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Homonymy in phonological change

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Abstract

This study examines the role of homonymy as a motivator of phonological change in treatment. The relative effectiveness of two treatment structures in improving the production of treated and untreated error sounds was evaluated. One treatment structure emphasized homonymous forms by comparing 1 : 1 a desired ambient target with its corresponding replacement error from the child's grammar, consistent with conventional minimal pair treatment (Weiner, 1981). The other treatment did not focus on homonymy, nor did it make explicit reference to a child's grammar. In line with treatment of the empty or unknown set (Gierut, 1989), two errored sounds were simply compared with each other. Differential learning was observed among the treatments such that the non-homonymous structure resulted in greater accuracies of treated sounds and in more new untreated sounds being added to the phonological system. The findings have potential implications for the status of homonymy in phonological change and in the structure of phonological treatment.

Key words: Sound change, homonymy, child speech, phonological disorder.

One goal of phonological intervention is to reduce the occurrence of homonymy and thereby increase phonemic distinctiveness in a child's sound system. Leonard (1985) and others (Edwards, 1983; Grunwell, 1985) have suggested that homonymy in a child's sound system should be given consideration in treatment. Ingram (1976) recommended that the elimination of homonymy be one of the first elements to be taught during intervention.

Typically, the reduction of homonymy has been accomplished in treatment by pairing a desired ambient sound with its 1 : 1 corresponding replacement error from the child's grammar (Ferrier and Davis, 1973; Weiner, 1981). For instance, consider a child who consistently produces [p] for targets /p/ and /f/, resulting in homonyms like [pæn] 'pan' and 'fan' or [pʊt] 'put' and 'foot'. In treatment, to reduce homonymy, the desired target /f/ is paired for comparison with the child's error /p/. The child's attention is drawn to the lack of distinctiveness in his or her own speech as evidenced by the homonymous forms. The child learns that the collapse of contrast results in confusions on the part of the listener about the communicative intent. This approach to reducing homonymy and increasing distinctions has been used within a variety of theoretical frameworks, including distinctive features (McReynolds and Bennett, 1972), phonological processes (Weiner, 1981), and generative phonology (Gierut, Elbert and Dinnsen, 1987). The results of such treatment have reportedly benefited changes in both treated and untreated aspects of children's phonological systems.

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This treatment method of focusing the child's attention on homonymous forms relies on several as yet untested assumptions. First, it assumes that a child is aware that the occurrence of homonymy is not productive in language (Drachman, 1973; Ingram, 1975). That is, a child presumably senses and is bothered by the collapse of contrast among words. Second, it assumes that this lack of distinctiveness in communication will motivate a child to modify aspects of his or her grammar (Weiner, 1981: 102). In other words, homonymy serves as a potential precipitator of phonological change. Third, it assumes that a child must make explicit reference to his or her existing phonological system in order to learn new distinctions in language (Ingram, 1976). Here, the acquisition of new phonological information is apparently enhanced by comparisons with old or already known distinctions. Together these assumptions provide an intuitively appealing functional account of phonological change.

Yet is this emphasis on reducing homonymy an important and essential component of phonological intervention? Clearly, the reduction of homonymy is a desired goal of intervention, but is it also necessary that it serves to structure such treatment? Or are there alternative and perhaps more effective ways of introducing phonemic distinctions? The literature on primary languages, language acquisition, and language intervention may provide preliminary insight into these questions.

Homonymy is a phenomenon observed in primary languages. Languages have homonyms but confusions among these forms rarely seem to occur in everyday language use (Hochberg, 1986; Kornfeld and Goehl, 1974; Labov, 1987; Lyons, 1968; Malkiel, 1979; Poplack, 1980). Ambiguities of meaning resulting from homonyms are unlikely because there is usually sufficient information in semantic, pragmatic, and syntactic contexts for determining the communicative intent. Homonymy is also an aspect of certain synchronic and diachronic language processes. Synchronically, in some languages, phonological neutralization rules lead to increases in the occurrence of homonymy. Such neutralizations collapse underlying distinctions at the phonetic level in certain well-defined environments (Chomsky and Halle, 1968; Kenstowicz and Kisseberth, 1979). Diachronically, languages undergo sound changes involving lexical or grammatical mergers, sometimes resulting in homonymy. Importantly, speakers of languages that have neutralization rules or that have undergone sound change appear to have little difficulty identifying the intent of messages even in the face of seeming ambiguity (Charles-Luce, 1987; Dinnsen, 1985; Malkiel, 1979; Poplack, 1980). Thus, homonymy is a possible property of primary languages and seems to pose little problem in communication.

Homonymy is also observed in the course of language acquisition, and there has been debate about its function. Some investigators have noted that homonymy is a strategy a child may use to increase the number of items in his or her lexicon (Stoel-Gammon and Cooper, 1984; Vihman, 1981). A child apparently expands the lexicon at the expense of distinctiveness. In these cases, the child is seen as actively seeking homonyms. However, other researchers have described the occurrence of homonymy as a phenomenon a child tries to avoid (Drachman, 1973; Ingram, 1975; for compatible evidence from children with specific language impairments, see Ingram, 1981; Leonard, Camarata, Schwartz, Chapman and Messick, 1985). According to this view, a child's primary goal is to keep lexical items distinct, even if this means inconsistencies in productions or use of non-ambient sounds. Because a child actively strives for distinctiveness, homonymy is predicted to occur relatively infrequently. Thus, while there is question about whether homonymy serves as a strategy or an avoidance, there appears to be agreement that it is a relevant factor in phonological development.

Homonymy also has a place in language intervention. As mentioned previously, some phonological treatment approaches rely on a homonymous structure. Others are designed to increase phonemic distinctiveness without pairing homonymous forms or making explicit comparisons to a child's existing grammar (e.g. cycles approach, Hodson and Paden, 1983; maximal opposition treatment, Gierut, 1989; traditional treatment, Van Riper and Emerick, 1984). Within frameworks of contrast treatment, in particular, there are two such non-homonymous approaches. One approach is maximal opposition treatment (Gierut, 1989). Here, a child is presented with an errored, unknown sound to compare with a known and consistently correct sound from his or her existing system. This treatment fits the description of a non-homonymous approach because the sounds being compared are never 1 : 1 substitutes and therefore are not homonymous for the child. However, this treatment does make explicit comparisons to a child's grammar by referring to sounds already present and correct in his or her inventory. A second approach is treatment of the empty or unknown set (Gierut, 1989). This type of intervention is both non-homonymous and independent of the child's existing phonology. Here, a child is presented with two errored, unknown sounds in comparison to each other. A child is not instructed in how these previously errored sounds may have resulted in collapses of contrast, nor is a child explicitly taught how these new sounds relate to his or her existing phonological system. Presumably, by teaching unknown sounds in comparison to each other, a child might learn new phonemic distinctions and then use these in lexical representations. As a consequence, the potential for homonymous forms will decrease. Although this alternative strategy for introducing phonological distinctions has been described, it has not yet been experimentally tested.

The present study addressed the general concern of whether the presentation of potentially homonymous forms associated with a child's existing grammar is a necessary motivator of phonemic distinctiveness in the phonological system. This issue was evaluated by comparing the relative effectiveness of two different contrast treatments in improving the production of treated and untreated errored sounds measured on probes. One treatment emphasized homonymous forms by comparing 1 : 1 a desired ambient sound with its corresponding replacement error from the child's grammar, consistent with a conventional minimal pair approach (Weiner, 1981). The other treatment did not focus on homonymy, nor did it make explicit reference to a child's existing grammar. Here, in accord with treatment of the unknown set (Gierut, 1989), two errored sounds were simply compared to each other; there was no homonymy possible in this situation. Predictably, if homonymy is the key factor in phonological change, greater improvements in new and related sounds would be expected from the conventional minimal pair approach to treatment. The results to emerge would thus bear upon the status of homonymy in the motivation of phonological change and in the structure of phonological treatment.

Subjects

Two 5-year-old boys and one 4-year-old girl participated as subjects.† Children were identified through the diagnostic programme at the Speech and Hearing Center at

†Subjects were part of a larger project and were assigned subject numbers according to their order of entry; hence Subjects 6, 8 and 9 participated in this experiment.

Indiana University. Each child met the following criteria: (1) exclusion of a minimum of six sounds from both phonetic and phonemic inventories as established by a standard generative phonological analysis (see below); (2) normal hearing as determined by a standard audiometric screening (ASHA, 1985); (3) normal oral and speech motor abilities as determined by performance on the protocol developed by Robbins and Klee (1987); (4) no prior clinical intervention; and (5) residency in a monolingual English-speaking family. Additional subject information, shown in Table 1, was collected but not used to establish eligibility for participation.

Phonological descriptions

Standard generative phonological descriptions were developed for each child prior to treatment following procedures described by Gierut *et al.* (1987; also Dinnsen, 1984; Gierut, 1986; Kenstowicz and Kisseberth, 1979). Generative descriptions were based upon extended samples of spontaneous connected speech and were supplemented by the 198-item Phonological Knowledge Protocol (PKP; Gierut, 1985). Descriptions included characterizations of a child's phonetic and phonemic inventories; distribution of sounds; phonological rules and positional, inventory, and sequence constraints; and underlying representations of morphemes. In this study, the focus was only on those sounds described linguistically by inventory constraints. Qualitatively, these sounds were never produced or used (correctly or incorrectly) in any word positions or in any morphemes; quantitatively, these sounds were produced with 0% accuracy in non-imitative contexts. Sounds excluded from each child's inventory are displayed in Table 2.

Experimental procedures

Design

An alternating treatments design (ATD) was used in combination with a staggered multiple baseline across subjects (Barlow and Hayes, 1979; Brady and Smouse, 1978; Kazdin and Hartmann, 1978; see also Ellis-Weismer and Murray-Branch, 1989; Gierut, 1990; Thompson and McReynolds, 1986; Ward and Bankson, 1989, for applications of this design to communication disorders). The ATD allows specifically

Table 1. *Results of select entry testing for each subject*

Subject	Age (year: month)	GFTA[a] (errors)	TOLD-2P[b] (spoken language quotient)	PPVT[c] (standard score)	MLU[d] (morphemes)	Leiter[e] (intelligence quotient)
6	5:00	57	93	101	8.4	115
8	4:02	50	99	83	4.9	102
9	5:04	38	101	93	7.8	98

[a] *Goldman-Fristoe Test of Articulation* (Goldman and Fristoe, 1986).
[b] *Test of Language Development—2 Primary* (Newcomer and Hammill, 1988).
[c] *Peabody Picture Vocabulary Test-Revised* (Form L, Dunn and Dunn, 1981).
[d] Mean length of utterance (Brown, 1973; Johnston, 1982).
[e] *Leiter International Performance Scale* (Arthur Adaptation, Levine, 1986).

Table 2. ***Sounds excluded from each subject's inventory and sounds selected for treatment***

Subject	Sounds excluded	Sounds treated			
		Homonymous strategy		Non-homonymous strategy	
		Target : substitute	Opposition[a]	Target : target	Opposition[a]
6	kg v θð sz ʃ tʃ dʒ l r	ð : d	[continuant]	tʃ : dʒ	[voice]
8	kg θð z tʃ dʒ l	θ : f	[coronal] [strident]	z : dʒ	[anterior] [continuant]
9	θð sz ʃ r	ð : d	[continuant]	s : ʃ	[anterior]

[a]The Chomsky–Halle feature system was used to evaluate contrastive aspects of sound pairs; feature oppositions were always associated with the underlying, rather than phonetic, specification.

for a comparison of the relative effects of two experimental treatments on a single subject. The conditions of each treatment are rapidly and simultaneously varied in the treatment phase. Presumably, a subject differentiates between the treatments and thus responds differentially on associated probes.

In this study, each child was exposed to both treatments—the homonymous minimal pair approach and the non-homonymous treatment of the unknown set—in the remediation of two independent sound pairs. Both treatments, and hence both sound pairs, were presented within each session. Sessions were 60 min in length, three times per week. The order of treatment was randomly varied across sessions, such that a first approach (and its associated sound pair) was introduced, followed by a 10 min non-speech-related activity, and then a second approach (and its associated sound pair) was presented. Independent probes associated with each method of treatment were administered throughout to evaluate relative changes in a child's pretreatment inventory.

In addition, steps were taken to control for the possibility of multiple treatment interference (cf. Barlow and Hayes, 1979; Kazdin and Hartmann, 1978; McReynolds and Kearns, 1983). These included: (1) counterbalancing the order of presentation such that each treatment was delivered first in the session an equal number of times; (2) providing instructions to each child signalling the switch in treatments; (3) obtaining baselines, not essential to the ATD, as explicit endpoints for comparisons of relative treatment effects; and (4) incorporating a staggered multiple baseline across-subjects design, with the number of pretreatment baselines increasing by one as each successive subject entered the experimental sequence (for further discussion of these control procedures, see Gierut, 1990). In this last case, if multiple treatment interference were to be observed for a given subject, then baseline stability of successive subjects would be called upon for a demonstration of experimental control.

As will be seen, the effects of multiple treatment interference were not apparent in this study (Appendix and Figures 1–4). In particular, baseline responses remained stable for all subjects (cf. McReynolds and Kearns, 1983). Also, there were no observable additive effects of treatment, such that performance in one treatment enhanced performance in the other treatment on a given day. Differential responding associated with order of treatment presentation was not observed either. Consistent with the basic premise of the ATD design, differential responding was observed only on independent probes associated with the different approaches (Figures 1–4).

Sound pairs identified for treatment

For each child, two sound pairs were identified for treatment, independent and specific to the two treatment approaches. Specifically, the sound pair associated with the homonymous minimal pair treatment consisted of one sound excluded from a child's pretreatment inventory and one comparison sound that was its 1 : 1 substitute. The sound pair associated with the alternative non-homonymous treatment consisted of two sounds excluded from a child's pretreatment inventory. The specific sounds in each pair were different for each child; however, all were equated more generally by the higher-order linguistic category, inventory constraints.

All sound pairs were further defined in terms of phonological oppositions or distinctions. Phonological oppositions were considered because, in accord with a contrast treatment paradigm, it is presumably the feature distinction(s) that is actually being taught and learned (Compton, 1970; Costello and Onstine, 1976; Dinnsen, Chin, Elbert and Powell, 1990; McReynolds and Bennett, 1972; Winitz, 1975). In this study, phonological oppositions illustrated by sound pairs were specified according to the ambient feature specification. All sound pairs differed by the fewest possible number of unique features (i.e. two or fewer), as established by Archangeli's Contrastive Algorithm (1988). Across treatment conditions, sound pairs also differed by the same number of unique features. Moreover, these unique features never involved a major class distinction (i.e. [consonantal], [sonorant], [syllabic], following Chomsky and Halle, 1968). The specific sound pairs and oppositions identified for treatment for each child within each experimental conditions are shown in Table 2.

Phases of treatment

Intervention was delivered in two phases—imitation and spontaneous production—for each sound pair assigned to each treatment approach. Direct training was never provided for perception or discrimination of either phonological contrast. In both production phases a child was presented with picture pairs, with the same pairs used throughout. During the imitative phase, a child repeated the clinician's verbal model of the names of each picture pair. Responses were judged correct if a child accurately produced the treated sound pair as in the ambient. A child continued in the imitative phase until maintaining 75% accurate production over two consecutive sessions in at least one method of treatment or seven consecutive sessions, whichever occurred first. Treatment then shifted to the spontaneous phase. During the spontaneous phase, a child named the picture pairs without the clinician's model. The child continued in the spontaneous phase until he or she maintained 90% accurate production over three consecutive sessions in at least one of the treatments or 12 consecutive sessions, whichever occurred first.

Treatment stimuli and procedures

Treatment involved a nonsense word (NSW) procedure (Gierut, 1990; Leonard, Schwartz, Folger and Wilcox, 1978). Novel NSWs were introduced and assigned lexical meaning within the age-appropriate context of stories involving monsters and other imaginary creatures performing actions. For each child, sixteen NSW pairs were identified as training items, eight pairs for each treatment approach. NSW pairs associated with the conventional minimal pair treatment approach were always produced homonymously by the children pretreatment; whereas those associated with treatment of the unknown set were produced distinctively.‡ NSWs were unique to a given child, based on sound pairs identified for treatment. NSWs were consistent with English phonotactics and structurally uniform in terms of syntactic category, syllable shape, and vowel and consonant composition. Sound pairs were always taught in the initial position of NSWs.

NSW stories were read to a child prior to treatment, and then again once each subsequent week of treatment. Stories were colourfully depicted on large storyboards. For purposes of direct production treatment, NSW referents were depicted as smaller black-and-white line drawings of the original storyboard pictures. NSWs were taught at the single-word level using a variety of conceptually based activities: sorting, matching, informal story-telling, and disambiguation of word pairs (cf. Weiner, 1981). Children were also given worksheets, colouring books, and audiocassettes involving the NSW stimuli to complete or to listen to at home.

NSWs and stories had distinct advantages over the use of real words in treatment. NSWs ensured that children were exposed to true minimal pairs and that these were picturable and meaningful to the child. NSWs also made it possible to equate stimuli across the two treatment approaches. That is, NSWs were not more unusual, more frequently occurring, or of more common usage in one experimental condition than the other. NSWs were never differentiated from real words and all children readily accepted the NSWs into their everyday vocabulary. NSWs have also been used with success in other evaluations of phonological treatments (Elbert and McReynolds, 1978; Gerber, 1973; McReynolds and Bennett, 1972; Winitz, 1975).

Measurement of relative phonological change

Relative changes in a child's pretreatment inventory of sounds were evaluated using two different probe measures, each specific to a given treatment approach. Each probe consisted of a subset of items from the PKP and sampled all sounds excluded from a child's pretreatment inventory, both treated and untreated. Probe responses were elicited through a picture-naming task in a spontaneous mode of production. Responses were audiorecorded, phonetically transcribed, and judged correct if the sampled sound (but not necessarily the entire word) was produced accurately. Probe administrations were independent for each treatment approach; that is, immediately following delivery of a given treatment, its associated probe was administered. Probe

‡Judgements of homonymy in the NSW stimuli were based solely on auditory information; supplemental acoustic analyses may have revealed subtle, systematic subphonemic distinctions not perceptible to the clinician (cf. Camarata and Erwin, 1988; Forrest and Rockman, 1988; Gierut and Dinnsen, 1986; Leonard *et al.*, 1985; Maxwell and Weismer, 1982; Tyler *et al.*, 1990; Weismer *et al.*, 1981).

administrations also followed independent variable ratio schedules, averaging every other session. In addition, as a baseline measure, probes were administered to each child twice, prior to treatment. Then, with each successive child in the staggered multiple baseline sequence, administration of these pretreatment probes was increased by one. For any given child, the total number of independent probes administered under each treatment condition was identical.

Reliability

Interjudge reliability was calculated on 10% of the total number of probes administered to each child. The investigator and an independent judge (BB) phonetically transcribed each child's whole word responses on these randomly selected probes. Across subjects, a total of 450 consonants were transcribed. All consonant transcriptions were compared point-to-point. Mean interjudge agreement was 89%, with a range of 87% to 93% agreement. Importantly, there were only eight cases involving differences in judgements of sound accuracy. That is, only eight of the 450 consonants transcribed (i.e. 2%) involved relevant differences between the judges' transcriptions and their indication of whether these sounds were correct or incorrect relative to the ambient target.

Results and discussion

In this study, results of treatment were evaluated by considering relative changes in treated and untreated sounds excluded from a child's pretreatment inventory. Relative change was examined in these sounds as monitored on the independent probes associated with the homonymous versus the non-homonymous treatment approaches. There are, of course, other ways to evaluate relative phonological change including, for example, accuracy of production of treated (as opposed to probe) words, number of treatment trials to criterion, and number of treatment sessions. In this study, these alternative metrics did not seem applicable. Production of the NSW stimuli during the imitative and spontaneous phases of treatment did not distinguish among the conditions (see Appendix). Moreover, the ATD design dictated that the number of treatment trials and sessions be identical across conditions. It may be important in subsequent studies to assess relative phonological change using both treatment and probe data. Phonological changes observed during treatment may be especially revealing because children may mark seemingly homonymous treatment words in unique ways (Camarata and Erwin, 1988; Forrest and Rockman, 1988; Gierut and Dinnsen, 1986; Hoffman, Stager and Daniloff, 1983; Leonard *et al.*, 1985; Maxwell and Weismer, 1982; Tyler, Edwards and Saxman, 1990; Weismer, Dinnsen and Elbert, 1981).

Relative change in treated sounds

Learning curves based on each child's probe performance within each treatment condition were plotted, as in Figures 1, 2 and 3. Then, to establish differential learning of treated sounds across the two treatment conditions, the learning curves were examined relative to the highest percentage of accuracy achieved on any given

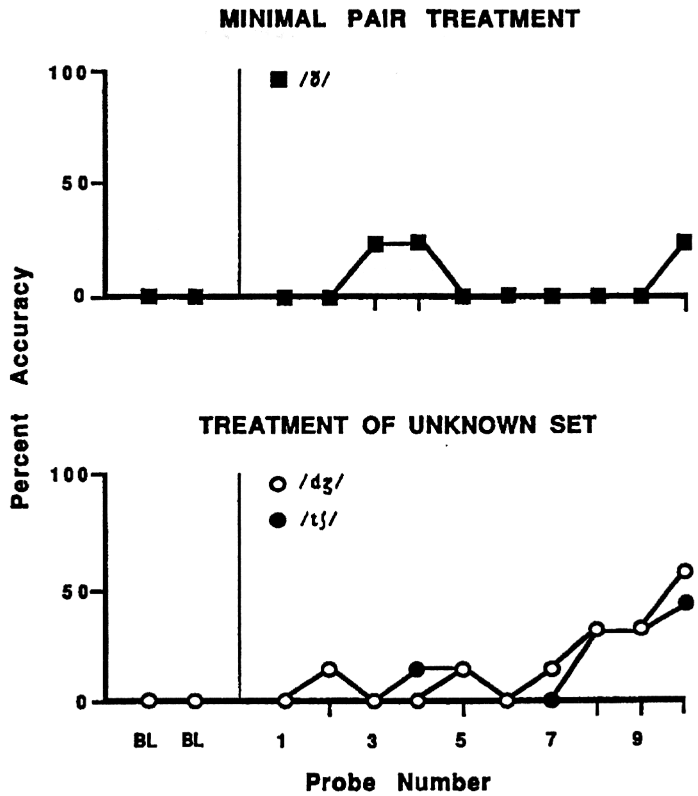

Figure 1. *Baseline and learning curves for treated sounds in each of the two treatment conditions as measured on probes for Subject 6.*

probe (cf. Ellis-Weismer and Murray-Branch, 1989) and the percentage of accuracy achieved on the final probe (cf. Winner and Elbert, 1988). These specific comparisons are displayed in Figure 4.

For all subjects, differences in learning treated sounds were observed between the two treatment approaches. In particular, greater gains were observed on probes associated with the non-homonymous treatment structure than with the homonymous structure. Treatment of the unknown set appeared to motivate more extensive change in treated sounds excluded from a child's pretreatment inventory than did conventional minimal pair treatment. That is, teaching two unknown sounds in comparison to each other resulted in relatively greater improvements in treated sounds than did teaching one unknown sound in comparison to its 1 : 1 substitute.

These observations were true for both evaluative parameters. With regard to peak probe accuracy, all three children exhibited higher percentages of accuracy on those probes associated with the non-homonymous structure of treatment, as displayed in the leftmost bar graphs of Figure 4. The highest percentages of probe accuracy in this condition ranged from 43% (Subject 6) to 86% (Subject 8); in contrast, peak probe performances in the alternative homonymous condition ranged from 25% (Subjects 6 and 9) to 50% (Subject 8). With regard to final probe accuracy, performance in the non-homonymous treatment condition again exceeded that observed in the homonymous condition, as seen in the rightmost bar graphs. This

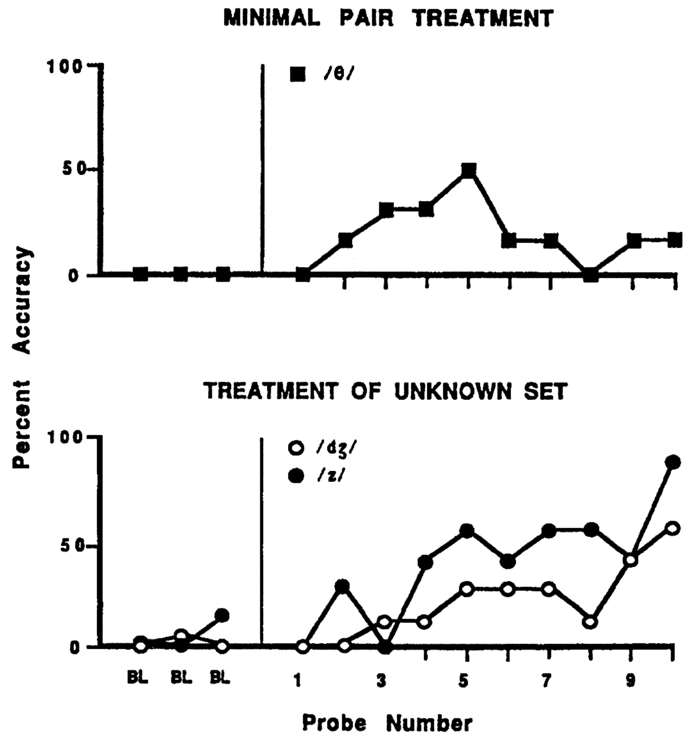

Figure 2. *Baseline and learning curves for treated sounds in each of the two treatment conditions as measured on probes for Subject 8.*

observation was especially notable in the case of Subject 9. This child exhibited 0% accurate production of the treated sound on the final probe administered in the homonymous condition, but showed 29% and 71% accuracy of treated sounds probed in the non-homonymous condition.

Thus, it appears that a non-homonymous treatment approach motivated relatively greater changes in treated sounds measured in single-word spontaneously produced probes than did a homonymous approach. One important question that remains is whether the observed differences were directly attributable to treatment structure or whether other factors may have played a role in phonological change. This question warrants serious attention and further evaluation, because all three subjects of this study received treatment on an interdental fricative /θ/ or /ð/ in the relatively less effective homonymous treatment. Perhaps treatment content, in addition to treatment structure, influenced phonological learning.

This potential confound is unfortunate; however, methodologically, interdental fricatives were originally selected for treatment only because they best met the conditions defined *a priori* for the homonymous condition (p. 124). Also, recall that a stated intent of contrast treatment is to teach phonological distinctions, and not specific sounds *per se* (Compton, 1970; Costello and Onstine, 1976; Dinnsen *et al.*, 1990; McReynolds and Bennett, 1972; Winitz, 1975); sounds merely serve to illustrate distinctions. If this, in fact, is true, then it is also necessary to consider specific features, in addition to particular sounds, taught in each condition. Table 2 lists the feature distinction(s) illustrated by the interdental fricatives in the homonymous

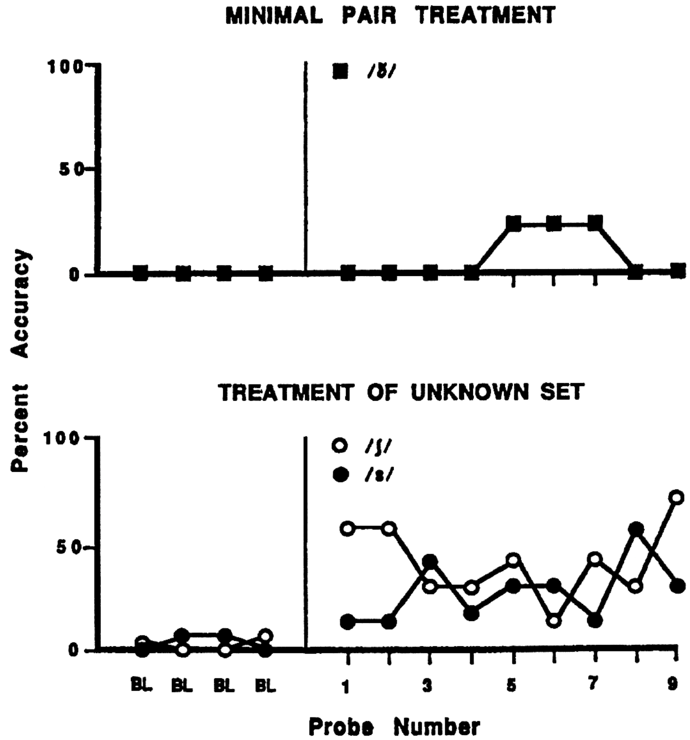

Figure 3. *Baseline and learning curves for treated sounds in each of the two treatment conditions as measured on probes for Subject 9.*

condition of this study. Note that, while the treated sound may have been the same for all children in this condition, the feature distinctions were not. Subjects 6 and 9 were being taught the continuancy distinction as illustrated by the fricative–stop pair, /ð/–/d/; whereas Subject 8 was being taught coronality and stridency as illustrated by the fricative–fricative pair, /θ/–/f/. Therefore, even though interdental fricatives were treated in the less effective homonymous condition, the manner class contrasts and feature distinctions the children were predicted to learn were unique.

To extend this one step further, notice that Subjects 6 and 9 in the homonymous condition were taught precisely the same distinction (i.e. continuancy) as Subject 8 in the non-homonymous condition. If treatment content were thought to be affecting phonological learning, it might be expected that all three of these subjects would exhibit similar patterns of learning. Yet, consistent with previous observations, Subject 8 evidenced greater performance when learning the continuancy distinction in the non-homonymous condition than did the other children learning this same distinction in the homonymous condition. This observation is particularly striking since Subject 8 was being taught the continuancy distinction in what might be taken as a 'difficult' contrast, namely, a fricative–affricate comparison illustrated by /z/–/dʒ/.

Two additional points deserve discussion in the examination of this potential relationship between treatment content and structure. First, interdental fricatives do not seem to be more difficult to produce or to learn than other types of sounds. Reportedly, interdental fricatives can be produced with similar degrees of accuracy

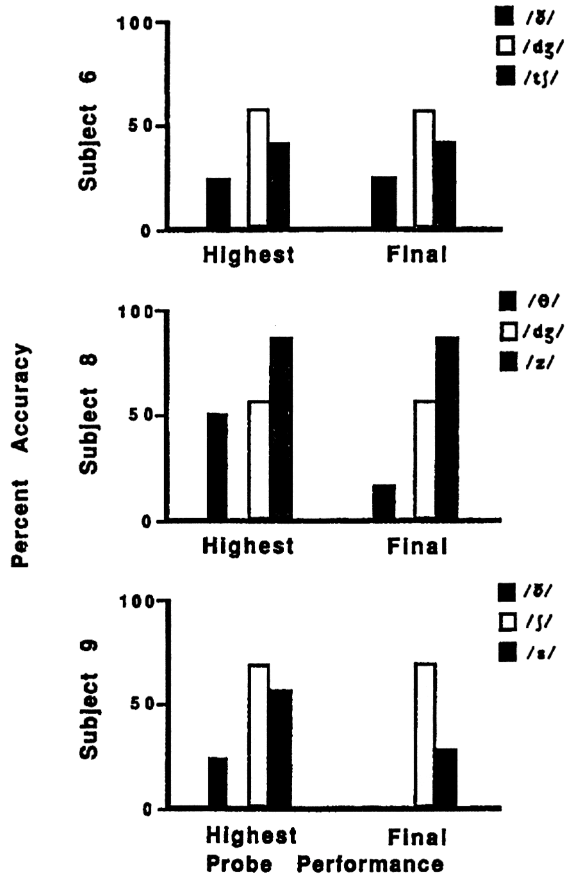

Figure 4. *Highest and final probe performance associated with the homonymous (■) and non-homonymous (□, ■) treatment strategies for Subjects 6, 8 and 9.*

as other treated sounds; moreover, patterns of learning associated with these fricatives approximate those of other sounds (see Appendix; Costello and Onstine, 1976; Dinnsen *et al.*, 1990; Elbert and McReynolds, 1978; Gierut *et al.*, 1987; Powell, 1989; Tyler, Edwards and Saxman, 1987). Second, the observed differential patterns of learning do not seem to correspond to a sequence of normative development. That is, a child's probe performance on earlier acquired sounds was not necessarily better than that on later acquired sounds. For example, Subject 8's probe performance on /θ/ and /z/ was not equivalent even though these sounds are presumably acquired at approximately the same age (Prather, Hedrick and Kern, 1975). The same was true of Subject 6's probe performace on /tʃ/ and /dʒ/. Also, Subject 9 performed more accurately on a later acquired sound, /ʃ/, than on an earlier sound, /s/. The accuracy of these predictions is, of course, wholly dependent on which developmental data are examined (Smit, 1986).

These considerations notwithstanding, it will be necessary to determine the possible effects of treatment content on treatment structure in subsequent studies. The present data support a conservative summary that differences in learning treated sounds (as measured in single-word spontaneously produced probes) may be a function of treatment structure, with a non-homonymous approach resulting in relatively greater phonological change than a homonymous approach.

Relative change in untreated sounds

Differences between the two treatment approaches were also evaluated by considering the number of new, untreated sounds added to each child's inventory post-treatment. The potential number and type of untreated sounds that could be added to each child's inventory are shown in Table 2 ('Sounds excluded'). Possible additions ranged in number from 3 (Subject 9) to 9 (Subject 6) new untreated sounds and included members of the classes: stop, fricative, affricate, and liquid.

To establish which specific sounds were added to the inventory under the different treatment conditions, mean probe performances were calculated for each untreated sound excluded from a child's inventory. Means were based on the total number of probes administered in a given treatment condition. (Recall that, for a given child, the total number of probes was identical across treatment conditions.) Comparisons were then made between the overall means associated with the homonymous versus the non-homonymous probes for each untreated sound. A minimum 10% difference in mean probe responding for any given untreated sound was taken as a relevant difference between the two treatment conditions (cf. Elbert, Dinnsen and Powell, 1984; Gierut, 1990). Table 3 displays the untreated sounds added to each child's inventory following this criterion of change.

For each child, the number of untreated sounds added to the post-treatment inventory was relatively greater in the non-homonymous treatment condition than in the homonymous condition. Each child showed a greater expansion of the post-treatment inventory when presented with two previously unknown sounds in comparison to each other. Subject 6 evidenced the greatest elaboration of his inventory, adding three new sounds including untreated /r/. Subjects 8 and 9 added two and one new sound, respectively, under this same treatment condition. In the alternative homonymous treatment condition, Subject 8 was the only child to expand the post-treatment inventory, adding one new sound. Subjects 6 and 9 did not add any untreated sounds to their inventories under this treatment approach.

Thus, the non-homonymous treatment appeared to guarantee the addition of untreated sounds to the inventory, whereas the homonymous structure may have promoted, but did not ensure comparable additions. It must be cautioned that the differential changes in untreated sounds were observed on independent probes affili-

Table 3. *Untreated sounds added to each subject's inventory under each treatment condition*

Subject	Homonymous strategy	Non-homonymous strategy
6		z
		θ
		r
8	ð	k
		g
9		z

ated in time with each of the different treatment approaches, as called for by the experimental design. To understand the full and integrated impact of these changes on a child's overall phonological system, future research will be called upon to evaluate relative changes in untreated sounds on measures other than controlled probes. More specifically, it may be important to consider the nature and accuracy of untreated sounds in spontaneous connected speech, since there may be a mismatch between the degree of new phonological information integrated into structured probes and that incorporated into running speech (Elbert, Dinnsen, Swartzlander and Chin, 1990). Another potential area of examination may involve fine-grained acoustic analyses of single-word probe productions under each of the two treatment conditions. Some investigators have speculated that subphonemic acoustic distinctions may precede and predict subsequent sound mastery (Forrest and Rockman, 1988; Tyler *et al.*, 1990; Weismer *et al.*, 1981). Finally, a focus on variation may reveal structured patterns of lexical change indicative of systematic but qualitative improvements in sound production (Elbert and McReynolds, 1979).

Clinical and theoretical implications

Initial evidence from relative changes in probe performance of both treated and untreated sounds indicated a differential learning pattern between the homonymous and non-homonymous treatment approaches. A non-homonymous treatment structure involving two new sounds in comparison to each other appeared to result in greater accuracies of treated sounds, and in more new untreated sounds being added to the inventory. A homonymous structure of teaching one new sound in relation to its corresponding error from the child's grammar also resulted in changes in children's phonological systems, but not nearly to the same extent or degree. The preliminary findings suggest that phonemic distinctiveness may show relatively more improvement when a child is simply presented with new phonological information and is allowed to discover its relationship to the existing grammar without direct instruction. These findings are relevant to potential changes in a child's underlying phonemic inventory as opposed to expansions of the surface phonetic inventory (cf. Dinnsen *et al.*, 1990).

There are obvious clinical applications that arise from these early findings. One recommended plan of treatment may be to identify ambient sounds excluded from a child's phonemic inventory. Of these unknown sounds, two may be selected and minimally paired with each other for treatment. Predictably, a child will elaborate distinctions in his or her grammar, changing both treated and untreated sounds, and will thereby reduce the potential for homonymy. A child's attention may not need to be focused on potentially homonymous forms or on comparisons between a desired ambient sound and its 1 : 1 corresponding error in order for this type of phonological change to occur. Importantly, these predictions about phonological learning are particular to changes in inventory constraints; with further evaluation they may also be applicable to the treatment of other types of phonotactic constraints and phonological rules.

A general theoretical concern raised by these results relates to the role of homonymy as the precipitator of phonological change. In this study homonymy was not a necessary condition for phonological change, since relatively greater changes occurred on probes associated with treatment of non-homonymous forms. Homonymy was not a sufficient condition either, since change was not ensured on probes associated with treatment of homonymous forms. Therefore, homonymy did not appear to be the principal motivator of phonological change in probe performance. This point is consistent with a structural (as opposed to a functional) account of homonymy in sound changes of languages of the world (Labov, 1987). From a structuralist perspective, homonymy is considered a derivative and not an axiomatic factor affecting change. A speaker's need to disambiguate homonymous forms for purposes of effective and efficient communication is taken to be a 'weak constraint on the development of linguistic form' (Labov, 1987: 330). More specifically, structuralists such as Labov (1987) and Malkiel (1979) contend that:

> phonemic contrasts can be suspended for a considerable period of time without disturbing the integrity of the word classes and the system they participate in. There is no doubt that phonemes do function to distinguish words. But the historical development of the system of phonemes is not narrowly controlled by that communicative function (Labov, 1987: 319).

Labov (1987) further recommends that contemporary research focus on problems where structural explanations can be balanced against alternative and competing functional accounts in order to establish the relative strength of each in conditioning phonological change.

With this suggestion in mind, three factors are offered as potential motivators of relatively greater phonological change noted in the non-homonymous condition of this study. One factor may be the number of new sounds taught. By teaching a child two new sounds, instead of one, up to twice as much phonological information may be provided and integrated into his or her sound system, thereby prompting greater change. On the other hand, it could be argued that learning two new sounds may be twice as difficult as learning one new sound. Here, amount of new information may be related to ease or difficulty of learning. Research independent of a contrast treatment paradigm may help sort out the importance of this factor in inducing change.

A second factor may be the role of the child's existing grammar in treatment. A child may not need to make overt associations among his or her errored and correct productions. Perhaps such a comparison may be an unnecessary, artificial, and potentially distracting treatment manipulation (Johnston and Smith, 1989; Kornfeld and Goehl, 1974; Locke, 1979; Priestly, 1980; Weiner and Ostrowski, 1979). The role of this factor may be addressed in comparisons of a more traditional treatment structure (i.e. teaching one new sound with no explicit association to the child's sound system) with conventional minimal pair treatment. Preliminary research along this line has indicated no difference between these two treatment structures in stimulating phonological change (Ward and Bankson, 1989), implying that direct associations to a child's existing grammar may play a rather minor role in learning.

A final factor may be the type of phonological information presented in treatment. Initial research has shown that the nature of the phonological distinction being taught may enhance sound change (Gierut, 1990). An important consideration will be whether treatment aids children in learning sounds, in learning ambient feature specifications illustrated by those sounds, or in learning new distinctions relative to the existing structure of their own unique phonological system. These three factors provide a starting point for further evaluations of both the structural and functional components involved in sound change, and may contribute to new directions in phonological treatment and theory.

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Appendix. NSW learning data (percentage accuracy) for each subject during each phase of treatment

Subject	Baseline	Imitation	Spontaneous
6	/ð/ 0	21 72 75 41 50 46 53	44 34 50 44 44 33 56 69 66 75 66 84
	/tʃ/ 0	0 13 13 22 50 50 69	25 66 33 75 69 79 50 72 79 84 84 78
	/dʒ/ 0	0 0 0 3 2 0 33	63 75 66 83 97 92 91 84 100 88 84 84
8	/θ/ 0	75 44 63 47 60 56 71	88 67 13 71 56 94 92 81 83 88 84 79
	/z/ 0	75 63 63 56 78 69 88	56 50 50 50 44 63 83 81 71 63 72 63
	/dʒ/ 0	13 0 19 31 31 31 46	56 42 38 46 31 44 42 34 50 94 88 88
9	/ð/ 0	25 66 29 79 83 — —	25 46 63 63 78 88 68 56 79 75 79 69
	/s/ 0	8 8 4 17 63 — —	19 21 22 19 38 31 31 44 50 31 63 28
	/ʃ/ 0	63 50 54 50 50 — —	63 83 66 56 78 31 25 56 54 31 46 66

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