

# Phonological Skills in the Spontaneous Speech of Children Who Do Not Stutter

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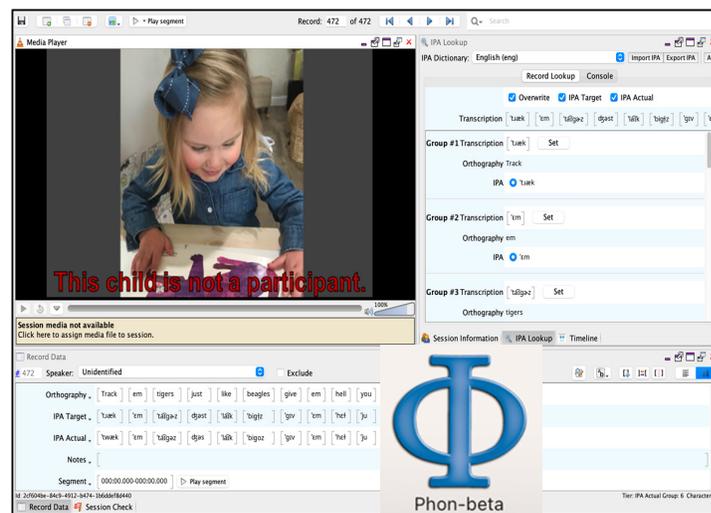
Previous studies have reported that differences in phonological abilities may exist between children who stutter and children who do not stutter (Paden et al., 1999; Spencer & Weber-Fox, 2014). Studies have used nonword repetition tasks (a test where the participant is asked to repeat sounds in the form of made-up words) to differentiate young children who stutter from other groups based on production accuracy (Anderson et al., 2006; Hakim & Bernstein Ratner, 2004). However, these studies have not observed differences in phonological abilities in school-aged children (Smith et al., 2012; Spray, 2020; Weber-Fox et al., 2008). This study also differs from previous studies because it calculates phonological measures using spontaneous speech, rather than individually produced words. Spontaneous speech gives a more holistic view of the participant's speech (because the utterances are longer and more natural), in comparison to the production of single words.

Our hypothesis in this study is that children who stutter will exhibit reduced phonological accuracy in spontaneous speech compared to children who do not stutter. This is measured by phonological mean length of utterance (PMLU) and proportion of whole-word proximity (PWP) (Ingram & Ingram, 2001).

For this portion of the study, speech samples from 10 monolingual children between the ages of 30-50 months of age were transcribed into the software CLAN (MacWhinney, 2000) and Phon (Rose & MacWhinney, 2014). These transcriptions are publicly available through FluencyBank (Bernstein Ratner & MacWhinney, 2018). The inclusion criteria for the children who do not stutter includes: monolingual English speakers, within 1.5 standard deviations of the mean on speech-language tests, no history of learning delay, a minimum of 75 spontaneously produced utterances

greater than two words each, and no previous history of stuttering.

One of the softwares used in this study, Phon, was a program that completes phonological analysis and calculates PMLU and PWP. After each speech sample was transcribed in CLAN, it was imported into Phon. Figure 1 illustrates Phon and an example transcription. Each word was reviewed within the speech sample to ensure proper phonetic transcription using the international phonetic alphabet (IPA). If a child's production of a word was incorrect, alterations to the IPA target were made. After transcription was completed, Phon calculated phonological accuracy and complexity.



**Fig. 1** Example of IPA target and IPA actual transcriptions in the Phon software.

To calculate PMLU, Phon assigns 1-point to each consonant and vowel produced in a word. There is an additional point given for each correct consonant produced in the target production. This results in a calculation of a target PMLU, which is what the child attempted to produce, and an actual PMLU, which is what the child

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actually produced.

Each speech sample was reviewed by two highly-trained Phon users. If issues arose, a qualified third party was consulted to ensure validity and reliability of results.

An independent samples t-test was used to determine whether between-group differences existed for phonological measures that are normally distributed. A Mann-Whitney U-Test was used for phonological measures that are not normally distributed. All results for phonological measures were considered significant at  $p < 0.05$ . Table 1 shows group averages calculated during the study.

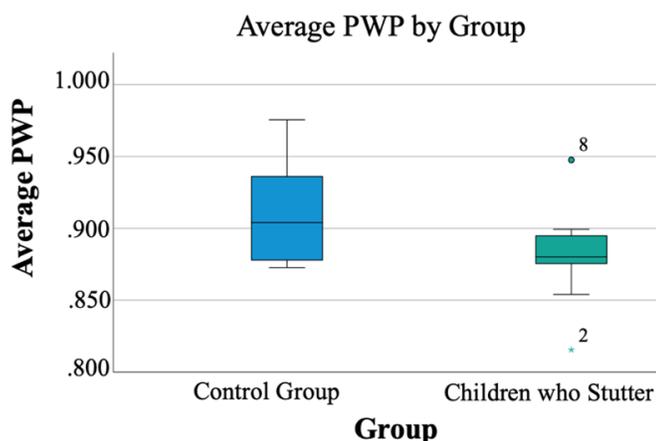
**Table 1** Differences between tPMLU, aPMLU, and PWP of children who stutter and children who do not stutter

**Table 1. Demographic Information & Behavioral Results**

Variable	Stutter N = 12	Control N = 10
Age (months)	38.0 (7.1)	38.8 (6.4)
tPMLU	4.67 (0.34)	4.67 (0.17)
aPMLU	4.26 (0.41)	4.12 (0.20)
PWP *	0.911 (0.034)	0.882 (0.031)

Note. Group averages are displayed above with standard deviations shown in parentheses. tPMLU = target phonological mean length of utterance, aPMLU = actual phonological mean length of utterance, PWP = proportion of whole-word proximity. \*  $p < 0.05$

The results of this study support our hypothesis that children who do not stutter exhibit increased phonological accuracy in spontaneous speech when compared to children who stutter. Figure 2 depicts a comparison of the two groups.



**Fig. 2** PWP is higher for control group in comparison to children who stutter

This report is one part of a multi-phase study. The data collected in this study is being used in comparison to children who stutter to determine differences that between groups.

Results from this study were presented at the 2023 American Speech-Language-Hearing Association Convention in Boston, MA and the 2024 Speech and Hearing Association of Alabama Convention in Birmingham, AL.

Overall, the results of the study add to the mounting evidence that children who stutter may exhibit delayed maturation as it relates to phonological speech production.

### Statement of Research Advisor

Katie Wallace made significant contributions to the project by transcribing speech samples of children who do not stutter. This transcription process included converting orthography into phonetic symbols, which were required to be highly accurate. In addition, Katie reviewed transcriptions completed by another research assistant who transcribed the utterances of children who stutter. Finally, Katie presented these findings at a national/international conference and a regional conference.

- Gregory Spray, Speech, Language, and Hearing Sciences, College of Liberal Arts

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## Authors Biography



Katie E. Wallace is a senior-year student pursuing a B.S. degree in Speech, Language, and Hearing Sciences at Auburn University. She has played a key research role in transcribing the sessions from 10 children who do not stutter into Phon. Katie is a member of multiple research laboratories at Auburn University and was a Peer Mentor at the BRAIN Program at Children's Healthcare of Atlanta.



Katelyn G. Gilson is a senior-year student pursuing a B.S. degree in Speech, Language, and Hearing Sciences at Auburn University. She transcribed the sessions from 12 children who stutter into Phon for this research study. Katelyn is an undergraduate research assistant in Auburn's Speech, Neurophysiology, & Attitude Perceptions (SNAP) Lab.



Meghan E. Stinnette is a graduate student in the Department of Speech, Language, and Hearing Sciences at Auburn University. She received a B.S. degree in Communication Sciences and Disorders from Radford University in 2022. She aided in analyzing and preparing data for this report.



Gregory J. Spray, Ph.D., CCC-SLP is an assistant professor in the Department of Speech, Language, and Hearing Sciences in the College of Liberal Arts. He is the director of the Speech, Neurophysiology & Attitude Perceptions Laboratory (SNAP Lab) at Auburn University.