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A dynamic approach to phonological assessment

AMY GLASPEY[1] & CAROL STOEL-GAMMON[2]

[1]*Miami University, USA, and* [2]*University of Washington, USA*

Abstract
Dynamic and static assessments in phonological disorders provide different information about a child's skills and development. Dynamic assessments evaluate a child's phonological system when given support, whereas static assessments evaluate skills without support. The Scaffolding Scale of Stimulability (SSS), described in this article, is one example of a dynamic assessment used to evaluate phonological disorders. The SSS comprises a 21-point hierarchy of cues and environmental manipulations that can be used to support a child in the production of phonemes. Use of the SSS is illustrated by a case study of a 4-year-old boy with moderate phonological disorder. The SSS is compared to a static assessment, a probe of 60 single words based on the child's error patterns. The two assessments are compared across treatment at three time intervals: prior to treatment, after 3 months of treatment, and after 6 months of treatment. Results indicated that scores on the SSS could differentiate the boy's phoneme productions based on the amount of support needed, while phoneme scores on the probe were at 0% accuracy. As a composite score, the SSS showed a greater percentage of change earlier in treatment and across time when compared to the probe.

Keywords: *Stimulability, dynamic, assessment, phonology, disorders.*

Introduction

The purpose of this special issue is to present an overview of applications of dynamic assessment across disciplines within communication disorders; the contribution of the following article is specific to the application of dynamic assessment in phonological disorders. Assessment practices in phonological disorders have included a variety of methods. In most cases, decisions about diagnosis and treatment are based on the results of picture-naming tasks and single-word productions elicited by the clinician using a "static" approach (i.e., without any cueing or feedback). The present article compares traditional static assessments to an alternative approach in which a child receives support designed to elicit accurate productions (i.e., a dynamic approach). In particular, the comparison focuses on assessment of *stimulability*, a type of phonological assessment that is dynamic in nature and that has been used for many years. In addition, a new measure of stimulability is presented: the Scaffolding Scale of Stimulability (Glaspey, 2006; Glaspey & Stoel-Gammon, 2001, 2002, 2005).

Static assessments

Traditional forms of phonological assessment typically measure a child's abilities in an unassisted context; in other words, they are *static* assessments. In the area of articulation and phonological disorders, individual phonemes and speech patterns are assessed in a static manner by presenting the child a series of pictures or objects and instructing the child to name the pictures, thus producing a target sound in a single-word production. During the assessment process, the child does not receive any feedback regarding the accuracy of productions. In fact, clinicians are trained to avoid any reinforcement indicators that might skew the results of the assessment. The clinician may comment to the child about good behaviour, attention to task, or participation, but cannot say anything about the phonemes themselves. Furthermore, the assessment is administered in a specified fashion and the protocol is not modified based on the child's responses; for example, if a child produces a [t] for /k/ in a target word, the clinician simply transcribes the production and continues the assessment. Clinicians may create static assessments that are individualized to children,

Correspondence: Amy Glaspey, Department of Speech Pathology and Audiology, College of Arts and Science, Miami University, 2 Bachelor Hall, Oxford, OH 45056, USA. Tel: +1 513-529-2547. Fax: +1 513-529-2502. E-mail: glaspeam@muohio.edu

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e.g., Gierut, Elbert, & Dinnsen (1987), Gierut, Morrisette, Hughes, & Rowland (1996), or choose from several published measures, e.g., the *Goldman-Fristoe Test of Articulation* (Goldman & Fristoe, 2000), the *Hodson Assessment of Phonological Patterns* (Hodson, 2004), or *The Photo Articulation Test* (Lippke, Dickey, Selmar, & Soder, 1997).

Static assessments have been traditionally used by speech-language pathologists and provide many benefits in the treatment process. Static assessments typically comprise simple materials (e.g., manipulatives or pictures books) and an established protocol for elicitation, scoring, and analysis of target speech productions (Velleman, 1998; Williams, 2000). Elicitation may involve spontaneous or imitated naming tasks using single words or sentences; the data collected includes opportunities for productions across a wide range of skills. Results from static assessments inform the clinician regarding severity levels, differential diagnosis, or treatment procedures. Other advantages of static assessments include: high procedural reliability, fast administration (under 20 – 30 minutes), a simple and low-stress task, a score or rating for comparison, and identification of specific error patterns and types.

Given these strengths, the question arises, why should other assessment procedures be considered? The simple answer is that static assessments do not provide a complete picture of a child's phonological abilities. Several disadvantages of using static assessments become apparent. One weakness relates to ecological validity. Most static assessments are based on single-word responses and some children with phonological disorders may easily produce single-words that they cannot produce in connected speech; for example, in a comparison of standard assessments and conversation speech samples, Morrison and Shriberg (1992) found an increased frequency of errors and types of errors on conversational speech samples that were not evident on the citation assessments. Furthermore, static assessments may not readily discriminate subtle differences across children that could indicate a differential diagnosis or phonological profile that would guide decision making in the treatment process.

Perhaps the biggest disadvantage of a static assessment is the length of time required before significant improvements can be observed; these assessments do not readily allow for measurement of small incremental steps that may occur prior to transfer of skills from treatment to the assessment. Challenges arise for clinicians who want to develop an intervention that is based on best evidence. A response-to-intervention approach, such as those applied in literacy remediation (Justice, 2006), may not be adapted to phonological treatment without measures that indicate subtle differences in treatments. Using static assessments, clinicians may not observe short-term change that could inform whether a specific treatment programme is having an effect or not.

Dynamic assessment

Clinicians seeking to gather more detailed information about the child's skills and the potential for the child to make progress in response to treatment may use a *dynamic assessment*. Dynamic assessment is a socio-cultural perspective that encompasses Vygotsky's model of cognitive development (Bain & Olswang, 1995; Vygotsky, 1978). Vygotsky suggested that there were two developmental levels: the *actual* developmental level and the *potential* developmental level. The actual developmental level is the performance of an individual when no assistance is given, as described above under static assessments. In contrast, the potential developmental level is the level of performance that an individual achieves when given assistance. The assessment includes analysis of the process and the object, and begins to explain the differences across individuals. Vygotsky claimed that individuals who performed in the same manner on basic stimulus-response tests, could in fact, be differentiated by the amount of support that they needed through the assessment of their potential. Vygotsky called the region between the actual development level and the potential development level the "zone of proximal development" (ZPD). In this way, he advocated for the study of both the product and the process of learning. Furthermore, dynamic assessment for the ZPD depends upon the relationship between the adult and the child and their interactions together because children are motivated through social needs.

Dynamic assessment may also be used to help determine whether a child is ready to learn. Vygotsky claimed that once the ZPD was documented, the assessment could be used to guide the learning process. For optimal learning to occur, instruction should be above the child's actual level but within the ZPD. In phonology, a child who cannot produce a phoneme on a static assessment, and who cannot produce a phoneme with assistance, may not be ready to learn the phoneme. Another child who cannot produce a phoneme on a static assessment, but can produce a phoneme when given some support may exhibit readiness in the learning process. More specifically, two children could both score 0/10 on a static picture naming task for the target /k/. Yet, when the two children are given some help in the production of /k/ they may suddenly appear very different. One child may produce /k/ when given only a verbal model as support, but the other may not produce the target at all even when given assistance in the form of instructions, a verbal model, and tactile cues. The child who could produce the /k/ with some minimal support would likely acquire the sound quickly in treatment.

If a child's phonological skills are assessed in an environment that is unsupported, it may seem as though the child is not capable of producing a phoneme or pattern; in fact, the child could be very close to producing a target phoneme if only given a little help. A child acquiring new information initially needs maximal adult assistance; however, as the child internalizes the information less adult assistance is needed until the child can perform independently. The goal is for the adult to systematically move through the ZPD to induce the greatest change.

Stimulability

Although terminology and theories of dynamic assessment are most often associated with language or cognitive development (Bain & Olswang, 1995; Lidz, 1991; Peña, Iglesias, & Lidz, 2001), similar concepts have been applied in phonological intervention through assessment of *stimulability*, i.e., testing a child's ability to produce a misarticulated sound when "stimulated" by the clinician to do so (Bauman-Waengler, 2000). Even in Vygotsky's works, references were made that the purpose of dynamic assessment was "to evaluate the response of a stimulating situation in a controlled way".

Stimulability testing typically follows the administration of a static assessment after error phonemes have been documented (Goldman & Fristoe, 2000). A "stimulating situation" is created through the manipulation of *cues* and the linguistic *environment*. Clinicians have used many types of cues and environmental manipulations over the past 75 years (Powell & Miccio, 1996). The cues might include placement instructions (Rvachew, Rafaat, & Martin, 1999), a verbal and/or visual model (Carter & Buck, 1958), or tactile cues (Bain, 1994). Most often, cues include both a verbal model and visual model: children are instructed to watch the clinician's face when the verbal model is presented (Carter & Buck, 1958; Goldman & Fristoe, 2000; Lof, 1996; Milisen, 1954; Scott & Milisen, 1954). Clinicians may choose different linguistic environments such as isolation, syllables, words, sentences, or connected speech. Another variation of stimulability includes the number of opportunities that are given to the child (Lof, 1996). The purpose of stimulability testing has included prognosis (Bain, 1994; Carter & Buck, 1958; Farquhar, 1961; Kisatsky, 1967; Sommers et al., 1967), diagnosis (Goldman & Fristoe, 2000), and the selection of treatment targets and treatment planning (Gierut, 1998; Gierut, Morrisette, Hughes, & Rowland, 1996; Hodson & Paden, 1991; Howell & Dean, 1994; Miccio, Elbert, & Forrest, 1999; Powell, Elbert, & Dinnsen, 1991; Powell & Miccio, 1996; Rvachew, Rafaat, & Martin, 1999; Secord, 1989).

Merging stimulability and dynamic assessment

While the uses of stimulability have varied, the theoretical construct of dynamic assessment was linked with stimulability by Bain (1994) who proposed a framework for applying the strategies of dynamic assessment to phonological disorders using stimulability. She applied the constructs of dynamic assessment in a previous study of language skills and suggested that the same could be done in phonology (Bain & Olswang, 1995). Bain proposed a tool that could help clinicians make better decisions during treatment by focusing on the clinical questions: "Who to treat?", "When to treat?", "How to treat?", and "What will be the prognosis for treatment?".

Bain's framework included suggestions for the manipulation of antecedents, responses, and consequences. First, the antecedents for manipulation included the different ways that the target could be presented to the child. During dynamic assessment, the clinician could present the target in a minimal pair, give an auditory model, give a visual model (or a combination of both), manipulate the frequency of stimulus presentation, alter the prosodic emphasis, describe visual imagery, suggest placement cues, or manipulate the articulators. Second, the responses could be manipulated in terms of linguistic complexity or through interactions with language components. Linguistic complexity varied from isolation, nonsense syllables, monosyllable words, multi-syllable words, and sentences or phrases. This hierarchy stems from concepts within the "traditional approach" of speech treatment (Secord, 1989). Further interaction could occur with manipulation of the language components of syntax, semantics, pragmatics, and phonology. Finally, the consequences of the child's response could be altered and manipulated through variations in schedules and types of reinforcement. Overall, Bain suggests that the clinician begin with the least supportive cues within the hierarchy and proceed to the most supportive cues until a correct production is reached. A weighted scoring system was suggested to document the differences in support needed across children. With a valid and reliable system such as this in place, clinicians could begin to answer many clinical questions.

Dynamic assessment has since been applied clinically in phonological disorders. Using Bain's framework, Perrine (1999) developed a cueing hierarchy for phonology in 4- to 6-year-old children with phonological disorder. The scale included seven cues with combinations of direct and indirect models, auditory and visual models, and placement cues, and three linguistic environments that included CVC words, nonsense syllables, and isolation. Results supported the construct validity of the hierarchy used within the scale. Further variations of a hierarchy of phonological assessment, slightly different from Perrine, have been developed and implemented with the Scaffolding Scale of Stimulability (SSS), a measure that incorporates the concepts of dynamic assessment with four cue levels and seven linguistic environments (Glaspey, 2006).

The Scaffolding Scale of Stimulability (SSS)

The Scaffolding Scale of Stimulability (SSS) is a dynamic assessment that has been recently developed for measuring phonological skills (Glaspey, 2006; Glaspey & Stoel-Gammon, 2001, 2002, 2005). Historically, dynamic assessments were used to measure the learning potential for cognitive skills. Various methods were developed to assess a child's potential for learning. The SSS uses a graduated prompt approach and simultaneously incorporates teaching into the testing procedure, which aligns most closely with Campione and Brown's methods for measuring cognitive skills (Campione & Brown, 1987; Lidz, 1991; Sternberg & Grigorenko, 2002). For example, a child is prompted to produce a speech sound within a word, much like a static assessment; but, if the sound is produced in error, the child is given a gradual series of assists until the target sound is produced correctly (or is unstimulable). In contrast, other methods of dynamic assessment for cognitive skills separate the testing and teaching components into a pre-test, a training phase, and a post-test (Budoff, 1987; Lidz, 1991; Sternberg & Grigorenko, 2002). Testing and training are not separated on the SSS.

Targets assessed

The Scaffolding Scale of Stimulability (SSS) comprises 48 target items: five consonant clusters and 43 singleton consonants. The consonant clusters are initial /tr/, /pl/, /sp/, /str/ and final /ts/. The consonant singletons are all phonemes of English in initial and final position of words in accordance with the phonotactics of English. The 22 consonants in initial position are: /m, n, p, b, t, d, k, g, f, v, θ, ð, ʃ, tʃ, dʒ, s, z, h, w, j, l, r/. The 21 consonants in final position are: /m, n, ŋ, p, b, t, d, k, g, f, v, θ, ð, ʃ, ʒ, tʃ, dʒ, s, z, l, r/. The targets are elicited with an established set of pictures and word/sentence prompts for reliability in administration.

Scale

The SSS uses dynamic assessment to rate the production of each target phoneme or cluster on a scale from 1 to 21 (see Figure 1) with 21 possible scaffolds that support the child's production of the target. A score of 1 (being best) represents the least amount of support needed by the child and indicates high stimulability. A score of 21 means the child needs the highest level of support and indicates no stimulability.

The scale is presented on a grid with manipulation of two factors: the *environment* and the *cues* (see Figure 1). The environment refers to the linguistic context in which a phoneme is produced, i.e., isolation, words, sentences. The cues include methods that the clinician can use to support the child within each environment, i.e., instructions, verbal model, tactile manipulation. The clinician changes the environment and the cues in response to each of the child's productions. If the child's production is correct, the environment is made more complex and support is removed; conversely, if the child's

CUES / LINGUISTIC ENVIRONMENTS	Level 0	Level 1 *Instructions*	Level 2 *Instructions, verbal model*	Level 3 *Instructions, verbal model, segmented, simultaneous production, tactile cues*
Not Stimulable				21
Isolation				20
Word	16	17	18	19
Carrier Phrase	12	13	14	15
Novel Phrase	9	10	11	
One-target sentence	6	7	8	
Two-target sentence	3	4	5	
Connected Speech	1	2		

Figure 1. The Scaffolding Scale of Stimulability: Cues and Environments.

production is in error, then cues are added and support is increased.

Environments

The SSS has seven environments for eliciting target sounds or patterns; they are shown in Table I in sequence from most supportive to least supportive: isolation, words, carrier phrase, novel phrase, one-target sentence, two-target sentence, and connected speech. The words and sentences were selected based on how easily they could be pictured and identified by preschool children, and on facilitative features of the consonants and vowels of the target word, e.g., fricative consonants were avoided in non-target consonants for elicitation of /s/.

Elicitations vary across the environments that are presented in Table I. At the top and most supported environment, a target in isolation is elicited with a verbal model and instructions about placement that are individualized to the child's errors. Moving down Table I, words are elicited by presenting the child a picture and asking, "What's this?". The next three environments are variations of sentence production and are elicited with the same picture for the word environment and the instruction, "Tell me about that". Two-target sentences are elicited by adding another picture and giving the instruction, "Tell me about these". In the most challenging environment, the child is given a picture scene and asked to tell about the picture. The picture is full of objects with the target phoneme and the child is required to say two correct productions in connected speech to receive credit.

Cue levels

The cues include instructions and modelling techniques that are used to assist the child with the correct production of consonants across the environments (see Table II). As shown at the top of Table II, the clinician first elicits a phoneme in an environment at the spontaneous level without cues. If the child produces an error response, the clinician modifies the elicitation by adding cues. The clinician begins by giving as little support as possible and gradually adds support as needed. The SSS includes four contexts of cueing which are labelled from zero to three. The cues are shown in sequence from least amount of support to most amount of support in Table II. The cues are cumulative and additive; once a cue is used, it may be used again as needed in the next level, but cues cannot be removed once they are added.

Table I. Environments on the SSS.

Environment	Description	Example: word-initial /m/
Isolation	Target alone or in a syllable with /ʌ/ for a CV or VC production depending on the articulatory features of the target consonant.	m-m-m-m
Word	CVC word with the exception of targets for clusters (CCVC or CVCC).	mop
Carrier Phrase	Repetitive phrase that begins with, "It's a..." or "I can..." and depends on whether the target is a noun or verb.	It's a mop.
Novel Phrase	Three-word sentence with the target consonant in a word at the end of the sentence.	Use the mop.
One-target Sentence	Four-to-five word sentence with the target consonant in a word in the middle of the sentence.	The mop is dirty.
Two-target Sentence	Four-to-five word sentence with the target consonant in two words in a sentence with at least one word occurring in the middle.	The mop is by the mat.
Connected Speech	Spontaneous production of the target consonant in two words while telling a story about a picture.	What a funny monkey. He's in the mud by the cow!

Table II. Cue Levels on the SSS.

Cue Level	Description	Example: word-final /ʃ/
0: Spontaneous	Absence of cueing. Clinician shows child a picture.	Clinician shows a picture of a bush.
1: Instruction	Clinician instructs regarding articulatory placement, depends upon the nature of the child's error.	"Not quite, make air come out, and try again".
2: Verbal Model	Clinician says the target in its environment and the child repeats immediately afterwards.	"Look at me. Say, bush". Child says, "bush".
3: (a) Segmentation,	(a) Clinician separates the target consonant from the rest of the word.	"bu" "sh"
(b) Prolongation,	(b) Clinician emphasizes the target sound and stretches the length of the sound.	"bu-sh-sh-sh"
(c) Simultaneous Production,	(c) Clinician and child say the target sound together.	"Join in with me, b-u-u-sh-sh-sh"
(d) Tactile	(d) Clinician manipulates the articulators or gives a tactile representation of the sound.	Clinician slides hand down arm to explain the length and frication of /ʃ/.

Administration procedures: Sequencing rules

When using a graduated prompt approach for dynamic assessment, testing typically begins in the least supported environment and then support is gradually and systematically added; the SSS is slightly different because the goal of the first step is to determine the least supportive environment in which additional cues are needed. The SSS includes several spontaneous environments: word, phrase, one-target sentence, two-target sentence, and connected speech. The dynamic assessment for each target always begins at the word level without any cues (Cue Level 0) to assess spontaneous productions. The clinician presents the child a picture and says, ''What's this?''. The child names the target word. Once the child produces the target word, the clinician makes an immediate judgement about the accuracy of the target production. If the child makes an *error response*, the clinician moves to the *right* on the hierarchy grid (to Cue Level 1) and adds instruction cues from Cue Level 1 (see Figure 2). The clinician gives an instruction regarding the participant's production, which may include feedback such as, ''Pull your tongue back, try again''. If the child continues to make errors, the clinician again moves to the *right* along the hierarchy and adds verbal models, Cue Level 2 and Cue Level 3, and with continued errors, moves *up* to the isolation environment. Once a cue is given, the clinician may not move back to a lesser level of support (i.e., to the left of the grid).

If the child makes a *correct response at the beginning*, the clinician changes the environment, removes support, and moves *down* the hierarchy to a more complex environment (see Figure 2). The clinician prompts the child, ''Tell me about that'', and elicits a sentence production. If the child produces a sentence correctly, the clinician again moves down to the two-target sentence environment. At Cue Level 0, the child is not required to produce targets in every sentence environment. With continued success, the clinician prompts the child to tell a story about a picture scene. If the child produces two targets correctly in connected speech, testing for the target is complete. Ultimately, the child is scored for each target based on the least supportive environment and cue level needed for a correct production.

During the dynamic assessment, children are given reinforcement in several ways. One type of reinforcement occurs when the clinician gives verbal praise and verbal feedback regarding their productions. Children are given praise for correct productions and feedback about error productions. The verbal reinforcement is administered with each step of the dynamic assessment. In addition to the verbal responses, the clinician may give token reinforcement in the form of game pieces and activities for attending to the task and responding to the elicitations. The amount of token reinforcement is variable throughout the sessions depending on each child's interest level and ability to stay on task. Over the course of the session, the token reinforcement may be increased if the child becomes fatigued.

The length of administration of the SSS varies depending on the stimulability levels, age, and attention abilities of each child. Typically, the assessment takes up to an hour to administer. Children with low stimulability complete the entire measure in less than an hour and children with higher stimulability take longer because of the connected speech task with the picture scenes. In general, younger children take longer for administration because more targets are assessed and their attention abilities require more reinforcement activities and breaks.

Sample scoring. The following section provides a sample administration of cueing and environmental manipulation for eliciting a target. The target

CUES / **LINGUISTIC ENVIRONMENTS**	**Level 0**	**Level 1** *Instructions*	**Level 2** *Instructions, verbal model*	**Level 3** *Instructions, verbal model, segmented, simultaneous production, tactile cues*
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Connected Speech	1	2		

Figure 2. Error Response: The clinician increases support to the child by moving to the *right* and *up* on the SSS grid. Correct Response: The clinician decreases support to the child by moving *down* on the SSS grid.

selected for illustration is word-initial /f/, first with a correct response, and second with an error response. The clinician's antecedent cues are described and possible responses from the child are given. The sequences are shown in Figures 3 and 4. In the first sample administration, the sequence is given for word-initial /f/ with a correct response in the first presentation (see the steps in Figure 3).

- Step 1. The clinician shows the child a picture of a *fin* and says, "What's this?". The child replies correctly [fɪn].
- Step 2. In response to the correct production, the clinician increases the level of environmental complexity to a sentence. The clinician says, "Great sounds! Tell me about that". The child replies correctly [hi haɪdə fɪn hɪr].
- Step 3. In response to the correct production, the clinician increases the level of the environmental complexity to a two-target sentence. The clinician shows the child two pictures (a *fin* and *phone*) and says, "You said all the sounds. Tell me about these". The child responds in error, producing, "He phone with a fin", as [hi poun wɪʔ ə fɪn].
- Step 4. In response to the error production, the clinician increases support by adding cues from Level 1 while maintaining the level of environmental complexity. The clinician says, "Nice try, but remember to make the sound with bunny teeth on this word too. Say that again" (points to *phone*). The child responds with the same error response, [hi poun wɪʔ ə fɪn].
- Step 5. In response to the error production, the clinician increases support by adding a verbal model from Cue Level 2 while maintaining environmental complexity. The clinician says, "You're trying very hard. Look at me. Say, a phone won't need a fin". The child responds correctly, [ə foun woʊnt nid ə fɪn]. The clinician ends the manipulation of cues and environments. The child's final score is 5.

In contrast, the next example illustrates the administration sequence for word-initial /f/ with an error

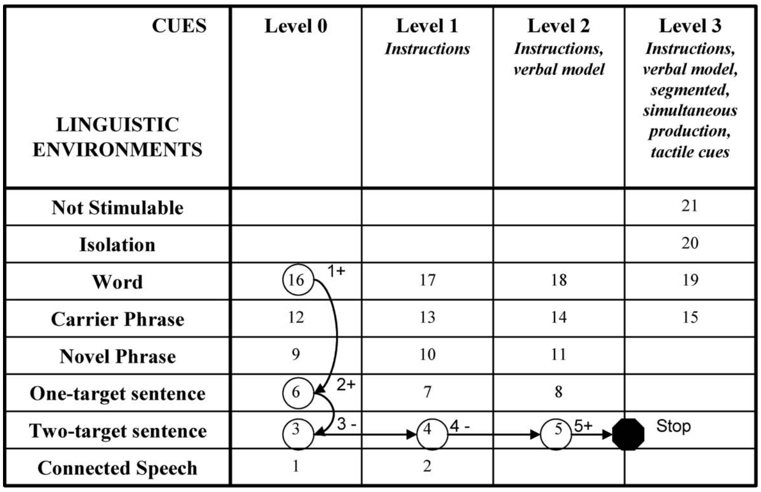

Figure 3. The SSS: The sequence for word-initial /f/ with a correct response in the first presentation.

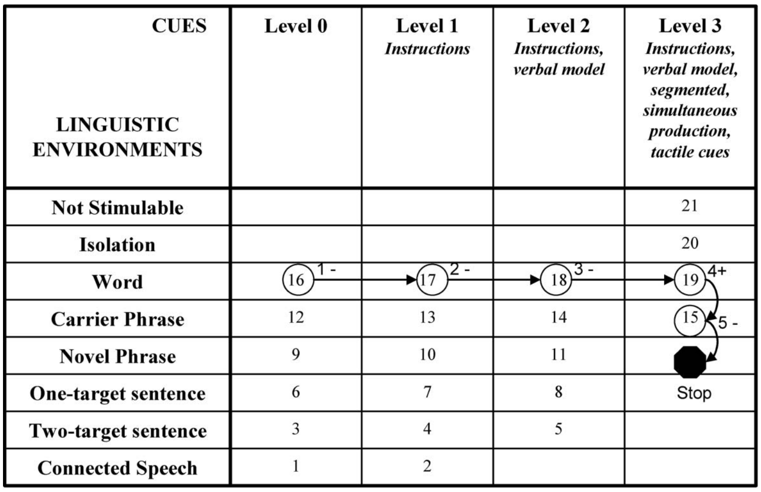

Figure 4. The SSS: The sequence for word-initial /f/ with an error response in the first presentation.

response in the first presentation (see the steps in Figure 4).

- Step 1. The clinician shows the child a picture of a "fin" and says, "What's this?". The child replies in error [pɪn].
- Step 2. In response to the error production, the clinician increases support by adding instruction cues from Cue Level 1 while maintaining the environmental complexity. The clinician says, "Nice try. Make the sound with bunny teeth". The child responds again in error, [pɪn].
- Step 3. In response to the error production, the clinician adds support with cues from Cue Level 2 while maintaining the environmental complexity. The clinician says, "Not quite. Watch me. Say, fin". The child says in error, [pɪn].
- Step 4. In response to the error production, the clinician increases support by adding prolongation cues from Cue Level 3 while maintaining the environmental complexity. The clinician says, "Try again. Watch me. Say, f-f-f-in". The child responds correctly, [fffɪn].
- Step 5. In response to the correct production, the clinician removes support by changing the environmental complexity. The clinician says, "You said the sound! Now watch me and say, 'It's a f-f-f-in'. The child responds in error, [ɪtsə pɪn]. The clinician ends the manipulation of cues and environments now that a threshold has been achieved. The child's final score is 19.

On the SSS, each consonant is given an individual score ranging from 1 – 21 (see Figure 1), scores are then added together to create a composite value. With 48 consonant targets (22 initial, 21 final, and five clusters), the composite score can range between 48 (for a child who is stimulable for all phonemes) and 1008 (not stimulable for any phonemes). The score reflects the number of cues and environmental supports that the child needs to produce all of the target phonemes.

Case study

How does a child's performance on a static assessment differ from performance on a dynamic assessment across 6 months of treatment? To answer this question, the test results for one child, who will be referred to as "Mark", are presented to illustrate the differences in performance on dynamic and static assessments. The data were extracted from a larger study of phonological change (Glaspey, 2006). Performance is compared on the composite scores and also individual phonemes.

Methods

Mark was a 4-year-old boy who was identified with moderate phonological disorder based on scores from the *Hodson Assessment of Phonological Patterns* (HAPP) (Hodson, 2004) and percentage of consonants correct in connected speech sample (Shriberg & Kwiatkowski, 1982; Shriberg, Austin, Lewis, McSweeny, & Wilson, 1997) of 55%. He exhibited several error patterns including: cluster reduction, gliding of liquids, stopping of stridents, deaffrication, and occasional velar fronting. All other developmental areas were within normal limits including language skills, cognition, and hearing, although Mark had a history of ear infections. The first author administered speech treatment two times per week for approximately 6 months using a Cycles approach (Hodson & Paden, 1991).

Dynamic and static assessments were administered to assess change across time. The dynamic assessment was the Scaffolding Scale of Stimulability and it was administered as described above. The static measure was a probe of 60 words that were selected based on Mark's error patterns; the words included at least three opportunities for target phonemes to be produced in initial and final position of words (with the exception of /θ, ð, ʒ/ which are uncommon). The words were elicited with pictures presented in a slide-show on a laptop computer. Mark was asked to name the pictures and was not given any feedback about his performance. The composite score on the probe could range from 0 (all targets produced incorrectly) to 95 (all targets produced correctly). The two measures were administered prior to treatment, after 3 months of treatment, and after 6 months of treatment, in other words, pre- and post-treatment cycle.

Results

Results from the two measures are compared as composite scores and also at the level of individual phonemes. In Figure 5, composite scores from the SSS and the probe are presented across time at Time 1 (prior to treatment), Time 2 (after 3 months of

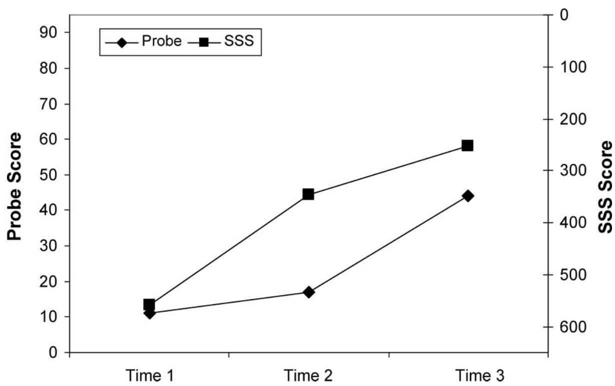

Figure 5. Composite scores compared on the SSS and the probe.

treatment), and Time 3 (after 6 months of treatment). The two measures are scored on two different scales with the probe on the left with a range up to 95, and the SSS on the right with a range up to 651. Because higher scores on the SSS indicate worse performance, the scale for the SSS was inverted so that both measures reflect improvement with an upward slope.

As shown in the Figure 5, change across 6 months of treatment was reflected differently on the two measures. The SSS and the probe indicated a similar level of composite scores at Time 1 (prior to treatment) relative to their own scales; however, differences are observed at Time 2 as the two measures diverge. On the SSS, Mark initially needed 559 forms of scaffolding at the first assessment. After 3 months of treatment, this number was reduced by over 200 scaffolds and after 6 months it was reduced by almost another 100 scaffolds; the biggest change was observed during the first cycle. In contrast, Mark's score on the probe only changed 6 points after 3 months of treatment; then it changed an additional 27 points after 6 months of treatment. After 6 months of treatment, the SSS shows a greater overall percentage of change (47%) when compared to the probe (34%).

Differences were also observed when individual phonemes are compared across the two measures over time. At Time 1, 87% of the targets on the probe were scored at 0% accuracy; however, scores on the SSS varied across the same targets ranging from 8 to 21. To give a more specific example, Mark's productions at Time 1 of word-initial /ɡ, f, dʒ, ð/ and word-final /f, dʒ/ were all scored at 0% accuracy on the probe (see sample of phoneme scores in Table III). In contrast, scores for these phonemes on the SSS showed differential needs for scaffolding. Word-final productions of the target /dʒ/ ("dg" as in "badge") were never correct, even with the highest level of support, and thus received a score of 21. However, Mark successfully produced initial /f/ with a good deal of support (SSS score of 20), final /f/ with a medium amount of support (SSS score of 15), and initial /ɡ/ with less support (SSS score of 8).

Table III. Sample of scores from 10 out of 31 targets on the SSS and the probe across treatment. The SSS ranges in score from 1 to 21 with a low score being best. The probe ranges in score from 0 to 3 with a high score being best.

	SSS			Probe		
	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3
/ɡ-/	8	5	1	0	1	3
/f-/	10	5	1	0	0	3
/-f/	15	14	3	0	0	3
/-v/	19	15	15	0	0	1
/ʃ-/	21	15	3	0	1	3
/-ʃ/	20	15	8	0	0	0
/-dʒ/	21	15	5	0	1	0
/ð-/	18	5	8	0	0	0
/r-/	21	21	19	0	0	0
/sp-/	19	15	8	0	0	0

Differences between the SSS and the probe are also apparent when productions are compared across time. For many targets, change occurred on the SSS, but not on the probe. For example, Mark's scores for word-final /ʃ/ ("sh" as in "wish") on the SSS changed from 20 to 15 to 8 across the 6-month time period; however on the probe, his scores for /ʃ/ were consistently scored at 0% accuracy across this time period (see Table III). Across all phonemes and clusters, scores on the probe remained at 0% accuracy for 68% of the targets at Time 2, and 42% of the targets at Time 3; by comparison, on the SSS, only one target remained unchanged across all three Time periods. In contrast, there were only three occurrences between cycles where the probe changed when the SSS did not (see, for example, /-v/ at Time 2 and Time 3 in Table III).

Simultaneous change also occurred across the two measures (see phonemes /ɡ-/ and /ʃ-/ in Table III). As Mark needed less scaffolding on the SSS, his scores on the probe began to improve. Overall, changes on the probe were not evident until Mark was at least at a score of 15 on the SSS. With this score, he was occasionally able to produce a target correctly on the probe (see, for example, /ʃ-/ and /-dʒ/ in Table III). When Mark scored a 1 on the SSS, accuracy was at 100% on the probe.

Summary and discussion

The case study illustrates that dynamic and static assessments provide different results at a given point in time and across time. Differences between the measures were found when individual phonemes were compared. In many instances, the SSS showed a hierarchy of skills and the probe did not. In a few cases, the probe showed differences and the SSS did not. As a composite score, the SSS indicated a greater overall change across time than the probe. In addition, the SSS documented a greater change during the first 3 months of treatment. Because it is often difficult to document change early in the treatment process, the scores suggest that the dynamic assessment is more sensitive to change than a static probe.

The results of these assessments may be used to guide clinical decision making. The differences on the SSS compared to the static measure could potentially be used in diagnosis, treatment planning, and documenting change across time. Diagnostically, the SSS could support standardized static assessments in the determination of a phonological disorder and has potential as a prognostic indicator, although past research remains mixed. Furthermore, the results relate directly to the child's skill levels and may be used to plan treatment. Scores on the SSS could be used for choosing treatment targets, whether one chooses least stimulable or most stimulable targets. A static assessment that scores multiple phonemes at 0% accuracy may not necessarily inform clinicians about where to begin treatment.

The SSS appears to be most beneficial for documenting progress in the early phases of treatment, when probe measures are less likely to indicate change. In the case of Mark, if the scores from the probe were used to document change, then one might think that he did not make any progress during this time period. The scores collected in a dynamic manner reflect the reduction of support Mark needed and the increase in accurate productions over time. Changes in support may also guide decisions regarding the termination of treatment. It is possible that a certain level of stimulability, may be a valid indicator of continued development and that 100% accuracy is not necessary for termination of treatment (see Olswang & Bain, 1986, for a similar view).

Ultimately, the relationship between static and dynamic measures may provide the most complete profile of a child's overall phonological skills. The case study presented here was part of a larger study of dynamic assessment (Glaspey, 2006). Similar results were found across six children with more change evident on the dynamic assessment during the early phases of treatment and more consistent change overall than on static assessments. While this study showed promise for improved documentation of phonological skills, more comparisons need to be made across children to determine whether children are consistent in their development of phonological skills, whether the hierarchy on the SSS is valid across children, and whether all steps within the hierarchy are necessary and equally weighted. Further research using this measure and additional static assessments may continue to inform treatment efficacy and support evidence-based practice.

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