How to Assist in the Production of Speech for Children with Apraxia of Speech by Modeling on an IPAD or IPOD

Retta Raddant, M.S., CCC-SLP – Tigerton School District

The Nitty Gritty

1. Discuss the item/event (for show-n-tell, this meant discussing facts about the object – may need to talk with teacher ahead of time to determine needs)
2. Decide with student what to include in the presentation/communication event (see sometimes did a little research on the web first)
3. Prepare the IPAD/IPOD and any written material or other material if needed (for show-n-tell, this included generating the pre-written questions for the classmates, and creating cues on the IPAD for the student to select at the appropriate time in the presentation – in this case the student drew pictures that correlated with the answers to the pre-established questions that her classmates would be asking).
4. Record what the student will be saying on the IPAD/IPOD. Speak slowly and over-exaggerate the enunciation/action of the articulators.
5. Have the student practice and provide feedback as needed. Ask for student’s feedback regarding student satisfaction with rate, length, and any other concerns or changes the student may need or desire. Make any changes as necessary.

(Note: Questions, the IPAD, and headset were taken to the classroom during lunch-time and put in a location that was pre-determined by the classroom teacher and the SLP. The teacher handed the slips of paper with questions on it to classmates, who in turn asked those questions to the student during show-n-tell. The student brought the IPAD back to the speech room after show-n-tell was over. Student also needs to know how to use the IPAD procedures for this.)

The Possibilities

- participating in a group presentation in class
- announcing the name of a carol that will be sung at the Christmas Concert
- more?
Readings

Integral stimulation – “watch me, listen, do as I do”
Six steps relevant to the treatment of children with CAS are as follows:
1. The clinician and child model simultaneously, producing the stimulus.
2. The clinician and child model, producing the stimulus simultaneously, the clinician
   provides cues and the child repeats.
3. The clinician models and elicits the child’s response to the question with no
   clinician interaction.
4. The clinician models and elicits the child’s spontaneous response.
5. The clinician models and elicits the child’s spontaneous response to the
   question, with no clinician interaction.
6. The clinician models and elicits the child’s spontaneous response to
   the question with the child responding spontaneously.

developmental apraxia of speech. *Journal of Medical Speech-Language Pathology, 8*, 295–300.

Acquired Apraxia of Speech - Rosenbek Continuum
1. “Watch me”, “listen to me”, simultaneous production
2. Clinician mimics together with client attempting utterance aloud
3. Imitation
4. Imitate clinician several times in a row
5. Written stimulus and simultaneous production
6. Written stimulus and delayed production
7. Utterance elicited by question
8. Response in a role-play situation


Readings (cont.)

- also interesting information - Initial VAST Clinical Trials (found in the website speakinmotion.com)
  Handout - Integral Stimulation Deconstructed by C. Glidersleeve-Neumann
  Handout from the ASHA Leader – C. Glidersleeve-Neumann
INTRODUCTION
Childhood apraxia of speech (CAS) is a rare neurological, sensorimotor speech disorder. A child with CAS demonstrates difficulties programming, combining, and sequencing motor movements needed for speech. These deficits often translate into poor intelligibility. Errors often include prosody errors, inconsistent consonant and vowel errors, and difficulty with articulatory transitions. CAS is hard to treat, with a slow response to treatment frequently reported. One reason for lack of evidence of improvement may be lack of treatment efficacy data for CAS.

PURPOSE OF STUDY
To explore the importance of frequency of target production in integral stimulation therapy.

RESEARCH HYPOTHESIS
Speech sounds treated with a higher frequency of production would show greater in-session production accuracy (motor performance) and generalization to untrained words (motor learning) than speech sounds treated with a lower frequency of production.

METHOD
Study Design
- Single-subject, alternating A-B design
- Two variations of integral stimulation
  - Treatment A (30-40 target productions)
  - Treatment B (100-150 target productions)
- A & B treatment phases implemented in each session
- Probes administered at end of each treatment phase to determine generalization
- 3 data collection phases:
  - Baseline (3-4 sessions)
  - Treatment
  - 5-10 weeks in length
  - 2 or 3 times per week
  - Post-treatment (1 session)

Participants
- Two male children
  - J, age 6;2
  - F, age 3;4

Procedures
- Targeted speech sounds randomly assigned to A or B
- Speech sounds treated in 15 minute phases in randomized treatment order
- Audio & video recording

Analysis
- # of correct productions tracked in each phase for each session
- Probes phonetically transcribed
- Pre- & post-speech samples compared to determine retention & generalization

RESULTS
J, In-Session Production Accuracy (Motor Performance)

F, Percent Correct Probe Words (Motor Learning)

DISCUSSION
Integral stimulation therapy was used in both treatment types. In both Treatment A and Treatment B, integral stimulation was an effective treatment for target sounds.

- Compared to Treatment A (30-40), Treatment B (100-150) targets showed:
  - Higher in-session accuracy
  - Greater generalization
  - Higher levels of accuracy achieved in fewer sessions
  - Less variability
  - Better generalization to untrained words
  - Better retention in post-treatment probes.

Results indicate that frequent and intense practice of speech sounds in the context of integral stimulation therapy resulted in faster acquisition of the targets, better in-session performance, and greater learning evidenced in transfer to untrained probe words for two children with moderate to severe CAS.

CONCLUSIONS
This study and previous studies show that integral stimulation is an effective treatment approach for remedying speech sound errors of children with moderate and severe CAS. While all aspects of integral stimulation are likely important for treatment success, this study highlights the importance of intense speech production to ensure treatment efficiency.

REFERENCES
Treatment for Childhood Apraxia of Speech

A Description of Integral Stimulation and Motor Learning

by Christina Gildersleeve-Neumann

SEE ALSO

- References

A diagnosis of childhood apraxia of speech (CAS) doesn't mean the same thing to everyone, making it difficult to discuss effective treatment measures. In fact, when surveyed on what they thought were the three defining features of CAS, 75 speech-language-pathologists identified 50 different characteristics (Forrest, 2003). Fortunately, differential diagnosis of CAS has become more straightforward with ASHA’s recently released position statement (2007a) and technical report (2007b). ASHA defines CAS as a "neurological childhood (pediatric) speech sound disorder in which the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits," noting that "the core impairment in planning and/or programming spatiotemporal parameters of movement sequences results in errors in speech sound production and prosody" (ASHA, 2007a, p. 1).

ASHA identifies three features that differentiate CAS from other speech sound disorders (ASHA, 2007a, p. 2):

- Inconsistent errors on consonants and vowels in repeated productions of syllables and words
- Lengthened coarticulatory transitions between sounds and syllables
- Inappropriate prosody, especially in the realization of lexical or phrasal stress

The following discussion focuses on integral stimulation therapy. To provide an understanding of this approach, I describe integral stimulation and the motor learning principles that are its foundation. Integral stimulation has been shown effective in the treatment of CAS in controlled research designs (Strand & Debertine, 2000; Strand, Stoeckel, & Baas, 2006). Both the intensity and the use of techniques that align closely with the core CAS deficit in motor planning and programming make integral stimulation an excellent treatment choice for children with CAS (ASHA 2007b).

Speech as a Motor Skill

The complexity of the speech motor act is easy to overlook because of its automaticity in adults. Adults are expert in the programming and preplanning necessary for successful speech, speaking rapidly and with relatively infrequent mistakes. In reality, speech acquisition is a complex, slow process even in the typically developing child, with 9-year-olds still not adult-like in aspects of speech production. Initially, infant vocalizations require little planning and preprogramming, with babbling and first words primarily consisting of highly
constrained consonant-vowel strings, slowly becoming more independently planned and accurately produced utterances. Over the years, children produce longer words and utterances, matching the needed increase in motor planning and preprogramming with greater linguistic and cognitive capacity and motoric skill.

When you work with a child with CAS, you gain a greater respect for the complexity of the speech task and why an understanding of motor learning theory is invaluable for treatment. What appears a straightforward natural progression toward complex motor movements in speech for the typically developing child is a much more effortful, slow, and inexact process for the child with CAS.

Treatment using integral stimulation requires knowledge of motor learning theory (see Magill, 1998; Schmidt, 2004). Understanding the type of motor task helps determine optimal practices for treatment. For instance, speech is a serial motor task, defined by a series of discrete movements; the order of motor movements is crucial. Speech is more like a complex gymnastics routine, in which many movements must be produced in a certain order, than like a repetitive movement such as walking, riding a bike, or repeating a syllable. For children with CAS, the planning and/or preprogramming necessary for the speech "routine" is a core deficit, likely resulting in a lack of generalization of repetitive movements to longer utterances. Thus, when possible, treatment goals should target facilitation of longer speech routines, rather than mastery of simple repetitive movements.

Cognitive Planning and Motor Execution

Both cognitive planning and motor execution are necessary for success of the speech movement. Speech movement is unlike many other motor tasks, in which motor or cognitive elements are of greater importance. For example, one can think about and preplan a golf swing, but it is only the quality of the swing itself that defines the golfer's success. To gain skill in movements in which the motor execution defines the success, repeated practice of the movement is necessary. In contrast, primarily cognitive motor movements (such as a chess move) are successful because of intellectual function and strategizing prior to the movement; the actual precision of the movement is far less important.

Speech requires both rapid and continuous decision-making prior to and during speaking, as well as relatively precise movements during speech. For this reason, treatment for children with CAS, for whom difficulties with motor tasks are central, should include a great deal of practice to gain experience with the new task. In addition, the cognitive planning necessary for speech suggests that treatment for CAS should involve a variety of speech tasks, in a variety of settings, so that children get ample practice and gain skills in the planning necessary for a variety of speech movements.

Like other open movement skills, in which the motor movement is too rapid for on-line perceptual feedback (Schmidt & Lee, 2005), speech is characterized by unpredictability and instability of movement from utterance to utterance. Becoming an expert at open skills
requires the ability to respond to unexpected demands—diversifying the task to meet the needs of the situation—rather than perfecting a particular series of movements. The open nature of speech movements is a core challenge for children with CAS because of their programming deficit. A perfect production of "sh" in syllables does not transfer easily to successful running speech using "sh," particularly for children with CAS. Instead, the ability to produce an "sh" in changing ways and in a variety of words and phrases that require novel motor programming with each utterance should be targeted early on in treatment.

**Integral Stimulation and Cognitive Motor Learning**

Integral stimulation is an excellent treatment choice for CAS, given the complexity of the speech movement and the difficulty it may create for children with motor planning deficits. Integral stimulation was originally applied to acquired apraxia of speech by Rosenbek et al. (1973). The use of integral stimulation with children with CAS has grown primarily because of the encouragement and research of Strand and colleagues (Strand & Skinder, 1999; Strand & Debertine, 2000; Strand, Stoeckel, & Baas, 2006). Integral stimulation is based on principles of cognitive motor learning in building a hierarchical approach to clinical intervention. It is often considered the "watch me, listen, do as I do" approach, using multimodal cues to teach the client the new information.

Integral stimulation was founded on a multi-step hierarchy of strategies for treatment. This hierarchy aids the clinician in determining what level of support to provide to children with CAS to achieve their goals. To facilitate learning in children with CAS—who are likely demonstrating profound difficulty in planning motor tasks independently—the steps provide clinician supports for eliciting stimuli, with decreasing levels of support as children achieve success.

Six steps relevant to treatment of children with CAS are as follows:

1. The child watches and listens and simultaneously produces the stimulus with the clinician.
2. The clinician models, then the child repeats the stimulus while the clinician simultaneously mouths it.
3. The clinician models and provides cues and the child repeats.
4. The clinician models and the child repeats with no cues provided.
5. The clinician elicits the stimulus without modeling, such as by asking a question, with the child responding spontaneously.
6. The child produces stimuli in less-directed situations with clinician encouragement, such as in role-play or games.

This hierarchy of strategies can be useful for determining the level of support for individual stimuli. The continuum of supports should be fluid, with daily and even minute-by-minute changes, particularly since accuracy levels can differ dramatically with the unpredictable nature of CAS.
Although integral stimulation was loosely built on the above hierarchy, its treatment as adapted for children primarily emphasizes cognitive motor learning strategies (see Schmidt & Wrisberg, 2004). Application of these strategies in the design of treatment for CAS allows one to best match motor learning to the current level of motor skill.

**Four Principles of Motor Learning**

Integral stimulation for children requires reflection of four motor learning principles in the design of successful treatment for CAS: precursors to motor learning, conditions of practice, feedback, and effects of rate (see Strand & Skinder, 1999). Application of these principles, allows goals to be targeted at the appropriate level and in the most efficacious manner for the individualized and ever-changing needs of a child.

1. **Precursors to Motor Learning**

   Children vary in their readiness for motor learning. To understand how motor learning will occur and to design the most effective treatment, an SLP must consider precursors to motor learning, or what the child brings to the treatment session that enhances or deters motor learning. Client motivation, family situation, the child’s attitude toward treatment, and individual factors such as developmental delay or attention deficit can all have an effect on learning; the clinician should optimize these factors when possible for greatest treatment success.

   For learning to occur, the child with CAS must be invested in the treatment. The child's belief that treatment will work may be the ultimate determinant in whether or not it is successful. When one considers that generalization of learning is difficult for the child with CAS, providing the child as much support as possible in maximizing the precursors is crucial. Ways to maximize precursors include motivating the child, working when attention can be maximized, helping the child focus on treatment tasks, clarifying with the child why you're doing what you're doing, and providing the child with early success so that his or her trust in you and treatment grows.

2. **Conditions of Practice**

   The second consideration in designing optimal treatment for cognitive motor learning is conditions of practice. The clinician must decide whether mass (long but infrequent) or distributed (shorter, more frequent) treatment will be more effective for maximal treatment response. For children with CAS, it is thought that distributed treatment is more likely to result in transfer of the new skills (Strand & Skinder, 1999). Another condition of practice is format—blocked or random. Blocked treatment, in which the target sound is repeated in a string of utterances (e.g., /k/ targeted in cow, cookie, car, cup), results in better short-term performance and is useful when first targeting a new goal (Wulf & Schmidt, 1997) or for a child with very little verbal output (Strand & Skinder, 1999). However, motor learning is more likely to be achieved with random treatment, in which target-goal utterances are interspersed
with non-target words (e.g., /k/ targeted in cow, toe, boo, cookie, mom, car). The randomized list requires more motor planning and cognitive involvement than the blocked list and is more likely to facilitate generalization to novel situations (Schmidt & Wrisberg, 2004; Strand & Skinder, 1999; Wulf & Schmidt, 1997).

The motor learning literature, therefore, suggests that in-session performance or mastery of a specific movement is enhanced by mass and block treatment, whereas learning is enhanced by distributed and random treatment. For CAS, treatment should be designed to move from conditions that maximize performance to those that enhance learning as quickly as possible.

3. Feedback

The third principle of motor learning requires clinicians to think of the type of feedback they provide, moving from extrinsic feedback (clinician-provided) to intrinsic feedback (client self-awareness). At the most basic level, extrinsic feedback is divided into knowledge of results (awesome, way to go) and knowledge of performance (you brought your lips together in the middle and slowed down and "homework" was very clear), with knowledge of performance resulting in greater learning. In addition, self-monitoring skills are emphasized in integral stimulation so that the client learns to provide his or her own feedback.

To encourage learning, clinicians are encouraged to consider the amount of feedback they provide, decreasing the amount as accuracy increases. Summary feedback (providing less-frequent but summative information) and bandwidth feedback (only when level of acceptable response decreases beyond that accepted) are other considerations as the clinician attempts to increase the client's learning of target information. Research suggests that too much feedback too soon disrupts the client's own feedback loop, diminishing the child's ability to gauge success (Swinnen, Schmidt, Nicholson, & Shapiro, 1990).

4. Effects of Rate

The fourth motor learning principle to consider in planning treatment is effects of rate. Slowing down the rate of speech is particularly important with CAS, because motor planning is thought to be the major area of impairment. The client should be encouraged to slow down to provide additional time to plan and program. In addition, the clinician should slow down to model and facilitate a slower rate for the client.

The overall focus of integral stimulation treatment needs to be on learning how to make the speech movement, rather than absolute success on individual sounds or isolated syllables. The clinician should constantly increase the complexity of the motor planning task as the child has success at a given level. For instance, practice with a sound or syllable shape should not continue until 80% accuracy is achieved. Rather some success in a simpler syllable shape should lead to attempts at the sound or sound combination in longer strings of
utterances, requiring more complex motor planning. For example, a child who is learning to produce /s/ could practice /si/ a few times and then be encouraged to attempt /s/ in "I see," then "I see Emma," then "I see Emma in a boat," practiced at a reduced rate. Whether this progression occurs in one session or over many sessions will depend on many individual factors; it is up to the clinician to decide the pace of progression.

A clinician must decide the best application of motor learning principles to facilitate learning of speech in a child with CAS. In-treatment performance may be the focus in the beginning, but it should shift to learning as quickly as possible. To achieve motor learning, experts suggest that extensive practice and experience with the new information is necessary, emphasizing that hundreds of target stimuli be elicited in a treatment session and underscoring that stimuli be designed for practice in functional situations outside of the treatment room (Strand & Skinder, 1999).

Clinicians can consult excellent resources on CAS, including ASHA’s new definition and three key features for diagnosing CAS. This information establishes a benchmark for future advances in the understanding of this disorder. In addition, this information aids us in furthering research on treatment for CAS, an area of research that is sorely lacking.

Christina Gildersleeve-Neumann, is an assistant professor in the Department of Speech and Hearing Sciences at Portland State University in Portland, Ore. She has treated children with CAS for more than 10 years and currently is conducting small-scale efficacy studies of integral stimulation for CAS. She served on the ad hoc committee that developed ASHA’s technical report and position statement on CAS. Contact her at cegn@pdx.edu.

Integral Stimulation Method (adapted for children as Dynamic Temporal and Tactile Cueing)

What Is It and How To Use It In Speech Therapy for Children with CAS
Published June 2005 | By Edythe Strand, Ph.D.

The term integral stimulation was introduced in the 1950s by Milisen, who described a program for articulatory treatment. The method involved imitation, and emphasized both visual and auditory models. Integral stimulation has long been used for articulation therapy and has also been suggested for use in treating dysarthria and acquired apraxia of speech. In practice, integral stimulation is perhaps the most common of all approaches to treating children with speech disorders. This term is still used to describe treatment that requires the child to imitate utterances modeled by the clinician. Attention is focused both on the auditory model as well as visual attention to the clinician’s face.

There are three main perspectives in treatment for children with apraxia of speech. These include: 1) Integral stimulation (“listen to me, watch me, do what I do”) which utilizes a “bottoms up” approach starting with short, phonetically simple utterances and gradually progressing to more phonetically difficult stimuli.; 2) approaches in which tactile cues as well as gestural cues are heavily employed to help the child to produce accurate movement gestures; and 3) prosodic cueing methods such as MIT or contrastive stress, which emphasize more prosody and incorporate more linguistic components and are typically used for less severe children or those further along in therapy. Of course, most treatments involve a combination of the above perspective. Individuals who use integral stimulation also employ a great deal of tactile and gestural cueing. Because it is important to facilitate improvement in the prosodic aspect of speech early on in treatment, activities to strengthen lexical and sentential stress are often brought into the integral stimulation techniques.

The non-verbal child, with very severe childhood apraxia of speech poses particular challenges for the clinician. These children frequently have no functional verbal communication, have a great deal of difficulty achieving movement gestures toward an initial articulatory configuration in direct imitation, and frequently exhibit numerous vowel distortions. One variation of integral stimulation that I have found to be extremely helpful for children with very severe apraxia is called Dynamic Temporal and Tactile Cueing for speech motor learning (DTTC). This is a strategy that I have developed over a number of years, which is based on a technique described John Rosenbek and others in 1973 (the Eight-step Continuum for Treatment of Acquired Apraxia of Speech). This approach was based a hierarchy of cueing, which varied the temporal relationship between the stimulus and the response, for adult apraxic individuals. The hierarchy begins with simultaneous production of the utterance with the patient. After the patient was able to produce the utterance simultaneously at a certain criteria, they then moved to direct imitation. Again, after reaching a certain criteria, they would add a two-second delay between the clinician’s verbal model and the patient’s response. Finally, after reaching criteria at that level,
they would elicit the response either through a written cue or in response to a question, etc. This was very helpful as I worked with adults who had apraxia of speech, and it seemed logical to me to apply the treatment method to children with severe verbal apraxia. However, I was not able to achieve the same degree of success. After some thought, I realized that children have never had experience with making these movement gestures as they have never spoken. Our goal is not rehabilitation but to help these children improve motor planning and programming processing, as they acquire speech and language. As a result, I modified the eight-step continuum method to allow for a continuous shaping of the movement gesture. That is, we began with direct imitation. If the child is unsuccessful, we move to simultaneous production where the therapist says the utterance with the child first very slowly and adding tactile or gestural cues as necessary. Holding the vowel longer at first can be helpful, as well as making sure that the jaw and lip postures are correct. We continue with practice, gradually increasing the rate toward normal, until the child can easily produce the utterance with the therapist with normal rate, no groping, and accurate movement gestures. At that point, the therapist slowly fades the simultaneous cue by reducing volume to the point where there is a simultaneous mime only. When the child seems secure at that level, the therapist then moves to direct imitation. The therapist provides an auditory model, making sure the child is watching the therapist’s face. The child repeats, and if additional support is needed, the therapist may go back to simultaneous production or mouth the movement gesture as the child attempts to repeat. As the miming is faded, the child continues to practice in direct imitation. The important part of this therapy procedure is that the clinician is constantly adding or fading auditory, visual, and tactile cues as might be necessary after each practice trial. Finally, after the child is producing the utterance in direct imitation, with normal rate, accurate movement gestures, and has been able to vary prosody, then the therapist adds a one- to two-second delay before the imitative response. The child will frequently have difficulty at this point. Using a mime while the child produces the delayed response can be very helpful. Finally, the clinician will work to elicit the utterance spontaneously. Keep in mind the hierarchy is constantly changing as the therapist adds or fades cues, depending on each of the child’s responses.

[note: This article originally appeared as an “Ask the Expert” column in the Apraxia-KIDS June 2005 newsletter]

[Dr. Strand is a consultant in the Department of Neurology, Division of Speech Pathology, at the Mayo Clinic in Rochester, Minnesota, and Associate Professor in the Mayo Medical School. Her primary research and clinical interests have been in Neurologic Communication Disorders, especially childhood and acquired apraxia of speech, dysarthria, and neurologic voice disorders. She has published articles and chapters regarding the clinical management of motor speech disorders in children, including treatment efficacy. Dr. Strand is co-editor of the book (1999), Clinical Management of Motor Speech Disorders of Children. She lectures frequently throughout the country on childhood apraxia and motor speech disorders in both children and adults. Dr. Strand is a member of the Childhood Apraxia of Speech Association Professional Advisory Board.]

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American Journal of Speech-Language Pathology
Principles of Motor Learning

Practice conditions.
—*Practice amount*: Small vs. **large** - Small: low number of practice trials or sessions; Large: high number of practice trials or sessions
—*Practice distribution*: Massed vs. **distributed** - Massed: practice a given number of trials or sessions in small period of time; Distributed: practice a given number of trials or sessions over longer period of time
—*Practice variability*: Constant vs. **variable** - Constant: practice on the same target, in the same context (e.g., syllable-initial /f/); Variable: practice on different targets, in different contexts (e.g., syllable-initial and final /f/, /z/, /b/)
—*Practice schedule*: Blocked vs. **random** - Blocked: different targets practiced in separate, successive blocks or treatment phases (e.g., treatment on /f/ before initiating treatment on /z/); Random: different targets practiced for AOS intermixed (e.g., practice on /f/ and /z/ in each session)
—*Attentional focus*: Internal vs. **external** - Internal: focus on bodily movements (e.g., articulatory placement); External: focus on effects of movements (e.g., acoustic signal)
—*Target complexity*: Simple vs. **complex** - Simple: easy, earlier acquired sounds and sound sequences (e.g., plosives, CV-syllables); Complex: difficult, later acquired sounds and sound sequences (e.g., affricates, CCV syllables)

Feedback conditions
—*Feedback type*: KP vs. **KR** - KP: knowledge of performance, how a sound was produced (e.g., biofeedback); KR: knowledge of results whether a sound was correct or incorrect
—*Feedback frequency*: High vs. **low/summary-KR** - High: feedback after every attempt at production (regardless of accuracy); Low: feedback only after some hypokinetic dysarthria attempts at production (regardless of accuracy)
—*Feedback timing*: Immediate vs. **delayed** - Immediate: feedback immediately following attempt at production; Delayed: feedback provided dysarthria with a delay (e.g., 5 s)

Note. Options that may be expected to enhance learning are indicated in bold.

Copied from:

**American Journal of Speech-Language Pathology** (from a case study)

**Prepractice**

Begin each session with prepractice, in which to address and review the following:

—*Motivation*: To facilitate motivation, select a number of potential functional targets together with the client, for example, those relating to his family’s names, his interests, and his work.

—*Explaining the target responses*: Any explanations about how sounds are made should be provided in prepractice and not during practice where feedback should only relate to the correctness of a response. Too much detail during practice may be distracting.

—*Focus of attention*: Instead of directing attention to the articulatory movements involved in producing a speech sound, direct the focus to how the target should sound.

—*Establish a reference of correctness*: Explain the criteria for a correct response, for example, that all sounds must be produced, the should be fluent, and so on.

—*Ensure stimulability*: Elicit at least one acceptable response for each target before moving to the practice phase, to ensure that the target is within the range of capability.

**Practice**

—*Large amounts of practice*: In order to (re)establish motor patterns, it is necessary to produce a large number of repetitions per target. It may be better to select fewer targets and practice them numerous times than to select a large number of targets and practice them a few times. For example, from the potential targets above, it was suggested to select three targets for the second goal and four targets for the third goal, and practice those seven items many times each session. Transfer to other words of functional relevance can be assessed intermittently over the course of treatment (using the end-of-treatment reading lists noted in the long-term goals).

—*Practice distribution*: Evidence from nonspeech motor learning suggests that spacing a given number of trials and sessions farther apart enhances learning. However, the only study to date in the speech domain suggests that there is no difference between four sessions per week versus two sessions per week. At present, it is unknown what the optimal practice distribution is for speech motor learning.

—*Random practice*: During practice sessions, the practice stimuli should be presented in random order rather than in blocked order. For example, instead of eliciting 10 trials of Brad, then 10 trials on truck, etc., present the items randomly.

—*Variability of practice*: Varying the targets and therapy environment may facilitate transfer. For example, targets can be varied by changing loudness, or pitch. The therapy environment can be varied by moving to a different location in the clinic.

—*Low-frequency feedback*: Feedback on whether the targets were correctly produced should only be on approximately 60% of the practice trials, to avoid disruption of the learning process and overreliance on the clinician’s judgments instead of learning to self-monitor.

—*Delayed feedback*: Feedback should not be given immediately after an attempt; the client should be given time to self-evaluate the movement. In addition, a time delay should also be given (once feedback is provided) before moving on to the next production, to allow time for comparing self-evaluation of the production with the judgment of the clinician.

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