The Capability-Focus Treatment Framework for Child Speech Disorders

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The goals of this report are to describe a treatment framework for child speech disorders, to summarize findings on the predictive validity of the framework, and to stimulate discussion of associated treatment issues. Since 1984, the capability-focus treatment framework has been used in a university speech clinic by over 200 student clinicians who treated approximately 260 preschool children with speech delay. The framework reflects a treatment philosophy that has been readily endorsed by student clinicians and clinical instructors for its efficacy but is challenging to document because of measurement constraints on the constructs of capability and focus. We describe theoretical and clinical foundations of the capability-focus framework, review findings from three studies using discriminant function and relative risk analyses, and discuss associated issues in measurement, theory, and clinical practice.

Treatment Perspectives

Centrality of Individual Differences in Treatment Models

In a lucid review of research on generalization of speech targets during treatment, McReynolds (1987) concluded that no phonological theory, articulatory theory, perceptual-motor theory, or environmental event can adequately account for generalization of speech targets during treatment. She stated that although research has "identified some variables that could be usefully applied to facilitate generalization," there is no single variable "that will guarantee complete generalization of intervention effects for all children" (p. 234). McReynolds made the trenchant point that what clinicians seem to need in working with children is "a means to facilitate discovery of the concept of generalization" (p. 235). She described such a discovery as an "aha" phenomenon that typically occurs in all children at some point during the course of intervention. Following such an experience, a child begins to use the target "in other contexts without manipulation of variables by the experimenter" (p. 235). McReynolds suggested that the concept of generalization might be developed faster if attention were given simultaneously to "what the subject brings into training and the stimuli in the environment that can be brought into the training setting" (p. 236).

In the more than 10 years since McReynolds' prescient observations, a significant trend in research in child speech disorders has been a continuing emphasis on what the child "brings into training" as keys to effecting speech-sound change and generalization. Perhaps the most widely studied individual-differences question is "what to teach" a particular child; that is, the issue of target selection and target sequencing. A frequent recommendation has been to target sound patterns emerging in the child's speech (e.g., Hodson & Paden, 1991). However, from several quite different theoretical perspectives, recommendations have been to target sounds or sound patterns that are not emergent in the child, such as sounds that are phonetically complex, are acoustically or auditorily undifferentiated, or are not stimulable (e.g., Powell, 1991; Powell, Elbert, & Dinnsen, 1991; Gierut, Morrisette, Hughes, & Rowland, 1996).

A second widely studied individual-differences question addresses "how to teach" a particular child to produce target sounds. Several contemporary approaches structure the teaching environment to mirror significantly the context of normal speech acquisition. Some examples include the *cycles approach* (Hodson & Paden, 1991), in which speech-sound learning is spread over relatively large spans of time; the *whole language* approach (Hoffman, 1993), in which language and speech are presumed to develop simultaneously within meaningful conversational interactions; and the *language-based interactive* method

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(Camarata, 1993), in which information on speech production is provided in a manner that acknowledges the child's verbal message rather than directly emphasizing the correctness of the child's speech. Although individual differences are underscored in such approaches, primary emphasis is on the descriptive-explanatory power of the primitives (i.e., the principal conceptual assumptions) of each theory. Thus, when progress in treatment is less than expected, the clinician looks to the primitives or conceptual assumptions of the theory for guidance on modifications that will enable the child to continue learning at the expected rate. The following section describes a two-factor approach whose primitives deal expressly with individual differences in both a child's linguistic capability and in his or her disposition to learn.

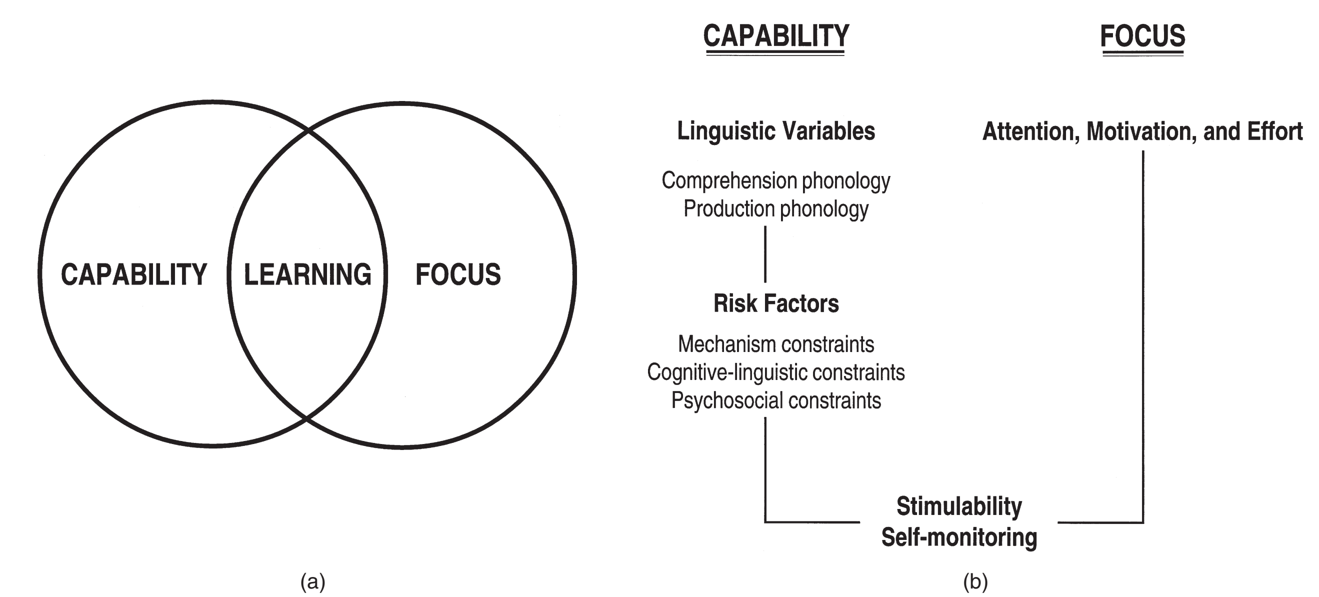
The Capability-Focus Framework

A two-factor approach termed the *capability-focus treatment framework* (henceforth, the *C-F framework*) was developed to address the child-based factors underscored in McReynolds' (1987) perspectives on generalization and, more generally, to account for individual differences in treatment outcomes. A child-based construct termed *focus* was proposed as a necessary addition to the construct of linguistic *capability* to explain and predict individual differences in treatment outcomes (Kwiatkowski & Shriberg, 1993; Shriberg, Kwiatkowski, & Gruber, 1994).

Figure 1 (panels a and b) depicts the C-F framework as presented in Kwiatkowski and Shriberg (1993), including constituents of the capability and focus constructs. As shown in Figure 1, learning of speech targets during treatment is presumed to require some minimal level of both capability and focus. Capability reflects the child's potential for speech change, as documented by competence on speech measures (comprehension and production phonology) and constraints associated with risk factors (mechanism, cognitive-linguistic, and psychosocial). Alternative metrics of speech competence and systems to classify risk factors for child speech disorders have been proposed elsewhere (Shriberg, 1993; Shriberg, Austin, Lewis, McSweeny, & Wilson, 1997a, 1997b; Shriberg & Kwiatkowski, 1994). Thus, capability includes linguistic and risk factor variables, with status in each a possible strength or constraint relative to rate of learning. The construct of focus subsumes the three concepts of *attention*, *motivation*, and *effort*, and reflects the child's disposition for speech change. Within this two-factor framework, *stimulability* and *self-monitoring* are presumed to include components of both capability and focus.

The primary emphasis in the C-F framework is on the child as a learner, with secondary concern placed on the technical details of what is to be learned. The C-F framework assumes that active involvement of the child in the learning process is the single most important treatment variable. To obtain and maintain the child's active involvement requires clinicians to develop and administer a treatment approach that is constantly attuned to the child's changing learning needs. Adjustments may need to be made in *how* the targets are taught, which may ultimately be more important than *what* should be taught and in what sequence. For example, some children learn only if speech-sound targets are practiced individually, whereas other children may be able to learn the multiple targets that are consistent with feature-based and phonological process-based programs. Individual differences in cues, task types, task durations, types of home practice, and degree of directness or indirectness in teaching are central technical options in the C-F framework. To enable clinicians the freedom to accommodate individual differences in such needs, the clinician cannot be bound to the task demands of a specific linguistic theory, with its obligatory implications

FIGURE 1. The capability-focus framework.



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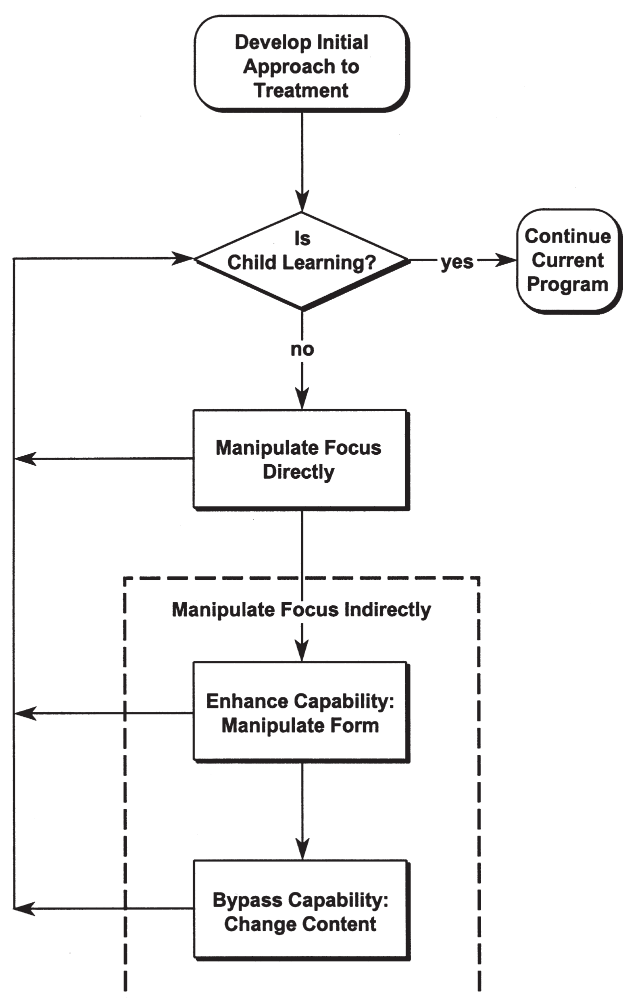
for target selection, target complexity, target sequencing, and so forth. Rather, the C-F framework allows clinicians and researchers to use whichever theoretical perspective is most highly valued in describing a child's comprehension and production phonology but does not bind treatment to the applied correlates of that theory. Similarly, although focus is concerned with aspects of motivation and effort, no specific theory of motivation is posited at present as the best way to understand focus as a psychoeducational construct. The clinician or researcher is free to use whichever procedures are effective in obtaining and maintaining a child's focus on learning. Accordingly, the focus construct is not limited to any one treatment approach. Presumably, focus is as much an issue for learning in nondirective approaches (such as Camarata, 1993) as it is in the more directive, structured treatment approach (Shriberg & Kwiatkowski, 1990) in which the C-F framework was developed.

Figure 2 is the decision procedure used expressly to obtain and maintain an appropriate rate of learning in the C-F treatment framework. The procedure has evolved through use of the C-F framework with over 200 student clinicians who have treated 260 children with speech delay in a university speech clinic using the treatment procedures described in Shriberg and Kwiatkowski (1990) and Kwiatkowski (1991). Although the C-F approach was developed for young children with speech delay of unknown origin, it has been used with children whose speech disorders are associated with known etiologies (e.g., cognitive disabilities, sensorineural hearing loss, orofacial dysmorphologies) and applied to the treatment of other speech-language disorders in children and adults.

FIGURE 2. The capability-focus procedure to obtain and maintain appropriate learning rates.



As shown in Figure 2, the C-F approach begins in a manner consistent with other treatment approaches. Initial decisions regarding "what to teach" are based on the child's linguistic capability, and decisions regarding "how to teach" on any of the many philosophical perspectives on effective teaching. Also, as with many other treatment approaches, focus is originally addressed in a standard way via the use of engaging materials and activities presented in an encouraging and supportive learning environment. As shown in Figure 2, the central question posed after *each* treatment session is: "Is the child learning?" Specifically, is the expected change in production of the speech targets occurring? A "yes" response validates the planned approach, and treatment continues without modification. A "no" response requires the clinician to consider alternative ways to modify treatment. The first alternative is direct manipulation of focus to increase a child's attention, motivation, and effort. Candidates for change include individualized modulation of reinforcers, including types and schedules of reinforcement. Focus is first addressed directly because, in the C-F framework, lack of motivation for speech change is considered a potentially sufficient cause of failure to learn. For some children, motivational constraints appear to be the sole barrier to learning. Specifically, some children immediately resume progress in correct production of speech targets after direct attention is placed on focus needs.

If direct manipulation of focus does not result in improvement in production of the speech targets, the alternative is indirect manipulation of focus by addressing the child's capability needs. As shown in Figure 2, the clinician first attempts to achieve focus by enhancing capability through manipulation of the form of treatment. Form refers to instructional elements, such as specific cues and prompts. Form also includes strategies to address risk factors, including attention to all mechanism, cognitive-linguistic, or psychosocial factors that might constrain a child's current ability to learn. For example, auditory bombardment might be added to facilitate development of correct underlying speech forms in children with possible fluctuant hearing loss associated with recurrent otitis media (a mechanism constraint). Second, if changes in the form of treatment are not productive, the clinician bypasses current capability limitations by changing the content of treatment, typically shifting to a different speech target or set of targets. Thus, the C-F framework changes linguistic targets as the last of alternative strategies to consider when rate of learning is inappropriate.

To summarize, the C-F treatment framework posits two

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sources of potential difficulty when children are not learning—capability and focus—and provides a three-step decision procedure to guide clinicians in sequencing changes in treatment until the child is learning at an appropriate rate. These two factors do not differ from constructs that are explicit or implicit in other treatment approaches. Clinicians and researchers routinely devise engaging tasks to get clients interested in learning, and adjust tasks on-line as needed to accommodate fluctuations of interest and involvement in the learning process. The significant difference in the present context is that the C-F framework accords focus primary, rather than secondary, emphasis. After developing the initial approach to treatment based on the child's linguistic capability and risk factors, treatment modifications based on inferred capability constraints are made only after direct changes in focus, and only for the purpose of increasing focus.

Self-Regulated Learning and the Focus Construct

The construct of *self-regulated learning* has important conceptual ties to the focus construct. As studied in the education literature (Schunk & Zimmerman, 1994), self-regulated learning has been defined as the degree to which "individuals are metacognitively, motivationally, and behaviorally active participants in their own learning process" (Zimmerman, 1994, p. 3). Zimmerman notes that although self-regulation is relatively straightforward as a descriptive construct, it has been difficult to constrain as an explanatory construct, citing the proliferation of theoretical and methodological paradigms used in self-regulation research. There is consensus, however, that self-regulated learning involves three processes: *planning*, *monitoring*, and *self-evaluating* (Schunk & Zimmerman, 1994). As described by Ertmer and Newby (1996), *planning* includes setting goals; selecting and sequencing cognitive strategies (e.g., memorizing, analogizing), motivational strategies (e.g., recalling prior success), and environmental strategies (e.g., removing distractions) to achieve those goals; and identifying potential obstacles to goal achievement. *Monitoring*, which occurs when implementing the plan, involves attention to feedback regarding the effectiveness of the selected cognitive, motivational, and environmental strategies, and adjusting the plan as needed. *Self-evaluation*, which occurs after the learning task is completed, involves a review of the extent to which the goal was achieved and the effectiveness and efficiency of the processes used to achieve it. Across a wide spectrum of learning targets, self-regulated learners have been found to be more successful and efficient than learners who lack such strategies and behaviors (Schunk & Zimmerman, 1994).

Ertmer and Newby (1996) recently expanded the definition of self-regulated learning, adding a fourth process termed *reflecting*. Reflecting on one's own learning process is the means used by a learner to translate metacognitive knowledge about the learning process into self-regulatory behaviors for metacognitive control of learning and for developing additional cognitive, motivational, and environmental strategies to facilitate later learning. Ertmer (1996) proposed that the Ertmer and Newby model might explain differences in generalization during speech intervention. He suggested that children who do not generalize may lack metacognitive awareness of one or more of the self-regulatory behaviors of planning, monitoring, evaluating, and reflecting. Research support for some components of this self-regulatory model to facilitate learning and generalization of speech targets has been reported in the literature, including planning (Ruscello & Shelton, 1979) and self-monitoring (e.g., Engel & Groth, 1976; Kern Koegel, Koegel, & Ingham, 1986; Koegel, Kern Koegel, Van Voy, & Ingham, 1988; Shriberg & Kwiatkowski, 1990).

Within the C-F framework, self-regulatory behaviors are a critical component of learning and are presumed to require both capability and focus. Capability includes skill in producing the speech target and the ability to use self-monitoring processes effectively to establish and maintain learning. Focus reflects the motivation to use these skills and abilities to effect speech change, including the deployment of attention and sustained effort. The C-F framework can accommodate both self- and other-directed regulatory processes, accounting for both the self-initiated speech monitoring and the clinician-directed monitoring observed in Shriberg and Kwiatkowski (1990). In that report of eight case studies, children demonstrated one of three levels of self-monitoring strategies: (a) use of self-monitoring behaviors only after being taught the behaviors, (b) use of taught self-monitoring behaviors only when externally rewarded for doing so, and (c) spontaneous use of self-monitoring behaviors without teaching or external reinforcement. Later discussion of findings from several studies of the C-F framework will include additional comment on self-regulated learning in relation to the focus construct.

Procedures to Assess Capability and Focus

The following sections provide summaries of the measurement approaches used to assess capability and focus in three studies of the C-F framework. We briefly describe each of the measures so that findings from all studies can be summarized together. Methodologic information on the procedures used to assess focus in the three studies, including subject information, procedural details, and statistical findings, are reported in an associated technical report (Kwiatkowski & Shriberg, 1997) available at http://www.waisman.wisc.edu/phonology/.

Capability Measures

Consonant Inventory. A child's consonant inventory at the onset of treatment was used to index capability in two (Study 1 and Study 3) of the three studies of the capability-focus framework to be summarized here. Study 1 was a retrospective study of 76 children treated for speech delay in our university clinic (Kwiatkowski & Shriberg, 1993), and Study 3 was a prospective study of 24 children with speech delay also treated in our clinic. Consonant inventory was

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selected to classify the children's capability because, among several other speech measures, it was the best predictor of speech outcomes in a longitudinal study of speech change (Shriberg et al., 1994). In both Study 1 and Study 3, children whose consonant inventory included representative phonemes from each of the six manner classes (nasal, stop, glide, fricative, affricate, and liquid, as developmentally appropriate) were classified as having high capability. Children whose inventories did not meet these developmental phonetic inventory criteria were classified as having low capability.

Percentage of Consonants Correct–Revised. The second study of the C-F framework to be reported, Study 2—a prospective study of 20 children with speech delay who were assessed but not treated in our clinic—used the Percentage of Consonants Correct–Revised (PCC-R) (Shriberg et al., 1997a) as the capability metric to predict treatment outcome. Unlike the Percentage of Consonants Correct (PCC; Shriberg & Kwiatkowski, 1982), the PCC-R scores only speech-sound deletions and substitutions as incorrect; all speech-sound distortions are scored as correct. Thus, of the several alternative measures of severity of involvement described in Shriberg et al. (1997a), the PCC-R was selected because it is most sensitive to severity of involvement (i.e., to deletions and substitutions) in young children. Moreover, because distortions are scored as correct, it has higher transcription reliability (McSweeny & Shriberg, 1995; Shriberg et al., 1997a). Based on PCC-R scores from conversational speech samples, children were categorized ordinally as having high or low capability. Dichotomous classification of capability was used because of the relatively small cell sizes for the planned statistical analyses and the nonnormality of the PCC-R distribution for this sample. Using the median PCC-R score for the 20 children (73%) in Study 2 as the dividing line, children with scores above the median were assigned high capability ($M = 77.3$, $SD = 4.0$), and those below the median were assigned low capability ($M = 62.5$, $SD = 9.0$).

To summarize, in the three studies of the C-F framework to be reported, either consonant inventory or PCC-R was used to classify children as having high or low capability. As discussed later, measurement of capability beyond the ordinal level is a constraint that needs to be addressed in future studies.

Focus Measures

Several procedures to assess focus prior to treatment were developed over a period of 4 years. The technical report (Kwiatkowski & Shriberg, 1997) provides protocols for each of the procedures and summarizes findings from validity (content, concurrent) and reliability (interjudge and intrajudge agreement, retest stability) studies. A "bootstraps" approach was used in which the construct of focus developed from subjective observational ratings was used for concurrent validity studies using a behavioral observation system. The first measurement approach, termed the Focus Rating System (Kwiatkowski & Shriberg, 1997), provided subjective ratings of focus during the Focus Task (described next) by experienced clinicians. Judgments of a child's focus on this task were then used as the concurrent criteria against which scores on the Focus Scoring System (described later) were compared.

The Focus Task. The structure of the Focus Task is consistent with dynamic assessment procedures described by Bain (1994) and with the treatment approach (Shriberg & Kwiatkowski, 1990) in which the C-F framework was developed. The goal of the task is to assess a child's disposition to learn, based on the child's responsiveness in learning trials reflecting a hierarchy of teaching conditions. Standard response evocation procedures are used in each of five teaching conditions, with the examiner attempting to shape and stabilize two different error sounds from the isolated sound to the word level. If the objective were to assess a child's potential to modify speech errors, response accuracy would be the primary goal; the hierarchy of teaching conditions would emphasize events antecedent to the response, such as type, frequency, and duration of cues. However, because the objective of the Focus Task is to assess motivation for speech change as reflected in the child's attention and effort, response accuracy is irrelevant. Rather, emphasis is on the need to manipulate conditions subsequent to the response, specifically, examiner feedback and delivery of reinforcement.

The five conditions of the Focus Task are ordered to provide most to least support relative to the child's participation (see Table 1, Kwiatkowski & Shriberg, 1997, technical report). In the least supportive condition, Condition V, the clinician provides only social reinforcement for participation. The child is given no external feedback on the intended duration of the task or progress through it. Therefore, maximal participation in Condition V is presumed to reflect a child's self-directed motivation for speech change. Using standard reinforcement hierarchies (Bleile, 1995), clinician support for participation is gradually increased in each of the other four conditions. Beginning with Condition IV, a token system is added. A token (i.e., a sticker) is moved one space on a six-space grid both to acknowledge the child's participation after every response and to identify the duration of the task and progress through it. Beginning with Condition III, a tangible reinforcer is introduced, with the child now keeping the tokens. Response contingencies are added in the remaining two conditions. In Condition II, movement of the token is contingent on participation. In Condition I, response-cost is added with the token moved backward each time the child does not participate. Thus, a child's participation at each of the successively more supportive levels is presumed to reflect his or her increasing need for externally directed motivation for speech change. As scored using the Focus Scoring System described in the next section, high focus scores on the least supportive condition (Condition V) are interpreted as support for the highest level of focus.

The Focus Scoring System. The Focus Scoring System was developed for use in research studies; its complexity prohibits its use in clinical contexts. As with the less complex Focus Rating System described in the technical report (Kwiatkowski & Shriberg, 1997), the Focus Scoring

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System can be used to assess focus on the Focus Task or during a period of any other clinical treatment activity. The Focus Scoring System is based on a procedure used in prior research to study children's levels of engagement in tabletop versus computer-based treatment programs (Shriberg, Kwiatkowski, & Snyder, 1989, 1990). The Focus Scoring System uses the customary three-event, sequential structure of response development termed *antecedent event*, *response*, and *subsequent event*. Using behavioral descriptors listed in the technical report (Kwiatkowski & Shriberg, 1997), the examiner codes behaviors from videotape using a 2-1-0 scoring system. Within each of three behavioral domains termed *postural*, *verbal*, and *facial*, behaviors are coded as indicating *acceptable focus* (2), *questionable focus* (1), or *reduced focus* (0). A summary score is determined for each domain by adding the scores for all trials and dividing by the number of trials. The average scores for the three domains are then added to obtain average scores for each condition. Thus, the 2-1-0 scoring system yields a maximum obtainable score of 6 for each of the five conditions in the Focus Task.

As described in the technical report (Kwiatkowski & Shriberg, 1997), the Focus Task is still under development. To date, there are no group-level data for children who have been tested in all five conditions. To accomplish the two studies to be reported that used the Focus Task (Studies 2 and 3), average Focus Task scores were limited to those obtained in Condition V. Owing to a design limitation, all 44 children in Study 2 and Study 3 had been tested only under Condition V for both target sounds. Pilot studies indicated that high focus children, as judged in a concurrent validity study (see technical report), had focus scores of 4.6 (i.e., out of a possible 6) or greater in Condition V. This cutoff point was used to divide children's Focus Scoring System scores into a high or low focus group in Study 2 and Study 3.

Use of Treatment Data to Assess Focus. For studies using retrospective or prospective clinical records rather than behavioral observations, it is possible to infer a child's focus status by inspecting what clinicians did/do when a child's rate of learning was/is not appropriate. This alternative to the Focus Scoring System was used for the earliest of the three studies (Study 1), described next. The decision procedure described in Figure 2 was used to code information in the case records. When the clinician's log indicated that focus was an issue during the course of treatment, as suggested by the need to use procedures similar to Condition III or lower on the Focus Task to directly manipulate focus (i.e., the continued need for contingent reinforcement systems), children were classified as having low focus.

To summarize, in the three studies to be reported, either focus scores in Condition V of the Focus Task or focus during treatment was used to classify children as having high or low focus. As discussed later, there are complex constraints on the measurement of both capability and focus.

Research Support for the Capability-Focus Framework

Research support to date for the C-F framework includes findings from one retrospective ($n = 76$) and two prospective ($ns = 20, 24$) studies of children with speech delay, all of whom were assessed in our university speech clinic. The first cohort of 20 children did not receive services in our clinic; follow-up information was gained at a 6-month reassessment. The second cohort of 24 children was both assessed and treated in our clinic. As indicated previously, methodological details for each study and psychometric information on the focus measures are available elsewhere (Kwiatkowski & Shriberg, 1993, 1997). For the present purposes—to share observations and stimulate discussion about the C-F framework—the following synthesis of research findings provides only brief information on methods.

Discriminant Function Findings

Table 1 is a summary of discriminant function findings from the three studies of the capability-focus framework. The dependent or treatment outcome variable in each study was *maximal outcome* or *nonmaximal outcome*. For Study 1 and Study 3, treatment outcomes at the end of one semester in the speech clinic were coded as maximal if most (≥75%) of a child's speech targets met the following

TABLE 1. Discriminant function findings in three studies of the capability-focus treatment framework.

		Variable in Equation		Percentage of children correctly classified		Discriminant function		
Study	*n*	Capability	Focus	Nonmaximal outcome[a]	Maximal outcome[a]	χ^2	*df*	*p*
1	76	Consonant inventory		33	100	20.35	1	<.001 ***
	75	Consonant inventory	Treatment records	59	91	31.04	2	<.001 ***
2	20	PCC-R[b]		70	70	3.06	1	.081 *ns*
	20	PCC-R	Focus Task/Focus Scoring System	90	50	6.72	2	.034 *
3	24	Consonant inventory		77	73	6.09	1	.013 *
	24	Consonant inventory	Focus Task/Focus Scoring System	85	64	9.48	2	.008 **

[a]See text for definition of nonmaximal and maximal outcomes. [b]PCC-R = Percentage of Consonants Correct–Revised.
*$p < .05$. **$p < .01$. ***$p < .001$.

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criteria: Targets that were at the sound level at the beginning of treatment progressed to the word/carrier phrase level, and targets that were begun at the word/carrier phrase level progressed to the generalization level or had generalized to spontaneous speech. All other treatment outcomes were coded nonmaximal. For Study 2, a gain score was computed by subtracting the child's PCC-R at initial assessment from his or her PCC-R at a 6-month follow-up. The similarity of initial PCC-R scores in the high and low focus groups allowed for subtraction of PCC-R scores without the need to adjust for possible differences in the absolute magnitude of initial scores. Using the median difference in PCC-R scores for these 20 children as the dividing point, children's short-term outcomes were classified as maximal (above the median) versus nonmaximal (below the median) progress. The goal of these three studies was to assess how well a child's capability and focus status, as measured several ways, predicted speech outcomes with and without treatment at our clinic. Preliminary analyses indicated that gender and age were not significantly associated with treatment outcomes, with *p* values for the six statistical comparisons ranging from .10 to .89.

As shown in Table 1, the statistical findings were essentially similar in each of the three studies. When pretreatment capability, as assessed either by consonant inventory or PCC-R, was used as the sole predictor variable, it significantly discriminated speech outcomes in Study 1 ($p < .001$) and Study 3 ($p = .013$), but not in Study 2 ($p = .081$). The capability variable in Study 1 and Study 3, consonant inventory, correctly classified 100% and 73% of children with maximal outcomes respectively in each study, and 33% and 77% of children with nonmaximal outcomes. When focus status was entered as a second predictor variable in each of the three discriminant functions, statistically significant gains in prediction were obtained. As shown in Table 1, these gains were associated with increasing accuracy of classification of children who had nonmaximal treatment outcomes. For children with nonmaximal outcomes after one semester of treatment, adding focus status to capability status increased correct classification from 33% to 59% (26% gain) in Study 1, from 70% to 90% (20% gain) in Study 2, and from 77% to 85% (8% gain) in Study 3. In each study, adding focus as the second predictor variable was associated with losses in correct classification of children with maximal outcomes: from 100% to 91% (9% loss) in Study 1, from 70% to 50% (20% loss) in Study 2, and from 73% to 64% (9% loss) in Study 3. In summary, across each of the three studies shown in Table 1, the correlates of focus—whether based on focus scoring using clinician logs (Study 1, the retrospective study) or on Focus Task scores using the Focus Scoring System prior to the beginning of treatment (Study 2, Study 3)—appear to be most sensitive to factors associated with the failure of children to obtain maximal treatment outcomes.

FIGURE 3. The capability-focus clinical typology.

		Focus +	Focus -
Capability	+	High Capability High Focus (HC - HF)	High Capability Low Focus (HC - LF)
	-	Low Capability High Focus (LC - HF)	Low Capability Low Focus (LC - LF)

Relative Risk Ratio Findings

Figure 3 is a capability-focus typology that sorts children into one of four classifications: high capability-high focus (HC-HF), high capability-low focus (HC-LF), low capability-high focus (LC-HF), and low capability-low focus (LC-LF). When classified in this way, *relative risk ratio* analyses can be used to describe the increased risk for a disorder (viz., less than optimum treatment outcome) in persons exposed to a risk factor (viz., low capability, low focus, or both) compared to those not exposed to that risk (Kahn & Sempos, 1989). The data from the 24 children in Study 3 were used for the analyses, using low consonant inventory and low focus scores on the Focus Task, respectively, as the capability and focus exposure variables. Analyses could not be completed for Study 1, in which children were not administered the Focus Task, or for Study 2, in which treatment histories were uncontrolled and nine of the children had no reported formal treatment. Because all of the children in Study 3 were treated at the university speech clinic during approximately the same period of time, they met criteria for a clinical cohort as required for computing relative risk ratios (Kahn & Sempos, 1989). Relative risk ratios with 95% confidence intervals and Fisher exact tests of proportions were obtained using the *Epi Info* epidemiology program (Dean et al., 1995).

Table 2 is a summary of the five relative risk ratio findings for children in Study 3. Each of the five comparisons calculates the relative risk (i.e., a ratio greater than 1:1) of nonmaximal treatment outcome for children classified by capability and focus.

The first analysis summarized in Table 2 tested the risk of nonmaximal treatment outcomes for the nine children who had high capability and high focus (HF-HC) compared to the six children with low capability and low focus (LC-LF) at the beginning of treatment. As shown in the Treatment Outcome column, 22.2% of the HC-HF children had nonmaximal outcomes, compared to 100% for the LC-LF children. The relative risk (RR) for this outcome, as expressed by the relevant proportion, is 4.50:1 (with a 95% confidence interval (CI) of 1.33–15.28). Thus, children in the LC-LF group had 4.50 increased risk for nonmaximal outcome compared to children in the HC-HF group ($p = .007$).

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TABLE 2. Relative risk ratio findings in a study of 24 children treated using the capability-focus treatment framework (Study 3).

	Comparison	*n*	Treatment Outcome % Nonmaximal	Treatment Outcome % Maximal	Relative Risk Ratio	Relative Risk Confidence Interval	Two-Tailed Fisher Exact Test
1.	High Capability-High Focus (HC-HF) vs.	9	22.2	77.9	4.50	1.33–15.28	.007**
	Low Capability-Low Focus (LC-LF)	6	100.0	0.0			
2.	High Capability (HC) vs.	11	27.3	72.7	2.82	1.03–7.74	.038*
	Low Capability (LC)	13	76.9	23.1			
3.	High Focus (HF) vs.	16	37.5	62.5	2.33	1.18–4.63	.033*
	Low Focus (LF)	8	87.5	12.5			
4.	High Capability-High Focus (HC-HF) vs.	9	22.2	77.9	2.57	0.65–10.23	.302 ns
	Low Capability-High Focus (LC-HF)	7	57.0	43.0			
5.	High Capability-High Focus (HC-HF) vs.	9	22.2	77.9	2.25	0.35–14.28	.491 ns
	High Capability-Low Focus (HC-LF)	2	50.0	50.0			

$^{*}p < .05$. $^{**}p < .01$.

The second relative risk analysis in Table 2 compared children with high capability (HC) to children with low capability (LC), regardless of their focus status. A total of 27.3% of the HC children had nonmaximal outcomes, compared to 76.9% for LC children. Thus, LC children had 2.82 (CI = 1.03–7.74) increased risk for nonmaximal treatment outcome compared to HC children ($p = .038$).

The third relative risk analysis compared children with high focus (HF) to children with low focus (LF), regardless of capability status. A total of 37.5% of the HF children had nonmaximal outcomes, compared to 87.5% for LF children. Thus, LF children had 2.33 (CI = 1.18–4.63) increased risk for nonmaximal treatment outcome compared to HF children ($p = .033$).

Two other relative risk analyses were completed comparing children whose status on the two risk variables was mixed (see Table 2). Neither was statistically significant.

Conceptual Associations Between Capability and Focus

The discriminant function and relative risk analyses were concerned with predictive associations between capability and focus relative to treatment outcome. Another question posed in these studies concerns conceptual associations between capability and focus. Although capability and focus are posited as independent domains in the two-factor C-F framework, an empirical question is the degree to which status on one variable is independent of status on the other. Although this issue has not been formally addressed to date, trends in the data could be marshaled to support both perspectives.

Trends That Support Capability and Focus as Independent Constructs. Support for the independence of the two constructs in the C-F framework can be induced from two trends. First, the percentage of Study 3 children whose scores on the Focus Task and capability status were concordant (i.e., high or low on both) totaled only 62.5% (15 of the 24 children). Specifically, 9 of the 24 children (37.5%) were classified as HC-HF, and an additional 6 children (25%) as LC-LF, with focus assessed on the Focus Task. The remaining 9 of the 24 children (over one third) had discordant status, 7 classified as LC-HF and 2 as HC-LF. Thus, especially for the 7 children classified as LC-HF, a certain level of speech competence was evidently not necessary for a child to have high focus or vice versa, supporting the perspective that capability status is independent of focus status.

A second trend supporting independence between the two constructs is that Focus Task scores were not highly concordant with status on stimulability and self-monitoring, two variables discussed earlier as requiring some degree of both capability and focus. Study 3 children's status on these variables indicated a 67% concordance rate for self-monitoring and focus, and only a 42% concordance rate for stimulability and focus. Again, for the remaining 33% and 58% of the 24 children, focus status was discordant with capability status on these variables.

Trends That Support Interdependence Between Capability and Focus. Support for a directional dependency between capability and focus status can also be induced from the data in Table 2 and additional data gathered in Study 3. First, whereas the unconditional probability of concordant status on the two constructs is 50% (i.e., 25% high on both and 25% low on both), the obtained concordance rate as reported above was only somewhat higher than chance at 62.5%, which, if a reliable difference, might actually support a dependence between the two constructs rather than independence as suggested earlier.

A second trend supporting interdependence between capability and focus concerns some additional data not shown in Table 1. Information on a child's focus during

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treatment was assembled from clinician logs for the 24 children in Study 3 who were treated in our speech clinic. Methods to code a child's focus during treatment were similar to those used in Study 1. Discriminant function analyses could not be completed on these data due to technical restrictions in the variance data. Descriptively, however, these data indicated that 75% of Study 3 children were concordant for capability status and focus during treatment (29% high consonant inventory-high focus plus 46% low consonant inventory-low focus), whereas only 62.5% were concordant for capability status and Focus Task score at the beginning of treatment (37.5% high consonant inventory-high focus plus 25% low consonant inventory-low focus). Thus, higher concordance rates were obtained for capability and focus during treatment than as assessed pretreatment on the Focus Task.

To pursue the possibility that a child's self-perceived capability during treatment might affect his or her focus (i.e., that the two constructs are interdependent), case records were reviewed for the 15 children in Study 3 who required attention to focus during treatment. These children could be divided into two types according to whether direct attention to focus was sufficient or whether capability issues had to be addressed as well (see Figure 2). For 7 of the 15 (46.7%), direct manipulation of focus was sufficient to resolve the problems of attention and effort. For the remaining 8 children (53.3%), focus status seemed dependent on the child's current capability to modify speech errors. For these latter children, direct manipulation of focus alone was not sufficient. Rather, improvements in focus occurred only when target sounds that were too challenging were replaced by target sounds for which the child had greater phonologic capability, including perceptual and articulatory considerations. In the clinician's logs, these children's focus status was perceived as reflecting feelings such as *frustration* due to their lack of immediate or consistent success in treatment. For example, data for one child indicated that focus varied directly with difficulty of the target sound—this child was always focused for his relatively easy targets and never focused for his difficult targets.

Discussion

Measurement Issues

Capability. As indicated in Figure 1, capability is taken to reflect ability and potential for change crossing an array of linguistic domains and risk factor constraints. This would suggest that capability might best be represented by more than the single variable that was used in the three studies of the C-F framework. However, because of small cell sizes, it was necessary to use a single capability index to meet statistical requirements. In each case, a measure of severity of speech involvement was selected because severity was presumed to be the product of multiple linguistic and risk factor constraints. As described, consonant inventory was selected for Study 1 and Study 3 because it was demonstrated to be the best predictor of speech change in a previous longitudinal study, and PCC-R was selected for Study 2 because it is most sensitive to severe speech delay in young children.

Further study of the C-F framework might benefit from a well-validated index that accurately reflects a child's articulatory-phonologic development or status. Although there are many measures that purport to index diverse aspects of normal and disordered speech acquisition (Kent, Miolo, & Bloedel, 1994), no one measure is a multivariate index reflecting status in those phonological and articulatory domains that are relevant for treatment efficacy concerns. Moreover, as discussed elsewhere, current speech metrics have not proven useful for some of the most difficult questions in speech research, including the quest for a phenotype marker for a genetically transmitted form of childhood speech disorder (Shriberg, 1993, 1994; Shriberg & Austin, 1998). In the current C-F framework as well, there is a clear need for a sensitive measure of linguistic capability. Future approaches include the possibility of deriving weighted indices from structural equation modeling (Shriberg, Friel-Patti, Flipsen, & Brown, 1998) and other multivariate approaches to the development of a robust metric of speech capability. Also, whereas prediction has been based on ordinal levels of measurement in the present studies, construct sensitivity and psychometric power presumably would be greatly enhanced by the use of interval-level measures for parametric analyses of speech capability.

Focus. As reported in the associated technical paper (Kwiatkowski & Shriberg, 1997), clinicians appear to be comfortable with the focus construct and with making subjective decisions regarding a child's focus during the Focus Task and also during treatment. For example, in a test of content validity for the Focus Scoring System, clinicians reported having no difficulty evaluating a child's participation in the Focus Task and readily offered rationales for why they viewed the child's behavior as indicating a negative state of participation. In the pilot studies, student clinicians in the university speech clinic immediately understood the focus construct and readily judged the focus of videotaped exemplars of children during treatment. Even without introduction to focus as a construct, student clinicians frequently commented on the focus status of the children using statements such as "very focused," "unfocused," or "lost focus."

Thus, although construct validity for focus can readily be documented anecdotally, there remains a need to develop measurement procedures for focus that have optimum sensitivity and specificity. Recall that for children in Study 3 who were classified as low focus on the Focus Task, there was good agreement between Focus Task classification and classification of focus during treatment. A total of 7 of the 8 children (88%) were classified as low focus on both focus measures. Of the 16 children classified as high focus on the Focus Task, however, only 8 (50%) were also classified as high focus during treatment. For the present concerns, the findings for children with low focus on the Focus Task and for half the children with high focus on the Focus Task are viewed as supporting the ability of the focus score on the Focus Task to predict focus during treatment. However, the failure of a high focus score to predict focus during treatment for half of the children suggests that focus may be more stable for children with

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low focus than for children with high focus on this task. At issue, as addressed later, is whether focus is best understood as a behavioral state or whether it has sufficient stability to be characterized as a behavioral trait.

To summarize, the discriminant function and relative risk ratio findings are viewed as promising support for measurement approaches to research on the C-F framework, particularly for the focus construct. There is obvious need for additional study, including the need for measures of both capability and focus that retain interval levels of sensitivity. It is difficult to separate measurement issues from conceptual issues when attempting to develop measures with adequate sensitivity and specificity. Whenever descriptive or statistical findings are not readily interpretable, the problem could be due to a lack of psychometric precision yielding insensitive or nonspecific measurement of the construct, or more basically, to a lack of conceptual clarity in defining the construct. For the crucial goal of developing effective and clinically efficient measures of capability and focus, multivariate methods with large, diverse clinical samples will be required.

Theoretical Issues

Findings from these studies would seem to provide at least preliminary support for the C-F framework as a theoretically defensible and clinically efficient model to effect speech change during treatment. The term *defensible* is used purposively here. Familiarity with the history of clinical speech-language pathology will attest to a certain skepticism about the legitimacy of terms such as *attention*, *motivation*, and *effort* as independent variables in treatment research, despite their prominent role in the clinic. Rather, treatment models have emphasized more theoretically tractable variables, such as those concerned with children's cognitive processes, linguistic knowledge, linguistic performance, articulatory skill, and with clinicians' uses of alternative instructional technologies. Three concepts about the nature and course of speech change relative to the focus variable during intervention warrant consideration.

First, findings indicate that a child's speech capability at the beginning of a course of treatment is a significant, but not a sufficient, predictor of treatment outcome. Similar findings have been underscored in reviews of predictive research in childhood speech disorders, but few variables have been proposed to increase predictive accuracy in regression and discriminant function designs (see Shriberg et al., 1994, Table 1). The present findings also indicate that low focus, which acts as a constraint on a child's learning, is a second, statistically significant predictive source. Regardless of children's capability status, children in Study 3 who were low focus at the beginning of treatment were less likely to have a maximal treatment outcome. Again, in response to an often-voiced perspective that constructs such as focus reflect the "soft," "subjective," or "unscientific" side of the behavioral science of speech-language pathology, these data would seem to accord the focus construct a certain legitimacy in clinical theory.

A second observation addresses individual differences in relation to descriptive and predictive aspects of the C-F framework. As with other attempts to formalize theory associated with speech change, there appears to be a need for the C-F framework to accommodate individual differences or perhaps typologies of learners. The findings suggested that capability and focus were essentially independent for some children with speech delay, whereas for others, capability issues may have influenced focus. Research is needed to test and explicate the important features of such typologies. Children for whom focus status was not a treatment issue would seem to be most consistent with the self-regulated learner concept (Ertmer & Newby, 1996; Schunk & Zimmerman, 1994) discussed earlier. For children for whom focus was an issue independent of capability status, the objective would be to facilitate self-regulated learning. Conversely, for children whose focus status is dependent on demonstrated capability, a successful treatment outcome might be based entirely on how a clinician responds to the child's capability needs. Suggested procedures are described in the final section.

A third perspective on the focus construct is whether low or high focus has consistency over time and differing environmental contexts, the hallmark of a behavioral trait. Session-by-session need for extrinsic support during treatment is consistent with the concept of a behavioral trait. Focus required such support for those children in Study 3 who were classified as having low focus during the Focus Task: 88% of such children continued to have low focus during treatment. However, focus was not stable for children classified as high focus on the Focus Task assessment: Only 50% of those children continued to have high focus during treatment. These few data provide only mixed support for focus as a behavioral trait. As suggested previously, measurement constraints currently limit theoretical explication and discussion. In addition to the need for a parametric measure of focus for speech learning, further attempts to delineate the focus construct will require information on children's learning in other environments.

Clinical Issues

For clinical interest it is useful to illustrate how the clinical decision procedure for the C-F framework was used with the children treated in our clinic in Study 3. Following the hierarchical sequence in Figure 2, when children were not learning at an appropriate rate, the first change was direct manipulation of focus. Obvious entries in clinician logs indicating the need for such manipulation were comments such as the child "does not see the need" or "have the desire" for speech change. More subtle indicants were comments such as the child seems "unengaged" or "distracted." Recall that 88% of the children with low focus scores on the Focus Task had low focus during treatment, so it was necessary to address focus needs directly for most children with low focus on the Focus Task.

For some children who had high focus scores on the Focus Task given at the beginning of treatment, it was still necessary to manipulate focus during intervention. However, for these children, as substantiated by a trend in the data, manipulation of focus was more likely if the child had low capability. Additional analyses indicated that of

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the eight children who had high focus on both the Focus Task and focus during treatment, six (75%) also had high capability at the beginning of treatment. In contrast, of the eight children who had high Focus Task scores but low focus during treatment, only three (38%) had high capability at the beginning of treatment. For these children with high Focus Task scores and low capability, learning was not facilitated by the direct manipulation of focus. Rather, indirect manipulation of focus by addressing capability issues (i.e., changing the targets) was necessary to achieve focus.

It is important to emphasize that successful manipulation of focus by the clinician did not guarantee a maximal treatment outcome. In Study 3, the use of the procedure cited in Figure 2 was effective in helping the child to achieve a focus state, however brief, thereby improving performance during treatment. However, the eventual level of treatment success was inversely related to the need for such external manipulations of focus. Thus, the association between focus and treatment outcomes in Study 3 supports the importance of intrinsic focus (perhaps allied to the term self-regulated learning) compared to extrinsically supported focus in predicting and effecting speech change. Each of the 13 children in Study 3 who made nonmaximal progress required extrinsic or other-directed focus. In contrast, 9 of the 11 children who made maximal progress had intrinsic or self-directed focus. For the remaining 2 children, each requiring extrinsic focus, the parents may have assumed the clinician's role in maintaining focus outside the treatment context. The parents of both of these children were very actively involved in creating opportunities for meaningful use of speech targets, indirectly correcting errors, and reinforcing spontaneous correct productions with the same sensitivity that is typically demonstrated by a supportive clinician. By extending other-directed focus into nontreatment environments, extensive parent involvement might have compensated for the absence of intrinsic focus or may have ultimately engendered it.

In the treatment procedures used in Study 3, children had different speech-sound targets based on the speech assessment data. Changes in target selection (see lower box within the dashed box in Figure 2) were made only for the children for whom focus could not be achieved by direct manipulation or by indirect manipulation through changes in the form of treatment (see higher box within the dashed box in Figure 2). The assumption for these children was that low focus during treatment reflected the child's response to his or her perceived capability to produce correct target sounds. For such children it may be important to exercise caution in applying the findings of extensive research on the selection of speech targets. As reviewed earlier, research findings on treatment efficacy include the recommendation to select for training sounds that are not stimulable because they are less likely to be acquired without training (Powell, 1991; Powell et al., 1991). Although this recommendation may be useful in selecting speech targets for children for whom focus is not an issue (or is an issue apart from capability status), it may not be appropriate for children for whom focus is an issue because of capability constraints. Because easy and tangible success producing speech targets is necessary for these children, the primary consideration in selecting speech targets should be the potential for success or learnability. Moreover, other guidelines for efficient target selection, such as selection of sounds that are phonetically complex or that are acoustically and auditorily undifferentiated (Gierut et al., 1996), might be inadvisable unless the recommended targets are also readily stimulable.

Summary and Conclusions

The goal of this report was to present findings to date for a treatment framework developed at a university clinic for child speech disorders. The C-F framework reflects an intervention philosophy whose efficacy has been readily endorsed by student clinicians, but is challenging to document. If all measurement issues can be resolved, elements of the C-F framework may be useful for three purposes in child speech disorders. First, the four-classification, clinical typology (see Figure 3) provided by the C-F framework could be used to identify and quantify sources of variance associated with individual differences in children enrolled in treatment studies. Second, because it is not theory specific, the intervention perspective afforded by the C-F framework could usefully be incorporated into any treatment approach, regardless of treatment philosophy or procedural characteristics. Finally, although tested to date only with the structured treatment approach described in Shriberg and Kwiatkowski (1990), findings suggest that the C-F framework has potential to predict rate of change during treatment and, possibly, to identify children whose speech will normalize without direct treatment.

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Copies of the technical reports referenced in this paper can be viewed and downloaded from the Phonology Project website: http://www.waisman.wisc.edu/phonology/

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