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Intervention for Preschool Children With Moderate-Severe Phonological Impairment

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Approximately 92% of speech-language pathologists (SLPs) who work with preschool children will provide treatment for articulation and/or phonological impairments (Shewan, 1988). Given that articulation and/or phonological impairments comprise about 32% of communication disorders (Slater, 1992), SLPs therefore spend a considerable amount of their time working with these children. Undoubtedly, SLPs want to provide services that are designed to bring about reasonably calculated gains in a child's phonological system in the shortest amount of time possible within the constraints of the schools or agencies they work for. Moreover, children who demonstrate moderate to severe problems in articulation/phonology will require more of a clinician's direct time and effort than children with milder problems.

A widely used metric for characterizing the severity of phonological impairment in children was developed by Shriberg and Kwiatkowski (1982) and involves the calculation of the percentage of consonants that are correct (PCC) in a continuous speech sample. PCC scores that range from 85 to 100% represent a mild impairment, whereas PCC scores from 65 to 85% represent a moderate impairment; scores between 50 and 65% represent a moderate-severe impairment, and scores less than 50% represent a severe impairment. It is likely that a clinician will spend considerably more time working with a client exhibiting a moderate-severe or severe impairment than one who exhibits a mild impairment. Efficient use of a clinician's time when working with children with moderate-severe to severe levels of impairment is dependent on the use of practices that are effective in treating speech-sound disorders. Put another way, clinicians who use effective practices in speech-sound treatments are able to work more efficiently. In this brief, we consider empirical evidence that provides guidance to SLPs who desire to use effective practices in bringing about phonological change for preschoolers with moderate-severe phonological disorders.

In this EBP brief, we addressed this topic by searching four databases to answer this clinical question: What intervention approaches are effective in improving articulation/phonological abilities for preschool children with moderate-severe phonological disorders? This clinical question is phrased following the "PICO" format (Straus & Sackett, 1998), with each part of the PICO acronym corresponding to one part of the clinical question. The "P" refers to the patient or client characteristics and the problem that he or she is experiencing; the "I" represents the intervention program, approach, method, or technique; the "C" refers to the comparison treatment (e.g., comparing minimal pair to multiple oppositions therapy); and the outcome is represented by "O." Outcomes are usually assessed with a standardized measure of performance. Thus, in this brief, we limited our review to studies in which participants were preschool children (P) who had moderate-severe phonological impairments. The studies reviewed also had to use a treatment approach (I) compared to a no-treatment or alternative treatment (C), for which the treatment approach was designed to target improved speech production (O) as measured using single words, phonological process pattern use, and/or measures typically obtained from spontaneous speech samples (e.g., percent consonants correct, [PCC]).

To locate studies that answered our specific clinical question, we used search engines that would be accessible to most SLPs. The databases we searched were the American Speech, Language, and Hearing Association (ASHA) website, Education Resources Information Center (ERIC), Cochrane.com, and Google Scholar. While this does not constitute an exhaustive search of the literature, these databases include the majority of clinically relevant studies. We conducted our search using the terms *preschool, severe, articulation, phonological,* and *intervention*. This search yielded 1,201 titles and abstracts. Only studies using one of the following research designs were considered for inclusion: meta-analysis, systematic review, randomized clinical trial (RCT), non-randomized study and/or study that compared two or more treatments (quasi-experimental), and single subject (multiple baseline)

experimental design. The criteria used for study selection are summarized in Table 1.

Examination of titles, abstracts, and methodologies of studies from these four searches revealed one meta-analysis and four research articles that met the criteria listed in Table 1. The following section summarizes each of these articles, all of which provide guidance for helping us to answer our question (i.e., What intervention approaches are effective in improving articulation/phonological abilities for preschool children with moderate-severe speech phonological disorders?). These studies are also summarized in the Appendix.

Article Summaries

Law, Garrett, and Nye (2004)

Law, Garrett, and Nye (2004) conducted a meta-analysis that examined the efficacy of treatment for children with developmental speech and language delays/disorders. Their review identified six randomized controlled trials that compared specific treatment approaches against a no-treatment or delayed-treatment condition for expressive phonology outcomes. Their analyses of these studies indicated that children who received treatment for phonological problems had better outcomes than children who did not receive treatment, with an average effect size of $d = 0.44$ (corresponding to about one-half of a standard deviation unit; $n = 264$). When parent-administered interventions were removed from analysis, treatment effects increased to $d = 0.67$ ($n = 214$); stronger effect sizes ($d = 0.74$; $n = 213$) were also seen when treatments of short durations (i.e., < 8 weeks) were removed from analysis. Details of the six studies reviewed are available in Law et al. (2004).

Tyler, Lewis, Haskill, and Tolbert (2002)

Tyler, Lewis, Haskill and Tolbert (2002) examined the cross-domain effects of preschool morphosyntactic and phonology intervention on the untreated domain (e.g., the effects of morphosyntactic intervention on phonology, and vice versa). Participants were 27 preschool children ranging in age from 3;6 to 4;8 years, all of whom exhibited impairments in both phonological (mean PCC = 60%) and morphosyntactic skills. Twenty of the children were randomly assigned to receive a 24-week intervention comprising two 12-week blocks beginning with either the phonology intervention ($n = 10$) or the morphosyntactic intervention ($n = 10$) followed by the other type of intervention. Phonological data were collected at pre-treatment, after the first intervention block, and at post-treatment. A control group comprising seven children (who were not randomly assigned to this condition) was assessed at the beginning and end of a time period equivalent to one intervention block.

The phonological intervention incorporated a combination of clinician- and child- centered techniques focusing on auditory awareness, sound contrast awareness, speech production, and phonological awareness activities. The morphosyntactic intervention incorporated auditory awareness, focused stimulation, and elicited production activities within the context of themes and written scripts. A finite morpheme composite score was calculated from children's spontaneous language samples to evaluate morphosyntactic development. A target/generalization phoneme composite score was calculated from single word productions on *The Bankson Bernthal Test of Phonology* (Bankson & Bernthal, 1990) to measure phonological change.

Both interventions were associated with improvement in the targeted domain when compared to the control group. The morphosyntax intervention, however, led to a cross-domain effect on phonology that was similar to the effect achieved by the phonology intervention. In contrast, the phonology intervention had no effect on morphosyntax. These findings suggest that morphosyntax should be the initial focus of intervention for children who exhibit both phonology and morphosyntactic problems, as morphosyntactic intervention can improve both morphosyntax and phonology simultaneously.

Tyler, Lewis, Haskill, and Tolbert (2003)

Tyler, Lewis, Haskill, and Tolbert (2003) conducted a follow-up to the Tyler et al. (2002) study described in the previous section. This 2003 study added two conditions to further examine the effects of different goal attack strategies on preschoolers' phonological and morphosyntactic abilities. Forty preschool children ages 4;0 to 4;6 years who exhibited impairments in both phonology (mean PCC = 58%) and morphosyntax were randomly assigned to one of four goal attack strategies: (a) phonology first (12-week block of phonology intervention followed by 12-week block of morphosyntax intervention); (b) morphosyntax first (12-week block of morphosyntax intervention followed by 12-week block of phonology intervention); (c) alternating

condition (phonology and morphosyntax goals alternated each week); and (d) simultaneous condition (phonological and morphosyntactic goals addressed in each session). Changes in children's expression of finite morphemes and target/generalization phoneme composites were assessed pre-treatment, after the first block of intervention, and after 24 weeks of intervention.

The alternating strategy resulted in the greatest amount of change in children's finite morpheme use. However, for the domain of phonology, no one approach was found to be most effective for affecting improvements in phonology. These findings suggest that alternating phonology and morphology intervention may be preferable when children have deficits in both of these domains.

Wolfe, Presley, and Mesaris (2003)

Wolfe, Presley, and Mesaris (2003) studied the effects of sound identification training on children's speech production. Nine preschool children ages 3;4 to 4;2 years with severe phonological disorders *(Goldman Fristoe Test of Articulation* [GFTA]; Goldman & Fristoe, 1986) scores between the 1st and 6th percentiles) were randomly assigned to receive training in speech production (n = 5) or training in both speech production and sound identification (n = 4). Production training consisted of a traditional, multiple-phonemic approach (see McCabe & Bradley, 1975) that progressed from syllables to words to phrases. Children in the production plus sound identification group received production training plus 10-minutes of sound identification training on the *Speech Assessment and Interactive Learning System* (SAILS; AVAAZ Innovations, 1995). All children received between 12 and 17 30-minute sessions delivered biweekly.

Pre- and post-treatment probes were used to assess children's sound production and identification abilities for three target sound errors. The production probes contained 10 stimuli and were elicited through the use of picture naming and sentence imitation. Perception probes were similar in that they contained 10 stimuli but were elicited through the use of the *SAILS* program and were individualized for all participants. Children were asked to listen to well-produced and misarticulated versions of target phonemes and identify the correct version. Foils included their own misarticulation of the stimulus sound. Children's performance on this probe was further classified as "well identified" or "poorly identified." Scores at 90% or better were "well identified," and scores less than 90% were "poorly identified."

No overall difference was found between the two treatment approaches except for sounds that had been poorly identified. Children made more progress on poorly identified sounds when treated with both production and sound identification training. The authors were also interested in determining whether production training influenced sound identification ability. For sounds receiving production-only training, the mean post-training identification score (7.66) significantly exceeded the mean pre-training identification score (5.73). Taken together, the findings of this study indicate that although production-only treatment improves children's sound-identification performance, sound-identification training may provide additional benefits to speech production especially when the sounds targeted are not well identified.

Rvachew, Nowak, and Cloutier (2004)

Rvachew, Nowak, and Cloutier (2004) examined the benefits of a perceptual training approach to treatment for moderate-severe expressive phonological delay (GFTA scores between the 1st and 6th percentile; mean PCC = 60%) in 34 preschoolers ages 3;4 to 4;9 years. Children were randomly assigned to an experimental or control group, with experimental participants receiving 16 15-minute training sessions in phonemic perception, letter recognition, letter sound correspondence, and onset-rime matching in a computerized program monitored by a parent or research assistant. Sounds taught included /t, p, m, k, l, r, f, s/ in initial position (first 8 weeks) and then final position (last 8 weeks). The phonemes were placed in the following words: *toe, pea, man, coat, lamb, rope, feet, soap, mitt, top, ham, book, nail, door, knife,* and *bus*.

For perceptual training, children were asked to identify a word from among foils that represented a stimulus word (e.g., *soap*). The foils shared phonological similarities to the stimulus (e.g., *soap* and *top*). Letter recognition, sound-letter correspondence, and onset-rime matching activities were conducted in a similar fashion and featured such prompts as "Point to the /s/ when you are asked to," "Point to the /s/ when you hear the snake sound," and "Point to the /s/ when you hear a word that starts like /sss/." The children in the control group listened to computerized books for an amount of time similar to that of the experimental group.

During the experiment, children in both groups received their regular speech therapy program from their SLPs, which involved for some a cyclic approach (Hodson & Paden, 1983), a sensorimotor approach (syllable shapes,

oral-motor exercises), or a traditional approach (one or two phonemes trained to mastery). Phonetic placement techniques were used by all of the clinicians. No additional perceptual training was provided outside of that provided to the children in the experimental group. The SLPs who provided regular intervention were not aware of the group assignments for participants.

Spontaneous speech samples were collected for each child, and PCC scores were calculated from these samples. A PCC-difficult score was obtained by calculating PCC for those sounds on which all of the children exhibited 60% or lower accuracy. In addition, children were administered the *GFTA-2* as a single word measure (Goldman & Fristoe, 2000), Bird, Bishop, and Freeman's (1995) test of phonological awareness, and the *SAILS* test of phonemic perception (AVAAZ Innovations, 1994). All assessments were given prior to and 6 months after intervention was completed.

Children in the experimental group who received perceptual training performed significantly better than control children in phonemic perception, single word production, and articulation in conversation. No differences were found for phonological awareness. This study shows that inclusion of perceptual training is beneficial to expressive phonological performance for children with moderate-severe phonological disorders.

Evaluation of Studies

Well-designed studies make it easier for clinicians to decide whether or not the approach or technique under investigation might be useful for or applicable to their own clients. Each study included in the present review was evaluated and rated according to the guidelines shown in Table 2 (Gillam & Gillam, 2006); the ratings are shown in Table 3. The items upon which studies are reviewed (see Table 2) are those that we feel are most relevant to practicing clinicians. As can be seen in Table 3, the studies included in the present review are variable in the level of quality displayed, with the Rvachew et al. (2004) study earning the highest rating. All of the studies, however, exhibited a majority of the eight items for which studies were rated, indicating that this corpus of work is generally of high quality.

Careful consideration of the data in Table 3 shows that the participants in the studies fit those outlined in our PICO question and that participants assigned to treatment versus control conditions were judged to be similar in terms of their phonological status at the outset of intervention. Further, all of the studies used valid outcome measures and reported reasonable, statistically significant findings for outcome variables related to phonological improvement, often in spite of the small number of participants included in the studies. All but one of the studies reported effect sizes (the exception being Wolfe et al., 2003), making it possible to examine the extent of practical benefit of the findings. One methodological weakness observed across the majority of studies is the lack of blinding procedures. Only Rvachew et al. (2004) featured use of examiners who were not involved in the provision of intervention and who were blind to children's treatment assignment. Given that effect sizes are somewhat larger in studies that do not employ blinding procedures (Balk, 2002), inclusion of blinding procedures makes this study the most compelling of those we located.

This noted, it is important to mention that all items for which the studies were rated are not equal in importance. Some items are more critical than others, especially in terms of evaluating the strength of causal interpretations (i.e., our confidence in the effects of treatment rather than some other factor/s). To illustrate, note from Table 3 that most of the studies included a control group and/or compared one or more intervention group(s), and children were assigned randomly to one group or another. However, in Tyler's studies, while children in the intervention groups were randomly assigned to a treatment condition, the children in the control groups were not randomly assigned to the control condition. A lack of random assignment can raise concerns about the strength of causal arguments. However, despite the lack of randomization in these studies, the results are compelling because it is clear that participants who received treatment made improvements in their phonological and morphosyntactic skills in comparison to children who did not receive treatment.

Summary and Conclusions

In the previous sections, we have discussed five studies investigating treatment outcomes for preschoolers with phonological impairment. What can we take from the studies reviewed in this brief This review showed that children who receive treatment for phonological impairment make more improvements in their phonological system than children who do not receive treatment (Law

et al., 2004). Importantly, this treatment can take many different forms. As a case in point, Law and colleagues' meta-analysis found that children who participated in the eight studies they reviewed participated in a variety of different programs using a number of different approaches and treatment methods. It has been argued that different treatment approaches are not distinguishable in affecting change in a child's sound system (Gierut, 2005). The fact that one treatment approach has not yet proven to be better than others led Gierut to conclude that *what* is treated may be more important than *how* it is taught.

The studies by Tyler and colleagues (2002, 2003) reviewed in this EBP brief provide tentative support to Gierut's (2005) position. Tyler and her colleagues found that the selection of phonological targets (e.g., final consonant deletion, final cluster reduction) that also held morphophonemic status (e.g., marking of past tense, third person singular) resulted in greater improvements in phonology (and morphosyntax) than working on one domain or the other. The results of their studies indicated that strategic selection of targets may be a more important variable to consider than whether or not to use one approach versus another.

In considering how such findings may influence evidence-based practices (EBP) in speech-language intervention, Kamhi (2006) recently argued that treatment decisions are influenced not only by empirical research, but also by a clinician's theoretical perspective and service delivery factors. He also suggested that clinicians typically use changes in client behavior to validate their clinical decisions. Kamhi's point was that treatment approaches must be experimentally validated with individual clients, which is not always easy to do. For example, whether or not to include perceptual training in intervention programs to improve articulation and phonology has been a matter of theoretical debate over the years. In light of the evidence reviewed in this brief, it would seem that perceptual training is an experimentally valid part of a program one might use to improve expressive phonology in preschool children (Rvachew et al., 2004; Wolfe et al., 2003). Nonetheless, in order to determine whether perceptual training is effective for a particular client, a clinician would need to show that improvement in his/her client was due to this training and not to some other component of treatment.

There are some limitations to this review that warrant comment. First, as was stated earlier, the review conducted for this brief does not constitute an exhaustive search of the literature. There may be studies that fit our inclusionary criteria that were unintentionally omitted. Second, although the studies we reviewed represent the best available evidence that we were able to obtain from our search, these studies did not all represent the best evidence. For example, none of the studies adhered to blinding procedures except Rvachew and colleagues (2004). In some cases, participants were also receiving other forms of intervention during the experimental intervention, which may have influenced children's outcomes within the experimental intervention (see Wolfe et al., 2003). These methodological limitations can raise questions about internal validity (i.e., the causal effects of treatment) as well as external validity (i.e., the generalization of results to one's own clients).

For these reasons, it is particularly important for clinicians to be in the "driver's seat" as they seek to integrate the best available empirical evidence with their own knowledge, experience, and expertise (Gillam & Gillam, 2006). In short, clinical judgment matters. As Kamhi (2006) recently wrote, clinical decisions should be based not just on existing research, but on clinical reasoning that considers clinical expertise and client values, as well as a clinician's theoretical perspective, service delivery factors, and experimental validation with individual clients.

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Table 1. Inclusionary Criteria for Studies of Articulation/Phonological Intervention

Design
Meta-analysis or systematic review, randomized clinical trial, quasi-experimental design, or single-subject experimental design
Participants
Preschoolers with moderate-severe articulation and/or phonological impairment
Treatment Approach
Intervention method, technique, or approach designed to improve speech production
Outcome Measure
Speech production as measured using single word, phonological process pattern use, and/or measures obtained from spontaneous speech samples (e.g., PCC)

Table 2. Guidelines for Rating Studies

Intervention design–Did the study include a control group? Did the method include one or more intervention groups?
Random assignment–Were the subjects assigned to intervention and/or control groups in a random fashion?
Participants–Do the children who participated in the study fit the PICO question? (Are they within the selected age range? Do they present with specified speech/language skills/impairments?)
Pre-intervention status–Did the children in the intervention groups start out with similar capabilities? (Note: The only factor that should be different between the participants is the type of intervention they received, not their initial abilities.)
Blinding–Were the professionals conducting the assessments unaware of group assignment and/or details of the study?
Outcome measures–Did the investigators use measures to demonstrate change that were reliable and valid?
Statistical significance–Did the authors report p values (the probability that a difference between the means of two or more groups would not occur by chance alone) that were less than .05?
Practical significance–Could Eta squared values (percent of variance accounted for) or standardized d values (number of standard deviations of difference between groups) be found or could they be calculated from the available data in the article? Are these values 0.40 or higher?

Note: "Yes" answers to each item are summed to arrive at a total score for each article (8 points possible)

Table 3. Ratings Summaries for Relevant Studies

	Tyler, Lewis, Haskill, & Tolbert (2002)	Tyler, Lewis, Haskill, & Tolbert (2003)	Wolfe, Presley, & Mesaris (2003)	Rvachew, Nowak, & Cloutier (2004)
Intervention design	Yes	Yes	Yes	Yes
Random assignment	Yes[a]	Yes[a]	Yes	Yes
Participants	Yes	Yes	Yes	Yes
Pre-intervention status	Yes	Yes	Yes	Yes
Blinding	No	No	No	Yes
Outcome measures	Yes	Yes	Yes	Yes
Statistical significance	Yes	Yes	Yes	Yes
Practical significance	Yes	Yes	Yes	Yes
Total	7	7	7	8

[a] Children were randomly assigned to treatment conditions but not to the control condition.

Appendix
Brief Summaries of Articles

Authors	Summaries
Tyler, Lewis, Haskill, and Tolbert (2002)	The purpose of the study was to compare morphosyntactic versus phonologic intervention for improving morphosyntactic skills (primarily expression of morphemes) and expressive phonological abilities in 20 preschoolers against a no-treatment control group (n = 7). The study also examined the effects of these intervention approaches on the non-targeted domain (morphosyntax, phonology), and for children who received both approaches. Children were randomly assigned to an intervention of two 12-week blocks beginning with either a block of phonology (n =10) or a block of morphosyntax (n = 10) followed by the alternative approach. Outcome measures included a finite morpheme composite (FMC) and a target/generalization phoneme composite (TGP). Both interventions were associated with improvement in the target domain (either morphosyntax or phonology) when compared to the control group. Statistical significance of morphosyntactic intervention as compared to the control group was associated with a large effect size (Cohen's d = 1.19). Statistical significance of phonological intervention as compared to the control group was associated with a moderately large effect size (d = .61). Greater improvement in phonological performance was seen for the morphosyntax intervention group as compared to the control group (d = 1.35).
Tyler, Lewis, Haskill, & Tolbert (2003)	The purpose of the study was to examine the effects of four different goal attack strategies: (a) phonology first (12-week block of phonological intervention followed by 12-week block of morphosyntax intervention); (b) morphosyntax first (12-week block of morphosyntax intervention followed by 12-week block of phonological intervention); (c) alternating (phonology and morphosyntax goals alternated each week); and (d) simultaneous (phonological and morphosyntactic goals addressed in each session). These conditions were studied for their impact on the phonological and morphosyntactic abilities of 47 preschool children with speech and language impairments. Forty children were randomly assigned to one of the four treatment approaches and seven comprised a no-treatment control group. Outcome measures were the same as those in Tyler et al. (2002). The alternating strategy resulted in the most change in finite morpheme use as compared to the phonology first (p = .0018; d = 1.55), morphosyntax first (p = .026; d = 1.06), or simultaneous conditions (p = .02; d = 1.13). The morphosyntax first (p = .05, d = 0.85), alternating group (p = .03, d = 0.94), and simultaneous conditions (p = .01, d = 1.22) were shown to bring about significant change in phonology composites when compared to the control group; however, the phonology first intervention did not (p = .06).
Wolfe, Presley, and Mesaris (2003)	The purpose of the study was to compare articulatory (production) and sound identification (perceptual) improvements following treatment with and without sound identification training for nine preschool children with severe phonological disorders. Children were randomly assigned to two groups for the treatment of three stimulable sound errors; the two groups were (a) production and sound identification training (n = 4) and (b) production-only training (n = 5). Pre- and post-treatment probes were used to assess sound production and identification abilities for the three target sound errors for each subject. A significant difference was found for sounds that had been poorly identified prior to treatment. Errors that were poorly identified were shown to improve more after production and sound identification training compared to production-only training.

continued

Appendix, continued

Authors	Summaries
Rvachew, Nowak, & Cloutier (2004)	The purpose of the study was to examine the benefits of a perceptual training approach to treatment for moderate-severe expressive phonological delay in 34 preschoolers. Children were randomly assigned to an experimental group featuring a range of perceptual activities (e.g., letter recognition, letter sound correspondence, onset rime awareness) or control group (who participated in neutral activities). Children simultaneously received speech-language intervention by therapists who used a range of approaches. Outcome measures included percentage of consonants correct (for difficult sounds), a test of phonological awareness, and a test of phonemic perception. Results showed that the children in the experimental group who received perceptual training demonstrated greater performance at a post-test in phonemic perception, single word production, and articulation in conversation; no differences were seen for phonological awareness.