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

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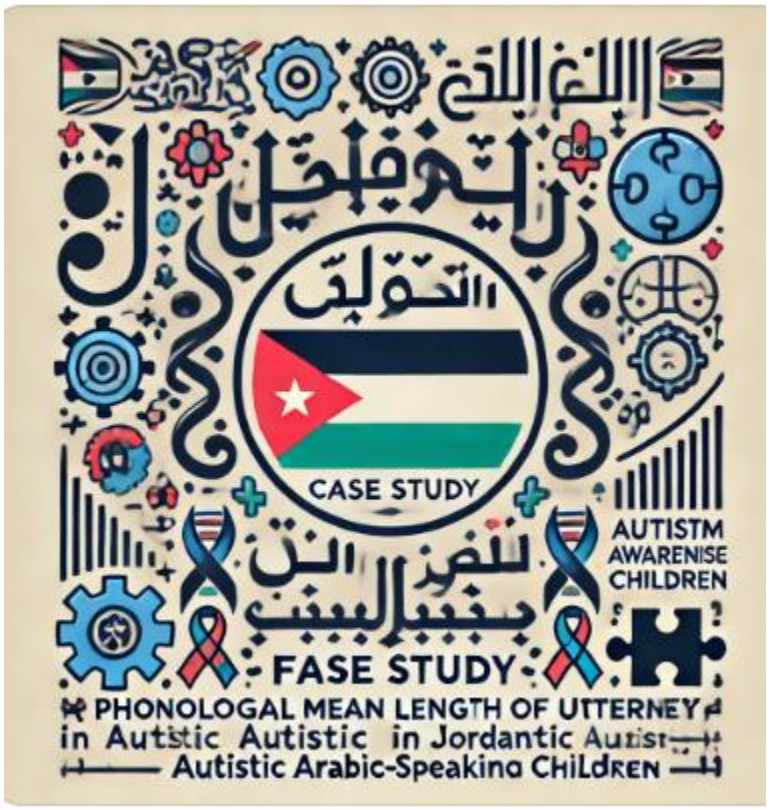
Case Study - Phonological Mean Length of Utterance in Autistic Jordanian Arabic-Speaking Children



4.0 Goal

The primary goal of this case study is to investigate the phonological mean length of utterance (pMLU) among Jordanian Arabic-speaking children diagnosed with Autism Spectrum Disorder (ASD) and compare their linguistic performance to that of typically developing (TD) peers. The study specifically aims to identify the unique phonological challenges faced by children with ASD, with a focus on understanding their language acquisition process and providing a basis for targeted intervention strategies.

4.1 Methods

Participants and Sampling

The study sample comprised 31 Jordanian Arabic-speaking children, who were divided into two distinct groups based on their diagnostic status. The first group consisted of 20 children diagnosed with high-functioning Autism Spectrum Disorder (ASD), including 18 males and 2 females. These children were between the ages of 5 and 8 years, a period crucial for language development. The second group consisted of 11 typically developing (TD) children, including 5 males and 6 females, matched to the ASD group by age and intellectual levels. The TD children served as a control group to compare typical phonological development with the ASD group's language patterns.

Recruitment of Participants

Participants in the ASD group were recruited from specialized educational and therapeutic centers in Amman and al-Zarqa, Jordan. These centers included Al Ghaith Academy for Learning Facilitation, Learning Time Academy, the Consulting Center for Autism, al-Rusaifa Comprehensive Center for Integrated Day Services, the Amman Center for Autism, the Hayati Center for Special Education, and the East Atlas Center for Autism. Children from these centers were selected following a rigorous screening process conducted by specialists at the respective institutions. Parents of the ASD children provided informed consent for their children's participation. The TD group consisted of children who were personally known to the researchers and were assessed in their home environments. None of the participants in either group had a history of neurodevelopmental disorders other than ASD, brain injuries, or any other impairments that could affect their language abilities.

Pilot Study and Validation

Before the main data collection, a pilot study was conducted to evaluate the feasibility and reliability of the phonological measures used in the study, including pMLU, PWP (Proportion of Whole-Word Proximity), PCC (Percentage of Consonants Correct), and PWC (Proportion of Whole-Word Correctness). The pilot study was crucial for identifying potential challenges in data collection and analysis. During the pilot, utterances were collected from a small sample of Arabic-speaking children with ASD to determine whether these phonological measures could be effectively applied to the Arabic language. The pilot study's results indicated that the measures were valid and reliable, with ASD children displaying lower scores across all phonological metrics compared to TD children. The pilot was reviewed by an associate professor of linguistics at The

Hashemite University, who is a native Arabic speaker. Feedback from this review was incorporated into the final data collection procedures to improve accuracy and consistency.

Data Collection Process

The data collection process was structured over ten weeks, during which each child was observed two to three times. The primary method of data collection involved eliciting spontaneous speech samples from the children. These samples were gathered by asking the children to identify objects in their classroom environment and by presenting them with a series of digital images displayed in a slideshow format. The images included common items such as animals, geometric shapes, and colors, which were familiar to the children. This approach was chosen to stimulate natural speech production rather than scripted or prompted responses, thus providing a more accurate representation of each child's phonological abilities.

Speech Sample Analysis

The children's speech samples were collected manually in a quiet room within the academy or home environment, depending on the participant's group. During each session, the children's speech was audio-recorded while they interacted with the examiner, who prompted them to name the objects in the images or describe their characteristics. The recordings were subsequently transcribed into the International Phonetic Alphabet (IPA) by trained linguists, ensuring that each phoneme was accurately represented. This transcription process was essential for applying the phonological measures and analyzing the children's utterances systematically.

Phonological Measures

The primary measure used in this study was the Phonological Mean Length of Utterance (pMLU), which evaluates the complexity of children's utterances by counting the number of phonemes (vowels and consonants) and assigning additional points for correctly produced consonants. For instance, in the target word /ʔaħmar/ (‘red’), the pMLU is 10, calculated by summing the six phonemes ([ʔ], [a], [ħ], [m], [a], [r]) and adding points for each correctly produced consonant. In contrast, a child’s production of /ʔuħnut/ would have a pMLU of 8, reflecting the number of phonemes correctly produced. Additionally, three other measures were used: PWP (which compares the produced pMLU to the target pMLU), PCC (which calculates the percentage of correctly produced consonants), and PWC (which assesses the proportion of entirely correct words in the speech sample).

Data Coding and Reliability

To ensure the reliability of the data, the transcribed speech samples were reviewed by three independent coders: two researchers from the Department of English Language and Literature and a speech pathologist from the Jordan University of Science and Technology. Each coder independently applied the phonological measures to the transcriptions, and their results were compared for consistency. Any discrepancies were resolved through discussion, and a consensus was reached on the final coding. This rigorous approach to data coding ensured that the results were reliable and reflective of the children's actual speech production.

Data Analysis

The coded data were entered into SPSS (Statistical Package for the Social Sciences) version 26.0 for statistical analysis. Descriptive statistics were calculated for each measure (pMLU, PWP, PCC,

and PWC) across the ASD and TD groups, and comparisons were made between the two groups as well as across different age ranges within each group. The statistical analysis also included correlations between the phonological measures and the children's chronological and mental ages. This approach provided a comprehensive understanding of how age and cognitive development influenced the children's phonological abilities.

Ethical Considerations

Throughout the study, ethical considerations were paramount. Informed consent was obtained from the parents or guardians of all participating children, and the confidentiality of the participants was strictly maintained. Personal identifiers were removed from the data to ensure anonymity. Additionally, the study adhered to the ethical guidelines for research involving human participants, as outlined by the Institutional Review Board (IRB) at the lead research institution. The well-being of the children was prioritized during data collection, with sessions conducted in a manner that minimized stress and discomfort for the participants.

4.2 Results

Phonological Mean Length of Utterance (pMLU) Findings

The analysis of the Phonological Mean Length of Utterance (pMLU) scores revealed significant differences between the ASD and TD groups across all age ranges. In the ASD group, the average pMLU score increased with age but remained consistently lower than the scores observed in the TD group. Specifically, the mean pMLU score for 5-year-old children with ASD was 5.58 (SD =

0.87), compared to a mean of 8.30 (SD = 0.06) for their TD counterparts. This difference indicates that ASD children at this age typically produce shorter and less complex utterances.

Among 6-year-old children, the mean pMLU score for the ASD group was 6.40 (SD = 0.48), while the TD group maintained a high mean pMLU of 8.40 (SD = 0.03). This shows a slight improvement in the ASD group's ability to produce longer utterances but still reflects a significant gap compared to TD children. The 7-year-old ASD group had a mean pMLU of 6.06 (SD = 0.80), which was lower than that of the 6-year-olds, indicating a potential stagnation or regression in phonological development. In contrast, the TD group at this age showed continued progress with a mean pMLU of 8.44 (SD = 0.01).

For 8-year-old children, the ASD group reached a mean pMLU of 7.17 (SD = 0.67), the highest within their group but still lower than the TD group's mean of 8.45 (SD = 0.00). This suggests that while ASD children continue to develop their phonological abilities, they do so at a slower pace and do not achieve the same level of linguistic complexity as their typically developing peers.

Proportion of Whole-Word Proximity (PWP) Findings

The Proportion of Whole-Word Proximity (PWP) scores showed a similar pattern to the pMLU results. For 5-year-old children, the mean PWP score was 68% (SD = 10.13%) in the ASD group, compared to 98% (SD = 0.52%) in the TD group. This large discrepancy indicates that ASD children produce words that are significantly less accurate compared to the target words.

At age 6, the mean PWP score for the ASD group increased to 77% (SD = 8.49%), while the TD group achieved a near-perfect mean score of 99% (SD = 0.12%). The 7-year-old ASD group had a mean PWP score of 73% (SD = 8.49%), showing a slight decline compared to the previous age

group. In contrast, the TD group continued to perform at an exceptionally high level, with a mean PWP score of 99.92% (SD = 0.12%).

The 8-year-old ASD group showed an improvement with a mean PWP score of 85% (SD = 7.67%), yet this score remained below the TD group's perfect PWP score of 100% (SD = 0.00%). These findings suggest that while ASD children improve in word accuracy as they age, they still lag significantly behind their typically developing peers.

Percentage of Consonants Correct (PCC) Findings

The Percentage of Consonants Correct (PCC) measure further highlighted the phonological challenges faced by the ASD group. For 5-year-olds, the mean PCC score in the ASD group was 51% (SD = 13.76%), compared to 95% (SD = 1.27%) in the TD group. This indicates that ASD children struggle significantly with producing consonants correctly.

In the 6-year-old group, the mean PCC score for ASD children was 62% (SD = 7.43%), showing some improvement but still well below the TD group’s mean of 98% (SD = 0.34%). The 7-year-old ASD group had a mean PCC score of 55% (SD = 7.43%), reflecting a slight regression, while the TD group maintained near-perfect consonant production with a mean score of 99% (SD = 0.34%).

For the 8-year-old children, the ASD group had a mean PCC score of 75% (SD = 8.70%), the highest within their group but still not reaching the TD group's perfect score of 100% (SD = 0.00%). These results underscore the persistent difficulties children with ASD face in producing consonants accurately.

Proportion of Whole-Word Correctness (PWC) Findings

The Proportion of Whole-Word Correctness (PWC) scores provided additional insight into the overall phonological development of the children. For 5-year-olds, the mean PWC score in the ASD group was 15 (SD = 13.14), indicating that only 15% of the words produced by these children were entirely correct. In contrast, the TD group had a much higher mean PWC score of 88 (SD = 5.29), reflecting their more accurate word production.

Among 6-year-olds, the mean PWC score for the ASD group was 24 (SD = 4.27), while the TD group continued to perform well with a mean score of 99 (SD = 2.88). The 7-year-old ASD group had a mean PWC score of 17 (SD = 5.12), showing a decline, whereas the TD group maintained a high mean score of 99 (SD = 1.15).

For 8-year-olds, the ASD group reached a mean PWC score of 42 (SD = 17.15), their highest score within this measure, but still considerably lower than the TD group's perfect score of 100 (SD = 0.00). These findings indicate that even as ASD children grow older, they continue to face challenges in producing completely accurate words.

Age-Related Trends in Phonological Development

The data revealed clear age-related trends in phonological development within both the ASD and TD groups. While both groups showed improvement in their phonological measures with age, the rate and extent of improvement were markedly different. For the ASD group, each year of age brought gradual increases in pMLU, PWP, PCC, and PWC scores, indicating slow but steady progress in their language abilities. However, the TD group consistently outperformed the ASD group across all measures and age ranges, achieving near-perfect scores by age 8.

The comparison between the chronological and mental ages of the ASD children also provided important insights. For instance, children with a mental age of 5.0 years had an average pMLU of 4.83 (SD = 0.20), while those with a mental age of 6.0 years had an average pMLU of 7.48 (SD = 0.02). This suggests that mental age plays a significant role in the phonological development of children with ASD, with higher mental ages correlating with better phonological outcomes.

Phonological Process Errors

An analysis of phonological process errors revealed that children with ASD exhibited a range of errors, including weak syllable deletion, cluster reduction, final consonant deletion, and Stridency Deletion (StD). These errors were more prevalent in the ASD group compared to the TD group and contributed to the lower scores observed in the phonological measures. For example, weak syllable deletion was common in words like /mu.θal.laθ/ (‘triangle’), which was often produced as /muθal/ by ASD children. Cluster reduction was also frequently observed, with words like /ʔaħmar/ (‘red’) being simplified to /ʔamma/ by the ASD group.

Statistical Correlations

The statistical analysis revealed significant correlations between age and phonological measures within the ASD group. Specifically, chronological age was positively correlated with pMLU ($r = 0.605$, $p < 0.01$), PWP ($r = 0.599$, $p < 0.01$), PCC ($r = 0.629$, $p < 0.01$), and PWC ($r = 0.590$, $p < 0.01$). Mental age showed even stronger correlations with these measures: pMLU ($r = 0.801$, $p < 0.01$), PWP ($r = 0.796$, $p < 0.01$), PCC ($r = 0.706$, $p < 0.01$), and PWC ($r = 0.738$, $p < 0.01$). These correlations suggest that as ASD children grow older, both chronologically and mentally, their phonological abilities improve, although not to the level of their TD peers.

Comparison of Best and Worst Words

The analysis of the best and worst words produced by the ASD group provided additional insights into their phonological abilities. The word /ʔaħmar/ (‘red’) had one of the highest pMLU scores in the ASD group, with a mean of 10, indicating that most children were able to produce this word relatively accurately. On the other hand, words like /maðallija/ (‘umbrella’) had much lower scores, with a mean pMLU of 5, reflecting the difficulties ASD children faced with more complex syllabic structures.

Overall Comparison Between ASD and TD Groups

The overall comparison between the ASD and TD groups across all phonological measures and age ranges highlighted significant disparities in language development. While TD children consistently achieved high scores in pMLU, PWP, PCC, and PWC, reflecting their advanced phonological abilities, children with ASD showed slower progress and greater variability in their scores. This suggests that ASD children face unique challenges in acquiring and using language, particularly in producing accurate and complex utterances.

Implications for Language Intervention

The findings of this study have important implications for language intervention programs aimed at children with ASD. The persistent gaps in phonological development between the ASD and TD groups highlight the need for targeted interventions that address the specific phonological challenges faced by ASD children. Interventions that focus on improving syllabic structure, consonant production, and word accuracy may be particularly beneficial in helping these children achieve better language outcomes.

4.3 Discussion

Phonological Development in ASD Children

The results of this study indicate that Jordanian Arabic-speaking children with ASD exhibit significant delays in phonological development compared to their typically developing peers. The consistently lower pMLU, PWP, PCC, and PWC scores across all age ranges suggest that children with ASD face challenges in constructing longer and more complex utterances, producing accurate consonant sounds, and using correct words in their speech. These findings align with previous research that has documented language delays and phonological impairments in children with ASD (Tager-Flusberg et al., 2005).

Impact of Age and Mental Age on Phonological Abilities

The analysis revealed that both chronological age and mental age play crucial roles in the phonological development of children with ASD. As children in the ASD group aged, their pMLU, PWP, PCC, and PWC scores improved, albeit at a slower rate than their TD peers. The strong correlations between mental age and phonological measures further underscore the importance of cognitive development in language acquisition. Children with higher mental ages were better able to produce longer utterances, more accurate consonants, and correct words, suggesting that interventions targeting cognitive development may also benefit phonological outcomes.

Challenges with Complex Syllabic Structures

One of the key findings of this study is the difficulty that ASD children have with producing words that have complex syllabic structures. Words with multiple syllables, consonant clusters, and final consonants were particularly challenging for the ASD group, as evidenced by the frequent errors in weak syllable deletion, cluster reduction, and final consonant deletion. These phonological simplifications contribute to the lower pMLU and PWC scores observed in the ASD group and highlight the need for interventions that focus on improving syllabic awareness and production.

Comparison with Typically Developing Children

The comparison between the ASD and TD groups underscores the significant disparities in language development. TD children consistently outperformed their ASD peers across all phonological measures, achieving near-perfect scores by age 8. This suggests that while TD children follow a relatively predictable trajectory of language acquisition, children with ASD experience a more protracted and uneven development. The persistence of these disparities across all age ranges highlights the importance of early identification and intervention for children with ASD to address their phonological and language challenges.

Phonological Process Errors

The study identified several phonological process errors that were more prevalent in the ASD group, including weak syllable deletion, cluster reduction, final consonant deletion, and Stridency Deletion (StD). These errors are indicative of the underlying phonological deficits that characterize language development in children with ASD. The frequent occurrence of these errors suggests that ASD children may have difficulty acquiring and generalizing the phonological rules of their native language, leading to persistent challenges in speech production.

Implications for Language Intervention Programs

The findings of this study have important implications for the design and implementation of language intervention programs for children with ASD. Interventions that focus on improving phonological awareness, syllabic structure, and consonant production are likely to be beneficial in helping ASD children develop more accurate and complex language skills. Additionally, interventions that incorporate cognitive development strategies may also support phonological development, given the strong correlation between mental age and phonological measures observed in this study.

Limitations of the Study

While this study provides valuable insights into the phonological development of Jordanian Arabic-speaking children with ASD, it is important to acknowledge its limitations. The sample size was relatively small, particularly for the TD group, which may limit the generalizability of the findings. Additionally, the study focused exclusively on children with high-functioning ASD, and the findings may not be applicable to children with lower-functioning ASD or those with co-occurring neurodevelopmental disorders.

Future Research Directions

Future research should aim to replicate this study with larger and more diverse samples to validate the findings and explore the phonological development of children with different levels of ASD severity. Additionally, longitudinal studies that track the phonological development of children with ASD over time would provide valuable insights into the trajectory of language acquisition in

this population. Research that explores the effectiveness of specific intervention strategies in improving phonological outcomes for children with ASD would also be beneficial.

Cultural Considerations in Phonological Development

The study's focus on Jordanian Arabic-speaking children highlights the importance of considering cultural and linguistic factors in the study of phonological development. The unique phonological features of the Arabic language, such as its consonant clusters and emphatic sounds, may present additional challenges for children with ASD, which are not present in other languages. This underscores the need for culturally and linguistically appropriate assessment and intervention strategies for children with ASD.

Conclusion

In conclusion, this study provides a comprehensive analysis of the phonological development of Jordanian Arabic-speaking children with ASD, revealing significant delays and challenges compared to their typically developing peers. The findings underscore the importance of early identification and targeted intervention for children with ASD to support their language development. While children with ASD do show progress in their phonological abilities as they age, they do so at a slower rate and with greater variability than TD children. These results highlight the need for ongoing support and intervention to help children with ASD achieve their full linguistic potential.

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