Current Approaches to Treating School-age Children with Apraxia of Speech and other Speech Sound Disorders

JONATHAN PRESTON, PHD
JOPRESTO@SYR.EDU
ASSOCIATE PROFESSOR
SYRACUSE UNIVERSITY
@JPRESTON_SLP

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Agenda

Part II

1:30-3:00	Dynamic Temporal and Tactile Cueing; Rapid Syllable Transition Training
3:00	BREAK
3:15-4:45	Cueing Late Developing Sounds, Speech Motor Chaining
	The evidence base of some older and newer approaches,
	Q&A

Motor Learning Principles Summary

TO **ACQUIRE** A SKILL
(MOTOR PERFORMANCE)

- Knowledge of performance
- High frequency of feedback
- Immediate feedback
- Many trials per session
- Blocked practice
- Constant practice
- Small stimulus set
- Simple targets

TO **RETAIN** A SKILL
(MOTOR LEARNING)

- Knowledge of results
- Lower frequency of feedback
- Delayed feedback
- Many trials per session
- Random practice
- Variable practice
- Large stimulus set
- Complex targets

CAS Treatment

A MOTOR LEARNING PERSPECTIVE

Challenge Point Framework

Maximum learning requires challenging the client

Optimum learning is a function of:

- Client's skills/knowledge
- Information available (feedback from SLP)
- Task difficulty (stimuli)

Rvachew & Brosseau-Lapré (2012); Guadagnoli & Lee (2004); Hitchcock & McAllister Byun, 2014)

Challenge Point Framework

We should be constantly adapting the task and the information available to facilitate learning

- But my goal for today is, "Child will produce phrases containing bilabials with minimal cueing."
- This is *not* flexible!
- We are working toward adaptive paradigms for treatment.

CAS Treatment

Dynamic Temporal & Tactile Cueing (DTTC)

Rapid Syllable Transition Training (ReST)

Speech Motor Chaining

Biofeedback

Other "hot topics" in CAS

DTTC

DYNAMIC TEMPORAL & TACTILE CUEING

INTEGRAL STIMULATION

DTTC/Integral Stimulation

Emphasize the movement, not isolated sounds

"Listen to me, what me, do what I do."

Increase complexity

- Start with simple syllables (my, bye, do), progress to harder words (mom, bob, dad, hi), them progress to phrases (e.g., "hi mom")

Within one level of complexity, fade cues (max → min)

- Simultaneous production, direct imitation, delayed imitation, visual cue
- Vary prosody

DTTC/Integral Stimulation

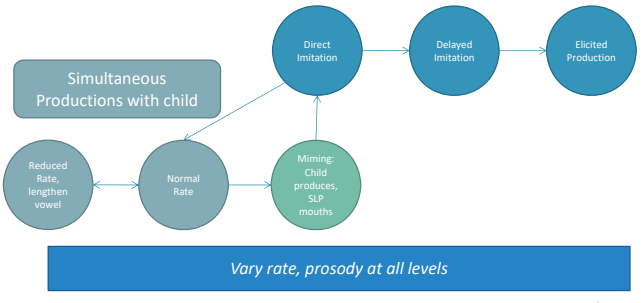
Dynamic framework for intervention

Does not follow prescribed order for each trial

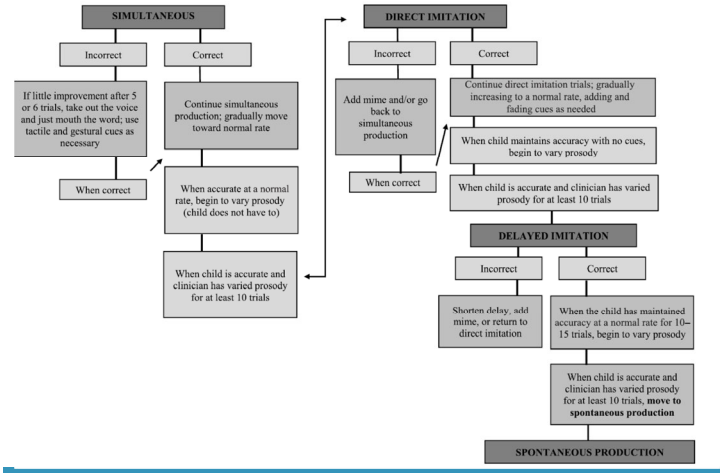
Prosody and rate are modified at all steps

Level and type of intervention depends on child's production and what is needed in that moment

DTTC: Levels of Support



Examples



Strand, 2019

DTTC/Integral Stimulation

When the production is incorrect, SLP provides verbal or **quick** tactile cue and moves back a step on the continuum based on the support needed by the child

Uses a small number of stimuli that are presented within modified blocks
- 5 words produced ~15 – 20 times each
- 3 different blocks

Child must be able to imitate

DTTC/Integral Stimulation

Free videos!
https://www.youtube.com/playlist?list=PL922IXvEXgbwuUAonyVdPeVwh441MV5mO

Video examples

Evidence
- Strand & Debertine (2000)
- Strand, Stoeckel, & Baas (2006)
- Strand & Skinder (1999)
- Maas & Farinella (2012)
- Mass, Butalla, & Farinella (2012)

DTTC/Integral Stimulation Case Study

You meet Tommy, a 4 year old with severe CAS. Tommy displays the ability to produce CV, CVCV, and a limited range of VC and CVC syllable shapes. While he displays the ability to produce /b, m, p, n, d/ and simple vowels /a, i, u, o/, he does not produce these consistently across contexts. He frequently displays vowel distortions across all syllable shapes, exhibits timing errors (voicing, nasality) and omits final consonants. You decide to try DTTC and target movement gestures for VC and CVC syllable shapes.

What are 2 target words that you could select in treatment that follow VC and CVC shapes and include sounds in his inventory?

Practice DTTC by moving up and down the cueing hierarchy – one person is the client, another the SLP. Be adaptive!

ReST

RAPID SYLLABLE TRANSITION TRAINING

Rapid Syllable Transition Tx (ReST)

A program designed to adhere to motor learning principles for CAS

Feedback/training focuses on

(a) articulatory accuracy (**SOUNDS)**

(b) appropriate stress **(BEATS)**

(c) smooth syllable transitions (**SMOOTHNESS)**

Rapid Syllable Transition Tx (ReST)

Select 20 nonsense words appropriate for the client

- 10 beginning with stressed syllable (e.g., DInarop)
- 10 beginning with unstressed syllable (e.g., reGLIsion)
- Phonemes already in client's inventory

Rapid Syllable Transition Tx (ReST)

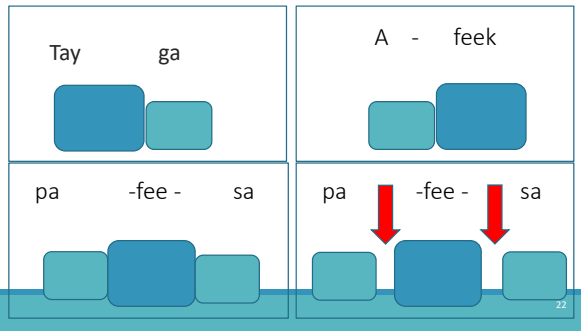
Pre-practice (about 10 minutes)

- Focus on performance/acquisition
- Blocked practice
- Immediate KP feedback on all trials
- Teach concept of accuracy, beats, smoothness
  - Correct trials must be correct in all 3 aspects
- Pre-practice ends when the client has 5 correct productions
  - Sessions 1 & 2 allow for 20 minutes of pre-practice to teach these concepts; if pre-practice exceeds 20 minutes without 5 correct, move to 2-syllable words

Don't forget Prosody!

Contrast stressed and unstressed syllables

(big blocks vs. little blocks)



Rapid Syllable Transition Tx (ReST) **Pre-practice** Example

Target	Child's Response	SLP Feedback
DInarop	**DINAROP**	"The beats weren't right"
DInarop	**DI**nawop	"The /r/ wasn't right"
DInarop	**DI**narop	"Good. You got the sounds, and beats, and it was smooth!"
a**REE**low	a . **REE** . low	"You didn't connect all the sounds. Keep it smooth, no pauses"
a**REE**low	a**REE**low	"Good. You got the sounds, the beats, and it was smooth."

Rapid Syllable Transition Tx (ReST)

Practice (motor-learning focused)

- 20 nonsense words are randomized
- Only delayed knowledge of results feedback
  - "Good" or
  - "Not that time."
- Feedback frequency is reduced throughout practice
  - 18/20 items, then 14/20 items, then 10/20 items, then 6/20 items, then 2/20 items
  - On average, feedback (delayed KR) is given on 50% of trials per session

Rapid Syllable Transition Tx (ReST) **Practice** Example

Target	Child's Response	SLP
gra**DAY**miture	gra**DAY**miture	(delay) "Good."
a**REE**low	a . **REE** . low	
DInarop	**DINAROP**	(delay) "Not quite that time."
re**GLI**sion	we**GLI**son	

Rapid Syllable Transition Tx (ReST)

How are pre-practice and practice different?

What principles of motor learning do you see in practice?

Nonsense words are treatment target (use written stimuli). Thoughts?

Rapid Syllable Transition Tx (ReST)

FREE materials, manuals, training videos, syllable generator:

http://sydney.edu.au/health-sciences/rest/resources.shtml

THE UNIVERSITY OF SYDNEY

Is ReST appropriate for my client?

Child and Family suitability questions	Y/N
Does the child have a diagnosis of CAS?	
Aged 4 -13 years old?	
If 4-5 years old	
- is the child resilient? Do they tolerate some level of failure without giving up?	
- has the child had at least one block of therapy previously or started formal schooling?	
Does the child have at least 4 consistent consonants?	
Does the child have at least 4 consistent vowels?	
Is CAS the only significant developmental diagnosis?	
Can the child tolerate about 10 minutes of drill therapy?	
Can the child tolerate a 50-60 minute speech therapy session?	
Can your child tolerate getting things wrong?	
Can you as a parent tolerate your child getting things wrong?	
Can the child have treatment by a clinician at least twice sessions a week, for 12 sessions?	

Clinician suitability questions	Y/N
Can you stick to a set program?	
Are you resilient to children having limited success in the early stages of therapy?	
Could you give feedback on only some of the child's productions?	
Can you take clinical data before treatment, every 4 sessions and after treatment on real words to check the work you are doing in ReST therapy is making a difference to the child's everyday speech?	

Rapid Syllable Transition Tx (ReST)

Has been used with children ages 4-13 years

Evidence

- Ballard, Robin, McCabe, & McDonald (2010)
- Thomas, McCabe, Ballard (2014)
- Murray, McCabe, & Ballard (2015)
- Thomas, McCabe, Ballard, & Lincoln, (2016)

Rapid Syllable Transition Tx (ReST) Case Study

Tommy is now a third grader. He has mastered most of the "early 8" and "middle 8" phonemes. However, he is inconsistent on (but stimulable for) /ʃ, tʃ, dʒ/. He is not stimulable for /r, l, s, z/. He has frequent errors on lexical stress and he often separates syllables.

You decide to try ReST

1. What are three appropriate 3-syllable nonsense words
2. Teach *sounds, beats, smoothness* in these nonsense words in Pre-practice
3. Now try Practice on these 3 nonwords
   - Randomize, only KR feedback. Reduce feedback!

Case Study

Tommy is now a 7th grader. His prosody is pretty good although there are still some occasional errors in stress and/or instances of syllable segregation.

He is not yet stimulable for /r/, /s/, /l/

How do you teach these sounds?

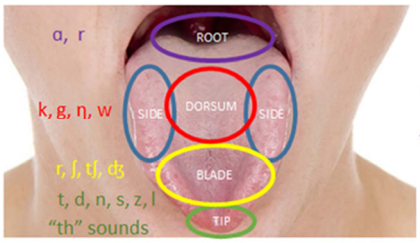
Cueing Late-Developing Sounds

MAKING SURE YOUR PRE-PRACTICE AND YOUR KNOWLEDGE OF RESULTS FEEDBACK IS SPECIFIC!

Be Specific in Your Cues

Avoiding cueing "move your tongue."

Be specific. The tongue is 3 dimensional and has functionally distinct parts.



https://www.researchgate.net/publication/260219525_An_Introduction_to_Phonetics/figures?lo=1

Be Specific in Your Cues: /r/

KNOW THE PHONETIC REQUIREMENTS OF THE SOUND

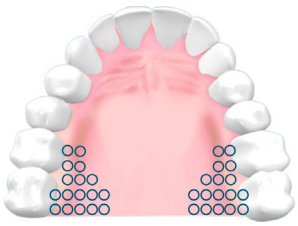
HAVE A GOOD GUESS AT WHAT YOUR CLIENT IS DOING WRONG

	Correct /r/	Distorted /r/
Front of tongue (tip, blade, anterior dorsum)	Up off floor of mouth toward hard palate	Too low
Posterior tongue dorsum	Low	Too high
Tongue root	Back in pharynx	Not retracted
Sides of tongue	Against back teeth	Lacking lateral contact

Be Specific in Your Cues: /r/

Tongue-palate contact

Correct /r/



Tongue shape

Correct /r/

Image: Boyce (2015)

These ultrasound images of the tongue are from a 7 year old with a derhoticized /ɹ/ and /ɝ/.

Notice the front of the tongue stays low during the rhotic sound.

Be Specific in Your Cues: /r/

	Phonetic Placement Cue	Shaping
Front of tongue (tip, blade, anterior dorsum)	Lift the front of the tongue up off the floor of the mouth	/l/ → /r/ to encourage elevation of front of tongue
Posterior tongue dorsum	Pull the back of the tongue down and back into your throat	/ɑ/ → /r/ to encourage low dorsum & tongue root retraction
Tongue root		
Sides of tongue	Feel the sides of the tongue against the back molars	/ʃ/ →/r/ or /i/ → /r/ to encourage elevation of sides of tongue

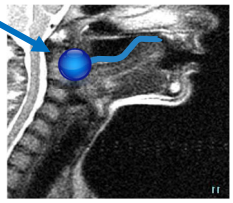
Be Specific in Your Cues: /r/

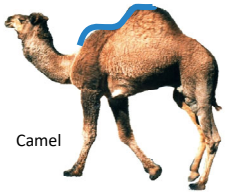
Analogies

Boat

Bird

Marble





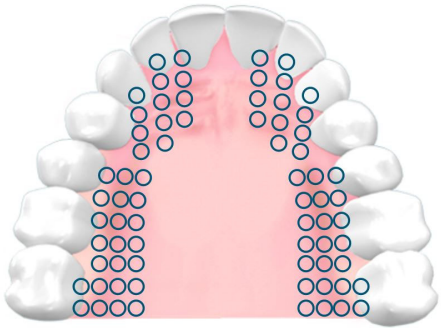
Camel

Be Specific in Your Cues

Use visual strategies to help children understand phonetic placement

- https://www.seeingspeech.ac.uk/ipa-charts/
- Sagittal ultrasound and animated images show children where the tongue should be in the mouth and what approximate shape
- Electropalatography images show where tongue contacts the hard palate

Be Specific in Your Cues: /s/



Be Specific in Your Cues: /s/

KNOW THE PHONETIC REQUIREMENTS OF THE SOUND

HAVE A GOOD GUESS AT WHAT ~~YOUR CLIENT IS DOING WRONG~~

	Correct /s/	Lateralized /s/	Dentalized /s/
Front of tongue (tip/blade)	Tip up to alveolar ridge forming a groove OR Tip down, blade up to alveolar ridge forming a groove	Tip up to alveolar ridge No groove	Tip or blade up against teeth (too far farward) Very minimal groove (too shallow/skinny)
Sides of tongue	Against back teeth	Lacking lateral contact	Against back teeth

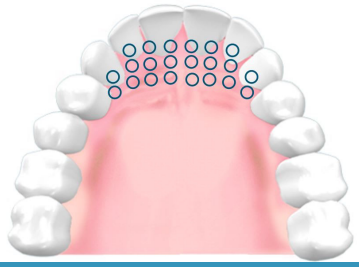
Be Specific in Your Cues: /s/

Cues for lateralized distortions of /s/, /z/, /ʃ/, /ʧ/

- Lift sides of the tongue up
- Press sides of the tongue against back teeth (molars)
- Air should go down the center of the tongue, not out the sides
- Make a groove in the middle of the tongue

Be Specific in Your Cues: /l/

Press the tip behind the top front teeth only

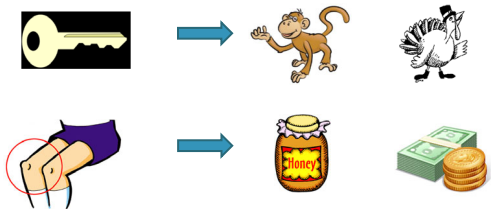


Speech-Motor Chaining

Speech Motor Chaining

Core syllable patterns: CC, VC, CC

Core syllable is targeted, then build around it



Young (1987)

Speech Motor Chaining

Forward Chaining
- /re/ → raid → radio → radio station
- /lo/ → load → loading → loading the truck

Backward Chaining
- /ro/ → rose → arrows → shoot the arrows
- /ɪʧ/ → witch → sandwich → make a sandwich

(cf. Preston et al., 2013, 2014)

Speech Motor Chaining General Session Structure

Pre-practice – Focus on *acquisition* of target syllable
- Cue, cue, cue, cue
- Feedback, feedback, feedback, feedback
- Make it easy. Give lots of help. Aim for success

Practice – *practice* the target
- Less cueing/feedback
- Make it systematically harder (but achievable)
- Aim to challenge the child. Some errors are okay.
- Focus on *motor learning*

Speech Motor Chaining Pre-Practice Structure

Focus on *acquisition* of target syllables, achieve stimulability

We aim for 12 correct productions of a sound in multiple examples of a syllable position (3 correct in each of 4 contexts)
- Ex: Target /r/ onset: /re/ /ro/ /tr/ /br/
- Ex: Target /s/ coda: /is/ /es/ /ps/ /ts/

Strategies
- Phonetic Placement Cueing
- Facilitating Contexts
- Shaping

Speech Motor Chaining Practice Conditions

Increasing complexity in 5 levels
- Syllables → monosyllabic words → multisyllabic words → phrases → sentences
- All in one session, if possible

Reducing amount of feedback

Changing type of feedback

Encouraging self-monitoring

Adding prosodic variation
- Varied rate (fast, slow)
- Varied loudness (loud, whisper)
- Varied intonation (rising, falling)

Speech Motor Chaining Practice Conditions

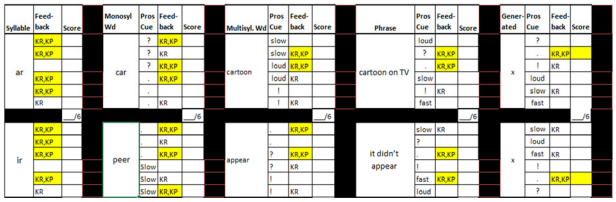
Practice occurs in blocks of 6 consecutive attempt

Decision is made after 6 attempts:

- Do I make the task harder?
- Do I make it easier?

We use 5/6 correct as our criteria for advancing

Speech Motor Chaining Sample Data Sheet



Speech Motor Chaining

Video Examples

Speech Motor Chaining Free Resources

Manuscript, sample speech motor chaining data sheet, video examples freely available https://osf.io/5jmf9/

Case Study

Tommy is now a 8th grader. His is still not yet stimulable for /r/, /s/, /l/

How do you teach these sounds?

Biofeedback Approaches

ON THE HORIZON

Ultrasound biofeedback training

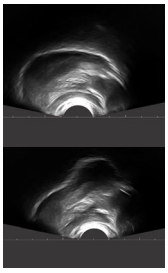
Ultrasound may be a useful biofeedback tool for correcting certain errors on lingual phonemes

- Liquids /r, l/
- Lateralized sibilants
- Velars
- Alveolars
- Vowels

*For CAS, ultrasound may give clients additional information about sequencing skills

What is ultrasound biofeedback and why might we want to use it?

Ultrasound visualization of the tongue in real-time



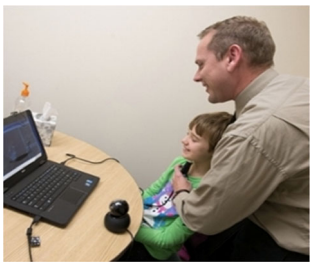
Preston et al 2013, 2014

What is ultrasound biofeedback and why might we want to use it?

Facilitate Acquisition

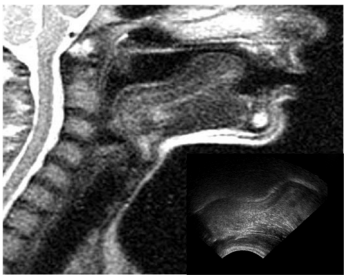
Teach stimulability for new sounds

Provide detailed feedback about tongue movements (Knowledge of Performance feedback)



Interpreting the Images: Sagittal view

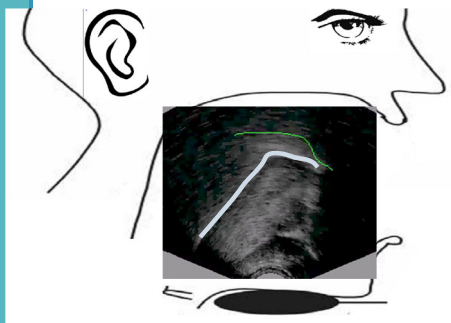
Images courtesy of Suzanne Boyce



Alveolar Consonants

What do you expect to see happening?

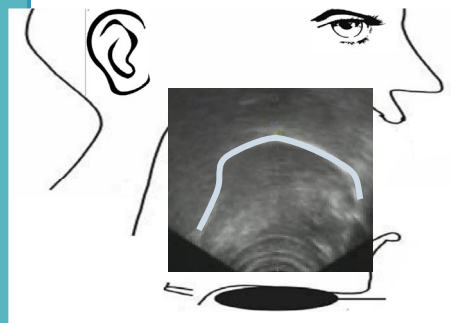
/t, d, n/

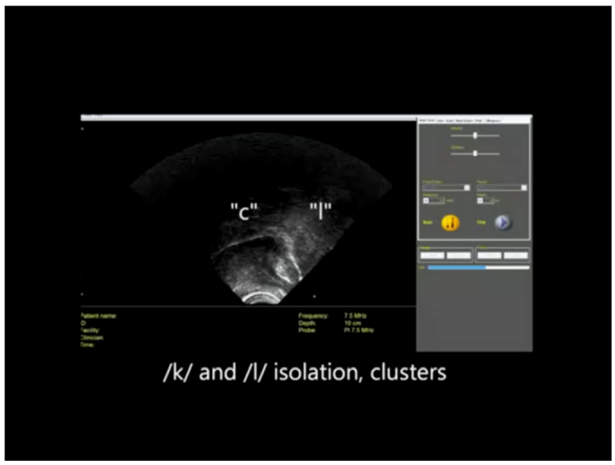


Velar Consonants

What do you expect to see happening?

/k, g, ŋ/

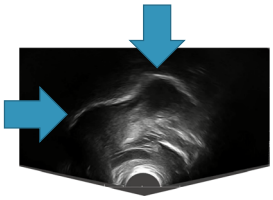




Rhotic sounds /r/

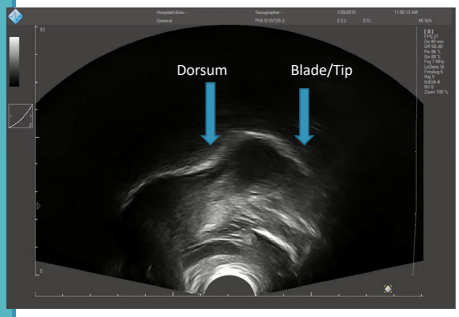
English /r/ has a complex articulatory configuration consisting of **two major tongue constrictions**:

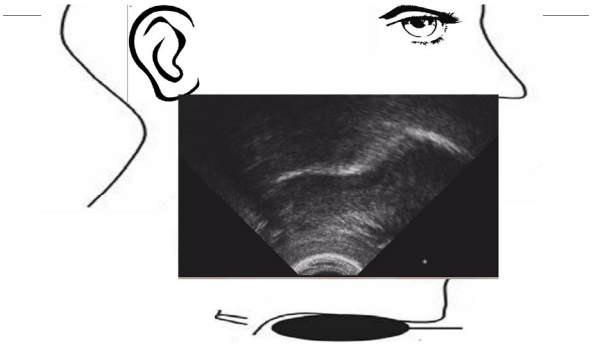
1. Anterior (oral)
2. Posterior (pharyngeal)

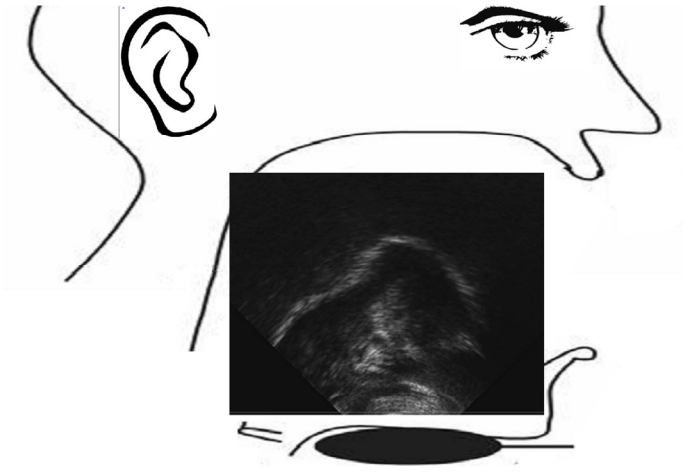


Sagittal view

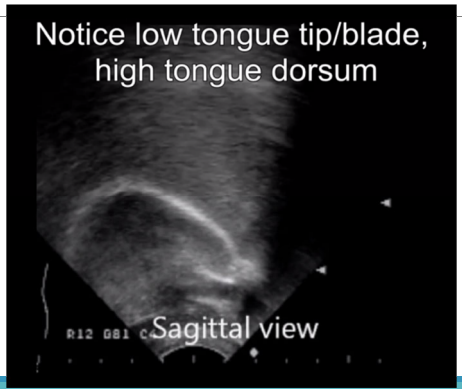
Bunched /r/



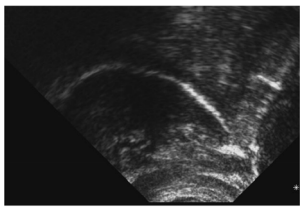
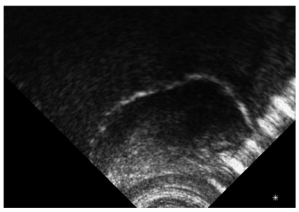




Distortion



Which do you think is “correct” /r/?

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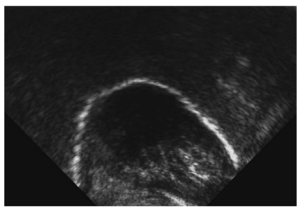
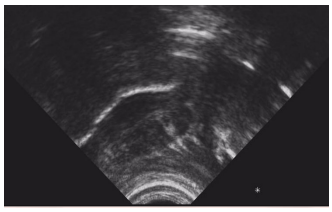
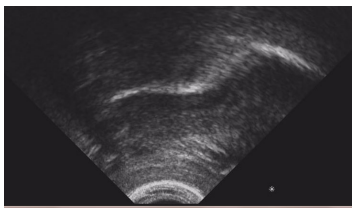
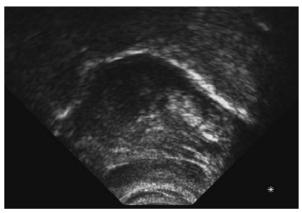
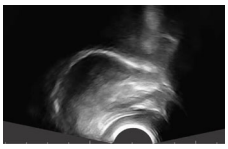
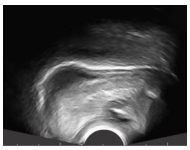
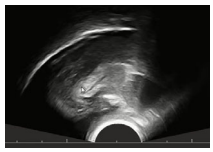



Which do you think is “correct” /r/?

Which do you think is “correct” /r/?

Ongoing efforts

Study in Syracuse testing whether ultrasound biofeedback improves treatment outcomes for kids with CAS

- Visual feedback can be used for /r, l, s, z, k, g, n, t, d, ʤ, ʧ, ʃ)

Also testing the effects of intensive therapy vs. traditional scheduling

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Other current topics in CAS

Non-speech Oral Motor Exercises to address speech?



Summary

Consider incorporating Principles of Motor Learning into treatment to facilitate generalization

- DTTC can be an effective approach for moderate to severe CAS
- ReST may be appropriate to address prosody and transitioning between sounds and syllables in moderate CAS
- Speech motor chaining (with or without ultrasound) may help establish consistent speech sounds or syllable transitions in varied stress patterns for mild or moderate CAS

Keep up the great work!

PhDs are always needed!

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Evidence Summary - Childhood Apraxia of Speech – September 2018

McCabe, P., Murray, E. & Thomas, D.

This document is a free summary of the current evidence on assessment, diagnosis and treatment of Childhood Apraxia of Speech (CAS; aka Dyspraxia). Please seek advice from your speech pathologist. **This evidence summary is only valid until December 2021**.

Background

Childhood Apraxia of Speech is a severe permanent and lifelong disorder of speech motor programming and planning which is present from birth and does not naturally resolve. In recent years, substantial progress has been made in improving speech pathology treatment for CAS but there remains a large number of older children, adolescents and adults who have severe limitations to all aspects of their lives due to ineffective and/or insufficient treatment in earlier years. Recent advances in treatment efficacy in preschool and primary years should reduce this extended prevalence tail over time however there is emerging evidence that a significant burden of psychosocial, educational, economic and communication deficits remains across the lifespan with resultant restrictions on participation and daily life.

Most people with CAS have an idiopathic diagnosis (unknown cause) however CAS can co-occur with all other developmental conditions including other communication disorders. In recent years, a spate of genetic micro duplications and deletions have been reported in syndromic presentations of CAS and there is a particularly prominent familiar presentation associated with severe CAS with dysarthria and language impairment associated with a particular FoxP2 genotype. CAS has increased frequency in children and adults with galactosaemia, epilepsy, or Down Syndrome but has no increased prevalence in children with autism above the population prevalence of approximately 1 in 1000 children.

CAS may occur as an isolated disorder or may present in combination with other speech, language, literacy and developmental disorders.

Assessment

Diagnosis of CAS requires skilled assessment by **a suitably qualified and experienced speech pathologist**. Best practice in assessment depends on the child's age, severity and comorbidities.

Suggested Assessment protocols

Younger or more severe speech impairment	**Older or milder speech impairment**
Single word speech sound inventory – word list does not have to be standardised but should include at least 50 common words appropriate for age and cultural background with a range of sounds and syllables	Single word test using at least 30 polysyllabic words appropriate for age, language, accent and culture and including weak onset word structures
Oral musculature structural and functional evaluation	Oral musculature structural and functional evaluation
Diagnostic evaluation of motor speech skills (DEMSS) or TOCS+ or Nuffield Dyspraxia Programme – 3rd edition assessment	Speech diadochokinesis tasks (e.g. 'peteke')
Hearing assessment prior to speech pathology assessment	Sample of connected speech including polysyllabic words (words of 3 or more syllables)
	Measure of inconsistency such as DEAP, SRT or repeated productions from the single word test used.

Diagnosis of CAS requires that a child at a minimum meets all three ASHA (2007) consensus-based features of CAS:

1. *Inconsistency across words and syllables*
2. *Lengthened and disrupted coarticulatory transitions.*
3. *Inappropriate prosody.*

Additionally, for a diagnosis of CAS to be accurate, children need to have a clear intent to communicate regardless of age or severity.

Speech Pathology
Sydney School of Health Sciences
The University of Sydney
S153 Cumberland Campus
Lidcombe
NSW 2141 Australia

T +61 2 9351 9747
E tricia.mccabe@sydney.edu.au
sydney.edu.au/health_sciences/staff/tricia_mccabe

ABN 15 211 513 464
CRICOS 00026A

Severity of CAS has not been formally defined within the literature however clinicians may use the following factors in determining severity:

1. Intelligibility – children with more severe CAS will struggle to be intelligible even to immediate family.
2. Speech inventory (number of sounds and syllable structures) in comparison to other people of the same chronological or language age.
3. Number of features of CAS present and severity of features. These lists of features come from two sources (ASHA, 2007 and Shriberg, Potter and Strand, 2010).
4. In older children, adolescents and adults: Difficulty saying new or longer words, avoiding speaking tasks such as using the phone, social isolation or reduced quality of life.

Treatment

Until 2015 there were no randomised control trials in treatment of CAS. Murray, McCabe and Ballard (2015) reported an RCT comparing the Nuffield Dyspraxia Programme (3rd ed; NDP3) with Rapid Syllable Transition Treatment (ReST). Both treatments were effective in changing the speech of children aged 4-12 with CAS. NDP3 had better immediate effect and ReST had better long term effect. Both treatments are therefore currently recommended when delivered as per the RCT (ie 4 days per week for 3 weeks @ 1 hour per day). These two are gold standard at this stage although work is underway on RCTs evaluating other CAS treatments.

Three systematic reviews have been conducted in the past 5 years. The first two (Murray, McCabe & Ballard, 2014 and Maas, Gildersleeve-Neumann, Jakielski & Stoeckel 2014) examined a broad range of treatment evidence for a range of quality measures. Murray et al recommended clinicians use

1. **Rapid Syllable Transition Treatment (ReST)**
2. **NDP3**
3. **Dynamic Temporal and Tactile Cueing (DTTC)**
4. **Integrated Phonological Awareness (IPA)**

From this list, ReST and IPA are suitable for less severe and/or older children. DTTC and NDP3 are more suitable for younger and/or more severe children. Resources and training for ReST, IPA and DTTC are freely available on the internet and NDP3 is a kit which can be purchased from the UK.

Maas and colleagues (2014) examined the treatment research to determine likely treatment approach and dose. They reported that on average effective treatment requires 2-6 sessions per week for an undescribed maximum (more than 1 year). In addition to the treatments listed above, Maas (2014) also included:

5. **Ultrasound biofeedback**

This is more suitable for primary school aged children and older with milder speech issues. Ultrasound biofeedback is beyond the scope of many clinicians due to costs of equipment.

In the most recent systematic review, Morgan, Murray, and Liégeois (2018) in the Cochrane Database reported that only ReST and NDP3 had RCT level evidence and called for more treatment research. They noted that there is now also single case experimental design evidence that ReST can be effective when delivered by telehealth 4 days per week and when provided twice per week face-to-face. In both of these service delivery options, the long term effect appears to be poorer than face-to face 4 days per week.

Effective treatment for children with CAS and comorbid speech disorders needs to take into account both evidence for CAS treatment and for dysarthria treatment. For example, a child with dysarthria and CAS may benefit from DTTC which has evidence of efficacy with both disorders.

Other treatments have less well developed evidence and should be undertaken with caution as they have not yet been shown to be effective in multiple studies of children who clearly had CAS.

Treatment Intensity

The CAS treatment evidence shows that therapy 4 times a week in blocks of 12-15 sessions followed by a 4-6 week break from therapy is optimal (Murray et al, 2015). All studies to date have showed that the greater the treatment intensity the more effective the therapy and the more efficient the progress (e.g. Edeal and Gildersleeve-Neumann, 2012). A minimum of two sessions a week has been shown to work clinically (e.g. Namasivayam et al, 2015; Thomas et al, 2014). Session length ideally should be 45-60 minutes but will depend on both the child and the treatment selected.

Group Therapy

There is no evidence for any group treatment being trialled in any level of research with any person with CAS since 1960. Group treatment is not recommended for any CAS feature and there is no theoretically sound reason for it to be trialled. People with CAS may benefit from evidence-based group therapy interventions for their co-morbid conditions but again there is no research evidence for such treatments in people with CAS who have comorbid conditions.

Therapy by people who are not Speech Pathologists.

There is very limited evidence that therapy for CAS can be provided by anyone other than a speech pathologist. In all but three studies, speech pathologists have provided therapy. Two studies (Thomas et al 2017; Lim in press) have trialled parent delivered therapy with limited success and it is not currently recommended. One study (Lim et al, 2019) has trialled teacher's aides providing DTTC therapy which was moderately successful.

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Speech Motor Chaining Datasheet

Clinician: **Participant:** **Session #:** **Time Period** A **Date:**

PREPRACTICE

Sound/Position Elicitation fc /rɑ/ Elicitation for /ri/

/r/onset Elicitation fc /ræ/ Elicitation for /re/

Syllable	Feed-back	Score	Self-Rate	Monosyl Wd	Pros Cue	Feed-back	Score	Self-Rate	Multisyl. Wd	Pros Cue	Feed-back	Score	Self-Rate	Phrase	Pros Cue	Feed-back	Score	Self-Rate	Gener-ated	Pros Cue	Feed-back	Score	Self-Rate
/rɑ/	KR,KP			rock	?	KR,KP			rocket	slow				a rocket into space	loud				x	?			
	KR,KP				?	KR				slow	KR,KP				?	KR,KP				.	KR,KP		
					?	KR,KP				loud	KR,KP				.	KR,KP				!	KR		
	KR,KP				.	KR,KP				loud	KR				slow					loud			
	KR,KP				.					!					!	KR				slow	KR		
	KR				.	KR				!	KR				fast					fast			
		0	0				0	0				0	0				0	0				0	0
/ræ/	KR,KP			rack	.	KR,KP			racket	.	KR,KP			too much racket	slow	KR			x	slow	KR		
	KR,KP				.	KR				.					?					loud			
	KR,KP				.	KR,KP				?	KR,KP				.	KR,KP				fast	KR		
					Slow					?	KR				!					!			
	KR,KP				Slow	KR				!					fast	KR,KP				.	KR,KP		
	KR				Slow	KR,KP				!	KR				loud					?			
		0	0				0	0				0	0				0	0				0	0
/ri/	KR,KP			read	slow	KR,KP			reading	slow	KR,KP			reading a good book	loud	KR,KP			x	fast	KR,KP		
					slow					slow					slow	KR				loud	KR		
	KR,KP				slow	KR				!	KR,KP				fast	KR,KP				?	KR		
	KR,KP				?	KR,KP				!	KR				?					slow			
	KR,KP				?	KR,KP				?					!					!			
	KR				?	KR				?	KR				.					.			
		0	0				0	0				0	0				0	0				0	0
/re/				race	.				racing	.				racing on bikes	.	KR			x	loud	KR		
	KR,KP				.	KR,KP				.	KR,KP				?					?			
	KR,KP				.	KR,KP				loud					slow	KR,KP				fast	KR		
	KR,KP				slow	KR				loud	KR				!					!			
	KR,KP				slow	KR,KP				!	KR,KP				fast	KR,KP				.	KR,KP		
	KR				slow	KR				!	KR				loud					slow			
		0	0				0	0				0	0				0	0				0	0
/rɑ/	KR,KP			rob	?	KR,KP			robbing	slow				robbing a bank	!				x	slow			
	KR,KP				?	KR				slow	KR,KP				?	KR,KP				?	KR		
	KR,KP				?	KR,KP				.					fast	KR,KP				!	KR,KP		
	KR,KP				slow	KR,KP				.	KR				slow					loud			
					slow					?	KR,KP				loud					fast			
	KR				slow	KR				?	KR				.	KR				.	KR		
		0	0				0	0				0	0				0	0				0	0
/ræ/	KR,KP			rat	.	KR,KP			rattlesnake	!	KR,KP			rattlesnake in the grass	?	KR,KP			x	fast	KR,KP		
	KR,KP				.					!	KR,KP				.					.			
					.	KR				slow	KR				fast	KR				?	KR		
	KR,KP				?	KR,KP				slow	KR				slow					loud			
	KR,KP				?	KR				.					loud					slow			
	KR				?	KR,KP				.					!	KR,KP				!	KR		
		0	0				0	0				0	0				0	0				0	0
/ri/	KR,KP			reek	slow	KR,KP			recline	?	KR,KP			recline on the couch	!	KR,KP			x	!	KR,KP		
	KR,KP				slow					?	KR,KP				?					fast			
					slow	KR				loud	KR				slow	KR				slow	KR		
	KR,KP				.	KR,KP				loud	KR				.					.			
	KR,KP				.	KR				.					loud					loud			
	KR				.	KR,KP				.					fast	KR,KP				?	KR		
		0	0				0	0				0	0				0	0				0	0
/re/	KR,KP			rain	?	KR,KP			rainy	slow	KR,KP			rainy day	fast	KR,KP			x	!	KR,KP		
	KR,KP				?					slow	KR,KP				loud					fast			
					?	KR				?	KR				?	KR				?	KR		
	KR,KP				slow	KR,KP				?	KR				!					loud			
	KR,KP				slow	KR				!					slow					slow			
	KR				slow	KR,KP				!					.	KR,KP					KR		
		0	0				0	0				0	0				0	0				0	0

Speech Motor Chaining Datasheet

Clinician: **Participant:** **Session #:** **Time Period** A **Date:**

PREPRACTICE

Sound/Position Elicitation for Elicitation for Elicitation for Elicitation for

Syllable	Feed-back	Score	Self-Rate	Monosyl Wd	Pros Cue	Feed-back	Score	Self-Rate	Multisyl. Wd	Pros Cue	Feed-back	Score	Self-Rate	Phrase	Pros Cue	Feed-back	Score	Self-Rate	Gener-ated	Pros Cue	Feed-back	Score	Self-Rate
	KR,KP				?	KR,KP				slow					loud					?			
	KR,KP				?	KR				slow	KR,KP				?	KR,KP				.	KR,KP		
					?	KR,KP				loud	KR,KP				.	KR,KP			x	!	KR		
	KR,KP				.	KR,KP				loud	KR				slow					loud			
	KR,KP				.					!					!	KR				slow	KR		
	KR				.	KR				!	KR				fast					fast			
		0	0				0	0				0	0				0	0				0	0
	KR,KP				.	KR,KP				.	KR,KP				slow	KR				slow	KR		
	KR,KP				.	KR				.					?					loud			
	KR,KP				.	KR,KP				?	KR,KP				.	KR,KP			x	fast	KR		
					Slow					?	KR				!					!			
	KR,KP				Slow	KR				!					fast	KR,KP				.	KR,KP		
	KR				Slow	KR,KP				!	KR				loud					?			
		0	0				0	0				0	0				0	0				0	0
	KR,KP				slow	KR,KP				slow	KR,KP				loud	KR,KP				fast	KR,KP		
					slow					slow					slow	KR				loud	KR		
	KR,KP				slow	KR				!	KR,KP				fast	KR,KP			x	?	KR		
	KR,KP				?	KR,KP				!	KR				?					slow			
	KR,KP				?	KR,KP				?					!					!			
	KR				?	KR				?	KR				.					.			
		0	0				0	0				0	0				0	0				0	0
					.					.					.	KR				loud	KR		
	KR,KP				.	KR,KP				.	KR,KP				?					?			
	KR,KP				.	KR,KP				loud					slow	KR,KP			x	fast	KR		
	KR,KP				slow	KR				loud	KR				!					!			
	KR,KP				slow	KR,KP				!	KR,KP				fast	KR,KP				.	KR,KP		
	KR				slow	KR				!	KR				loud					slow			
		0	0				0	0				0	0				0	0				0	0
	KR,KP				?	KR,KP				slow					!					slow			
	KR,KP				?	KR				slow	KR,KP				?	KR,KP				?	KR		
	KR,KP				?	KR,KP				.					fast	KR,KP			x	!	KR,KP		
	KR,KP				slow	KR,KP				.	KR				slow					loud			
					slow					?	KR,KP				loud					fast			
	KR				slow	KR				?	KR				.	KR				.	KR		
		0	0				0	0				0	0				0	0				0	0
	KR,KP				.	KR,KP				!	KR,KP				?	KR,KP				fast	KR,KP		
	KR,KP				.					!	KR,KP				.					.			
					.	KR				slow	KR				fast	KR				?	KR		
	KR,KP				?	KR,KP				slow	KR				slow				x	loud			
	KR,KP				?	KR				.					loud					slow			
	KR				?	KR,KP				.					!	KR,KP				!	KR		
		0	0				0	0				0	0				0	0				0	0
	KR,KP				slow	KR,KP				?	KR,KP				!	KR,KP				!	KR,KP		
	KR,KP				slow					?	KR,KP				?					fast			
					slow	KR				loud	KR				slow	KR			x	slow	KR		
	KR,KP				.	KR,KP				loud	KR				.					.			
	KR,KP				.	KR				.					loud					loud			
	KR				.	KR,KP				.					fast	KR,KP				?	KR		
		0	0				0	0				0	0				0	0				0	0
	KR,KP				?	KR,KP				slow	KR,KP				fast	KR,KP				!	KR,KP		
	KR,KP				?					slow	KR,KP				loud					fast			
					?	KR				?	KR				?	KR			x	?	KR		
	KR,KP				slow	KR,KP				?	KR				!					loud			
	KR,KP				slow	KR				!					slow					slow			
	KR				slow	KR,KP				!					.	KR,KP					KR		
		0	0				0	0				0	0				0	0				0	0