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Comparing the Mullen Scales of Early Learning and the Preschool Language Scale – Fifth Edition for Young Children with Autism Spectrum Disorder

Emma Riley

Queensland University of Technology

Jessica Paynter

Griffith University

Linda Gilmore

Queensland University of Technology

Abstract

Communication is a key area for early intervention for pre-schoolers with Autism Spectrum Disorder (ASD). Therefore, there is a need for reliable and valid communication assessment measures for this population. Two commonly used measures are the language scales of the Mullen Scales of Early Learning (MSEL) and the Preschool Language Scale – Fifth Edition (PLS – 5). To date, limited research has compared these. The aim of the present study was to investigate the similarities and differences in scores on the two instruments for children with ASD and those who were developing typically. The MSEL and the PLS – 5 assessments were administered to 49 pre-schoolers including 24 children with ASD and 25 typically developing (TD) children. Language scores on the MSEL and PLS – 5 were highly correlated within each group. As expected, children with ASD performed significantly lower on both language measures compared to children who were developing typically. Children from both groups performed higher on the PLS – 5 than the MSEL on the expressive language scale, and typically developing children also performed higher on the receptive language scale. Limitations and future directions for research in terms of test selection are discussed.

Keywords: Autism Spectrum Disorders, Mullen Scales of Early Learning, Preschool Language Scale – 5, Language Assessments, Early Intervention

Comparing the Mullen Scales of Early Learning and the Preschool Language Scale – Fifth Edition for Young Children with Autism Spectrum Disorder

A key target of early intervention programs for pre-schoolers aged 2-6 years with Autism Spectrum Disorder (ASD) is to increase functional communication skills (Zwaigenbaum et al. 2015). With social communication challenges being part of the diagnosis, children with ASD typically perform lower on standardised measures compared to same-aged peers without ASD (for a recent meta-analysis of 74 studies see Kwok, Brown, Smyth, and Cardy 2015). However, significant variability in level of impairment is observed ranging from little to no speech through to more subtle impairments in pragmatic (i.e. social) use of language (e.g., Weismer, Lord, and Esler 2010). Reliable and valid assessment of the spectrum of communication skills in pre-schoolers with ASD is thus essential to inform diagnosis, set goals in early intervention, monitor progress, and evaluate outcomes. While a range of tools are available that assess receptive and expressive language in pre-schoolers (see McConachie et al. 2015 for a comprehensive review), within early intervention research two commonly employed direct child assessments measures are the Mullen Scales of Early Learning (MSEL; Mullen 1995) and the Preschool Language Scale – Fifth Edition (PLS – 5; Zimmerman, Steiner and Pond 2011).

The MSEL has been used in multiple studies of children with ASD (see McConachie et al. 2015 for a review of studies). The MSEL measures receptive and expressive language (as well as gross motor skills, visual reception, and fine motor skills) for children from birth to 68 months. Previous research (Akshoomoff 2006) has found children with ASD (n = 22) obtained significantly lower MSEL subscale scores when compared to age-matched typically developing children (n = 20). Comparing subscales within groups, children with ASD had lower age equivalent means on the receptive language scale compared to the expressive. This finding (expressive > receptive language) has been replicated in toddlers with ASD, and toddlers with Autistic Disorder or Pervasive Developmental Disorder – Not Otherwise Specified (Luyster, Kadlec, Carter and Tager-Flusberg, 2008; Weismer et al., 2010).

Akshoomoff (2006) in contrast, found typically developing children displayed a reverse pattern of results with receptive language scores higher than expressive. This is consistent with some previous research with typically developing children (e.g., Seol et al. 2014). However, this finding is in contrast to the design of the scale, whereby scores across subscales should be similar at a group level. This suggests a need for further investigation of how typically developing children perform on the MSEL as findings are in contrast to the design of the measure.

The PLS-5 also assesses receptive (referred to as auditory comprehension on the PLS-5) and expressive language for young children (from 2 weeks to 83 months of age). Consistent with research with the MSEL, studies employing the PLS have found expressive language scores were greater than receptive language scores in children with ASD. Hudry et al. (2010) used the PLS-5 with 151 preschool aged children with a diagnosis of ASD with ranging verbal abilities and found that a subset of approximately one third of the children performed significantly better on the PLS expressive communication age equivalent scores compared to age equivalent PLS auditory comprehension scale. Consistent with these findings, Volden et al. (2011) found the same pattern of higher expressive than receptive age equivalent scores on the PLS with 294 newly diagnosed preschool-aged (24-59 months) children with ASD.

To our knowledge, the only direct comparison of MSEL and PLS – 5 results for children with ASD was a study conducted by Moody and Lord (2015) who correlated MSEL overall language scores with the PLS – 5. The participants were 25 children with ASD (aged 54 -102 months). The composite score created from the two MSEL language scales (M = 24.32, SD = 7.23) and the PLS – 5 total language (M = 28.32, SD = 9.01) had a significant and strong positive correlation (r = .83). This finding provides initial evidence that these two measures may yield similar estimates of children with ASD's overall language ability, at least at the group level.

There are, however, several differences between the two instruments. Similar to the MSEL, the PLS-5 includes play-based items, but also includes more items and a wider array of skills assessing semantics (e.g., vocabulary, qualitative concepts, spatial concepts), language structure (morphology, syntax), play, and vocal development. It also has more recent normative data (1,400 US children collected in 2010; see Zimmerman, Steiner, and Pond 2011) compared to the MSEL (1, 849 US children collected between 1981-1989). These measures also differ in terms of how they conceptualise expressive/receptive language and their theoretical basis with the Mullen Scales developed using an information processing model, and cognitive ability focus (Mullen 1995). In contrast, the PLS-5 draws from research on language development including gestural communication, theory of mind, and emergent literacy (Zimmerman et al. 2011). Further, the PLS – 5 provides more visual aids (a stimulus book with pictures is provided for most items) compared to the MSEL (most items are presented verbally only), especially as the item number (i.e. difficulty) increases.

Differences in visual supports in each test may be a particularly important difference, as within the literature, it has been suggested that the use of visual aids may facilitate performance for children with ASD (e.g., Ganz, Earles-Vollrath, Heath, Parker, Rispoli, and Duran 2012; Quill 1997). For example, some studies find that individuals with ASD have superior performance on tasks requiring visual processing, such as embedded figures tests (e.g., Dakin and Frith 2005). Further, visual aids in the form of picture-based augmentative and alternative communication (AAC) systems have been shown in previous research to have positive effects on a range of areas including academic skills and communication (see Ganz et al. 2012 for a review). Thus, children with ASD may perform better on the PLS-5 than the MSEL due to this difference, particularly given some similarities in items beyond this (e.g., both include pronouns, counting, labelling objects and so on). However, recently researchers (Trembath, Vivianti, Iacono, and Dissanayake 2015) have found evidence of a lack of visual attention to picture stimuli in children with ASD when following instructions, and a benefit instead for typically developing children. Thus, whether children with ASD do benefit from visuals, and whether this is unique to ASD or may also be seen in typical development, when following instructions or answering questions as in standardised assessments is still open for debate.

The aim of the present study was to explore the similarities and differences in scores between the MSEL (expressive and receptive scales) and the PLS – 5 (auditory comprehension and expressive communication) in children with ASD and typically-developing pre-schoolers aged 2-6 years. Given norms for both tests are based on typical development, we were interested in how children with ASD may differ in their pattern of strengths and weaknesses relative to typically-developing children. First, we hypothesised that children with ASD would score significantly lower on both the MSEL and the PLS – 5, compared to children who were developing typically. Second, we hypothesised that children with ASD would show greater expressive than receptive language skills, and predicted that typically developing children may show the reverse pattern based on more recent (than normative data) studies finding this pattern (Akshoomoff 2006; Seol et al. 2014). Third, we predicted that the MSEL receptive language scale and the PLS –5 auditory comprehension scale, and the MSEL expressive language scale and the PLS– 5 expressive comprehension scale would be strongly correlated as they aim to measure similar constructs. Finally, we tentatively hypothesised that children with ASD would score higher on the PLS– 5 language scales compared to the MSEL language scales due to the greater use of visual supports in the former measure. No specific hypotheses were made for typically developing children.

Method

Participants

Data for the ASD group (*n* = 24) were extracted from an existing database of a local early intervention provider with inclusion criteria for the study completion of the MSEL and PLS-5 at intake to the service and verified ASD diagnosis using the Autism Diagnostic Observation Schedule-Second Edition (ADOS-2).

Eligibility into the EI service required a Diagnostic and Statistical Manual of Mental Disorders (DSM – IV; American Psychiatric Association [APA] 2000) diagnosis of ASD including Autistic Disorder, Asperger's Disorder, or PDD–NOS by a medical practitioner (paediatrician, child psychiatrist, or neurologist), and an age between 30 and 72 months. The majority (*n* = 18) had a diagnosis of ASD, and six children had a diagnosis of Autism/Autistic Disorder/Infantile Autism. Two children in the sample had comorbid diagnoses (global developmental delay; sleep apnoea and double hernia). The majority of children (*n* = 22) spoke English as their sole language at home. Two children in the ASD group also spoke additional languages at home, however English was their first and main language. Non-verbal mental ages ranged from 17.50 to 49.50 months (*M* = 25.75, *SD* = 8.15), see Table 1.

A typically developing comparison group was recruited via childcare centres or word of mouth and were selected to approximately match the range (with a range of 16-53 months) of non-verbal intellectual functioning of the ASD group, given the high rates of intellectual impairment (e.g., Centers for Disease Control and Prevention 2018) in this population. This group had a mean non-verbal mental age of 36.58 months (*SD* = 11.38). Inclusion criteria were chronological age between two and six years, and no developmental or sensory impairments. The typically developing group consisted of 25 children (14 males, 11 females). All spoke English at home as their primary or sole language, with two children coming from a culturally and linguistically diverse background. The majority of TD children were attending childcare services (19/25). All except one (who was born in New Zealand) were born in Australia, and 75% of parents of typically developing children held bachelor or postgraduate degrees, compared to 51% of parents in the ASD sample. Descriptive characteristics of the two samples are presented in Table 1.

[Insert Table 1 here]

Procedure

The study used a between-groups design using both existing data (ASD group data were extracted from a larger study database) and new data collected for the purpose of this study from a typically developing comparison group. Data for the children with ASD were collected as part of the usual intake assessment process at a community-based ASD early intervention centre. Assessments were conducted by staff at the organisation with at least a four-year undergraduate degree in psychology under the supervision of the second author who is a registered psychologist. Parents also completed a range of measures, including a demographic form and the SCQ, as part of this process. Children completed an ADOS-2, the MSEL and the PLS-5 in one session (ranging between 2 to 3 hours in length including an initial interview with parents). The MSEL was administered first, followed by the PLS – 5, and both were conducted in a standardised format.

Assessment of the typically-developing comparison group was conducted by the first author, a provisionally registered psychologist, who was undertaking postgraduate training under supervision of the second and third authors. Assessments were predominantly completed in participants' homes, except for one that was conducted at the Queensland University of Technology Health Clinic. Parents completed a history form and the SCQ. No participants were excluded as none of the children met the threshold on the SCQ (> 11) and none of the parents reported developmental concerns. The two assessments were administered in the same order (MSEL then PLS– 5) as for the ASD sample, in one test session that ranged from 1.5 to 2 hours in length. Between the two assessments, children were given a five to ten-minute break.

Measures

Demographic information. For the typically developing group information was obtained through a parent completed questionnaire including the child's age, ethnicity, and gender, parental education, and primary language spoken at home, as well as use of childcare services, and any previous concerns or developmental delays. Data for children in the ASD group were extracted from the organisation's database.

Social Communication Questionnaire (SCQ; Rutter, Bailey and Lord 2003)**.** The SCQ includes 40 dichotomous (yes/no) statements to which parents indicate whether a child displays the characteristic of ASD. Total scores range from 0 to 39 (or to 36 for children without phrase speech). A score of 11 was used consistent with previous research in this age group (e.g., Eapen, Črnčec and Walter 2013; Paynter, Riley, Beamish, Scott, and Heussler 2015) to screen for ASD and verify non-diagnosis in the typically developing group. The SCQ has been shown to have good internal validity (total score, α = .90) and adequate item–total correlations (Berument, Rutter, Lord, Pickles, and Bailey 1999).

Autism Diagnostic Observation Schedule-Second Edition (ADOS-2; Lord et al. 2012). The ADOS-2 was used to verify ASD diagnosis for the children with ASD. This measure is a standardised observational instrument that quantifies autism symptoms in social reciprocity, communication, play and repetitive behaviours (Lord et al., 2001). All children in the ASD sample obtained an ADOS-2 calibrated symptom severity score consistent with a classification of ASD (with a range in this sample of 5-10).

Mullen Scales of Early Learning (MSEL; Mullen 1995). The MSEL is an individually administered measure of Fine Motor, Visual Reception, Receptive Language, and Expressive Language for children from birth to 68 months of age, and Gross Motor for young children from birth to 33 months of age. As per previous research (e.g., Paynter et al. 2015), the Gross Motor Scale was not administered in the current study due to the low ceiling. A nonverbal mental age composite was calculated by averaging age-equivalent scores on the Fine Motor and Visual Receptive scales. This score was used as an estimate of cognitive ability, as per previous ASD research (e.g., Akshoomoff 2006; Venker, Ray-Subramanian, Bolt, and Weismer 2014). Analyses were conducted using age equivalent scores to capture more fully the range of individual differences, as in previous studies (e.g., Hudry et al. 2010), as children with ASD often do not reach the basal raw score for meaningful MSEL standardised scores.

Preschool Language Scale – Fifth Edition (PLS – 5; Zimmerman et al. 2011). The PLS – 5 is a clinician administered measure of language, designed to evaluate receptive and expressive language abilities for children from 2 weeks to 83 months of age (Zimmerman et al. 2011). The PLS – 5 provides standard scores, percentile ranks, and age equivalent scores for auditory comprehension, expressive communication, and total language ability. However, as shown in previous studies (e.g., Hudry et al. 2010), many children with ASD do not reach the basal raw scores that are necessary to obtain meaningful PLS standard scores. Thus, as per the MSEL, the analyses were conducted with age equivalent scores that allowed us to capture the range of individual differences and enabled direct comparison to the MSEL.

Data Analyses

Prior to analysis data were screened for missing data and assumptions for analyses. Across analyses, as discussed above, age equivalent scores were used for PLS – 5 and MSEL scales. Age equivalent scores better capture the range of scores in the ASD population as many children do not reach basal raw scores for calculation of meaningful standard scores which can lead to floor effects. To address hypothesis one (ASD < typically developing) an analysis of co-variance (ANCOVA) with NVMA as a covariate, and group as the independent variable, was conducted within each measure for each scale. To address hypothesis two of patterns of receptive and expressive language performance within each group paired t-tests with language scale (receptive or expressive) as the independent variable split by group were conducted for the PLS and MSEL. To address hypothesis three of the relationship between measures correlations were conducted between PLS and MSEL subscales. Finally, to address hypothesis four of relative performance across measures we conducted paired t-tests split by group for the receptive/auditory comprehension subscales of the MSEL and PLS-5 respectively, and for the expressive language subscale across each.

Results

There were no missing data for either group, and no major deviations in terms of outliers or normality were observed. However, for the ASD group, visual reception, fine motor and receptive language scales in the MSEL and PLS – 5 were positively skewed. As the analyses conducted (analysis of covariance [ANCOVA] and *t*-tests) are robust to moderate departures from normality (Kim 2013), results were analysed without transformation for ease of interpretation. Despite matching on the range of NVMA, children between groups did significantly differ on NVMA with the typically developing group (*M* = 36.58) higher than the ASD group (*M* = 25.75), *t* (47) = 3.82, *p* = <.001, *d* = 1.09). NVMA was consequently controlled in the main analyses; exceptions were comparisons on the MSEL of fine motor and visual reception (due to being components of NVMA).

Between Groups Comparison of Performance on the MSEL and PLS

Table 2 presents the mean age equivalent scores and standard deviation scores by group for each scale of the MSEL and PLS – 5. Overall, typically developing children had significantly higher scores on each subscale. These differences were significant for MSEL receptive language, *F* (1, 46) = 21.68, *p* < .001, η_p^2 = .32; MSEL expressive language, *F* (1, 46) = 12.60, *p* < .001, η_p^2 = .22; PLS – 5 auditory comprehension, *F* (1, 46) = 25.44, *p* < .001, η_p^2 = .37; and PLS – 5 expressive communication scales, *F* (1, 46) = 17.26, *p* < .001, η_p^2 = .27. The typically developing children also showed significantly higher visual reception, *t* (47) = 4.14, *p* < .001, *d* = 1.19, and fine motor scores, *t* (47) = 2.94, *p* = .005, *d* = 0.84.

[Insert Table 2 here]

Language Profiles

To explore language profiles within each group, paired *t*-tests were conducted to compare receptive and expressive language within each assessment tool. In the typically-developing group children performed similarly on the MSEL receptive language scale (*M* = 38.16, *SD* = 11.04) and MSEL expressive language scale (*M* = 37.28, *SD* = 11.68), *t* (24) = 1.08, *p* = .290, *ns, d* = 0.22. Likewise, on the PLS-5, typically-developing children performed similarly across the receptive language scale (*M* = 41.56, *SD* = 11.22) and the expressive scale (*M* = 39.96, *SD* = 8.16), *t* (24) = 1.40, *p* = .175, *ns*, *d* = 0.32. For the ASD group, no significant differences were found comparing the MSEL expressive language scale (*M* = 19.92, *SD* = 10.57) and the receptive language scale (*M* = 19.38, *SD* = 10.91), *t* (23) = -.54, *p* = .597, *ns*, *d* = 0.10. However, on the PLS – 5, children with ASD performed significantly better on the expressive (*M* = 23.79, *SD* = 10.71), compared to the receptive scale (*M* = 20.75, *SD* = 11.43), *t* (23) = -2.93, *p* = .008, *d* = 0.54.

Correlation between Language Measures

The average MSEL composite of language scales (mean of receptive and expressive age equivalent scores) correlated strongly and positively with the PLS – 5 language scales in both the ASD (r = .94, p < .001) and typically-developing (r = .95, p < .001) groups. As seen in Table 3, results for the ASD group revealed strong and positive correlations between MSEL receptive language and PLS – 5 auditory comprehension, and between MSEL expressive language and PLS – 5 expressive communication. Results were similar for the typically developing group.

[Insert Table 3 here]

Within Groups Comparison of Performance on MSEL and PLS

To test whether children with ASD would score higher on the PLS – 5 compared to the MSEL, paired *t*-tests were conducted. Children with ASD scored significantly higher on the PLS – 5 expressive comprehension age equivalent (M = 23.79, SD = 10.71) compared to the MSEL expressive language age equivalent (M = 19.92, SD = 10.57), t (23) = -3.47, p = .002, d = 0.71. There was a non–significant difference between scores on the PLS – 5 auditory comprehension scale (M = 20.75, SD = 11.43) and the MSEL receptive language scale (M = 19.38, SD = 10.91), t (23) = -1.55, p = .135, d = 0.33. Within the typically-developing group, children performed significantly better on PLS– 5 auditory comprehension (M = 41.56, SD = 11.22) compared to MSEL receptive scale (M = 38.16, SD = 11.04), t (24) = -3.28, p = .003, d = 0.65, and significantly better on PLS – 5 expressive communication (M = 39.96, SD = 8.16) compared to MSEL expressive language (M = 37.28, SD = 11.68), t (24) = -2.36, p = .027, d = 0.60.

Individual score profiles were explored to investigate patterns of performance at the individual level by comparing age equivalent scores to see which were numerically higher in months. For the ASD group, 20 children had higher PLS – 5 total age equivalent scores, while four had higher MSEL total language composite age equivalent scores. The difference between MSEL total language composite age equivalent scores and PLS – 5 total language age equivalent scores ranged between .5 and 12.5 months (M = 3.94, SD = 2.67). In the typically-developing group, 18 children had higher PLS – 5 total language age equivalent scores, and six had higher MSEL scores. One child performed equally across measures. The difference between age equivalent scores in this group across measures ranged between 0 and 11 months (M = 4.24, SD = 3.14).

Discussion

We aimed to explore performance on the MSEL and PLS– 5 in children with ASD or typical development. Given the communication impairments that are typically found in ASD, and the findings from previous research (e.g., Akshoomoff 2006; Weismer et al. 2010), we expected lower performance across measures in the ASD group. The results are in line with our expectations. Second, we hypothesised differing language profiles within each group. However, we found similar scores across scales within each measure in both groups, with the exception of the comparison of the PLS – 5 scales for the ASD group where, as predicted, children performed better on the expressive than receptive (auditory comprehension) subscale. Third, we predicted strong correlations across measures on receptive and expressive language subscales which were found. Finally, we tentatively hypothesised that children with ASD would perform higher on the PLS– 5 language scales compared to the MSEL language scales due to the greater availability of visual supports in the former measure. This hypothesis was supported for the expressive scale only. Typically developing children were also found to perform better on both scales of the PLS– 5 than on the equivalent MSEL scales. In both groups, more individual children obtained higher overall scores on the PLS– 5 than on the MSEL.

With respect to language profiles, typically developing children performed similarly across receptive and expressive scales on both tests. Similarly, children with ASD performed similarly across MSEL subscales. This is what would be expected at a group level based on these instruments being constructed to show similar mean scores across scales (Mullen 1995; Zimmerman et al. 2011), however these findings are in contrast to some of the previous research (e.g., Akshoomoff 2006; Seol et al. 2014) that has found differences in performance across subscales. Differing results may reflect dissimilarities in samples assessed (toddlers vs. pre-schoolers), cultural/country differences (Australia vs. US and Korea respectively) and/or be due to the sample being underpowered to detect smaller effects/more subtle differences between scores. In contrast, however, the hypothesised higher performance on the expressive compared to receptive communication scale was found on the PLS– 5 in the ASD group, consistent with Hudry et al. (2010). This suggests children with ASD may show a different language profile on the PLS – 5 than children who are typically developing. It is also feasible that differing profiles may reflect differences between participants drawn from Australia and the US norming sample used in the PLS – 5 (Zimmerman et al. 2014); however, this does not explain why different profiles were seen for the ASD group only.

Our results provide evidence of convergent validity of the receptive and expressive subscales of the MSEL and PLS– 5 through showing these are strongly correlated for both children with ASD and those who are typically developing. These findings are consistent with previous research with children with ASD (Moody and Lord 2015), that likewise found strong correlations between a composite measure of overall language across both measures. Our results extend this work by demonstrating strong correlations also at the subscale level for both groups. This suggests that where change over time is the focus of an assessment, either measure may be used rather than both, provided the same measure is used across time points, thus reducing the number of assessments and burden on both services (in terms of resources) and children and their families.

We predicted that children with ASD may perform better on the PLS – 5 as this measure employs more visual stimuli which may be helpful for this population, compared to the MSEL. Although we found that the majority of children with ASD (20/24) performed better on the PLS – 5, our hypothesis was only partially supported. We found that children with ASD performed significantly better on the expressive scale of the PLS – 5 compared to the MSEL. However, results were not significantly different for the receptive scales. Further, the typically developing group performed significantly better on both scales on the PLS – 5 compared to the language scales on the MSEL. The finding that typically developing children performed better on the test with visuals (while the ASD group only did for one subscale at a group level) is consistent with Trembath et al. (2015) who found that the typically-developing children visually attended to supports when instructions were given and showed greater benefit from visual supports. It may be that both children with ASD and typically developing children benefit from visual supports for expressive language tasks, but differ in the extent to which they can utilise these supports for language comprehension which was the area of weakness for the ASD group. How and whether visual supports facilitate standardised assessment performance in children with ASD is an important question for future research, and may be studied using eye-tracking during assessment to investigate attention to these additional supports (Trembath et al. 2015).

Both groups showed better performance, at least on the expressive language scale, on the PLS than the MSEL. At an individual level, however, we found large discrepancies of as much as 12.5 months in age-equivalent scores. There are a number of possible explanations for the better performance of some individual children (regardless of group) on the PLS – 5. For example, individual differences in visual attention to picture stimulus may have led to the PLS-5 being easier for some children able to use these stimulus to support task completion, than the MSEL. Further, some of the earlier items on the PLS-5 may be completed using caregiver report, however this seems an unlikely explanation for differences as these are the items designed for infants rather than our older sample of pre-schoolers. Alternatively, differences in wording between tasks for similar concepts (e.g., expressive labelling of items) may have been more familiar to children leading to greater performance on one test than the other. Finally the greater number of items and array of skills assessed by the PLS may provide greater opportunities to show the extent of a child’s skills. Future research exploring factors related to greater concordance or discrepancy (e.g., ADOS calibrated severity scores, NVMA, or overall VMA) would be important to explore to determine the appropriateness and suitability of these measures for specific children or groups of children with ASD.

Systematic differences in difficulty, given high correlations, have implication for test selection for diagnostic or eligibility assessments (e.g., verification of communication impairment). If delays are minimised or hidden due to better performance on the PLS – 5, diagnosis may be delayed, with consequent delays in funding and targeted early intervention services. For example, if better performance on the PLS-5 reflects differences in task requirements or stimulus, rather than true abilities, this may lead to under-detection of areas of need, where if the same child completed the MSEL these may have been detected. Therefore, whether differences between these measures reflect over or under estimation of scores for each child is an important question for future research. These findings also highlight the importance of consistency for research projects and interventions, particularly those involving longitudinal designs or comparisons across participants, to use the same measure for pre/post comparisons as well as comparisons between participants.

Limitations

A number of limitations should be considered when interpreting the results of this research. First, our study had a relatively small sample size which may limit generalisation and power to detect smaller effects. However, we were interested predominantly in clinically-significant large effects that would impact on interpretation of assessments, which were detected for comparisons between measures on both groups for the expressive language scale and suggest caution in using these measures interchangeably. Second, we acknowledge the potential conversely for Type II errors due to not correcting for multiple comparisons, as we were interested in identifying potential effects worthy of future study with larger samples, which we feel is an important area for future research. Third, we were unable to determine inter-rater reliability in test administration as data were drawn from an existing database for the ASD, which would be an important inclusion for future studies to strengthen confidence in these findings. Finally, the fixed order of assessments may have impacted on performance, although this seems unlikely as children tended to perform better on the later assessment (PLS-5) which may have been more prone to fatigue. Nevertheless, randomisation in future research would strengthen confidence in our findings. Despite these limitations, this research has addressed a paucity in the literature of performance across these common language measures, highlighting cautions for use in clinical practice and paving the way for further research investigations.

The present study adds to the body of research examining the similarities and differences between two commonly used language measures – the MSEL and the PLS – 5. We built on previous research showing strong correlations between these measures at the subscale level, and highlighted potential differences in difficulty. Our findings have important implications for research to inform selection and interpretation of language measures for diagnostic or eligibility assessments, and for comparisons of performance over time. Whether the better PLS – 5 performance is due to children benefiting from visual supports is an important question for future research with both ASD and typically-developing samples. Understanding the similarities and differences in measures across assessments will provide valuable information to guide more targeted assessment protocols that will reduce burden on children, families, clinicians and service-providers.

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Author Contributions

ER: collaborated with designing the study, collected data for the study, entered/extracted data, analysed results, and prepared the initial manuscript. JP: provided supervision to ER for data collection, analysis, and manuscript preparation, initiated the study design, and collaborated in writing, revising, and editing the final manuscript. LG: provided supervision to ER for data collection, analysis, and manuscript preparation, and collaborated in writing and editing of the final manuscript.

Compliance with Ethical Standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Ethics approval was granted by Queensland University of Technology Ethics (Protocol Number 1500001048) and access to the ASD data was granted by the Research Advisory Group at the AEIOU Foundation. Signed informed consent was obtained from parents of all participating children and assent was obtained from children.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

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Tables

Table 1

Descriptive Characteristics for Children with ASD and TD Children

Variable	ASD (*n* = 24)		TD (*n* = 25)		
	Mean (SD)	Range	Mean (SD)	Range	*t(47)*
Chronological age (months)	45.75 (10.77)	28.48 – 67.45	39.82 (8.89)	24.34 – 53.68	2.11*
MSEL nonverbal mental age (months)	25.75 (8.15)	17.50 – 49.50	36.58 (11.38)	16 – 53	3.82*
ADOS Calibrated Severity Score	6.67 (1.34)	5-10	-	-	

Note. ASD = Autism Spectrum Disorder; *TD* = typically developing; *ADOS* = Autism Diagnostic Observation Schedule; *MSEL* = Mullen Scales of Early Learning; $^*p < .05$

Table 2

Mean and Standard Deviation Age Equivalents for TD and ASD Group on Each Language Assessment Measure

	ASD Group (*n* = 24)	TD Group (*n* = 25)
Mean Chronological Age in months*	45.75 (10.77)	39.82 (8.89)
MSEL		
Visual Reception*	25.58 (10.02)	39.36 (13.02)
Fine Motor*	25.92 (8.37)	33.80 (10.26)
Receptive Language*	19.38 (10.91)	38.16 (11.04)
Expressive Language*	19.92 (10.57)	37.23 (11.68)
PLS – 5		
Auditory comprehension*	20.75 (11.43)	41.56 (11.22)
Expressive communication*	23.79 (10.71)	39.96 (8.16)

Note: Standard deviation in brackets; * $p < .05$ for comparison between groups

Table 3

Pearson Correlation Coefficients between Each Scale on the MSEL and PLS – 5 for TD and ASD Children

	Children with ASD	TD children
MSEL RL – MSEL EL	.86**	.94**
AC – MSEL RL	.93**	.89**
PLS AC – MSEL EL	.82**	.93**
PLS AC – PLS EC	.87**	.87**
PLS EC – MSEL RL	.94**	.90**
PLS EC – MSEL EL	.87**	.90**

Note. MSEL = Mullen Scales of Early Learning; *RL* = receptive language; *EL* = expressive language; *PLS* = Preschool Language Scale – 5th edition; *AC* = auditory comprehension; *EC* = expressive communication
** $p < .001$