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The Function of Repeating: The Relation Between Word class and Repetition Type in Developmental Stuttering

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Abstract

Purpose—The purpose of the present study was to investigate repetitions associated with monosyllabic words in preschool-age children who stutter (CWS). Specifically, it was hypothesized that repetition type should vary according to word class in preschool-age CWS and children who do not stutter (CWNS).

Method—Thirteen preschool-age CWS and 15 preschool-age CWNS produced age-appropriate narratives, which were transcribed and coded for part-word repetitions (PWR) and whole-word repetitions (WWR) occurring on monosyllabic words. Each repetition type location was also coded for word class (i.e., function vs. content).

Results—Results indicated that although CWS and CWNS were significantly more likely to produce PWR on content words, this tendency did not differ between the two talker groups. Further, CWS and CWNS did not differ in their tendencies to produce PWR versus WWR overall, but the tendency to produce repetitions on function words was significantly greater for CWS versus CWNS.

Conclusion—Findings are taken to suggest that repetitions of monosyllabic words in young children are not easily explained from the perspective of phonological errors, but may instead be considered from an incremental planning of speech perspective.

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Keywords

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1. Introduction

An issue that remains unresolved with respect to developmental (childhood) stuttering is the nature of a potential linguistic contribution to the occurrence of speech disfluencies (for review, see Ntourou, Conture, & Lipsey, 2011). As part of the traditional model of language production, it has been proposed that different repetition types are by-products of errors occurring at different levels of linguistic encoding (e.g., Levelt, Roelofs, & Meyer, 1999), For example, part-word repetitions (PWR) are proposed to result from errors at the level of phonological encoding, and whole-word repetitions (WWR) are proposed to result from errors at the level of lexical planning (Postma & Kolk, 1993). From the standpoint of the traditional model, content words are more susceptible to phonological encoding errors (Garrett, 1975; Stemburger, 1984). Potential linguistic encoding problems can therefore be tested empirically by comparing the likelihood of producing PWR versus WWR on content versus function words. Using this framework, this study explored a potential phonological factor in childhood stuttering.

1.1 Part- and whole-word repetitions and linguistic encoding

According to the traditional model of language production, linguistic planning is thought to be a lexically driven process, in which both phonological and syntactic elements of a sentence are driven by the selection of a word (Levelt, 1989; Levelt, et al. 1999). Accordingly, a phonological error can be detected prior to its occurrence in overt speech by monitoring internal speech. Once the error is detected, overt speech can be interrupted for error repair, and the speaker's retrace span, measured from the point of interruption to where the speaker restarts the utterance, is thought to reflect the level of planning at which the error occurred. For example, a speaker's correction of a syntactic error would involve a retrace span of a single phrase (e.g., “Go to the- to the left.”) or a single word (e.g., “Go to -to the left”). Correction of a phonological error would involve a retrace span of part of a word (e.g., “G -Go to the left”)[1].

Speech errors are typically associated with content words such as nouns, verbs, and adjectives (Fromkin, 1971). According to the traditional model of language production (Levelt et al., 1999), speech errors can emerge during linguistic planning, as content words are assigned to their relevant slots within a syntactic structure (e.g., a noun phrase). During this process interference can occur between content words, resulting in anticipation, perseveration, or exchange errors (Dell, 1986). Such interference is apparent in a tongue twister such as “she sells sea shells,” in which anticipation of *sh* in “shells” might result in the selection of *sh* at the syllable-initial position of the preceding word “sea”, resulting in an

[1]It should be noted that our definition of part-word repetition is an attempt at a particular utterance that involves the repetition of something less than the fully-formed syllable. To this end, vocalization that is produced with central tongue position (i.e., schwa) is not considered to be the vocalic portion of the syllable.

error. According to the traditional model, an interruption occurring within a content word would be assumed to originate at a *phonological* level. In contrast, function words such as conjunctions, prepositions, and determiners play a grammatical role in the serial ordering of content words, and are not thought to be associated with phonological errors (Garrett, 1975).

1.2. Linguistic encoding

Among various language factors, a potential phonological factor has been theoretically identified as a core deficit that contributes to childhood stuttering (e.g., The Covert Repair Hypothesis, Postma & Kolk, 1993). Phonological factors have been empirically assessed in childhood stuttering in several ways, including 1) performance on standardized tests of phonological or articulation, 2) phonological complexity of stuttered words, and 3) phonological processing (for review, see Sasisekaran, 2014). First, CWS as a group do not appear to differ in terms of metaphonological abilities or on standardized measures of phonology (Bajaj, Paden, & Schommer-Aikins, 2004; Paden, Ambrose, & Yairi, 1999), although there may be a subgroup of CWS who exhibit poor performance on measures of phonology (e.g., Paden, Ambrose, & Yairi, 1999). Second, phonological complexity of the word spoken has not been found to influence the likelihood of stuttering (Howell & Au-Yeung, 1995; Throneburg, Yairi, & Paden, 1994). However, Anderson (2007) reported that words associated with PWR were significantly lower in word frequency but not lower phonological density compared to fluently produced words. Third, empirical investigations have reported that stuttering frequency is not correlated to frequency of phonological process errors (e.g., Wolk, Blomgren, & Smith, 2000). However, Yaruss and Conture (1996) reported a correlation between stuttering frequency and slips of the tongue. As a result of equivocal evidence for a phonological factor in stuttering in the aforementioned studies, it has been speculated that a phonological factor does not contribute to stuttering (e.g., Nippold, 2002).

Given that the retrace span after repairing a phonological error is likely to occur within a content word (Postma & Kolk, 1993), empirical studies regarding the tendency for children to stutter on function words presents a novel means to investigate a potential phonological factor in developmental stuttering. Although the traditional model would predict that phonological encoding problems should manifest on content words, young children tend to stutter on *function* words (e.g, Au-Yeung, Howell, & Pilgrim, 1998). Empirical studies have shown that stuttering is more likely to occur at the beginning of an utterance, and for preschool-age children, function words are more likely to occur at this initial position (Buhr & Zebrowski, 2009; Richels, Buhr, Conture, & Ntourou, 2010). Although these findings suggest that sentence planning is related to the tendency to stutter on function words, factors related to the word itself could lead to stuttering on content words.

1.3 Purpose of study

To investigate a potential phonological factor in developmental stuttering, content and function words associated with whole-word repetitions (WWR) and part-word repetitions (PWR) were examined in young children who stutter (CWS) and young children who do not stutter (CWNS). The following three hypotheses were designed to test the relation between repetition type and word class:

First, it is hypothesized that both CWS and CWNS will tend to produce more PWR than WWR on content compared to function words. If this hypothesis is supported by empirical findings, it would suggest that each repetition type is more likely to manifest as a result of different aspects of sentence production.

Second, preschool-age CWS are hypothesized to be more likely than preschool-age CWNS to produce PWR relative to WWR overall, regardless of word class (function or content words). If this hypothesis is supported by empirical findings, it would lend support to the notion that phonological encoding difficulties play a prominent role in developmental stuttering.

Third, preschool-age CWS are hypothesized to be more likely than preschool-age CWNS to produce PWR relative to WWR on content words. If this hypothesis is supported by empirical findings, it would lend further support to the notion that phonological encoding difficulties play a prominent role in developmental stuttering.

2. Method

2.1 Participants

Thirteen preschool-age children who stuttered (CWS; mean age = 48.0 months, range 37-60 months; 4 males) and 15 preschool-age children who did not stutter (CWNS; mean age = 49.0 months, range 37-59 months; 7 males) participated. All participants were monolingual English-speaking preschool-age children. Participants were paid volunteers whose parents learned of the study in a free local monthly parent magazine, were contacted from Tennessee State birth records or were referred to the Vanderbilt Bill Wilkerson Hearing and Speech Center for evaluation. None of the CWS had received treatment for their stuttering prior to or during the study. The protocol was approved by the Vanderbilt University Institutional Review Board. Parents provided informed consent and children assented to the study.

From an initial pool of 19 possible CWS and 21 possible CWNS, 5 CWS and 2 CWNS were eliminated because the low audio intensity of their audio-video recordings made it difficult to accurately transcribe their narratives. In addition, transcripts from 1 CWS and 4 CWNS were eliminated because stuttered repetitions (i.e., PWR and WWR) were too infrequent to permit meaningful assessment. Exclusion of these CWS and CWNS for the reasons stated resulted in the inclusion of 13 CWS, all of whom were Caucasians, and 15 CWNS, 14 of whom were Caucasians and one an African-American.

A child was considered a CWS if (a) three or more stuttered disfluencies (i.e., sound/syllable repetitions, monosyllabic whole-word repetitions, and sound prolongations) were produced per 100 words of conversational speech (Clark, Conture, & Walden, 2013), and (b) received a score of 11 or higher (i.e., severity of at least “mild”) on the Stuttering Severity Instrument-3 (SSI-3; Riley, 1994). A child was considered a CWNS if (a) two or fewer stuttered disfluenices were produced per 100 words of conversational speech, and (b) received a score of 10 or lower (i.e., severity of less than “mild”) on the SSI-3. Descriptive statistics are presented in Table 1.

To minimize the possibility of stuttering being confounded by clinically significant concerns with speech or language abilities, children had to score above the 16th percentile, or one standard deviation below the mean, on the Peabody Picture Vocabulary Test-Third Edition (Dunn & Dunn, 1997), the Expressive Vocabulary Test (Williams, 1997), the Test of Early Language Development-3 (Hresko, Reid, & Hamill, 1999), and the "Sounds in Words" subtest of the Goldman-Fristoe Test of Articulation-2 (GFTA-2; Goldman & Fristoe, 2000). Group means are presented in Table 2.

2.2 Procedure

Upon arrival at the Vanderbilt University Developmental Stuttering Project laboratory, participants were led into a room and seated in a car safety seat situated directly in front of a computer monitor. This setup was designed to resemble a jeep to make participation more inviting for preschool-age children. Participants were asked to produce a narrative using one of four storybooks about a boy, a dog, and a frog, all by the author Mercer Mayer, including: Frog, Where Are You? (1969), A Boy, a Dog and a Frog (1967), Frog on his Own (1973) or *A Boy, a Dog, a Frog and a Friend (1971)*. The use of narratives provided a consistent speaking context across participants.

Audio/video recordings of these narratives were subsequently used to produce computer-based transcripts (SALT, Systematic Analysis of Language Transcripts; Miller, & Iglesias, 2008). Utterance segmentation was based on identification of either: 1) a new independent clause, or 2) a pause of more than 1 second. Utterances containing singing, recitation, or unintelligible words, as well as those that were abandoned or interrupted were excluded from final data analysis. If a child listed information (e.g., "cow, dog, sheep..."), items after the first two were placed in parentheses for exclusion from analysis. Finally, utterances consisting of a single word (e.g., yes, no) were included in the data set. Using these transcripts, the final data set consisted of 22,552 words within 4529 utterances across 15 CWNS and 13 CWS.

Several disfluency types were coded within each participant's transcribed narrative. Stuttered disfluencies included part-word repetitions (PWR), monosyllabic whole-word repetitions (WWR), and sound prolongations (PRO). Non-stuttered disfluencies included interjections (INT), multi-syllable word repetitions (MWR), phrase repetitions (PR), and revisions (REV). However, only repetitions occurring on monosyllabic words were used for the purposes of the present study, as noted earlier. Restricting analysis to only monosyllabic words allowed the researchers to control for potential differences in planning demand on multi- versus monosyllabic words.

A PWR was defined as the repetition of part of a single-syllable word, (e.g., "co- come over here"). A WWR was defined as a repetition of a single-syllable word ("come- come over here"). A PWR or WWR that occurred on a monosyllabic word associated with a phrase repetition was coded if the word within the repeated material also occurred in the final production (e.g., "g- go to go to the store"). Finally, monosyllabic words on which both a PWR and WWR occurred (i.e., a disfluency cluster) were not used for the present analysis. The occurrence of disfluency clusters was very infrequent. Word class was categorized using the Au-Yeung et al. (1998) scheme.

2.3 Measurement Reliability

One of the three narratives for each participant was chosen at random for assessment of measurement reliability and transcribed and coded by a second experimenter. At syllable locations, measurement reliability comparisons were made for fluency type (stuttered or fluent) and repetition type (PWR or WWR). For fluency type, agreement was 85% with a kappa coefficient of .70 and for repetition type, agreement was 91% with a kappa coefficient of .72.

2.4 Dependent measures

To assess between-group differences in frequency of repetition types of interest (i.e., PWR and WWR), repetition frequency was used as a dependent variable. Repetition frequency was defined as frequency of repetition type per 100 words. This measure was log-transformed on data combined from both groups to normalize its distribution (Tumanova, Conture, Lambert & Walden, 2014). Finally, a regression model was used to evaluate potential between-group differences according to Age, Gender, and socioeconomic status (SES; Hollingshead, 1975).

To examine Hypotheses 1-3, a list of words on which either a PWR or a WWR occurred was first generated using SALT (Miller & Iglesias, 2008) for both CWS and CWNS. For each word, the number of times a PWR versus a WWR occurred was recorded. As mentioned above, only *monosyllabic* words were used and each was identified as a content word or a function word. Content words included nouns, main verbs, adverbs, and adjectives. Function words included auxiliary verbs, pronouns, prepositions, conjunctions, and determiners. Thus, the words associated with PWR and WWR were coded as either a function or a content word for both CWS and CWNS.

2.5 Data Analysis

Demographic information and frequencies of PWR and WWR—In addition to comparing CWS and CWNS on standardized language skills, log-transformed values of frequency of repetition type were used as dependent measures in independent samples t-tests to assess between-group differences in frequency of repetition type (i.e., PWR and WWR). Results of this analysis allowed researchers to confirm that CWS and CWNS significantly differed in their frequency per 100 words of PWR and WWR.

Relation between word class and repetition type: Within-group comparisons—Chi-square tests of independence were used to assess the first hypothesis, that is, whether CWS and CWNS were more likely to produce PWR than WWR on function vs. content words. Cramer's V is reported as the effect size, with a value of 0.1 indicating a small effect, a value of 0.3 indicating a moderate effect, and a value of 0.5 indicating a large effect.

Relation between word class and repetition type: Between-group comparisons—Chi-square tests of independence were used to assess between-group differences regarding the tendencies to produce 1) repetitions on function vs. content words (first hypothesis), 2) repetitions on PWR vs. WWR (second hypothesis), 3) PWR on content words (third hypothesis), and 4) WWR on function words. As with the above within-group comparison of the relation between word class and repetition type, Cramer's V was employed for this within-group assessment of the same relation.

3. Results

3.1 Demographic information and frequencies of PWR and WWR

First, as might be expected based on SSI-3 group classification criteria, CWS produced significantly more stuttered repetitions, $\beta = 1.071$, $t(22) = 4.602$, $p < 0.001$. There were, however, no significant differences in repetition frequency according to Gender, $\beta = -.366$, $t(22) = 1.479$, $p = .142$, Age, $\beta = .012$, $t(22) = 0.937$, $p = .351$, or SES, $\beta = .007$, $t(22) = 0.822$, $p = .413$, and the interaction between Gender and SSI group classification was not significant, $\beta = -.163$, $t(22) = 0.431$, $p = .667$. Likewise, performance on standardized language tests did not significantly differ between CWS and CWNS ($p > 0.10$ for all comparisons). Finally, as shown in Table 3, CWS produced a significantly greater repetition frequency of both PWR and WWR compared to CWNS.

3.2 Word class and repetition type: Within-group comparisons

First, regarding Hypothesis 1, results of chi-square tests of independence indicated that for CWS, the tendency to produce WWR versus PWR differed between function and content words, χ^2 (1, $N = 448$) = 7.143, $p = .008$, Cramer's V = 0.13. This tendency to produce WWR versus PWR also differed between function and content words for CWNS, χ^2 (1, $N = 177$) = 4.181, $p = 0.041$, Cramer's V = 0.15. As can be seen on the right hand side of Figure 1, both groups tended to produce PWR on content words. And as can be seen on the left hand of Figure 1, both groups tended to produce WWR on function words. These results suggest that each repetition type is more likely to manifest from different aspects of sentence production. Table 4 presents information regarding within-group comparisons.

3.3 Word class and repetition type: Between-group comparisons

First, results of chi-square tests of independence indicated that the tendency to produce repetitions on function compared to content words significantly differed between CWS and CWNS, χ^2 (1, N = 625) = 4.019, p = .045, Cramer's V = 0.08. Specifically, CWS exhibited a greater tendency than CWNS to produce repetitions on function versus content words. Second, regarding Hypothesis 2, CWS and CWNS did not differ in their tendency to produce PWR compared to WWR, regardless of word class, χ^2 (1, N = 625) = 0.959, p = .33. This finding does not support the notion that phonological encoding difficulties play a prominent role in developmental stuttering. Third, regarding Hypothesis 3, CWS and CWNS did not differ in their tendencies to produce PWR relative to WWR on content words, χ^2 (1, N = 625) = 0.117, p = .73. This finding also does not support the notion that phonological encoding difficulties play a prominent role in developmental stuttering. Finally, there was no significant difference between CWS and CWNS in their tendency to produce WWR on function words, χ^2 (1, N = 625) = 0.236, p = .63. Results of between-group comparisons are presented in Table 5.

3.4 Summary of results

The present study resulted in three main findings, relating to each of the three hypotheses. First, regarding Hypothesis 1, both CWS and CWNS produced more PWR than WWR on content words compared to function words. Second regarding Hypothesis 2, CWS were not more likely than CWNS to produce PWR than WWR overall. Rather, CWS were significantly more likely than CWNS to produce repetitions on function compared to content words. Third, regarding Hypothesis 3, CWS were not significantly more likely than CWNS to produce PWR on content words.

4. Discussion

The three main findings will be discussed first, followed by a more general discussion of the main findings.

4.1 Within-group comparisons of PWR relative to WWR on content and function words (Hypothesis 1)

First, regarding Hypothesis 1, CWS and CWNS both tended to produce WWR on function compared to content words (Figure 1). Given that children tend to stutter at the beginning of an utterance, a position where function words are most likely to occur (e.g., Buhr & Zebrowski, 2009; Richels et al., 2010), this finding suggests that WWR occurring on function words is related to aspects of sentence planning. If the size of the retrace span is related to the linguistic unit being planned by the speaker (Levelt et al., 1999), WWR may be related to increased planning requirements for lexical selection at the beginning of an utterance, the position where planning requirements are thought to be greatest (e.g., Clark & Wasow, 1998; Rispoli, Hadley, & Holt, 2008).

It can also be seen in Figure 1 that both CWS and CWNS did produce PWR on function words. Relevant to this finding, Wijnen (1992) reported that adults produced virtually no sound errors on what was defined as minor classes of words (i.e., adverbs, pronouns, determiners, prepositions), and his analysis of child speech samples revealed that only 24% of their sound errors were on minor classes of words. This suggests that PWR need not occur due to phonological encoding errors. Rather, other factors might have contributed to the occurrence of PWR for preschool-age children in the study.

4.2 Between-group comparison of PWR relative to WWR (Hypothesis 2)

Second, regarding Hypothesis 2, it was hypothesized that CWS would be more likely than CWNS to produce PWR than WWR, regardless of word class. To the extent that the phonological factors drive PWR, such a finding would indicate that phonological encoding difficulties play a prominent role in developmental stuttering. However, results did not reveal a difference between CWS and CWNS in their tendency to produce PWR versus WWR.

4.3 Between-group comparisons of PWR relative to WWR on content words (Hypothesis 3)

Finally, regarding Hypothesis 3, it was hypothesized that, if phonological factors contribute to developmental stuttering, CWS would be significantly more likely than CWNS to produce PWR on content words, as content words are thought to be most susceptible to phonological errors (Garrett, 1975; Levelt, 1989; Stemberger, 1984). As can be seen in Figure 1, of all repetitions produced on content words, the percentage that consisted of PWR (compared to WWR) was 61% for preschool-age CWNS and 56% for preschool-age CWS. Thus, although both groups tended to produce PWR on content words, this tendency did not distinguish CWS from CWNS. This finding does not support to the notion that phonological difficulties are involved in developmental stuttering.

4.4. Incremental Speech Production

In the present study, preschool-age CWS produced a greater frequency of repetitions than CWNS for both PWR and WWR, consistent with group classification and confirming that preschool-age CWS are less fluent in general (Tumanova, et al., 2014). To the extent that different repetition types result from different levels of linguistic planning, a theoretical account is needed to explain this finding. One possibility is that WWR could also relate to phonological encoding errors. However, this would mean that the overt manifestation of a repetition would not reflect the origin of the original error (i.e., phonological or lexical), contrary to the traditional model (Levelt et al, 1999).

A more parsimonious explanation of present findings is that repetition types relate to a single factor that can manifest in more than one way in overt speech (e.g., PWR or WWR). One possibility is the development of incremental speaking skills, or the ability to simultaneously articulate an utterance while planning what to articulate next (Ferreira & Swets, 2002; Levelt et al., 1999). For example, a speaker who has made a syntactic commitment (Clark & Wasow, 1998) may repeat the initial function word to "buy time" for planning (e.g., Au-Yeung, et al., 1998). To this end, a child's articulation of the phrase-initial function word of a noun phrase (e.g., *The* in "The boy...") can begin if it agrees syntactically with the yet-to-be-selected content word (i.e., *boy*), reflecting a speaker's commitment at a syntactic level of planning. Thus, the incremental nature of speech allows speakers to begin speaking while utterance planning is not yet completed.

With respect to the present study, the finding that preschool-age CWS are significantly more likely than preschool-age CWNS to produce repetitions on function words suggests that CWS may have greater difficulty with incremental speaking skills. This difficulty may result in a greater tendency to produce repetitions on function words as a tactic to "buy time" for further planning (Au-Yeung et al., 1998). In addition, children for whom incremental speech is developing may take more time to plan what to articulate next, resulting in a greater likelihood of overt interruptions within an utterance. To this end, an interruption may occur either within or between words, and the retrace span may encompass one or multiple syllables.

4.5 Incremental Speech and Repetition Type

Children for whom incremental speaking skills are developing might produce a relatively greater frequency of PWR *and* WWR. The tendency to produce WWR on function words may be tied to utterance planning, and WWR on function words would therefore be expected to occur at the beginning of an utterance, where function words tend to occur for preschool-age children (Buhr & Zebrowski, 2009; Richels et al., 2010). On the other hand, the greater frequency of PWR may relate to the ability to plan an interruption *in advance*. Clark and Wasow (1998) have suggested that speakers choose to interrupt between words and retrace back to a constituent boundary (e.g., “I wa- I want to go.”), thus facilitating formulation and comprehension for speaker and listener.

Empirical findings have shown that adult speakers choose to delay an interruption until planning has been completed (Seyfeddinpur, Kita, & Indefrey, 2008), or to interrupt between words to make the resumption easier (Tydgat, Stevens, Hartsuiker, & Pickering, 2011). To this end, children for whom incremental speech is developing may be less able to plan an interruption at syllable boundaries, resulting in a greater frequency of PWR. Thus, planning in advance an interruption to occur within a syllable versus between syllable boundaries is a possibility worth further empirical investigation.

4.6 Limitations

This present study has several limitations that would benefit from being addressed in future empirical investigations. One limitation is that only repetitions were examined. However, this made it possible to develop relatively straightforward hypotheses regarding the occurrence of PWR and WWR that could be tested in both CWS and CWNS. Subsequent empirical investigations in this area may also want to consider other disfluency types, for example, sound prolongations.

A second limitation is the gender distribution is unequal between CWS and CWNS and did not reflect the stuttering population at large. However, a regression model did not indicate any gender-related differences. It is worth considering that some children in the study were on different developmental tracks. For example, females are more likely to recover from stuttering (Conture, 2001). However, it is unknown how different developmental tracks might have influenced the relation between word class and repetition type in preschool-age children.

A third limitation is that syllable stress was not examined. To the extent that young children are acquiring the prosodic patterns of their language, prosodic factors could also contribute to the occurrence of repetitions, particularly on content words (e.g., Natke, Sandrieser, van Ark, Pietrowski, & Kalvaram, 2004; Packman; Onslow, Richard, & van Doorn, 1996).

A fourth limitation is that narratives were used in the present study, whereas much previous literature has used conversational data. Although conversational and narrative tasks likely differ in some language production processes, it is not clear that this is true for phonological encoding, the primary focus of the study. Additionally, there is no empirical evidence that these authors are aware of that stuttering frequency significantly differs between conversations and narratives. This is an empirical question that must await future study.

A final limitation is that the design was descriptive rather than experimental in nature. Perhaps future studies may employ other speaking tasks that permit greater degree of control over factors relating to developing incremental speech production.

4.7 Conclusion

Findings of the present study revealed that, although both preschool-age CWS and CWNS were more likely to produce PWR than WWR on content words, this tendency did not differ between the two groups. This finding is inconsistent with the notion that stuttering of preschool-aged CWS is associated with phonological encoding difficulties. Although results of the present study do not rule out the possibility that at least some repetitions produced by preschool-age CWS could be by-products of phonological encoding errors, obtaining empirical evidence in support of this possibility is a challenge for future empirical studies. An alternative explanation of the present findings is that incremental planning of speech parsimoniously accounts for the occurrence of PWR and WWR on content versus function words.

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What this paper adds

It is already known that preschool-age children who stutter tend to stutter on function words at the beginning of sentences. It is also known that this tendency exists for young children who do not stutter as well. However, the precise relation between word class and repetition type in preschool-age stuttering is unknown.

This study specifically adds key detail that preschool age children who stutter and preschool-age children who do not stutter both tend to produce whole-word repetitions on function words and part-word repetitions on content words. This study also adds the key detail that preschool-age children who stutter tend to stutter more on function words than content relative to preschool-age children who do not stutter. These findings suggest that the developing incremental speaking skills might better account for stuttering in preschool-age children compared to phonological processing accounts.

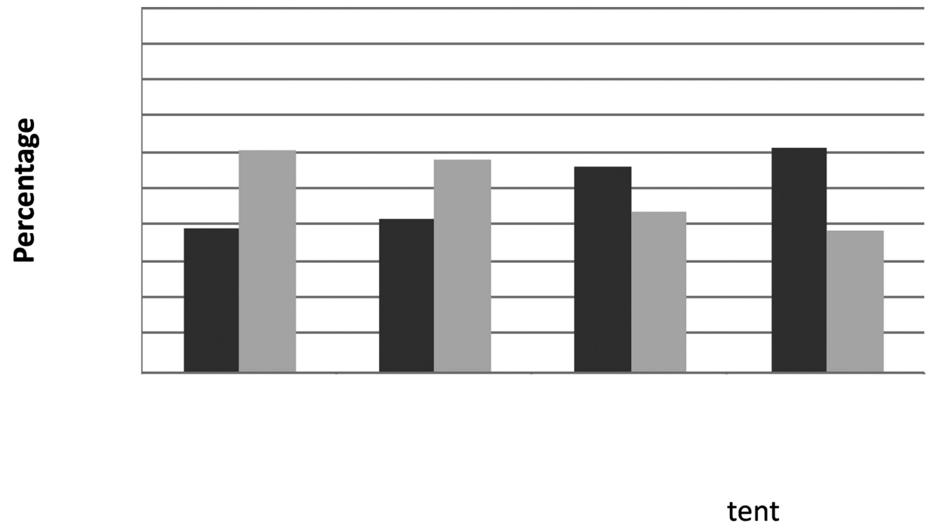

Figure 1.
Interaction between word class (function vs. content) and repetition type for children who do stutter (CWS) and children who do not stutter (CWNS).

Table 1

Mean and standard deviation (SD) for preschool-age children who stutter (CWS; n = 13) and preschool-age children who do no stutter (CWNS; n = 15).

	Gender		Months		SES		Word/Utt		SSI score		ST rate		NST rate	
Group	**M**	**F**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
CWS	4	9	48.0	7.29	38.50	7.13	4.78	1.13	17.62	5.30	5.31	2.30	10.04	6.34
CWNS	7	8	49.0	7.67	47.03	12.29	5.22	0.88	6.53	2.07	1.87	0.90	5.50	2.70

Note: SES = socioeconomic status; SSI score obtained from SSI-3; ST = stuttered disfluencies; NST = non-stuttered disfluencies. ST and NST rates obtained from transcriptions of narratives.

Table 2

Mean and standard deviation (SD) of standardized languages scores for preschool-age children who stutter (CWS; n = 13) and preschool-age children who do not stutter (CWNS; n = 15).

	TELD3-R		TELD3-E		PPVT3		EVT		GFTA2	
Group	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
CWS	114.9	16.83	104.3	14.10	110.8	15.05	111.8	12.60	103.3	31.28
CWNS	114.9	11.75	109.2	11.82	112.3	7.71	112.7	10.53	105.1	10.27

Note: TELD3-R = Test of Early Language Development-Receptive; TELD3-E = Test of Early Language Development-Expressive; PPVT3 = Peabody Picture Vocabulary Test; EVT = Expressive Vocabulary Test; GFTA2 = Goldman Fristoe Test of Articulation.

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Table 3

Mean, standard deviation (SD), and range of frequency per 100 words, and between-group comparisons of frequency per 100 words (Welch t-tests), for preschool-age children who stutter (CWS; n = 13) and preschool-age children who do not stutter (CWNS; n = 15).

Type	Group	Mean	SD	Range	df	t	p
PWR	CWS	2.15	1.55	0.54 - 6.63	26	4.708	<0.001
	CWNS	0.68	0.42	0.11 - 1.54	-	-	-
WWR	CWS	2.43	1.38	1.10 - 6.32	24	5.421	<0.001
	CWNS	0.79	0.82	0.11 - 3.61	-	-	-
Total	CWS	2.29	1.44	0.54 - 6.63	-	-	-
	CWNS	0.74	0.64	0.11 - 3.61	-	-	-

Note: PWR = part-word repetition; WWR = whole-word repetition.

Table 4

Results of within-group chi-square tests of independence used to assess if preschool-age children who stutter (CWS; n = 13) and preschool-age children who do not stutter (CWNS; n = 15) were more likely to produce PWR or WWR on content and function words.

		Repetitions		Chi-Square Test for Independence				
CWS		**PWR**	**WWR**	**N**	**df**	**χ2**	**p**	**Craver's V**
	Function	145	225	448	1	7.143	0.008	0.13
	Content	44	34					
CWNS								
	Function	56	77	177	1	4.181	0.041	0.15
	Content	27	17					

Note: PWR = part-word repetition; WWR = whole-word repetition.

Table 5

Results of between-group chi-square tests of independence used to assess if preschool-age children who stutter (CWS; n = 13) and preschool-age children who do not stutter (CWNS; n = 15) were more likely to produce PWR or WWR on content and function words.

	Repetitions		Chi-Square Test for Independence				
Word Class	**Function**	**Content**	**N**	**df**	**χ2**	**p**	**Craver's V**
CWS	370	78	625	1	4.016	0.045	0.08
CWNS	133	44					
Repetition Type	**PWR**	**WWR**	**N**	**df**	**χ2**	**p**	**Craver's V**
CWS	189	259	625	1	0.1166	0.733	0.01
CWNS	83	94					
Content Words	**PWR**	**WWR**	**N**	**df**	**χ2**	**p**	**Craver's V**
CWS	44	34	625	1	0.1166	0.733	0.01
CWNS	27	17					
Function Words	**PWR**	**WWR**	**N**	**df**	**χ2**	**p**	**Craver's V**
CWS	145	225	625	1	0.236	0.627	0.03
CWNS	56	77					

Note: PWR = part-word repetition; WWR = whole-word repetition.