The frequency of simultaneous disfluency and phonological errors in children: A preliminary investigation

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THE FREQUENCY OF SIMULTANEOUS DISFLUENCY AND PHONOLOGICAL ERRORS IN CHILDREN: A PRELIMINARY INVESTIGATION

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The frequency of simultaneous disfluency and phonological errors was examined in seven young English-speaking children exhibiting coexisting stuttering and phonological disorders. Data were gathered during 30 minutes of mother-child conversation and analyzed in three parts: (1) stuttering, (2) phonological errors, and (3) stuttering and phonological error co-occurrence. Results indicated that stuttering did not occur more frequently on syllables with phonological errors than on syllables without phonological errors. However, the frequency of disfluency on word-initial consonant clusters with phonological errors was significantly higher than on word-initial consonant clusters without phonological errors. Theoretical and clinical implications are discussed. © 2000 Elsevier Science Inc.

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Traditionally, speech-language pathologists have evaluated and treated many communication disorders in isolation. Recently, there has been a growing interest in the co-occurrence of more than one speech disorder in the same individual. For example, the co-occurrence of stuttering and phonological[1] disorders in young children has been investigated in some detail (Howell &

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[1]Although the terms ‘phonological error’ and ‘phonological disorder’ are used throughout this paper, such errors and disorders may involve nonlinguistic motor factors that are often described as ‘articulatory’ elsewhere.

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Au-Yeung, 1995; Logan & Conture, 1997; Louko, Edwards, & Conture, 1990; Paden & Yairi, 1996; Wolk, Edwards, & Conture, 1993; Yaruss & Conture, 1996). In these studies, stuttering was typically described by some pattern of sound/syllable repetitions, monosyllabic whole-word repetitions, and/or audible and inaudible sound prolongations (Conture, 1990). In contrast to stuttering, phonological disorders are typically described by persistence of a immature phonological process or production of an atypical process. An example of a persistent error pattern is the deletion of final consonant after developmental age when such a pattern is considered normal (e.g., “ca” for “cat”). An atypical error has been described as a production pattern that does not usually occur during speech development such as substitution of a stop for a glide (e.g., “bill” for “will”) (Stoel-Gammon & Dunn, 1985).

To some extent, interest in the co-occurrence of stuttering and phonological disorders developed from findings that the incidence of phonological disorders in young children who stutter is reported to be higher than in normally fluent children (e.g., Andrews & Harris, 1964; Darley, 1955; Louko et al., 1990; McDowell, 1928). Findings from previous studies have generally indicated that approximately 30–40% of young stutterers also exhibit phonological problems (See review in Wolk, Conture, & Edwards, 1990). However, until recently, research examining the coexistence of stuttering and phonological disorders was largely epidemiological in nature. That is, studies mainly explored the prevalence of phonological disorders among young children who stutter. Over the past decade, studies have become more descriptive in their reports of children who exhibit both disorders. For example, Louko et al. (1990) investigated stutterers’ speech sound production from a phonological perspective. Compared with their normally fluent peers, children who stuttered exhibited a greater variety of phonological processes. Wolk et al. (1993) assessed differences in stuttering, phonological, and diadochokinetic behavior in children who exhibited both stuttering and disordered phonology and in children who exhibited only one of these disorders. They found that children who exhibit both stuttering and disordered phonology produced significantly more sound prolongations and significantly fewer iterations per whole-word repetitions than did the group who exhibited only stuttering.

Other studies have examined the phonological aspects of words and utterances that contain disfluencies. Yaruss and Conture (1996) evaluated aspects of the Covert Repair Hypothesis (CRH) with regard to speech characteristics of children with coexisting stuttering and phonological disorders. Yaruss and Conture’s CRH prediction that disfluencies and phonological errors would co-occur were supported for nonsystematic (i.e., ‘slip of the tongue’) errors but not for systematic (i.e., phonological-based) speech errors. Logan and Conture (1997) investigated temporal, grammatical, and phonological characteristics of children who stutter. They found that utterances that contained more clausal elements than length-matched utterances contained more disfluency.

In their examination of phonological factors, however, they found no significant difference between syllable structure of length-matched utterances with respect to stuttering frequency or duration. Throneburg, Yairi, and Paden (1994) examined phonological aspects of disfluent words and the words immediately following disfluency. They reported that phonological difficulty did not appear to influence the occurrence of disfluency. Howell and Au-Yeung (1995) reported similar results, and added that phonological complexity did not appear to be an important factor in stuttering of children as old as 12 years.

Although these previous studies focused on the co-occurrence of stuttering and phonological disruption within the same words and utterances, co-occurrence within the same syllable has not yet been thoroughly investigated. Caruso, Angello, and Sommers (1993) conducted a case study on a preschool child with a coexisting disfluency and phonological disorder. They found more disfluencies on words containing consistently misarticulated sounds than on words containing inconsistently misarticulated sounds. Although Caruso et al. looked at only one child, their results suggest that further investigation of simultaneous occurrence within the same syllable[2] is warranted.

Understanding occurrence of stuttering and phonological errors within the same syllable may shed light on aspects of motor planning and execution in both of these speech disorders. One approach to achieving this understanding is described in the Covert Repair Hypothesis (Kolk, Conture, Postma, & Louko, 1991; Postma & Kolk, 1993). This model addresses errors in the motor planning of children and adults who stutter. Yaruss and Conture (1996) summarized the core assumptions of the CRH. They stated that (1) speakers typically monitor their speech for accuracy, content, and form before it is produced; (2) during the monitoring process, speakers can detect errors that arise in their phonetic plan before the error is actually produced; (3) following detection of an error, a speaker may interrupt their ongoing speech in order to repair the error; and (4) when speakers exhibit disfluencies, they are producing ‘by-products’ of an attempt to *covertly* repair an error in their phonetic plan before the error is actually produced. In accordance with this model, one may predict that more stuttering would occur at instances of phonological difficulty, although this prediction has not yet been tested directly.

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[2]In the assessment of a stuttering moment, it is often difficult to examine breakdown solely at the allophonic or phonemic level. Instead, stuttering appears to be better “expressed at the level of the syllable” (Wingate, 1988, p. 179). For example, although audible or inaudible sound prolongations may occur on a particular phoneme, sound or syllable repetitions typically extend over two or more phonemes, a syllable repetition may involve a reiteration of a series of phonemes. Even repetitions of the initial portion of a syllable usually extend over two phonemes (e.g., “pu-pu-pu pull”). In addition, as there is considerable overlap in phonemes during the production of speech, the smallest unit of speech production has often been identified as the syllable (Kozhevnikov & Chistovich, 1966; Lieberman, 1977; Stetson, 1951). For these reasons, we chose the syllable as the basic unit of speech production in which moments of stuttering and phonological errors were contrasted.

One may further speculate that disfluencies have a greater probability of co-occurring with phonological errors when speech targets are more complex. Whether in terms of production skill, perceptual salience, or both, certain articulatory gestures appear to be more complex than others. For example, consonant clusters are precise sequences of phonemes that involve increased phonological complexity (Levelt, 1989). In addition, consonant clusters are later developing phonological forms. The normal phonological process of consonant cluster reduction often persists past age 3–4 years (Stoel-Gammon & Dunn, 1985), when most singletons (i.e., single consonant in a CV syllable) can already be produced with reasonable accuracy. Consonant clusters involve more complex motoric programming, and exquisite timing control. Thus, one may predict a greater percentage of disfluencies at moments of increased articulatory complexity. Additionally, greater disfluency may occur in the initial position of words (Brown, 1938), making word-initial consonant clusters an interesting target for investigation. Throneburg, Yairi, and Paden (1994) included consonant clusters in their measure of phonological difficulty of *words*, but they found that clusters did not contribute to fluency disruption. However, rather than words, different results may be obtained through a more specific examination at the level of the syllable and within consonant clusters. Howell, Sackin, & Williams (1999) have recently suggested that by examining word-initial phonological properties, an interaction between phonology and stuttering is observable.

In summary, it appears the theoretical underpinnings of investigating the co-occurrence of stuttering and phonological errors have both interested and challenged past researchers. In addition, it is believed a greater understanding of coexisting phonological and fluency disorders might provide useful clinical applications. The specific purpose of the present study was to investigate the frequency of intra-syllabic co-occurrence of disfluencies and phonological errors in young children. Measures included (1) the frequency of disfluency on speech with and without phonological errors, and (2) the frequency of disfluency on word-initial consonant clusters with and without phonological errors.

METHOD

Subjects

Subjects were seven English-speaking male children (age 4:5–5:11 years) who were initially recruited in upstate New York for a previous study; a detailed description of selection criteria is available in that paper (Wolk et al., 1993). Selection for inclusion in the present study was based on an observed and reported coexistence of stuttering with disordered phonology. No prior articulation, language ,or stuttering treatment was reported, and hearing was found to be normal based on pure tone audiometry and tympanometry. Additionally, receptive and expressive language functioning was normal, as determined by the Northwestern Syntax Screening Test (Lee, 1969).

Stuttering was initially assessed through parental interview and evaluation of a conversational speech sample. The selected children produced within-word disfluencies (sound/syllable repetitions, sound prolongation, or monosyllabic whole-word repetitions) in 5–30% of words in samples of conversational speech. One participant was described as a severe stutterer, five as moderate stutterers, and one as mild according the Stuttering Severity Index (Riley & Riley, 1980). The children also exhibited at least two age-inappropriate phonological processes (i.e., phonological error patterns) during the sample of conversational speech. The majority of these phonological processes were typical error patterns (e.g., velar fronting, palatal fronting, cluster reduction, and labialization). These phonological patterns are commonly found in normal speech development of children who are younger than the participants in the present study. One of the seven subjects also produced phonological processes that were “unusual” or “atypical”, i.e., processes not typical of normal development (Edwards & Shriberg, 1983; Stoel-Gammon & Dunn, 1985). These processes were velarization and glottal replacement.

Data Collection

Speech samples were obtained during a loosely structured conversational speech task between each child and his mother. The conversations lasted approximately 30 minutes and were centered on a set of toys used by all of the children.

A minimum sample of 300 syllables of conversational speech was collected from each child. Children were audio and video recorded in a room designed to minimize ambient noise and maximize the quality and clarity of the recordings. Each child was tested individually (See Wolk et al., 1993 for a detailed description). Two Panasonic color video cameras were used; one directed toward the mother and the other directed toward the child. The cameras were positioned to view both the mother’s and the child’s head, upper torso, arms, and hands. Lapel microphones were placed on the clothing of the mother and the child, approximately 6 inches from his/her mouth. The two images were combined to form a split-screen composite that were used for analysis.

Data Analyses

For the purposes of this study, the co-occurrence of a disfluency and a phonological error was defined as an instance in which at least one disfluency and at least one speech misarticulation occurred in the same syllable. Stuttering was defined as sound/syllable repetitions, sound prolongations, silent blocks, or monosyllabic whole-word repetitions. Phonological errors were defined as cases in which phonemes were omitted, substituted, or distorted when compared with phonemes in the standard, adult form of the syllable.

The entire 30-minute video recording of each child's spontaneous speech sample was used for analysis. The average sample length was 424 syllables (range: 304–539). The entire conversational corpus for each child was transcribed in the form of adult targets by an ASHA certified Speech-Language Pathologist (MB). All instances of disfluencies were identified perceptually and coded as to whether a phonological error was present. The overall percent disfluency was calculated by dividing the number of stuttered syllables by the total number of syllables for each child. All instances of phonological errors were marked in the sample. The overall percent of phonological errors was calculated by dividing the number of syllables with phonological errors by the total number of syllables. Syllables containing phonological errors were evaluated for the co-occurrence with disfluency. The co-occurrence of a disfluency and phonological error was determined to exist when both were present in the same syllable (e.g., "t-t-t-time" for "climb"). Such errors were transcribed phonetically. The percent of disfluency on syllables with phonological errors was determined by dividing the total number of syllables with co-occurring disfluency by the total number of syllables with phonological errors. The percent of disfluency on syllables without phonological errors was calculated by dividing the number of disfluencies occurring in phonologically correct syllables disfluency by the total number of syllables with phonological errors.

All consonant clusters were identified and classified as correct or incorrect. The frequency of disfluency was calculated separately for phonologically correct and incorrect clusters. The following calculations were entered into the analysis:

1. Percentage of disfluencies on speech with phonological errors.
2. Percentage of disfluencies on speech without phonological errors.
3. Percentage of disfluencies on word-initial consonant clusters with phonological errors.
4. Percentage of disfluencies on word-initial consonant clusters without phonological errors.

Reliability

To obtain interjudge measurement reliability, the conversational samples from 2 subjects were randomly chosen from the group of 7. For both subjects, all of the data were transcribed and analyzed by a second speech-language pathologist. An overall count of stuttering events was obtained for each subject and each rater. Agreement between the two raters ranged from 0.94–1.00. Interjudge agreement on frequency of disfluency was 0.98 and 0.99 for subjects one and two, respectively. Interjudge agreement on frequency of phonological errors was 0.97 and 0.94 for subjects one and two. Finally, interjudge reliability on percentage of words with initial consonant clusters was 1.00 and 0.99 for subjects one and two, respectively.

Statistical Analyses

Due to factors such as small sample size, and potential violation of normality assumptions, nonparametric statistical data analyses (Wilcoxon Signed Rank Test) were employed.

RESULTS

The disfluency and phonological error analysis results for the 7 children are presented in Table 1. The second column shows the overall disfluency percentage for each participant's spontaneous speech sample. Column three shows the percentage of syllables with phonological errors out of the total number of syllables for each subject. In parentheses are the absolute numbers of syllables with phonological errors, followed by the total number of syllables produced by each child. The fourth column shows the percentage of syllables without phonological errors that was disfluent. For example, participant 1 produced 317 syllables with phonological errors. Of these, 107 (or 33.7%)

Table 1. Frequency of Disfluency With and Without Phonological Errors

Participant	Overall disfluency (%)	Overall phonological errors (%)	Disfluency on syllables without phonological errors (%)	Disfluency on syllables with phonological errors (%)
1	35.0	18.3 (71/388)	33.7 (107/317)	40.8 (29/71)
2	8.0	47.5 (244/514)	10.7 (29/270)	4.9 (12/244)
3	16.0	16.2 (54/334)	15.5 (43/280)	18.5 (10/54)
4	13.0	30.4 (64/539)	16.3 (61/375)	5.5 (9/164)
5	9.0	18.7 (57/308)	8.1 (20/244)	12.3 (7/57)
6	7.0	20.7 (99/478)	7.5 (29/379)	5.0 (5/99)
7	9.0	18.9 (78/413)	9.3 (31/335)	7.7 (6/78)
Means (SD)	13.9 (9.1)	24.4 (10.4)	14.4 (8.5)	13.6 (12.0)

Instances of occurrence in relation to total syllables analyzed are presented in parentheses.

Table 2. Word-Initial Consonant Cluster (WICC) Analysis: Frequency of Disfluency With and Without Phonological Errors.

Participant	Words with WICCs (% of all words)	WICCs with phonological errors (%)	Disfluency on all WICCs (%)	Disfluency on WICCs without phonological errors (%)	Disfluency on WICCs with phonological errors (%)
1	12.7	25.0	43.0	30.3	90.8
	(44/344)	(11/44)	(19/44)	(10/33)	(9/11)
2	2.1	100.0	22.2	0.0	22.2
	(9/421)	(9/9)	(2/9)	(0/0)	(2/9)
3	4.9	53.3	13.3	0.0	25.0
	(15/304)	(8/15)	(2/15)	(0/7)	(2/8)
4	6.0	82.8	13.8	20.0	12.5
	(29/480)	(24/29)	(4/29)	(1/5)	(3/24)
5	4.3	33.0	8.3	0.0	25.0
	(12/279)	(4/12)	(1/12)	(0/8)	(1/4)
6	5.1	59.0	13.6	11.1	15.4
	(22/434)	(13/22)	(3/22)	(1/9)	(2/13)
7	7.1	46.2	11.5	7.1	17.0
	(26/367)	(12/26)	(3/26)	(1/14)	(2/12)
Means	6.0	57.0	18.0	9.8	29.9
(SD)	(3.1)	(24.6)	(10.9)	(10.8)	(25.3)

Instances of occurrence in relations to total syllables analyzed are presented in parentheses.

were disfluent. Finally, column five shows the percentage of syllables with phonological errors that was disfluent. For example, Participant 1 produced 71 syllables with phonological errors; 29 of which (or 40.8%) were disfluent.

The Wilcoxon Signed Rank Test revealed that the frequency of disfluency on speech with phonological errors (13.6%) was not significantly different from the speech disfluency without phonological errors (14.4%). A slight trend in the opposite direction from the hypothesized effect was noted.

The frequency of disfluency on consonant clusters with phonological errors (29.9%) was compared with the frequency of disfluency on consonant clusters without phonological errors (9.8%). Table 2 shows the specific percentages for each participant. Disfluency on clusters with phonological errors occurred significantly more often than clusters without phonological errors. ($p < 0.05$).

DISCUSSION

This study was an attempt to investigate how disfluency and phonological errors may interact in children exhibiting stuttering and phonological disorders at an intrasyllabic level. Contrary to our initial expectations, the overall frequency of disfluency on syllables with phonological errors was similar to those produced without errors. In accordance with the CRH (Kolk, Conture, Postma, & Louko, 1991; Postma & Kolk, 1993), one may have predicted that more disfluency would occur during instances of phonological errors. Furthermore, within 'trading relationships' accounts, and the Demands and Capacities Model (Adams, 1990; Starkweather & Gottwald, 1990), it might have been expected that phonological difficulties place increased demands (or be an effect of increased demands) resulting in increased disfluency. The Demands and Capacity Model states that stuttering can be the result of too much demand (in a variety of domains) on a limited capacity system. Similarly, a 'trading relationships' account might account for disfluency (or phonological errors) with increased demands in other domains. For children with both stuttering and phonological difficulties, it would seem that the demands would be increased during syllables with phonological errors.[3]

The frequency of disfluency on initial consonant clusters with phonological errors was found to be significantly higher than on initial consonant clusters without phonological errors. This may reflect a greater likelihood of disfluency at specific moments of increased phonological complexity (i.e., during consonant clusters containing phonological errors). A consonant cluster is a complex phonological form, requiring rapid movements which may result in increased phonological loading and planning requirements compared with singletons. Consonant clusters are well known to occur later in normal acquisition and are frequently problematic in a variety of phonological disorders (e.g., Bernthal & Bankson, 1993; Stoel-Gammon & Dunn, 1985; Weiss, Gordon, & Lillywhite, 1987). Therefore, the results involving word-initial consonant clusters are consistent with the prediction of fluency disruption during greater phonological demands.

The present findings should be interpreted with caution given the small sample size. However, when taken together with other research (Au-Yeung, Howell, & Pilgrim, 1998; Howell & Au-Yeung, 1995; Logan & Conture, 1997; Throneburg, Yairi, & Paden, 1994; Yaruss & Conture, 1996) several possibilities may be explored. One explanation for the results is that the two disorders (stuttering and disordered phonology) may indeed be separate entities. Although stuttering and phonological errors may co-occur in the same child, they may not interact in the same syllable. Another explanation might be drawn from alternate CRH predictions. As noted by Yaruss and Conture (1996), children may be largely unaware that their underlying forms are different from those of adults. In this case, they would not initiate the theorized

[3]Recent work (Au-Yeung, Howell, & Pilgrim, 1998; Howell & Au-Yeung, 1995; Howell, Au-Yeung & Sackin, 1999) may provide a different perspective on our results: Function and content words tend to differ phonetically. Therefore, this linguistic factor may contribute to whether words with certain phonemes contain disfluency.

repair process. Alternatively, assuming that children do detect phonological errors, the CRH may also be interpreted to predict a decreased likelihood of co-occurrence on the same syllable because the disfluency may have been a consequence of a covert repair of a phonological error. In this case, the disfluency may occur secondary to 'system stress' caused by a child repairing a phonological error in the speech plan. Based on this assumption, equal (or perhaps less) co-occurrence of stuttering and phonological breakdown on the same syllable may be predicted. In effect, the disfluency may be an overt sign of a covert phonological repair. Finally, children may stutter on syllables preceding phonological errors, in anticipation of phonological complexity. This would be consistent with accounts of children stuttering often on function words, which tend to be phonologically simpler than the content words they precede (Au-Yeung, Howell, & Pilgrim, 1998; Howell & Au-Yeung, 1995; Howell, Au-Yeung, & Sackin, 1999; Howell, Sackin, & Williams, 1999).

From a clinical perspective, it is important to focus on designing suitable therapy techniques that best facilitate fluency and phonological accuracy. For example, the issue of whether to provide phonological therapy to an individual with a coexisting fluency disorder has been raised. Conture, Louko, and Edwards (1993) suggested a "blended" treatment program that combined fluency therapy into activities designed to address phonological remediation. This idea has been supported in later work (e.g., Wolk, 1998). In an evaluation of therapy options for concomitant fluency and language/phonological impairment, Ratner (1995), stated "to the extent that all fluency-shaping goals need to be practiced in some communication activity, it is efficient to practice them while working on other areas of communication development. The practice holds true only to the extent that either the articulation / language skill to be worked on does not inherently stress the fluency system" (p. 183). Further understanding the degree to which phonological errors and disfluency influence each other may help determine (a) if targeting phonological errors does, in fact, further stress the speech motor system, (b) whether training certain phonological targets may facilitate fluency, and (c) which order to address these two disorders in therapy.

With specific reference to consonant clusters, children exhibiting co-occurring disfluency and phonological errors may benefit from therapeutic intervention that includes a graded hierarchy of syllabic complexity. That is, progressing from CV to CVC to CCVC to CCCVC may be useful in managing increased phonological complexity. Another possibility is splitting the cluster (e.g., from CCV to CVCV) as an interim therapy strategy to encourage smoother temporal transitions using reduced speech rate, prolonged speech, and easy onsets, and then gradually returning to the correct phonological form (i.e., the consonant cluster).

Future research on larger sample sizes is needed to explore whether disfluency increases at moments of phonological complexity. If indeed this were the case, we need to incorporate these coexistence factors into clinical management. Future exploration into the exact nature of various clusters and other complex segment and syllable forms may also be useful. For example, investigations of two-element versus three-element consonant clusters, and consonants that require more precise timing and/or precise gestures such as fricatives or affricates may reveal differences between disfluency on correctly and misarticulated speech. The clinical ramifications may be important for children who exhibit coexisting stuttering and phonological disabilities. It is possible that for children who only stutter, we may discover phonological strategies that facilitate fluency. Finally, future research of the moment of co-occurrence should involve in-depth investigations of the moment of co-occurrence using both acoustic and perceptual evaluations. Research such as this could extend current models of speech motor organization underlying both speech fluency and phonology.

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REFERENCES

Adams, M. (1990). The Demands and Capacities Model I: Theoretical elaborations. *Journal of Fluency Disorders 15*, 135–141.

Andrews, G., & Harris, M. (1964). The syndrome of stuttering. London: The Spastics Society Medical Education and Information Unit in Association with Williams Heineman Medical Books. Chapters 4, 5, 6.

Au-Yeung, J., Howell, P., & Pilgrim, L. (1998). Phonological words and stuttering on function words. *Journal of Speech, Language, and Hearing Research 41*, 1019–1030.

Bernthal, J., & Bankson, N. (1993). *Articulation and phonological disorders.* Englewood Cliffs, NJ: Prentice Hall.

Brown, S. (1938). A further study of stuttering in relation to various speech sounds. *Quarterly Journal of Speech 24*, 390–397.

Caruso, A., Angello, C., & Sommers, R. (1993, November). Interactions between fluency and phonological disorders: A case study. Paper presented at the Annual Conference of the American Speech-Language-Hearing Association, Anaheim, CA.

Conture, E. (1990). *Stuttering* (2nd ed.). Englewood Cliffs, NJ: Prentice Hall.

Conture, E., Louko, L., & Edwards, M. L. (1993). Simultaneously treating stuttering and disordered phonology in children: Experimental therapy, preliminary findings. American *Journal of Speech-Language Pathology 2*(3), 72–81.

Darley, F. (1955). The relationship of parental attitudes and adjustments to the development of stuttering. In W. Johnson & R. Leutenegger (Eds.), *Stuttering in children and adults.* Minneapolis, MN: University of Minnesota Press.

Edwards, M., & Shriberg, L. (1983). *Phonology: Applications in communicative disorders.* San Diego, CA: College-Hill Press.

Howell, P., & Au-Yeung, J. (1995). The association between stuttering, Brown's factors, and phonological categories in child stutterers ranging in age between 2 and 12 years. *Journal of Fluency Disorders 20*, 331–344.

Howell, P., Au-Yeung, J., & Sackin, S. (1999). Exchange of Stuttering from function words to content words with age. *Journal of Speech, Language, and Hearing Research 42*, 345–354.

Howell, P., Sackin, S., & Williams, R. (1999). Differential effects of frequency-shifted feedback between child and adult stutterers. *Journal of Fluency Disorders 24*, 127–136.

Kolk, H., Conture, E., Postma, A., & Louko, L. (1991, November). The covert-repair hypothesis and childhood stuttering. Paper presented at the Annual Conference of the American Speech-Language-Hearing Association, Atlanta, GA.

Kozhevnikov, V., & Chistovich, L. (1966). Speech: Articulation and Perception. Springfield, VA: Joint Publication Research Service, United States Department of Commerce.

Lee, L. (1969). *Northwestern Syntax Screening Test (NSST).* Evanston, IL: Northwestern University Press.

Levelt, W. (1989). *Speaking: From intention to articulation.* Cambridge, MA: MIT Press.

Lieberman, P. (1977). *Speech physiology and acoustic phonetics: An introduction.* New York: Macmillan.

Logan, K., & Conture, E. (1997). Selected temporal, grammatical, and phonological characteristics of conversational utterances produced by children who stutter. *Journal of Speech, Language, and Hearing Research 40*, 107–120.

Louko, L., Edwards, M., & Conture, E. (1990). Phonological characteristics of young stutterers and their normally fluent peers: Preliminary findings. *Journal of Fluency Disorders 15*, 121–191.

McDowell, E. (1928). *Educational and emotional adjustment of stuttering children.* New York: Columbia University Teachers College.

Paden, E., & Yairi, E. (1996). Phonological characteristics of children whose stuttering persisted or recovered. *Journal of Speech and Hearing Research 39*, 981–990.

Postma, A., & Kolk, H. (1993). The covert repair hypothesis: Prearticulatory repair processes in normal and stuttered disfluencies. *Journal of Speech and Hearing Research 36*, 472–487.

Ratner, N. (1995). Treating the child who stutters with concomitant language or phonological impairment. *Language, Speech, and Hearing Services in Schools 26*(2), 180–186.

Riley, G. D., & Riley, J. (1980). *Stuttering severity instrument.* Tigard, OR: CC Publications.

Starkweather, C. W., & Gottwald, S. (1990). The Demands and Capacities Model II: Clinical applications. *Journal of Fluency Disorders 15*, 143–157.

Stetson, R. (1951). *Motor phonetics: A study of speech movements in action.* Amsterdam: North Holland.

Stoel-Gammon, C., & Dunn, C. (1985). *Normal and disordered phonology in children.* Austin, TX: Pro-ed.

Throneburg, R., Yairi, E., & Paden, E. (1994). Relation between phonologic difficulty and the occurrence of disfluencies in the early stage of stuttering. *Journal of Speech and Hearing Research 37*, 504–509.

Weiss, C. E., Gordon, M. E., & Lillywhite, H. S. (1987). *Clinical management of articulatory and phonologic disorders*, (2nd ed.). Williams & Wilkins: Baltimore.

Wingate, M. (1988). *Stuttering: A psycholinguistic analysis.* New York: Springer-Verlag.

Wolk, L. (1998). Intervention strategies for children who exhibit coexisting phonological disorders and fluency disorders: A clinical note. *Child Language Teaching and Therapy 14*(2), 69–82.

Wolk, L., Conture, E. G., & Edwards, M. L. (1990). Comorbidity of stuttering and disordered phonology in young children. *South African Journal of Communication Disorders 37*, 15–20.

Wolk, L., Edwards, M., & Conture, E. (1993). Coexistence of stuttering and disordered phonology in young children. *Journal of Speech and Hearing Research 36*, 906–917.

Yaruss, J., & Conture, E. (1996). Stuttering and phonological disorders in children: Examination of the Covert Repair Hypothesis. *Journal of Speech and Hearing Research 39*, 349–364.