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Phonological Disorders in Children

Clinical Decision Making in Assessment and Intervention

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Chapter 17

Phonological Intervention

The How or the What?

JUDITH A. GIERUT

When asked clinical questions about my views on phonological intervention, the most appropriate place to begin the discussion is with an examination of the desired goals of treatment. A clear understanding of what is to be ultimately accomplished in treatment will directly inform the structure and course of such treatment. That is to say, the end serves to define the means. In this regard, the primary goal of phonological treatment is to induce change in a child's presenting knowledge of the sound system of the surrounding speech community. The aim is for *normalization* by way of inducing changes in a child's linguistic knowledge (Gierut, Elbert, & Dinnsen, 1987; Shriberg & Kwiatkowski, 1994). Given the known critical period for phonological learning (Shriberg, Gruber, & Kwiatkowski, 1994), this must be achieved in the most efficient and expedient way possible. Thus, two key questions emerge: What does it mean to change linguistic knowledge, and how can change be induced efficaciously in treatment? The answers to these questions will lead us in a straight path to the plan and delivery of phonological intervention.

Before answering these questions, it is necessary to place my remarks within the larger context of the conduct of clinical research. We have been engaged on the Learnability Project (http://www.indiana.edu/~sndlrng) in treatment efficacy research that is designed to evaluate the impact of linguistic and psycholinguistic variables on children's phonological learning for purposes of informing evidence-based clinical practice. The research setting affords the unique opportunity to systematically vary aspects of treatment and to measure the nature and extent of change in children's sound systems in rich detail. While this environment closely resembles the clinic and our results have direct bearing on service delivery, it is imperative that experimental control be maintained. The protocol followed in clinical research must be pre-scripted in order for the treatment results to be reliable, valid, and replicable. Therefore, children enrolled in the Learnability Project are exposed to the same type and amount of treatment, with little room for variation. Treatment procedures and stimulus materials are fixed a priori to align with the research question being addressed, and greater attention is paid to measurement. These details notwithstanding, the

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principles employed in treatment research are actually drawn from those used in the clinical setting including, for example, obtaining baseline measures, providing models, delivering corrective feedback, capitalizing on successive approximations, and incorporating branching as needed. Olswang (1998) outlined the relevant components of treatment that are common to both research and clinical settings, and underscores the continuity between treatment efficacy research and efficacious clinical treatment. These recommended components have been adopted and incorporated into our own research. With this harmony between treatment research and clinical treatment in mind, we now turn to the key questions of change in knowledge and change with treatment as the fundamentals of phonological intervention.

CHANGE IN KNOWLEDGE WITH TREATMENT

Change essentially translates to generalization and its potential effect on treated and/or untreated sounds that a child produces in error. Change in sound production, however, does not necessarily imply change in linguistic knowledge. In a seminal clinical exchange on the construct of generalization, Johnston (1988) made this important distinction between *underlying change in linguistic knowledge* versus *surface change in behavior.* Change in knowledge includes, for example, an increase in the membership of a linguistic category, expansion of the scope of a linguistic category, or insight into the constituent structure of a linguistic category. According to Johnston, change in knowledge is associated with an elaboration, modification, or restructuring of the inherent linguistic categories of a child's internal grammar. As applied to the sound system, change in linguistic knowledge translates to a change in the phonotactics of the child's grammar. *Phonotactics* are generally defined as the permissible sounds and sound sequences of a language. Change may therefore include an elaboration of new manners or places of articulation, an extension of sounds to new contexts or syllable shapes, or an implementation of new phonemic distinctions or contrasts, as a few examples. Thus far, these types of gains have been documented across various levels of the phonological hierarchy, thereby affecting a child's knowledge of the feature, segment, syllable, foot, or prosodic word (e.g., Elbert & McReynolds, 1979; Gierut, 1999; Kehoe, 1997; Tyler & Figurski, 1994).

Change in knowledge contrasts with change in behavior, which is described as automatization or consistent use of language structures (Johnston, 1988). As applied to the sound system, change in behavior may be associated with gains in production accuracy of sounds that are already being used by a child but that are used inconsistently. As another example, behavior changes may be associated with improved self-monitoring skills. Changes in behavior have also been documented (e.g., Koegel, Koegel, Voy, & Ingham, 1988), but as Johnston acknowledges, the latter are quantitative improvements; they do not also reflect qualitative advances in the state of a child's linguistic knowledge. Thus, the desired goal of phonological intervention is to alter the child's underlying knowledge of the ambient sound system.

Considering how change in knowledge can best be triggered in clinical treatment, an obvious answer may be found in the particular methods, approaches, or paradigms that are employed in teaching. Many documented and widely used methods of phonological intervention are available. Some available options include traditional (Van Riper, 1963), cycles (Hodson & Paden, 1983), conventional minimal pair (Weiner, 1981), whole language (Norris & Hoffman, 1990), or Metaphon approaches to intervention (Howell & Dean, 1994). These differ in their implementation and goal attack strategy and vary in their emphasis on perception, production and/or metalinguistic skills, and focused and/or distributed practice in treatment. Despite these differences, numerous comprehensive reviews attest to the effectiveness of these methods in inducing change in a child's knowledge of the sound system (for a summary, see Bernthal & Bankson, 2004).

Although it appears that the available treatment paradigms have strong merit, the choice among treatments is less clear. That is, which treatment method should be used with which child? This bears on the topic of *treatment efficiency,* or whether one teaching approach is better than another in inducing generalization and change. To date, only a handful of clinical investigations have ventured to ask this question. Specifically, the efficiency of the traditional method has been tested relative to conventional minimal pair (Ward & Bankson, 1989) and (modified) Metaphon procedures (Powell, Elbert, Miccio, Strike-Roussos, & Brasseur, 1998). Likewise, the conventional minimal pair approach has been evaluated relative to (modified) cycles (Tyler, Edwards, & Saxman, 1987) and whole language (Hoffman, Norris, & Monjure, 1990) paradigms. These are landmark studies; yet, a number of gaps remain. The full complement of methodological comparisons has not yet been explored, and systematic replications are lacking. Also, in some cases, a treatment approach may have been altered from its original conceptualization (e.g., Powell et al., 1998; Tyler et al., 1987); consequently, the reported efficiency may not be the same as when the method is implemented in its original format. These limitations notwithstanding, a common theme has emerged from these comparisons of treatment efficiency; namely, the different teaching approaches have been shown to be on par with each other in affecting change in a child's linguistic knowledge, such that no single treatment method has surfaced as being better than another. This observation has led to the suggestion that the method of treatment may be secondary to promoting change in a child's linguistic knowledge of the sound system (Gierut, 1998c). This poses a clinical dilemma, however. If our teaching method is of secondary importance, then which elements of intervention are most essential? Following from typical language development, an alternate solution is that the input of treatment may serve instead as the primary trigger of linguistic change (e.g., Connell, 1988; Gleitman & Newport, 2000; Johnston, 1988). For clinical purposes, this means that the target sounds and phonological structures to which we expose a child in treatment may be crucial to generalization. The implication is that *what* is treated may be more important than *how* it is taught (Gierut, 2001, 2003). By way of analogy, think about this relative to standard educational practices. Federal and state governments and local school corporations set curricular goals for given grade levels (i.e., the "what to teach"), but individual classroom teachers are afforded the flexibility to use methods, strategies, and approaches to teaching that best match their own educational philosophies and the children they are instructing (i.e., the "how to teach"). My suggestion then is that establishing the phonological curriculum may be the real key to motivating linguistic change, with the methods to be used in teaching that curriculum being open to vary by clinician and child. Thus, in my view, the three most important elements in the implementation of phonological intervention are the nature of the input, the predicted generalization that derives from that input, and the measurement of change in linguistic knowledge that follows from that input.

INPUT, PREDICTIONS, AND MEASUREMENT

One consistent outcome of recent treatment efficacy research conducted in our lab and others is that more complex linguistic input promotes the greatest change in a child's overall sound system (for review, see Gierut, 1998c, 2001, 2003; Gierut, Morrisette, Hughes, & Rowland, 1996). The effects of a complex treatment target have been shown to have a positive impact on the treated sound in untreated contexts, in addition to other untreated sounds. Change in untreated sounds includes within-class generalization or generalization to sounds that share the same manner of articulation as the treated sound (e.g., treat a fricative, learn other untreated fricatives). It also includes across-class generalization, or generalization to sounds that differ in manner from the treated sound (e.g., treat a liquid, learn other untreated nasals). Thus, the end result is that systemwide changes in the phonotactics of a child's grammar take place following treatment of a complex target. Notably, this accords with Johnston's (1988) description of change in linguistic knowledge.

At first glance, treatment of a complex phonological target may seem to be at odds with the expected course of typical development as defined by normative scales. However, on close inspection, the construct of complexity is wholly consistent with principles of language learnability that have been shown to cut across modules of grammar—that is, syntax, semantics, and phonology (Pinker, 1995; Tesar & Smolensky, 1998; Wexler, 1982; cf. Gierut, 2003, for review). In other words, the way in which typical language acquisition proceeds is by exposure to more complex components of grammar. This is termed *positive evidence;* namely, it is input that illustrates for the child the full range of advanced constructions, categories, and structures that are permissible in the target language. It seems then that the current findings of treatment efficacy research are actually mirroring what takes place and has long been known about typical language development.

Thus far, treatment effects following exposure to complex phonological targets have been reported for different levels of the phonological hierarchy including, for example, the phonetic (Tyler & Figurski, 1994), phonemic (Gierut, 1992), and syllabic (Gierut & Champion, 2001) levels of structure. In addition, complexity has been evaluated with respect to clinical considerations in sound selection including developmental norms (Gierut et al., 1996), stimulability (Powell, Elbert, & Dinnsen, 1991), and consistency (Gierut et al., 1987), to name a few. Complexity has even been tested relative to the words that are used as input in treatment (Morrisette & Gierut, 2002). That is, when a sound is taught in high-frequency words that have few rhyming counterparts, this leads to greater systemwide generalization and change. Table 17.1 provides a representative listing of some of the treatment targets that have been identified from investigations of phonological complexity. The changes that are expected to occur following treatment of such targets are also shown.

By examining these factors relative to a child's presenting sound system, the treatment target and the words to be presented in treatment can be identified directly, thus informing one of three critical components of intervention. We briefly illustrate this approach to intervention with a focus on the segmental level; a more detailed clinical case application

Table 17.1. Representative examples of treatment targets that are based on phonological complexity, and corresponding changes that are predicted in other aspects of the phonological system

Complex treatment targets	Predicted changes
Affricates	Fricatives
Clusters	Singletons, specifically affricates
Consonants	Vowels
Fricatives	Stops
Fricative + liquid clusters	Stop + liquid clusters
Late acquired sounds	Early acquired sounds
Liquids	Nasals
Consonant + liquid clusters in onset position	Occurrence of liquids in coda position
Nonstimulable sounds	Stimulable sounds
Stridency contrast between [s] and θ	One liquid, either [l] or [r]
Velars	Coronals
Voiced stops, fricatives, or affricates	Voiceless stops, fricatives, or affricates

Note: For more complete listings with corresponding references, see Gierut (2001, 2003).

is reported in Gierut (2004). Comparable steps may be taken when treatment is to be directed at the featural, syllabic, or other levels of the phonological hierarchy. A first step is to identify those sounds that are produced with 0% accuracy across all contexts, because these are phonotactically excluded from a child's grammar. This defines the initial pool of potential targets for treatment. Next in the process is to eliminate from the pool any sounds that are predicted to be learned from treatment of another target. For example, if a child produces both stops and fricatives in error, stops would be removed as a potential treatment target. As shown in Table 17.1, the reason is that treatment of fricatives predictably enhances the learnability of stops. Continuing in this way, additional sounds that are removed from the pool may be those that are stimulable or acquired early relative to normative scales. This process of whittling the pool of potential target sounds continues, allowing a clinician to hone in on the optimal complex input for each child. Sounds eliminated from the pool, however, should not be disregarded. These are central to the remaining two elements that are essential to intervention because they predict generalization and, consequently, they must be monitored to confirm (or refute) those predictions.

In terms of monitoring change, it is possible to document generalization through formal diagnostic testing; however, the inherent limitations of such tests result in somewhat shallow phonological samples. Consider, for example, that conventional phonological tests elicit a given target sound just once in each relevant word position. This gives the child a limited opportunity to demonstrate his or her range of phonological abilities. Informal probe measures designed specific to an individual child's sound system may be more informative. A number of word lists are readily available, which sample the phonological properties of English at phonetic, phonemic, and morphological levels across word positions and in multiple exemplars, while taking into account a word's frequency and its rhyming counterparts (e.g., Gierut, 1998a; Gierut et al., 1987). In our research, we administer such probes in measurement of change in the treated complex target and other untreated sounds, all of which were part of the initial pool of potential treatment targets. (For research purposes, we do sample all sounds of English whether correct or incorrect in production, in addition to onset and coda clusters.) This more extensive sample provides a measure of treated sound accuracy in untreated words and untreated positions, as well as untreated sound production within and across classes. It is necessary to underscore that an evaluation of change in linguistic knowledge must extend the probe sample beyond the treated sound. Often in clinical settings, only the treated sound is probed for generalization and change, with the expectation that what is treated is what will change. Following from treatment of complex linguistic input, however, other broader possibilities for change arise. Consequently, probe measures must be structured to monitor systemwide improvements that encompass treated and also untreated aspects of a child's presenting sound system.

On the Learnability Project, we administer such detailed probes using a spontaneous picture-naming task, with samples obtained at five points over the course of treatment. The format is that a child sees a picture and is asked to name it. Feedback is provided in the form of general encouragement to attend to the task, but there is no commentary about the (in)accuracy of responding. Multiple versions of the probe have been developed so that a child's responses do not become stimulus bound. That is, the words remain the same on each probe, but the order of administration and stimulus pictures vary at each sampling point. To illustrate, the word *red* in the first sample might be the second item of the probe, elicited by a picture of a red wagon. In the second sample, it might be the fifteenth item presented, being elicited by a red balloon. In the third sample, it might be the 29th, elicited by a red fire engine, and so forth. On each probe, the child is producing the word "red," but the corresponding picture is varied. These different versions of the probe are then randomized across children of a given study. The resulting probe data are phonetically transcribed for descriptive purposes, and accuracy of sound production is computed to obtain a quantitative evaluation of the amount and extent of change in treated and untreated sounds as a measure of generalization. It should be noted that the words of the probe are reserved specifically for purposes of documenting generalization. Probe items are never introduced in treatment.

The time course of probing is in sync with the treatment sequence that is used on the Learnability Project. Given the need to maintain experimental control in clinical research, there is procedural consistency across children. Every child goes through a baseline phase. During baseline, an extensive probe sample (described previously) is obtained and repeated depending on a child's order of enrollment. That is, the number of baselines increases as successive children are enrolled. Following baseline, children then receive a phase of imitation treatment whereby a target sound (or sounds, depending on the experimental question) is elicited following the clinician's model. The target sound occupies the initial position of either real words or nonwords, with the latter being specific to an experiment. Also, depending on the experiment, the target sound may either be presented autonomously or in contrast to another sound (Barlow & Gierut, 2002). Treatment always begins at the level of the sound in a real word and/or nonword. Following from the literature (Elbert, Dinnsen, Swartzlander, & Chin, 1990; Weiner, 1981), isolated sound production is not part of our protocol, nor is treatment in connected speech. The real/nonwords used in treatment correspond to visual referents that are presented either in paper or digital format, again particular to an experiment. The number of stimuli is also experiment specific, with the range of items being 6 to 16 (Elbert, Powell, & Swartzlander, 1991). In the imitation phase of treatment, drill play is used because this has been shown to be most effective (Shriberg & Kwiatkowski, 1982). Children are provided with feedback about the accuracy of each production. This takes the form of praise and encouragement for correct outputs and an additional input model for errored outputs following a fixed feedback loop. The fixed feedback loop works like this: Following an errored response, the clinician provides corrective feedback about placement, then repeats the model of the target word for a second production attempt by the child. If a child's second attempt is correct, positive remarks are made; if it is incorrect, treatment advances to the next trial and next item. Thus, for every errored response, a child is given corrective feedback with one and only one additional opportunity to incorporate this feedback before moving on. We recognize that, at first, treatment of complex targets may appear to be a daunting task because it may seem that a child is being set up to fail given the nature of the input. However, all of the conventional supporting methods that are used clinically to stabilize a child's response are employed. Successive approximations are accepted along the way (cf. Gierut & Champion, 2001, for illustration in treatment of three-element clusters) and placement cues are provided (cf. Shriberg, 1980, for illustration of evocation of /r/). The fixed feedback loop also ensures that a child receives appropriate encouragement for outputs that are correct and an added model for those that are incorrect. Treatment continues in the imitation phase for a maximum of seven sessions or until a child achieves 75% accuracy of production over two consecutive treatment sessions, whichever of these comes first. Following this, the probe (as in baseline) is again administered. Treatment then shifts to a spontaneous mode of responding, whereby a child produces the target sound in the stimulus words without a preceding model. The visual displays remain the same as in imitation, as does the drill play procedure with corrective feedback and feedback loop. Treatment in the spontaneous phase continues for a maximum of 12 sessions or until a child achieves 90% accuracy over three consecutive treatment sessions, whichever of these comes first.

At the completion of treatment, the probe is again repeated. The child receives no further intervention, but the sound system continues to be monitored in a posttreatment period of follow-up. At 2 weeks and 2 months following the completion of treatment, the probe measure is administered.

Thus, all children participate in a maximum of 19 treatment sessions, with these being scheduled three times per week in 1-hour blocks (i.e., 19 hours of individualized intervention). Throughout, there are five sampling points: baseline, phase shift, posttreatment, 2 weeks posttreatment, and 2 months posttreatment. At each sample, generalization data are collected to evaluate the treated target in untreated words and contexts, as well as all other untreated sounds in error. We should point out that these procedural details were established by consulting the prior treatment efficacy literature, and reflect average or typical sequences reported by others. It is also the case that the experimental design of given studies may necessitate slight departures from what we have described herein.

Given the necessity to maintain experimental control, demonstrate reliability and validity, and ensure replicability, no supplementary or complementary treatment is provided for other linguistic, motoric, or other nonlinguistic limitations; also, no home program is provided. These are areas in which a clinical setting may afford some more flexibility. For the most part, our clinical treatment research has emphasized the role of complex input on children's production as the mode of response. The reason relates to observed precedence relationships between perception and production (Williams & McReynolds, 1975), and metalinguistic abilities and production (Gierut, 1998b). Likewise, however, a child's response mode in treatment is driven by the experimental question being raised and by documented deficits. That is to say, perceptual and/or metalinguistic treatment may not be warranted unless diagnostic testing demonstrates that a child's performance in these domains is affected.

SUMMARY

We have been using these laboratory procedures with an emphasis on input complexity in the clinical treatment of preschool children who are preliterate with functional phonological delays. However, emerging evidence suggests that the same intervention approach may assist a range of populations and disorder types. Some examples of the populations that have been reported as benefiting from a complexity approach to treatment include toddlers (Tyler & Figurski, 1994); bilinguals (Anderson, 2002) and second language learners of English (Eckman & Iverson, 1993); children with developmental apraxia (Colone & Forrest, 2000) and hearing impairment (McReynolds & Jetzke, 1986); and those evidencing cognitive impairments (Dyer, Santarcangelo, & Luce, 1987) and nonfunctional (i.e., organic) disorders (Ballard & Thompson, 1999). This intervention approach not only appears to be relevant to phonology but also to syntax and semantics (Kiran & Thompson, 2003; Thompson, Shapiro, Kiran, & Sobecks, 2003). Although far more treatment efficacy research remains to be done, the construct of input complexity may hold promise as a general strategy that defines the structure, course, and ultimate outcome of clinical intervention.

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