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Research Note

Language Impairment in Autistic Adolescents and Young Adults

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ABSTRACT

Purpose: Little is known about the specific nature of language abilities of autistic adolescents and young adults with language impairment (LI), limiting our knowledge of developmental trajectories and ability to develop efficacious speech/language supports. An important first step is establishing proof of concept of identification of LI in this population, with considerations for feasibility of assessment. This research note describes such a study in a sample of autistic adolescents and young adults with LI.
Method: Thirteen autistic adolescents and young adults completed an assessment protocol of age-referenced language and nonverbal cognitive assessments. Assessment took place once per year for 3 years; the first two assessments were conducted in person, and the final was conducted online due to the pandemic. All assessments included measures of overall language and morphosyntax; the third added measures of expressive and receptive vocabulary, verbal working memory, and nonverbal intelligence (NVIQ). Analysis included descriptives and comparison of individual performance with epidemiological criteria for LI.
Results: All participants qualified for LI, with overall receptive and expressive language scores persistently in the LI range. Other outcomes were variable. Some participants had nonword repetition and vocabulary abilities within age expectations, and some consistently showed adultlike morphosyntactic performance. NVIQ was variable, with no consistent associations with language outcomes.
Discussion: Our findings support the use of the current protocol, as implemented in person or online, to identify LI in autistic adolescents and young adults. This exploratory work is limited by a small sample and missing data. The findings contribute to our understanding of linguistic strengths and variability in the language skills of autistic young adults with LI.

Although early language acquisition is predictive of later outcomes in autistic individuals (Howlin & Magiati, 2017; Tager-Flusberg, 2016), there is a broad knowledge gap about the language abilities of autistic young adults (Shattuck et al., 2018). Given that over half a million autistic individuals will enter adulthood in the next decade (Roux et al., 2015) and face challenges to living autonomously (Billstedt et al., 2005, 2011), understanding later language is important. In addition to young adults, autism research systematically excludes individuals with language impairment (LI) and intellectual disability (ID; Durkin et al., 2015; Russell et al., 2019). Omitting the full autistic population from language research limits our understanding of phenotypic variability (Durkin et al., 2015), which is critical for development of diagnostic assessments and criteria that generalize to all autistic individuals. This research note describes a preliminary study to (a) establish proof of concept for a language assessment protocol to identify LI in autistic young adults varying in nonverbal intelligence (NVIQ) and (b) establish feasibility of repeated assessment across in-person and online modalities.

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Language in Autism

Diagnostic Criteria Considerations for LI in Autism Spectrum Disorder

Under current diagnostic criteria for autism spectrum disorder (ASD; American Psychiatric Association; APA, 2013), although all autistic individuals show difficulties with language use for social communication, not all have structural impairments, or LI. ASD can co-occur with LI only if cognitive difficulties do not better explain language difficulties (APA, 2013). However, criteria for differential diagnosis are unclear, with no minimum NVIQ required for LI (APA, 2013). Prior work uses diagnostic criteria that confound LI with ID, as autistic children with LI perform nearly 1 *SD* lower on verbal intelligence (VIQ) than NVIQ tests (Grondhuis et al., 2018). For example, Bennett et al. (2014) used full-scale IQ < 70, which includes VIQ, to differentiate LI and ID in autistic individuals.

Studies also use inconsistent criteria for identifying LI. For instance, Roberts et al. (2004) required scores of more than 2 *SD*s below the mean on the Peabody Picture Vocabulary Test, whereas Huang & Finestack (2020) used a cutoff scaled score of 95 on the Structured Photographic Expressive Language Test–Third Edition (Dawson et al., 2005). Two epidemiological studies of LI in nonautistic children offer alternative systems. In a study of kindergartners with LI and NVIQ > 87, Tomblin et al. (1996) found cutoffs of −1.25 *SD* on two or more standardized measures of expressive and receptive vocabulary, grammar, or narration to be clinically relevant. In a study of children with LI and NVIQ ≥ 70, Norbury et al. (2016) used a cutoff of −1.5 *SD* on two of five language composites of expressive overall language, receptive overall language, grammar, vocabulary, and narration; this yielded a similar prevalence estimate (7.58%) as in Tomblin et al. (1996). Altogether, it is important to consider how to characterize LI in ASD with regard to diagnostic criteria that change over time.

LI in ASD

Autistic individuals vary widely in their language abilities (Kwok et al., 2015; Magiati et al., 2014), with some having LI in early but not later childhood (e.g., ages 2–4 years; Bennett et al., 2014) and many showing challenges with higher order language (e.g., complex syntax; Kjelgaard & Tager-Flusberg, 2001; Loucas et al., 2008). Our focus here is on the dimensions of language that differentiate individuals with and without LI.

Receptive and expressive overall language. Autistic children with LI (ages 5–14 years) perform lower than their autistic peers without LI on expressive and receptive measures (Eigsti et al., 2007; Huang & Finestack, 2020; Kjelgaard & Tager-Flusberg, 2001; McGregor et al., 2012; Roberts et al., 2004; Tager-Flusberg, 2006). However, autistic individuals also vary in their linguistic profiles. Some autistic individuals ages 2–14 years have stronger expressive than receptive language (Ellis Weismer et al., 2010; Kjelgaard & Tager-Flusberg, 2001; McGregor et al., 2012). Others, such as preschool (2–5 years old) minimally verbal autistic children, show the reverse pattern (Haebig & Sterling, 2017; Woynaroski et al., 2015). Still, other autistic children and young adults (ages 4–21 years) show no differences in receptive–expressive language (e.g., Condouris et al., 2003; Girolamo et al., 2020; Lindgren et al., 2009; Loucas et al., 2008). Comprehensive assessment may help contextualize such discrepancies.

Receptive and expressive vocabulary. Vocabulary ability can identify LI in autistic individuals (Roberts et al., 2004). As with overall language, some autistic individuals (ages 4–21 years) have stronger expressive than receptive vocabulary (Haebig & Sterling, 2017; Kover et al., 2013; Plesa Skwerer et al., 2016; Wittke et al., 2017; Woynaroski et al., 2015), whereas others (ages 4–21 years) have stronger receptive than expressive vocabulary (Haebig & Sterling, 2017) or no differences (Barton-Hulsey & Sterling, 2020; Kjelgaard & Tager-Flusberg, 2001; Loucas et al., 2008; Modyanova et al., 2017; Sterling, 2018; Wittke et al., 2017). Expressive and receptive vocabularies are tightly correlated with performance across diverse tasks, including grammaticality judgment, language sampling, nonword repetition, and tense marking in autistic children and adolescents with and without LI, as well as with and without ID (ages 4–17 years; Condouris et al., 2003; Eigsti & Bennetto, 2009; Eigsti et al., 2007; Roberts et al., 2004; Tager-Flusberg, 2006). Expressive vocabulary and receptive vocabulary intercorrelate in some studies of children and adolescents (ages 2–15 years; Haebig & Sterling, 2017; Woynaroski et al., 2015).

Morphosyntax. Morphosyntax is useful in differentiating autistic individuals with and without LI. In the work of Roberts et al. (2004), autistic individuals with LI ages 5–15 years omitted tense markers for third-person singular present and past tenses more often than autistic peers without LI. Other areas of difficulty for some autistic individuals with LI (ages 10–21 years) have included auxiliary BE, copula BE, auxiliary DO, and past tense (Barton-Hulsey & Sterling, 2020; Girolamo et al., 2020; Modyanova et al., 2017; Roberts et al., 2004; Sterling, 2018). Conversely, areas of strength for some autistic individuals (ages 7–21 years) with and without LI are third-person singular, auxiliary BE, and copula BE (Barton-Hulsey & Sterling, 2020; Girolamo et al., 2020; Sterling, 2018; Tager-Flusberg, 2006). As for receptive morphosyntax, autistic individuals ages 10–17 years have shown less sensitivity than nonautistic age peers on grammaticality judgment tasks with morphosyntactic errors that are hallmarks of LI (e.g., third-person singular present tense markers)—but only in long sentences (Eigsti & Bennetto, 2009). In more recent work, autistic individuals with and without LI (ages 9–21 years) performed below age expectations on grammaticality judgment with omission of tense, agreement errors, and dropped aspect marking of *-ing* (Barton-Hulsey & Sterling, 2020; Girolamo et al., 2020).

Speech sound disorder (SSD), ASD characteristics, and IQ. Additional considerations are relevant to framing LI in ASD. The first involves ruling out limitations in articulation and speech, which can impact language assessment performance (Norbury et al., 2016; Rice & Wexler, 2001; Tomblin et al., 1996). Some studies use nonword repetition tasks (e.g., the Syllable Repetition Task; Shriberg & Lohmeier, 2008) as a speech measure; however, these tasks also require verbal working memory and differentiate autistic individuals with and without LI (Lindgren et al., 2009; McGregor et al., 2012; Riches et al., 2011; Tager-Flusberg, 2015). A second consideration involves autistic characteristics, which may or may not impact language outcomes in autistic individuals with and without LI (no effect for individuals ages 4–15 years; Haebig & Sterling, 2017; Kover et al., 2013; Lindgren et al., 2009; Loucas et al., 2008; in contrast, see the works of Bennett et al., 2008; Ellis Weismer et al., 2010; Paul et al., 2008, for individuals ages 1;4–17 [years; months]). One possibility is that the structure of standardized assessments is not accessible to some autistic individuals. A last consideration involves tracking which kind of IQ is used to identify LI. For instance, VIQ correlated with grammaticality judgment task performance in some studies of autistic individuals ages 5–16 years (Eigsti & Bennetto, 2009; Roberts et al., 2004), suggesting VIQ and grammatical performance tap into the same linguistic abilities. In contrast, NVIQ did not predict the use of finiteness markers or GJ task performance in studies of autistic children ages 5–16 years with and without LI and ID (Barton-Hulsey & Sterling, 2020; Roberts et al., 2004).

This Study

To better understand how to identify LI in autistic young adults, a first step is establishing proof of concept of a protocol for identification of LI and feasibility of assessment for such individuals. Research questions were the following.

1. Do participants change over time, and across modalities, in their performance on a measure of overall expressive and receptive language and a measure of morphosyntactic abilities?
2. Are some language domains (i.e., nonword repetition, receptive and expressive overall language, vocabulary, and morphosyntax) more likely to categorize individuals as having LI?

Because participants are beyond the age range when language skills dynamically change, we did not expect assessment performance to change over time. Given findings on the validity of online versus in-person assessment, assessment performance was expected to be similar across modalities. On the basis of this preliminary findings (Girolamo et al. 2020), we expected that morphosyntax would differentiate participants more than measures of other linguistic domains.

Method

Participants

Eligibility criteria were (a) formal diagnosis of ASD, determined by educational placement, which required a formal diagnosis of ASD for enrollment and confirmed by caregiver report; (b) BIPOC; (c) age 14 years and up; (d) monolingual speaker of General American English, to avoid confounding LI with language background and determined by self- and caregiver report and post hoc inspection of data; and (e) educated in a 100% self-contained setting at the time of recruitment. This final point facilitated targeted recruitment of participants with a specific diagnosis and controlled for possible confounding effects due to differing educational experience. Participants who did not have normal hearing or normal/corrected-to-normal vision were excluded, as were participants who did not use oral language, per self- and caregiver report, as we used verbal tasks.

All participants were BIPOC: 10 of 13 (77%) were Black/African American, one of 11 (9%) was multiracial (two unknown), and five of 11 (45%) were Hispanic or Latinx (two unknown). “Unknown” means some participants did not know how to respond to U.S. Census categories, which they felt did not capture their identities. One participant was female. Maternal level of education and NVIQ varied (M = 79.6, SD = 15.3; range: 52–104), with two participants qualifying for ID; see Table 1. Levels of autism characteristics, as indicated by SRS-2 (Constantino & Gruber, 2012) total t score, were “moderate” (M = 67, SD = 8; range: 45–84). There was one participant who did not meet the cutoff of 60 for clinically significant autism characteristics; this participant did have a prior formal diagnosis of autism and was judged by the examiner to meet criteria. This discrepancy may have been due to the pathologizing nature of the SRS-2. Anecdotally, some caregivers expressed surprise about the framing of items on the SRS-2 (e.g., being perceived as odd or weird) and responded holistically about their child, rather than treating them as deficient.

Procedure

This study received institutional review board approval. Recruitment took place yearly from 2018 to 2020. At T1,

Table 1. Participant demographics, nonverbal intelligence (NVIQ), and autism characteristics.

ID	Maternal level of Ed.	Years of Ed.	NVIQ	SRS-2 total *t* score	Age		
					T1	T2	T3
1	N/A	—	—	—	21.1	—	—
2	HS	15.92	93	63	16.6	18.45	18.9
3	HS	18.79	104	45	20.1	21.91	22.5
4	MA	19.5	100	73	19.4	21.29	21.9
5	BA	12.64	75	64	15.3	17.08	17.6
6	HS	14.28	73	84	15.9	17.73	18.3
7	AS	14.49	52	62	17.2	18.93	19.5
8	BA	16.07	93	63	18.9	20.69	21.3
9	MA	17.82	75	62	21.3	—	23.6
10	N/A		—	—	17.3	—	—
11	HS	11.41	72	77	—	—	17.4
12	HS	14.25	75	66	—	—	20.3
13	HS	19.38	63	67	—	—	21.6
M		15.87	79.55	67.00	18.31	19.44	20.3
SD		2.62	15.29	7.99	2.04	1.72	1.98
max.		19.5	104	84	21.3	21.91	23.6

Note. Some participants were not seen at a given time point, as indicated by dashes. Social Responsiveness Scale -Second Edition (SRS-2) *t* score *M* = 50; *SD* = 10. Total *t* score < 59 = low to no autism characteristics, 60–65 = mild to moderate deficits in social interaction, 66–75 = moderate deficits in social interaction, and > 76 = “severe” deficits and strongly associated with autism spectrum disorder (ASD). Ed. = education; NVIQ = Raven’s standard score; T1 = Time 1; T2 = Time 2; T3 = Time 3; N/A = not available; HS = high school; MA = master’s; BA = bachelor’s; AS = associate’s degree or some college; max. = maximum.

the first author recruited participants by (a) partnering with a community organization to distribute and collect consent-to-contact forms to potential participants, (b) providing personalized consultation about the study to participants and their parents, and (c) obtaining informed consent (Girolamo et al., 2020). At T2 and T3, the first author rerecruited previous participants, participants who had previously returned a consent-to-contact form, and participants referred to the study. Participants and their caregivers received compensation upon completing study activities. In this preliminary study, determination of sample size did not include power analysis. The sample size at T1 was 10, 7 at T2, and 11 at T3. The plan was to stop collecting data after reaching 20 participants or after no new recruitment occurred after 2 months. Attrition occurred for unknown reasons for four participants from T1.

Data collection took place yearly from 2018 to 2020. At T1 and T2, the author administered behavioral assessments in person in community settings. At T3, data collection took place online via Zoom videoconference due to COVID-19. Participants completed direct behavioral assessments, and their caregivers completed questionnaires. On average, the protocol required one 2-hr session. A coder blind to the study checked accuracy of the data. Point-by-point interrater reliability before resolving disagreements via discussion and consensus was 93.9%–100%.

Measures

Table 2 shows the materials used at the three time points, which were all valid for remote administration following copyright law. To administer assessments via

Table 2. Assessment area and assessments at Time 1 (T1), T2, and T3.

Assessment area	Assessment	T1	T2	T3
Expressive language	Clinical Evaluation of Language Fundamentals—Third Edition	X	X	
	Clinical Evaluation of Language Fundamentals—Fifth Edition			X
Receptive language	Clinical Evaluation of Language Fundamentals—Third Edition	X	X	
	Clinical Evaluation of Language Fundamentals—Fifth Edition			X
Expressive vocabulary	Expressive Vocabulary Test—Third Edition			X
Receptive vocabulary	Peabody Picture Vocabulary Test—Fifth Edition			X
Nonword repetition	Syllable Repetition Task			X
Speech sound ability	Test of Early Grammatical Impairment	X	X	X
Grammatical ability	Test of Early Grammatical Impairment	X	X	X
Nonverbal intelligence	Columbia Mental Maturity Scale (Burgemeister et al., 1972)	X	X	
	Raven’s Progressive Matrices—Second Edition (Raven, 2018)			X
Autism characteristics	Social Responsiveness Scale—Second Edition			X
Working memory	Wechsler Intelligence Scales for Children Digit Span—Third Edition (Wechsler, 1991)	X	X	

videoconference, the first author followed guidance on online assessment from Pearson (n.d.) and utilized digital assessments. Prior work has established the validity of online assessment for articulation and speech (e.g., Waite et al., 2012), autism traits (e.g., Smith et al., 2017), IQ (e.g., Hodge et al., 2019), overall language (e.g., Sutherland et al., 2019), and vocabulary (Eriks-Brophy et al., 2008).

To assess change over time and across modalities, the primary outcomes were CELF composite and subscale standard scores, as well as Test of Early Grammatical Impairment (TEGI; Rice & Wexler, 2001)–elicited grammar composite and subtest scores (e.g., third-person singular, past tense, BE, and DO probe scores, as well as A' scores for dropped marker, agreement, and dropped "-ing" grammaticality judgment tasks). TEGI probe scores are on a scale of 0%–100%, and A' scores have a maximum of 1.00 or perfect discrimination of grammatical and ungrammatical utterances correcting for bias (Grier, 1971; Rice & Wexler, 2001). To assess whether some language domains are more likely to categorize individuals as having LI, primary outcomes also included Peabody Picture Vocabulary Test–Fifth Edition (PPVT-5; Dunn, 2019) and Expressive Vocabulary Test–Third Edition (EVT-3) standard scores, as well as the Syllable Repetition Task (SRT; Shriberg & Lohmeier, 2008) percent consonants correct. Secondary outcomes were the SRT encoding score (auditory-perceptual representation), SRT transcoding score (speech motor planning abilities), and SRT memory score (verbal working memory).

Analyses

Given the preliminary nature of the study and sample size, analysis included descriptives and nonparametric measures, as no variables were normally distributed. All responses were included. Scoring followed manual instructions. We adopted Tomblin et al.'s (1996) multivariate cutoff for LI of −1.25 *SD* on two or more measures (SRT percent consonants correct, CELF-5 core language, PPVT-5, EVT-3, and TEGI-elicited grammar composite), which is benchmarked to clinical judgments (Records & Tomblin, 1994). To address change over time and across modalities, analysis included descriptives and Friedman (1937) tests. CELF scores were transformed into *z* scores. TEGI scores were analyzed as total accuracy and were not transformed into *z* scores; scores were effectively at ceiling in the norming sample (i.e., children ages 6;6–6;11 with no speech or language delays; Rice & Wexler, 2001), and as such, *z* scores would obscure performance in the current sample. To address whether profiles of abilities across language domains categorized individuals as having LI, analysis included descriptives. Effect size was measured using Spearman rank-order correlations and defined as *Very strong* (.8–.99), *Strong* (.6–.79), and *Moderate* (.4–.59). Analyses used a significance level of $p < .05$. Because the study was exploratory, results were not corrected for multiple comparisons; the goal was to look for patterns across language domains to draw tentative directions for future research.

Results

We evaluated patterns of language strengths and weaknesses in autistic young adults who did not show limitations in articulation and speech that would impact language assessment performance; see Table 3. Effect sizes are presented in Tables 4 to 6.

Participant Change Over Time in Relative Performance Levels

Consistent with our hypothesis, performance on the CELF and TEGI was stable over time and across modalities. At a group level (n = 7), Friedman (1937)

Table 3. Score summary for SRT, CELF-5, PPVT-5, EVT-3, and TEGI (*N* = 11).

Measure	*M*	*SD*	Max
SRT			
Percentage consonants correct	74.36	14.33	98.00
Encoding	68.42	16.24	100
Memory	80.48	25.04	100
Transcoding	97.98	3.75	100
CELF-5			
Total	53.00	13.56	80
Receptive	59.27	11.63	86
Expressive	56.91	15.15	87
Difference	.91	9.28	24
PPVT-5	68.45	15.12	99
EVT-3	71.82	14.30	109
Vocabulary difference	3.36	7.27	16
TEGI third-person singular			
Phonological probe	100	0	100
3s	72.45	31.87	100
Past tense	83.9	27.94	100
Auxiliary and copula BE	81.09	20.11	100
Auxiliary DO	63.7	42.70	100
Elicited grammar composite	74.1	21.7	100
GJ Dropped Marker A'	.69	.26	1.00
GJ Dropped *-ing* A'	.73	.25	1.00
GJ Agreement A'	.71	.34	1.00

Note. Syllable Repetition Task (SRT) administered at T3 only. CELF-5 = Clinical Evaluation of Language Fundamentals–Fifth Edition; PPVT-5 = Peabody Picture Vocabulary Test–Fifth Edition; EVT-3 = Expressive Vocabulary Test–Third Edition; TEGI = Test of Early Grammatical Impairment; Receptive = CELF-5 receptive language index score; Expressive = CELF-5 expressive language index score; CELF-5 difference score = receptive language standard score - expressive language standard score; Vocabulary difference = EVT-3 standard score - PPVT-5 standard score; TEGI elicited grammar composite = average of third-person singular, past tense, BE and DO scores; GJ = grammaticality judgment.

Table 4. CELF standard median scores and TEGI median scores of participants as a group and Friedman tests.

				χ^2		
Subtest	**T1**	**T2**	**T3**	**Value**	***df***	***p***
CELF Total	50.00	50.00	54.00	2.70	2	.260
CELF Receptive	50.00	50.00	63.00	3.60	2	.165
CELF Expressive	50.00	50.00	63.00	1.37	2	.504
CELF Word Classes	3.00	3.00	3.00	0.36	2	.834
CELF Semantic Relationships	3.00	3.00	4.00	0.70	2	.705
CELF Sentence Assembly	3.00	3.00	5.00	2.00	2	.368
CELF Recall Sentences	3.00	3.00	2.00	0.61	2	.738
CELF Formulated Sentences	3.00	3.00	1.00	3.92	2	.141
TEGI 3s	95.00	100.00	90.00	2.71	2	.257
TEGI Past	100.00	94.00	100.00	2.47	2	.291
TEGI BE	100.00	100.00	95.50	6.00	2	.050
TEGI DO	100.00	100.00	100.00	0.429	2	.807
TEGI GJ Dropped Marker	80.00	90.00	82.50	1.13	2	.568
TEGI GJ Agreement	81.50	100.00	90.00	2.00	2	.368
TEGI GJ Dropped *-ing*	89.00	100.00	100.00	2.00	2	.368

Note. Friedman tests compared Time 1 (T1), T2, and T3 scores with test for significant differences between the three time points (i.e., to test whether the distribution of scores at each time point were the same). T1 and T2 used CELF-3, which has a minimum composite score of 50 and a minimum subtest score of 3, and in-person assessment. T3 used CELF-5, which has a minimum composite score of 40 and a minimum subtest score of 1, and online assessment. CELF = Clinical Evaluation of Language Fundamentals; TEGI = Test of Early Grammatical Impairment; TEGI-elicited grammar = average of 3s, past tense, BE, and DO probes.

tests revealed that the scores for the broadest language assessment, the CELF, and the TEGI did not significantly differ across time points; see Table 4. While TEGI median scores were nearly at ceiling (100%), CELF median standard scores were close to floor (CELF-3: 3 on subtest and 50 on composite scores; CELF-5: 1 on subtest and 40 on composite scores). Only one participant had a score at floor on the total language score at T3.

Individual participant LI status was highly consistent. The same four participants qualified for LI on the CELF only at all time points; the same two participants qualified for LI on both the CELF and LI on the TEGI at all time points. LI status only changed for one participant across time points; at T2, this participant had a TEGI-elicited grammar score of 88% (cutoff for LI = 86.5%) with scores of 78% at T1 and 85% at T3. Participants' performance on subtests was also consistent over time; see Figure 1. All participants performed at least −1.25 *SD* on CELF Semantic Relationships, Sentence Assembly, and Sentence Recall. One participant had

Table 5. Correlations between language assessment outcomes.

Score	**EL**	**PPVT-5**	**EVT-3**	**PCC**	**MEM**	**TRANS**	**3s**	**Past**	**BE**	**DO**	**DM**	**AGR**	**-ING**
RL	.75*	.68*	.83**	.71*	.19	.44	.81**	.57	.34	.38	.64*	.67*	.75**
EL		.55	.66*	.94**	.58	.51	.82**	.47	.46	.32	.65*	.58	.53
PPVT-5			.93**	.51	.13	.31	.69*	.14	.63*	.37	.85**	.84**	.90**
EVT-3				.59	.15	.39	.73*	.23	.48	.36	.76**	.73*	.87**
PCC					.49	.25	.82**	.48	.48	.10	.64*	.56	.43
MEM						.25	.45	−.05	−.01	−.10	.20	.06	.06
TRANS							.17	−.05	.14	.80**	.37	.37	.50
3s								.63	.61*	.16	.76**	.74**	.68*
Past									.21	.38	.32	.49	.31
BE										.27	.73*	.76**	.57
DO											.39	.54	.56
DM												.95**	.90**
AGR													.92**

Note. EL = CELF-5 expressive language; PPVT-5 = Peabody Picture Vocabulary Test–Fifth Edition; EVT-3 = Expressive Vocabulary Test–Third Edition; PCC = Syllable Repetition Task (SRT) percentage consonants correct (i.e., competence score); MEM = SRT memory score; TRANS = SRT transcoding score; 3s = TEGI third-person present-tense probe; Past = TEGI third-person past-tense probe; BE = TEGI be probe; DO = TEGI Do probe; DM = TEGI grammaticality judgment (GJ) dropped marker; AGR = TEGI GJ agreement; -ING = TEGI GJ dropped -ing; RL = CELF-5 receptive language.

*$p < .05$. **$p < .001$.

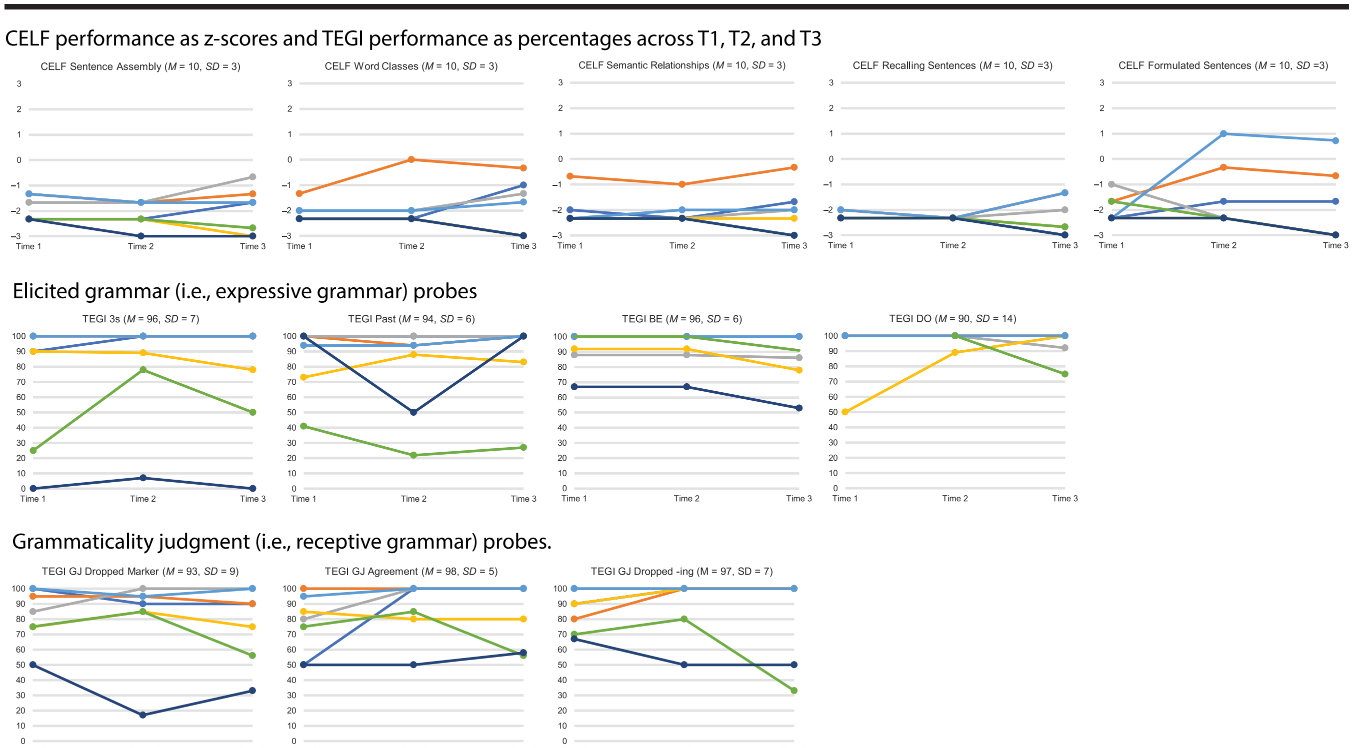
Table 6. Correlations between language outcomes and child variables.

Language	Age	Years of education	Maternal level of education	SRS-2 total *t* score	Raven's 2
SRT PCC	.01	.17	–.47	.11	.23
SRT Memory	–.22	–.22	.06	.03	.03
SRT Transcoding	–.44	–.24	.08	–.06	.31
CELF-5 Receptive	–.09	.05	–.39	–.01	.62*
CELF-5 Expressive	–.12	.01	–.33	.05	.33
CELF-5 Difference Score	.21	.20	–.02	.27	–.01
PPVT-5	.00	.13	–.09	–.15	.37
EVT-3	–.18	–.10	–.28	.01	.37
Vocabulary Difference Score	–.05	.01	–.25	.19	.35
TEGI 3s	.17	.22	–.17	–.08	.54
TEGI Past	.38	.48	–.18	–.02	.73*
TEGI BE	.36	.43	.03	–.44	.23
TEGI DO	–.19	–.02	.13	–.25	.52
TEGI Elicited Grammar Composite	.06	.13	.01	–.30	.55
TEGI Dropped Marker	.11	.37	.10	.03	.38
TEGI Agreement	.21	.46	.09	–.16	.56
TEGI Dropped *-ing*	–.04	.17	.10	–.04	.53

Note. SRT = Syllable Repetition Task; CELF-5 = Clinical Evaluation of Language Fundamentals–Fifth Edition; PPVT-5 = Peabody Picture Vocabulary Test–Fifth Edition; EVT-3 = Expressive Vocabulary Test–Third Edition; TEGI = Test of Early Grammatical Impairment.
*$p < .05$.

typical performance on CELF Word Classes at Time 2, and one participant had typical performance on CELF Formulated Sentences at Times 2 and 3, although the versions of the CELF differed. Participants showed more variability on TEGI subtests, with some performing near 100%. In the absence of significant differences across time points, subsequent analyses utilized T3 scores.

Figure 1. CELF performance as *z* scores and TEGI performance as percentages at Time 1 (T1), T2, and T3. CELF = Clinical Evaluation of Language Fundamentals; TEGI = Test of Early Grammatical Impairment.



Individual Differences in Dimensions of Language Relevant to Identifying LI

Nonword Repetition

Ten of 11 participants qualified for LI on the SRT percent consonants correct (i.e., ≤ 89.45%; Shriberg & Lohmeier, 2008; Shriberg & Mabie, 2017); see Figure 2. SRT encoding and memory scores were also well below 100%; see Table 3. Because percent consonants correct scores and encoding scores showed high multicollinearity, $r_s(11) = .91$, $p < .001$, subsequent comparison of the SRT to other language outcomes used only percent consonants correct scores. Percent consonants correct scores had strong to very strong, positive relationships with other language measures (expressive and receptive overall language scores, as well as with TEGI 3s and GJ dropped marker scores; see 0 5) but did not correlate with NVIQ or demographic variables; see Table 6. Transcoding scores had only a strong, positive relationship with TEGI DO scores, $r_s(11) = .80$, $p < .001$, and memory scores had no significant effects. Thus, verbal working memory, as assessed by the percent consonants correct score, may be informative for identifying LI in autistic young adults.

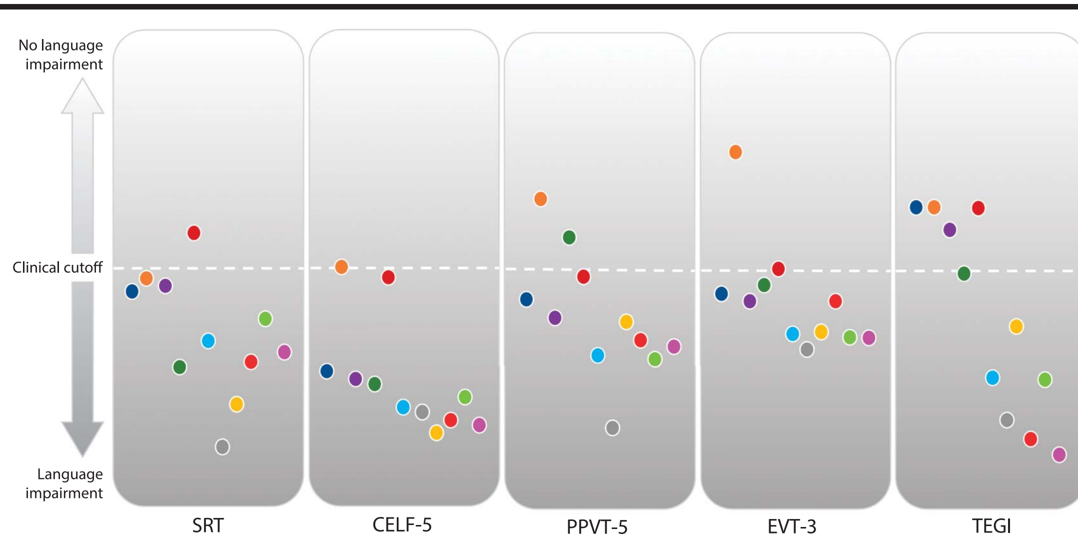
Receptive and Expressive Language

Ten of 11 participants qualified for LI on the CELF-5 total language score (i.e., ≤ 81.25); see Figure 2. Group mean receptive language and expressive scores were near the floor, with no significant receptive–expressive differences; see Table 3. Two individual participants had stronger expressive than receptive language (difference scores = 9 and 24; Wiig et al., 2013). Only receptive language showed a strong, positive correlation with NVIQ (see Table 6). Receptive and expressive language scores had strong, positive relationships with one another, consistent with test norming data (Wiig et al., 2013), as well as strong to very strong positive relationships with expressive vocabulary, TEGI 3s, TEGI GJ dropped marker, and SRT percent consonants correct scores (see Table 5). Receptive language also had strong to very strong positive relationships with receptive vocabulary and the other TEGI GJ scores (i.e., agreement and dropped *-ing*). In all, receptive language may be useful in characterizing LI in autistic adolescents and young adults.

Expressive and Receptive Vocabulary

Nine of 11 participants qualified for LI on the PPVT-5, and 10 of 11 qualified for LI on the EVT-3 (i.e., ≤ 81.25), but one participant performed in the borderline LI range on both measures; see Figure 2. Group mean receptive vocabulary and expressive vocabulary scores were about −2 *SD* (receptive: $M = 68.45$, $SD = 15.12$; expressive: $M = 71.82$, $SD = 14.30$); see Table 3. Three participants had stronger expressive than receptive vocabulary scores (difference scores = 9, 16, and 11; William, 2019), one of whom also had stronger expressive than receptive overall language scores. One participant had stronger receptive than expressive vocabulary scores (difference score = −11; Williams, 2019). Receptive and expressive vocabulary scores related to other language outcomes but not demographic variables or NVIQ (see Table 6). Receptive and expressive vocabulary had strong to very strong, positive relationships with one another, the TEGI 3s, TEGI GJs (dropped *-ing*, dropped marker, and agreement), and CELF-5 receptive language scores; see Table 4. Expressive vocabulary also had strong, positive relationships with CELF-5 expressive language scores. Altogether, these data support the practicality of vocabulary measures for identifying LI in autistic young adults.

Figure 2. Time 3 (T3) diagnostic outcomes on the SRT, Clinical Evaluation of Language Fundamentals–Fifth Edition (CELF-5), Peabody Picture Vocabulary Test–Fifth Edition (PPVT-5), Expressive Vocabulary Test–Third Edition (EVT-3), and Test of Early Grammatical Impairment (TEGI).



Receptive and Expressive Morphosyntax

TEGI group mean subtest scores were below adultlike performance, or 100%; see Table 3. However, there were two groups of participants on the TEGI, with seven of 11 not qualifying on the elicited grammar composite (i.e., 86.5%; see Figure 2). Participants who did not qualify for LI on the TEGI performed at adultlike levels in their elicited production of finiteness markers and did not show receptive–expressive morphosyntactic differences (M_{3s} = 100; M_{past} = 100; M_{BE} = 96.5; M_{DO} = 98); see Figure 3. This group showed similarly high GJ performance, with A' scores near 1.00. Of the four participants who did not qualify for LI on the TEGI, one also did not qualify for LI on the PPVT-5 or EVT-3, and one did not qualify for LI on the SRT and scored in the borderline range on the CELF-5, PPVT-5, and EVT-3. Furthermore, one had a borderline elicited grammar composite score; this same participant did not qualify for LI on the PPVT-5. In contrast, participants who qualified for LI on the TEGI showed more variability in their use of finiteness markers (M_{3s} = 56.7; M_{past} = 73.2; M_{BE} = 75.5; M_{DO} = 40.8) and performed near chance, or the likelihood of correctly judging sentences in a forced-choice task, on GJs (dropped marker: .53 vs. .95; dropped *-ing*: .55 vs. 1.00; agreement: .58 vs. 1.00).

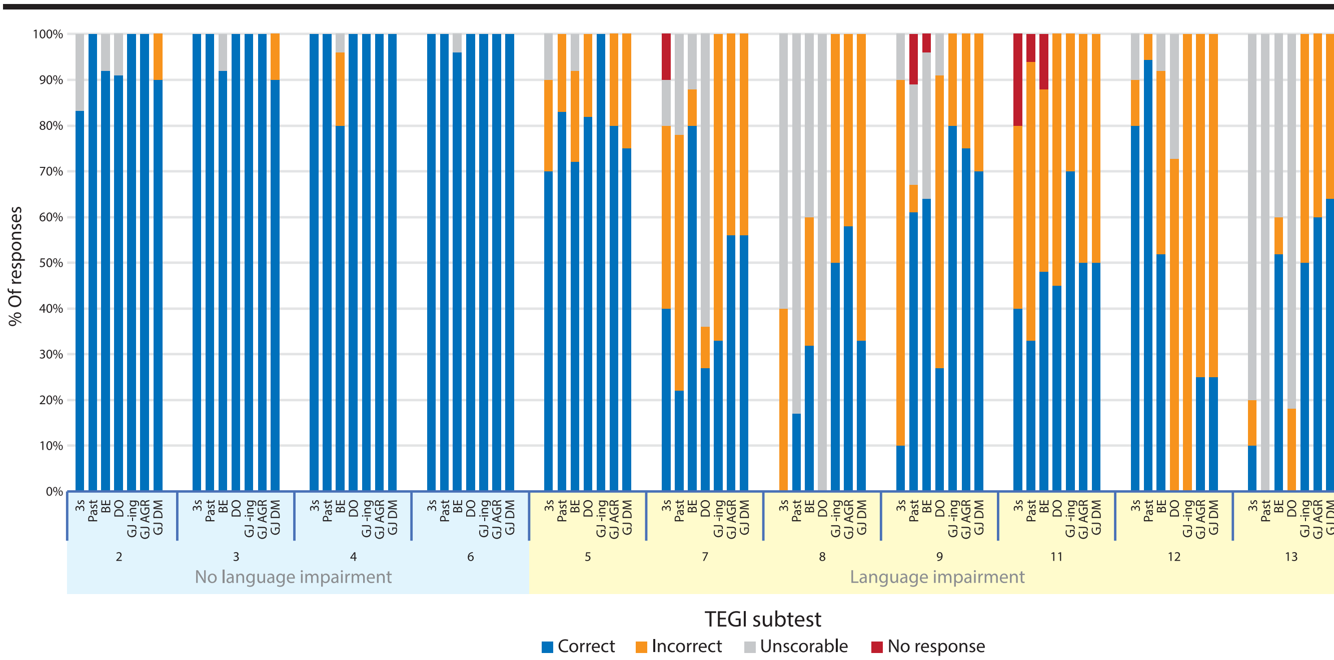
While TEGI subtest scores rated to one another and to other language measures (see Table 5), they were independent of demographic variables and mostly independent of NVIQ (see Table 6). The 3s probe and GJ scores had strong to very strong, positive relationships with all other TEGI subtests and language scores *except* for SRT memory and transcoding scores, TEGI past tense, DO, and select GJ scores. Of the TEGI GJs, only the GJ dropped *-ing* score did not significantly correlate with TEGI BE scores, and only the GJ dropped marker score had a strong, positive relationship with SRT PCC or with CELF-5 expressive language. In all, use of finiteness markers and GJs as a morphosyntactic comprehension task may be informative for identifying LI and interindividual variation in autistic individuals with LI.

Discussion

Identification of LI in Autistic Young Adults

In administering an assessment protocol, this report established proof of concept of identifying LI and feasibility of repeated assessment across modalities. Participant performance on overall language and morphosyntax remained constant, with nonword repetition, receptive and expressive overall language, receptive and expressive vocabulary, and morphosyntactic outcomes generally −1.25 *SD* at T3. As in prior work, there was no one singular expressive–receptive profiles (e.g., Barton-Hulsey & Sterling, 2020), and morphosyntax was the most sensitive to interindividual variation (e.g., Kjelgaard & Tager-Flusberg, 2001; Riches et al., 2010, 2011; Roberts et al., 2004). This may be because participants were well beyond the age of acquisition of obligatory finiteness marking relative to children with typical language (Rice & Wexler, 2001). Another consideration involves sociocognitive task demands. For instance, the TEGI past-

Figure 3. Proportion of response types on Test of Early Grammatical Impairment (TEGI) subtests per participant by language impairment status.



tense probe features two images requiring the participant to make a mental shift from the first image showing the action in progress to the second image showing the completed action *and* to comment only on the completed action. Similarly, the starting point of the EVT-3 (Williams, 2019) for young adults shows a picture of a truck, with the prompt to provide another word for "big." Participants often provided descriptions of the picture (e.g., "truck") and not synonyms. Consistent with previous findings, inhibiting attention to the highly salient pictured object, and shifting focus to the prompted response, may involve executive processes that can be challenging for autistic individuals (Barton-Hulsey & Sterling, 2020; Kjelgaard & Tager-Flusberg, 2001). Last, in this study, language outcomes were largely independent of NVIQ. This important finding highlights the utility of these language measures for identifying LI in autistic individuals varying in NVIQ (e.g., Barton-Hulsey & Sterling, 2020; Haebig & Sterling, 2017; Plesa Skwerer et al., 2016). Given that autism research has systematically excluded individuals with ID (Russell et al., 2019), further work in this area is urgently needed to understand the relationship of language to NVIQ in this population.

Clinical and Research Implications

One takeaway from this study entails the utility of multivariate assessment in identifying LI in autistic young adults. Our preliminary findings that participants with LI were unlikely to omit finiteness markers might appear to run counter to other work showing the opposite (e.g., Modyanova et al., 2017). However, Modyanova et al. (2017) used verbal IQ, indexed by performance on a vocabulary subtest of an intelligence assessment to identify LI in autistic adolescents; the use of VIQ could conflate LI with cognitive ability (Grondhuis et al., 2018). Such instances require expert clinical judgment. A second takeaway involves the consistency of scores on measures of overall language and morphosyntax over time, which coincided with differences in assessment modality. Although the CELF-3 had a floor of 50 and the CELF-5 a floor of 40, the median score changed by just 4 points (i.e., either score is > -3 *SD*). Testing autistic young adults with LI online or in person may be feasible and yield similar results. In summary, clinicians and researchers need to consider assessment sensitivity in terms of ability to differentiate language ability in autistic individuals with varying profiles.

Limitations and Future Directions

This study has important limitations. Longitudinal data were available for only a subset of participants in a small sample, due to the challenges inherent in research with underserved, low-incidence populations using community-based methods versus convenience sampling (Girolamo et al., in revision). A second limitation is the generalizability of findings, which are preliminary and should not be assumed to be generalizable without further research in larger samples (Russell et al., 2019). A third limitation involves the sensitivity of measures to variability in the low end of the normal curve, such that even though many participants did not show floor effects, they scored well below the mean across measures. Better understanding the transition to adulthood requires development of sensitive assessment instruments for autistic individuals with LI (Shattuck et al., 2018).

Our preliminary findings set the stage for future research to determine the utility of this assessment protocol for identifying LI in autistic young adults. This work is currently underway, with a fifth year of data collection via community-based partnerships with neurodiverse self-advocates to increase sample size. Moreover, given that performance was relatively flat across measures, future work should focus on identifying measures sensitive to variability in autistic young adults with LI. One possible approach is to rely on direct behavioral probes using psychophysiological tools such as functional near-infrared spectroscopy (fNIRS; Butler et al., 2020; Girolamo et al., in press). This research is underway, with the aim of better understanding variability across methodologies (direct behavioral assessment and fNIRS) and within each methodology (e.g., fNIRS). These investigations would allow enhanced insight into the cues that support language comprehension and production, as well as the underlying mechanisms of behavioral language tasks.

Data Availability

The data supporting the results reported in the article are unavailable, due to participants and their caregivers opting not to share their deidentified data. In a dynamic consent process that provided concrete examples of sharing deidentified data and that used a graded consent form, participants and their caregivers elected what data to share and how. Information on data structure is available upon request.

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