Dynamic Temporal and Tactile Cueing
A Treatment Approach for Severe CAS

Edythe Strand, Ph.D. BC-NCD
Emeritus Speech Pathologist, Mayo Clinic
Emeritus Professor, Mayo College of Medicine

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Learning Objectives
- Understand the uses for DTTC
- Population
- Prerequisites
- Rationale
- Describe the approach
- Understand how and why to incorporate principles of motor learning
- Review efficacy for DTTC

Introduction
- Treatment for children with Childhood Apraxia of Speech (CAS) is challenging for many reasons
  - We’re not always sure who has CAS
  - Haven’t had good dynamic assessment procedures to allow good judgments of severity and prognosis which facilitates clinical decision making
  - The frequent presence of co-existing language and cognitive challenges
- Children who have severe CAS pose even harder challenges
  - May be non verbal
  - Frequently have had little success with traditional therapy approaches and therefore don’t yet trust us - or the process
Introduction

- This webinar is focused on a specific treatment approach for children with severe CAS - Dynamic Temporal and Tactile Cueing (DTTC)
- This approach, which utilizes integral stimulation, is focused on improving motor speech skill, and implements the principles of motor learning
- Treatment efficacy has been demonstrated for this approach

Theoretical Rational for DTTC

What’s involved in Treatment

Explaining the disorder to parents

Planning the therapy - clinical decisions

Implementing therapy – clinical decisions
It would be nice if one could merely choose a method, take a book off the shelf and implement it.

Treatment planning, however, requires a number of important clinical questions we ask ourselves.

Clinical Decisions As We Plan Treatment

- These decisions include (but are not limited to):
  - **Approach - Techniques**
  - The length and frequency of the sessions
  - Stimuli
    - What type (phonemic and phonetic content, syllable structure, real vs. nonsense words, etc.)
    - Length and phonetic complexity
    - How many to target each session

Clinical Decision While Implementing Treatment

- As we implement treatment
  - We make continuous on-line clinical decisions that shape the learning context, and/or intervention solutions
    - Pacing
    - Methods of cueing
    - Types and frequency of feedback
We make decisions regarding when to change the treatment plan (goals; approach; methods; stimuli, etc.)

Choosing the Method

- Terminology can be confusing!
- For today, let's call DTTC a “Method” which we might define as “a set of procedures designed to treat a specific type of impairment or inefficiency in speech production” (Strand, in preparation)
- This method utilizes a number of strategies or techniques which we typically call “cues”

Choosing a Method

- Some methods (approaches – treatments) for speech sound disorders emphasize language processing and phonologic development
- There are many of these – too many to discuss in this webinar, but in general they frequently:
  - Utilize auditory stimulation
  - Focus on distinctive features or sound classes
  - Involve perceptually based interventions
Choosing a Method

- Other Methods (treatments; approaches) focus more on articulatory function – for example
- Traditional articulation therapy utilizing integral stimulation and bottom up approaches to improving articulatory skill
- More recent methods which incorporate motor learning theory to facilitate movement accuracy, consistency of the accurate movement and habituation of the accurate movement across contexts

Our challenge as a clinician is to choose a method that best targets the underlying impairment

- Since there are typically co-existing types of impairment, therapy approaches often include a blending of methods, for example
- For a child with severe motor speech difficulty, beginning with a motoric method at first until the child has improved motor skill to the point where he or she has at least a core vocabulary
- Then, bringing in more linguistic strategies as are needed in addition to the motoric method(s)

How do We Choose a Method?

- Answers I have heard include
  - Because I learned it in school
  - Because I went to a workshop and learned how to do it
  - Because it says it is for apraxia
  - Because the techniques in this approach facilitates improvement in the deficit skill
So how do we know an approach facilitates improvement in the deficit skill

- First, one has to be clear about what that deficit is
- In CAS, the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits. The core impairment in planning and/or programming spatio-temporal parameters of movement sequences results in errors in speech sound production and prosody (ASHA Position Statement) pg 6)
- It is generally agreed the core impairment is in the mechanisms of planning and programing (specification of movement parameters)

Sounds are produced because of specific sequences of movement that have to be produced in a particular way in order for the acoustic signal to be meaningful

- This means parameters of movement have to be specified as to:
  - Range of motion
  - Direction of the movement
  - Speed
  - Force
  - And with a specific amount of muscle contraction

In apraxia of speech, the difficulty is with the specification of movement parameters required to produce articulatory configurations and constrictions to make those sounds

Therefore, it is helpful to think in terms of treating movement sequences or transitions rather than phonemes

- Students and clinicians are accustomed to thinking in terms of "sound errors" and treating "sound" production
- Because speech consists of meaningful sound combinations that are realized because of specific sequences of movement, then facilitating accuracy of that movement has to be the ultimate goal in apraxia of speech treatment
Treatment Methods for CAS

- Most utilize a form of integral stimulation, but vary in terms of what types of cues are used or emphasized
- Articulatory approaches – listen, watch, imitate
- Prosodic approaches – stress and melody
- Gestural/tactile approaches – tactile or gestural cues
- Many treatment utilize all these types of cueing strategies to some degree, but vary in which are emphasized

Rationale for DTTC

- Because children with CAS have difficulty with movement accuracy, then it makes sense that the goal or the focus of treatment is to improve the child’s ability to assemble, retrieve, and execute motor plans for speech
- This is a bit of a paradigmatic shift since we are so used to focusing on sound production

SO -

- The focus or target of treatment is the movement – vs. the sound
- In order to do that, the child must be offered the opportunity to practice the movement
- At first maximum cues are provided, and then they are faded, giving the child increasing responsibility to formulate and execute the plan on his or her own motor plans
How does one focus treatment on movement?

- If the nature of the movement impairment is one of weakness due to spasticity or flaccidity, such as might occur in dysarthria, movement is treated by improving physiologic support.
- The movement disorder in apraxia, however, is characterized by difficulty achieving articulatory configurations and transitioning into and out of these configurations.

Therefore

- Practice should focus on making those movement transitions, in the context of speech.
- At first, the clinician will provide maximum support by providing visual, tactile and auditory models, fading those cues over time.
- DTTC works well as a motor approach to treatment, because the focus is on the movement patterns in order to achieve the correct acoustic speech result.

Changing the focus of treatment to movement vs. the phoneme – changes everything!

- How we choose stimuli for practice
- How we organize that practice
- We use the principles of motor learning to facilitate all our clinical decisions
Children for whom DTTC may be Most Useful

- Children with childhood apraxia of speech (CAS)
- Children with phonologic impairment who also present with at least some evidence for delayed motor planning/programming skill. (McCuskey & Strand, 1999)

Prerequisites to benefit from DTTC

- There is no “age” that is required, but the child
  - Needs to have the functional intent to communicate
  - Needs to be able to attend to the clinician’s face
  - Needs to be able to focus attention to the task, at least for short periods of time.

Dynamic Temporal and Tactile Cueing for Speech Motor Learning (DTTC)
“Movement Gestures”

○ I often refer to the term “movement gestures” or movement sequences, e.g.
○ “The core impairment in planning and/or programming spatio-temporal parameters of movement sequences,” or
○ “Focus of treatment is on movement gestures – not sounds”
○ This term refers to the articulatory movement gesture required to achieve an initial articulatory configuration and the transition from that position into and through the vowel and on to the next articulatory placement.

I use the word movement gesture to emphasize that we don’t target specific placement alone,

○ The target is the dynamic continuous series of movement toward a temporal and spatial target.
○ The important thing is that it is a dynamic movement and relates specifically to how we treat kids with CAS – we treat the movement gestures (in terms of selecting stimuli, how and when we cue, how and what we provide feedback on, etc.) The movement is the target – not a sound.

Dynamic Temporal and Tactile Cueing for Speech Motor Learning (DTTC)

○ When DTTC was first described, it was simply referred to as integral stimulation (Strand & Skinder, 1999), however it is just one of many methods of treatment incorporating integral stimulation – and is now referred to by the name DTTC.

○ The Method uses specific cueing strategies to facilitate accurate movement gestures for specific targets
○ Support is maximized at first to the point where the child can achieve movement accuracy
○ That support is faded as soon as possible
Procedures Involved in the DTTC treatment Method

Integral to the method is the use of a specific hierarchy of temporal delay

- Simultaneous production
- Immediate repetition
- Repetition after delay
- Spontaneous production

Rationale
- Provides maximum support at first
- Emphasizes and makes salient proprioceptive afferent information
- Allows for more accurate movement
- Fades the amount of support to maximize motor learning

Additional Cues Utilized in DTTC
- In addition to the many supported (cued) attempts at repetition (simultaneous, immediate, or delayed repetition), multimodality cueing is also used, including techniques such as:
  - Phonetic placement
  - Tactile cueing
  - Gestural cueing
  - Prosodic cueing
DTTC Procedures

- Therapist says the utterance while child watches the clinician's face - child attempts to repeat
- If the child is unsuccessful, move to simultaneous production (therapist with client), slowing rate and adding tactile or gestural cues as necessary
- Maintain both auditory and visual stimuli
- With each practice trial
  - Move slowly toward natural rate
  - Give specific feedback at first, gradually moving to less specific and less frequent feedback

DTTC Procedures

- Continue practice until the child can easily produce the utterance with the therapist
- Then slowly fade the simultaneous cue by reducing volume, so the child has less auditory information
- When the child is accurate, at normal rate and with no struggle or hesitation, then begin to vary prosody (inflection/emotion/volume, etc.) The rationale here is to bring in variability of practice

DTTC Procedures

- When the child is accurate, uses normal rate and has no hesitation, then move to immediate repetition
- Therapist provides auditory model (again making sure the child is watching the therapist's face)
- Child repeats
  - If the child is unsuccessful, add more cues
    - Therapist mouths the gesture (mime)
    - Add a gestural or tactile cue
    - As the child gets closer, fade the cues - adding them back in as necessary - even going back to simultaneous production if necessary
DTTC Procedures

- Continue to proceed with adding and fading cues until the child can repeat the selected target.
- As before, when the child is accurate, speaking at normal rate and with no struggle or hesitation, then begin to vary prosody and move to the next level, which is the delayed condition.

Addition of delay

- Therapist says the target utterance.
- Insert a delay (one to three seconds) before imitative response.
- After the child is successful at repeating the utterance after a 2 or 3 second delay, have the child repeat the target several times without intervening stimuli.
- As before, always add or fade cues as necessary until the child is accurate, with no hesitation and normal rate, and can vary prosody.

Finally, work to elicit the utterance spontaneously with questions.

- In a bit, we’ll talk briefly about how to incorporate principles of motor learning, including random practice.
- At this point, the target is likely being practiced randomly and will be elicited sporadically throughout the session.

- Keep in mind, the hierarchy of cueing is not linear or static.
- It is constantly changing as the therapist adds or fades cues depending on each of the child's responses.
- Also, different targets may be at different places in the cueing hierarchy.

Incorporating Principles of Motor Learning (PML) in DTTC

- DTTC was designed to incorporate PML
- The treatment efficacy studies for DTTC have included these principles during application of the treatment
- These principles guide all clinical decisions during treatment planning and during implementation of treatment.

Clinical Decisions

- No matter what approach you use in treating speech sound disorders, a number of important clinical decisions have to be made that directly impact the efficacy and efficiency of treatment.
  - How often will you see the child – for how long
  - How many stimuli, as well as
    - Phonetic Content
    - Syllable shape
    - Length
    - Vowel content
    - Prosodic content

Clinical Decisions

- How will you organize or schedule the practice of those stimuli?
- What kind of feedback will you provide?
  - Just right or wrong – or specific?
  - How often?
  - How soon after the child’s attempt?
- Will you vary rate – how? When? Why?
Principles of Motor Learning (PML)

- For methods, such as DTTC that focus on improving motor skill, the PML are important guides in making all these decisions.
- Because DTTC focuses on facilitating movement accuracy, it has been designed to incorporate PML.
- There is not enough time in this short presentation to go into many of these principles or to discuss them in detail, but we will take time to demonstrate a few clinical decisions to illustrate how PML should be used in both planning and implementing DTTC treatment.

Using PML at Initiation of Treatment

Precursors to treatment

- Motivation
  - Children have to have the intent to improve movement
  - Have to trust us and the process
- Focused attention
  - Bring the child’s attention to movement
  - Give them initial practice in varying movement parameters

Use of PML in DTTC

- Clinical Decisions
  - Frequency and length of sessions
  - What should the treatment targets be? How many?
  - How much and what type of practice?
  - How should that practice be organized?
  - Should feedback be given? How much? What type? When?
Important Note

- It is important to distinguish two terms:
  - **Motor Performance (MP)**: How the movement is performed during training, within the session
  - **Motor Learning (ML)**: How the movement is performed at another time or in another setting (generalization)

- Clinical decisions will vary depending on whether the clinician wants to maximize MP vs. ML
- The impact on learning is very different for each

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Use of PML in DTTC

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<thead>
<tr>
<th>Decision</th>
<th>PML</th>
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<tbody>
<tr>
<td>Frequency and length of sessions</td>
<td>Mass vs. Distributed Practice</td>
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<tr>
<td>How many treatment targets should be practiced each session?</td>
<td>Mass leads to better MP but negatively impacts ML</td>
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<td>Distributed practice – results in better ML but it may take much longer to become accurate</td>
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<td>So how might that impact your clinical decisions on this slide?</td>
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Choosing the frequency of treatment sessions and the number of initial target stimuli

Consider

- The severity of the motor speech disorder
- The immediate goal:
  - Mass yields quick development of the skill, but poor generalization for incorporating into other motor skill
  - Distributed takes longer, but facilitates motor learning
Choosing the frequency of treatment sessions and the number of initial target stimuli

- For non-verbal or children with very severe CAS, they may need more mass practice at first (therefore fewer training targets) to become accurate, but then one has to move to a bigger set for more distributed practice to facilitate motor learning.
- So, the more severe the disorder, I use more frequent sessions and fewer stimuli.

Use of PML in DTTC

**Decision**
- How much and what type of practice?
- How should that practice be organized?

**PML**
- The motor learning literature has robust data to show that in order to learn motor skill, one **MUST**
  - Practice the movement – a lot
  - Practice the movement in the context for which it will be used

How much and what type of practice?

**What type?**
- In order to learn motor skill, one must practice the movement in the context for which it will be used.
- So, the practice should be speech:
  - Functional real words
  - Target specific sounds that are frequently distorted as well as early developing consonants
  - Typical early targets for low or non-verbal children
    - Hi no mom eat up mine
    - Bye on down out daddly baby
How much and what type of practice?

**How much practice?** - A LOT
- Treatment planning: must build this in
  - Choose quick reinforcers that take little time
  - May help to stay away from pictures and games that take their attention from the clinician’s face
- Quality of practice (attention; feedback)
  - Avoid letting them get into “automatic pilot”
  - Learning requires they maintain attention to how it feels, how they did, etc.

Use of PML in DTTC

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<td>How much and what type of practice?</td>
<td>Random vs. Blocked Practice</td>
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<td>How should that practice be organized?</td>
<td>Blocked leads to better MP but negatively impacts ML</td>
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Organizing Practice

Within the session, one needs to decide how to present and practice the stimuli
- **Blocked trials** - practice one utterance a lot - put it away, move to the next - and so on
  - Facilitates motor performance
  - Hinders motor learning
- **Random trials** - mix up all stimuli, practice each once
  - Hinders motor performance (takes longer to get accurate)
  - Facilitates motor learning
Thinking clinically, one might

- Use a modified block strategy
  - Start with short blocks of practice, moving to more random practice as the child's performance on that utterance improves
  - May want to choose 1 or 2 of your initial set to give additional blocks of practice
  - Make sure to practice each target for at least one block to provide at least some distributed practice, even early on
  - As each utterance reaches a criteria you have set for "completion" of training, then that utterance goes to a generalization phase and a new target is brought in

- Just like the cueing hierarchy, for each individual treatment target, the modified block strategy will change over the course of therapy
  - As each utterance improves, and the child can produce the target after delays and in response to questions – have him or her practice randomly, in the spontaneous condition throughout a couple sessions before moving to the maintenance/generalization phase of treatment
  - At this point it is important to advise the parents, teachers, para-professionals, etc to elicit the target across contexts

Use of PML in DTTC

**Decision**
- What type of feedback to use
- How often should it be given – when?

**PML**
- Knowledge of Performance
  - Specific information about what they did or what they should change
  - Facilitates MP
- Knowledge of Results
  - Just feedback regarding right or wrong
  - Facilitates ML
Feedback

- Intrinsic - sensory information within the learner
- Extrinsic - generated outside the learner
  - Knowledge of Results
  - Knowledge of Performance

Feedback

- Extrinsic feedback -
  - more important early and with more severe impairment
  - later in treatment, give less extrinsic feedback (as too much reliance on extrinsic may lead to decreased motor learning)
- Amount and precision of feedback should be great at first, then decreased as magnitude of errors decreases (to facilitate motor learning)

Feedback

- Timing and Frequency of Feedback:
  - Immediate - use early in treatment and when impairment is severe as this improves motor performance
  - As child improves, use less immediate and less frequent feedback to facilitate motor learning
Influence of Rate

- There is a trade off between rate and accuracy (slowing rate will increase accuracy up to a point)
- Varying rate can be an effective tool during repetitive practice of targeted utterances (to allow habituation of articulatory movement accuracy while working toward natural rate and prosody).

Give more time for sensory motor feedback in order to maximize:
- accuracy of movement
- tactile feedback
- proprioceptive processing
- Have the child stay in the initial articulatory position longer

Prosody

- Prosodic deficits are common in children with CAS
  - Equal stress
  - Segmentation
  - Lexical stress errors
- It is important to build natural prosody (EARLY) into movement practice
- With older children, or those who have more speech but are slow and lack prosodic variation, work at the sentence and conversational level
Treatment Efficacy for DTTC

- A number of studies have shown treatment efficacy for DTTC:
  - Strand & Debertine, 2000
  - Strand, Stoeckel, & Baas, 2006
  - Baas, Strand & Stoeckel, 2008
  - Maas, Butallaa & Farinella, 2012
  - Maas, & Farinella, 2012
  - Murray, McCabe, & Ballard, (2014) (systematic review including evidence for efficacy of DTTC)

Strand & Debertine, 2000; Strand, Stoeckel, & Baas, 2006
Baas, Strand & Stoeckel, 2008

- These studies showed that DTTC resulted in improvement in articulatory accuracy and verbal communication for three of four children who had been non-verbal at the initiation of treatment, in spite of long periods of previous therapy.
- While DTTC and the implementation of several principles of motor learning were shown to facilitate the acquisition of speech production in severely apraxic children, these data speak to the treatment package as a whole.
- We do not know the extent to which the frequency of practice sessions, the number of practice trials per session, or the use of parent practice may have contributed to the treatment effects.

Maas, Butallaa & Farinella, 2012; Maas, & Farinella, 2012

- These studies utilized DTTC, examining feedback frequency and random vs. blocked practice, respectively
- In the feedback frequency study
  - Three of four children improved with DTTC
  - Two showed an advantage for low-frequency feedback
  - One showed an advantage for high frequency feedback
Maas, Butalla & Farinella, 2012; Maas, & Farinella, 2012

- In the random vs. blocked study, they found
  - Three of four children improved with DTTC
  - Two children showed an advantage for blocked treatment
  - One child showed a random practice advantage
  - One child did not improve

Murray, McCabe, & Ballard, (2014)

- In a systematic review of treatment efficacy research in CAS they found evidence for treatment efficacy for three treatments (2 motor, one linguistic)
  - DTTC appeared to work best for children with more severe CAS
  - Integrated Phonological Awareness intervention was efficacious for children 4-7 with more mild CAS
  - ReST for children 7-10 with mild to moderate CAS.

Conclusions

- DTTC is one type of integral stimulation therapy appropriate for children with severe speech impairment.
- It is especially appropriate for children with CAS because it focuses on movement performance and emphasizes the principles of motor learning
  - The movement target is the continuous movement gesture for the syllable
  - Therefore, movements for individual sounds are never separated within a syllable (e.g., Boy)
- While the focus is on auditory and visual stimulation and repetition, tactile and gestural cues are often used as important facilitators.
○ DTTC allows high levels of success in very severe children due to the maximum support provided
○ It is designed and intended to be used with PML as guiding principles in all clinical decisions
○ DTTC utilizes emphasizes extensive practice
○ DTTC varies the ratio of random vs blocked practice depending on severity and progress within performance for each target utterance
○ DTTC varies the type, frequency and timing of feedback depending on severity and progress within performance for each target utterance

○ DTTC was designed to use meaningful and useful utterances to provide the child early motivation and functional communication
○ Cueing strategies, especially slowing rate at first, and having the child stay in articulatory positions for a bit (when that is difficult) maximizes proprioceptive input

**Conclusion**

○ There are many appropriate methods of treatment for CAS. DTTC is just one of them. It is important to remember
○ CAS is a motor speech disorder, needing a motoric approach, with the focus or target of treatment being the movement
○ Because children with CAS often have co-existing language and phonologic impairment, other treatment approaches may also be brought in as necessary and appropriate
○ Although DTTC was designed for use at early stages of treatment with children with severe CAS, the method may be helpful with recalcitrant residual speech disorders as well.