONS and CDI after controlling the digit span performance and education level in ANCOVA. Chi-square test was used to compare categorical variables between the groups. Gender effect was evaluated with two-factor ANOVA in group comparison for each dependent variable. Pearson correlation coefficient was calculated for binary relationships. The predictors of SFS were explored with multiple hierarchical linear regression analysis. Indirect effects of mediation were computed with random sampling in 5000 bootstrapped resamples using IBM Statistical Package for Social Sciences (SPSS) program version PROCESS 3.2 (20) which could provide more robust estimation. Significance level was set to α=0.05 at two-tailed.

RESULTS

Descriptive Statistics of the Participants

Groups did not differ in terms of age, gender and education level. The data of the clinical features and psychiatric history of the patients are presented in Table 2.

The Group Differences of Non-Verbal Sensitivity, the Rates of Verbal Disturbance, and the Level of Social Functioning

The difference between the groups in terms of NVS was statistically significant (t (76)=5.579; p<0.001). The performance on overall cue types of Mini-PONS was significantly worse in SCH than HC (2.119<t (76) <5.579, p_{all} <0.05). Separate 2×2 ANOVAs run for all of cue components yielded neither gender main effect or interaction effect of gender by group (Table 3). In ANCOVA models in which digit span test[1] and education level[2] were included as covariates, the Mini-PONS score was maintained to be higher in HC after controlled ((F_{main} (1,75)=25.563, p<0.001)[2]; F_{main} (1.75)=27.532, p<0.001)[1]). The split-plot analysis of variance was run to compare groups on the proportions of correct response in type of channels. The analysis generated a significant group main effect (F (1,76)=27.673, p<0.001) and significant channel main effect (F (5,380)=17.643, p<0.001) but not interaction effect (F (5,380)=1.066, p=0.373). Post-hocs in SCH showed that the highest accuracy was achieved in FACE+FC, and the lowest in RS. On the other hand, FACE+RS did not make a significant contribution to accuracy beyond the RS alone. The overall VCD was rated significantly higher in SCH rather than HC (t (76)=3.746, p<0.001).

Table 2. Clinical features of the schizophrenia group

	n	Mean	Standart deviation	Min	Max
Age of disease onset	38	22.89	7.64	13.0	44.0
Duration of disorder (years)	38	18.65	9.25	4	43
Number of psychotic episodes	17	2.0	2.68	1.0	7.0
Last psychotic episode (months ago)	20	39.90	35.61	4.0	120.0
Antipsychotic equivalent dose (olanzapine/mg)	38	24.78	13.52	5.0	63.3
PANNS-P	38	14.71	5.44	7.0	27.0
PANNS-N	38	18.21	6.97	7.0	38.0
PANNS-G	38	29.92	7.41	17.0	54.0
PANNSTotal	38	62.84	16.24	32.0	119.0
CDSS	38	3.18	3.88	0.0	14.0
***HAM-D**	40	1.85	2.38	0.0	8.0

PANNS: Positive and Negative Syndrome Scale P:Positive, N: Negative G: General Psychopathology Scale CDSS: The Calgary Depression Scale for Schizophrenia HAM-D: Hamilton Depression Scale *Control group data

Table 3. Findings on the comparison of the scores of the Mini-PONS channels according to the groupsand the effect of gender

Mini-PONS	Scizophrenia (n=38) Mean±SD	Healthy controls (n=40) Mean±SD	t	p‡	F (Main effect)†
Face	10.12±1.28	11.30±1.18	-4.235	<0.001	14.174***
Body	10.35±1.67	11.57±1.95	-2.971	0.004	9.281**
Voice-RC	4.30±1.66	5.22±1.49	-2.591	0.011	5.618*
Voice-FC	4.48±1.41	5.07±0.86	-2.246	0.028	5.981*
Voice-total	8.77±2.04	10.30±1.74	-3.554	0.001	12.135**
Face+RC	4.77±1.43	5.42±1.28	-2.119	0.037	1.853
Face+FC	5.73±1.57	7.00±0.98	-4.241	<0.001	12.995**
Total	39.75±4.96	45.60±4.28	-5.579	<0.001	24.982***

†Two-way ANOVA (Gender was determined as the 2nd factor "interaction" and gender "main effect" was not statistically significant, p>0.05). *p<0.05 **p<0.01 ***p<0.001 ‡Student t test.

There was a consistent trend for SCH to have a greater overall VCD even after controlling of education level[1] and attention performance[2] (F^1_{main} (1,75)=11.905, p<0.001; F^2_{main} (1,75)=13.263, p<0.001). Schizophrenia patients were rated higher in all error subtypes except the WW. (1.728<t (76) <3.746, p_{all} <0.05). While MI had a highest effect size among all error types, WW had lowest (d_{MI}=0.788, d_{WW}=0.404) (Table 4).

The Pairwise Associations of Nonverbal Sensitivity, Verbal Disturbances, Social Functioning and Symptom Severity

The significant positively moderate correlation between Mini-PONS total scores and SFS total scores was shown in SCH (r (36)=0.348, p=0.032), but not in HC. No significant correlation was found between Mini-PONS total scores and all subscales of PANSS. The negative linear

Table 4. Findings on the comparison of CDI means by groups and on the effect of gender

	Scizophrenia (n=38) Mean±SD	Healthy controls (n=40) Mean±SD	t	p†	F‡ (Main effect)
CDI					
Grammatical unclarity (GU)	0.65±0.44	0.46±0.26	2.298	**0.025**	3.401
Missing information (MI)	0.19±0.20	0.06±0.12	3.662	**0.001**	7.898**
Vague reference (VR)	0.45±0.35	0.26±0.19	2.882	**0.005**	9.897**
Confuced reference (CR)	0.17±0.21	0.07±0.07	2.799	**0.008**	10.040**
Wrong word (WW)	0.23±0.30	0.14±0.10	1.728	0.091	2.010
Ambigious word (AW)	0.08±0.10	0.04±0.06	2.191	**0.032**	8.276**
Total	1.77±1.14	1.03±0.45	3.746	**<0.001**	12.430**
Total word count	735.58±239.55	1008.85±206.54	-5.404	**<0.001**	34.662***

CDI: Communication Disturbance Index; Mean±SD = Mean±Standard Deviation
†Student t, ‡Two-way ANOVA (Gender was determined as the second factor. Gender "main effect" and "interaction" were not statistically significant, p>0.05. ("Total Word count" "intereaction F(1.74)=4,636, p= 0.035).

Table 5. The pairwise associations of study tests and some sociodemographic characterstics in SCH

	CDI-T	Mini-PONS-T	SFS-T	Digit-span test	PANSS-T	CDSS	Age	Education (years)	Duration of illness
CDI-Total	-	-0.175	**-0.326**	0.025	**0.447**	-0.218	0.073	0.107	0.214
MI	-	-0.148	**-0.370**	0.225	0.557	-0.153	0.044	-0.152	0.172
VR	-	-0.181	**-0.353**	-0.096	**0.404**	-0.103	0.216	-0.181	0.252
CR	-	-0.208	-0.212	0.259	0.292	-0.191	0.008	-0.051	**0.340**
WW	-	0.09	0.047	-0.086	0.121	-0.203	0.015	-0.068	0.027
AW	-	-0.004	**-0.414**	-0.036	**0.614**	-0.005	-0.164	-0.244	**0.089**
GU	-	-0.146	-0.227	-0.019	0.216	-0.183	0.018	0.063	0.071
Mini-PONS-Total	-0.175	-	**0.348**	0.229	-0.118	0.243	-0.184	0.216	-0.250
Face	-0.005	-	0.011	0.246	0.013	-0.037	-0.50	**0.368**	-0.038
Body	-0.144	-	0.176	0.256	-0.096	0.203	-0.192	0.004	-0.169
RS	-0.271	-	**0.346**	**0.343**	-0.045	0.123	**-0.480**	**0.359**	-0.219
FC	-0.193	-	**0.487**	0.038	**-0.559**	0.021	**0.363**	0.192	0.030
Face+RS	-0.161	-	0.165	-0.043	-0.093	0.207	-0.028	0.061	-0.154
Face+FC	-0.197	-	**0.342**	-0.106	-0.105	0.306	-0.051	0.085	-0.274
Total-voice	**-0.354**	-	**0.619**	0.306	**-0.424**	0.114	-0.139	**0.426**	-0.157
SFS-Total	**-0.326**	**0.348**	-	0.124	**-0.643**	-0.099	0.034	0.295	-0.104
With drawal	-0.139	-0.075	-	0.090	-0.088	-0.026	-0.082	0.128	0.085
Inter personal (IPB)	**-0.470**	0.098	-	-0.079	**-0.420**	0.036	0.196	0.036	-0.029
Prosocial	-0.311	**0.388**	-	0.210	-0.263	-0.122	-0.300	0.293	-0.196
Recreation	0.161	0.191	-	0.035	-0.085	-0.185	0.174	0.140	0.157
Independence-Competence	-0.280	**0.394**	-	0.215	**-0.499**	0.125	-0.107	0.387	-0.317
Independence-Performance	-0.100	0.297	-	-0.030	**-0.463**	-0.092	0.128	0.288	-0.054
Employement	-0.026	0.063	-	0.092	**-0.525**	-0.121	0.045	-0.083	-0.048

CDI: Communication Disturbance Index; Mini-PONS: Mini Profile of Nonverbal Sensitivity; SFS: Social Functioning Scale; PANSS: Positive and Negative Syndrome Scale; CDSS: Calgary Depression Scale for Schizophrenia; *p<0.05,**p<0.01

relationship between CDI total score and SFS total score was shown to be statistically significant (r (36)=-0.326, p=0.046) in SCH, but insignificant in HC (r (38)=0.069, p=0.672). In addition, there were significant positive correlations among CDI total score, general and positive symptom scores of PANNS along with the total score (0.396<r (36) <0.447,p_{all} <0.05). There was no significant correlation between the Mini-PONS total score and CDI score both in groups, even the trend of insignificant association with Mini-PONS was reflected in all cue types of CDI. The findings of the correlation analyses were given in Table 5.

Nonverbal Sensitivity, Verbal Disturbance and Symptom Severity as Predictors of Social Functioning in SCH

Given the notable pairwise associations, we ultimately aimed to explore the hierarchy of communication failures which are consisted of nonverbal insensitivity and VCD within the variance that explains SF. A hierarchical regression analysis was carried out in a total of 4 blocks, in the last of which only the order of insertion was changed. Because of the significant strong correlation with symptom severity on SF, we fixed PANNS total score as a control variable in the first step in model. Positive and negative syndrome scale was superior to the other predictors in all blocks, which was strongly associated with SFS in the first step (β=-0.64, t=-5.04, p<0.001). The addition of Mini-PONS to Block II raised slightly the variance of SF with significant increment of 0.7% in all proportion of 46% (F (2,35)=16.74, p<0.001) and with significant effect (β=0.28, t=2.27,p=0.03). Communication disturbance index had no significant effect on SFS in Block III which accounted for 38% of variance explaining SF (F (2,35)=12.45, p<0.001). Mini-PONS retained its contribution, with almost same effect, to SF beyond the impact of PANNS and CDI in Block IV (ΔR^2=0.07, p=0.03). Unlike, there was no significant further effect for CDI to variance of SF explained by PANNS and Mini-PONS (Block V). Overall, three variables in one block significantly predicted approximately 45% of the variance in SF (F (3,34)=10.84, p<0.01). The results of regression analysis were presented in Table 6.

The Mediational Effect of Symptom Severity in the Relationship Between Verbal Disturbance and Social Functioning in SCH

Prerequisite associations for possible mediation between the symptom severity, VCD and SF were found in previous correlation analysis. Block III pointed out a drastic reduction in the proportion of CDI in the variance of SF when added to equation following PANNS. We proceeded to test the mediational effect of symptom severity in the relation between VCD and SF (20). The association between CDI and SFS was abolished when PANSS was included as a mediator (β=-0.048, p=0.74). The total effect of CDI on SFS (*b*=-12.54, 95%[-24.83, -0.24]) was operated through the PANNS with a significant indirect effect (*b*=-10.69.95%[-22.02, -0.38])), but insignificant direct effect (*b*=-1.84, 95%[-13.12, 9.44]). The outcome suggested that symptom severity fully mediated the relationship between VCD and SF. The findings relevant to mediation analysis were illustrated in Figure 2.

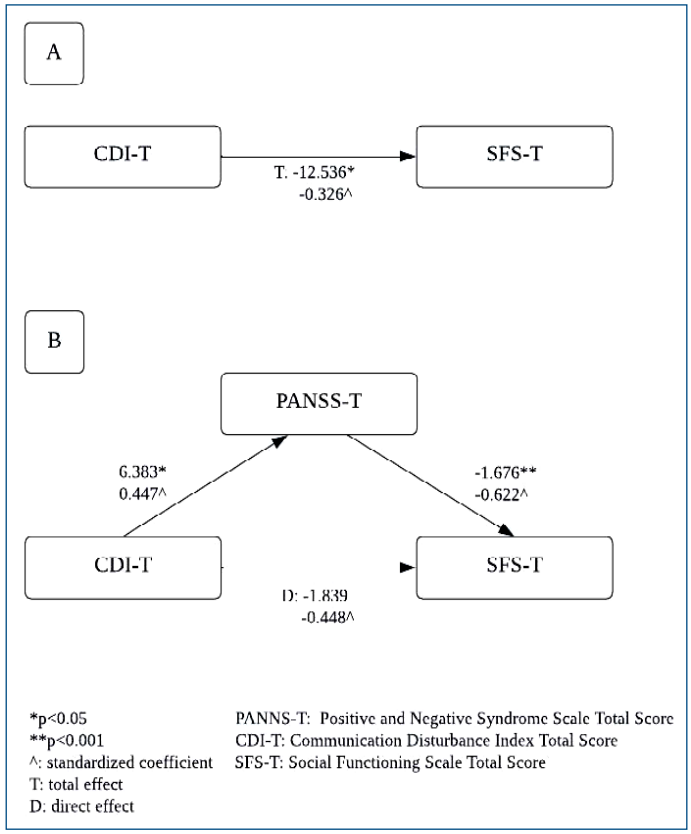

Figure 2. A represents the simple model on relationship between CDI and SFS-T, B represents the simple mediation model in which PANNS-T was included.

Table 6. The predictors of social functioning in SCH: Hierarchical regression analysis

Predictors			SFS				
Block	**Order**	**Step**	β	**t**	R^2_{adj}	**ΔR²**	**ΔF**
I	1	PANSS	-0.64⁺	-5.04	0.40⁺	0.41	25.41⁺
II	1	PANSS	-0.61⁺	-5.02	0.46⁺	0.07	5.14*
	2	M-PONS	0.28*	2.27			
III	1	PANSS	-0.62⁺	-4.31	0.38⁺	0.02	0.11
	2	CDI	-0.05	-0.33			
IV	1	PANSS	-0.61⁺	-4.43	0.44⁺	0.07	4.90*
	2	CDI	-0.01	-0.01			
	3	M-PONS	0.28*	2.21			
V	1	PANSS	-0.61⁺	-4.43	0.44⁺	<0.01	0.02
	3	CDI	-0.01	-0.01			
	2	MPONS	0.28*	2.21			

PANSS: Positive and Negative Syndrome Scale; M-PONS: Mini Profile of Nonverbal Sensitivity; CDI: Communication Disturbance Index; SFS: Social Functioning Scale
*p<0.05*p<0.01⁺p<0.001.

DISCUSSION

We had four prominent outcomes: 1) SCHs were less sensitive to nonverbal signs compared to HCs, and discourse failures were higher in SCHs, 2) increased both nonverbal and verbal communication deviance were related to poor SF in SCHs, 3) NVS was the main predictor of overall social outcomes in SCH 4) symptom severity of SCHs was the full mediator of relationship between speech disturbance and SF.

Schizophrenia patients performed worse on the Mini-PONS compared to HCs, which is consistent with a number of research showing that SCHs have lower sensitivity to nonverbal cues than HCs. (8,19,21). This corresponds with previous findings on emotion recognition deficits in schizophrenia (22), reflecting a closely related aspect of nonverbal processing. Aligning with some earlier results, symptom severity of SCH was not related to nonverbal perception deficits in the present study (21,23). This finding implies that insensitivity to social signs might be a fundamental trait of schizophrenia, corroborated by studies reporting social cognition impairments in first-degree relatives of SCHs (24).

Another finding indicated that NVS was associated withsocial capacity. There is strong evidence in the literature that social cognition is the distinct correlate of functionality in SCH (4,25). The present study extends these findings by showing social outcome was particularly associated with perception of fragmented vocal signs. Although vocal affect recognition was found to be connected only to occupational dysfunction in a prior study (25), the manipulated vocal features in Mini-PONS may require advanced decoding skills in the present study, potentially linking them to wider social challenges.

Patients' speech displayed a greater proportion of VCD in each type of error, which was congruent with the findings of a series of studies using CDI (26–28). Missing information has been proposed to be characteristic of schizophrenia in all error types (13). Similarly, we found that MI distinguished markedly the groups. This can be explained by the fact that MI is closely associated with impairments in neurocognitive functions such as working memory and attention, which are common in SCH (28). We also demonstrated that symptom severity was mildly to moderately related to referential failures on CDI, in contrast to prior studies that tended to find no or weak correlations between the CDI and positive symptom but not with negative symptom (29,30). Nevertheless, our finding does not rule out the possibility that discourse impairments are specific to schizophrenia, as evidence from a novel study in healthy individuals has shown a link between schizotypal traits and discourse (31). On the other hand, our findings are supported by another prior evidence showing a link between psychotic symptoms and comprehensive level of pragmatic deficits (32), even with different measurement approaches.

Another of our main findings was the correlation between CDI and SF. Although the close relation between social impairment of schizophrenia and speech disorder is well-documented, outcomes have been mainly obtained as a by-product of formal thought deficit theory (33). A study from the limited body of research further supports our finding that pragmatic abilities in SCHs mediate the relationship between cognitive functions and daily functioning (34). Another related study identified a connection between pragmatic language and quality of life in SCHs (32). We confirm and extend existing literature by showing a significant association between SF and the impaired pragmatic linguistic profile of SCH.

The unexpected finding of the present study is the lack of a relationship between CDI and Mini-PONS in SCHs, even across all sub-dimensions. We contradicted, to our knowledge, the findings of the only study that used the same measures, reporting a moderate relationship between Half-PONS and CDI (27). It could be argued that both measurements failed to produce common variance because the effect size might be too small to support the hypothesis. This may be due to the reduced content in Mini-PONS compared to its original version. As a result it may not fully capture certain unique aspects of Turkish culture and thus limits the overlap between Mini-PONS and the referential errors in CDI. In opposition to our findings, certain evidence has been reported. For example, a meta-analysis shows that pragmatic abilities are moderately linked to social cognition (35). Likewise, impairments in detecting gesture-speech mismatches (36) and deficits in gesture-speech timing and synchronization in schizophrenia suggest a potential interconnection between verbal and nonverbal communication in SCH (37). A novel computational technique further validated the relationship between certain domains of social cognition and speech disorder, also showing that clinical ratings of speech impairment align well with these areas of social cognition (38). Taken together, these findings converge on the relationship between verbal impairments and specific dimensions of social cognition, presenting a challenge to the interpretation of our results. However, our contradictory findings may stem from differences in the domains of social cognition assessed, as our study specifically focused on NVS as a unique dimension of social cognition, while others may have examined different facets of it.

One of the important aims of our study was to explore the communicative underpinnings of social outcomes in a hierarchical manner. Regression analysis revealed that Mini-PONS was more proximal to SF than CDI. The literature does not provide a clear answer on whether verbal or non-verbal aspects of communication are more influential in daily social impairments. However, the notion that nonverbal communication is often considered to have phylogenetic primacy over verbal communication may help us better understand our finding (2). In the same vein, Vogel et al. (2016) suggests that nonverbal dominance, though diminished in intensity compared to healthy individuals, remains in schizophrenia patients (39). This supports our finding about significant role of nonverbal communication in their social functioning.

Another key finding of our study was the full mediating role of symptom severity in the relationship between CDI and SFS. This finding indicates that reducing symptom severity in SCHs could potentially improve the influence of speech disturbances on social functioning. Despite all compelling arguments, it is important to note that communication skills may not be clear indicators of social functioning in various settings, as the linear relationships found in a cross-sectional sample limit causal conclusion.

Our study had several limitations that needed to be taken into consideration. First, our sample size was relatively small to test causality. However, we recruited participants to study over a priori calculated sample size. The power of the present study was achieved >90% on both measurement of communication. Second, social outcome was ascertained by self-reporting of patients. But at the same time, SFS ensured that biased appraisal of patients was confirmed by their relatives. Third, although our study analyzed the relationship between PANSS scores and other variables, subgroup analyses based on symptomatology differences could be conducted due to limited sample size. We recommend analyzing schizophrenia subgroups in future research. Finally, our study was assessing verbal communication through language use and nonverbal communication through social cue perception. Comparing receptive or expressive abilities across both domains might provide clearer insights.

There are several strengths to the present study. First, this study is one of the rare investigations that simultaneously examines the effects of both aspects of communication on social functioning in patients with schizophrenia. Additionally, our study is the first to utilize the CDI in

modern standard Turkish, which was previously employed in a sample of Turkish-speaking Iranians (30). Unlike previous studies, where the CDI was administered by mental health professionals, this study allowed linguists to apply it for the first time. Another significant contribution is that this study is the first to apply any version of the PONS test within Turkish culture. However, cultural differences in nonverbal communication patterns, such as reliance on specific facial expressions or gestures, may influence the interpretation of these findings. Future studies could compare Turkish-speaking populations with other cultural groups to explore this further.

Our results add to the great body of studies investigating the association between communication disorders and SF of SCHs. Altogether, nonverbal insensitivity and discourse failures were shown to have a unique contribution to social impairment beyond the psychotic symptomatology. The present study gave us a new insight into communicational underpinnings of SF in SCHs. These findings suggest that addressing communication abnormalities may be crucial for improving social disabilities, beyond just focusing on alleviating clinical dysfunction. A deeper understanding of the aforementioned relationships would promote a new therapeutical model for future studies. Interventions designed to enhance nonverbal sensitivity, such as training in emotion recognition or social perception tasks, may lead to significant improvements in social functioning. Likewise, addressing verbal communication deficits through cognitive remediation therapy could provide additional benefits.

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