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Enhancing Language Development in Children with Autism: A Comprehensive Guide to Phonological Assessment and Intervention

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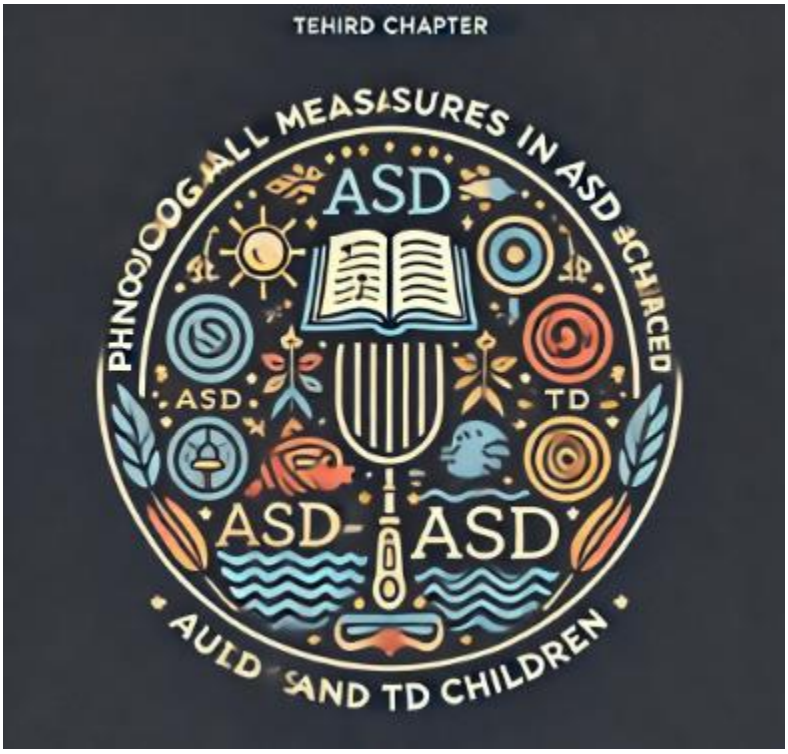
Chapter 3:

Phonological Measures in ASD and TD Children



3.0 Introduction

Phonological measures are essential tools in the assessment of language development, especially when comparing typically developing (TD) children and those with Autism Spectrum Disorder (ASD). These metrics, including the phonological mean length of utterance (pMLU), Proportion of Whole-Word Proximity (PWP), Percentage of Consonants Correct (PCC), and Proportion of Whole-Word Correctness (PWC), allow researchers and clinicians to quantify the complexity and accuracy of a child's speech. This chapter explores the application of these measures in both TD and ASD populations, highlighting key findings from research and discussing the implications of these findings for understanding the linguistic challenges faced by children with ASD.

3.1 Within-Group Comparison in ASD Children

3.1.1 pMLU in ASD Children

Phonological Mean Length of Utterance (pMLU) is a critical metric in understanding the speech development of children with ASD. Research has consistently shown that children with ASD exhibit lower pMLU scores compared to their typically developing peers. This reduction in pMLU is often attributed to the simplified speech patterns commonly observed in ASD, where children tend to produce shorter, less phonetically complex utterances. The reduced complexity in their speech reflects underlying difficulties in phonological processing and motor planning, which are core challenges in ASD（Shriberg & Kwiatkowski, 1982; Tager-Flusberg et al., 2005）.

One of the reasons for these lower pMLU scores is the tendency of children with ASD to rely on repetitive and stereotyped speech patterns, which limits the diversity and complexity of their utterances. These repetitive speech patterns, often referred to as echolalia, can significantly reduce the overall phonological richness of the child’s spoken language. Moreover, children with ASD may struggle with the acquisition of complex phonological structures, leading to a reliance on

simpler, more easily articulated words. This difficulty is compounded by challenges in social communication, which further restricts the opportunities for these children to engage in the diverse verbal interactions that typically lead to the development of more complex speech patterns（Paul, Hopf, & Larriba-Quest, 2017; Saaristo-Helin, 2011）.

Furthermore, studies have indicated that the pMLU scores in children with ASD can vary significantly depending on the severity of their condition. Children with more pronounced ASD symptoms often exhibit the lowest pMLU scores, reflecting more significant impairments in their phonological development. This variability underscores the importance of using pMLU as a diagnostic tool to assess the extent of phonological impairment in children with ASD and to tailor interventions that address these specific deficits（Pratt, Hopf, & Larriba-Quest, 2017; Sandbank & Yoder, 2016）.

3.1.2 PWP in ASD Children

Proportion of Whole-Word Proximity (PWP) is another vital measure that has been used to assess the phonological development of children with ASD. PWP evaluates how closely a child's word production approximates the target word in terms of phonological structure. Lower PWP scores in children with ASD indicate a greater deviation from the expected phonological form, which can be attributed to various factors, including difficulties in phonological processing and motor speech planning. These lower scores reflect the broader challenges that children with ASD face in producing phonetically accurate speech（Shriberg & Kwiatkowski, 1982; Tager-Flusberg, 1992）.

One significant factor contributing to the lower PWP scores in children with ASD is their difficulty in producing complex speech sounds. For instance, children with ASD may struggle with consonant clusters or multisyllabic words, leading them to simplify their speech by omitting sounds or syllables. This simplification process results in words that are phonetically less accurate, thereby reducing their PWP scores. Additionally, children with ASD often exhibit delays in the development of phonological working memory, which hinders their ability to retain and manipulate phonological information, further impacting their ability to produce accurate speech（Vogan et al., 2014; Shriberg et al., 1997）.

Moreover, PWP scores can be influenced by the social and communicative contexts in which children with ASD are speaking. For example, in situations where the child feels more comfortable or less pressured, their PWP scores may improve as they produce speech that is closer to the target phonological structure. This context-dependence highlights the importance of assessing PWP in a variety of settings to gain a comprehensive understanding of the child's phonological abilities and to identify specific areas where intervention may be needed（Shillingsburg et al., 2020; Aljameel et al., 2017）.

3.1.3 PCC in ASD Children

The Percentage of Consonants Correct (PCC) is a widely used measure for assessing the accuracy of consonant production in children's speech. In children with ASD, PCC scores are generally lower than in their TD peers, reflecting significant challenges in speech sound production. These challenges include difficulties in articulating specific consonants, inconsistent production of speech sounds, and a higher prevalence of speech sound distortions. Lower PCC scores in children with ASD highlight the need for targeted speech therapy to address these phonological deficits（Shriberg & Kwiatkowski, 1982; Shriberg et al., 1997）.

Several factors contribute to the lower PCC scores observed in children with ASD. One key factor is the motor planning difficulties that are often associated with ASD. These children may struggle with coordinating the fine motor movements required to produce speech sounds accurately, leading to frequent errors in consonant production. Additionally, children with ASD may have difficulty generalizing phonological rules across different contexts, resulting in inconsistent production of consonants across different words or sentences（Paul et al., 2011; Shillingsburg et al., 2020）.

Furthermore, the social communication difficulties characteristic of ASD can exacerbate these phonological challenges. Children with ASD may have limited opportunities for meaningful verbal interaction, which is crucial for the practice and refinement of speech sound production. Without sufficient practice, these children may not develop the phonological accuracy that typically developing children achieve through regular social interactions. As a result, their PCC scores remain lower, indicating a need for interventions that not only focus on speech sound production but also encourage more frequent and meaningful verbal communication（Sendhilnathan & Chengappa, 2020; Tager-Flusberg et al., 2005）.

3.1.4 PWC in ASD Children

Proportion of Whole-Word Correctness (PWC) is a measure that evaluates the overall accuracy of word production, taking into account both the phonological complexity and the correctness of the words produced. Children with ASD typically have lower PWC scores compared to their TD peers, indicating greater difficulty in producing accurate and phonetically complex words. These lower scores reflect the broader phonological challenges faced by children with ASD, including issues with speech sound production, phonological processing, and motor planning（Ingram & Ingram, 2001; Shriberg et al., 1997）.

The challenges that contribute to lower PWC scores in children with ASD are multifaceted. For instance, these children often exhibit a narrower range of phonological structures in their speech, which limits their ability to produce a diverse and accurate set of words. This limitation is compounded by difficulties in phonological awareness, which hinders their ability to recognize and produce the correct phonological forms of words. Additionally, children with ASD may struggle with the temporal aspects of speech production, such as the timing and sequencing of phonemes, leading to errors in word production that further reduce their PWC scores（Pratt, Hopf, & Larriba-Quest, 2017; Saaristo-Helin, 2011）.

Moreover, the repetitive and stereotyped speech patterns often observed in children with ASD can also contribute to lower PWC scores. These patterns involve the frequent repetition of simple words or phrases, which do not require the same level of phonological complexity as more varied

and spontaneous speech. As a result, the child's overall word production accuracy is reduced, as measured by PWC. Addressing these challenges requires a comprehensive approach that not only targets speech sound production but also encourages the use of more varied and complex language structures（Tager-Flusberg, 1992; Sandbank & Yoder, 2016）.

3.2 The Effect of Age in Typically Developing (TD) Children

3.2.1 pMLU in TD Children

In typically developing children, the phonological mean length of utterance (pMLU) is a valuable indicator of the progression of phonological development. Research consistently shows that pMLU scores increase with age as children acquire more complex phonological structures and expand their vocabulary. This increase in pMLU reflects the natural development of language skills, where children progress from producing simple, monosyllabic words to more complex, multisyllabic words with a higher number of phonological segments （Saaristo-Helin, 2011; Shriberg & Kwiatkowski, 1982）.

The growth in pMLU is closely tied to the child's expanding phonological awareness and their ability to manipulate phonological units within words. As children develop, they become more adept at producing words that are not only longer but also more phonetically diverse. This progression is supported by the child's increasing exposure to language, both in social interactions and through educational experiences, which provides them with the opportunities to practice and refine their phonological skills（Beers, Rodenburg, & Gerrits, 2019; Sandbank & Yoder, 2016）.

Furthermore, the increase in pMLU is also influenced by the child's growing fine motor control, which is essential for producing the more complex articulatory movements required for longer words. As children mature, their ability to coordinate these movements improves, allowing them to produce speech that is not only longer but also more phonetically accurate. This development is a key marker of the child's overall linguistic proficiency and is reflected in their steadily increasing pMLU scores as they age（Pratt, Hopf, & Larriba-Quest, 2017; Vogan et al., 2014）.

3.2.2 PWP in TD Children

Proportion of Whole-Word Proximity (PWP) is another measure that tends to improve with age in typically developing children. As children's language skills develop, their word production becomes increasingly phonetically accurate, leading to higher PWP scores. This improvement reflects the child's growing ability to produce words that closely match the phonological structure of adult speech, a key indicator of phonological development（Ingram & Ingram, 2001; Saaristo-Helin, 2011）.

The improvement in PWP is closely linked to the child's advancing phonological processing skills, which enable them to produce speech that is more accurate and reflective of the target words. As children become more familiar with the sounds and structures of their language, they are better able to produce words that are phonetically precise. This precision is crucial for effective communication, as it allows the child to convey their intended meaning more clearly and accurately（Beers, Rodenburg, & Gerrits, 2019; Shillingsburg et al., 2020）.

Additionally, the increase in PWP scores is supported by the child's growing cognitive abilities, including their memory and attention skills. As children develop, they are better able to remember

and reproduce the correct phonological forms of words, leading to more accurate speech production. This development is particularly important in the context of learning new vocabulary, where the ability to accurately produce new words is a key component of language acquisition（Saaristo-Helin, 2011; Shriberg & Kwiatkowski, 1982）.

3.2.3 PCC in TD Children

The Percentage of Consonants Correct (PCC) is a critical measure for assessing the accuracy of consonant production in typically developing children. Research indicates that PCC scores increase with age as children's phonological development progresses, reflecting their growing proficiency in producing consonants accurately across different word forms. This increase in PCC is a key marker of the child's phonological maturation and their ability to produce speech that is clear and intelligible（Shriberg et al., 1997; Saaristo-Helin, 2011）.

As children develop, their PCC scores improve due to several factors, including increased exposure to language, enhanced phonological awareness, and improved motor control. These factors contribute to the child's ability to produce consonants consistently and accurately across different contexts. Moreover, as children's cognitive and linguistic skills develop, they become better at internalizing phonological rules and applying them to their speech, leading to more accurate consonant production（Shriberg & Kwiatkowski, 1982; Vogan et al., 2014）.

The development of PCC is also influenced by the child's social interactions, which provide opportunities for practicing and refining speech sounds in a variety of communicative contexts. Through these interactions, children learn to adjust their speech to be more intelligible to their conversational partners, which in turn supports the development of higher PCC scores. This social component of language development is crucial for ensuring that children's speech becomes not

only more accurate but also more effective in conveying meaning（Paul et al., 2011; Sandbank & Yoder, 2016）.

3.2.4 PWC in TD Children

Proportion of Whole-Word Correctness (PWC) is a measure that reflects the overall accuracy of word production in typically developing children. Similar to other phonological measures, PWC scores tend to increase with age as children's language skills develop. This increase indicates that children are becoming more proficient at producing words that are both phonetically complex and accurate, which is a key indicator of their overall language development（Ingram & Ingram, 2001; Shriberg et al., 1997）.

The improvement in PWC scores is closely tied to the child's growing ability to manage the complexity of word production. As children's phonological processing and motor planning skills develop, they are better able to produce words that are not only accurate but also complex in their phonological structure. This development is crucial for effective communication, as it allows the child to express a wider range of meanings and ideas through their speech（Saaristo-Helin, 2011; Shillingsburg et al., 2020）.

Moreover, the increase in PWC scores is supported by the child's expanding vocabulary, which provides more opportunities for practicing and refining word production. As children learn new words, they must integrate these words into their phonological system, ensuring that they can produce them accurately in a variety of contexts. This process of integration is reflected in the steady increase in PWC scores as children age, indicating their growing linguistic competence（Shriberg & Kwiatkowski, 1982; Paul et al., 2011）.

3.3 Comparing Language Measures in ASD and TD Children

3.3.1 Comparing Language Measures in 5-Year-Old ASD and TD Children

When comparing the phonological measures of 5-year-old children with ASD to their typically developing peers, research shows significant differences across all metrics. At this early age, children with ASD generally exhibit lower pMLU, PWP, PCC, and PWC scores compared to TD children. These differences highlight the early language challenges faced by children with ASD, particularly in their ability to produce phonetically complex words and accurate speech sounds. The disparities observed at this age are critical, as they often set the stage for the more persistent language difficulties seen in older children with ASD （Tager-Flusberg, 1992; Shriberg & Kwiatkowski, 1982）.

The lower scores observed in ASD children at this age can be attributed to several factors, including delays in phonological processing, difficulties with motor planning, and the prevalence of repetitive and stereotyped speech patterns. These factors contribute to a reduced ability to produce complex and phonetically accurate speech, which is reflected in the lower scores across all phonological measures. Early identification and intervention are crucial at this stage to address these challenges and support the development of more accurate and complex speech in children with ASD（Paul et al., 2011; Vogan et al., 2014）.

Furthermore, the differences in phonological measures between ASD and TD children at age 5 are also indicative of broader cognitive and linguistic differences. Children with ASD may exhibit difficulties with auditory processing and memory, which can impact their ability to retain and produce phonological information accurately. These challenges underscore the importance of using phonological measures not only as diagnostic tools but also as a means of tracking the

effectiveness of early interventions （Pratt, Hopf, & Larriba-Quest, 2017; Sandbank & Yoder, 2016）.

3.3.2 Comparing Language Measures in 6-Year-Old ASD and TD Children

By the age of 6, typically developing children have made significant strides in their phonological development, as reflected in higher scores across all language measures. In contrast, children with ASD continue to lag behind their TD peers, particularly in terms of pMLU and PCC. These continued deficits in phonological development underscore the persistent challenges faced by children with ASD in acquiring complex phonological structures and producing speech sounds accurately. The gap between ASD and TD children at this age highlights the ongoing need for targeted interventions to support phonological development in children with ASD （Shriberg & Kwiatkowski, 1982; Shillingsburg et al., 2020）.

At this age, the phonological measures of TD children typically reflect an increasing ability to produce longer, more complex words with a high degree of phonetic accuracy. In contrast, children with ASD may exhibit a slower rate of improvement or even a plateau in their phonological development. This stagnation can be attributed to the persistent challenges in phonological processing and motor planning that are characteristic of ASD. As a result, children with ASD may continue to struggle with producing phonetically complex words and maintaining accurate speech sound production（Shriberg et al., 1997; Tager-Flusberg et al., 2005）.

The differences observed between ASD and TD children at age 6 also highlight the importance of individualized intervention plans that address the specific phonological challenges faced by each child. These plans should incorporate strategies that target both the production of accurate speech

sounds and the development of more complex phonological structures. By addressing these challenges early on, it is possible to support the ongoing phonological development of children with ASD and help them achieve greater linguistic competence（Paul et al., 2011; Saaristo-Helin, 2011）.

3.3.3 Comparing Language Measures in 7-Year-Old ASD and TD Children

At age 7, the gap between ASD and TD children in terms of phonological measures often becomes more pronounced. Research shows that while TD children continue to improve in their pMLU, PWP, PCC, and PWC scores, children with ASD may show slower progress or even a plateau in their development. This plateauing can be particularly evident in measures like PCC, where the accuracy of consonant production may not improve significantly in children with ASD. These findings highlight the ongoing need for specialized interventions to support phonological development in older children with ASD（Shriberg & Kwiatkowski, 1982; Shriberg et al., 1997）.

The challenges faced by children with ASD at this age are multifaceted and include difficulties in both the production and processing of phonological information. For instance, children with ASD may continue to struggle with the coordination of motor movements required for accurate speech sound production, leading to persistent errors in their speech. Additionally, the social communication difficulties characteristic of ASD can further limit the opportunities for these children to practice and refine their phonological skills, resulting in lower scores across all measures（Paul et al., 2011; Vogan et al., 2014）.

The persistent gaps in phonological measures between ASD and TD children at age 7 also underscore the importance of continued monitoring and assessment. By regularly evaluating the

phonological development of children with ASD, clinicians can identify areas where additional support is needed and adjust intervention strategies accordingly. This ongoing assessment is crucial for ensuring that children with ASD receive the support they need to continue developing their phonological and linguistic skills （Saaristo-Helin, 2011; Sendhilnathan & Chengappa, 2020）.

3.3.4 Comparing Language Measures in 8-Year-Old ASD and TD Children

By the age of 8, typically developing children have generally achieved high levels of phonological proficiency, as reflected in near-ceiling scores across all measures. In contrast, children with ASD often continue to exhibit significant deficits in pMLU, PWP, PCC, and PWC. These persistent deficits in phonological development suggest that children with ASD may require ongoing support and intervention beyond the early childhood years to address their language challenges. The differences between ASD and TD children at this age highlight the need for longitudinal studies to better understand the trajectory of phonological development in children with ASD（Shriberg et al., 1997; Tager-Flusberg et al., 2005）.

The continued phonological challenges faced by children with ASD at this age are indicative of broader developmental delays that may impact other areas of language and communication. For example, children with ASD may struggle with more complex linguistic tasks, such as narrative production or conversational turn-taking, which require a higher level of phonological and syntactic proficiency. These challenges underscore the importance of providing comprehensive language interventions that address both the phonological and broader linguistic needs of children with ASD（Shriberg & Kwiatkowski, 1982; Saaristo-Helin, 2011）.

The differences observed between ASD and TD children at age 8 also highlight the importance of individualized education plans (IEPs) that are tailored to the specific needs of each child. These plans should include goals related to the development of phonological skills, as well as strategies for supporting the child's broader language and communication abilities. By taking a holistic approach to language intervention, it is possible to support the ongoing development of children with ASD and help them achieve greater success in both academic and social contexts（Paul et al., 2011; Shillingsburg et al., 2020）.

3.4 Phonological Processes in ASD Children's Productions

Phonological processes are patterns of sound errors that children typically use to simplify speech as they are developing their language skills. In children with ASD, these processes can be more pronounced and may persist longer than in TD children. Common phonological processes observed in children with ASD include final consonant deletion, cluster reduction, and weak syllable deletion. These processes contribute to the overall lower scores observed in pMLU, PWP, PCC, and PWC measures, as they result in simpler and less accurate word productions（Paul et al., 2011; Shriberg et al., 1997）.

One of the primary reasons these phonological processes persist in children with ASD is due to their difficulties with phonological awareness and motor planning. Phonological awareness is the ability to recognize and manipulate the sound structures within words, and it is a critical skill for developing accurate speech. Children with ASD may have delayed or impaired phonological awareness, which makes it challenging for them to produce the correct phonological forms of words. Additionally, motor planning difficulties, which are common in ASD, can make it difficult

for children to produce the necessary articulatory movements to achieve accurate speech（Shriberg & Kwiatkowski, 1982; Tager-Flusberg et al., 2005）.

Moreover, the persistence of these phonological processes can have a significant impact on the child's overall communication abilities. When children consistently use simplified speech patterns, it can lead to difficulties in being understood by others, which in turn can affect their social interactions and academic performance. Addressing these phonological processes through targeted interventions is crucial for helping children with ASD develop clearer and more accurate speech, which is essential for effective communication（Shriberg et al., 1997; Vogan et al., 2014）.

3.5 Chapter Summary

This chapter has provided a detailed overview of the use of phonological measures to assess and compare language development in children with ASD and typically developing children. The metrics discussed—pMLU, PWP, PCC, and PWC—offer valuable insights into the phonological challenges faced by children with ASD, as well as the developmental progression of TD children. The comparison across different age groups highlights the persistent language deficits in children with ASD and underscores the importance of early and ongoing interventions to support their phonological development. Understanding these differences is key to developing effective strategies for improving language outcomes in children with ASD.

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