ABSTRACT

USE OF CONCURRENT TREATMENT IN PHONOLOGICAL TREATMENT AND ACROSS-PHONEME GENERALIZATION

Concurrent Treatment is a method of treating children with phonologic disorders. Tasks are administered in randomized order, at all levels, within a treatment session. This method has been found to be an effective and efficient treatment program for children with phonological disorders, characterized by multiple sound errors. A multiple-baselines-across-subjects research design was conducted with three 4- to 6-year-old participants. Two phonemes of maximal contrast within a sound class that were produced in error by the participants were selected as treatment targets. A small number of exemplars were selected as treatment stimuli. Generalization across taught and untaught phonemes probes were conducted throughout this study. Several generalization across settings probes were administered. The results showed an increase in production accuracy by all participants when treated using the concurrent treatment method, as well as generalization across taught and untaught phonemes and settings.

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USE OF CONCURRENT TREATMENT IN PHONOLOGICAL TREATMENT AND ACROSS-PHONEME GENERALIZATION

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CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW

Phonological processes occur in children's speech as a normal course of development. According to Pena-Brooks and Hegde (2007), phonological processes are patterns of modifications of an adult production by typically developing children. Phonologic processes affect the syllable structure of words as well as affect classes of sounds. Normal development of phonological skills include: syllable structure, substitution, and assimilation processes. These processes gradually disappear in typically developing children.

Phonological processes affect a child's level of intelligibility. Speech intelligibility continues to improve as the child begins to incorporate phonological skills into conversational speech. A phonological disorder may be diagnosed if a child presents various phonological processes, has poor intelligibility and multiple misarticulations, has a restricted phonetic inventory, and has limited syllable shapes. In addition, a phonological disorder may also be diagnosed if there is retention of developmental processes beyond the age appropriate period or the use of atypical processes. Pena-Brooks and Hegde (2007) reported that by 5 years of age, typically developing children are nearly 100% understandable.

A variety of approaches are available to treat phonologic disorders in children. Clinicians must select treatment techniques that have been experimentally evaluated with favorable results and have been replicated across clinicians, settings, and clients. The generality of treatment effects is demonstrated by replication of a treatment technique. Clinicians should select treatment techniques that have positive functional results and are a result of replicated and controlled evidence (Hegde, 1998).

Selecting appropriate treatment targets, as well as the selection of an adequate number of exemplars, are also important choices for the clinician to consider. Careful consideration should not only be given to the treatment approach used, but to the number of treatment exemplars used for generalization to occur in phonologically disordered children. The motoric aspect (learning correct articulatory placement with ease) and the integration aspect (ability to perceive the similarity of the taught sound and to use that sound in untaught words) also need to be recognized as integral components of generalization (Elbert, Powell, & Swartzlander, 1991).

Treatment Approaches for Phonological Disorders

The following treatment methods are commonly used to treat phonological disorders. Some are substantiated in clinical research and some have not been experimentally evaluated.

Cycles Approach

The *cycles phonological remediation approach* (cycles) was developed by Barbara Williams Hodson and Elaine Pagel Paden in experimental phonology clinics that treated highly unintelligible children. These experimental clinics were located at the University of Illinois in 1975, San Diego State University in 1981, and Wichita State University in 1989. These experimental clinics provided the setting in which the Cycles approach was developed, tested, and refined (Hodson & Paden, 1991).

Assessment procedures included at least 10 opportunities for phonological patterns to occur in single-word productions. The Assessment of Phonological Processes-Revised (APP-R) was used to elicit 50 spontaneous utterances; this list consisted of 34 words containing consecutive consonants as well as words

containing three consecutive consonant sounds. Along with the use of the APP-R, a spontaneous conversational speech sample was obtained to note phonological patterns, as well as allow the researcher to make a comparison with conversational speech at a later date to evaluate and validate intelligibility gains after treatment. The clinician identified characteristics of a child's sound system, identified phonologic processes, and facilitated the selection of target patterns (Hodson & Paden, 1991).

The child's phonological speech deficiencies were analyzed, keeping in mind the frequency that the process was used and the effects these processes had on the child's delivery of communicative intent. Remediation focused on target processes, not on isolated phonemes. Phonological process percentage-of-occurrence scores that were greater than 40% were considered priorities for treatment. The phonemes targeted for treatment were chosen within a deficient pattern, with the intention of the phonemes selected to generalize to other phonemes within the class (Hodson & Paden, 1991).

In addition, only one phoneme is selected to teach a new pattern (e.g., the use of final consonants at the end of words) per session during Cycle 1. Two to five exemplar words are chosen for the first sessions, emphasizing many correct productions of the same words. Time considerations are emphasized when using the Cycles method (2-6 hours for each targeted process and 60 minutes for each target phoneme for each cycle) (Hodson & Paden, 1991). The selection of contrasting phonemes within a class is not a consideration.

According to Hodson and Paden (1991), a *cycle* is a time period to target processes. During the time in which each process is treated, specific phonemes are treated for a maximum of 60 minutes. Cycle 1 is referred to as the first targeting of phonological patterns that have been identified by the clinician

through analysis of the assessment. Upon the completion of Cycle 1, the APP-R is readministered to determine whether any of the phonological processes targeted have been incorporated into the child's sound system. Cycle 2 continues by moving through the processes used in Cycle 1, in addition to adding new processes. The child's performance is again reevaluated at the end of Cycle 2. Cycles are continued until all patterns are treated. The authors anecdotally noted that most children in their phonology program only required two or three cycles to become intelligible (Hodson & Paden, 1991).

Within each treatment session, a standard set of procedures were used to facilitate phonological remediation. Children listened to words containing the target sound or sequence at a low level of amplification. This amplified auditory stimulation (auditory bombardment) takes place at the beginning and end of every treatment session. The child wears earphones that provide low amplification; the words with the target sound are read clearly, but not exaggerated, by the clinician (Hodson & Paden, 1991).

Tactile and visual cues were used when a new target sound was presented. These cues are individual to each client and are prompted by the needs of each client. The child was also instructed to watch the clinician's mouth while the correct production was being made. A mirror was also used if this aided the child in making correct productions. All cues were faded as the child gained competence in production (Hodson & Paden, 1991).

Experimental efficacy studies of this approach have not been published. There are two efficacy studies that used a modified version of the program. It has also not been compared to other methods of treating phonological disorders that have been proven to be effective, such as minimal-pairs treatment (Weiner, 1981), maximal oppositions (Gierut, 1990), naturalistic conversation training (Camarata,

1993), and Concurrent Treatment (Skelton, 2004). Hodson and Paden (1991) had the children practice the target phoneme only at the word level. Though the ultimate goal is for the child to produce the target sound in conversational speech, the Cycles approach does not treat the target sound at the phrase, sentence, or conversational speech levels.

Contrastive Approaches

Minimal Pairs

A treatment strategy that has been used with children with unintelligible speech is contrast treatment, or minimal-pairs treatment. This treatment approach selects word pairs that are produced as homonyms by the child, but differ by a single vowel or consonant. When a child uses the process of final consonant deletion, a word pair such as *bee* and *bead* would be selected as treatment targets because both words are produced as the word *bee.* Weiner (1981) investigated the minimal-contrast treatment method to determine if it was an effective way of reducing phonological processes in children.

The participants in this study were two male children, ages 4 years 10 months and 4 years 4 months. The phonological processes selected for treatment for both participants were stopping, the deletion of final consonants, and fronting of initial consonants. To treat the process of final consonant deletion, the words *bow* and *boat* were chosen as treatment targets because these words were produced by the child as the same word (Weiner, 1981).

According to Weiner (1981), the treatment strategy using these words informs the participants that the misarticulations of these words results in miscommunication. A game situation is created, making the participants aware of the miscommunication. The clinician had five pictures of *boat* and four pictures

of *bow*. The object of the game was to have the participant to get the clinician to pick up five pictures of the boat. When the participant said boat, the clinician picked up the corresponding picture. When the clinician had all five pictures, the participant was allowed to place a star on the paper. The clinician picked up the picture named by the participant. If the participant deleted the final consonant in *boat*, the clinician picked up the picture of the *bow*. The clinician offered instructions after two consecutive errors, reminding the participant to say the /t/ sound at the end of *boat* if that was the picture that he was referring to. Verbal reinforcement was given for each correct production. A production was considered correct if the process was eliminated; any final consonant was considered a correct production.

Weiner (1981) used a multi-response (a version of multiple-baseline across subjects and behaviors) treatment design. This method confirmed that changes in behavior are due to treatment, and behavior only changes when treatment is applied. Four target words were selected within a minimal pair; each word was repeated five times for a total of 20 target words for each process treated. Three processes were addressed during treatment. Two baseline measures of each treatment target were taken before treatment began to determine the frequency of the phonological process. After baseline measures were taken, phase 1 of the minimal pairs treatment technique was applied to the 20 target words that were selected to eliminate the particular phonological process (final consonant deletion). After two treatment trials of the target words, baseline measures were taken for the second (stopping) and third (fronting) phonological processes chosen for treatment. Baselines were taken every two treatment sessions until the participant decreased his use of the phase 1 phonological process (final consonant deletion) in less than 50 % of responses. Phase 2 of minimal pair treatment then

began, and followed the same procedures as with phase 1. Non-treatment words were used as generalization probes once each session (Weiner, 1981).

Weiner (1981) showed that the minimal pairs treatment method was effective at reducing the phonological processes targeted for treatment. There was also generalization across untaught phonemes affected by the target process. Placement instructions and verbal reinforcement of a correct response were used as part of minimal-pairs treatment procedures. This makes it difficult to ascertain if the selected stimuli or motoric instructions had an effect on correct productions by the participants. Although the results displayed efficiency and effectiveness in the decreased use of phonological processes at the word level as well as generalization of untaught words, it is unknown if these skills transferred to the phrase, sentence, and conversation levels.

Another study by Saben and Ingham (1991) also researched the effects of minimal pairs treatment. Untreated phonemes within the class of sounds taught were probed to determine generalization of treatment effects. This study used minimal pairs treatment and removed motoric components as part of the treatment program; prior research in the effectiveness of minimal pairs therapy did not remove this component. For instance, in Weiner's study the motoric component was not removed from treatment; placement instructions and verbal reinforcement of a correct response may have more of an effect than the minimal pairs treatment. It is unknown if the prior success of minimal pairs therapy to treat phonologic disorders is a result of imitation and phonetic placement instructions (motoric component) or the result of the use of minimal pair stimuli.

Saben and Ingham (1991) selected two children diagnosed with a phonological disorder as participants. A single phonologic process was chosen as a treatment target for each of the two participants; several phonemes served as

exemplars. The first participant's treatment target was the use of fricatives in the final position with the initial exemplar of /f/ used during treatment. The phonemes /s/, /z/, and /θ/ were successively treated. The second participant's treatment target was also the use of fricatives in the final position with the initial exemplar of /s/ used to begin treatment. The phoneme /v/ was successively treated. Five exemplars were chosen for each phoneme in error that was treated.

In the Saben and Ingham (1991) study, a response was considered correct if a fricative was produced in the final position of a word. The exemplar phoneme selected did not have to be produced for the response to be considered correct. The researchers pointed out that the goal of treatment is to treat a process, not necessarily a phoneme. For instance, for participant 1, any fricative that was produced in the final position was considered correct. A probe of untaught words was administered before treatment began to establish a baseline, then again at predetermined steps within treatment. The probe list was created for each participant and contained words that were not used in treatment and represented every phoneme that the process that was targeted could affect.

Results of the Saben and Ingham (1991) research indicated that although the participants met the criteria that are required at each step of treatment, there was a failure to generalize the treatment effect in taught and untaught phonemes and words. The research also indicated that motoric imitation activities were added to treatment to meet the criteria. As a result, the researchers questioned the usefulness of this treatment method.

Maximal Opposition

A variation of minimal-pairs or contrast treatment is maximal oppositions treatment. This is another contrast method available to treat phonological

disorders. This contrastive approach uses treatment targets that vary among multiple feature dimensions of manner, voice, and placement. This is opposed to minimal pair treatment: word pair treatment targets are selected based on one feature, such as a voiced versus a voiceless phoneme (Gierut, 1989).

Gierut (1989) was among the first to research a maximal opposition approach to treat phonological disorders. A single-subject multiple baseline design was used with the maximal opposition approach to treatment. Twenty-one sounds were chosen to baseline. One maximal opposition contrast was chosen for treatment. The participant only used voiced sounds in the initial position of words (voicing feature), bilabial sounds were primarily used in the initial word position (placement feature), and stops were also used in the initial position (manner feature). Therefore, the maximal opposition chosen was a voiceless sound produced in a posterior region of the mouth that was a fricative was chosen for treatment. The selection of these maximally different treatment targets is an important distinction of this study; manner, voice, and placement features were crucial when considering treatment targets that would change phonological systems of children with speech sound errors (Gierut, 1989).

Five word pairs were chosen for treatment using the target phoneme /s/ (*e.g., sad-mad, sat-mat, see-bee, suit-boot, sail-whale).* The participant was required to name the words after the researcher's model, and then produce the words without the model. After reaching criterion in imitative and spontaneous treatment trials, a generalization probe was administered to all 21 sounds chosen as treatment targets. This treatment procedure continued with a second set and third set selection of maximal opposition; generalization probes followed the mastery criterion for each set. A spontaneous speech sample was also obtained 1 week after the end of treatment (Gierut, 1989).

Results indicated that in a relatively short intervention (3 months, or 23 treatment sessions), the participant made improvements and changes in his phonological system. The generalization data revealed that the maximal oppositions treatment approach was successful with treating the participant's extensive omissions. However, the data also revealed that the participant overgeneralized certain phonemes in his speech, which suggests that all sounds omitted in the initial position of words were treated as equivalent. The maximal oppositions approach may only be appropriate to treat particular error patterns and extensive omissions.

Gierut (1990) continued to research the maximal opposition approach by contrasting this treatment with the previously discussed minimal pairs approach. These treatment methods are different in the number of oppositions contrasted in a word pair; minimal pairs contrasts sounds within word pairs in as few features as possible. Maximal oppositions sounds are contrasted in as many features as possible. Although both treatment methods are attempting to reduce homonymy, the researcher attempted to evaluate which method would result in a change the participants' phonological learning.

An alternating treatments design was used with three participants. This design allows for comparison of treatment effects of two different treatment methods on a single participant. All participants were taught with minimal pairs treatment methods and maximal oppositions treatment method within each treatment session; two different sound pairs were also taught. To account for carry-over effects, the order of presentation of each treatment method was taught first in the session an equal number of times (Gierut, 1990).

Word pairs were different and appropriate for each participant. Treatment began with an imitation phase until criterion was reached. The imitation phase

was followed by the spontaneous phase, which continued until criterion was reached. After both phases, probes were evaluated to determine the differences in the data between the minimal pairs treatment method and the maximal oppositions treatment method. These data were analyzed for each participant and differences between treatments were based on the highest level of accuracy on a probe, accuracy on final treatment probe, and improvement between first and final probe (Gierut, 1990).

Although the results seemed favorable, the participants had varying levels of success. Results of this research indicated that the first and second participants experienced the greatest phonological change with the maximal opposition treatment method. The third participant demonstrated comparable learning with both treatment approaches. The ultimate goal is for the child to produce the target sound in conversational speech; maximal oppositions does not treat the target sound at the phrase, sentence, or conversational speech levels. Treatment at these levels might create better generalization effects. Treatment at only the word level has not been shown to have an effect on conversational speech.

Multiple Oppositions

Minimal pairs and maximal oppositions are both contrastive approaches to treat phonological disorders. The multiple oppositions treatment approach is also a contrastive approach; however, this approach addresses the absence of sounds that have resulted in phonemic collapses by the child. A phonemic collapse results in homonymy of many words when several sounds are absent from a child's speech; intelligibility is greatly reduced and communicative breakdowns result. The multiple oppositions approach selects several sounds within a phonemic collapse and treats these sounds simultaneously to reduce homonymy in the

child's speech. This differs from minimal pairs in that larger treatment contrast sets are used. The larger treatment sets addresses the child's phonemic collapse (Williams, 2000a).

Williams (2000a) described the multiple oppositions approach as broad training; this exposed the child to a variety of training exemplars that were applicable to a particular phonologic rule. Exposure to the entire phonological rule may assist the progress of learning and may have the child integrate the contrasts into a new rule, making multiple oppositions more efficient. According to Williams (2000a), this broad training has "resulted in significantly higher generalization performance for the child with the severe phonological disorder" (p. 283). Although the multiple oppositions approach sounds promising as a treatment method, Williams only supplied a theoretical case within this study to support this claim.

In another study, Williams (2000b) tested the effectiveness and efficiency of various treatment options. Williams (2000b) examined three clinical treatment options that are often used as phonological interventions: multiple oppositions, minimal pairs, and naturalistic speech intelligibility (NSI) training. Multiple opposition and minimal pairs treatment approaches are contrastive models that structure treatment at the word level. Williams believed that intervention at the word level might be sufficient for some children; however, some children with phonological disorders require treatment at the conversational level in order to see treatment effects at the conversational level. To meet this need, Williams (2000b) researched a treatment option, NSI, which is a conversation-based treatment model.

Williams (2000b) chose to do a longitudinal intervention study using ten children with a phonological disorder. These participants were grouped by

severity: moderate, severe, and profound based on the number of sounds in error. Multiple oppositions and minimal pairs treatment methods were used to teach the targeted phonemes for each of the 10 participants. Criterion was met at 90% accuracy of targeted phonemes after two sequential training sets. When this criterion was met, the treatment method was changed to NSI training.

Sounds chosen as treatment targets were selected as mentioned by Gierut (1989). Treatment target sounds chosen had maximal distinction in manner, voice, and placement from the child's error, with the goal of expanding the child's repertoire of sounds. Target selection had traditionally been based on stimulability and developmental norms. In this study, target sounds chosen for treatment were not selected by this traditional criterion. The selection of the target sounds with maximal distinction and maximal classification (represent the sound classes not produced) were chosen with the goal of phonological reorganization with minimal amount of intervention (Williams, 2000b).

Williams (2000b) reported that this longitudinal study revealed that children with greater severity required more intervention, with a maximum of five semesters and 105 treatment sessions. One participant required articulatory placement instructions of target sounds due to motoric difficulties with production of target sounds. One participant received multiple opposition intervention, followed by NSI intervention. Two other participants only required multiple opposition intervention "to achieve their final levels of phonological restructuring" (p. 295). Five of the 10 children required intervention at the conversational level; NSI treatment was administered to these participants.

Williams (2000b) reported the results of this longitudinal intervention study in a "departure from the traditional format of controlled research studies in which treatment outcomes are typically examined" (p. 298). It is unclear how to interpret

this study: some participants required NSI training and some did not. Does "final levels of phonological restructuring" (p. 295) refer to adult-like conversational speech? When minimal pairs treatment was used, was the motoric component included or removed? Because the research design is not specified, it is unclear how to interpret the results of this study, as well as how to clinically apply the results.

Naturalistic Speech Intelligibility Training

Williams (2000b) uses the NSI treatment approach to facilitate treatment at the conversation level. This study cites Camarata's (1993) work with an approach that is comparable to NSI. Camarata (1993) does not call this method NSI; he refers to it as naturalistic conversation training. In Camarata's (1993) study, which followed a multiple baseline across subjects and behaviors design featuring two participants, examined the effect of naturalistic conversation training on the accuracy of speech production. In order to be selected as a target sound, the participant needed 0% production accuracy of that phoneme in a minimum of three baselines. The phoneme selected was also developmentally appropriate to each participant. Treatment sessions were manipulated to provide many opportunities for the child to use the target phoneme; toys and stimulus items available were purposely chosen to elicit the target sound. Feedback provided by the clinician consisted of a correct model immediately following an incorrect production produced by the child. A naturalistic conversation ensued; the child was not required to imitate the clinician's correct production.

Camarata (1993) reported results that indicated the efficacy for conversation-based speech sound training. This study calls attention to the idea that some children with communication disorders may require multiple, correct

models to learn a sound that has been used in error. Naturalistic conversation training provided these contrived opportunities to produce these sounds, as well as hear a correct model of the sound as soon as an error was made. Camarata (1995) states that this new treatment approach should not "totally displace existing practice" (p. 63). It was the researcher's intention to call attention to the effectiveness of naturalistic conversation training and extend speech intelligibility treatment options.

Concurrent Treatment

In all previously discussed methods of treatment, a phonological disorder was typically treated in a presumed easy-to-hard incremental sequence of treatment tasks. This task sequence can be described as using the target phonemes in a hierarchy: in isolation, syllables, words, phases, sentences, and conversational speech. As the client progresses within treatment, the responses are sequenced and designed to make each step increase in difficulty. Although this treatment hierarchy is typically used in treatment, this sequence has not been demonstrated to be a necessity to teach exemplars or affect generalization of taught phonemes (Skelton, 2004).

An intermixed random order of tasks would be an alternative way of sequencing teaching exemplars. Treatment tasks presented in a random, variable order would allow the child with a phonologic disorder to practice each target sound at every level. Randomizing the order of treatment tasks within each treatment session would allow presentation of every level (e.g., isolation, syllable, word, phrase, sentence, or conversation) without predetermined sequence (e.g., easy exemplars followed by difficult exemplars). Concurrent Treatment is the

only treatment method that randomly intermixes easy and hard exemplars (Skelton, 2004).

Skelton (2004) used the Concurrent Treatment method to evaluate how participants acquired, generalized, and maintained the effects of this method when used as a phonologic treatment program. A multiple-baseline-across-subjects design was used with four participants, ages ranging from 7 years, 5 months to 7 years, 10 months, that had speech-sound production disorders. The target behavior was the /s/ phoneme (dependent variable); only a correct production of /s/ was accepted as correct. Multiple baselines were taken for each participant in order to reveal the affect of the independent variable (randomized sequence of exemplars). All participants received a 0% correct for non-imitated /s/ words, with the /s/ phoneme in all position of words.

Skelton (2004) used 29 different types of exemplars, including imitative and evoked trials of the phoneme in all word positions (e.g., initial singleton, cluster, intervocalic, and final singleton) and in all levels (syllables, words, two-to four-word phrases, sentences, and evoked conversational segments). Treatment consisted of two components: pretreatment training and randomized sequences of treatment. Pretreatment trials were necessary to establish articulatory placement of the /s/ phoneme; randomized sequences of treatment followed the pretreatment training trials.

Each treatment session was 30 minutes, with the sequence of exemplars randomized for each session. Generalization was measured during and after the treatment phase in three conditions: untaught exemplars within the clinic setting, conversations within the clinic setting, and across settings at the participant's home or school setting. When treatment was concluded, probes were administered three times during the post-treatment phase (Skelton, 2004).

The results of this study revealed stable baselines for each participant. Each participant increased the production of /s/ in the first treatment session, as well as generalization to untaught exemplars with a high percentage of correct /s/ productions. Conversational probes within the clinic setting revealed that two participants with at least 80% correct productions of /s/ on the final probes; these participants also showed some generalization in home and school conversations during the treatment phase. The other two participants had minimal generalization in the clinic setting and no generalization in the home and school settings (Skelton, 2004).

Results revealed that Concurrent Treatment was effective and efficient in teaching the speech sound in error. According to Hegde (1998), treatment procedures selected need to be replicated across participants, examiners, and settings with well-documented controls and data. Favorable and controlled evidence of improvement were shown using the Concurrent Treatment therapy method. Replicated evidence was needed to establish the highest level of positive evidence.

Skelton and Funk (2004) continued to research Concurrent Treatment to evaluate and validate the effects of using a variable sequence of tasks. These tasks were used to elicit the target sound in various word positions. An AB research design replicated across participants was used with three children, ages 4 years 8 months to 5 years 11 months. Each participant had reduced speech intelligibility and received treatment for one phoneme in all word positions. Hegde (1998) asserts that the AB research design clearly shows the effectiveness of a treatment.

Baseline measures were consistent before treatment began. Correct productions of the sound in error were from 0%-2%. After completion of baseline measures, the participants were given placement instruction of the sound in error

in isolation. This was followed by instruction of the target phoneme before and after a vowel. Sixteen randomized tasks were presented during treatment, as well as a task of telling a story with the target phoneme in an uncontrolled word position. A verbal correction was given with a production error of the target phoneme (Skelton & Funk, 2004).

Results of this study indicated an increase (45% to 56%) of correct productions with the use of Concurrent Treatment, within the first five to eight sessions of treatment. Generalization to untaught tasks was observed. Final generalization probes revealed greater than 60% correct productions; final conversational probes revealed 30% to 50% correct productions. The results of this study further demonstrate that a randomized, variable sequence of tasks may be an effective and efficient way to teach speech sounds in error (Skelton & Funk, 2004).

Kerber (2005) further evaluated the efficacy of Concurrent Treatment by using a multiple-baseline-across-subjects design. Four participants, ages 3 years 8 months to 6 years 1 month, were chosen and determined to have a phonological disorder. The research design used in Kerber's (2005) study is similar to that of Skelton's (2004) research. However, Kerber (2005) selected four targets rather than the one target chosen in the Skelton (2004) study. Targets chosen were based on manner, voicing, and placement differences. Baselines included word and conversation tasks, as well as nine generalization probe phonemes. No improvement was made during baseline measures, indicating validity of this research design.

After baserating, establishment training began with all four participants. Stimulus items consisted of picture cards with the target phonemes in the initial, medial, and final positions of words. Ten stimulus items were chosen for each

phoneme, and each participant was taught the target sound using one word from the selected stimulus items. Progressive part practice was used to establish the sound. When the participant was able to produce the words at 80% accuracy, Concurrent Treatment began (Kerber, 2005).

Kerber (2005) conducted 40-minute treatment sessions twice weekly. The 28 randomized tasks were generated by computer and followed during the treatment session. Tasks included imitated and evoked trials at the word, 2- to 4-word phrase level, and single sentence levels, as well as an evoked conversation for each of the four target phonemes. Generalization probes across phonemes were taken every 5 to 6 sessions to determine if the treatment effects were noticeable in other phonemes not taught during the study. Within-clinic conversational probes were also taken every 5 to 6 sessions throughout the study.

Kerber (2005) reported the results of within-clinic conversational probes which revealed generalization of untaught phonemes for three of the participants that completed the study at an average of 96% correct productions. Specifically, participant 2 began with 0% baseline on three target phonemes and 10% baseline on the fourth target phoneme. By the fourth teaching session, the participant had an average of 92.75% correct production of the target phonemes. Presumed difficulty of the task did not hinder the acquisition of the correct production of the target phonemes. Furthermore, choosing four phonemes as treatment targets for each participant also did not hinder the acquisition of correct productions. All four participants made progress within the first treatment session. Kerber (2005) found that with Concurrent Treatment target sounds were learned with greater speed, compared to other phonological treatments; the extent to which the sounds were generalized make this treatment effective and efficient.

Kerber (2005) suggested further research with Concurrent Treatment by replicating this study, as well as determining generalization of untaught and taught phonemes outside of the clinic setting. Resciniti (2007) replicated Kerber's (2005) Concurrent Treatment research to further investigate its effectiveness in teaching multiple speech sounds. Resciniti (2007) included detailed probes to assess across phoneme generalization, as well as probes to measure generalization across settings. A multiple-baseline-across-subjects design was used with 3 participants, ages 4 years 2 months to 5 years 10 months. All participants had phonologic disorders, characterized by reduced intelligibility and multiple speech sound errors.

Resciniti (2007) determined that all participants exhibited the phonological process of stopping of fricatives; therefore, the same four target sounds from the fricative sound class were chosen as treatment targets. However, participant 1 was not able to produce the phoneme /z/ in isolation after 11 sessions; therefore, this phoneme was discontinued as a treatment target. Resciniti (2007) followed the same treatment procedures as Kerber (2005) in terms of baselines, teaching trials for correct phoneme establishment, as well concurrent task sequence trials.

Resciniti (2007) probed for generalization across phonemes upon initiating treatment and after every fifth presentation of the randomized tasks. Forty-eight responses were elicited for each probe; 24 stimulus cards were presented in each word and conversation task. Three words were used for each target phoneme as well as three words for each cognate pair. Resciniti (2007) also probed for generalization across settings.

This study found consistent increases in correct productions of the target phonemes for all participants. Participant 1 reached 50% accuracy with taught phonemes in words by the final probe and reached 67% accuracy of taught

phonemes in conversation. Probes of untaught phonemes (in the same fricative sound class) in words were recorded at 33% correct production and at 25% correct production at the conversation level. The final probe of taught phonemes revealed that participant 2 reached 66% correct production of words and 66% correct production at the conversation level; untaught phonemes at the word and conversation level were at 50% correct production. Baselines taken for Participant 1 and Participant 2 revealed 0% correct production of the target phonemes in conversation across settings, and a final probe of 80% accuracy of the target phonemes in conversation across settings (Resciniti, 2007). Participant 3 had a correct production rate of 33% for both taught and untaught phonemes at the word level. Participant 3 did not complete the study, thus making it a possibility that slight generalization across taught and untaught phonemes was a result of the reduced number of treatment sessions (Resciniti, 2007).

Behaviors used in the clinic setting have to be used outside of the clinic setting to become generalized. According to Hegde (1998), the behaviors established in the clinic setting used across settings will improve social communication. Hegde (1998) stated that a treatment method selected should be effective and have an outcome that is functional for the client. Hegde (1998) furthers explains functionality from a communicative disorders viewpoint as an improvement in communication in meaningful and natural social contexts. Resciniti (2007) conducted probes to assess generalization across settings. Although generalization probes were not conclusive for the third participant, Resciniti (2007) measured generalizations across settings, which was unique to this research study. Resciniti (2007) revealed rapid increases in targeted speech sounds that were in error and generalization across settings. Replication of the

Resciniti (2007) research would provide additional evidence of the efficacy of this method of treatment.

Exemplars and Generalization

Regardless of the treatment method selected, consideration should be given to the number of exemplars selected during treatment for generalization to occur. Elbert et al. (1991) presented a descriptive study to investigate the number of exemplars needed to meet a generalization criterion. The investigators chose the minimal pairs treatment method for their study, with the intention of providing a structured treatment program that could be replicated by investigators in the future.

Participants in this descriptive study included 19 English-only speaking children ranging in ages of 3 years, 5 months to 6 years, 7 months. All participants scored below the average range in speech sound production skills, as measured by the Goldman-Fristoe Test of Articulation and in the average range for receptive vocabulary, as measured by the Peabody Picture Vocabulary Test-Revised. The 19 participants selected also obtained a mean baseline accuracy of less than 5% across three baseline measures. A single word speech sample, which included spontaneous and elicited responses, was also analyzed for phonological processes for each participant. Based on these analyses, three phonemes in the initial word position were selected for treatment for each participant, for a total of 29 treatment targets. A probe word list was also generated, consisting of 20-25 words that assessed the targeted phoneme in the initial word position (Elbert et al., 1991).

Participants were treated twice weekly for approximately 30 minutes using three minimal pair contrast exemplars. As discussed previously, minimal pairs

treatment consists of contrasting the child's incorrect production with the target sound. When the participant reached 90% accuracy and produced both words of the minimal pairs set correctly, a generalization probe was administered. Two additional exemplars (for a total of 5 exemplars) were added during treatment if the generalization criterion was not met. A generalization probe was again administered after the participant again reached 90% accuracy. Participants who did not reach the generalization criterion were taught an additional 5 exemplars, for a total of 10 exemplars. A generalization probe was administered after every third treatment session for those that did not meet the criterion using the 10 minimal pair exemplars; additional exemplars were not added (Elbert et al., 1991).

Generalization criterion was considered met when the participants were able to correctly produce 50% of the probe items. Twenty seven of the 29 test cases met generalization criterion. In 17 of the 29 cases, the use of three exemplars was adequate for the participants to achieve generalization of the taught phoneme to untaught words. In 6 of the 29 cases, five exemplars were used before generalization criterion was met. Ten exemplars were used in 4 of the 29 cases in order for the participants to meet the generalization criterion. Although there were differences in the number of trials needed to meet the generalization criterion for each participant, this study revealed that generalization occurred using a small number of exemplars (Elbert et al., 1991).

According to Elbert et al. (1991), clinical implications can be derived from the results of this study. The minimal number of exemplars needed to meet generalization criterion brought focus to the motoric and integration aspects of sound production. The motoric aspect to learning articulatory placement, as well as the participant being able to associate the resemblance of the sound taught to an untaught word containing the same sound may both play a factor in generalization.

Treatment programs for phonologically disordered children may take these aspects into consideration, as well as the speculation highlighted by this study that a small number of exemplars assists in the acquisition of automatic, motoric articulatory placement.

Purpose of the Experiment

This study will be evaluating the effects of Concurrent Treatment to teach two phonemes of maximal contrast within a sound class that were produced in error by the participants. Three to four exemplars will be used for each taught phoneme, representing initial, medial, and final positions of words. Generalization probes will also be a focus of this research, as these results are an important factor in the selection of treatment procedures. Although generalization across settings was addressed in the Resciniti (2007) study, probes will be taken frequently in this study to determine treatment effects.

Concurrent Treatment will be used to treat a phonological process, and appropriate phonemes within a sound class will be selected as treatment targets. This research varies from the Resciniti (2007) study in that two phonemes will be selected within a class that have maximal contrast, as opposed to the four phonemes selected in the Resciniti (2007) study. Across phoneme probes will also be administered to determine if the selection two phonemes with maximal differences within a class promotes generalization to correct production of other phonemes within a class.

The use of the Concurrent Treatment method to treat phonologic disorders in children is hypothesized to reveal positive results similar to those garnered by previous studies. It is hypothesized that positive generalization results will occur across taught and untaught phonemes and settings. It is assumed that Concurrent

Treatment will again be proven to be an effective and efficient treatment method to teach targeted phonemes. It is expected that across phoneme and settings probes will reveal the generalization of treatment effects and support the use of Concurrent Treatment as an efficacious way to teach clients with a phonological disorder. In addition, it is expected that the selection of two maximally different phonemes within a class of sounds will lead to generalization of other sounds within that class. In the following chapter, the methods used to conduct this research will be discussed.

CHAPTER 2: METHODS

Research Design

This study used a multiple-baselines-across subjects research design. In this research design, two fricative phonemes were chosen as treatment targets for the three participants. The target behavior was baserated across all participants for three consecutive sessions. After these three consecutive sessions, the establishment phase of treatment began for Participant 1 and Participants 2 and 3 were baserated a fourth time. Participant 2 then began the establishment phase of treatment and Participant 3 was baserated for a fifth time. This research design showed if the target behavior only increased when treated (Hegde, 1998).

This research design handles threats to internal validity by obtaining multiple baselines across participants. Consistent baselines across all participants shows if a cause-effect relationship exists between the dependent and independent variable. The change in the dependent variable can be attributed to the implementation of the independent variable. This research design revealed that all participants had a change in the dependent variable when the independent variable was applied (Hegde, 2003).

Participant Selection

This study included three participants between the ages of 4 and 6 years. The participants were monolingual English children and did not have any other diagnoses that were known to cause a speech sound disorder. All three participants had phonologic disorders, characterized by sound errors that affected speech intelligibility. When the *Goldman Fristoe Test of Articulation, Second Edition* (GFTA-2) was administered, it was revealed that the participants committed speech errors that were determined to be developmentally inappropriate. Participants also

needed an average or above average score on the core language subtests of the *Clinical Evaluation of Language Fundamentals-Preschool, Second Edition* (CELF-P; Wiig, Secord, & Semel, 2004). This included the Sentence Structure, Word Structure, and Expressive Vocabulary subtests. Results are displayed in Table 1. Tables 2-4 provide information about sound errors and phonological patterns of each participant.

Table 1

Participant Information and Standardized Assessment Data

Qualifying Information	Participant 1	Participant 2	Participant 3
Age	4 years, 7 months	4 years, 5 months	4 years
Gender	male	male	female
GFTA-2	92	68	67
CELF-P	106	112	118

Table 2

Participant Sound Errors and Phonological Patterns, Participant 1

Cluster Reduction		Final Consonant Deletion	Devoicing	/s/ Preference for Fricatives and Affricates
f/fr	k/kl	p, d, r, v	f/v	s/ʃ
g/gr	k/kr		θ/ð	s/tʃ
b/br	t/tr		s/z	
d/dr				

Table 3

Participant Sound Errors and Phonological Patterns, Participant 2

Cluster Reduction		Final Consonant Deletion	Initial Consonant Deletion	Stopping	/s/ Preference for Fricatives and Affricates
b/bl	p/pl	f, t, z	f, t, ʃ, tʃ, s	d/θ	s/ʃ
b/br	p/sp			d/dʒ	s/tʃ
g/gl	s/st			b/v	
k/kl	k/kr				
-/fl,	-/kw				
-/sl	-/sw				
-/tr	-/fr				

Table 4

Participant Sound Errors and Phonological Patterns, Participant 3

Cluster Reduction		Final Consonant Deletion	Devoicing	Stopping	/s/ Preference for Fricatives and Affricates
b/bl	k/kw	t, l, r	t/d	d/dʒ	s/v
b/br	p/pl		s/z	p/z	s/θ
g/gl	s/sl				s/tʃ
g/gr	s/st				s/ʃ
k/kl	s/sw				s/f
k/kr	t/tr				

In addition, each participant was required to pass a bilateral hearing screening, administered at 25dB for 500, 1000, 2000, 4000Hz. This hearing screening was conducted with a portable calibrated audiometer from the California State University, Fresno, Speech-Language and Hearing Clinic. All participants passed the hearing screening. Also, each participant received an orofacial examination. The results of the orofacial examinations showed that the structure and function of the oral mechanism of each participant were within normal limits.

The parents of the participants selected for this study signed a consent form to authorize their child to participate in treatment sessions. This form is located in Appendix A. Parents committed to bring their child to two, 40-minute weekly sessions and were informed that it was anticipated that the study would have a maximum of 33 therapy sessions. Additionally, parents were informed that they would be asked to audio-record several conversations with their child at home to further assess the use of the sounds across settings.

Dependent and Independent Variables

In this experiment, the dependent variables were the correct productions of the two phonemes chosen for treatment. A correct or incorrect production of the targeted phonemes was determined by the investigator's discernment of production accuracy. The independent variable was the procedures of concurrent treatment, as discussed below.

Setting and Materials

This study took place at California State University, Fresno in the Professional Human Services building. Sessions took place in a room typically used as an office space. The office space was a 2.4 meter (m) by 4.9 m room. The investigator was seated across from the participant at a .48 m by .74 m table

during the sessions. During seven of the sessions for each participant, a student from the Communicative Disorders and Deaf Studies program sat next to the examiner to ensure internal validity of the results. The door was kept ajar to allow parent observation of the sessions. One or both parents were seated in the hallway outside of the door at each session.

The investigator used picture cards paired with a verbal question or comment as stimulus items. A .05 m by .05 m color picture was placed on a .08 m by .13 m laminated card. There were 10 stimulus cards for each taught phoneme, for a total of 20 cards. There were 24 stimulus cards in total for generalization probes. Six cards represented untaught words for the taught phonemes, and the remaining 18 cards represented untaught words for the untaught phonemes (3 stimulus cards for each). The treatment and generalization words are contained in Appendix B.

A conditioned generalized reinforcer (tokens) was used throughout baseline and treatment sessions. During the baseline phase a token was given for on-task behavior. During treatment, a token was given contingent on a correct response. Tokens earned were placed in a clear, cylinder token tower. When the participant obtained approximately 20 tokens, a highly motivating activity was allowed for approximately 3 minutes. Examples of activities were iPad games, playing with toy trains, puzzles, modeling clay, action figures, and board games with the examiner.

A variable interval schedule of reinforcement was also used during all baseline and treatment sessions. The participant selected a prize (e.g., stickers, art supplies, small snack, toy cars) before the session began. The chosen prize was placed within view of the participant throughout the session. The variable interval schedule of reinforcement was set at two minutes using the R+Remind Version 1.0

APP on an Apple iPhone 4. The APP emitted a reminder tone on an average of every two minutes. According to Hegde (1998), this variable interval schedule of reinforcement "generates a consistently high response rate with no pause after reinforcement" (p. 110). If the participant displayed on task behavior during this signal, a stamp was placed on a paper containing 21 circles. If the participant earned all of the stamps, the participant was allowed to collect the prize at the end of the treatment session.

A Sony digital recorder was given to the participants' parent(s) to record conversations at home. These recordings of conversations across settings provided the speech sample data that were analyzed by the investigator to determine generalization across settings.

Procedures

Selection of Target Behaviors

The target behaviors selected were chosen based on the participants' GFTA-2 results. Sound errors were then analyzed and categorized into phonological processes. All participants had errors in the fricative sound class as a result of cluster reduction, initial consonant deletion, final consonant deletion, devoicing, and/or errors that resulted from a sound substitution. Therefore, the phonemes /ʃ/ and /v/ from the fricative sound class were chosen as target behaviors. The remaining fricatives (/θ, ð, f, s, z, ʒ/) were probed for generalization across the fricative sound class.

Concurrent Treatment Practice Tasks

Concurrent Treatment practice tasks consisted of imitated and evoked syllables, single words, two-word phrases, three-word phrases, sentences, and storytelling. Resciniti (2007) defined the tasks as follows.

Imitative tasks. The investigator visually presented the stimulus card(s) to the participant, as well as orally provided the target syllable, phrase, sentence, or story. The participant was instructed to repeat, or imitate, the target production (p. 22).

Evoked tasks. The investigator visually presented the stimulus card(s) to the participant and orally provided a prompt or carrier phrase to elicit the appropriate production length (p. 24).

Syllable tasks (imitated). The investigator visually presented the stimulus card and orally provided the consonant-vowel or vowel-consonant syllable containing the target phoneme. For example, if the target word was *olive*, the participant was asked to repeat /ɪv/. This syllable task had to be imitated and was never evoked.

Word tasks (evoked and imitated). The stimulus card was visually presented to the participant. If the task was evoked, the investigator would ask, "What is this?" and the participant provided the target word. If the participant was unsure of the stimulus item (target word), the investigator provided a carrier phrase and the participant completed the sentence with the target word. For example, if the target word was "van," the investigator provided the carrier phrase, "My mom drives a blue _____" <van>. If the task was imitated, the investigator provided the target word and instructed the participant to repeat (p. 24).

Two and three word phrase tasks (evoked and imitated). An imitated phrase task began with the visual presentation of the target word. In an evoked task, the investigator elicited a response from the participant by providing a carrier phrase that would encourage the production of a phrase of appropriate length. An example of a two word phrase task for the target word "van" would be, "That's not a train, that's _____" <a van>. Additionally, an example of a three word phrase task for the target word "van" would be, "I drive to school _____" <in a van>. An imitated 2 and 3 word phrase task had the client imitate the phrase of appropriate length, provided by the investigator (p. 24).

Sentence tasks (evoked and imitated). The visual presentation of the target word was presented with the question, "Tell me about this picture" in an evoked sentence task. If the participant did not provide a sentence, the investigator provided a carrier phrase. For example, for the target word "van," the investigator would say, "I didn't ride a bike to school…" and the participant responded with, "I rode in a van." An imitated task had the participant repeat a sentence provided by the investigator (p. 24).

Storytelling tasks (evoked and imitated). Three stimulus cards were placed on the table in front of the participant. For an evoked storytelling task, the participant was asked to make up a story using the three stimulus cards. An imitated story telling task had the investigator make up the story and had the participant repeat the story that contained the target words (p. 25).

Baseline Measures

Baseline measures were taken in an increasing number of sessions before treatment began. The first participant had three baseline sessions, the second

participant had four baseline sessions, and the third participant had five baseline sessions. All participants were baserated using the 20 taught pictured stimuli at the word and storytelling levels. Baselines were also taken using the 24 untaught picture stimuli at the word and story telling levels.

Treatment Procedures

Establishment

Treatment trials began after the baseline phase was completed. The target phonemes were /ʃ/ and /v/ in initial, medial, and final word positions. Three stimulus cards per phoneme were used during establishment treatment trials.

The participant was shown the stimulus card with the picture of the target word. The investigator provided the model of the word and instructed the participant to repeat the word. If the imitation of the word was not correct, the target sound was practiced in isolation. When the participant was able to produce the target sound five times in isolation, the investigator provided a verbal model of the target sound and a vowel or a vowel and the target sound. For example, if the target word was "van," the participant was instructed to say "/væ/." If the target word was "wave," the participant was instructed to say "/ev/." The participant repeated the vowel/target sound combination five times. Teaching trials continued until the participant had 80% correct production of all treatment targets at the word level over three consecutive sessions.

The investigator modeled the tactile cue of placing the hand to the neck to signal "voice on" for the /v/ phoneme. The tactile cue for the /ʃ/ phoneme was the placement of the index finger to lips, signaling lips protracted and a sustained, central airstream. The participant was instructed to use the tactile cues during production if an incorrect production was made. The use of the tactile cue was

gradually faded out by the investigator and participant as correct productions increased.

Establishment treatment trials were administered specific to each participant. Participant 1 was able to correctly produce the target phonemes (/ʃ/ and /v/) in words in four treatment sessions; therefore, randomized treatment tasks began on the fifth session. Participant 2 met criterion of correct production of the target phonemes in six treatment sessions. Four treatment sessions were recorded above 80% accuracy; however, the first establishment session in which the participant met criterion required a tactile cue by the investigator and/or the participant for the majority of correct responses produced. In the three subsequent establishment treatment sessions, the investigator and participant were able to fade the tactile cues, and the participant maintained criterion.

The establishment treatment sessions began for Participant 3 after five baseline sessions. Participant 3 met criterion for one session after ten establishment treatment sessions. Due to time constraints, the investigator decided to accept one session as criterion to begin randomized treatment tasks, as opposed to the three sessions required of the other participants.

Random Variable Practice

An intermixed, randomized task sequence was presented to each participant using the Make Dice Version 2.4 Application (APP) on an iPad 3. The tasks were randomized using the Make Dice Version 2.4 APP on an iPad 3. Each side of the die represented a specific task. Two dice were used together to determine the sequence of the randomized tasks. One die, having 6 sides, had evoked or spontaneous on 3 sides and imitative or retelling on the other 3 sides. The other die had story, sentence, 3-word phrase, 2-word phrase, single word, and syllable.

The participant was instructed to "roll the dice" by pressing the appropriate icon. The teaching task was intermixed and randomized with each "roll" of the dice. An example of an intermixed, randomized treatment task sequence is: evoked word, imitated sentence, imitated storytelling, evoked syllable, imitated 2 word phrase. The investigator administered as many teaching tasks as the 40 minute session allowed.

The investigator used a 1:1 reinforcement schedule for correction production of the target sound. An incorrect production by the participant was followed by a four level correction procedure (Resciniti, 2007). Level 1: "I didn't hear [target phoneme]." Level 2: "Watch my mouth" (visual cue paired with sound). Level 3: "Say [syllable, word, phrase] or [sentence]." Level 4: "Say [syllable, word, phrase] or [sentence]," with a visual cue. Treatment was discontinued for that task if a correct response was not produced after this correction sequence. Treatment continued to the next randomized task. Token reinforcement was given for an initial correct production, not during the correction sequence.

Generalization Measures

During the random variable practice treatment phase, probes were taken as a measurement of generalization across taught and untaught phonemes at the word and storytelling levels. The teaching sounds were also included in this probe as a measurement of generalization of taught sounds to untaught tasks. Additionally, probes were taken across settings to measure generalization of taught and untaught phonemes outside of the treatment setting.

Generalization Probes Across Phonemes

Generalization probes across taught and untaught phonemes occurred every third treatment session. Three words for each phoneme were chosen as target words. These words contained phonemes in the fricative sound class, for a total of 24 stimulus cards. Probe words can be found in Appendix B.

Probes measured generalization of taught and untaught phonemes at the word and storytelling levels. Word task probes included presentation of the stimulus card, followed by the investigator asking, "What is this?" Storytelling probes were conducted by the investigator presenting three cards and instructing the participant to tell a "silly story." Noncontingent reinforcement was given during probes; verbal praise was given for on task behavior. Correct productions at the word and storytelling levels were recorded as "+" and incorrect productions were recorded as "-" on the scoring sheet.

Probes Across Settings

Probes of generalization across settings occurred every fourth treatment session. A Sony digital recorder, model ICD-PX820, was sent home with each participant's parent. Parents were instructed to record conversations with the participant as they read a book and also as they engaged in an activity together. The recorder was returned to the investigator and analyzed.

Conversations were analyzed for correct production of phonemes in the fricative sound class. The investigator determined the total number of opportunities that the participant had to produce a fricative phoneme at the conversation level by listening to the recorded conversation. The number of correct productions out of the number of opportunities to produce a fricative phoneme was calculated to reveal a correct production percentage.

Data Collection

The investigator used a data collection sheet to record correct and incorrect productions. A correct production was recorded as "+" and an incorrect production was recorded as "-." A number of sessions were recorded with a digital recorder and examined by the investigator. This recorder was also given to parents to use at home to record conversations with the participant.

Reliability

Interjudge reliability was determined with the assistance of three students enrolled in the Communicative Disorders and Deaf Studies program at California State University, Fresno. Each student was trained in the scoring of correct and incorrect productions and was present in the room with the investigator and participant for 25% of the sessions, for a total of 7 sessions. The investigator and graduate students' scores were analyzed for agreement through unit-by-unit reliability standards. Each unit consisted of five trials recorded by the investigator compared with five trials recorded by the student to determine percent agreement. The agreement range was 79% to 100%, with a mean of 87%.

CHAPTER 3: RESULTS

Baseline Results by Participant

Baseline measures were taken for each participant before treatment began. Participant 1 was baserated over three treatment sessions, Participant 2 over four sessions, and Participant 3 over five sessions. Table 5-7 include the baseline results for each participant.

Table 5

Baseline Results, Participant 1

Levels	Baseline 1	Baseline 2	Baseline 3
Taught Word Level	30%	20%	25%
Taught Story Telling	20%	20%	30%
Untaught Word Level	46%	46%	50%
Untaught Story Telling	33%	38%	67%

Table 6

Baseline Results, Participant 2

Levels	Baseline 1	Baseline 2	Baseline 3	Baseline 4
Taught Word Level	5%	15%	10%	10%
Taught Story Telling	0%	5%	0%	5%
Untaught Word Level	0%	0%	4%	4%
Untaught Story Telling	0%	4%	0%	0%

Table 7

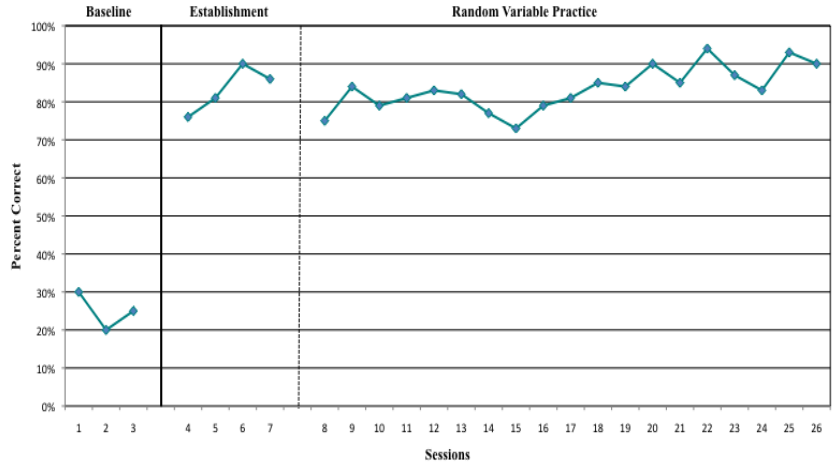
Baseline Results, Participant 3

Levels	Baseline 1	Baseline 2	Baseline 3	Baseline 4	Baseline 5
Taught Word Level	0%	5%	0%	5%	10%
Taught Story Telling	0%	0%	5%	0%	0%
Untaught Word Level	21%	17%	21%	8%	4%
Untaught Story Telling	17%	13%	13%	8%	8%

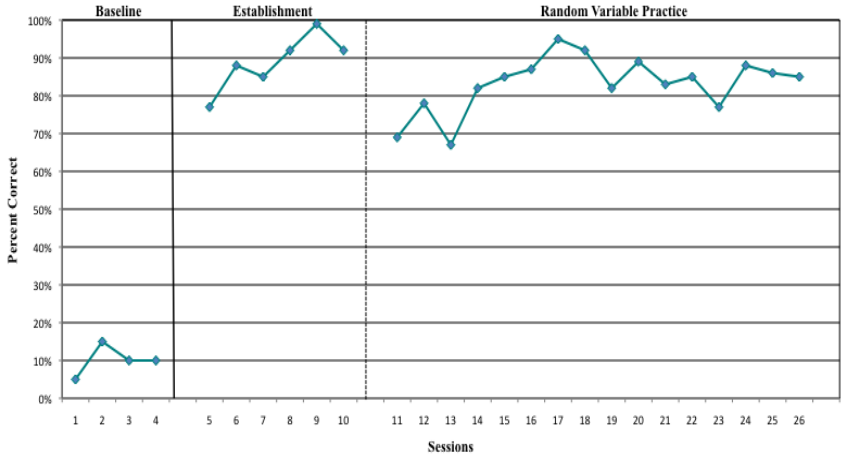
Concurrent Treatment Results by Participant

The total percent correct for the two phonemes taught to each participant, at all task levels, are shown in the results in Figure 1. After obtaining baselines for each participant, establishment teaching trials began. The correct production of the target phonemes was taught during establishment treatment trials. Three exemplars were used for each of the two target phonemes, for a total of six exemplars. Each exemplar represented the phoneme in the initial, medial, and final word position. Establishment treatment trial words were selected from the taught words that would be used during randomized treatment sessions. Words used for /v/ during the establishment treatment sessions were: van, seven, and wave. Words used for /ʃ/ during the establishment treatment sessions were: ship, washer, and fish. Once the participants correctly produced these words with 80% accuracy over three treatment sessions, randomized variable treatment began.

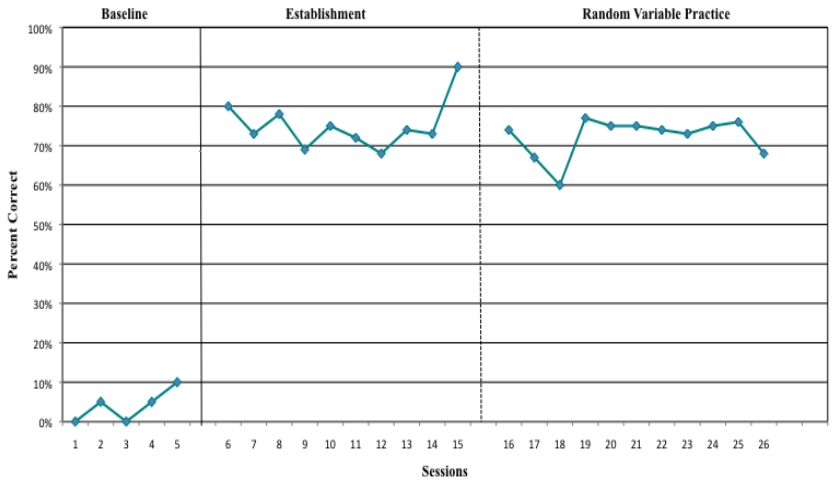
All participants completed 26 treatment sessions. Participant 1 established the two target sounds in four sessions. Participant 2 established the two target sounds in six sessions. Participant 3 met establishment criterion for one treatment session after 10 sessions. This participant had difficulty with voicing the /v/



Participant 1



Participant 2



Participant 3

Figure 1. Total percent correct across two taught phonemes per participant

phoneme in the middle and final positions. Due to time constraints, the investigator accepted one establishment session as meeting criterion and random variable practice began at session 16.

There was an increase in correct production accuracy for Participants 1 and 2 after the initial random variable practice treatment. Participant 3 had a decrease in the initial three random variable practice sessions. This decrease in accurate productions was followed by an increase at the fourth treatment session. This trend of production accuracy continued for the remainder of treatment session until the final session. Participant 3 attended the final session on a day and time that was out of routine of all previous sessions, possibly contributing to the lower percentage of accurate productions.

Generalization Probes

Generalization Across Phonemes for Words and Story Telling

Results for generalization probes across phonemes for words and story telling tasks are shown in Figure 2. Generalization probes at the word and storytelling levels were administered every three treatment sessions. The investigator randomly presented 24 stimulus cards, which included three exemplars for each fricative phoneme. The three exemplars for each phoneme represented a fricative in the initial, medial, and final word positions. The stimuli presented for probes were also presented for baseline measures.

The investigator presented the stimulus card and asked, “What is this?” to elicit a one word response from the participant. Three stimulus cards were placed on the table in front of the participant to elicit a storytelling response. The investigator instructed the participant to tell a “silly story” using the three words presented. Forty-eight probe tasks were administered at each probe session.

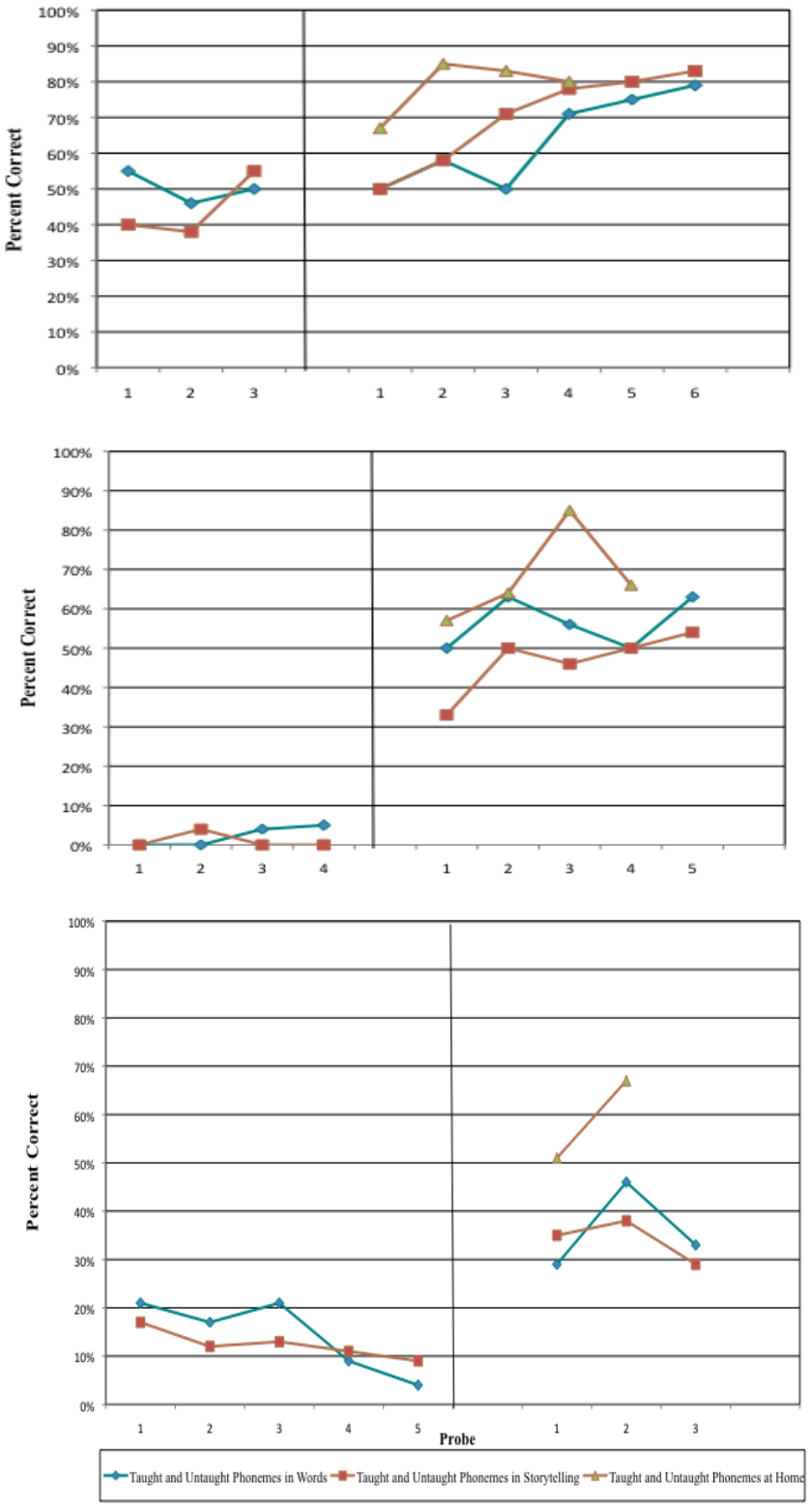


Figure 2. Generalization probes for words and storytelling tasks across phonemes and generalization probes across settings

Participant 1 scored 55%, 46%, and 50% accurate productions during baseline measures for untaught words. The final probe revealed 79% correct productions. This probe revealed moderate generalization to fricative sounds, as well as untaught words containing the two fricative phonemes taught during the treatment sessions. Storytelling baseline accuracy was measured at 40%, 38%, and 55%. The final probe revealed 83% accurate productions for untaught words, including taught and untaught fricative phonemes, at the story- telling level, revealing substantial generalization results.

Participant 2 demonstrated the greatest amount of generalization for all tasks. Baseline measures were recorded at 0%, 0%, 4%, and 5% accurate productions for untaught words. The final probe revealed 63% correct productions of untaught words, which contained taught and untaught fricative phonemes. Generalization to storytelling tasks was also observed. Baseline measures were recorded at 0%, 4%, 0%, 0% accurate productions. The final probe revealed 54% accurate productions for untaught words at the story telling level.

In addition, Participant 2 also showed within-clinic generalization observed during treatment session 15. Participant 2 correctly produced five words containing fricative phonemes, two of which were treatment exemplars, during spontaneous speech with the investigator. During session 18, the participant correctly produced 15 words containing fricative phonemes during spontaneous speech with the investigator, none of which were exemplars. Within-clinic generalization of taught and untaught fricative phonemes was not observed with Participants 1 and 2 during spontaneous speech with the investigator.

Generalization results for Participant 3 revealed moderate generalization. The investigator analyzed only three generalization probes. As mentioned previously, Participant 3 did not begin random variable practice until session 16.

Generalization probes were taken after 3 treatment probes, which only allowed for 3 probes from session 16 to session 26. Baseline measures were recorded at 21%, 17%, 21%, 9%, and 4% accurate productions for untaught words. Slight generalization was revealed by the last probe, which was recorded at 33% accurate productions. Slight generalization to story telling tasks was also observed. Baseline measures were recorded at 17%, 12%, 13%, 11%, and 9% accurate productions. The final probe revealed 29% production accuracy.

Generalization Across Settings

Results for generalization probes across settings for taught and untaught fricative phonemes in conversation tasks are also shown in Figure 2. Generalization probes across settings were administered every fourth treatment session. These percentages were determined by calculating the number of correct production of fricative phonemes over the total number of opportunities to produce a fricative phoneme (/ʃ, v, θ, ð, f, s, z, ʒ/).

The generalization probe across settings was gathered by the investigator as a result of parents recording conversations at home. The investigator analyzed these recordings to determine if the taught and untaught fricative phonemes were generalizing to the home setting. These samples were collected after every 4 randomized practice treatment sessions; therefore, Participants 1 and 2 had 4 probes administered and Participant 3 had 2 probes administered. Conversation across settings baseline data were not gathered; baseline results recorded during story telling tasks show the percentage of production accuracy in connected speech before treatment began. An assumption can be made that baseline measures would reveal similar results; however, this cannot be certain.

Baseline measures for Participant 1 for storytelling tasks containing taught and untaught fricatives showed 40%, 38%, and 55% accurate productions. Probe

data showed an increase in correct production of taught and untaught phonemes across settings at the conversation level, with the highest percentage correct recorded at 83%. Participant 2's baselines were recorded at 0%, 4%, 0%, and 0% for storytelling tasks using words containing taught and untaught fricatives. An increase of correct production was recorded at the conversation level; Participant 2 reached 85% accuracy in the third across settings conversation probe. Participant 3's baseline scores for storytelling tasks were 17%, 12%, 13%, 11%, and 9%. Two across settings conversation probe showed an increase in production accuracy, with the highest percentage correct recorded at 67%.

Effect Size

Gierut and Morrisette (2011) described effect size (ES) as a way to compare the degree of treatment effects, which is not typically applied in phonology studies. Determining ES makes it possible to "to directly compare the magnitude of treatment effects within or across children, experimental conditions or studies" (p. 975). A benefit of calculating ES is the potential ability to compare ES within meta-analyses. Although ES may not completely determine the value of the treatment for individual children, ES would document a standard to compare phonology treatments.

Table 4 shows ES measures for each participant for treatment and probe data. As recommended by Gierut and Morrisette (2011), ES was determined by finding the difference between mean of treatment or generalization data and the mean of the baseline data for each participant, divided by the standard deviation of pooled baseline data across all participants.

Table 8

Effect Size: Standard Mean Difference (SMD) for Treatment and Probes

		Probes	
Participant #	Treatment	Word	Storytelling
Participant 1	5.95	.87	1.63
Participant 2	7.87	2.87	3.34
Participant 3	7.14	1.14	3.75

CHAPTER 4: DISCUSSION OF RESULTS

Results of this study revealed the effectiveness and efficiency of treating children with phonologic disorders with the Concurrent Treatment method. Teaching two maximally different phonemes within a class showed slight to moderate generalization to other sounds within the fricative class. A small number of exemplars were used, suggesting a positive effect on generalization to untaught words containing taught and untaught fricative phonemes. An increase of accurate productions was also shown in data gathered from probes across settings.

Comparison to Previous Concurrent Treatment Research

Previous studies have also revealed positive results when treating sound errors with this treatment method (Kerber, 2005; Resciniti, 2007; Skelton, 2004; Skelton & Funk, 2004). There was documentation of rapid acquisition of taught phonemes with this treatment method. Resciniti (2007) and Kerber (2005) both conducted generalization probes for word and storytelling tasks for taught and untaught phonemes. Resciniti (2007) showed moderate generalization across probe tasks; Kerber (2005) showed a final probe of 100% accuracy in word and conversation tasks for three participants, with the exception of one phoneme. The probe data of the current study revealed slight to moderate generalization results across taught and untaught phonemes for word and storytelling tasks.

Comparison with Other Phonologic Treatments

The results of this study show Concurrent Treatment is an effective and efficient method of treatment for phonologic disorders. Previous studies investigating treatment for phonologic disorders such as cycles (Hodson & Paden, 1991), minimal pairs (Saben & Ingham, 1991; Weiner, 1981; Williams, 2000b),

maximal oppositions (Gierut 1989, 1990), multiple oppositions (Williams, 2000b), and naturalistic conversation training (Camarata, 1993; Williams, 2000b) have all shown positive results in treating phonologic disorders. However, Concurrent Treatment has been found to be an effective treatment; target sounds were learned at a high accuracy rate, generalization to other phonemes within the sound class occurred, and generalization of treatment effects across settings was observed within a relatively short amount of time (26 treatment sessions over 4 months).

Other treatment methods required longer periods of time for the participants to acquire the target phonemes selected for treatment. Hodson and Paden (1991) anecdotally noted that two to three cycles of treatment were required for children with phonological disorders to become intelligible when administering the cycles treatment procedures. Each cycle consisted of 2 to 6 hours for each targeted process and 60 minutes for each targeted phoneme. Generalization across phonemes and settings was not assessed. Saben and Ingham (1991) showed that minimal pairs treatment therapy treatment targets were met to criterion after a significant number of treatment trials (70-220); however, generalization to untreated phonemes or words was not observed. Generalization across settings was not addressed. Gierut (1989) reported after 23 treatment sessions administering the maximal oppositions treatment method, changes and improvements were observed in the participant's phonological system. Generalization across phonemes probes showed overgeneralization of particular phonemes; generalization across settings was also not addressed in this research.

Generalization Across Settings

Generalization across-settings probes were administered throughout this study. Research conducted investigating treatment for phonology disorders usually does not include generalization across settings findings. Hegde (1998)

stated that a treatment method selected should be effective and have an outcome that improves communication in meaningful and natural social contexts. Research data collected should include generalization probes, as these results help to determine if a treatment method selected has proven to increase communication outside of the clinic setting.

Resciniti's (2007) research included generalization across-settings data. The results showed slight to moderate generalization of the target sounds across settings. Skelton (2004) administered probes across-settings during the treatment phase, which showed some generalization results. In this study, Participants 1 and 2 reached an accuracy level of at least 80% or above on at least one across-settings probe. Participant 3 never reached 80% correct productions on probes during the treatment phase.

Treatment Components for Phonologic Disorders

Motor Component

A motor-based component was included in the establishment treatment sessions before randomized variable treatment began. The two target sounds were established motorically in isolation and word level before treatment at the variable levels began. The participants were able to produce the phoneme within a word before treatment began. Weiner (1981) revealed a motor-based branch step was added to the linguistically based minimal pairs treatment method. Results of this study revealed that participants were able to meet the criterion with this motor-based branch step added, as well as demonstrate generalization across phonemes. Saben and Ingham (1991) removed the motor-based component from their study using the minimal pairs treatment method. Generalization across phonemes

findings was not found, possibly because the motor-based component is crucial in the treatment of phonological disorders.

Target Selection

Target selection has traditionally been based on stimulability and developmental norms. In this study, the selection of treatment target sounds was not based on this traditional criterion. The selection and treatment of target sounds within a class, with maximal distinction in manner, voice, and placement may have expanded the participants' repertoire of sounds and assisted with phonological reorganization with minimal amount of intervention (Williams, 2000b), thus showing generalization across the fricative sound class.

Presentation of Tasks

The Concurrent Treatment method included an intermixed random order of tasks, which was an alternate way of sequencing teaching exemplars. Randomizing the order of treatment tasks within each treatment session allowed presentation of every level (e.g., isolation, syllable, word, phrase, sentence, or conversation) without predetermined sequence (e.g., easy exemplars followed by difficult exemplars). Through this study, Concurrent Treatment has once again been found to be effective and efficient for treatment of multiple speech sound errors, similar to the results of previous studies (Kerber 2005; Resciniti, 2007; Skelton, 2004; Skelton & Funk, 2004). This study also supports the idea expressed in Williams (2000b): intervention at the word level may be sufficient for some children; however, some children with phonological disorders require treatment at the conversational level in order to see treatment effects at the conversational level.

The Concurrent Treatment method allowed the participants to practice the target behaviors at a variety of levels. Cycles approach and contrastive approaches (minimal pairs, maximal oppositions, and multiple oppositions) limits children to single word tasks during therapy sessions. Criterion of mastery at each level of task difficulty is not mandatory when using the Concurrent Treatment method; syllable, word, phrase, and storytelling tasks are practiced during each session. Though the ultimate goal is for the child to produce the target sound in conversational speech, the aforementioned approaches do not treat the target sound at the phrase, sentence, or conversational speech levels.

Number of Exemplars Used

As mentioned in the Elbert et al. (1991) study, a small number of exemplars may have assisted in the learning of automatic, motoric articulatory placement of the target phonemes that were produced in error. A small number (three) of exemplars were used for each of the two target phonemes during the establishment phase of treatment. Seven additional exemplars were added during randomized variable treatment; however these exemplars were not added until 80% criterion was reached over three sessions, with the exception of Participant 3, due to time constraints. Generalization to untaught words containing taught and untaught fricative phonemes may be a result of the selection of a small number of exemplars.

Limitations and Recommendations

Three participants were used in this study. Although positive results were garnered from using the Concurrent Treatment method, generalization to a larger population is not possible. Replication of this study is necessary to determine if the same results can be achieved across participants, settings, and investigators.

Location of this experiment was not ideal for a scientific experiment. Treatment sessions took place in a room designed as an office space in the CSU Fresno Professional Human Services Building. Ideally, the sessions would have taken place in the Speech-Language and Hearing Clinic. A clinic room with an observation window would allow parents as well as students assisting with interjudge reliability to remain outside of the treatment room and observe the session. This setting was not available during this experiment, so the alternate office space was used. Parents were outside of the ajar door, and although the participants were placed with their back to the door, one participant frequently checked for parent location by turning and looking through the space provided by slightly opened door. An additional external variable that could not be controlled due to the location of the office space was the noise generated by the university students entering and exiting classrooms in the common hallway. In addition, the student assisting with interjudge reliability was required to sit next to the investigator during the seven sessions, possibly distracting the participants.

Treatment effects of previous speech therapy cannot be ruled out as impacting the results of this study. All 3 participants were receiving speech therapy at a school site or the university clinic. The investigator contacted the Speech-Language Pathologists or clinician involved in treatment of the participants. All clinicians verbally agreed through phone conversations not to treat the participants for any fricative sounds produced in error during the length of this experiment. It was also determined by the investigator that participants were not treated with a method similar to the Concurrent Treatment method.

A limitation to this study is the amount of time Participant 3 was treated for speech sound errors with random variable practice. The number of sessions required for the participant to reach criterion greatly reduced the number of

treatment sessions in which random variable practice was implemented. Data collected from probes conducted to measure generalization across words, storytelling, and settings were also reduced as these probes did not begin until session 18.

A generalization probe across settings collected after the termination of treatment would also strengthen the generalization results. A probe across settings after an extended time period in the absence of treatment would show if treatment effects are being maintained.

Implications for Further Research

The results of this study and previous studies using Concurrent Treatment (Kerber, 2005; Resciniti, 2007; Skelton, 2004; Skelton & Funk, 2004) revealed positive outcomes; replication would further support the use of this treatment method. Across investigator effectiveness would further support the use of this treatment method to treat children with phonological disorders. In addition, a group research design would assist with the comparison of Concurrent Treatment and other phonological treatment methods.

Summary

This research was conducted to further show the efficiency and efficacy of the concurrent treatment method to treat children with phonological disorders. The selection of two maximally different phonemes within a class of sounds may have contributed to generalization of other phonemes within the sound class. The target phonemes were established to criterion using a small number of exemplars, as well as incorporating a motor-based component at the word level, before random variable treatment began. The results revealed an increase in the correct production of the target sounds, as well as generalization results across taught and

untaught phonemes. Positive generalization across settings results were also documented during treatment. Replication of this research would further strengthen the use of the concurrent treatment method to treat children with phonological disorders.

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APPENDICES

APPENDIX A: CONSENT FORM

CALIFORNIA STATE UNIVERSITY, FRESNO
Department of Communicative Disorders and Deaf Studies

Parental Consent for Child's Participation in Research Study

Principal Investigator: Steven L. Skelton, Ph.D., CCC-SLP
California State University, Fresno; sskelton@csufresno.edu
Student Researcher: Allison Cole, B.A.
California State University, Fresno; allicole@mail.fresnostate.edu

Your consent is requested to allow your child, _____, to be a participant in a research study. The purpose of this study is to investigate the use of concurrent treatment to teach speech sounds to children with phonological disorder. Children who exhibit phonological disorder have multiple age-inappropriate sound errors with reduced speech intelligibility.

Traditionally, speech sounds are taught using an easy-to-hard sequence or during conversational speech. Concurrent treatment presents therapy tasks in a randomized order. As a result, your child will practice the targeted sounds in multiple response lengths during each treatment session. These response lengths include single words, phrases, sentences, and story-telling tasks.

The study begins with a standard speech and language assessment conducted with your child. This will determine if your child meets the requirements to participate in this study. Only children who meet the entrance requirements will actually receive speech therapy through this study. Thus, your consent does not guarantee your child's participation in the remainder of this study. Furthermore, participants may be withdrawn from the study due to lack of cooperation during treatment sessions. However, noneligibility for this study does not affect or determine your child's eligibility for any public school special education program (such as speech-language therapy). The study will consist of a series of speech-language therapy sessions, conducted by Allison Cole, a graduate student in the Department of Communicative Disorders and Deaf Studies, under the supervision of Dr. Steven L. Skelton. We will use procedures that are common to speech-language sessions conducted by speech pathologists in everyday clinical practice. These sessions will be held at the Speech, Language, and Hearing Clinic at California State University, Fresno. During the first sessions, your child's use of the target sounds will be tested. Each testing session will include (1) use of the target sound in response to pictures and questions, and (2) a conversation with the experimenter. These sessions will be audiotape recorded. The therapy sessions will use standard clinical materials (e.g., books, pictures, questions) during which your child will be taught the target sounds. To encourage your child's learning, he or she will be able to earn tokens. These tokens will be exchanged for a small prize at the end of the session. The prizes can include stickers, pencils, pens, erasers, toy cars, etc. During the course of the study, your child cannot receive other treatment for his or her language disorder as this may interfere with the results of the study. It is anticipated that the study will have a maximum of 33 therapy sessions. The sessions will be conducted 2 times a week at 40 minutes per session. Additionally, to further assess your child's use of the sounds, you will be asked to audio-record several conversations with your child at home. These recordings can be of conversations between your child and yourself, a sibling, or a friend. However, the same person must conduct all of the conversations. No tape recordings will be made without your prior knowledge. These

recordings will be conducted during and at the end of the study. An audio-recorder (for home use) will be provided to you without charge. There are no known risks involved in the use of the stimuli, materials, and procedures in this study. You and your child's confidentiality will be strictly protected. A subject number will be assigned to your child, eliminating the use of names and insuring confidentiality. Audio-recordings of your child's speech will be labeled only with the appropriate subject number. These recordings will be kept in the investigator's possession or in a locked office in the CSUF Department of Communicative Disorders and Deaf Studies. The audiotapes will be erased after the completion of the study, unless you give us permission to keep theme for future analysis (confidentiality will be maintained as described above). A space is provided at the end of the form for your permission for us to keep the recordings. The results of this study may be published in journals, a thesis, or orally presented to professional or scientific audiences without identifying the child or family. Audio-recordings may be similarly presented without the name of your child. Participation in this study will involve no cost to you and is entirely voluntary. You may withdraw your consent at any time without penalty or loss of benefits to which your child is otherwise entitled. If your child has been referred for this study through the cooperation of his or her public school, participation, nonparticipation, or withdrawal from this study will in no way affect his or her receiving any special education services as entitled under California State Law. Also, participation does not affect your child's eligibility for speech-language services at the CSUF Speech, Language, and Hearing Clinic; it does not affect the child's position on the "waiting list" at the clinic, if applicable. If you have any questions, you may contact us at the Department of Communicative Disorders and Deaf Studies, (559) 278-2698 or via email at sskelton@csufresno.edu.

The Committee for the Protection of Human Subjects at California State University, Fresno, reviewed the researchers' protocol and approved this study. This committee may be contacted at 278-4468. Your signature below shows that you consent to your child's participation in the study described above. You will be provided a copy of this signed consent form.

Thank you,

Allison Cole, B.A.

Steven L. Skelton, Ph.D., CCC-SLP
Associate Professor

I consent to permit my child, _____, to participate in the study described above. I give permission for the audiotapes to be kept after the conclusion of the study, as described above.

_____ Date _____
Parent (or Legal Guardian)

_____ Date _____
Parent (or Legal Guardian)

_____ Date _____
Witness

APPENDIX B: TREATMENT AND GENERALIZATION WORDS

Taught Words

/ʃ/	/v/
Shell	Vine
Shoe	Van
Ship	Vet
Shape	Seven
Trash Can	Beaver
Dishtowel	Diver
Washer	Olive
Push	Dove
Dish	Cave
Fish	Wave

Untaught Words

/ʃ/	/v/	/s/	/f/	/θ/	/ð/	/z/	/ʒ/
Sheep	Vase	Sun	Fan	Thirsty	Brother	Zoo	Treasure
Fishbowl	Movie	Recess	Waffle	Toothpaste	Feather	Puzzle	Measure
Leash	Five	Gas	Cough	Mouth	Weather	Bees	Garage

California State University, Fresno

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Allison Marie Cole

Type full name as it appears on submission

March 12, 2013

Date