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Viewpoint

Stuttering and Phonology: Is There an Interaction?

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Speech-language pathologists have been interested in the phonological skills of children who stutter at least since the 1920s (McDowell, 1928). During the past decade, however, interest in this complex topic has increased dramatically. Many investigators have reported that children who stutter are far more likely to have a phonological disorder than their peers who do not stutter (Bloodstein, 1995; Louko, 1995; Louko, Conture, & Edwards, 1999; Louko, Edwards, & Conture, 1990; St. Louis & Hinzman, 1988; St. Louis, Murray, & Ashworth, 1991; Tetnowski, 1998; Wolk, Edwards, & Conture, 1993; Yaruss & Conture, 1996; Yaruss, LaSalle, & Conture, 1998). Prevalence estimates of phonological disorders in children not identified as having a stuttering problem range from 2% to 13% (Shriberg, Tomblin, & McSweeny, 1999). In contrast, it is commonly reported that 30%–40% of children who stutter have a co-occurring phonological disorder (Bernstein Ratner, 1995; Conture, 2001; Conture, Louko, & Edwards, 1993; Louko, 1995; Melnick & Conture, 2000; Wolk, 1998; Wolk, Blomgren, & Smith, 2000).

Reports of this nature have prompted researchers to examine the possibility that stuttering and phonology may interact in some way. As Edwards (1997) explained, interest in exploring the "stuttering-phonology connection" (p. 11) arose (a) from the belief that phonological disorders co-occur in a substantial portion of children who stutter, and (b) from the clinical observation that children being treated for phonological disorders sometimes became disfluent. Accordingly, researchers have been keen to determine if the presence of phonological errors influences a child's stuttering behavior (Louko et al., 1990; Ryan, 1992; Wolk et al, 1993; Yaruss & Conture, 1996; Yaruss et al., 1998); if the child's efforts to produce phonologically complex units lead to increased stuttering (Howell & Au-Yeung, 1995; Logan & Conture, 1997; Melnick & Conture, 2000; Throneburg, Yairi, & Paden, 1994; Wolk et al., 2000), and if a phonological delay in a young child who stutters predicts the persistence of stuttering in that child (Paden & Yairi, 1996; Paden, Yairi, & Ambrose, 1999; Ryan, 2001; Yairi, Ambrose, Paden, & Throneburg, 1996).

One goal of this research has been to determine if children who stutter and have a co-occurring phonological disorder require an approach to treatment different from that for children whose only speech disorder is stuttering and, if so, what types of treatment are best (Conture et al., 1993; Louko, 1995; Louko et al., 1999; Wolk, 1998). In the intervention literature, it is often recommended that treatment for children who stutter and have a phonological disorder take an indirect approach. Such advice is based on the belief that direct intervention may inadvertently contribute to negative interactions between the disorders (e.g., Conture, 2001). Typically, with an *indirect* approach, the parents are taught to converse with the child in a manner that provides a model of slow, relaxed, and effortless speech, and the clinician models the correct production of speech sounds that are in error. At the same time, the parents and clinician refrain from any behaviors that would call attention to the child's speech, such as asking the child to speak slowly, to repeat a word or phrase fluently, or to produce a speech sound correctly (e.g., Conture et al., 1993; Louko et al., 1999). In contrast, with a *direct* approach, the parents may be taught to praise the child's fluent utterances (e.g., "Good talking—no bumpy words!") and occasionally to call attention to stuttered speech (e.g., "I heard a bumpy word") and to ask the child to repeat a stuttered word fluently (e.g., Onslow, Costa, & Rue, 1990). When a phonological disorder is also present, the clinician may implement traditional therapy in which the child is shown how to produce the target sounds and is asked to use those sounds correctly in increasingly difficult phonetic contexts (e.g., syllables, words, sentences). See Van Riper & Emerick, 1990.

The recommendation to employ an indirect approach to treatment is based on the "Demands and Capacities" model, a hypothesis put forth to explain the possible causes of stuttering. According to this hypothesis, disfluencies result when environmental and/or self-imposed communicative demands exceed a child's capacities in one or more areas of development, which may include linguistic, motoric, emotional, and/or cognitive (Adams, 1990; Starkweather & Gottwald, 1990). This would

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suggest, for example, that a weakness in phonological (linguistic) and/or articulatory (motoric) development could exacerbate stuttering if communicative demands on the child are excessive. Accordingly, Bernstein Ratner (1995) cautioned that because of "trading relationships" between fluency and phonology, efforts to remediate phonological disorders "are likely to exacerbate patterns of fluency failure" (p. 182). To avoid aggravating a child's stuttering behavior, she recommended that the clinician not provide direct correction of the child's phonological errors. Conture et al. (1993) and Louko et al. (1999) also expressed concerns about possible negative interactions between stuttering and phonology, suggesting that the two disorders be treated simultaneously but using indirect procedures that do not involve overt correction of stuttering or phonological errors. In recommending an indirect approach, Louko et al. stated that their goal was "to minimize the chances of winning the battle with the child's phonology, but losing the war by exacerbating and/or worsening the child's stuttering" (p. 135). However, both Conture et al. and Louko et al. emphasized that little information was available from research concerning effective methods of treating children who stutter and have a co-occurring phonological disorder.

In summary, the recommendation to employ an indirect rather than a direct approach to treatment when stuttering and phonological disorders co-occur is based on the assumption that stuttering and phonology interact in some way. This assumption may hold some intuitive appeal, particularly in view of reports indicating a high rate of co-occurrence for stuttering and phonological disorders (e.g., Louko et al., 1990; St. Louis et al., 1991; Yaruss et al., 1998). However, in a recent review of the literature that addressed the frequency with which stuttering and phonological disorders co-occur, Nippold (2001) found that frequency rates varied widely from one study to another, partly because of differences in the way in which phonological disorders were defined and identified. Because of these discrepancies, combined with certain methodological limitations in the research, Nippold suggested that the 30%–40% figure that is commonly cited (e.g., Conture, 2001; Conture et al., 1993; Louko, 1995; Louko et al., 1999; Wolk, 1998; Wolk et al., 2000) may overestimate the rate of co-occurrence.

This is not to deny that stuttering and phonological disorders sometimes co-occur. Clearly, some children who stutter also have a phonological disorder (e.g., Wolk et al., 1993; Yaruss & Conture, 1996). However, purely on logical grounds, the co-occurrence of two phenomena does not necessarily imply an interaction. For example, blue eyes and red hair often co-occur but it is not assumed that one condition implies the other. In a science-driven profession such as speech-language pathology, it is essential that the knowledge base upon which clinical decisions are made be as accurate as possible. Efforts to understand a possible interaction between stuttering and phonology, therefore, are of high priority. Because interest in this topic has increased dramatically during the past decade, this article examines studies published since 1990 that addressed the following question: *Is there an interaction between stuttering and phonology in children?* The findings are reported and analyzed. Suggestions are offered for conducting further studies to explore this topic and to address issues regarding the clinical management of children who stutter and have a co-occurring phonological disorder.

What the Literature Says

Stuttering and Phonological Development

Louko, Edwards, and Conture (1990) examined 30 children (28 boys, 2 girls) who stuttered for the presence of phonological processes (e.g., cluster reduction, stopping, gliding) in conversational speech. The group had a mean age of 4;6 (years;months) (range = 2;5–6;11). Each child was audio-recorded while playing with his or her mother in a clinic room stocked with toys, objects, and pictures. A speech sample of about 300 words was analyzed for phonological processes, using criteria from Edwards and Shriberg (1983), Grunwell (1982), and Stoel-Gammon and Dunn (1985). To examine a possible relationship between stuttering and phonology, correlation coefficients were calculated between the number of phonological processes that occurred during the speech sample and three different measures of stuttering behavior: frequency, duration, and sound prolongation. However, none were statistically significant ($p > .05$), indicating that children with more severe stuttering were not necessarily using a greater number of phonological processes than those with milder stuttering.

Ryan (1992) also investigated the phonological skills of children who stuttered. Twenty children (15 boys, 5 girls) having a mean age of 4;4 (range = 2;10–5;9) were administered the Arizona Articulation Proficiency Scale (AAPS; Barker, 1973). To examine a possible relationship between stuttering and phonology, a correlation coefficient was calculated between the number of disfluent words produced per minute during a fluency interview and raw

scores on the AAPS. The findings were not statistically significant ($p > .05$), indicating that children who stuttered more did not necessarily produce more speech sound errors.

As part of a larger study to examine patterns of speech and language development in preschool children, Anderson and Conture (2000) administered the "Sounds-in-Words" subtest of the Goldman-Fristoe Test of Articulation (GFTA; Goldman & Fristoe, 1986) to 20 children (16 boys, 4 girls) who stuttered. The group had a mean age of 3;11 (range = 3;0–5;10). A 300-word sample of conversational speech was elicited from each child during a play session with a clinician. The sample was used to obtain a score on the Stuttering Severity Instrument–3 (SSI-3; Riley, 1994) and to determine the frequency of within-word disfluencies (WWD: broken words, sound/syllable repetitions, and sound prolongations) and total disfluencies (TD: within- and between-words) per 100 words of speech. Each child's performance on each of these measures was reported in Table 1 (p. 287) but the data were largely unanalyzed. Subsequent analyses by these authors indicated that the 20 children obtained a mean percentile rank of 57.25 on the GFTA (range = 23–99); a mean overall score of 21.50 (range = 14–34) on the SSI-3; a mean WWD (percent) of 14.08 (range = 5–33); and a mean TD (percent) of 17.54 (range = 10.30–36). These results indicated that the children demonstrated normal phonological development but mild to severe levels of stuttering. Using the data reported in the same table, this author also computed correlation coefficients between the GFTA and each of the fluency measures. However, none were statistically significant ($p > .05$), indicating that children who produced more speech sound errors did not necessarily stutter more severely.

Using a different research design from the studies just discussed, Wolk, Edwards, and Conture (1993) examined the relationship between stuttering and phonology in 21 boys (age range = 4:2 to 5:11). Each child represented one of three groups ($n = 7$ per group), characterized by (a) stuttering with normal phonology (S + NP); (b) stuttering with disordered phonology (S + DP); and (c) normal fluency with disordered phonology (NF + DP). The researchers attempted to determine if stuttering behavior differed in children with normal phonology (Group 1) from that of those with disordered phonology (Group 2) and if phonological disorders differed in children who stuttered (Group 2) from those with normal fluency (Group 3).

A conversational speech sample of 300 words was elicited from each child while interacting with his mother in a clinical setting. The sample was used to examine aspects of stuttering, including the frequency and types of disfluencies. It also served as a basis for obtaining a severity score on the Stuttering Severity Instrument (SSI; Riley, 1980). A picture-naming task was also administered to examine the child's production of English consonants in initial, medial, and final word positions and the presence of phonological processes. Any instances of stuttering that occurred during the picture-naming task were also noted.

Regarding stuttering behavior, no statistically significant differences were found between the S + DP and S + NP groups in terms of the frequency of stuttering during the conversational speech task or the picture naming task ($p > .05$), and total scores on the SSI for those two groups were not significantly different ($p > .05$). However, upon examining the types of disfluencies, the researchers found that the S + DP group produced a greater percentage of sound prolongations than the S + NP group during the conversational task ($p < .05$) but not during the picture naming task ($p > .05$). The groups did not differ significantly on the percentage of sound or syllable repetitions (SSR) during either task ($p > .05$) or on the duration of within-word disfluencies during the conversational task ($p > .05$). The number of iterations, or repeated units, that occurred during each SSR and each whole-word repetition (WWR) were noted during the conversational task. Although the groups did not show a statistically significant difference on the number of iterations per SSR ($p > .05$), the S + NP group produced a significantly greater number of iterations per WWR than the S + DP group ($p < .05$).

Regarding phonological behavior, the S + DP and NF + DP groups did not differ significantly in the Percentage of Consonants Correct (PCC; Shriberg & Kwiatkowski, 1982a) on the picture-naming task ($p > .05$), and both groups fell into the moderate to severe range of phonological disorder. The types of phonological processes produced on this task were also examined, and the 15 most common processes were identified. Statistical analyses indicated that the groups did not differ significantly in frequency of occurrence for any of these processes ($p > .05$). For both groups, cluster reduction was the most common process. Other processes often produced by both groups included vocalization, gliding of liquids, weak syllable deletion, and syllable coalescence. Thus, in terms of phonological patterns and behaviors, children who stuttered did not appear to differ from their peers with normal fluency.

In a similar investigation, Yaruss, LaSalle,

and Conture (1998) reviewed the diagnostic data of 99 children, who were between 2 and 6 years old (mean age = 4;7). Over a twelve-year period (1978–1990), all children had been evaluated at a university speech and language clinic to determine the presence of stuttering and any other speech or language disorders. A phonological disorder was identified if two or more atypical or age-inappropriate processes occurred during a picture-naming task or when a child was talking spontaneously with his or her parent.

To examine a possible relationship between stuttering and phonology, Yaruss et al. (1998) divided the children into two groups—those who were thought to have a phonological disorder (n = 37) and those who were thought to have normal phonological development (n = 62). The groups were then compared on measures of stuttering severity, including the Stuttering Severity Instrument (SSI; Riley, 1980) and the Iowa Scale for Measuring the Severity of Stuttering (Johnson, Darley, & Spriestersbach, 1963). However, no differences between groups were statistically significant ($p > .05$), indicating that children with phonological disorders did not necessarily stutter more severely than those with normal phonological development.

Stuttering and the Covert Repair Hypothesis

Another approach to examining a possible interaction between stuttering and phonology has involved the Covert Repair Hypothesis (CRH), originally proposed by Postma and Kolk (1993). See Kolk & Postma, 1997, for a detailed discussion. Yaruss and Conture (1996) attempted to extend the CRH to developmental phonological disorders. According to Yaruss and Conture, the CRH proposes that speech disfluencies, including stuttering behaviors, occur "when a speaker disrupts ongoing speech production in an attempt to *covertly* repair errors within their phonetic plan *before* such errors are overtly produced" (p. 350). Yaruss and Conture suggested that children who stutter might have "a slow-to-activate phonological encoding mechanism" (p. 350), which makes it difficult for them to select appropriate phonological targets for speech, resulting in stuttering behavior. They also suggested that children with numerous phonological errors might be more disfluent than those with fewer errors because the presence of those errors might create "more opportunities for error detection and self repair" (p. 352). Yaruss and Conture hypothesized that if the CRH is correct and if there is a link between difficulty in phonological encoding and stuttering, then children who stutter and have a phonological disorder (S + DP) could be expected to stutter more frequently than children who stutter but have normal phonology (S + NP).

Yaruss and Conture (1996) examined the speech behaviors of children that met those two profiles, S + DP and S + NP (n = 9 per group). The children in each group, all boys, had a mean age of 5 years (range = 3–6 years). Each child participated in a 30-min spontaneous conversation with his mother in a clinical setting. The middle portion of each sample, consisting of 75 consecutive utterances, was analyzed for fluency characteristics and phonological errors.

Despite the prediction that S + DP children would produce more within-word disfluencies (e.g., sound-syllable repetitions, sound prolongations, pauses within words) than S + NP children, no statistically significant differences between groups emerged in the frequency, duration, or types of disfluencies that occurred during spontaneous conversation ($p > .05$). It should be noted that this result was inconsistent with the earlier report of Wolk et al. (1993) that S + DP children produced a greater percentage of sound prolongations during conversation than S + NP children. For each group, correlation coefficients were calculated between the number of phonological processes (e.g., gliding, vocalization) and the number of within-word disfluencies that occurred during the speech sample, but none were statistically significant ($p > .05$). Therefore, this study did not support the hypothesis that children who stutter and have a phonological disorder stutter more frequently than those who stutter but have normal phonology.

To further investigate the CRH, Logan and Conture (1997) examined the relationship between speech disfluency and syllable structure complexity in 14 boys who stuttered (mean age = 4;4; range = 3;0–5;6). All children demonstrated normal speech and language development with the exception of their stuttering. The researchers proposed that if stuttering is related to impaired phonological encoding as argued by the CRH, then the frequency and duration of speech disfluencies should increase during the production of words characterized by greater syllabic complexity, such as those containing consonant clusters or multiple phonemes, particularly during the communicative demands of conversational speech.

A conversational speech sample of at least 100 utterances was elicited from each child while he interacted for 30 min with his mother in a clinical setting. The samples were audio- and videotaped and analyzed for speech disfluencies in relation to syllabic complexity. Correlation coefficients were calculated between syllabic complexity measures (number of filled onsets, filled codas, consonants, and consonant clusters) and measures of stuttering frequency (number of

syllables stuttered) and duration (length of disfluency in seconds). None of the coefficients reached statistical significance ($p > .05$). Hence, this study did not provide evidence to support the CRH in young children or an interaction between stuttering and phonology.

In a recent effort to investigate the CRH, Melnick and Conture (2000) asked whether S + DP children would produce a greater number of phonological process errors during stuttered compared to non-stuttered utterances, particularly when the utterances were long and grammatically complex. Like Yaruss and Conture (1996) and Logan and Conture (1997), Melnick and Conture attempted to extend the CRH to developmental phonological disorders. Based on the CRH, they stated that "if the frequency of stuttering is greater for longer and more complex utterances, then the reason for this increase may be a greater number of phonological errors, errors that are detected, repaired, and hence stuttered on" (p. 23).

Ten S + DP boys having a mean age of 4:3 (range = 2:10–6:2) interacted with their mothers during a spontaneous conversation in a clinical setting, and a sample of at least 300 words was audio- and video-recorded. A picture-naming task was administered to each child in order to identify all possible phonological processes the child used. Then, from the conversational sample, 25 stuttered and 25 non-stuttered utterances were analyzed for instances of those processes. The data were combined for all 10 children ($10 \times 25 = 250$ stuttered utterances; $10 \times 25 = 250$ non-stuttered utterances). A multiple regression analysis was performed to determine if the frequency of phonological processes could be predicted by utterance length (number of syllables), grammatical complexity (number of clauses), and fluency status (stuttered or non-stuttered). The results indicated that none of the factors was a statistically significant ($p > .05$) predictor of phonological processes in conversational speech. In particular, words produced with phonological processes were not necessarily accompanied by greater amounts of stuttering, and phonological process errors were not necessarily more common in longer and more complex utterances. Hence, this study also failed to support the CRH and an interaction between stuttering and phonology.

Stuttering and the Phonological Complexity of Words and Syllables

A possible interaction between stuttering and phonology has been examined using other approaches as well. Throneburg, Yairi, and Paden (1994) conducted a study to determine if the phonological complexity of words had any effect on the frequency of disfluencies in children's spontaneous conversational speech. The question of interest was whether or not young children who stuttered were more likely to be disfluent on words that were phonologically complex (e.g., *elephant*) than on words that were phonologically simple (e.g., *can*). The participants were 24 children (mean age = 3;5; range = 2;5–4;11) who stuttered. Twelve children had a mild stuttering problem and 12 had a severe problem. Stuttering severity was determined using a rating scale of 0 to 8 (e.g., 0 = normal speech; 1 = mild stuttering through 8 = very severe stuttering). Within each subgroup, 6 children had adequate phonological development and 6 had a phonological disorder. Phonological status was determined using the Assessment of Phonological Processes–Revised (APP-R; Hodson, 1986), which requires the child to name a series of 50 common objects and allows for an examination of phonological errors and patterns at the single-word level. Each child was audio-recorded while interacting with his or her mother in a play setting. A speech sample of approximately 1,000 words was analyzed. For each instance of stuttering, the disfluent word and the word immediately following it were classified as phonologically complex or simple. There were seven different categories of phonologically complex words. Each was marked by at least one of the following features: contains a late-developing sound (e.g., r, l), contains a consonant cluster, is multisyllabic. Phonologically simple words included early-developing sounds, no consonant clusters, and monosyllables.

The results indicated that disfluent words and words that immediately followed them were no more likely to be phonologically complex than fluent words. It was also found that the majority of words—disfluent, those that followed the disfluent words, and fluent—were phonologically simple for all four subgroups. Analysis of variance failed to yield any statistically significant relationships ($p > .05$) between disfluencies and phonological complexity for any of the subgroups, even for children with severe stuttering and disordered phonology. It was concluded that "phonologic difficulty does not have much of an influence on disfluency for these young children at the early stage of stuttering" (p. 507).

Unfortunately, the use of spontaneous conversational samples by Throneburg et al. (1994) could not ensure that the children would attempt to produce phonologically complex words. Because the content and vocabulary of the samples was determined solely by the child and mother, it was possible for a child to avoid

phonologically complex words. Given that most of the words the children produced were phonologically simple, it would be interesting to replicate this study using procedures that would prompt the children more directly to produce a greater number of phonologically complex words in discourse. For example, children could be asked to re-tell stories, generated by the examiner, that contain numerous key words that are phonologically complex (e.g., *brontosaurus, triceratops)*. To heighten the chances that a child would attempt to produce those words, they could be incorporated into the most salient story-grammar components (e.g., initiating event, attempt, direct consequence), elements that are critical to an accurate retelling of a story (Merritt & Liles, 1987). Similarly, it would be interesting to examine children's ability to repeat phonologically complex phrases or clauses (e.g., *brown and blue plaid pants, the priest blessed the bread*) in relation to their stuttering behavior, a task that can detect subtle phonological weaknesses in children (Catts, 1986, p. 505).

In a similar investigation, Howell and Au-Yeung (1995) explored a possible interaction between stuttering and phonological complexity, but examined children of a wider age range. The children, whose stuttering ranged from mild to severe, represented three age groups: "young" (2–6 years, mean age = 4;2; $n = 6$), "middle" (6–9 years, mean age = 7;3; $n = 15$), and "old" (9–12 years, mean age = 11;4; $n = 10$). Each child conversed for about 10 minutes with an interviewer who asked questions concerning such topics as school, television, family, and friends. Children were encouraged to elaborate on their answers and to express their opinions. After the samples were transcribed, all words produced by each child were analyzed for phonological complexity, using the same system as Throneburg et al. (1994) described above. The samples were also analyzed for all instances of stuttering, such as sound prolongations; repetitions of sounds, syllables, and words; and extraneous noises.

Consistent with the study by Throneburg et al. (1994), the majority of words produced by the children were phonologically simple, a pattern that held for all three age groups. Comparatively few words were multisyllabic or contained late-developing consonants or consonant clusters, although the two older groups produced more of those types of words than the youngest group. It was also reported that analysis of variance failed to yield any statistically significant relationships ($p > .05$) between stuttering and phonological complexity, regardless of the children's ages or the severity of their stuttering. These results also were consistent with Throneburg et al. (1994) and Howell and Au-Yeung (1995), who concluded that the phonological difficulty of words did not increase the likelihood they would be produced with stuttering.

However, as suggested above, it may be profitable to replicate this study using a story-retelling task designed specifically to prompt the children's production of a greater number of phonologically-complex words in discourse by incorporating those words into key story grammar elements. The children's efforts to repeat phonologically complex utterances (e.g., *Stan sledded down the slippery, snowy slope*) could also be examined in relation to their stuttering.

Whereas Throneburg et al. (1994) and Howell and Au-Yeung (1995) examined phonological complexity at the word level, Wolk, Blomgren, and Smith (2000) focused on children's productions at the syllabic level. Their objective was to examine the frequency of stuttering on syllables with and without phonological errors in order to identify a possible interaction between stuttering and phonology. The participants were 7 preschool boys (age range = 4;5–5;11) who stuttered and had a co-occurring phonological disorder. A conversational speech sample was elicited from each child while interacting with his mother in an informal play session. For each child, a sample of at least 300 syllables was analyzed for the simultaneous occurrence of stuttering and phonological errors. For example, if a child produced *doggie* as "g-g-g-oggie," the initial syllable of the word contained stuttering and a phonological error.

Because of the small number of participants, nonparametric statistics (Wilcoxon Signed Rank Test) were used to analyze the data. Results indicated that the frequency of stuttering on syllables with phonological errors (mean = 13.6%) did not differ significantly from the frequency of stuttering on syllables without phonological errors (mean = 14.4%, $p > .05$). However, when the investigators focused specifically on syllables that began with consonant clusters, they found that stuttering occurred significantly more often when clusters were produced with phonological errors (25.3%) than when they were produced correctly (mean = 10.8%, $p < .05$). In keeping with the Demands and Capacities model, Wolk et al. interpreted this finding to reflect "a greater likelihood of disfluency at specific moments of increased phonological complexity" (p. 277). This result suggests that additional studies with larger numbers of children should be conducted to explore a possible link between stuttering and the production of consonant clusters.

Stuttering and Early Phonological Delays

In addition to the studies discussed so far, other approaches have been employed to examine a possible interaction between stuttering and phonology. Paden and Yairi (1996) examined the possibility that phonological patterns in young children could be used to help predict the persistence of stuttering. They selected 36 children from a pool of more than 100 stuttering children who were participating in a larger, longitudinal research project. A control group of 50 nonstuttering children were participating as well. Upon entry into the project, the 36 children who stuttered ranged in age from 2;3 to 5;5. The longitudinal nature of the project allowed the researchers to assign each stuttering child to one of three groups (n = 12 per group): those who continued to stutter more than 36 months from the time of onset ("persistent"); those who recovered from stuttering 18–36 months after onset ("late recovered"); and those who recovered from stuttering within 18 months of onset ("early recovered"). Each child who stuttered was matched to a fluent child on the basis of age and sex. At entry into the project, all children in the stuttering and nonstuttering groups had been administered the APP-R (Hodson, 1986), described above. The conversational speech of all children was analyzed for disfluencies but not for phonological development.

Scores that had been obtained on the APP-R by the children who stuttered were compared to those that had been obtained by the matched control children. Although there were no statistically significant differences between either recovered group and its control ($p > .05$), the persistent group made significantly more phonological errors than its control ($p < .05$). The researchers noted, however, that there were wide individual differences within each of the stuttering and control groups. For example, there were some children in the persistent group who did not have phonological problems, and there were some in the recovered groups who did have them. Thus, they cautioned that the presence of a phonological problem should not be used as the only factor to predict the long-term outcome for stuttering.

In a subsequent report on these same children, Yairi, Ambrose, Paden, and Throneburg (1996) indicated that the phonological skills of children in all three stuttering groups, including the persistent group, had improved one year following entry into the study when the APP-R was re-administered. In fact, 11 out of 12 (92%) children in the persistent stuttering group had moved into the mild range on the APP-R, a level that did not indicate the need for intervention. This suggests that the presence of a phonological problem as a predictor of persistent stuttering may be helpful only for a relatively brief period of time in a child's development.

As part of the same longitudinal research project, Paden, Yairi, and Ambrose (1999) reported on the phonological skills of a larger group of 84 children (58 boys, 26 girls) who stuttered: 22 whose stuttering would persist for at least 48 months past the point of onset ("persistent group") and 42 whose stuttering would resolve in less than 48 months ("recovered group"). During the initial evaluation, the phonological skills of each child were evaluated using the APP-R. At that time, the mean ages of the persistent and recovered groups, respectively, were 3;8 and 3;3 (range = 2;1–4;11 for both groups).

Because the children in the persistent group were, on average, 5 months older than those in the recovered group, it was necessary to use age-weighted scores when comparing the groups' performance on the APP-R. Age-weighted mean error scores of 30.45 and 23.18 were obtained by the persistent and recovered groups, respectively, a difference that was statistically significant ($p < .05$). Although both groups demonstrated normal phonological patterns, the persistent group was developing more slowly than the recovered group. Problems with consonant clusters, in particular, were more common in the persistent group. The study indicated, therefore, that young children near the onset of stuttering whose stuttering would persist had weaker phonological skills than those whose stuttering would resolve. However, like Paden and Yairi (1996), Paden et al. (1999) cautioned that there were many exceptions to this trend and that children in both groups showed wide individual differences. They recommended, therefore, that the presence of a phonological delay near the onset of stuttering should be considered only a warning sign for persistent stuttering rather than a definite predictor.

Collectively, these three studies (Paden & Yairi, 1996; Paden et al., 1999; Yairi et al., 1996) suggest that there *may* be an interaction between stuttering and phonology in *some* children, particularly in those whose stuttering persists. However, the phonological problems in these children seem to be subtle and fleeting, making it difficult to detect an interaction. It also should be noted that a longitudinal study recently published by Ryan (2001) failed to support the hypothesis that an early phonological delay can predict the persistence of stuttering.

In Ryan's (2001) study, 22 preschool children who stuttered (14 boys and 8 girls) were formally evaluated at a university speech and hearing clinic every 3 to 5 months over a 2-year period. At the outset of the study, the children had a mean age of 4;2 (range = 2;4–5;10). At each of the first four evaluation sessions, the child was administered the Arizona Articulation Proficiency Scale (AAPS, Barker, 1973) to monitor phonological development and participated in a fluency interview to determine the number of stuttered words per minute (SW/M). By the fourth session, it was determined that 15 children had recovered from their stuttering whereas 7 persisted, patterns that were confirmed during subsequent sessions. Raw scores on the AAPS were examined for each child in the recovered and persistent groups for sessions 1 through 4. Although both groups' scores on this test improved over time, there were no statistically significant differences between the groups at any of the sessions ($p > .05$). Therefore, children whose stuttering persisted were no more likely to have a phonological delay than those whose stuttering stopped. To further examine a possible relationship between stuttering and phonology, correlation coefficients were calculated between scores on the AAPS at session 1 and the number of SW/M at session 4, and between scores on the AAPS at session 4 and the number of SW/M at session 1. The data were analyzed for each group individually and for all children combined. However, none of the results were statistically significant ($p > .01$).

Discussion

In the introduction to this article, the following question was highlighted: *Is there an interaction between stuttering and phonology in children?* Fifteen studies have addressed this question in a variety of ways, but solid evidence of an interaction remains elusive. Methods of investigation have included correlating the frequency of disfluencies with the number of phonological errors a child produces (Louko et al., 1990; Ryan, 1992, 2001; Yaruss & Conture, 1996); comparing the stuttering behavior of children with phonological disorders to that of children with normal phonological development (Wolk et al., 1993; Yaruss et al., 1998); comparing the phonological behavior of children who stutter to that of children with normal fluency (Wolk et al., 1993); examining the CRH in children who stutter (Logan & Conture, 1997; Melnick & Conture, 2000; Yaruss & Conture, 1996); examining the phonological complexity of words and syllables in relation to instances of stuttered speech (Howell & Au-Yeung, 1995; Throneburg et al., 1994; Wolk et al., 2000); and tracking the persistence of stuttering in relation to early phonological delays (Paden & Yairi, 1996; Paden et al., 1999; Ryan, 2001; Yairi et al., 1996).

As described above, this research was motivated partly by clinical issues. In particular, it has been important to determine if children who stutter and have a co-occurring phonological disorder require a unique approach to treatment, based on the hypothesis that the presence of one disorder might exacerbate the symptoms of the other. However, the research to date has not provided strong empirical evidence of an interaction between stuttering and phonology.

This conclusion is based on a detailed analysis of studies published since 1990 and an attempt to evaluate their contributions individually and collectively. Although the interaction hypothesis has been examined in a variety of ways, studies failed to demonstrate that greater amounts of stuttering were associated with a greater number of phonological errors (Anderson & Conture, 2000; Louko et al., 1990; Ryan, 1992, 2001; Wolk et al., 2000; Yaruss & Conture, 1996); that stuttering severity differed in children with phonological disorders compared to those with normal phonological development (Wolk et al., 1993; Yaruss & Conture, 1996; Yaruss et al., 1998); that phonological behavior differed in children who stuttered compared to those who were fluent (Wolk et al., 1993); that the effort to produce phonologically complex words was associated with greater amounts of stuttering (Howell & Au-Yeung, 1995; Logan & Conture, 1997; Throneburg et al., 1994); or that phonological processes in children's conversational speech occurred more often during stuttered than nonstuttered utterances (Melnick & Conture, 2000). Although one study (Wolk et al., 1993) found that S + DP children produced a greater percentage of sound prolongations during conversation than S + NP children, raising the possibility of qualitative differences in stuttering as a function of phonological status, another study (Yaruss & Conture, 1996) was unable to replicate that finding.

On the positive side, one study (Wolk et al., 2000) reported that children stuttered more frequently on word-initial consonant clusters that were misarticulated than on clusters that were produced correctly in conversation, and two other studies (Paden & Yairi, 1996; Paden et al., 1999) reported that an early phonological delay was associated with the persistence of stuttering, results that suggest a *possible* interaction. However, another study (Ryan,

2001) failed to support the link between early phonological delays and the persistence of stuttering.

Future Research

Perhaps the largely negative findings indicate there is little or no interaction between stuttering and phonology. The failure to find statistically significant correlation coefficients between the frequency of disfluencies that young children produce and the frequency of their phonological errors in five different studies (Anderson & Conture, 2000; Louko et al., 1990; Ryan, 1992, 2001; Yaruss & Conture, 1996) seems particularly damaging to the interaction hypothesis. The use of correlation coefficients to detect a possible relationship between stuttering and phonology is a powerful technique because it focuses on the child's overt behaviors and avoids the problem of having to diagnose a speech disorder. As is well known, with young children, the diagnosis of stuttering is often subject to uncertainty (Adams, 1977; Gordon & Luper, 1992; Onslow, 1992), as is the diagnosis of a phonological disorder (Shriberg & Kwiatkowski, 1982b). This uncertainty occurs because typically developing children often produce the same types of disfluencies and phonological errors as their peers who have disordered speech (Adams, 1977; Stoel-Gammon & Dunn, 1985). Importantly, statistically significant correlation coefficients do not imply cause-effect relationships between two factors, *x* and *y*. However, they do indicate that when *x* moves in a certain direction, *y* tends to do so as well (Schiavetti & Metz, 1997). Therefore, if "trading relationships" (Bernstein Ratner, 1995, p. 182) do exist between fluency and phonology, it is reasonable to expect that the number of disfluencies that children produce would co-vary with the number of phonological errors that occur in their speech. The lack of evidence for such a pattern weakens the hypothesis.

However, before one can reject the hypothesis that stuttering and phonology interact, it is essential that further research be conducted, particularly in view of the possible clinical implications of an interaction. Suggestions have been offered for ways to replicate some of the studies using slightly different methodology to detect an interaction. For example, it might be worthwhile to attempt to challenge children's phonological abilities more fully by presenting tasks that directly prompt a child to produce a large number of phonologically complex words (e.g., *brontosaurus*) or phrases (e.g., *brown and blue plaid pants*) through repetition tasks or story-retelling activities where it is difficult to avoid those words. In particular, children's productions of consonant clusters (both correct and incorrect) should be analyzed carefully in relation to their stuttering behavior during those tasks. This could allow for a more rigorous examination of children's phonological skills in relation to their stuttering.

The possibility that the persistence of stuttering might be predicted by an early phonological delay is an intriguing hypothesis that has emerged through longitudinal research (Paden & Yairi, 1996; Paden et al., 1999; Yairi et al., 1996). Although a recently published longitudinal study (Ryan, 2001) did not support the hypothesis, it should be investigated in further detail through additional studies to examine patterns of phonological development in children whose stuttering persists compared to those whose stuttering resolves, including the existence of residual speech sound errors during the school-age years. Given the wide individual differences in phonological development reported in children with persistent stuttering (Paden & Yairi, 1996; Paden et al., 1999), it would be helpful to determine *why* certain children with persistent stuttering have a phonological delay while others do not and to identify the nature of that delay and any associated weaknesses (e.g., linguistic, cognitive, social, motoric, sensory). There are many types of phonological problems that children can display (Shriberg, 1997; Shriberg & Kwiatkowski, 1982b). Because children who stutter are heterogeneous in their speech and nonspeech behaviors (Schwartz & Conture, 1988), it would not be surprising to find that they display a wide variety of phonological problems as well.

Perhaps the most pressing topic for research concerns the clinical management of children who stutter and have a co-occurring phonological disorder. Although it is difficult to state with confidence just how frequently the two disorders co-occur (Nippold, 2001), it is clear that some children who stutter also have a phonological disorder (e.g., Wolk et al., 1993; Yaruss & Conture, 1996). In the intervention literature, it is commonly recommended that children affected by both disorders receive an indirect approach to treatment, based on the belief that a direct approach could contribute to negative interactions (e.g., Bernstein Ratner, 1995; Conture, 2001; Conture et al. 1993; Louko et al., 1999). However, there is little empirical evidence of an interaction between stuttering and phonology, and the effects of direct treatment on children affected by both disorders have not yet been investigated. In the absence of data concerning the effects of direct versus indirect treatment, it is reasonable to

question the common advice that children with both disorders should receive an indirect approach to treatment.

Research that has employed a direct approach to the treatment of stuttering in young children not identified as having a phonological disorder has yielded positive results (e.g., Lincoln & Onslow, 1997; Lincoln, Onslow, & Reed, 1997; Onslow, Andrews, & Lincoln, 1994; Onslow, Costa, & Rue, 1990). Similarly, phonological disorders in young children not identified as having a stuttering problem have been treated successfully using direct techniques (e.g., Gierut, 1998; Kwiatkowski & Shriberg, 1993; Shriberg & Kwiatkowski, 1982c; Shriberg, Kwiatkowski, & Snyder, 1989, 1990). At the same time, it is unknown what impact a direct approach to the treatment of stuttering and a co-occurring phonological disorder would have.

Well-designed studies with large numbers of children are essential to examine the effects of direct versus indirect treatment on those with a co-occurring disorder, and to determine what adjustments are necessary when implementing the treatment. Importantly, such studies would offer the opportunity to test the interaction hypothesis in a direct and robust fashion. In conducting such studies, it will be important to attend to the performance of individual children, in addition to the larger group, because young children who stutter are heterogeneous (Schwartz & Conture, 1988), and it is possible that different children may respond differently to the same treatment approach. Hence, when conducting such studies, researchers should carefully examine subgroups of children who stutter and have a co-occurring phonological disorder. Without this type of research, it is impossible to offer scientifically defensible recommendations for the clinical management of children who stutter and have a co-occurring phonological disorder.

In the meantime, clinicians should employ a cautious approach to the treatment of children who exhibit both disorders, particularly in view of clinical reports of children becoming disfluent while receiving direct treatment for phonological disorders (Conture, 2001; Edwards, 1997). A cause-effect relationship between direct phonological treatment and stuttering has not been established through empirical research. Nevertheless, if the clinician employs a direct approach to the treatment of both disorders, it may be wise to teach the child to produce the target sounds in a relaxed and unhurried manner in order to avoid placing excessive demands on the child's linguistic/motoric capacities (Conture, 2001). Adopting a scientific perspective, the clinician should observe the child closely to determine if the frequency of stuttering increases as the target sounds are produced in longer and more complex lexical and syntactic units. This type of ongoing, data-based monitoring will allow the clinician to modify the treatment plan so that the child achieves and maintains a high level of fluency while phonological skills improve.

To conclude, interest in the topic of stuttering and co-occurring phonological disorders has increased dramatically during the past decade and is currently a prominent topic in the literature. Although it is commonly believed that the two disorders may affect each other, a careful analysis of the research reveals that the existence of an interaction between stuttering and phonology is not well supported by empirical evidence. Therefore, caution should be exercised before embracing the view that the presence of one disorder exacerbates the symptoms of the other and that an indirect approach to treatment is necessarily the best choice of action.

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findings pointed to problems in areas such as voice, fluency, or language reception, for instance.

The participants were also asked that their descriptions be sufficiently concrete and step-by-step that a reader could do the same evaluation if they so wished.

The papers that follow offer five different views of the proverbial elephant. To better highlight similarities and differences between the approaches, the first paper describes an evaluation approach, and the following papers offer responses to that description. None of the approaches are intended to demonstrate "the right way," nor do the papers in total represent the complete range of approaches. Rather, for those in the early stages of clinical training, the forum offers an opportunity to observe how experienced clinicians wrestle with the dichotomy between "what should be done under ideal conditions" and "what is possible within real life clinical settings." More experienced clinicians may find the forum useful to see how others wrestle with common types of clinical problems. The hope of all involved is that the papers stimulate others to discuss practical options and approaches to the evaluation and treatment of persons with communication disorders.

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Erratum

In the April 2002 issue, in the "Stuttering and Phonology: Is There an Interaction?" article by Marilyn A. Nippold, an editing error (on p. 101, left column) misrepresented who performed certain analyses. Below is the correct wording of the sentence in question, with the operative words in bold:

Subsequent analyses by **this author** [meaning Marilyn A. Nippold] indicated that the 20 children obtained a mean percentile rank of 57.25 on the GFTA (range = 23–99); a mean overall score of 21.50 (range = 14–34) on the SSI-3; a mean WWD (percent) of 14.08 (range = 5–33); and a mean TD (percent) of 17.54 (range = 10.30–36).

Stuttering and Phonology: Is There an Interaction?

Marilyn A. Nippold
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