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Target Selection in Speech Therapy: Is a Non-Developmental Approach More Efficient Than a Developmental Approach?

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Structured Abstract

Clinical Question: For a preschool student with a severe phonological disorder, will incorporating a non-developmental target sequence be a more efficient approach than a developmental target sequence for improving speech sound production?

Method: EBP Intervention Comparison Review

Sources: ASHA publications, PsycINFO database, PubMed database

Search Terms: phonological disorder, speech sound disorder, target selection, and non-developmental sequence

Number of Included Studies: 6

Primary Results:

(1) When examining speech production changes of targeted sounds, results were equivocal with respect to the approach (i.e., developmental, non-developmental) to therapy target selection.

(2) When examining generalization outcomes on untreated sounds, results favored the non-developmental approach to therapy target selection.

Conclusions:

(1) These studies indicate that incorporating a non-developmental approach may be more efficient in supporting widespread phonological learning; however, the effectiveness of this approach varies according to children's stimulability for target sounds.

(2) SLPs should consider children's inventory of stimulable and non-stimulable sounds when deciding whether a non-developmental approach to therapy target selection is appropriate.

Clinical Scenario

Jane is a speech-language pathologist (SLP) in a rural school district in the Midwestern United States. She has 15 years of clinical experience, 13 of those working in the public school setting. Jane provides services to children in the school district's special education preschool and two elementary school buildings, and almost half of her caseload consists of students with phonological disorders.

Ben is a preschooler with a severe phonological disorder. Jane worked with Ben the previous school year and has developed growing concerns about his progress. Jane was expecting Ben to be further in his treatment program, given his motivation during therapy sessions and the additional practice he gets at home working with his mom. In a recent evaluation where she obtained his percentage of consonants correct (PCC), Jane discovered that, compared to his baseline PCC level, Ben had made minimal progress with his overall speech production skills. To ensure she had not overlooked any other explanation for his lack of improvement, Jane administered communication, cognitive, and academic assessments. Review of this information revealed no concomitant developmental issues or additional impairments that could be affecting his speech sound development.

Adding to her concern was her realization that this would be Ben's last year of preschool before moving on to kindergarten. With only nine months left to work with him, Jane felt compelled to re-evaluate Ben's existing treatment program and consider ways to deliver his therapy as effectively and efficiently as possible.

Jane's previous approach in designing Ben's phonological intervention incorporated a developmental sequence of sound acquisition to select treatment targets. Jane was taught that treatment should begin with "easier" or earlier-developing sounds (e.g., /b/, /p/) and that once children had successfully acquired those sounds, treatment could then focus on "harder" or later-developing sounds (e.g., /l/, /r/). Although the use of the developmental sequence of sound acquisition to select treatment targets had been successful with many of her students, Jane remembered an approach she had heard about at a conference the previous year. The conference session suggested that using a non-developmental sequence of sound acquisition to select treatment targets for speech sound disorder (SSD) therapy could yield greater therapeutic efficiency than the traditional developmental approach. That is, children would exhibit improvement not only on the sounds targeted in therapy, but also on sounds that therapy did not directly target. At the time, Jane thought it was intriguing but counterintuitive to everything she had learned during her clinical training. However, puzzled by Ben's slow rate of improvement, Jane felt she should at least investigate a non-developmental approach, as it could potentially address the issue of her constrained therapy time as well as Ben's lack of progress with the existing intervention.

Clinical Question

Jane used a PICO question structure to create her clinical question. A PICO structure highlights key information to incorporate in the clinical question, specifically **P**atient (or **P**roblem); **I**ntervention of interest; **C**omparison of the intervention of interest; and **O**utcome (Dollaghan, 2007; Gillam & Gillam, 2006; Johnson, 2006). For Jane's question, the relevant information included:

P: preschool students with severe phonological disorders

I: a non-developmental target sequence

C: a developmental target sequence

O: improved speech production (for targeted sounds and generalization)

From this format, Jane created the following question: "For a preschool student with a severe phonological disorder, will incorporating a non-developmental target sequence be a more efficient approach than a developmental target sequence for improving speech sound production?"

Search for Evidence

Prior to beginning her search, Jane thought it pertinent to review some of the background literature relevant to her research question. In doing so, she realized that there might be some overlap between the construct she was interested in comparing (i.e., target selection) and the therapeutic approaches, or techniques, that could be used to address therapy targets. For example, a study examining the effectiveness of the maximal oppositions approach might contrast developmental and non-developmental speech sound targets as part of that

therapy (e.g., Gierut, 1989). However, Jane reconciled that because her interests were focused on determining the efficiency of integrating a non-developmental sequence of speech sound targets, her search for evidence should concentrate only on studies that examined the construct of therapy target selection, irrespective of the therapy technique utilized.

To initiate her search process, Jane decided upon inclusion and exclusion criteria for selecting articles to review. First, she decided to limit her review to articles that had been published in peer-reviewed journals to obtain high-quality data. Second, because she needed evidence regarding the therapeutic efficiency of a non-developmental sequence for target selection, it was essential to choose articles that explicitly compared outcomes from non-developmental and developmental approaches to therapy target selection. Finally, it was critical that the results provided information about children's outcomes on both treated and untreated sounds (i.e., generalization to other sounds or sound patterns) so that the efficiency of the approaches to widespread phonological change could also be compared. With her inclusion and exclusion criteria decided, she determined that using varying combinations of the search terms of phonological disorder, speech sound disorder, target selection, and non-developmental sequence would yield results specific to the construct of therapy target selection.

As a member of the American Speech Language and Hearing Association (ASHA), Jane had full access to the three peer-reviewed ASHA journals: *American Journal of Speech-Language Pathology, Journal of Speech, Language and Hearing Research,* and *Language, Speech, and Hearing Services in the Schools.* Additionally, she remembered using the PsycINFO and PubMed databases to search for clinically relevant literature as a graduate student, and she was able to enter her search terms into these publicly available databases. Jane could freely view the abstracts for these articles, eliminate duplicates, and then ascertain the articles that would potentially meet her inclusion criteria from either the title or abstract. To facilitate the management of her search process, Jane created a table listing the databases that were searched, the initial number of resulting articles, the final number of articles downloaded or purchased, as well as the reasons that other articles were not included (see Table 1).

Evaluating the Evidence

After pulling the articles that met the search criteria, Jane felt she had sufficient data to address her clinical research question. Across the six studies conducted between 1984 and 2001, 71 children with SSD between the ages of 2:8 and 6:3 were studied. Jane also noted that of her selected articles (see Table 2), only one utilized a group design study (Rvachew & Nowak, 2001) and the remaining five articles reported on data from single-subject design studies (Gierut, Elbert, & Dinnsen, 1987; Gierut, Morrisette, Hughes, & Rowland, 1996; Powell & Elbert, 1984; Powell, Elbert, & Dinnsen, 1991; Tyler & Figurski, 1994).

To assess the quality of the studies in terms of their methodological rigor specific to each study design, Jane used the Critical Appraisal of Treatment Effectiveness (CATE) to evaluate group design studies and the Checklist for Appraising Patient/Practice Evidence (CAPE) to evaluate the single-subject design studies (Dollaghan, 2007). These evaluative tools allowed Jane to compare key elements of the studies, including the rationale for the study, clear description of the procedures, validity, reliability, treatment fidelity, randomization, blinding, statistical significance of the results, as well as the practical significance of the findings (Dollaghan, 2007). The CATE and the CAPE consist of yes or no questions, where yes equals a score of "1," no equals a score of "0," and a half point may be assigned if only one part of a two-part section is addressed in the study (see Tables 3 and 4). A higher total score would therefore indicate higher overall quality. As the final step in her evaluative process, Jane converted the overall scores of each study to percentages in order to determine the relative methodological strength of each article and the extent to which she could include that evidence in her clinical decision for Ben's treatment program.

Jane noted that all of the reviewed articles were of moderate to high quality, as evidenced by their CAPE or CATE scores, but there was some degree of variability that warranted attention. For example, although one study found that a non-developmental approach would result in significantly better outcomes for sounds that were targeted in therapy (Tyler & Figurski, 1994), that particular study was of moderate methodological quality and had only two participants. Comparatively, the article suggesting that the developmental approach to target

selection resulted in significantly greater outcomes was of higher quality and included 48 participants. In order to understand the results with respect to the study quality, Jane created a table that ranked the studies according to their percentage scores from the CATE and CAPE. Additionally, she included information concerning the number of participants, the outcomes addressing her two main points of interest—outcomes on the targeted sound and outcomes on generalization to untreated sounds or words—and the extent to which the treatment targets were stimulable for the study participants (see Table 5).

The group design study (Rvachew & Nowak, 2001) received a score of 9.5 out of 10 on the CATE, losing half a point because the article did not discuss the study's treatment fidelity or the extent to which study procedures were consistent. Rvachew and Nowak's study investigated acquiring target sounds as well as overall generalization to phonological inventory for preschool children with SSD who were randomly assigned to two treatment groups. Whereas one group of children received treatment on early-developing sounds (i.e., "developmental sequence") for which they had some phonological knowledge, the other group of children received treatment of late-developing sounds (i.e., "non-developmental sequence") for which they had limited phonological knowledge. The results from this study indicated that children in the early-developing sound group made greater progress with their treatment targets as compared to children in the late-developing group. However, there was no significant difference in the generalization of treatment targets to the child's phonological inventory.

The remaining five single-subject design studies were comparable in overall CAPE scores, with two yielding a score of 7 out of 12 and three yielding a score of 8. The studies differed, however, in the way that the non-developmental target sequence was selected. Three studies utilized a norm-based approach to determine which treatment pattern would be non-developmental. For example, Gierut et al. (1996) chose treatment targets according to age-appropriate developmental norms and hypothesized that children treated on later-acquired sounds (based on chronological age) would demonstrate greater progress for both treated sounds and generalization as compared to early-acquired sounds. Similarly, Powell and Elbert (1984) focused on developmental norms of cluster production and compared speech sound outcomes for children who received therapy targeting either earlier-developing (developmental) or later-developing (non-developmental) clusters in therapy. Finally, Tyler and Figurski (1994) compared outcomes of children treated on two levels of feature complexity. Specifically, one child was treated for the liquid /l/, which was considered more complex according to developmental norms than the fricative /s/, for which a second participating child was treated. Thus, these three studies chose non-developmental treatment targets according to empirically or theoretically defined developmental sequences of speech sound acquisition.

The remaining two single-subject design studies, however, generated a non-developmental sequence of treatment targets based upon children's individual patterns of speech acquisition. Specifically, Gierut et al. (1987) compared outcomes from treating children on sounds for which they demonstrated least phonological knowledge or greatest phonological knowledge, as determined by their phonetic inventory. In this study, Gierut and colleagues hypothesized that targeting sounds that children were initially unable to produce would generate greater overall change, enhancing their phonological knowledge of the treated, unfamiliar sounds and also boosting their ability to produce other sounds that were familiar but not yet accurate. Similarly, Powell et al. (1991) focused on stimulability as a means for determining treatment targets. As such, initial treatment targets were not stimulable for the children in the study; it was thus proposed that treating children on sounds that they could not produce at all would lead to a more efficient acquisition of sounds that they could produce only in isolated instances.

In four out of the five single-subject studies, progress with respect to the treated sound was comparable when examining outcomes of children in the developmental and non-developmental target groups. Only one study (Tyler & Figurski, 1994) found that a child treated on later-developing (i.e., non-developmental) sounds demonstrated a greater change in PCC compared to a child treated on earlier-developing sounds. Four of the five single-subject design studies, however, found that generalization to untreated sounds was greater for the children who were treated using non-developmental target(s) (i.e., later acquired, more complex, least knowledge, non-stimulable). The study investigating outcomes from children treated on earlier-developing clusters and later-developing clusters (Powell & Elbert, 1984) found no differences in generalization between the two conditions.

Summarizing findings from all the studies, Jane determined that with respect to outcomes on treatment targets, one study favored the non-developmental approach to target selection, one favored the developmental approach, and four studies found no difference between the two approaches. With respect to generalized phonological learning, four studies found improved outcomes from the non-developmental approach whereas the remaining two studies found no difference. Thus, no study found that the developmental approach to target selection yielded greater generalization than the non-developmental approach.

Importantly, Jane's review of the evidence also reinforced to her the value of assessing a child's stimulability for sounds when designing a treatment plan. Half of the studies she reviewed were deliberate in treating children on sounds that they could produce in isolation (Gierut et al., 1996; Tyler & Figurski, 1994) or training their stimulability on target sounds prior to treatment (Powell & Elbert, 1984). Notably, these three studies were of lower methodological quality and the findings with respect to immediate learning and generalization were mixed. The study receiving the highest quality rating with the greatest number of participants (Rvachew & Nowak, 2001) found that the non-developmental approach to target selection was less effective compared to the developmental approach; however, that particular study did not control for children's stimulability of treatment targets.

Stimulability of treatment targets was intentionally varied in the Powell et al. (1991) study, and children's productive phonological knowledge was also the basis of treatment targets in the study by Gierut et al. (1987). Jane was intrigued that both studies reported similar findings that favored targeting a non-stimulable sound. Specifically, the evidence suggested that selecting either stimulable sounds or sounds for which children demonstrated some productive phonological knowledge would lead to learning of the target sound but limited generalization to untreated sounds. Conversely, targeting non-stimulable sounds, or sounds for which children demonstrated very little phonological knowledge, would lead to learning the treated sound as well as increased generalized phonological learning. In sum, data from the reviewed studies suggested that if earlier- and later-developing sounds were both stimulable, targeting the later-developing sound would result in broader generalization. However, if considering a child's sound inventory, targeting a non-stimulable sound would result in greater generalization than even stimulable sounds.

The Evidence-Based Decision

After having some time to review the relevant literature, Jane returned to her original PICO question. Overall, according to the table she created to rank the articles, she felt that the evidence did not particularly support either the developmental or non-developmental approach to target selection with respect to treated sounds. That is, the evidence indicated that either approach had the potential to be successful. However, with respect to generalized phonological learning of untreated sounds, the evidence more strongly suggested that a non-developmental approach to target selection would produce greater change in children's overall speech production skills. Jane's primary motivation in undertaking this evaluation was to find an alternative to the current approach to Ben's therapy, which was proving to be neither effective nor efficient. Armed with the knowledge gained from her review of the evidence, she felt it was worthwhile to incorporate a different method for therapy target selection.

In order to incorporate the two characteristics of treatment targets that her review had shown could potentially impact therapeutic efficiency (i.e., later-acquired and non-stimulable), Jane developed a trial treatment plan that would initially target Ben's non-stimulable sounds that were considered later-developing. As a first step, Jane conducted a stimulability probe for all of Ben's speech sound errors and reviewed the developmental norms created by Smit, Hand, Freilinger, Bernthal, and Bird (1990), as used in the Gierut et al. (1996) study. A specific therapeutic technique was not examined in the current studies; therefore, Jane decided she would use a minimal pairs approach because of her familiarity with it and because it was used in several of the reviewed studies (Gierut et al., 1987; Powell & Elbert, 1984; Powell et al., 1991). Following each therapy session and at the end of the nine-week grading period, Jane would collect treatment data, reassess Ben's PCC level, and analyze his spontaneous speech sample for improved accuracy of the later-acquired treated target as well as other untreated phonemes. Jane realized that this approach may not be optimal for all children with SSD, but her search of the evidence showed the importance of

evaluating each child's unique and individual speech patterns. Thus, she was hopeful that this trial treatment program would accelerate Ben's initial progress and instigate widespread, more efficient improvement in his speech sound production.

Author Note

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Smit, A. B., Hand, L., Freilinger, J. J., Bernthal, J. E., & Bird, A. (1990). The Iowa articulation norms project and its Nebraska replication. *Journal of Speech and Hearing Disorders, 55,* 779–798.

Tyler, A. A. & Figurski, G. R. (1994). Phonetic inventory changes after treating distinctions along an implicational hierarchy. *Clinical Linguistics and Phonetics, 8,* 91–107.

Table 1. Database Search and Selection Process for Articles to Review

Database	Initial # of Articles	Articles to Download	Reasons Others Were Discarded
ASHA	24	5	Did not include children with SSD: 3 Did not compare target selection: 4 Not about phoneme target selection: 6 Not an intervention study: 6 Meta-analysis: 1
PsycINFO	7	0	Not about phoneme target selection: 7
PubMed	9	1	Duplicate: 2 Not about phoneme target selection: 3 Not an intervention study: 2 Review: 1

Table 2. Characteristics of Selected Articles

Article	Number of Participants	Study Design
Gierut, Elbert, & Dinnsen (1987)	6	Single-subject
Gierut, Morrisette, Hughes, & Rowland (1996)	9	Single-subject
Powell & Elbert (1984)	6	Single-subject
Powell, Elbert, & Dinnsen (1991)	6	Single-subject
Rvachew & Nowak (2001)	48	Group
Tyler & Figurski (1994)	2	Single-subject

Table 3. CATE Evaluation Scores (Dollaghan, 2007)

CATE Quality Indicators	Rvachew & Nowak (2001)
1. Was there a plausible rationale for study?	1
2. Was the evidence from an experimental study?	1
3. Was there a control group or condition?	1
4. Was randomization used to create contrasting conditions?	1
5. Were methods and participants specified prospectively?	1
6. Was treatment described clearly and implemented as intended?	0.5
7. Was the measure valid and reliable, in principle and as employed?	1
8. Was the outcome (at minimum) evaluated with blinding?	1
9. Were nuisance variable(s) that could have seriously distorted the findings reported?	1
10. Was the treatment finding statistically significant?	1
Total	9.5
Percentage score	95%

Adapted from Dollaghan, C. A. (2007). *The handbook for evidence-based practice in communication disorders.* Baltimore, MD: Paul H. Brookes Publishing Co.

Table 4. CAPE Evaluation Scores (Dollaghan, 2007)

CAPE Quality Indicators	Gierut et al. (1987)	Gierut et al. (1996)	Powell & Elbert (1984)	Powell et al. (1991)	Tyler & Figurski (1994)
1. Was the design experimental (e.g., A-B-A, alternating treatments, multiple baseline)?	1	1	1	1	1
2. Was there randomization or counterbalancing (e.g., targets to conditions, other conditions) in applicable situations?	1	1	1	0	0
3. Were there stable baseline(s)?	1	1	1	1	1
4. Was the length of treatment phase(s) adequate?	0	1	1	1	1
5. Was there treatment consistency, fidelity?	0	0	0	0	0
6. Were nuisance variables acknowledged and/or controlled for?	1	0	0	0	1
7. Were the measures used valid?	1	1	1	1	1
8. Were the measures used reliable?	1	1	1	1	1
9. Were measures administered with blinding?	0	0	0	0	0
10. Was the magnitude of treatment noticeable from baseline to treatment phase?	0	1	1	1	1
11. Was there evidence of maintenance or generalization of treatment effect?	1	1	0	1	0
12. Was there evidence of data-based social validity of treatment effect?	0	0	0	1	0
Total	7	8	7	8	7
Percentage Score	58%	67%	58%	67%	58%

Adapted from Dollaghan, C. A. (2007). *The handbook for evidence-based practice in communication disorders.* Baltimore, MD: Paul H. Brookes Publishing Co.

Table 5. Outcomes of Studies Ranked by Score

Ranking	Study	Score	Number of Participants	Is non-developmental approach better for treated sounds?	Is non-developmental approach better for generalization?	Were treatment targets stimulable sounds?
1	Rvachew & Nowak (2001)	95%	48	No	No difference	Not all
2	Gierut et al. (1996)	67%	9	No difference	Yes	Yes
2	Powell et al. (1991)	67%	6	No difference	Mostly for stimulable sounds	Not all
3	Gierut et al. (1987)	58%	6	No difference	Yes	Yes
3	Powell & Elbert (1984)	58%	6	No difference	No difference	Yes
3	Tyler & Figurski (1994)	58%	2	Yes	Yes	Yes

Appendix. Articles Selected for Review

Reference	Study Design	Participant Description	Basis of Non-developmental Target Selection	Comparison Target Selection	Intervention Intensity/ Duration	Outcome Measure
Gierut et al. (1987)	Single-subject. Multiple probe and multiple baseline.	*N* = 6; age range 3:7–4:6	Based on assessment of children's phonological knowledge. Children were randomly assigned to receive treatment starting at the end of their knowledge continuum.	Sounds that child had most knowledge of.	Information not provided.	PCC and phonological knowledge protocol (PKP; Gierut, 1990)
Gierut et al. (1996)	Single-subject. Alternating treatment design and staggered multiple baseline.	*N* = 9; age range 3:7–5:6	Phoneme selection based on earlier- or later-acquired sounds, and differed per each child's phonemic inventory.	Later-acquired sounds. Treatment was initially delivered in an imitative phase, until child reached 75% accuracy. Spontaneous phase was next and continued until accuracy was 90%.	1-hour sessions, 3 times per week. Specific treatment duration was not reported, but follow-up probes were administered 2 weeks and 2 months post-treatment.	PKP
Powell & Elbert (1984)	Single-subject. Multiple baseline.	*N* = 6; age range 4:4–6:3	Based on normal acquisition of liquid clusters. Non-developmental group treated on fricative + liquid clusters (e.g., [fl]).	Developmental target was stop + liquid clusters (e.g., [pl]).	Specific information not provided; visual analysis revealed experiment lasted over the course of 9 months.	Percentage accuracy for targeted and non-targeted sounds
Powell et al. (1991)	Single-subject design. Multiple baseline.	*N* = 6; age range 4:11–5:6	Comparison was made looking at /r/ and one other sound that was not present in each child's phonetic inventory. Children in non-developmental group either had /r/ as a non-stimulable sound (*n* = 2) or a different non-stimulable treatment sound (*n* = 2).	There were 2 children receiving treatment for 2 stimulable sounds.	Children were seen 3 times a week with each session consisting of 100 minimal pair responses (approximately 30-minute sessions).	Percentage accuracy for targeted sounds
Rvachew & Nowak (2001)	Randomized controlled group design	*N* = 48; mean age 51.46 months (*SD* = 6.02) in the developmental targets group; mean age of 49.63 months (*SD* = 4.99) in the non-developmental targets group.	Late-acquired phonemes and those for which children had little phonological knowledge.	Early-acquired phonemes and those for which children had greater phonological knowledge.	Initial assessment, 6 weeks of treatment; assessment, 6 weeks of treatment; post-assessment. 30–40 minutes per session.	PCC and PKP
Tyler & Figurski (1994)	Single-subject; ABAB withdrawal and multiple probe.	*N* = 2; ages 2:8 and 2:10.	Targets chosen according to feature complexity. Child 1 treated on /l/.	Child 2 was treated on /s/ (a less complex feature).	Baseline was 3–5 weeks, followed by a treatment period of 9 weeks. 5-week withdrawal period was followed by a second treatment period of 9 weeks and another withdrawal period. Session duration not reported.	Percentage accuracy for targeted sounds and PCC