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A systematic perspective for assessment and intervention: A case study

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Abstract
A systemic perspective was employed in completing a phonological analysis and developing an intervention plan for Jarrod, a 7;0 year old child who exhibited a severe speech sound disorder characterized by inconsistency. Results of the *Systemic Phonological Analysis of Child Speech* (SPACS) revealed a limited sound system that was characterized by phonotactic inventory constraints, positional constraints, and sequence constraints. Mapping the child-to-adult sound systems through phoneme collapses revealed a logical and symmetrical system that maintained systematicity, yet permitted variability. Based on the organizational principles suggested by the phoneme collapses, targets were identified for intervention using the distance metric approach, which is based on the function of sounds within a given system rather than the characteristics of a given sound, and assumes that targets will interact dynamically with the child's unique sound system. Finally, a multiple oppositions treatment approach intended to facilitate learning across phoneme collapses and lead to system-wide phonological restructuring was described.

Keywords: *Systemic phonological analysis, distance metric, multiple oppositions, phonology.*

Introduction

A systemic perspective in clinical phonology implies that interactions within and between components of the sound system exist and that these interactions are dynamic (Williams, 2005b). That is, the components of the sound system have a direct and active influence on each other. In terms of describing sound systems, one would expect to find symmetry and logical rules that have been created to accommodate a limited sound system relative to the ambient sound system (Leonard & Brown, 1984; Williams, 2005b; Yavas, 1994). Grunwell (1997) referred to this aspect of phonological description as determining "the order in the disorder". Consequently, the goal of phonological assessment is to determine the organization of the sound system through a description of general rules that account for the symmetry, orderly, and lawful principles that occur in all human languages (cf. Dinnsen, 1984; Dinnsen, Chin, & Elbert, 1992; Dinnsen, Chin, Elbert, & Powell, 1990). The assessment, then, provides a basis for selecting treatment targets and choosing the intervention that will lead to the greatest amount of reorganization, or restructuring, of the system in the least amount of time (Williams, 2005b).

The task at hand in this paper is to provide a systemic phonological description of Jarrod (aged 7;0 [years;months]) who has been diagnosed as exhibiting a severe speech sound disorder characterized by inconsistency. Using dynamic principles, the analysis will then be used as the foundation on which to select treatment targets to be used within a multiple oppositions treatment approach. Both the selection of targets and the multiple oppositions approach are presumed to interact with Jarrod's unique phonological organization to efficiently restructure his sound system to align more with the adult sound system. This paper will include a brief description of the child, followed by a systemic phonological analysis, recommendations for selection of treatment targets, and development of a multiple oppositions treatment approach.

Case study participant

Jarrod is a 7;0 year old male from Queensland, Australia, who is enrolled in an Intensive Language Class for children identified with communication difficulties and is repeating the Year 1 curriculum. He first received speech therapy at the age of 4;0 years that has involved private and school-based services over the past three years. Although Jarrod had an early history of otitis media, no hearing difficulties have been evident since his last hearing test at age 4;1. Jarrod was described by his mother and classroom teacher as interactive with his peers

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and adults and as not appearing to be frustrated when not understood. His medical and behavioural history is remarkable for asthma, for which he uses a nebuliser as needed, and Attention Deficit Hyperactivity Disorder (ADHD), for which he takes Ritalin. Additional details about Jarrod's family, social, development, and educational history can be found in Holm and Crosbie (2006).

Jarrod participated in three assessment sessions in which a battery of tests was administered to evaluate his speech, psycholinguistic abilities, oromotor skills, and phonemic awareness. A complete description of his performance on these measures is provided in Holm and Crosbie (2006).

Systemic phonological analysis

An independent and relational analysis was completed on Jarrod's single-word responses using the *Systemic Phonological Analysis of Child Speech* (SPACS; Williams, 2001; 2003a; 2005b). SPACS is a child-based assessment that maps the child's sound system onto the adult sound system in terms of phoneme collapses, which show the phonetic resemblance between the child's error production and the multiple adult target sounds that are collapsed to the child's error. This assessment approach is based largely on the "model and replica" processes that formed Ferguson's (1968) contrastive analysis in which the relationships between the child's sounds and the corresponding sounds in adult speech were presented in word-initial and word-final phonetic inventory charts. An extension of this was Grunwell's (1987; 1992) contrastive assessment in which comparisons of the child's sets of contrastive phones were made with the adult sound system in order to examine the patterns of organization of the two systems. Grunwell (1987) stated that the basic principle of contrastive assessment is very different than an error analysis where the comparison is sound-to-sound within specific words. With contrastive assessment, a system-to-system comparison is made between child and adult sound systems. This matches Ferguson's stated goals of a phonological assessment. According to Ferguson (1968), studying children's phonological development as a unique, independent system is important, but he also stressed that it is useful to compare a child's grammar to the adult grammar in order to understand the model-replica processes that are relevant in the child's phonological development. For these goals, Ferguson suggested the contrastive analysis was a basic tool. By comparing the child and adult sound systems, the loss of phonological contrasts can be seen in the child's smaller sound system. This comparison further reveals the child's tendency to produce one sound for several adult targets resulting in multiple loss of phonological contrasts. Weiner (1981) described the child's production of one sound for multiple adult sounds as a sound preference, which is considered a "collapsing process wherein a group of sounds having certain features in common are represented by a restricted feature arrangement" (p. 286).

Theoretically, Ferguson's model-replica basis for the contrastive analysis and Grunwell's contrastive assessment both viewed a close relationship between phonetics and phonology. As Grunwell (1997) stated, sound systems have a phonological function to signal meaning differences and this function operates in "a phonetically systematic set of combinations that result in economical combinations of phonetic features in the phonologies of natural languages" (p. 65). As a consequence, there tends to be a relationship between the phonetic properties of the adult target and the phonetic properties of the child's production. This relationship can be more easily identified and described when the two sound systems are mapped onto each other.

The database on which SPACS is typically completed is an extensive 245-item elicitation probe (*Systemic Phonological Protocol* [SPP]; Williams, 2003a). However, given the number of tests that were administered to Jarrod, the SPACS was completed on the compilation of the 242 word samples derived from the *Diagnostic Evaluation of Articulation and Phonology* (DEAP, Dodd, Zhu, Crosbie, Holm, & Ozanne, 2002) and *Hodson Assessment of Phonological Patterns* (HAPP-3, Hodson, 2004), as well as word lists submitted by Bernhardt, Stemberger and Major (2006) and Morrisette, Farris and Gierut (2006). Detailed, narrow phonetic transcriptions were completed on Jarrod's single word responses and provided to the author in Holm (2005). This compiled database is included in Appendix A. Although the SPP shares similarities with this compiled database with regard to length and general distribution of all English consonants across the three word positions, the SPP differs from these databases in terms of a minimum of five occurrences of each consonant in each word position and the elicitation of potential minimal pairs and morphophonemic alternations. The effect of this difference was to limit the available information on within word consonant production to determine consistency and assess the nature of underlying representations for post-vocalic consonants.

From the 242-item database, an independent analysis was completed that described Jarrod's phonetic inventory and the distributional and phonotactic characteristics of his sound system. A relational analysis was then completed, mapping Jarrod's error productions for adult target sounds in terms of phoneme collapses. The phoneme collapses provide a visual representation of the child's error production across several adult targets without reference to a finite, predetermined set of categories or processes. Thus, what might be described as several different phonological processes may be captured by a single phoneme collapse.

There are three characteristics of mapping a child's system onto the adult system using phoneme collapses. First, the phoneme collapse illustrates the phonetic resemblance between the child's error substitute and the adult target sounds. The child's error production shares phonetic features with the adult targets that are collapsed to the child's error. Grunwell (1997) states that this phonetic resemblance, or homophony, is a characteristic of a phonological disability.

The phonetic resemblance highlights the second feature of phoneme collapses. The phoneme collapses show a child's organization of a limited sound system relative to the full adult sound system. As a consequence, the phoneme collapses can be seen as compensatory strategies developed by the child to accommodate a limited sound system to a full adult sound system.

Related to the phonetic resemblance and compensatory strategies, the third characteristic of phoneme collapses is the logical and symmetrical aspects upon which the child has developed their sound system. Once the organizing (or compensatory) principle has been identified through the phoneme collapses, it is possible to see how the phoneme collapses are created as complementary, or mirror, rules. For example, as discussed in Williams (2005b), "Mark" (data taken from Grunwell, 1987) produced a voiceless continuant [h] for voiceless continuants /f, s, ʃ/, but produced the voiced continuant [j] for voiced continuants /l, r/ word-initially. Additionally, Mark collapsed word-initial voiced noncontinuants and clusters /g, dʒ, gr/ to the voiced stop [d] and voiceless noncontinuants and clusters, /k, tʃ, tr/ to the voiceless stop [t]. As illustrated in this example, Mark organized his sound system along the parameters of voicing and continuancy. With binary features of each parameter (+/−voicing and +/−continuancy), Mark had four phoneme collapses that accommodated the combination of each parameter, as summarized below:

+voicing/+continuant → [j]
−voicing/+continuant → [h]
+voicing/−continuant → [d]
−voicing/−continuant → [t]

This example highlights all three characteristics of Mark's sound system that are captured by the phoneme collapses: (1) the phonetic resemblance between his substitution and the adult targets; (2) strategies developed to compensate for a limited phonetic inventory; and (3) symmetrical and logical characteristics of the sound system in terms of mirror rules, as illustrated within and between each parameter (+/− voicing and +/− continuant).

In sum, the phoneme collapses of SPACS provide a systemic description of a child's errors rather than a fragmented description that views errors in terms of categories that are based on patterns related to broad categories of production, such as place, voice, or manner. The SPACS, then, provides a *system-to-system* comparison between child and adult rather than a *sound-to-sound* comparison of pattern approaches, such as phonological processes.

Systemic phonological description of Jarrod's sound system

As noted previously, independent and relational analyses are completed within the SPACS analysis. Jarrod's phonetic inventory of consonants is summarized in Table I for word-initial and word-final positions. Consonants that were consistently produced (regardless of accuracy) are included in the inventory. Marginal consonants that occurred a limited number of times, but at least twice in that position (cf. Stoel-Gammon, 1987) are enclosed in parentheses to differentiate them from stable sounds. Open boxes represent consonants that are part of the English inventory, but were never produced by Jarrod. As seen in Table I, Jarrod exhibited a restricted word-initial phonetic inventory that was characterized primarily by anterior stops [p, b, d], nasals [m, n], and glides [(w), j, (h)].[1] His word-final inventory was limited to nasals [(m), n, ŋ] and marginal productions of stops [(t), (d), (k)]. In summary, Jarrod exhibited a limited phonetic inventory characterized primarily by early developing anterior stops, nasals, and glides.

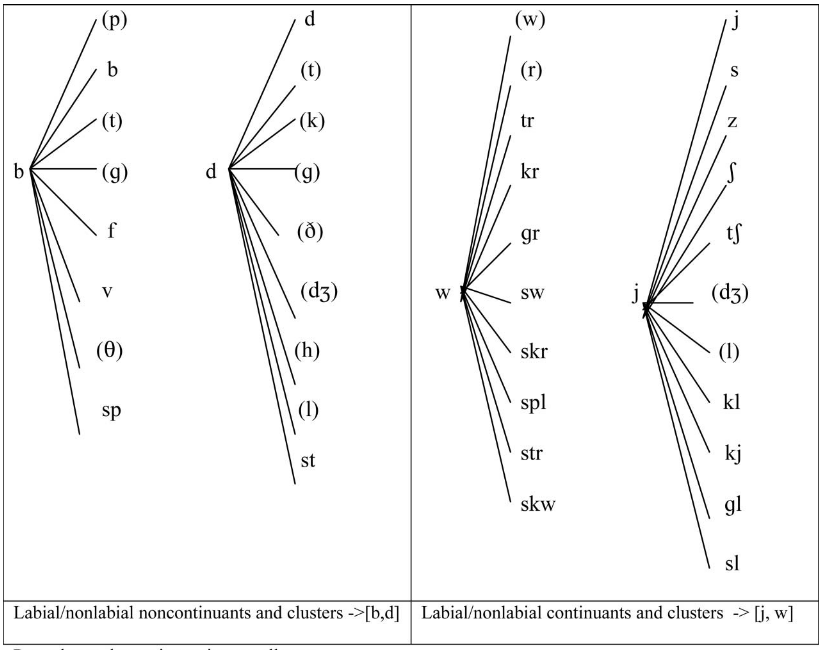
Jarrod's limited sound system is further reflected in the presence of phonotactic positional, inventory, and sequence constraints. As noted above, Jarrod's word-initial inventory was larger than his final inventory, which is represented by the presence of phonotactic positional constraints. Specifically, Jarrod deleted all fricatives and affricates, most target stops, and frequently deleted nasals. His production of target liquids word-finally was vowelized, which may have been dialectal. With regard to phonotactic inventory constraints, Jarrod never produced fricatives [f, v, s, z, ʃ], affricates [tʃ, dʒ], or the liquid [l] in any position.[2] The following marginal consonants could be considered emerging: [t, k, g, θ, ð, w, h, r]. Finally, phonotactic sequence constraints resulted in Jarrod's production of most consonant clusters as singletons. An exception to this was the occasional production of labial stop + sonorant, [bw, br], which might be considered an emerging context for cluster production.

The predominant phoneme collapses that occurred as a result of the phonotactic constraints are diagrammed by word position in Figures 2–4. It is through the phoneme collapses that we can see how Jarrod has organized his limited sound system in relation to the adult system and discover "the order in the disorder". As noted previously, Jarrod's word-initial inventory was more fully developed than his post-vocalic inventory. Concomitantly, his phoneme collapses reflect a more differentiated sound system word-initially than post-vocalically. Figure 1 shows

Table I. Independent analysis of Jarrod's word-initial and word-final phonetic inventory.

Manner	Word-Initial					Word-Final			
Stops	p, b	□ d		□□		□□	(t) (d)		(k) □
Nasals	m	n				(m)	n		ŋ
Fricatives	□□(θ)(ð)	□□	□			□□□	□□	□	
Affricates			□□					□□	
Glides	(w)		j		(h)				
Liquids		□	□				□	□	

Parentheses denote marginal occurrence; open boxes denote absence.



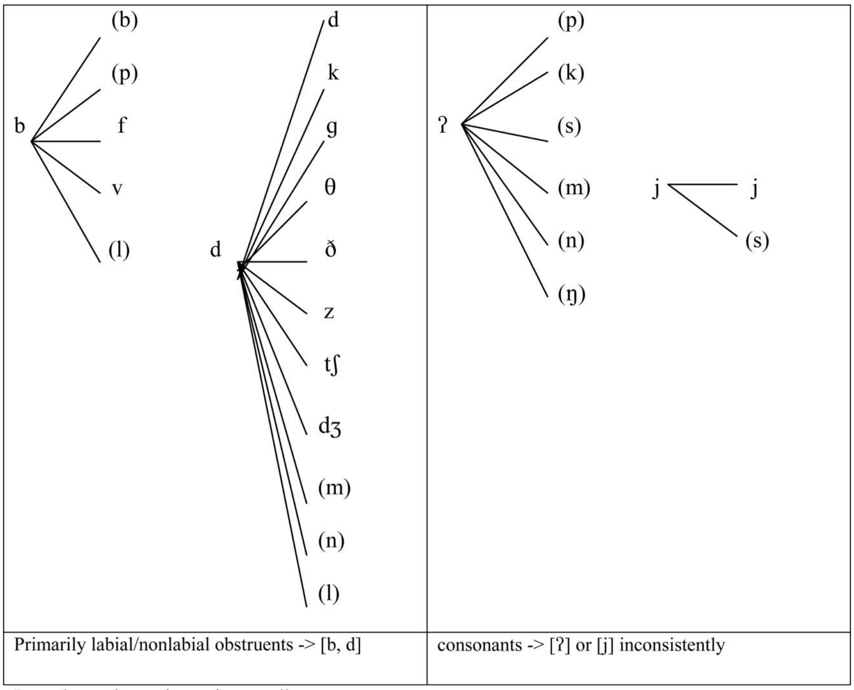
Parentheses denote inconsistent collapse

Figure 1. Jarrod's word-initial phoneme collapses.

that Jarrod organized his word-initial sound system along the parameters of labiality and continuancy. Given the symmetry of mirror rules, there are four phoneme collapses that describe this organization: +/− labial crossed with +/− continuant. Specifically, primarily labial and nonlabial noncontinuants and clusters are produced as [b] or [d], respectively. Conversely, primarily labial and nonlabial continuants and clusters are produced as [w] or [j], respectively. Notice the phonetic resemblances between Jarrod's error substitute for the target phonemes. That is, [b] is a labial noncontinuant that is produced for several target labial noncontinuants; [d] is a nonlabial noncontinuant produced for several target nonlabial noncontinuants; [w] is a labial continuant produced for labial continuants; and [j] is a nonlabial continuant produced for nonlabial continuants. Therefore, Jarrod's error substitutes reflect a logical and systemic strategy that "stretches", or compensates for his limited sound inventory to accommodate the full adult sound system.

There are a couple of features of the word-initial phoneme collapses that are worthy of note. First, there is some overlap of consonants occurring in both phoneme collapses. The stops /t, g/ occur in both collapses. Further, these phonemes violate the labial aspect of the collapse to [b]. This exception might be accounted for the possibility that /b, d/ have functioned as allophones in Jarrod's sound system or possibly be an artifact of intervention. Although the majority of Jarrod's error substitutions for target /t, g/ were predominantly [d], the few exceptions of [b] substitutions suggests that Jarrod's earlier sound development might have reflected the allophonic free variation between /b, d/ and this sample represented a differentiation of these stops at this point in time in his phonological development. The few substitution exceptions noted in the sample could not be accounted for by assimilation.

Secondly, it will also be noted that there are a few exceptions to the rules described by each phoneme collapse. This, again, might be accounted for by the phonological growth and differentiation that is occurring in a developing sound system. The phoneme collapses are written generally to capture the predominant target sounds that are represented in the collapse. Generally, the exceptions, indicated in parentheses, have limited occurrence.



Parentheses denote inconsistent collapse

Figure 2. Jarrod's word-medial phoneme collapses.

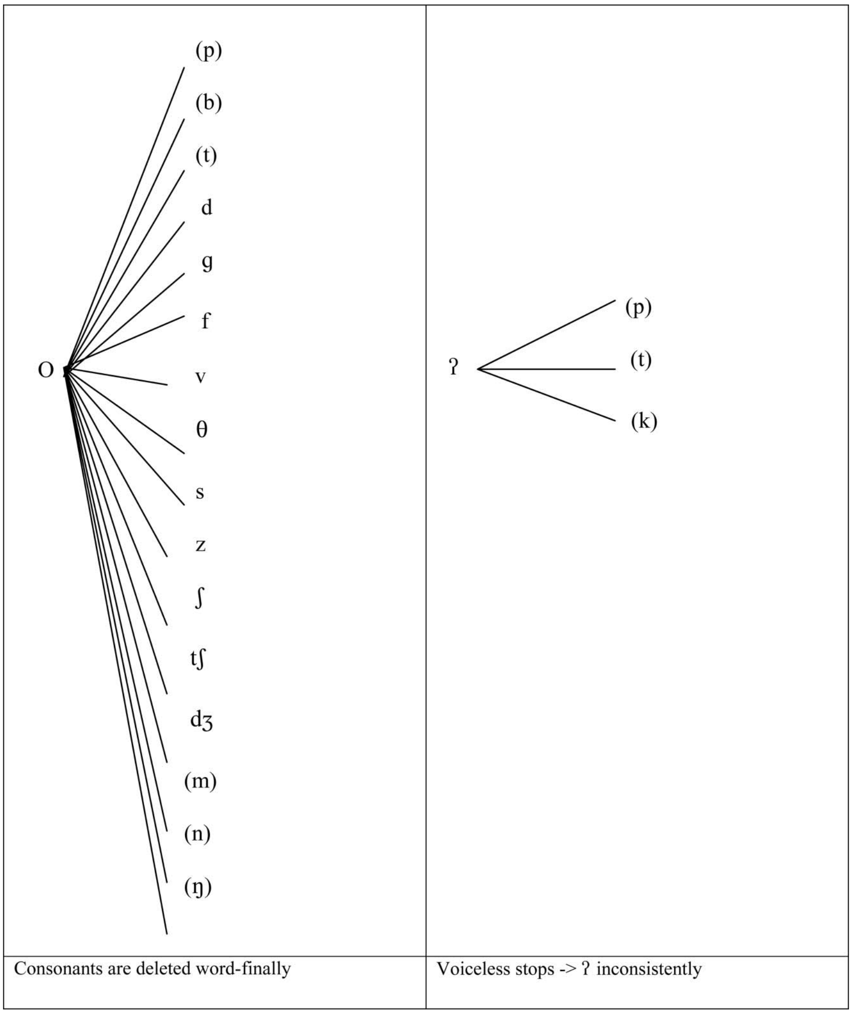


Figure 3. Jarrod's word-final phoneme collapses.

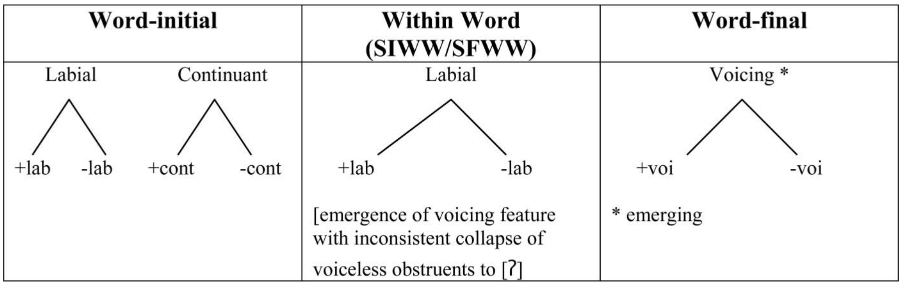


Figure 4. Summary of the organizational principles of Jarrod's phoneme collapses.

The post-vocalic phoneme collapses reflect less phonological differentiation than was present word-initially. This corresponds with the phonetic inventory and phonotactic characteristics of Jarrod's sound system that were described previously. Within words, Jarrod's primary phoneme collapses are organized basically on one parameter, i.e. labiality. As shown in Figure 2, primarily labial obstruents are collapsed to [b] and nonlabial obstruents are collapsed to [d]. Notice again the phonetic resemblances between Jarrod's error substitutes and the collapsed target sounds. Also, notice the symmetry of the phoneme collapses. Unlike the word-initial phoneme collapses, Jarrod did not maintain a continuant distinction. Therefore, there are only two primary within word phoneme collapses. However, there are two secondary phoneme collapses that are emerging with inconsistent collapses. Inconsistent productions of voiceless stops, [p, k], fricative [s], and nasals [m, n, ŋ] are produced as the glottal stop, [ʔ], which also is emerging as a word-final collapse. The inconsistent collapse of /s/ to [j] within words is likely a carry-over from his word-initial error substitution.

In Figure 3, the least phonological differentiation is reflected in the word-final phoneme collapses. Basically, Jarrod deletes all consonants word-finally as well as exhibits vowelization syllable final word final (SFWF). An emerging rule appears in which he inconsistently glottalizes voiceless stops.

To summarize, Jarrod appears to organize his limited sound system primarily along the place parameter of labiality and secondarily according to a manner feature of continuancy. An emerging feature of voice is appearing post-vocalically. Jarrod exhibits greatest phonological differentiation word-initially, with less differentiation within words, the least differentiation occurred word-finally. His word-initial organization is captured by two sets of mirror rules in which primarily labial and nonlabial noncontinuant obstruents and clusters are collapsed to [b] and [d], respectively, and labial and nonlabial continuants and clusters are collapsed to [w] and [j], correspondingly. Less phonological differentiation is observed within words with basically one mirror rule that involves labial and nonlabial obstruents collapsed to [b] or [d]. Word-finally, the least differentiation is noted with basically all consonants deleted. The organizational principles of these phoneme collapses can be summarized in Figure 4.

These organization principles demonstrate the symmetry of the mirror rules that govern the phonological organization that Jarrod has created to compensate for a limited sound system. Further, these phoneme collapses reflect the logical, lawful, and nonrandom characteristics that are typical of disordered sound systems (cf. Dinnsen et al., 1990).

Treatment recommendations from a systemic perspective

Using a distance metric for selection of targets

With an understanding of Jarrod's phonological organization, a treatment plan to efficiently reorganize his sound system can be proposed. Given the mirror rules word-initially, treatment targets selected from each set (labial/nonlabial noncontinuants and labial/nonlabial continuants) should generalize to the corresponding rule. The fact that Jarrod's within word phoneme collapses reflect some characteristics from his word-initial organization, as well as reflect the emergence of voicing word-finally, selection of targets from initial and final word positions would be expected to generalize to the within word position and provide more salient contexts for intervention. Thus, a secondary target would be to address the deletion of consonants word-finally.

With these basic principles in mind, specific selection of treatment targets will be based on the distance metric approach (Williams, 2003b; 2005b; c). The distance metric is a systemic approach to target selection that is based on the function of a target sound within a child's system rather than the characteristics of a sound that is independent of the child's phonological rule. The function of a sound assumes that the importance of target sounds is broader than the characteristics of the sound itself. Consequently, dichotomous characteristics such as early versus later developing sounds, stimulable or non-stimulable sounds, least or most knowledge are not considered in selecting the target sound. Rather, the distance metric to target selection is based on two parameters: (1) maximal classification and (2) maximal distinction of sounds included in a given phoneme collapse. Maximal classification involves selection of targets that represent different manners, places, and voicing within the set of adult sounds included in one rule set of a phoneme collapse. By selecting targets that are represented within a phoneme collapse, intervention is focused across the rule set. Maximal classification is therefore a vertical parameter in which targets are maximally classified from across the phoneme collapse, i.e.

target sound 1

↕

target sound x

Maximal distinction represents a horizontal parameter (i.e. child's error ←→ target sound) in which targets are selected that represent a maximal distinction between the target and the child's error with regard to place, voice, manner, or linguistic unit (singleton versus cluster). Selection of targets that are maximally distinct from the child's error ensures that the targets are more salient and therefore presumably more learnable (cf. Gierut, 2001; 2003).

Collectively, the two parameters of the distance metric indicate that targets will represent the extremes of a child's rule, or phoneme collapse, much like the corner pieces of a puzzle. Analogous to a puzzle, the two parameters of the distance metric provide the critical "corner pieces" of a puzzle by using salient, focused input that will facilitate individual children's phonological learning and reorganization. Presumably, the salient targets selected by the distance metric will not only facilitate their learning, but will also permit the child to fill in the pieces (untrained sounds) that lie between the extreme margins of the phoneme collapse. Conversely, targets selected on the basis of the characteristics of individual sounds that are independent of a child's unique phonological organization would be analogous to presenting the child with the interior puzzle pieces.

With the distance metric, up to four targets can be selected from a single phoneme collapse using the multiple oppositions intervention approach. As noted previously, selecting targets from opposing sets of phoneme collapses word-initially should yield the greatest phonological change. Therefore, it is recommended that targets be selected from the labial noncontinuant obstruents and clusters to [b] and the nonlabial continuants and clusters to [j] phoneme collapses. Using the distance metric, the specific targets selected would include [b] ~ /f, sp/ and [j] ~ /s, ʃ, tʃ, gl/. Only two targets were selected from the collapse to [b] because targets /t, g, θ/ were infrequently produced as [b]. These targets have the potential to enlarge the relevant frame of learning for Jarrod by including targets from different places (labio-dental, alveolar, palatal), manners (fricative, affricate), and linguistic units (singleton, cluster) of production. Inclusion of target clusters along with the singleton targets for intervention addresses the phonotactic inventory and sequence constraints that operated in Jarrod's phonological system. Word-finally, null (O) will be contrasted with the targets /t, v, z, dʒ/. Again, these targets include a range of targets with regard to place (alveolar, labio-dental, palatal), manner (stop, fricative, affricate), and voicing (voiceless, voiced). The targets recommended for treatment are summarized in Table II.

Constructing a multiple oppositions intervention program

As noted above, the targets selected extend the relevant frame of learning for Jarrod by confronting him with the range of targets included in each phoneme collapse with regard to place, voice, manner, and linguistic unit. A horizontal goal attack strategy (Fey, 1986) would be recommended in which each target contrast would be addressed within each treatment session. The targets would be incorporated within a multiple oppositions treatment approach, which is based on the assumption that learning is facilitated by the size and nature of the linguistic "chunks" that are presented to the child. The larger treatment sets of multiple oppositions address several error sounds simultaneously from one rule set to facilitate systemic sound learning, which is based on principles of distributed learning (Williams, 2005a; b). Further, the larger treatment sets confront the child with the extent of phonological change that must be achieved while exposing him to the relatedness of the target sounds within a rule set.

Generally, treatment is initiated with five sets of contrastive word pairs for each phonological goal (cf. Elbert, Powell, & Swartzlander, 1991). Using the *Sound Contrasts in Phonology* (*SCIP*)™ (Williams, 2006) software program to generate the treatment stimuli, the training exemplars that would be used to address each goal are listed in Table III.

Table II. Summary of phonological targets selected for intervention.

Word position	Target contrasts	Targeted features	Treatment approach
Word-initial	[b] ~ /f, sp/	+/− continuancy; labiodental; clusters	Multiple oppositions
	[j] ~ /s, ʃ, tʃ, gl/	+/− continuancy; alveolar, palatal; clusters	Multiple oppositions
Word-final	O ~ /t, v, z, dʒ/	+/− continuancy; labiodental, alveolar, palatal; voice; clusters	Multiple oppositions

Table III. Treatment exemplars for each of Jarrod's phonological goals.

Goal	Treatment stimuli
[b] ~ f, sp/# ___	bat ~ fat, spat buy ~ fie, spy bit ~ fit, spit bin ~ fin, spin bead ~ feed, speed
[j] ~ s, ʃ, tʃ, gl/# ___	you ~ Sue, shoe, chew, glue ye ~ see, she, chi, glee yo ~ sew, show, Cho, glow yum ~ sum, /ʃʌm/, chum, glum yip ~ sip, ship, chip, /glɪp/
O ~ t, v, z, dʒ/_ _ _ #	K ~ Kate, cave, K's, cage weigh ~ wait, wave, weighs, wage stay ~ state, stave, stays, stage pay ~ /pet/, pave, pays, page A ~ eight, /ev/, A's, age

Treatment exemplars were chosen with consideration of Jarrod's phonotactic constraints as much as possible, while selecting a variety of vowel contexts for each goal. As much as possible, real words were selected. However, two of the exemplars chosen were nonsense words in order to maintain diverse vowel contexts and remain within Jarrod's permissible word structure and inventory.

With the multiple oppositions approach, each target word is presented in contrast with the comparison word. For the goal of [b] ~ /f, sp/ word-initially, the clinician would model *bat ~ fat* and the child would repeat both words of the contrastive word pair. Then the clinician would model *bat ~ spat* for the child to imitate. Then the next set of contrastive word pairs would be addressed until all five sets of contrasts were completed for a total of 10 responses. One treatment set of 20 responses would be completed on each of the three targeted phonological goals (i.e. [b] collapse; [j] collapse; null collapse) for a total of 60 responses in one 30-minute treatment session. Following the focused intervention of the contrastive word pairs, a short naturalistic play activity is included at the end of each session to address the target sounds within sound-loaded communicative contexts. Treatment continues at an imitative response level until the child achieves the treatment criterion of 70% accuracy across two consecutive treatment sets for a given target. Once that criterion is met, intervention switches to a spontaneous level of production. Treatment is terminated on a given sound when the generalization criterion of 90% accuracy on untrained probe items has been met and the child produces the target sound correctly at least 50% of the time during a brief conversational sample. Data on the child's responses for each target sound are kept for each session using a plus/minus scoring system. Details about the training sequence and procedures are provided in the treatment paradigm described by Williams (2003a).

Conclusion

Assessment of speech sound disorders in children forms the foundation on which intervention is based. The theoretical constructs that we use in assessing disordered speech provide a set of assumptions about how errors are characterized, how the sound system is organized, and how children learn the ambient sound system. These theoretical constructs, in turn, guide clinicians in a principled way to design intervention strategies which are congruent with this view of children's phonological systems in order to maximize intervention outcomes. By utilizing an assessment framework that views a sound system as dynamic, logical, and symmetrical, we can commence with the task of phonological analysis as a "detective" in search of the order within the disorder. The assessment framework described in this paper utilized a systemic perspective that incorporates phonological analysis, target selection, and intervention in a unified approach to the clinical management of speech disorders in children. Each component of the systemic perspective interacts with the other components and contributes to the eventual goal of phonological restructuring. Thus, a systemic perspective assumes that there is a dynamic interaction between a child's unique phonological profile and the teaching input of the targets selected and the intervention. It is further hypothesized that the greatest system-wide change will result from the integrated intervention of multiple oppositions that provides distributed, focused treatment across a rule set.

In conclusion, the ultimate test of our theoretical assumptions lies in the treatment outcomes. If the phonological descriptions that we generate from our assessment framework are valid, the child should achieve greater phonological change in less time. The comparative benefit of different assessment frameworks in effecting treatment outcomes is an area of investigation that is lacking in our field. Although there have been a few published reports which compared different assessment frameworks in providing a thorough phonological description of one child (e.g., clinical forums coordinated by Shelton, 1993, and Williams, 2002; and a comparative analysis of different phonological process analyses by Dunn, 1982, and Dyson & Robinson, 1987), there have been no studies that have examined the treatment outcomes resulting from different assessments. A couple of studies have compared the differences in target selection resulting from divergent assessments of the sound system of one child (Baker & Bernhardt, 2004; Dyer-Mistone, Guello, & Williams, 1993). Obviously, further study of different assessment frameworks is needed to extend the comparative differences of assessment relative to treatment in order to validate their efficacy in effecting the greatest phonological change. As clinical researchers, we need to pursue such investigations to establish evidence-based practices for the clinicians who must determine which assessments will provide the most effective information within their clinics and to the children they serve.

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Notes

1 Some linguists classify /h/ as a glide rather than a fricative based on its distributional characteristics. Similar to the glides, /h/ can only occur word-initially and within words, never word-finally.

2 The voiced velar stop, [g], was a marginal consonant as it occurred once word-initially and once within words. However, it was not included in the word-initial or word-final phonetic inventories since it did not occur twice in either position.

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Appendix A

Compiled database of Jarrod's single-word responses.

#_	V_V	_#
	/p/	
page	puppy	sheep
pages	slippery	sleep
paint	zipper	soap
parrot		stop
paste		stripe
pig		sweep
potato		
puppy		
	/b/	
balloon	ladybird	crab
banana	rabbit	scrub
basket	strawberry	shrub
bath		spiderweb
bird		web
birthday		
biscuits		
boat		
boats		
book		
box		
boy		
burnt		
	/t/	
teeth	potato	basket
television	pretty	boat
tiger	tomato	foot
tomato	vegetable	fruit
tongue		gate
toothbrush		goat
towel		hat
		parrot
		plate
		quiet
		rabbit
		skate
		splitting
		street
		that
	/d/	
desk	ladybird	bird
	(ladybeetle?)	
dinosaur	spider	bread
door		cloud
duck		ladybird
		(ladybeetle?)
		shred
		slide
		spread
		thread

(*continued*)

Appendix A (*Continued*).

#_	V_V	_#
	/k/	
cake	chicken	black
candle	helicopter	book
car	vacuum	cake
cowboy hat		clock
kangaroo		duck
kitchen		quack
		rock
		shark
		shrink
		smoke
		snake
		sock
		squeak
		truck
	/g/	
gate	dragon	egg
game	kangaroo	flag
girl	tiger	frog
gorilla	billy goat	pig
gum	bubblegum	
	chewing gum	
	/f/	
feather	elephant	giraffe
fish	goldfish	knife
fishing		leaf
five		roof
foot		
fork		
	/v/	
vacuum	heavy	drive
van	screwdriver	five
vase	television	glove
vegetable	TV	sleeve
		stove
		twelve
	/θ/	
thank	nothing	bath
thing		teeth
thirsty		mouth
thumb		
	/ð/	
that	feather	
there	other	
this		
	/s/	
sausage	dinosaur	dress
scissors	glasses	grass
sister	sausage	house

(*continued*)

Appendix A (*Continued*).

#_	V_V	_#
soap		ice
sock		lighthouse
socks		this
		vase
	/z/	
zebra	music box	cheese
zero	present	glasses
zipper	scissors	pages
		nose
		prize
		scissors
		sneeze
		twins
		watches
	/ʃ/	
shark	fishing	fish
sheep		goldfish
shoe		splash
		toothbrush
	/tʃ/	
chair	kitchen	scratch
chased	watches	watch
cheese		witch
chicken		
chips		
	/dʒ/	
giraffe	pages	bridge
jam	television	page
jump	vegetable	sausage
	/ʒ/	
	television	
	/m/	
mask	animal	drum
mummy	mommy	game
monkey	swimming	gum
moon	tomato	jam
mouth		pram
music box		scream
		swim
		thumb
		vacuum
	/n/	
knife	animal	balloon
nose	banana	blown
nothing	cleaner	brown
	dinosaur	chicken
		clown

(*continued*)

Appendix A (*Continued*).

#_	V_V	_#
		dragon
		green
		kitchen
		moon
		aeroplane
		queen
		rain
		spoon
		train
		television
		van
	/ŋ/	
	kangaroo	fishing
	monkey	nothing
		planting
		ring
		shrink
		splashing
		spring
		string
		swimming
		swing
		thing
		tongue
	/w/	
watch	flower	
watches	towel	
web		
wind		
witch		
	/j/	
yeah	yoyo	
yellow		
yes		
you		
yoyo		
	/h/	
hat		
heavy		
helicopter		
house		
	/l/	
ladybird	balloon	animal
(ladybeetle?)		
leaf	elephant	crawl
legs	gorilla	girl
lighthouse	helicopter	school
	television	smile
	twelve	smell

(*continued*)

Appendix A (*Continued*).

#_	V_V	_#
	umbrella	snail
	yellow	spill
		squirrel
		towel
	/r/	
rabbit	bird	
raced	birthday	
rain	burnt	
rained	giraffe	
ring	gorilla	
rock	girl	
rocks	kangaroo	
roof	orange	
	parrot	
	scissors	
	shark	
	slippery	
	squirrel	
	strawberry	
	thirsty	
	zero	
	Clusters	
p + C	b + C	t + C
plane	black	train
planting	blow	truck
plate	blue	twelve
play	bread	twins
pram	bridge	twist
present	brown	
pretty		
prize		
k + C	g+ C	f + C
cleaner	glasses	flower
clock	glove	fly
cloud	gloves	flag
clown	glue	frog
crab	grass	front
crawl	green	fruit
cry	grow	
cubes		
quack		
queen		
quiet		

(*continued*)

Appendix A (*Continued*).

	Clusters	
θ + C	ʃ + C	d + C
thread	shred	dress
three	shrink	drive
throw	shrub	drum
s + C(C)	CC/ V_V	CC __#
scarf	toothbrush	apple
school	birthday	biscuits
scream	biscuits	burnt
scrub	helicopter	chips
skate	lighthouse	elephant
sleep	painting	front
sleeve	planting	gloves
slippery	umbrella	jump
slide	zebra	legs
smell		orange
smile		paint
smoke		paste
snail		present
snake		raced
sneeze		rained
spider		rocks
spill		scratch
spoon		socks
splashing		wind
split		
spray		
spread		
spring		
square		
squeak		
squirrel		
star		
strawberry		
stop		
street		
stripe		
stove		
sweep		
swim		
swimming		
swing		