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## Thought, language, and communication deficits and association with everyday functional outcomes among community-dwelling middle-aged and older adults with schizophrenia

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### ABSTRACT

Older adults with schizophrenia experience poorer community integration and social functioning compared to same-age peers with no mental health disorders; these individuals are at elevated risk for functional decline and early institutionalization in long-term care facilities. Deficits in thought, language, and communication (TLC; that is, thought disorder and alogia) are core features of schizophrenia and may worsen with age; however, little research focuses on the functional sequelae of these impairments among older adults with schizophrenia. The present study aimed to examine the relationships among age, TLC deficits, and functional outcomes in a sample of community-dwelling middle-aged and older adults with schizophrenia ( $N = 245$ ; ages 40–85). Participants completed assessments of symptoms, neurocognition, TLC deficits, and functional outcomes. Two different categories of TLC deficits were examined: verbal underproductivity (i.e., alogia) and disconnected speech. Regression analyses, controlling for gender, age, Veteran status, smoking status, cognitive impairment, and symptom severity, found that disconnected speech predicted occupational functioning, while verbal underproductivity predicted capacity to communicate skillfully in semi-structured social situations, as well as community functioning across interpersonal, occupational, and everyday living domains. Exploratory mediation analyses found significant indirect effects of age, through TLC deficits, on certain functional outcomes. Targeted training to improve TLC deficits, especially verbal underproductivity, among older adults with schizophrenia could have downstream effects on community functioning, improving outcomes for a vulnerable group.

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### 1. Introduction

Community-dwelling older adults with schizophrenia experience poorer community integration and social functioning when compared to their same-age peers, including elevated rates of unemployment, underperformance in everyday activities, and social isolation (Abdallah et al., 2009; Madioed et al., 2012; Meesters et al., 2010). Moreover, older adults with schizophrenia are vastly overrepresented in nursing homes (Miller and Rosenheck, 2006, 2007) and are at increased risk for nursing home placement as early as their forties (Andrews et al., 2009). This indicates that, although there is great

heterogeneity in outcomes as individuals with schizophrenia age (Jeste et al., 2011), for some, aging may be accompanied by faster and more severe functional decline than that experienced by their same-age peers without psychiatric disorders. Further elucidation of the factors which contribute to poor functional outcomes in community-dwelling older adults with schizophrenia is necessary to inform targeted interventions for this group.

While cognitive decline accounts for worsening of functional outcomes in older adults with schizophrenia in some cases (Reichenberg et al., 2014), research indicates that only a subset of these individuals exhibit substantial cognitive decline with age (Harvey et al., 2010; Thompson et al., 2013). Additionally, while considerable research has examined the relationships among neurocognition, symptom severity, and functional outcomes in adults with schizophrenia (e.g., Bowie et al., 2006), much less attention has focused on one of the cardinal features of the illness: impairments in thought, language, and communication.

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Thought, language, and communication (TLC) deficits, also referred to as formal thought disorder and alogia, are common in schizophrenia, and are associated with impairments in everyday functioning (Racenstein et al., 1999; Bowie et al., 2011). TLC deficits are thought to fall into two categories: “positive” thought disorder, characterized by the presence of disorganized, circumstantial, or tangential speech, and “negative” thought disorder (i.e., alogia), characterized by an absence of speech production (Andreasen, 1986). Previous research with chronically institutionalized older patients with schizophrenia, both “positive” TLC deficits (hereafter referred to as disconnected speech) and “negative” TLC deficits (hereafter referred to as verbal underproductivity) were associated with deficits in social outcomes, but not with deficits in other functional domains (e.g., activities of daily living, recreation; Bowie and Harvey, 2008). Additionally, verbal underproductivity worsened with age, especially among the older-old and oldest-old patients (ages 74 and up; Bowie et al., 2005). Importantly, the relationships among age, TLC deficits, and functional outcomes have not been examined in community-dwelling older adults with schizophrenia, for whom adaptive functioning may be much more dependent on the ability to skillfully communicate.

Previous studies on TLC deficits and functional outcomes in schizophrenia have generally relied on consumer or informant reports of everyday functioning (Racenstein et al., 1999; Bowie and Harvey, 2008). One limitation of this approach is that real-world functional performance may be influenced by factors beyond a consumer’s communication abilities, such as socioenvironmental constraints. Therefore, it is unknown whether TLC deficits are associated with poorer functional outcomes because they directly influence a consumer’s ability to successfully communicate (i.e., a consumer cannot communicate his/her thoughts or needs when given the opportunity) or because that consumer has fewer opportunities to communicate (i.e., TLC deficits lead to increased social isolation and fewer opportunities for interaction). To address this, performance-based measures of functioning, which prompt participants to demonstrate social and occupational skills through in-vivo tasks, may be used. These measures capture functional capacity, or their ability to accomplish activities of daily living under optimal conditions (Bowie et al., 2006). The only study to examine the association of TLC deficits with functional capacity in adults with schizophrenia, found that both verbal underproductivity and disconnected speech were associated with performance on in-vivo, social skills based role plays (Bowie et al., 2011). These associations have not been examined in an older adult sample of individuals with schizophrenia.

The present study aimed to further elucidate the association of TLC deficits and functional outcomes among community-dwelling middle-aged and older adults with schizophrenia. We aimed to examine, adjusting for demographic factors, cognitive impairment, and symptom severity, whether verbal underproductivity and disconnected speech would be associated with poorer clinician-rated community functioning across occupational, everyday living, and interpersonal domains. Secondly, we aimed to examine, again adjusting for demographic factors, cognitive impairment, and symptom severity, whether verbal underproductivity and disconnected speech would be associated with poorer performance on laboratory social skills tasks and functional tasks of communication. Exploratory analyses tested whether TLC deficits mediated relationships between age and functional outcomes, to explain the greater functional deficits seen in older people with schizophrenia.

## 2. Methods

### 2.1. Participants

This study presents analyses of baseline data from a large longitudinal study, which assessed the course of cognition and functioning in a sample of community-dwelling adults with

schizophrenia (see Bowie et al., 2006 for more details on methodology). The present analyses utilized data from all participants with a schizophrenia diagnosis, ages 40 and up, who completed baseline assessments for the study ( $N = 245$ ; see Table 1). Participants were recruited through academic, state, and VA outpatient treatment programs, and were required to meet criteria for a primary DSM-IV diagnosis of schizophrenia or schizoaffective disorder, as assessed through the Comprehensive Assessment of Symptoms and History (Andreasen et al., 1992). Additionally, individuals needed to exhibit evidence of current active illness at baseline assessment, as evidenced by an inpatient hospitalization or emergency room visit for psychosis within the last two years, or at least moderate levels of positive symptoms. Exclusion criteria were the presence of medical illnesses that could impact cognitive functioning, and a Mini-Mental Status Examination (MMSE; Folstein et al., 1975) score below 18.

**Table 1**  
Demographics and descriptive statistics ( $N = 245$ ).

Variable	n (%)	
Gender		
Male	178	(72.7%)
Female	64	(26.1%)
Race		
White	128	(52.2%)
African-American	71	(29.0%)
Other	16	(6.5%)
Marital status		
Never married	124	(50.6%)
Veteran status		
Yes	94	(38.4%)
No	151	(61.6%)
Smokes cigarettes		
Yes	147	(60.0%)
No	92	(37.6%)
Missing	6	(2.4%)
	M (SD)	Range
Age (years)	56.01 (9.07)	40.00–85.00
Education (years)	12.75 (0.16)	5.00–20.00
BDI total	11.90 (10.11)	0.00–50.00
PANSS Positive <sup>a</sup>	11.81 (4.51)	6.00–26.00
PANSS Negative <sup>a</sup>	9.88 (3.64)	5.00–23.00
Cognitive composite <sup>b</sup>	−1.48 (0.99)	−3.94–0.48
TLC_DS <sup>c</sup>	0.27 (0.37)	0.00–1.60
TLC_VU <sup>d</sup>	0.39 (0.66)	0.00–2.00
SLOF work <sup>e</sup>	24.17 (5.64)	6.00–30.00
SLOF activities <sup>e</sup>	49.66 (7.28)	24.00–55.00
SLOF interpersonal <sup>e</sup>	29.73 (5.37)	14.00–35.00
UPSA communication <sup>f</sup>	16.77 (5.26)	0.00–25.00
SSPA mean <sup>g</sup>	3.83 (0.75)	1.36–5.00

Notes. BDI = Beck Depression Inventory; PANSS = Positive and Negative Syndrome Scale; TLC\_DS = Thought, Language, and Communication Scale, Disconnected Speech; TLC\_VU = Thought, Language, and Communication Scale, Verbal Underproductivity;

SLOF = Specific Levels of Functioning scale; UPSA = University of California San Diego Performance-Based Skills Assessment; SSPA = Social Skills Performance Assessment.

<sup>a</sup> PANSS scores do not include conceptual disorganization, lack of spontaneity and flow of conversation, and passive/apathetic social withdrawal items. Higher scores reflect more severe psychopathology.

<sup>b</sup> Mean of z-scores across a battery of neurocognitive measures.

<sup>c</sup> Scores can range from 0 to 4, with higher scores reflecting more extreme disconnections in speech.

<sup>d</sup> Scores can range from 0 to 4, with higher scores reflecting higher verbal underproductivity.

<sup>e</sup> SLOF work scores can range from 6 to 30, SLOF Activities scores can range from 11 to 55, SLOF Interpersonal scores can range from 7 to 35. For each domain, higher scores indicate better functioning.

<sup>f</sup> Scores can range from 0 to 25 with lower scores reflecting more impairment in functioning.

<sup>g</sup> Scores can range from 1 to 5 with lower scores reflecting more difficulties with social skills.

## 2.2. Procedures

All study procedures were approved by the appropriate institutional review boards and participants completed written informed consent prior to participating in any study activities. Eligible participants completed assessments of cognition, functional and communication skills, and symptoms. All assessments were completed by trained raters. Participants' case managers completed ratings of community functioning within one week of the assessments.

## 2.3. Measures

Demographic information and smoking status were ascertained from the participant. Height, weight, and presence of diabetes and heart disease were ascertained by chart review when available.

### 2.3.1. Symptom severity

The Positive and Negative Syndrome Scale (PANSS; Kay, 1991) was used as a measure of clinical symptom severity. The PANSS is comprised of 30 individual items that are scored using seven point Likert scales (1 = absent, 7 = extreme) and was rated through a structured interview with the participant and collateral information (i.e., chart review and clinician informant). The interrater reliability for this measure was high (Bowie and Harvey, 2008). The PANSS Positive and PANSS Negative scale scores were calculated excluding three individual items, due to their high overlap with TLC: conceptual disorganization, lack of spontaneity and flow of conversation, and social withdrawal (Bowie and Harvey, 2008). The widely used and well-validated Beck Depression Inventory (BDI; Beck et al., 1986) was used as a measure of depression symptom severity.

### 2.3.2. Global cognition

Global cognitive functioning was assessed through comprehensive neuropsychological assessment. Age-based norms were used to produce standard scores, and these scores were combined to create a cognitive composite score which included the following domains: constructional praxis, attention and concentration, executive functioning, and verbal learning, memory, and fluency. For a detailed description of the cognitive composite see Bowie et al. (2006).

### 2.3.3. TLC deficits

The Thought, Language, and Communications (TLC) Scale is an 18-item interviewer-rated measure of thought disorder, based on participant speech and communication during unscripted conversation (Andreasen, 1986). The TLC scale has been successfully used in previous research to measure two subtypes of TLC deficits: disconnected speech (TLC\_DS) and verbal underproductivity (TLC\_VU; Bowie et al., 2005; Bowie and Harvey, 2008). TLC\_DS is calculated as a mean of a six items representing loose or incoherent speech (e.g., tangentiality, circumstantiality), while TLC\_VU was defined by the poverty of speech item. This use of the TLC measure has demonstrated adequate-to-good interrater reliability (Bowie et al., 2005; Bowie and Harvey, 2008; Harvey et al., 1997).

### 2.3.4. Performance-based measures of functional capacity

Performance-based functional and social skills were measured using the UCSD Performance-based Skills Assessment (UPSA; Patterson et al., 2001a) and the Social Skills Performance Assessment (SSPA; Patterson et al., 2001b). The UPSA was created to assess functional skills among older outpatients with serious mental illness in five domains: communication, finance, transportation, planning recreational activities, and household chores (Bowie et al., 2006). For the purposes of this study, the communication domain (UPSA communication) was utilized as a measure of functional communication abilities. Participants completed a series of task-oriented role plays (e.g., making an emergency phone call) assessing their ability to successfully complete each

communication task, producing a communication subscale score, with higher scores indicating better performance.

The SSPA involves a series of role plays performed between the participant and the interviewer. Role plays are less structured and involve unscripted communication with the interviewer in two different "scenes": greeting a new neighbor and negotiating with a landlord. These scored role plays follow a practice scene where the participant has to make plans with a friend. Role plays are coded on a scale from 1 to 5 (1 = low; 5 = high) on the following items: interest, fluency, clarity, focus, affect, grooming, negotiation ability, submission, overall argument/overall conversation, and social appropriateness. The mean score (SSPA mean) represents a global estimate of social skill level for each participant. The SSPA has good test-retest and interrater reliability (Patterson et al., 2001a,b).

### 2.3.5. Community functioning

Community functioning was assessed through the Specific Level of Function Scale (SLOF; Schneider and Struening, 1983). This measure has high interrater reliability, internal consistency, and factorial validity (Bowie et al., 2006; Harvey et al., 2011). The SLOF contains 43 items rated on a 5-point Likert scale. Ratings are based on informant report of an individual's performance across six functional domains. The relevant domains for the present analyses were: interpersonal relationships (SLOF interpersonal; e.g., forming friendships), daily activities (SLOF activities; e.g., shopping, taking medication, handling personal finances), and work skills (SLOF work; e.g., has employable skills). Case managers who had at least a 'very good' (score 4 or 5 on a 5 point scale) knowledge of the participants rated these items within one week of the assessment and they were unaware of any of the other assessment results.

## 2.4. Data analysis

First, multiple linear regression analyses were performed to test our primary hypotheses, with the following measures as outcome variables: SLOF work, SLOF activities, SLOF interpersonal, UPSA communication, and SSPA mean. In each regression, gender, Veteran status, and smoking status were entered simultaneously in the first step. Then, age, global cognitive impairment, depression severity, positive symptom severity, and negative symptom severity were entered simultaneously in the next step. Then, TLC\_DS and TLC\_VU were entered in the final step as predictor variables. Cumulative R-squared statistics were generated to examine the relative contribution of each step in the model. Finally, for each functional outcome which had at least one TLC measure as a significant predictor, an exploratory mediation analysis was conducted using the PROCESS macro for SPSS. For each mediation analysis, gender, Veteran status, smoking status, global cognitive impairment, depression symptom severity, positive symptom severity, and negative symptom severity were entered as covariates in the model, with age as the predictor and TLC\_VU and/or TLC\_DS as mediators, depending on which TLC measures were significant predictors in the regression model for that functional outcome. PROCESS uses a bootstrapping, regression-based procedure to estimate the magnitude and significance of the indirect effect (Hayes, 2013); in this analysis, if the confidence interval does not include zero, the indirect effect is assumed to be significant. Number of bootstrap samples was set to 5000.

## 3. Results

Demographics and descriptive statistics are presented in Table 1. Age ranged from 40 to 85 years. All participants were receiving antipsychotic and/or other psychotropic medication(s). Among participants for whom chart data was available (~70%), the majority of participants were overweight or obese (mean BMI = 30.34 ± 7.05), 14.2% had Type I or II diabetes, and 5.9% had heart disease. Missing data was <10% for all variables in the analyses except the SLOF scale, which was missing for approximately 20% of participants, typically due to lack of

availability of or responsiveness from a case manager with sufficient knowledge of the participant. All available data was used for each analysis, resulting in different sample sizes for each analysis. Bivariate correlations among variables are displayed in Table 2; because a number of variables exhibited non-normality, especially the TLC and SLOF scales, Spearman's rho correlations are reported. Older age was associated with worse performance on the UPSA and the SSPA, more disconnected speech, and poorer performance on work and everyday activities. Higher performance on cognitive tests was associated with less verbal underproductivity, better work and everyday activity performance, and better scores on the UPSA and SSPA.

Results from regression analyses are displayed in Table 3. All analyses controlled for gender, Veteran status, smoking status, age, global cognitive impairment, depression symptom severity, positive symptom severity, and negative symptom severity. TLC\_DS and TLC\_VU were significantly associated with SLOF work, explaining 4.7% additional variance, collectively. TLC\_VU was also significantly associated with SLOF activities (explaining 4.8% additional variance), SLOF interpersonal (explaining 4.8% additional variance), and SSPA mean (explaining 3.4% additional variance). All regression models met assumptions of approximately normal distribution of residuals, with no evidence of problematic multicollinearity or autocorrelation.

Exploratory mediation analyses indicated that, controlling for gender, Veteran status, smoking status, age, global cognitive impairment, depression symptom severity, positive symptom severity, and negative symptom severity, TLC\_VU mediated the relationships between age and SLOF interpersonal (95% CI =  $-0.050$ ,  $-0.001$ ). TLC\_DS mediated the relationship between age and SLOF work (95% CI =  $-0.065$ ,  $-0.002$ ). The TLC measures were not significant mediators in any other mediation analysis.

#### 4. Discussion

Older adults with schizophrenia were previously reported to exhibit age-related changes in cognition, communication, and everyday functioning. In this sample of community-dwelling middle-aged and older adults with schizophrenia, TLC deficits were associated with poorer functioning across occupational, interpersonal, and everyday living domains, accounting for between 3.4% and 4.8% of the variance in community functioning. This is in contrast to previous work with chronically institutionalized older adults with schizophrenia, which found that TLC deficits were solely associated with social functioning deficits (Bowie and Harvey, 2008). It may be that in a sample that consisted of a chronically institutionalized population, occupational and self-care functioning was generally limited in terms of opportunities; this lack of variance may have precluded significant associations between TLC

deficits and functional outcomes. Alternatively, functional outcomes may be less dependent on communication skills for older adults with schizophrenia in long-term care facilities, who have access to structure and support in performing activities of daily living and recreation. In contrast, adaptive functioning for older adults with schizophrenia in the community requires proactive engagement and seeking out of opportunities, which is highly dependent on communication skills. Community-dwelling older adults with schizophrenia could benefit from targeted treatment aimed at improving TLC deficits.

Findings suggest that disconnected speech and verbal underproductivity are associated with functional outcomes in different ways. Disconnected speech was associated with deficits in work skills, but not with deficits in other areas of community functioning. Verbal underproductivity, on the other hand, was associated with deficits across multiple domains of functioning. It makes intuitive sense that reduced verbal output would be associated with decreased success in interpersonal relationships, posing a barrier to initiating and maintaining conversations and friendships; this was in fact, one of the functional domains in which verbal underproductivity accounted for the most variance (4.8%). In addition, verbal underproductivity was associated with poorer performance in semi-structured social situations (accounting for 3.4% of the variance explained), but not with social skills tasks with specific instructions. Therefore, with structure, older adults with schizophrenia may be able to overcome verbal underproductivity to accomplish specific tasks or activities. However, verbal underproductivity poses a barrier to connecting with others or expressing one's needs in less structured interactions. Verbal underproductivity was also associated with poorer work skills and performance of daily activities; these associations are more difficult to explain. Poverty of speech in and of itself should not prevent an individual from successfully completing work tasks without supervision, for example, or engaging in daily activities such as taking care of household chores or managing his/her personal finances. It may be that verbal underproductivity is associated with general social isolation, which leads to decreased opportunities to engage in activities of daily living and demonstrate functional skills.

Exploratory analyses examined whether TLC deficits mediated the link between older age and poorer functional outcomes. Findings indicated that disconnected speech mediated the link between age and poorer work functioning. In addition, the effect of age on interpersonal functioning was mediated through verbal underproductivity. Given that older age is associated with greater social isolation in the general population (Cattan et al., 2005), and with increased verbal underproductivity with age among adults with schizophrenia (Bowie et al., 2005), the interaction of these factors could lead to even greater social isolation and poorer functional outcomes. Worsening in TLC deficits with age could contribute to

**Table 2**  
Spearman's Rho bivariate correlations.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Age												
2. BDI total	-0.165*											
3. PANSS Positive	-0.233**	0.214**										
4. PANSS Negative	0.030	0.135*	0.265**									
5. Cognitive composite	-0.004	-0.048	-0.049	-0.212*								
6. TLC_VU	0.100	0.052	-0.099	0.378**	-0.245**							
7. TLC_DS	0.341**	-0.025	0.043	0.171**	-0.097	-0.006						
8. SLOF work	-0.304*	-0.080	0.108	-0.144*	0.233**	-0.274**	-0.279**					
9. SLOF activities	-0.394**	-0.033	0.162*	-0.193**	0.377**	-0.387**	-0.284**	0.683**				
10. SLOF interpersonal	-0.114	-0.125	0.044	-0.345**	0.131	-0.369**	-0.216**	0.472**	0.411**			
11. UPSA communication	-0.254**	-0.024	-0.046	-0.185**	0.481**	-0.184**	-0.282**	0.299**	0.366**	0.142		
12. SSPA mean	-0.172**	0.012	0.026	-0.345**	0.360**	-0.373**	-0.139*	0.361**	0.386**	0.253**	0.326**	

Notes. BDI = Beck Depression Inventory; PANSS = Positive and Negative Syndrome Scale; TLC\_VU = Thought, Language, and Communication Scale, Verbal Underproductivity; TLC\_DS = Thought, Language, and Communication Scale, Disconnected Speech; SLOF = Specific Levels of Functioning scale; UPSA = University of California San Diego Performance-Based Skills Assessment; SSPA = Social Skills Performance Assessment. All available data were used for each correlation, resulting in different sample sizes for each correlation, ranging from  $n = 184$  to  $n = 241$ .

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

**Table 3**  
Multiple regressions: TLC deficits predicting functional outcomes.

Step		$\beta$	t	p	R <sup>2</sup>	R <sup>2</sup> change
SLOF work (n = 189)						
1.	Gender*	0.133	2.014	0.046	0.293	0.076
	Veteran status	-0.030	-0.408	0.683		
	Smoking status	-0.109	-1.679	0.095		
2.	Age**	-0.312	-4.215	<0.001		0.170
	Cognitive composite	0.109	1.642	0.102		
	BDI total	-0.098	-1.472	0.143		
	PANSS Positive	0.103	1.393	0.165		
	PANSS Negative	0.005	0.062	0.950		
3.	TLC_DS*	-0.205	-2.784	0.006		0.047
	TLC_VU*	-0.182	-2.435	0.016		
SLOF activities (n = 186)						
1.	Gender	0.012	0.191	0.849	0.420	0.079
	Veteran status	-0.050	-0.743	0.459		
	Smoking status	-0.002	-0.033	0.974		
2.	Age**	-0.370	-5.461	<0.001		0.293
	Cognitive composite**	0.240	3.965	<0.001		
	BDI total	-0.050	-0.821	0.413		
	PANSS Positive	0.154	2.269	0.024		
	PANSS Negative	-0.004	-0.061	0.952		
3.	TLC_DS	-0.093	-1.387	0.167		0.048
	TLC_VU**	-0.253	-3.709	<0.001		
SLOF interpersonal (n = 189)						
1.	Gender	0.107	1.558	0.121	0.234	0.020
	Veteran status	0.037	0.492	0.624		
	Smoking status	0.012	0.178	0.859		
2.	Age	-0.056	-0.724	0.470		0.166
	Cognitive composite	-0.032	-0.466	0.642		
	BDI total*	-0.138	-2.003	0.047		
	PANSS Positive	0.143	1.849	0.066		
	PANSS Negative*	-0.244	-3.062	0.003		
3.	TLC_DS	-0.082	-1.066	0.288		0.048
	TLC_VU*	-0.255	-3.281	0.001		
UPSA communication (n = 224)						
1.	Gender	-0.012	-0.214	0.831	0.368	0.045
	Veteran status	-0.084	-1.333	0.184		
	Smoking status	-0.013	-0.236	0.813		
2.	Age**	-0.262	-4.081	<0.001		0.313
	Cognitive composite**	0.456	7.940	<0.001		
	BDI total	-0.008	-0.137	0.891		
	PANSS Positive	-0.067	-1.037	0.301		
	PANSS Negative	-0.026	-0.400	0.689		
3.	TLC_DS	-0.117	-1.842	0.067		0.010
	TLC_VU	-0.021	-0.327	0.744		
SSPA mean (n = 222)						
1.	Gender	0.086	1.485	0.139	0.358	0.047
	Veteran status	-0.029	-0.451	0.652		
	Smoking status*	-0.185	-3.259	0.001		
2.	Age**	-0.269	-4.150	<0.001		0.277
	Cognitive composite**	0.268	4.610	<0.001		
	BDI total	0.030	0.512	0.609		
	PANSS Positive	-0.011	-0.170	0.865		
	PANSS Negative*	-0.194	-2.898	0.004		
3.	TLC_DS	0.020	0.309	0.758		0.034
	TLC_VU*	-0.212	-3.243	0.001		

Notes. SLOF = Specific Levels of Functioning scale; BDI = Beck Depression Inventory; PANSS = Positive and Negative Syndrome Scale; TLC\_VU = Thought, Language, and Communication Scale, Verbal Underproductivity; TLC\_DS = Thought, Language, and Communication Scale, Disconnected Speech; UPSA = University of California San Diego Performance-Based Skills Assessment; SSPA = Social Skills Performance Assessment.

\*  $p < 0.05$ .

\*\*  $p < 0.001$ .

functional decline among older adults with schizophrenia. These individuals may benefit from skills training with a focus on decreasing disconnected speech, which could improve performance on work tasks, and increasing verbal output in unstructured social situations, which could have downstream effects across functional domains.

The present study utilized a large sample of an understudied population; namely, community-dwelling middle-aged and older adults

with schizophrenia, including older-old individuals in their 70s and 80s. In addition the present study utilized rigorous clinical assessment procedures, and ratings of community functioning were made by independent observers who were not involved in other study assessments. While these are considerable strengths, there are also limitations of note. This is a post-hoc analysis on data which were not collected to test the hypotheses put forth here; thus these findings need to be confirmed in a prospective hypothesis testing study. Data analyses included multiple comparisons, increasing risk for Type I error. In addition, participant scores on the TLC measure were generally low, indicating generally low levels of thought disorder and alolia in the sample. At the same time, participant scores on the community functioning measure were generally high, indicating a relatively high-functioning sample. This restriction of range may have led to an underestimate of the association between TLC deficits and functional outcomes. Furthermore, the sample was predominantly male and restricted to individuals with active illness; thus, the findings may not apply to largely female groups or to asymptomatic individuals with schizophrenia. In addition, we were unable to account for the effects of psychotropic medications on TLC deficits or functional outcomes. We also did not have a measure of family or social support so could not examine the impact of these variables on outcomes. Finally, given that this is a cross-sectional study, causal conclusions regarding the associations among the variables cannot be made. Future studies should examine the impact of TLC deficits on functioning in a sample with greater variance in TLC deficits, and could utilize a longitudinal research design.

In conclusion, in a sample of community-dwelling middle-aged and older adults with schizophrenia, TLC deficits were associated with poorer community functioning across domains, even when controlling for demographic factors, symptom severity, and cognitive impairment. Disconnected speech was associated with deficits in occupational functioning, while verbal underproductivity was associated with poorer performance in unstructured social interactions, and poorer community functioning across occupational, interpersonal, and everyday activity domains. Targeted training to improve these deficits among older adults with schizophrenia could improve social skills performance and have downstream effects on community functioning, improving functional outcomes for a vulnerable and complex group.

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#### Contributors

Dr. Harvey obtained the research funding and designed the overall study with Dr. Bowie. Dr. Bowie supervised data collection. Dr. Muralidharan conceptualized the research question, conducted data analyses, and oversaw the writing of the manuscript. All four authors contributed to the writing of this manuscript. All authors contributed to and have approved the final manuscript.

#### Conflict of interest

Dr. Muralidharan and Dr. Finch have no conflicts of interest to report with regard to this work.

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