Title

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Journal

Journal of Speech Language and Hearing Research, 67(2)

ISSN

1092-4388

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Publication Date

2024-02-12

DOI

10.1044/2023_jslhr-23-00442

Peer reviewed

ASHA American Speech-Language-Hearing Association

JSLHR

Research Article

Utility of the Language Use Inventory in Young Children at Elevated Likelihood of Autism

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ARTICLE INFO

Article History:
Received July 25, 2023
Revision received November 3, 2023
Accepted November 10, 2023

Editor-in-Chief: Julie A. Washington
Editor: Mahchid Namazi

https://doi.org/10.1044/2023_JSLHR-23-00442

ABSTRACT

Purpose: The aims of this study were (a) to evaluate the convergent validity of the Language Use Inventory (LUI) with measures of autism spectrum disorder (ASD) symptoms, language, and social skills and (b) to assess discriminant validity of the LUI with measures of nonlanguage skills, including daily living skills and motor development.
Method: This study sample included participants from a longitudinal study (n = 239) of infant siblings with elevated familial likelihood of ASD and lower familial likelihood. Assessment measures completed at 36 months included the LUI, the Autism Diagnostic Observation Schedule–Second Edition (ADOS-2), the Mullen Scales of Early Learning, and the Vineland Adaptive Behavior Scales–Second Edition. Bivariate Pearson correlations were estimated between ADOS-2 comparison scores and four language and social skills measures. Additional correlations were estimated between LUI total scores and standard scores from nonlanguage measures. A series of Fisher's Z transformations were applied to evaluate whether bivariate correlations were significantly different.
Results: All four language and social skill measures were moderately to strongly associated with each other and ASD symptom severity scores. The correlation between ADOS-2 comparison scores and LUI total scores was significantly stronger than ADOS-2 correlations with all other measures.
Conclusions: Our findings provide support for the LUI as a feasible, pragmatic language–targeted instrument for inclusion in early developmental evaluations prompted by language concerns. Administration of the LUI may accelerate earlier referral for a comprehensive assessment of ASD symptoms. Given the high correlation with ADOS-2 scores, an LUI total score in a clinical range of concern may encourage a clinician to refer families for a full diagnostic evaluation of ASD.

Autism spectrum disorder (ASD) is increasing in prevalence, both nationally and globally (Hyman et al., 2020). Current prevalence rates estimate one in 36 children presents with ASD in the United States (Maenner et al., 2023), a rate that has more than doubled since 2012 (one in 88; see Taylor et al., 2013). As the number of children identified as meeting the diagnostic criteria for ASD continues to escalate, the need for accessible screening and assessment tools is warranted. Delayed speech production, gesture use, and social communicative behaviors (e.g., gaze following, affect sharing) often co-occur with concerns about possible ASD, prompting caregivers to seek evaluation for early treatment services such as speech-language therapy (Delahunty, 2015; Guinchat et al., 2012; Kozlowski et al., 2011; Ozonoff et al., 2010). Early language delays may indeed be the most predictive symptom leading to early ASD diagnosis (Nitzan et al., 2023). Retrospective review of parent-reported concerns within a

Correspondence to Jessica Blume: Jessica.Blume@ttuhsc.edu. ***Disclosure:*** *Daniela K. O'Neill is the founder and president of Knowledge in Development (KID), Inc. KID, Inc., holds the copyright to and publishes the original English version of the Language Use Inventory (LUI) commercially (https://languageuseinventory.com/). KID, Inc., receives all proceeds from the LUI, and thus, Daniela K. O'Neill is a beneficiary of proceeds from the LUI. This is a continuing relationship. All other authors have declared that no competing financial or nonfinancial interests existed at the time of publication.*

general pediatric population concluded that language skills accounted for more variability in age of ASD diagnosis (i.e., greater likelihood of being diagnosed at a younger age) than cognitive skills, restricted and repetitive behaviors, or social symptoms (Nitzan et al., 2023). Since the global average age of diagnosis is approximately 5 years (van't Hof et al., 2021), there is a critical need for versatile ASD screening tools normed across the early childhood period. Therefore, strategic use of early language screening and assessment measures may result in earlier identification of an elevated likelihood of ASD.

Complications in Early Assessment of ASD

Early identification of potential ASD can prompt timely referrals to and engagement with early intervention specialists and treatment teams. When children with or at elevated likelihood for ASD enroll in treatment at an earlier age, they can make more advantageous gains in language skills, social behavior, cognitive development, adaptive behavior, gross motor skills, and self-care skills, along with reductions in ASD symptom severity (Guthrie et al., 2023; Kasari et al., 2012; Rogers et al., 2012; Towle et al., 2020; Virues-Ortega et al., 2013; Vivanti & Dissanayake, 2016). However, many families experience accessibility barriers when seeking standardized assessment of their child's ASD symptoms (Albert et al., 2017; Ning et al., 2019). The path to seeking an ASD diagnostic evaluation, as well as the pursuit of treatment options, often includes long waitlists and reliance on successful referral to a professional with ASD expertise (Austin et al., 2016; Brookman-Frazee et al., 2012; Pickard & Ingersoll, 2016). Comprehensive assessment with both observational and parent report measures is considered the gold standard practice for an ASD diagnosis. Examples of such measures include the Autism Diagnostic Observation Schedule–Second Edition (ADOS-2; Lord et al., 2012) and the Autism Diagnostic Interview–Revised (Rutter, LeCouteur, & Lord, 2003), both of which require clinicians to complete intensive and often expensive trainings in order to administer the measures. Moreover, travel to a clinic or research lab with trained assessors may be burdensome due to geographical distance, limited scheduling availability, or health and safety concerns (Cole et al., 2019; Drahota et al., 2020; Theodoros, 2011).

Given the potential benefits of early interventions regardless of a confirmed ASD diagnosis (Penner et al., 2015; Schertz et al., 2011; Tolmie et al., 2016), accessible evaluation of early ASD symptoms remains a matter of urgency. Many children with ASD will initially present after parents become concerned about expressive language delays (Buzhardt et al., 2022; Kover et al., 2016). Thus, identifying standardized, easy-to-administer language assessment measures that also identify elevated likelihood for ASD is an efficient approach to expediting timely referrals for diagnostic evaluation (Nitzan et al., 2023). Including a targeted pragmatic language measure that may better identify elevated likelihood of ASD in a language screening or assessment could be a feasible strategy that prompts the pursuit of, or contraindicates the need for, more intensive ASD symptom assessment.

Early Presentation of ASD and Elevated Likelihood for ASD

Delayed ASD diagnosis impedes access to a variety of early intervention resources that can significantly improve developmental outcomes (Pickles et al., 2016; Preeti et al., 2016; Reichow et al., 2012; Rogers et al., 2012). While most children with ASD are diagnosed between 3 and 5 years of age (Maenner et al., 2023; Rondeau et al., 2011), behavioral symptoms consistent with ASD can be observed as early as 12–18 months of age, such as limited experience sharing (i.e., showing toys to adults, commenting), reduced frequency of eye contact, and a narrow range of play behaviors (Chlebowski et al., 2013; Mayes, 2018; Robins et al., 2014; Turner-Brown et al., 2013). Recognition of ASD or elevated likelihood for ASD can be expedited with identification of joint attention deficits, since this pivotal skill is one of the earliest indicators of ASD (Adamson et al., 2009; Carpenter et al., 1998; Werner et al., 2000). Delays in joint attention and differences in social motivation contribute to further delays in functional social communication skills and language development (Baranek et al., 2013; Mundy & Sigman, 2006; Shumway & Wetherby, 2009).

Many young children with ASD have delayed speech production and gesture development (e.g., Kjelgaard & Tager-Flusberg, 2001; Rice & Hoffman, 2015; Wodka et al., 2013). However, language skill trajectories over time are extremely variable: Some children with ASD develop a functional, comprehensive, and syntactically complex spoken language system, while others develop minimal language even with intensive intervention (Tager-Flusberg & Kasari, 2013; Talbott et al., 2020; Tek et al., 2014; Yoder et al., 2015). Although language skills vary within this population, deficits in social communication and pragmatic skills are pivotal components of the diagnostic criteria for ASD (American Psychiatric Association, 2013; Baron-Cohen, 1988; Landa, 2000; Tager-Flusberg, 2015; Young et al., 2005). Whereas social communication is a broad term that also encompasses early nonverbal skills such as joint attention and use of gestures and eye contact, the term *pragmatics* more often specifically refers to expressive language being used and interpreted effectively and appropriately within a social context (Bishop, 1997; Bloom & Lahey, 1978; Volden et al., 2009). Thus,

assessment and intervention approaches that target language delays in children with ASD or at elevated likelihood for ASD warrant a specific focus on pragmatic language functioning.

Several well-established standardized language measures exist that are relevant to the age range of children in this study (under 4 years of age), with some available for young children in prelinguistic stages or with emerging spoken language, such as the MacArthur Communicative Development Inventories: Words and Gestures (Boudreault et al., 2007; Fenson et al., 1993). Notably, most language assessments utilized by clinical professionals with such young children focus on vocabulary and grammar. Standardized measures that specifically assess young children's pragmatic language functioning are limited. The Communication and Symbolic Behavior Scales (CSBS; Wetherby & Prizant, 2002) is a directly administered test that has a broader focus encompassing social communication and early symbolic functioning (e.g., pretend play). The CSBS requires training and is quite lengthy in terms of administration and scoring. A shorter, standardized parent report checklist was developed for screening purposes, the CSBS-DP Infant–Toddler Checklist (Wetherby & Prizant, 2002), but the upper end of its chronological age norms is 24 months.

Language Use Inventory

The Language Use Inventory (LUI; O'Neill, 2009) is a standardized parent report measure developed to specifically assess social pragmatic language use in children ages 18–47 months. The LUI is based on the premise that language development is interrelated with a child's concurrent growth in social cognition, particularly their understanding of others' perspectives (O'Neill, 2007). Items on the LUI ask parents about their children's language use in a broad variety of settings and daily activities with other people, and thus, the LUI's focus on a child's communicative participation in natural environments is consistent with contemporary models of health and disability (World Health Organization, 2007). The LUI has demonstrated strong concurrent validity with other measures including the CSBS (O'Neill, 2009) and the CDI (Luyster & Arunchalam, 2018). In a study of its predictive validity (Pesco & O'Neill, 2012), which followed up on a subset of over 300 from the LUI norming study, children's scores on the LUI were strongly related to their performance at school entry on several language measures including the Child Communication Checklist (Bishop, 2006), the Clinical Evaluation of Language Fundamentals Preschool–Second Edition (Wiig et al., 2004), and the Diagnostic Evaluation of Language Variation (Seymour et al., 2005). Additionally, the LUI has been utilized with samples of children with ASD and at elevated likelihood for ASD (Miller et al., 2015) and recommended as a benchmark measure to assess spoken language in the domain of pragmatics (Tager-Flusberg et al., 2009). Given its parent report format (a questionnaire that does not need to be directly administered by a clinician), strong psychometric properties (Pesco & O'Neill, 2012), and focus on pragmatics, the LUI has evolved to be used as both a screening tool (Conti et al., 2020) and as part of a more comprehensive assessment of young children's pragmatic language functioning (Di Sante et al., 2019). However, the specific associations between performance on the LUI, ASD symptom assessments, and nonlanguage measures have yet to be investigated.

The primary aim of the current study was to evaluate the LUI's convergent validity by examining how children's LUI total scores were associated with concurrent ASD symptoms as measured by the ADOS-2 as well as measures of language (e.g., Expressive and Receptive Language subscales from the Mullen Scales of Early Learning [MSEL]; Mullen, 1995) and social skills (i.e., Socialization subscale from the Vineland Adaptive Behavior Scales–Second Edition [Vineland-II]; Sparrow et al., 2005). We anticipated that the correlation between LUI and ADOS scores would be stronger than the correlation between MSEL language and ADOS scores, given the LUI's focus on pragmatic language and social communication and the MSEL's focus on structural aspects of language like vocabulary. Since the LUI measures pragmatic language use (e.g., spoken language), we also anticipated that LUI total scores would be more strongly correlated with MSEL Expressive Language scores than MSEL Receptive Language scores. We additionally predicted that LUI total scores would correlate strongly with the Vineland-II Socialization and Communication scales due to the shared measurement of communication within social situations.

We also evaluated discriminant validity by examining how LUI total scores were associated with measures of nonlanguage abilities, such as daily living skills and motor development via the Vineland-II and the MSEL. Based on previous demonstrations of LUI specificity (O'Neill, 2007; Pesco & O'Neill, 2012), we anticipated that the correlation between LUI and MSEL language scores would be stronger than the correlation between LUI and nonlanguage Vineland-II and MSEL scores.

Method

Participants

The current study utilized a sample of children (n = 239) from a larger longitudinal study conducted at

the University of California, Davis. The longitudinal study was approved by the University of California, Davis Institutional Review Board. Participants included infant siblings with elevated familial likelihood of ASD (e.g., having an older sibling diagnosed with ASD) or low-familial likelihood (e.g., having an older sibling or siblings with typical development [TD]). Inclusion criteria required study enrollment by 9 months of age. High-familial likelihood was confirmed with administration of the ADOS and the Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003) to a sibling with scores indicating ASD, and low-familial likelihood was confirmed with administration of the SCQ to all older siblings with scores below the ASD range. Exclusion criteria for both groups included birth before 36 weeks of gestation. Having an older sibling with a known genetic disorder (i.e., fragile X syndrome) also resulted in exclusion from the high-familial likelihood group. Additional exclusion criteria for the lower familial likelihood group included having an older sibling with any developmental or learning condition, as well as a diagnosis of ASD for any first-, second-, or third-degree relative. Although this longitudinal study included data collection points from 6 to 36 months (i.e., 6, 9, 12, 18, 24, and 36 months), only data from the 36-month visit were used in the current analyses. Participant age at this visit ranged from 33 to 41 months. To minimize biases of parent report from observations of testing or clinical feedback, parents completed all questionnaires, including the LUI, prior to visits. In the longitudinal study, children were evaluated for ASD at every visit, and diagnoses were made whenever a child met *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (*DSM-5*) criteria. Application of inclusion and exclusion criteria yielded a final sample of 145 elevated likelihood siblings and 94 low-familial likelihood siblings in the analyzed sample. See Table 1 for total sample and likelihood group demographic information. Total sample and likelihood group scores for each descriptive measure are also presented in Table 2.

Measures

All assessments were administered and scored by examiners who were unaware of group membership (e.g., elevated or low-familial likelihood for ASD).

ADOS-2

Autism symptoms were assessed with the ADOS-2 (Lord et al., 2012), a semistructured standardized interaction and observation tool. The ADOS-2 measures both social communication abilities and repetitive behaviors. Since children were administered different modules at 36 months based on verbal language skills (e.g., use of limited phrases vs. fluent sentence production), ADOS-2 comparison scores were utilized. These severity scores range from 0 to 10, with a score of 4 or higher indicative of ASD.

LUI

The LUI (O'Neill, 2009) contains 180 items organized into 14 subscales presented in three sections, Part 1 (how your child communicates with gestures), Part 2 (your child's communication with words), and Part 3 (your child's longer sentences), reflecting a largely chronological sequence (O'Neill, 2007). The LUI is completed by a parent within about 20–25 min. The analyses in the current study focused on LUI scores from the 36-month visit (age range: 33.61–41.03 months). The LUI's total score, which was used in analyses, is calculated from the 10 scored subscales in Parts 2 and 3 that assess spoken language only. The subscales comprising the LUI total score include, for example, questions to a parent about the types of words used by their child, how their child uses words to get their help or get them to notice something, the child's questions and comments about things and people, their use of words in activities with others, their ability to adapt their conversation to other people, and their ability to build longer stories. For example, Part 1 includes items such as how frequently the child "lifts his/her arms to ask to be carried" or "points at what he/she finds interesting." In Part 2, example items include how frequently does the child "use his/her words to ask for help" as well as "what types of words" the child has begun to say (i.e., animals, here/there, do/doing/did). Items in Part 3 describe things a parent has heard a child talk about like "how old he/she is" and whether a child expresses interest in words and language such as by "making dolls or animals talk to each other during pretend play." Response options for scored items are yes/no for the majority, with a few Likert scale items (e.g., never, rarely, sometimes, often). The maximum total score on the LUI is 161. LUI total raw scores were used in analyses. Raw scores can be converted to percentile rank scores based on age norms reported in the LUI manual (O'Neill, 2009) and are also provided below.

MSEL

This standardized measure is designed for children aged 0–68 months. Raw subscale scores for MSEL (Mullen, 1995) fine motor, visual reception, expressive language, and expressive language were converted to *T* scores per specifications. All subscales have a mean *T* score of 50, with an *SD* of 10. For the current study, the Gross Motor subscale was not utilized as this scale is normed for children ages 33 months and younger.

Table 1. Demographic information for participants at the 36-month visit.

Variable	EFL group (n = 145)	LFL group (n = 94)	Total sample (n = 239)	Group differences χ^2 (p)
Gender				0.864 (.353)
% Male	63.4	57.4	61.1	
Race				10.374 (.110)
% White	66.9	74.5	69.9	
% Black	2.1	5.3	3.3	
% Asian	9.7	2.1	6.7	
% Other, including multiple	21.3	18.1	20.1	
Ethnicity				0.175 (.916)
% Non-Hispanic	78.6	76.6	77.8	
% Hispanic or Latino	17.9	19.1	18.4	
% Unknown or not reported	3.5	4.3	3.8	
Household income				5.393 (.715)
% < $25,000	3.4	3.3	3.3	
% $25,000–50,000	6.9	2.1	5.0	
% $50,000–80,000	9.7	16	12.1	
% $80,000–100,000	13.1	10.6	12.1	
% $100,000–125,000	12.4	14.9	13.4	
% $125,000–150,000	12.4	11.7	12.1	
% $150,000–200,000	11	10.6	10.9	
% > $200,000	19.3	21.3	20.1	
% Unknown or not reported	11.8	9.5	10.9	

Note. EFL = elevated familial likelihood; LFL = low-familial likelihood.

Vineland-II

Parents rated child adaptive behavior skills in the domains of Communication, Socialization, Motor, and Daily Living Skills with the Vineland-II (Sparrow et al., 2005). The Communication domain reflects how children listen, pay attention, understand, and use words and gestures to share information. The Socialization domain describes how children interact with others and play. For young children, the Daily Living Skills domain captures how children regulate behaviors related to safety and personal care within home and community settings whereas the Motor domain captures use of fine and gross motor skills.

Outcome Classification

Scores on the ADOS-2, *DSM-5* criteria, and MSEL Expressive and Receptive Language subtest scores were also used to yield an algorithm classification of ASD, non-typical development (NTD), or TD based on criteria

Table 2. Descriptive measures for participants at the 36-month visit.

	EFL group (n = 145)		LFL group (n = 94)		Total sample (n = 239)		Group differences
Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*	*t* (p)
ADOS-2 Comparison scores	2.50	2.22	1.42	.98	2.07	1.90	–4.411 (< .001)
LUI total	106.50	38.01	132.36	23.62	116.67	35.39	5.897 (< .001)
MSEL Receptive	48.04	9.83	53.71	9.55	50.31	10.08	4.354 (< .001)
MSEL Expressive	49.85	11.03	54.83	8.33	51.85	10.31	3.721 (< .001)
MSEL Fine Motor	47.21	13.94	50.51	12.20	48.46	13.31	1.876 (.062)
MSEL Visual Reception	55.73	15.72	61.15	11.45	57.86	14.53	2.888 (.004)
Vineland-II Communication	98.63	14.21	105.65	11.01	101.49	13.42	4.005 (< .001)
Vineland-II Socialization	95.85	14.72	103.32	13.82	98.92	14.81	3.900 (< .001)
Vineland-II Daily Living Skills	93.73	13.58	101.60	13.58	96.92	14.12	4.280 (< .001)
Vineland-II Motor Skills	95.72	14.21	100.91	11.72	97.82	13.48	2.880 (.004)

Note. EFL = elevated familial likelihood; LFL = low-familial likelihood; ADOS-2 = Autism Diagnostic Observation Schedule–Second Edition; LUI = Language Use Inventory; MSEL = Mullen Scales of Early Learning; Vineland-II = Vineland Adaptive Behavior Scales–Second Edition.

developed by the Baby Siblings Research Consortium (Ozonoff et al., 2014). Children in the ASD outcome group (n = 24) scored over the ADOS-2 threshold for ASD (e.g., comparison scores of 4 or higher) and met *DSM-5* criteria for ASD. Children in the NTD group (n = 30) did not meet *DSM-5* criteria for ASD but had either elevated ADOS-2 comparison scores (e.g., 3 or higher) or low MSEL scores (defined as two or more subscales 1.5 *SD* below the mean or one subscale score 2 *SD* below the mean). All participants not meeting either of these classifications were placed in the TD group (n = 185).

Analysis Plan

Analyses were performed using IBM SPSS for Mac (Version 28). First, bivariate Pearson correlations were estimated between LUI total scores, ADOS-2 Comparison scores, Vineland-II Socialization scores, and all language measures (e.g., MSEL Receptive and Expressive Language *T* scores, Vineland-II Communication scores). Then, additional bivariate correlations were estimated between LUI total scores and Vineland-II scores for the nonlanguage subscales, Daily Living and Motor Skills, as well as MSEL Visual Reception and Fine Motor scores. Subsequently, Fisher's *Z* transformations were applied to evaluate whether bivariate correlations between LUI and social and language measures were significantly different from those between LUI and the autism symptom severity measure, as well as LUI and nonlanguage measures.

Results

Prior to estimating correlations, testing was completed to verify variability in LUI total scores across familial likelihood groups and outcome groups. Preliminary analysis confirmed differences between LUI total scores for participants in the low versus elevated likelihood groups, $F(1, 237) = 34.774$, $p < .001$, and within the outcome groups, $F(2, 236) = 107.591$, $p < .001$ (see Table 3). Among the 24 children diagnosed with ASD, when their raw scores were converted to percentile rank scores according to the LUI's norms (O'Neill, 2009), 18 (75%) had raw scores falling at or below the first percentile (< −2.0 *SD*). All participants with ASD but one fell at or below the 10th percentile (a single child's LUI score was at the 17th percentile). In contrast, 83% of children in the TD outcome group had scores above the 10th percentile (vs. 33% in the NTD group).

Convergent Validity: Associations Between Pragmatic Language and Other Social and Language Measures

LUI and Language Measures

The LUI was significantly associated with all language measures (see Table 4). The LUI total score correlations with MSEL and Vineland-II language/communication scores were strong (MSEL Receptive Language, $r = .567$, $p < .001$; MSEL Expressive Language, $r = .679$, $p < .001$; Vineland-II Communication, $r = .749$, $p < .001$). Interpretation of all effect sizes were consistent with Cohen's (1988) guidelines. Fisher's *Z*-score transformations showed that the correlation between the LUI total score and Vineland-II Communication score was stronger compared to correlations with MSEL Receptive and Expressive Language scores ($z = 3.56$, $p < .001$ and $z = 1.56$, $p = .119$, respectively). Notably, both the Vineland-II and the LUI are parent report questionnaires and therefore shared method variance may be present.

LUI and Autism Symptom Severity

The association between LUI total scores and ADOS-2 comparison scores was strong ($r = -.661$, $p < .001$), such that higher LUI total scores and therefore better pragmatic language abilities were associated with less severe ASD symptoms. Next, we examined which language measure was

Table 3. Comparison of Language Use Inventory performance scores by algorithm outcome group.

Variable	Typically developing	Autism spectrum disorder	Non-typically developing
n	185	24	30
% Male	59.46%	83.33%	66.67%
Age range in months (*M*)	33.61–41.03 (36.33)	34.89–37.16 (36.24)	34.79–38.7 (36.07)
Mean raw score (*SD*)	128.61 (23.41)	51.50 (32.09)	95.20 (32.91)
Range of raw scores	23–161	5–112	45–155
Mean percentile rank score	42.4	2.3	17.5
Range of percentiles	1–99	1–17	1–74
Post hoc comparisons: *t* (*p*)			
Typically developing vs. autism spectrum disorder: 14.494 (< .001)			
Typically developing vs. non-typically developing: 6.814 (< .001)			
Autism spectrum disorder vs. non-typically developing: −4.902 (< .001)			

Note. $F(2, 236) = 107.591$, $p < .001$.

Table 4. Correlations for convergent validity analyses between language measures and Autism Diagnostic Observation Schedule–Second Edition (ADOS-2) Comparison scores at the 36 month visit.

Measure	Correlation	1	2	3	4	5	6
1. LUI total score	Pearson	1.00					
	Sig.	—					
2. ADOS-2 Comparison score	Pearson	–.661	1.00				
	Sig.	< .001	—				
3. MSEL Receptive	Pearson	.567	–.365	1.00			
	Sig.	< .001	< .001	—			
4. MSEL Expressive	Pearson	.679	–.432	.724	1.00		
	Sig.	< .001	< .001	< .001	—		
5. Vineland-II Communication	Pearson	.749	–.471	.570	.635	1.00	
	Sig.	< .001	< .001	< .001	< .001	—	
6. Vineland-II Socialization	Pearson	.581	–.491	.338	.391	.543	1.00
	Sig.	< .001	< .001	< .001	< .001	< .001	—

Note. LUI = Language Use Inventory; Sig. = significance; MSEL = Mullen Scales of Early Learning; Vineland-II = Vineland Adaptive Behavior Scales–Second Edition.

most closely related to the ADOS-2 and therefore might index elevated likelihood for ASD within the context of a language evaluation and indicate the need for a referral for ASD evaluation. In contrast to its strong association with the LUI, the ADOS-2 was only moderately correlated with other language measures (see Table 4). After applying Fisher's *Z*-score transformations, the correlation between ADOS-2 Comparison scores and LUI total scores was confirmed to be significantly stronger than correlations between ADOS-2 scores and other language scores. Specifically, the correlation between LUI total scores and ADOS-2 comparison scores was significantly stronger than the correlations between the LUI total scores and MSEL Receptive Language ($z = -4.47$, $p < .001$), LUI total scores and MSEL Expressive Language ($z = -3.61$, $p < .001$), and LUI total scores and Vineland-II Communication ($z = -3.08$, $p < .01$) scores.

LUI and Social Measures

The correlation between LUI total and Vineland-II Socialization scores ($r = .581$, $p < .001$) was significant but moderate in magnitude. Applying the Fisher's *Z*-score transformation indicated the LUI–Vineland-II Socialization correlation was significantly weaker than the LUI–ADOS-2 correlation ($z = 15.84$, $p < .001$).

Discriminant Validity: Associations Between Pragmatic Language and Nonlanguage Measures

The strength of associations between LUI total scores and nonlanguage Vineland-II and MSEL scores were moderate (see Table 5). The correlation between LUI total and Vineland-II Daily Living scores was also moderate ($r = .489$, $p < .001$), as was the correlation

Table 5. Correlations for discriminant validity analyses between pragmatic language measure scores and adaptive behavior domain scores at age 36 months.

Measure	Correlation	LUI total	Vineland-II Daily Living Skills	Vineland-II Motor Skills	MSEL Visual Reception	MSEL Fine Motor
LUI total	Pearson	1.00				
	Sig.	—				
Vineland-II Daily Living Skills	Pearson	.489	1.00			
	Sig.	< .001	—			
Vineland-II Motor Skills	Pearson	.385	.556	1.00		
	Sig.	< .001	< .001	—		
MSEL Visual Reception	Pearson	.530	.391	.344	1.00	
	Sig.	< .001	< .001	< .001	—	
MSEL Fine Motor	Pearson	.450	.337	.401	.565	1.00
	Sig.	< .001	< .001	< .001	< .001	—

Note. LUI = Language Use Inventory; Vineland-II = Vineland Adaptive Behavior Scales–Second Edition; MSEL = Mullen Scales of Early Learning; Sig. = significance.

between LUI total and Vineland-II Motor Skills scores ($r = .385$, $p < .001$). Similarly, correlations between LUI total and MSEL Visual Reception and Fine Motor scores were moderate ($r = .530$, $p < .001$ and $r = .450$, $p < .001$, respectively). Based on the Fisher's Z-score transformations, the correlation between LUI total scores and ADOS-2 Comparison scores was found to be significantly stronger than correlations between LUI total scores and Vineland-II Daily Living Skills ($z = -14.44$, $p < .001$), Vineland-II Motor Skills ($z = -13.04$, $p < .001$), MSEL Visual Reception ($z = -15.04$, $p < .001$), and MSEL Fine Motor ($z = -13.9$, $p < .001$) subscale scores.

The LUI total-MSEL Expressive Language score correlation was stronger than that with Vineland-II Daily Living Skills ($z = 3.18$, $p < .001$), Vineland-II Motor Skills ($z = 4.58$, $p < .001$), MSEL Visual Reception ($z = 2.58$, $p < .01$), and MSEL Fine Motor ($z = 3.72$, $p < .001$) subscale scores. However, the LUI total–MSEL Receptive Language score correlation was only stronger than that with Vineland-II Motor Skills ($z = 2.58$, $p < .01$) and not the Vineland-II Daily Living Skills ($z = 1.18$, $p = .119$), MSEL Visual Reception ($z = 0.58$, $p = .562$), or MSEL Fine Motor ($z = 1.72$, $p = .085$) subscale scores. The LUI total–Vineland-II Communication correlation was also stronger than the LUI total–Vineland-II Daily Living Skills correlation ($z = 4.74$, $p < .001$), LUI total–Vineland-II Motor Skills correlation ($z = 6.13$, $p < .001$), LUI total–MSEL Visual Reception correlation ($z = 4.13$, $p < .001$), and LUI total–MSEL Fine Motor correlation ($z = 5.28$, $p < .001$).

Discussion

Aims of the present study included evaluating how the assessment of pragmatic language skills in 36-month-old children with the LUI relates to assessment of ASD symptoms with the ADOS-2, related profiles of language and social communication skills, and contrasting assessments of nonlanguage skills. After comparing a comprehensive series of associations between this pragmatic language parent report questionnaire and a gold standard ASD symptom severity measure, language measures, social skill measures, and nonlanguage measures, we found that the LUI's correlations with other measures that capture social and communication skills was stronger than with those that determine structural aspects of language or other nonlanguage (e.g., motor and adaptive) skills. Specifically, the LUI was significantly more strongly associated with ASD symptom severity on the ADOS-2 than were other language or communication subscales from the MSEL and the Vineland-II. This was expected, as both the LUI and the ADOS-2 measure social communication, whereas the MSEL and the Vineland-II measure more general language components. Among the 24 children with ASD outcomes, 75% had LUI total raw scores falling at or below the first percentile (< −2.0 *SD*), and 96% obtained scores that fell at or below the 10th percentile. This suggests that a low percentile score that falls in a range typical of clinical concern at 36 months on the LUI might index elevated likelihood for ASD within the context of a language evaluation and indicate the need for a diagnostic referral for ASD. Previous investigation of the LUI's psychometrics and predictive validity revealed that a child with a score at or below the fifth percentile had a 27 times greater probability (risk) of exhibiting significant later language difficulties at ages 5–6 years revealed via battery of administered standardized language tests (Pesco & O'Neill, 2012). Similar, additional investigation regarding the LUI's psychometric properties, including sensitivity, specificity, and positive predictive value, in identifying autism would be needed to establish its utility as a screening measure for ASD specifically (see Conti et al., 2020).

Consistent with prior empirical work with other parent report language measures (e.g., Ring & Fenson, 2000; Sachse & Suchodoletz, 2008), scores from the LUI were also aligned with scores from directly administered language measures. Although empirical support for the use of parent report measures in early developmental assessments is not novel (Luyster et al., 2008; Su et al., 2021; Yoder et al., 2015), we emphasize the utility of the LUI as a parent report measure specifically within the complex, time-sensitive assessment niche area of ASD. Our findings corroborate prior evidence regarding the use of parent report measures to help identify developmental concerns in children present within a specific language domain, such as pragmatic language, when concerns may not be observed in other language skills such as phonology, morphology, syntax, semantics, or narrative recall skills (Adams et al., 2012; Flanagan & Smith, 2019). The LUI is especially practical when children and families are seeking prompt evaluation of both language delays and possible ASD in the context of assessment and early intervention accessibility barriers. That is, information from the parent report LUI measure could be incorporated with other clinical impressions while families remain waitlisted for administration of observational measures like the ADOS-2; LUI scores in a clinical range of concern could affirm the more urgent need for further diagnostic assessments. Thus, when speech-language pathologists utilize the LUI, in addition to other assessments and skilled observations they are already conducting, the results may indicate the need to prioritize ASD-specific referrals. Incorporation of the LUI in early language and social communication evaluations could also help ensure children with significant,

but perhaps more difficult-to-detect, social communication delays are directed to such waitlists in a more timely manner. Moreover, having low standardized scores from the LUI may confer greater diagnostic urgency for children referred to physicians, further expediting waitlist entry and, ultimately, diagnostic services (Penner & Lai, 2023).

During the critical period of neural development from birth to 3, synaptic connections to support early social and communication skills are formed and consolidated; for some children, this window also includes the initial emergence of ASD features (Barbaro & Dissanayake, 2009; Landa et al., 2007; Yirmiya & Charman, 2010). The current study's findings suggest that the LUI is a valuable tool for profiling pragmatic language abilities in 36-month-old children. Further investigation of its utility in identifying elevated likelihood of ASD in younger children (e.g., 18–24 months) is still needed (see Conti et al., 2020). Low standard or percentile rank scores on any standardized language measures should signal a clinician to consider elevated likelihood for ASD; however, language delays and difficulties with a more specific evaluation of pragmatic language (see Norbury, 2014; Reindal et al., 2021) such as the LUI could suggest the need for more urgent access to resources including a full diagnostic evaluation. Of note, in the current study, all but one child with ASD had an LUI total score at or below the 10th percentile (with 75% at the 1st percentile), thus indicating a significant delay that would warrant immediate further investigation. Overall, our findings provide support for additional merits of the LUI as a feasible, pragmatic language–targeted instrument for inclusion in early developmental evaluations prompted by language concerns.

Limitations

Strengths of the current study included utilization of several well-established assessment measures and inclusion of both high and low-familial likelihood groups, but this study is not without limitations. We utilized data resulting from a single time point (36-month visit) and therefore cannot evaluate the LUI's utility in identifying ASD concerns at earlier ages. Furthermore, this analysis did not compare scores from the LUI specifically to other pragmatic language or social pragmatic communication measures, such as the CSBS (Wetherby & Prizant, 2002), although this has been done in other studies (O'Neill, 2009). That is, this study aimed to assess the utility of the LUI in detecting ASD symptoms by examining correlations with the ADOS-2 rather than by comparing LUI scores to other commonly utilized pragmatic language measures, which are primarily designed for broader age ranges (e.g., preschool, school age). Another limitation is the small size of the ASD group in this study. Future investigations with larger samples and with a more general pediatric population as opposed to a familial likelihood sample could permit evaluation with more advanced statistical approaches and enhanced power to predict group membership. Such future investigations are a necessary step for evaluation of the LUI's convergent and discriminant validity with respect to autism. An additional next step for investigation could be evaluation of how LUI scores in the toddler period predict ADOS severity scores at later ages (e.g., preschool, school age) for both children diagnosed with autism and elevated likelihood siblings who may present with milder symptoms.

Conclusions

Our findings suggest the LUI is a practical and functional addition to the assessment toolbox for speech-language pathologists and early intervention evaluation teams. Incorporation of the LUI into a comprehensive language assessment battery can support children and families by expediting referrals for ASD evaluations. When evaluating young children and young children with ASD specifically, parent report measures such as the LUI may provide distinctive information regarding a child's functional communication skills to support information gained from directly administered language assessments and naturalistic language samples.

Data Availability Statement

The data set is currently restricted to investigator access only as data analysis is still in progress.

Acknowledgments

The data included in the current study were collected as part of a National Institutes of Health–funded investigation Grant R01 MH068398 (awarded to S.O.).

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