
Letters to the Editor

Unified Treatment Recommendations: A Response to Rvachew and Nowak (2001)

A recent report by Rvachew and Nowak (2001) would seem to call into question some of the work of Gierut and colleagues (Gierut, Elbert, & Dinnsen, 1987; Gierut, Morrisette, Hughes, & Rowland, 1996), which has shown that treatment of more complex targets results in system-wide changes in phonological acquisition (see Gierut, 2001, for a review). Our purpose here is to show that Rvachew and Nowak's findings do not challenge earlier findings, but in fact, they extend the generalizability of those results in positive ways. In order to fully appreciate the compatibility of these studies, a comparative summary of the studies by Gierut et al. and Rvachew and Nowak is presented below.

Briefly, Gierut et al. (1987) examined the role of a child's productive phonological knowledge in generalization learning. Productive phonological knowledge refers to a child's linguistic competence and performance as determined by their phonetic and phonemic inventory, the distribution of sounds, the use of phonological rules and/or phonotactic constraints, and the underlying lexical representation of morphemes. Taking these basic properties of sound systems into consideration, six types of phonological knowledge were then established to characterize children's phonological systems (Gierut, 1985). These types formed a continuum from most-to-least phonological knowledge of the target phonology, with Type 1 knowledge describing sound productions consistently correct relative to the adult target (i.e., most knowledge) and Type 6 knowledge indicating consistently incorrect productions relative to the adult target (i.e., least knowledge). Gierut et al. conducted three related investigations to test the psychological reality of claims about phonological knowledge against learning by 6 preschool children with functional phonological delays. Studies 1 and 3 provided descriptive characterizations of each child's phonological knowledge prior to treatment and following treatment, respectively. Study 2 was a multiple baseline (multiple probe) across-subjects experiment wherein each child was taught three sounds in sequence from either most-to-least knowledge or the reverse, least-to-most knowledge, as based on their unique knowledge continuum. The dependent variable was generalization learning to treated and untreated sounds along the knowledge continuum (i.e., most and least knowledge). Quantitative results, based on percentages of accurate sound production, indicated that children taught in either treatment sequence, most-to-least or least-to-most knowledge, evidenced generalization learning for sounds of which they had most knowledge pretreatment (cf. Dinnsen & Elbert, 1984). Qualitative results, based on change in knowledge type, indicated that children taught in either treatment sequence also evidenced positive changes in their knowledge

continuum for the treated sounds. Thus, either treatment sequence, most-to-least or least-to-most, resulted in changes in most knowledge and in treated sounds. Importantly, however, children taught in the sequence from least-to-most knowledge evidenced the greatest system-wide change, as demonstrated by quantitative and qualitative improvements to other untreated sounds for which they had least knowledge of prior to treatment. Given this, Gierut et al. concluded that the least-to-most order of treatment proved most effective because it induced system-wide change.

Subsequently, Gierut et al. (1996) reported the results of two complementary single-subject experiments aimed at establishing the effects of treatment based on normative age-of-sound acquisition. A single-subject alternating treatments design was used in Study 1 for a within-subject comparison of the treatment effects for 3 children with functional phonological delays. A multiple baseline across-subjects design was used in Study 2 for a complementary across-subjects comparison of 6 children with functional phonological delays. Early versus late acquired sounds were manipulated as the treatment targets. Notably, only sounds excluded from a child's pretreatment inventory were selected for treatment. In terms of phonological knowledge, this translated to "least knowledge" on the continuum. Thus, phonological knowledge was held constant across children. The dependent variable was again generalization learning to treated and untreated sounds. Across these two studies, results indicated that all children learned the treated sound, albeit early or late acquired. Also, specific to the multiple baseline across-subjects design, all children evidenced within-class generalization learning of untreated sounds from the same manner class as the treated sound. Thus, an early acquired or late acquired target in treatment resulted in changes in the treated sound itself and promoted within-class generalization. Importantly, however, only those children taught late acquired sounds evidenced across-class generalization to untreated sounds from different manner classes than the treated sound. Given this, Gierut et al. concluded that treatment of late acquired sounds proved more effective because it produced system-wide change.

Extending the results of Gierut et al. (1987, 1996), Rvachew and Nowak (2001) conducted a group treatment study of the combinatorial effects of phonological knowledge and normative age-of-sound acquisition with 48 children with functional phonological delays. Children were randomly assigned to one of two groups: treatment of an early acquired sound of which they had most knowledge (most knowledge/early acquired sound) or treatment of a late acquired sound of which they had least knowledge (least knowledge/late acquired sound). Dependent variables measured generalization learning, as in Gierut et al., but also included treatment progress

and child–parent satisfaction. Generalization learning was reported as children's overall production accuracy to all target English sounds and sounds for which they had Type 6 (or least) knowledge. Treatment progress was reflected by the number of incremental steps of the treatment program that were completed, ranging from imitated syllables to spontaneous sentences, whereas child and parent satisfaction were measured through subjective rating scales. Results indicated no statistically significant differences between the groups in terms of generalization learning; however, children in the most knowledge/early acquired sound group completed significantly more steps of the treatment program. There were also no statistically significant differences between groups in terms of outcome measures of satisfaction, with one exception: Parents of children in the most knowledge/early acquired sound group were subjectively more satisfied with their child's treatment progress. Given this, Rvachew and Nowak advocated treatment of most knowledge/early acquired sounds. This would seem to contradict conclusions drawn by Gierut et al. that least knowledge and late acquired sounds are most effective in treatment. We aim now to reconcile these apparent differences by focusing on the independent and dependent variables of these studies.

Independent Variables

In each of their studies, Gierut et al. (1987, 1996) examined the variables of phonological knowledge or normative age-of-sound acquisition independently in treatment. This is illustrated in Gierut et al. (1987), wherein children taught in a given treatment sequence (i.e., most-to-least or least-to-most knowledge) were taught both early and late acquired sounds. That is, in certain cases, children evidenced most knowledge of relatively late acquired sounds and least knowledge of relatively early acquired sounds. Similarly, Gierut et al. (1996) varied age-of-sound acquisition while holding knowledge type constant. Thus, children were taught early or late acquired sounds for which they had least knowledge. By comparison, Rvachew and Nowak (2001) manipulated these same variables in tandem, but only partially, by treating most knowledge/early acquired sounds versus least knowledge/late acquired sounds. Rvachew and Nowak did not fully cross the variables to also include the logically remaining conditions: most knowledge/late acquired sound and least knowledge/early acquired sound. Without these conditions, it is not possible to determine the extent to which each variable (e.g., knowledge or normative age-of-sound acquisition) is responsible for the treatment effects. Thus, these cells are crucial to evaluating the combinatorial effects of knowledge and normative age-of-sound acquisition and

to understanding the role that phonological knowledge and developmental normative sequence have in clinical treatment. There is a further complication of baseline accuracy associated with this gap in the design. By Rvachew and Nowak's definition, children in the most knowledge/early acquired sound group were already producing the treated sounds accurately in some contexts and words prior to intervention. The reported average pretreatment level of accuracy was 30% for this group (range = 0%–93%; see www.medserv.mcgill.ca/srvachew for complete data). In contrast, children in the least knowledge/late acquired sound group maintained an average of less than 5% accuracy of the treatment sounds at pretreatment (range = 0%–67%). The fact that the children's pretreatment performance across groups was noncomparable may have extraneously contributed to group differences in the number of completed steps in the program and parent satisfaction with the number of steps completed. However, even with these differences in pretreatment baselines, it is striking that there were no significant differences among groups in terms of generalization learning. That is to say, children with some production accuracy prior to treatment (most knowledge/early acquired sound) did not have an edge over those with minimal to no accuracy (least knowledge/late acquired sound) in terms of generalization learning or vice versa. This bears a strong resemblance to Gierut et al.'s findings that orders of treatment (most-to-least/least-to-most) were comparable on some dimensions of generalization (i.e., change in treated and most knowledge sounds), as were normative ages-of-sound acquisition (i.e., change in treated sounds and within-class generalization). Importantly, however, where these variables critically differ is in terms of across-class or system-wide change in the phonological system. Gierut et al. were able to discern these differences because of sensitivities in their dependent measures to untreated sound change, as is specifically afforded by the multiple baseline across-subjects design (Hersen & Barlow, 1976, p. 228).

Dependent Variables

Across studies, Gierut et al. (1987, 1996) examined qualitative and quantitative changes across all properties of children's phonological systems. This provided differential opportunities to evaluate change in linguistic characterizations of productive knowledge, accuracy of treated sound production, within-class generalization, and across-class generalization. By comparison, Rvachew and Nowak (2001) either collapsed quantitative change across all sounds of the system, including sounds that were correct and incorrect for which the children had most and least knowledge, or they focused

exclusively on changes in only one property of the knowledge continuum (i.e., least knowledge or sounds with 0% baseline accuracy). Because there was no further differentiation in generalization to untreated sounds, it was not possible to establish potential differences associated with within- versus across-class changes in these children's systems that may have been revealing of system-wide gains.

Also, across Gierut et al.'s studies (1987, 1996), delivery of treatment was held constant, with all children completing the same steps in treatment (i.e., imitation and spontaneous production of words) to prestablished time and performance criteria. Yet, even when children completed the same steps in treatment, across-class generalization differences emerged favoring treatment targets associated with least knowledge and late acquired sounds. Although progress in treatment was not among the dependent variables in their studies, Gierut et al. were able to examine the point at which generalization first occurred, at least in their normative report: Late acquired treatment targets promoted immediate generalization to treated and untreated sounds, within and across class, during the course of treatment, whereas early acquired targets delayed generalization to the completion of treatment. The fact that Rvachew and Nowak monitored number of treatment steps as a dependent factor would appear to be a much needed addition to conventional efficacy variables, which are typically associated with performance rather than time (cf. Tyler, Edwards, & Saxman, 1987). In future studies, however, evaluations of these variables will require that time (e.g., number of steps in treatment) and performance be independent. In the case of Rvachew and Nowak, the group of children who progressed through the most steps of the treatment program was also the same group of children who were already producing the treated sound accurately in certain contexts at the start of intervention.

Finally, Gierut et al.'s studies (1987, 1996) were limited in that they focused on treatment efficacy but not also treatment outcomes (cf. Frattali, 1998). Rvachew and Nowak's (2001) inclusion of satisfaction surveys provides this complement, although no group differences were found in parent or child satisfaction except along the aforementioned dimension of number of treatment steps completed. Treatment outcomes for phonological delays is an avenue of study that may warrant future development (Goldstein & Gierut, 1998).

Conclusion

Collectively then, these three research reports converged on parallel sets of findings. Across five single-subject evaluations (Gierut et al., 1987, 1996; $N = 15$)

and one group study (Rvachew & Nowak, 2001; $N = 48$), involving a total of 63 children with phonological delays, treatment targets selected on the basis of a child's productive knowledge and/or normative sequence do not seem to differentially impact how a child learns the treated sound or generalizes to untreated sounds of the same manner class. The real significance (and perhaps also a tension) lies in the evaluation of treatment efficacy versus outcomes. Efficacy measures of across-class generalization or system-wide changes, as in Gierut et al.'s work, reveal that performance differences do emerge, favoring treatment target selection based on least knowledge and late acquired sounds. Outcome measures of parent satisfaction, as in Rvachew and Nowak's work, also revealed differences, favoring treatment target selection based on most knowledge and early acquired sounds. Clearly, future research will be needed to help us better understand the trade-offs between a child's phonological gains that foster generalization and affect intelligibility and the steps achieved in treatment relative to parents' subjective satisfaction with progress.

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