



Clinician Manual for Rapid Syllable Transition Treatment (ReST)

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Rapid Syllable Transition Treatment

known as ReST

Introduction

This treatment was designed to directly address the underlying motor planning and programming problems experienced by children with Childhood Apraxia of Speech (CAS also dyspraxia), particularly with managing lexical stress and transition from sound to sound or syllable to syllable (ASHA, 2007).

We aimed to use as many of the principles of motor learning (neuroplasticity) as we could so each treatment session is designed to have two parts. First a **Training phase** (called *pre-practice* in the motor learning literature) and second a **Practice phase** (also called *practice* in the motor learning literature). These two components require different behaviours from both clinician and child.

The **Training phase** of each session looks pretty much like traditional speech-based therapy. The clinician uses all of the tools in their repertoire to teach the child what they need to do. The **Practice phase** of each session looks very different to traditional therapy and is the part that challenges most experienced clinicians.

Theoretical background

ReST is different from other CAS treatments as it is grounded in theory based on the current best evidence and theory in motor planning and programming (van der Merwe, 2009), Schema Theory (Schmidt, 1975), Principles of Motor Learning (Maas et al, 2008) and prosody and stimuli selection. Here is an overview of these theories.

CAS is believed to be a disorder of speech motor planning and programming (ASHA, 2007). This means the child knows what they want to say and can select appropriate words and sounds however the instructions on when and how to move their lips, tongue, jaw, soft palate and vocal folds in real time are degraded (van der Merwe, 2009). They can move their lips, tongue, jaw, soft palate and vocal folds accurately for example when eating, but have difficulty creating, modifying, evaluating, retrieving or storing motor instructions or plans and programs for speech.

According to Schema Theory (Schmidt, 1975 and subsequent) we store regular or learned movements such as sounds, syllables, words and phrases that are used frequently in General Motor Plans (GMP). These are “the idea” of the movement and not any given utterance. When we come to say a word we take this and modify it by a range of movement “parameters”. Parameters are the variations in the sequence, rate, range, or strength of movement. In speech these parameters allow us to speak slower or faster, louder or softer and most importantly allow us to use co-articulation to make speech easier and more fluent. Parameterisation also influences both sentence prosody and emotional prosody. Once we have applied the relevant parameters we have a Specific Motor Plan (SMP) which is the set of instructions sent to the muscles and includes all the timing instructions as well as the individual phones.

During and after the movement, we use our senses of touch, proprioception and hearing for feedforward and feedback commands. Feedforward allows us to modify what is coming up. Feedback allows us to evaluate and store the GMP for use on another occasion. There is current evidence which suggests breakdown in CAS in both feedforward and feedback mechanisms.

Once you have practiced a motor movement, and used your feedback mechanism you need to store the movement memory (in your brain, muscles do not have memories). We also currently believe that children with CAS may have trouble storing or retrieving these movement memories

The ReST treatment specifically uses nonsense words with varied stress (beats) and sounds so children learn the instructions to say these words, but also to use these as a template to learn other words and fix existing real word productions. A major part of learning motor movements is adapting the General Motor Plan and the main way to do this is through practice – that is, learning to make these movements automatically. ReST meets this goal by implementing Principles of Motor Learning to ensure the capacity for learning movement is improved generally – not just for the nonsense words as part of the treatment. The nonsense words are a means to an end, helping us teach the CAS consensus-based core features. Therefore data collection for ReST needs to include the treatment nonsense words but also generalization probes of real words.

ReST is designed to activate and use components of the speech motor system without reference to the broader language system (except of course phonology) by using nonsense words chosen for each child. We believe that by creating novel motor plans, practicing them frequently, and using both feedforward and feedback to improve the production of the target nonsense words we may be improving the child's capacity to use speech motor planning and programming effectively.

Disclaimers

While ReST has been shown to be effective in Australian English with children and young people aged 4-13, it has not been independently tested and we do not know what the active ingredients in the therapy are. It may be that over time we will discover that only some of the program is required but for now, since we don't know which parts you can safely omit and retain a therapy effect, we recommend that you include all components of the treatment, regardless of your "belief" in their utility.

ReST therapy will not suit all children. In the pilot phase we treated two three-year-olds. This was unsuccessful. We have not yet researched using ReST with children with syndromes or hearing impairment so clinicians should proceed cautiously, and ideally should collect the kind of session and progress data we report in the single case experimental design papers to ensure they know if they have treatment efficacy for the individual child.

The content of this manual differs from each of the research studies in several ways. Firstly, we have shown a number of variations have been effective and therefore these variations are included. Secondly, some of the things we did in the research were for research purposes rather than clinical ones, these have been omitted. We have however provided you with all the materials you will need to administer ReST as per the research so the client you are seeing can be expected to succeed. We have tried to assist with that by putting therapy cards, PowerPoint slides, data sheets and data collection ideas on the ReST website.

This therapy is different to usual speech pathology practice and in each of the research studies speech pathology students were trained to deliver the treatment effectively. The hardest part of treatment is giving cues and providing feedback for prosody (lexical stress), syllable segregation (smoothness) and articulation including mixed resonance at the same time. It is possible you will need to update your transcription skills with diacritics and to practice listening to these aspects to provide successful treatment. The accompanying website contains listening exercises to help with this revision.

Finally, it is important to remember that a child with CAS may also, independently or as a consequence of their CAS, have phonological or articulation errors, stuttering, or a voice disorder. These should be considered in goal setting in ReST and may need treatment before or after a block of ReST therapy.

Child and Clinician Minimum Requirements.

ReST is designed to be used with children who can produce a reasonable number of sounds and use CV structured syllables. The minimum repertoire is 4 consonants and 4 vowels. We have used it successfully with children aged 4-13 but the younger children (especially 4year olds) need to be resilient and all the successful 4year olds have had previous speech therapy. Most 5year olds who are attending school have no problems with the therapy. At the other end of the age range, older children and adolescents enjoy the treatment.

Children need to be able to tolerate about 10 minutes of drill at a time and a 50-60 minute therapy session. Children (and parents and clinicians) need to have some resilience or tolerance of failure.

Clinicians also need to be able to follow a set program, be resilient to children having limited success in the early stages, and be able to resist the temptation to give feedback on every turn. Clinicians may need to revise their knowledge of prosody and the accuracy of their transcription with supplemental diacritics as needed for resonance, prosody and other errors.

We have created a ReST Readiness checklist which you can obtain from the website.

Service delivery models and therapy intensity.

ReST uses the principles of motor learning (neuroplasticity) which means children receive intensive therapy. In most of our studies, we have seen children for 4 sessions per week for 3 weeks. When therapy is delivered this way, most children have continued to improve with no extra therapy for up to 4 months following therapy.

We have also looked at less intense therapy consisting of 2 sessions per week for 6 weeks. These children made the same progress during treatment as those in the more intense format BUT they didn't improve as much after therapy finished.

We have also tried training parents to do the therapy but the treatment worked for fewer children than clinician-delivered therapy. The parents weren't able to reliably judge prosodic accuracy and they felt uncomfortable being the 'therapist'. Not all parents were able to satisfactorily implement the therapy, and they felt worried about doing the therapy incorrectly. At this stage **we are NOT recommending parent delivery of ReST**, even as supplementary homework.

All studies had a session length of about 1 hour, so a total of 12 hours therapy. All studies were individual therapy. ReST is not recommended for group treatment as it has not been tested in that format. **No homework is required** regardless of whether you do therapy 2 or 4 times per week.

Currently we recommend that children who complete an intensive block of ReST have a break from therapy or a break from speech work for a period of at least 6 weeks while the therapeutic effects are continuing. Children who have the less intensive therapy are less likely to have the flow on effect and therefore may not need a break but as yet we do not know how long ReST can be continued with effectiveness.

How to do ReST therapy

How do I know where to start?

If in doubt, start at **three syllables** ([See flowchart for outline](#)). More precisely:

- **Start at three syllables:** As long as the child can produce at least five different word of three syllables (albeit not 100% accurately), start at three syllables.
- **Two syllables:** For a child with fewer than 5 two syllable productions, start at two syllables.
- **For older children** who only have problems with prosody and longer words, start at three syllables but be prepared to step up to Cloze sentences (more about this later).
- **If you are choosing between 2 and 3 syllable words**, please consider:
 - Temperament of the child. Some children will have a go at the nonsense words without being overly concerned but others will not attempt the words if they are perceived to be difficult. Therefore start the child on the level they will engage with the treatment.
 - Setting them up for success. If you are unsure if they can do 2 or 3 syllables, starting on 2 syllables will allow them to learn what is expected in the treatment before stepping up to 3 syllable words. The 2 syllable words become a basis for the 3 syllable words, and 3 syllables for 4 syllable words and/or phrases.
 - The accuracy of their 3 syllable words. Children need to be able to produce at least 2 CVCVCV words to start on 3 syllable words (although they do not need to be perfect). Frequent sound (CV -> V) and syllable deletions may be best addressed in 2 syllable words initially.

Therapy goals

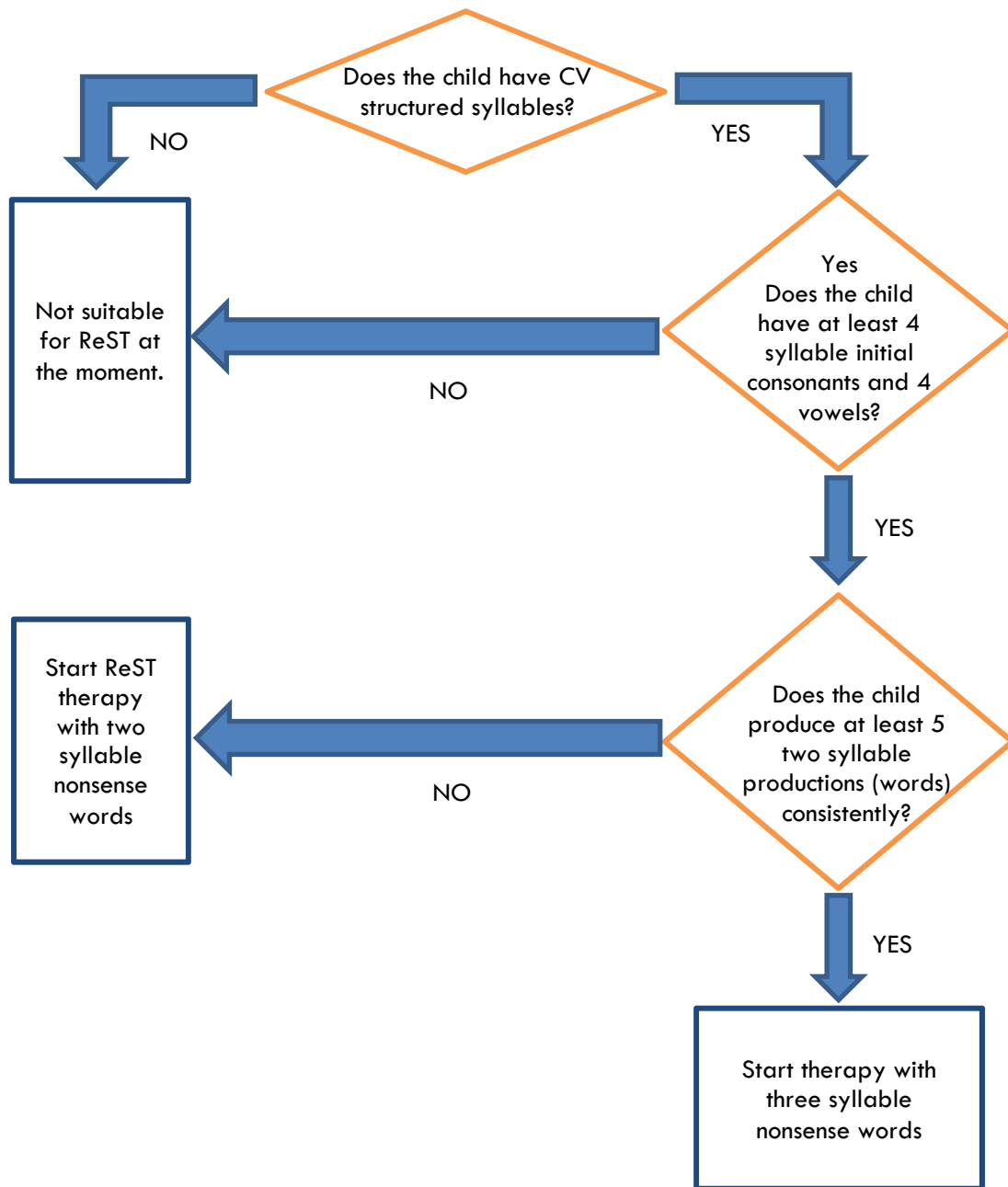
The goal of therapy is for the child to exactly match the adult model of how to say the nonsense words. If the child can do this in the Practice Phase to 80% correct over 100 trials and over two consecutive sessions, then the child moves up to the next step in the hierarchy.

Within a session, if the child has done two practice blocks with less than 10% correct across the blocks, the clinician should do another training block and then resume with the next practice block. If the child achieves less than 10% correct in the learning phase of two consecutive sessions then you should step down. See flow charts for clinical decision making.

We have not established discharge criteria from the research as each child was only seen for 12 sessions regardless of severity.

On the next page you will find a Goal Setting Flowchart, followed by some example goals.

ReST Goal Setting Flowchart



Example Goals

Basic goal: [Name] will produce 3 syllable nonsense words with simultaneously correct sounds, beats and smoothness in 80% of 100 trials in the practice phase.

Step up from the basic goal: [Name] will produce close phrases with a 3 syllable nonsense word with simultaneously correct sounds, beats and smoothness in 80% of 100 trials in the practice phase.

Step down from the basic goal 1: [Name] will produce 2 syllable nonsense words with simultaneously correct sounds, beats and smoothness in 80% of 100 trials in the practice phase.

Further step down 2: [Name] will produce 2 syllable nonsense words with two simultaneously correct elements (either sounds +beats, sounds + smoothness, or beats +smoothness) in 80% of 100 trials in the practice phase.

Preparation of Treatment Materials

Clinicians can:

- a. use an existing list of nonsense words from our website as is, if it suits the child, or
- b. adapt an existing list of nonsense words from our website by changing one or more consonants or vowels using a 'find and replace' command in Word, or
- c. use a specifically designed web application which has been created as a resource for this purpose, or
- d. create their own materials (see below).

Target Selection

The nonsense word sets focus on **4 consonants, 3 long vowels and schwa**.

Consonants:

The consonants should be in the child's inventory in **syllable initial position**.

The nonsense words have consonants that are **different** to each other – including at least **one voiced** and **one voiceless** phoneme. The nonsense words need at least 2 manner classes – e.g. plosives, fricatives/affricates, nasals or liquids.

An example of consonant combinations that were used in the research and have associated resources is /b, f, g, t/ (Murray, McCabe and Ballard, 2015). This word set also has other sounds (e.g. /m/ or /n/ for resonance and some short vowels as well as schwa to make the words as close to real words as possible). Sets of existing materials are available on the website (sydney.edu.au/health-sciences/rest).

Avoid later developing sounds or any sounds if there is any concern about the child being able to articulate them accurately in CV syllables. Therefore, if you want to use an existing set of nonsense-words, replace the sound they cannot say without lots of assistance with one in the same manner class (e.g. swap 'f' for 's' so keeping a fricative).

Vowels:

1. Choose **three long vowels** from the child's repertoire.
2. Also select **one weak or neutral vowel (e.g. schwa)**.
3. For some children in the research we selected **two long, one short and schwa**.

Nonsense words

As described above, you have four options for a nonsense word set for each child:

1. Use an existing set without modification, which are available at sydney.edu.au/health-sciences/rest
2. Use an existing set and modify it for your child
3. Make a new set using the app
4. Make a new set by hand.

More details of each option follow.

1. Existing lists of nonsense words.

We have loaded a number of word lists on the website www.sydney.edu.au/health-sciences/rest.

With the existing word lists you will find a range of resources that have been made for use in therapy including Word cards to print, PowerPoint lists of words, and session data sheets for the practice phase of each session. These resources were used in one or more of the research studies.

These lists will only be useful as is, if the entire set of consonants and vowels are appropriate targets for your child. Please use them cautiously. The words are phonotactically and phonemically allowable in Australian English so you may have to consider your own accent/dialect and modify either the spelling or the transcription.

2. Modifying existing lists of nonsense words.

If you would like to modify the lists please use the 'replace all' function in Word or PowerPoint to ensure you don't miss any changes. You can replace a consonant or vowel sound as needed so that the words match the consonants you have selected for the child.

3. Web application for creating nonsense words

We have created a web app that will help you create your nonsense words <http://128.199.223.3:4000>.

To use the app you will have to know which sounds you want to use for the child you are working with (see above [Target Selection](#) section for how to choose sounds). On the site you will find three sets of syllables in 3 columns – you simply choose 5 from each column and the program will create 10 Sww and 10 wSw words for you. If you don't like the words it provides simply ask the app to mix them up and start again. **Please do not delete any syllables.**

Syllabear These are the existing syllables. Click on four in each column then (they will be pale green)

	a	b	c
	bar	bee	dor
	dur	far	fee
	fer	for	kar
	kee	kor	kur
	par	pee	por
	pur	sar	see
	sor	sur	tar
	tee	tor	tur
		ba	fe
		ka	ke
		pa	pe
		sa	se
		ta	te
			ba
			ber
			bi
			da
			der
			di
			fa
			fer
			fi
			ka
			ker
			ki
			pa
			per
			pi
			sa
			si
			ta
			ter
			ti

When you have selected your syllables Click on the green tick to make your words

If the syllables we've provided are not the ones you need (e.g. wrong consonants or vowels), you can add more syllables to each list by selecting the yellow pencil icon. Again, please do not delete syllables.

To start-over select the red cross icon.

If you need two syllable words, create the three syllable words and remove the final syllable.

The syllables currently provided are phonotactically and phonemically permissible in Australian English but they may not work in your accent or language, so please check and work out that you can say them consistently and easily as you will be saying them many times.

Syllabear

Here are your new words

Sww	wSw
barketer	sabeedi
beeketer	pebeeter
beepeder	sabardi
barpedi	kebarter
korsadi	bakorter
korbadi	pedurba
beesada	sabarder
beekeda	pekorda
barpeder	sabarter
dorpeba	pebeeda

Click here to save them

Click here to shuffle the syllables

Read fonts.gstatic.com

You can save your wordlists to your computer by clicking on the folder icon and then on the floppy disk/save icon.

4. Making nonsense words by hand

1. Make nonsense syllables:

- Make syllables from the chosen consonants and vowels – each vowel and each consonant should be paired together.

For example:

Vowel	/p/	/s/	/d/	/k/
/u/	/pu/	/su/	/du/	/ku/
/a/	/pa/	/sa/	/da/	/ka/
/i/	/pi/	/si/	/di/	/ki/
/ə/	/pə/	/sə/	/də/	/kə/

2. Combine the nonsense syllables into nonsense words:

- From the **nonsense syllables** you will need to **compile nonsense words** at the level of complexity suitable for the individual child. Create 10 words with the format of [Sww]- Strong syllable (long vowel), Weak syllable [schwa or short vowel], Weak syllable [schwa/short vowel] e.g. “pahsikeh”/pasIkə/
- Create 10 words with the format of [wSw] -Weak syllable [schwa], Strong syllable (long vowel), Weak syllable [schwa/short vowel] e.g. “pesakeh” /pəsakə/ or /pəsakΛ/.

NB: Vowel phonemes and consonants should not repeat in any individual nonsense word.

In 3 syllable nonsense words the first weak syllable should always have a schwa and the final syllable can have either a short production of a vowel such as /Λ/ or schwa.

If the child needs the two syllable words, then make them Sw and wS, leaving off the final syllable. In this case the weak syllable will always be a schwa and from the examples above we get Sw /pasə/ ‘passeh’ and wS /pəsə/ ‘pehsah’.

Spelling the nonsense words

In our research we have mostly used “orthographically biased” words. This means we have used typical spellings that are always only produced one way. Since you probably don’t have access to the same database we used, we suggest that you use very clear spelling, and check with a number of adults from the child’s speech community for how they would say the nonsense words.

For example: “beedega” in Australian English is almost always said /bidəgΛ/ but it might be said as /bidəgɑː/ in American English - this is why you will need to check each word for your own accent. Generally in English, written double vowels are said as long vowels, but remember “book” and “moon” have the same spelling and different vowel sounds in many accents.

Final therapy preparations

Practice saying the nonsense words

Write the words phonetically if that will help you produce them consistently. It is really important that your models of the words are consistent and “normal”. By this we mean you must have a clear distinction between strong and weak syllables, normal speech rate and other prosody (relative syllable duration, pitch and volume). **Do not exaggerate your productions in the models.**

Prepare therapy materials

Write all 20 words orthographically on PowerPoint, cards, or pieces of paper.

When writing out the words, it's sometimes necessary to adjust the spelling. For example, the word 'pesake' could be read as pee – sake /piseIk/ (a two syllable word), when it should be /pəsakə/. Therefore, you might change the spelling to 'pesakeh'.

Starting Therapy

Sample Session Plans

TIME	Sessions 1-2	TIME	Sessions 3-12
0 - 0.05	Welcome, overview	0 - 0.05	Welcome, overview
0.05-0.25	Training	0.05-0.15	Training
0.25-0.55	Practice including 1. 20 trials (2 minute game) 2. 20 trials (2 minute game) 3. 20 trials (2 minute game) 4. 20 trials	0.15-0.55	Practice including 1. 20 trials (2 minute game) 2. 20 trials (2 minute game) 3. 20 trials (2 minute game) 4. 20 trials (2 minute game) 5. 20 trials
0.55	Summary, farewell	0.55	Summary, farewell

Training Phase

The first part of the session is aimed at developing a “**minimal reference of correctness**” for the child, which means they gain an understanding of the task and have some early success. This phase corresponds to Prepractice in the motor learning literature. The steps for teaching the ReST concepts might include:

1. Explain to the child that they need to **exactly match the way the clinician says the word**.
2. Explain how to do that.
 - a. Match all the sounds – say them the same way as the clinician
 - b. Match the beats – get the stress pattern correct
 - c. Match the smoothness – have all the syllables joined together the same way as the clinician

NB: These three things need to happen ALL at once for the production to be correct but you can start by teaching them separately, and then combine them in the training phase.
3. Randomly select words for training (in the first session) OR
Choose words which were consistently incorrect in the previous session for the next training session.
4. Provide any/all cues to the child on how to get the production correct. This could include:
 - a. Use modeling, visuals and explanations
 - b. Ask for an attempt
 - c. Provide “knowledge of results” feedback – saying whether it was correct or not and why. For example, “*Great work, you said it really smoothly*” or “*Nice sounds but it was all bumpy, Let’s try it again and get all the parts to join together*”
 - d. Ask for self-evaluation

- e. Play back a recording for the child to listen to
 - f. Break the three syllable word into a 2 syllables + 1 syllable, build up accuracy and then combine them back into the 3 syllables. **Be careful not to model staccato or robotic (equal stress) at any time.**
 - g. Some children appear impulsive in their productions. They may perseverate on a production possibly because they cannot suppress the old motor plan. Use cueing and explanation to get the child to delay attempting the word for a few seconds, they don't need to start immediately and some kids benefit from a delay.
 - h. Try simultaneous slow- or normal-speed productions
 - i. Slow down to increase accuracy and then speed up. If you slow-down be careful to retain the relative stress patterns across syllables.
5. Repeat all of these steps as required **until the child has made 5 correct productions of ANY of the nonsense words** with whatever feedback or teaching is required (doesn't have to be spontaneous or consecutive productions).

This phase could take 20-30 minutes in session 1 and 2 but should be restricted to no more than 10 minutes in all subsequent sessions. If you've done 10 minutes in subsequent sessions but the child still hasn't achieved 5 correct productions with lots of cueing, you may need to step down to two syllable nonsense words and start from there.

Teaching the concepts of Sounds, Beats and Smooth.

Depending on the age of the child, we use:

- the written words Sounds, Beats, Smooth
- wooden blocks/magnetic strips of varying length to indicate long and short syllables
- paper and pen to draw long and short, write letters, explain with pictures
- a drum for loud and soft beats
- a toy train with two carriages that attach or chain links to teach smoothness
- pictures which the child already associates with individual sounds
- dolls or pictures of people/animals that can be made to hold hands (smoothness)

Practice Phase

This is the most important part of the treatment.

This section is designed around those principles of motor learning known to facilitate long term change in motor skills.

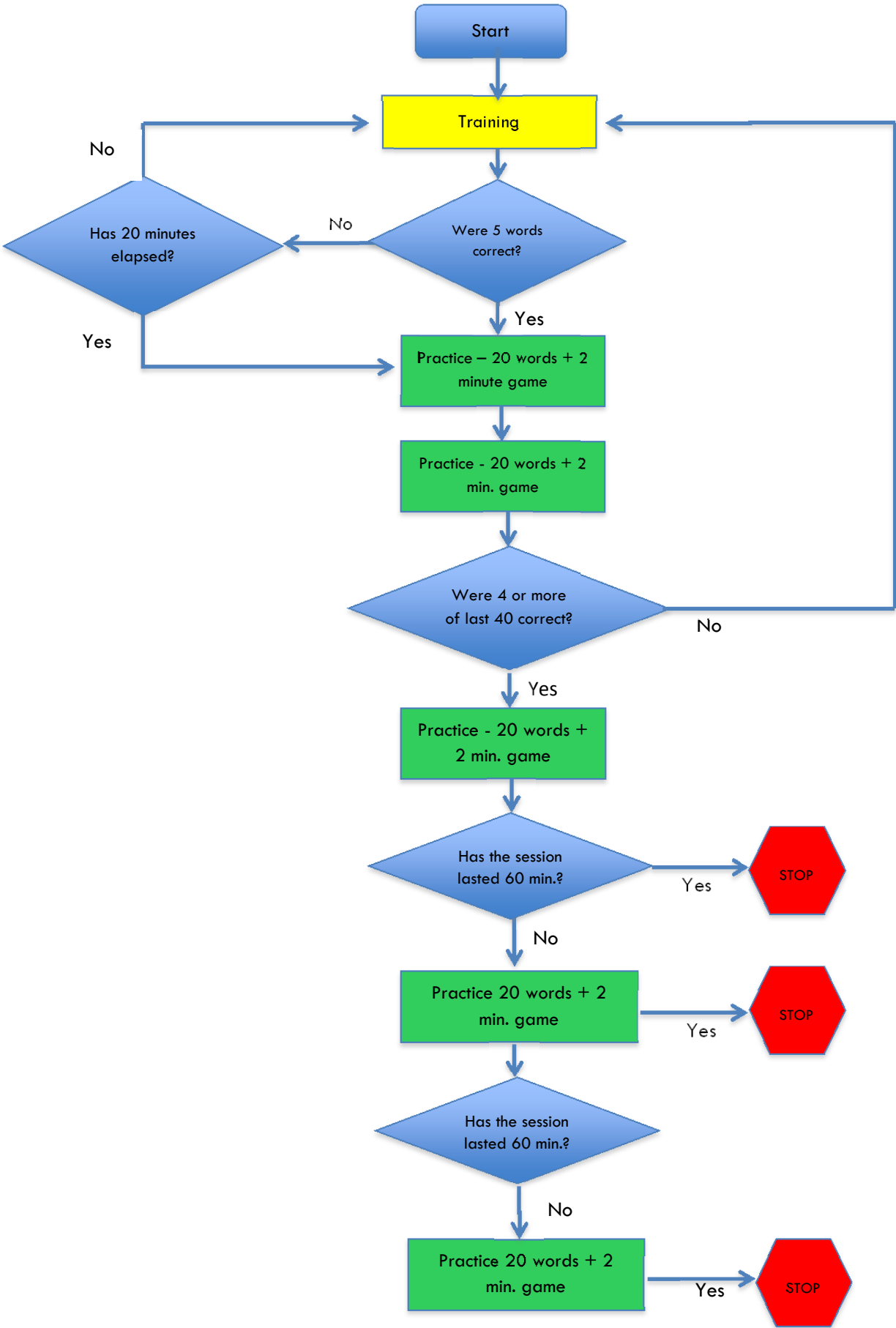
Do not be tempted to spend more time on training and less on practice as you will not get the same results. For an overview of the principles of motor learning, please see Maas et al., (2008).

Practice happens in 20 trial drill blocks, with a 2 minute non therapy game between blocks to reward the child and provide a very short break from the intense practice. The games can be anything you will both enjoy, such as trash bin basketball, Jenga, or tic-tac-toe, but should not be focused on speech, language or literacy (e.g. not Scrabble).

Remind the child that they need to get the Sounds, Beats and Smoothness correct all at once to be correct. Tell them, that you will tell them when they get it right or wrong but won't be able to help them fix it. Ask them to listen carefully and to only try to say the word when they are ready.

The PowerPoint files and data sheets have the words randomly presented. Present the first card or PowerPoint slide and say the word to the child. Ask the child to copy you. Listen to the child's production and check whether the child matched (or did not match) your production. In order to be a match, the word needs the same sounds, the same stress pattern and the same smoothness as the model.

Treatment Session Flowchart



Phonemically transcribe the child's response – this gives you a delay before you give feedback. You should wait for at least 3 seconds before you give feedback. Delayed feedback is a principle of motor learning and is known to facilitate storage of the correct production and self-evaluation.

You are aiming for 100 of these productions every session. You should present 20 randomly selected words in a block and then have your short break.

Providing Feedback to the child

Knowledge of Results Feedback

Give feedback on whether the child said the word the same as you (correct) or differently (incorrect). Do not tell them how to fix it. This type of feedback is called “*Knowledge of Results*”. For example “*Great work*”, “*Not that time*”. This is the opposite of what many people are told to do as beginning speech pathologists, because it is deliberately not specific. It is important to give Knowledge of Results feedback because it facilitates the child making self-directed changes to their speech.

You can also give summative feedback, such as “in that block you got 10/20 right. This is more useful for older children.

Rate of Feedback

Give feedback on 50% of the items in the practice phase. The asterisks on the data sheet indicate which items to provide feedback. The asterisks have been randomly allocated to items in the following manner:

- On the first block of 20, feedback for a random 18/20 attempts.
- On the next block, feedback for 14/20 attempts.
- On the third block, feedback for 10/20
- On the fourth block, feedback for 6/20
- and on the final block, feedback for 2/20 attempts.

This gives you random feedback on 50% of attempts. Random, low-frequency feedback results in better retention than feedback on 100% of items.

Phrase level step up.

As mentioned above, children who can accurately say the 3 syllable nonsense words to 80% correct over 2 consecutive sessions should be stepped up to Cloze sentences. You need 10 of these and they should also be randomized along with the randomized presentation of words. This is harder not only because the child has to get all aspects of the word correct, but because **they need to say the whole sentence as a match** to your production on sounds, beats and smoothness.

Below are the sentences we have previously used. You will notice that the target word is always treated as a noun and is always put in the final word position.

1. I saw a _____
2. I want a _____
3. She has a big _____
4. I went to the _____
5. Where's the _____?
6. He gave me a _____
7. It's his _____
8. There's a _____
9. Can I have a _____?
10. Here's the new _____

Anything formatted as a question needs to be said as a question (rising terminal pitch) and if it's a statement it needs statement prosody. If the child gets 80% correct on the phrases you can make them more complex by including two nonsense words. Here is an example of such a sentence.

I saw a _____ and a _____

Judging correct and incorrect productions/ Teaching the components

Each attempt at a nonsense word needs to be evaluated for whether the sounds, beats and smoothness are correct. In the Practice phase, all need to be correct at once and across the whole word for the child to score as correct.

Sounds: These are the consonants and vowels. Sounds must match the adult model i.e. if a child produced a distorted 'f' sound, their 'sounds' would be incorrect. We are aiming for accurate and consistent production of all phonemes.

Beats: This is the relative stress between syllables, which again must match the adult model. To make stressed syllables in English we lengthen the vowel, increase the volume of the syllable, or raise the pitch of the syllable. Children may benefit from cueing in the Training phase on any of these features but we have found the easiest to be length (duration) and the hardest to be pitch (frequency). When choosing a cue for beats, start with making the syllable longer or shorter. If this is unsuccessful over several sessions, cue for louder or softer and finally cue for a change in pitch. Any production that sounds robotic, very slow, or has equal stress, is wrong. Younger children are likely to have more trouble with the wS(w) words than the Sw(w) words, so this may require specific attention in the next Training phase. Strong beats are in bold on the pronunciation guide for existing word sets.

Smoothness: This is the hardest to judge and requires that the syllables are continuous with each other. Of course, if you have a stop consonant there will be a slight pause between syllables but again, the child's production needs to match the adult's production. Any production that sounds stilted or staccato is wrong.

If you have any doubt about whether the production was correct or not then you SHOULD SCORE IT AS INCORRECT

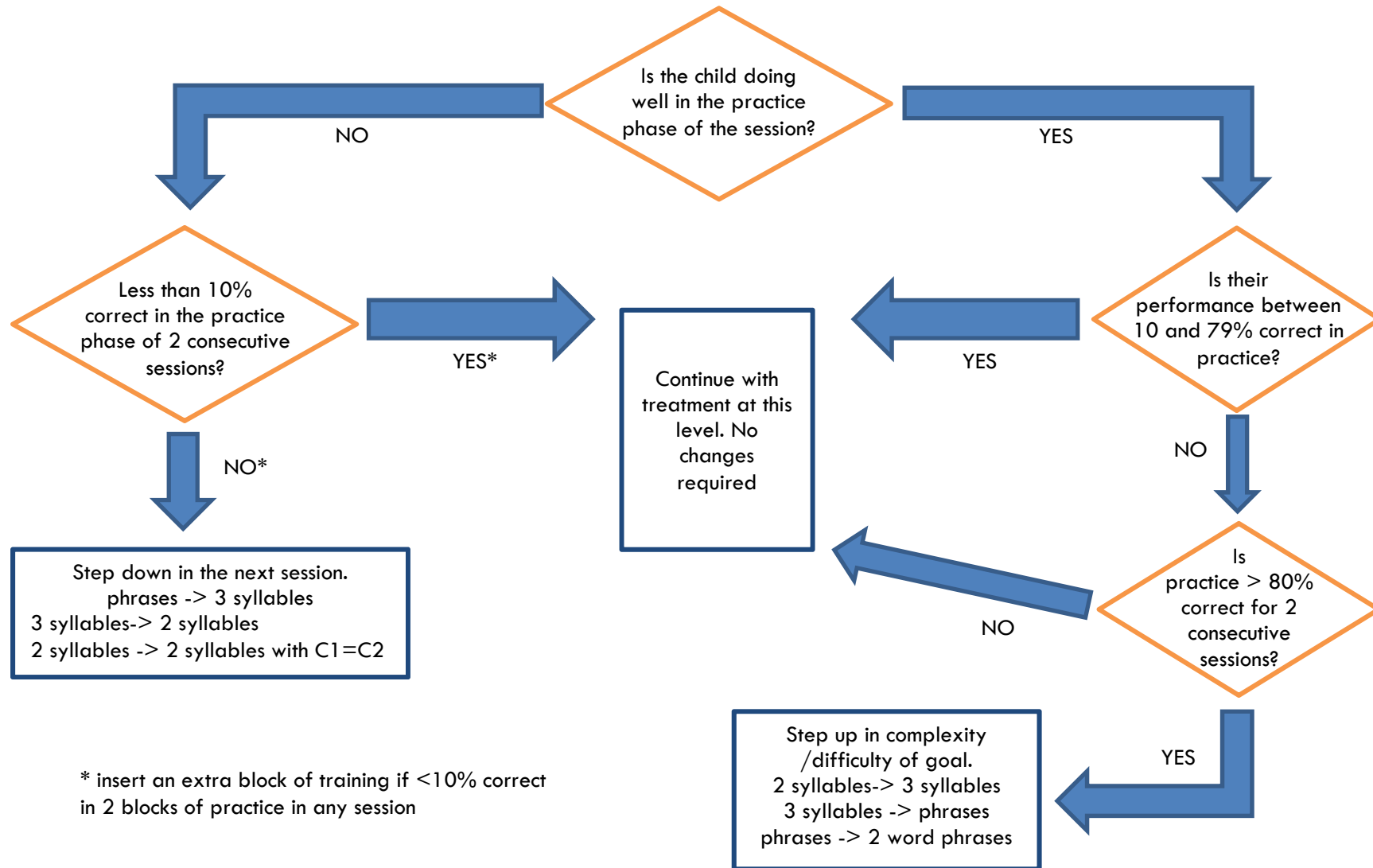
Keeping track of progress

There are 2 main questions to answer when you are completing treatment for a child.

The first is, is the treatment working and are the cues making the child's productions change? According to Olswang and Bain (2011), this is answered by your treatment session data. The data sheets found with the existing stimuli can help you answer if the child's productions are (1) becoming more accurate in Pre-practice/ Training and which cues helped and (2) if they are becoming more accurate in Practice over time, meaning they are learning how to say nonsense words with simultaneously correct sounds, beats and smoothness.

The second is, is the treatment changing the child's planning and programming of other real words? This is what caregivers are most keen to see, and need to be measured. According to Olswang and Bain (2011), this is answered by generalization data. This needs to be planned before treatment starts, so similar 2 and 3 syllable words alone and in phrases are probed before treatment, at the start of session 4, session 8 and session 12 to show progress. Examples of generalization probes we have used are on the resources page – [<http://sydney.edu.au/health-sciences/rest/resources.shtml>]. In addition, you may want to assess intelligibility and other speech areas of interest for the child you are teaching, before and after treatment. For example, we have used inconsistency subtests and articulation tests for this purpose.

Therapy progress



Frequently asked questions

What if I'm not sure whether the word was correct or incorrect?

If you're not sure, you should tell the child the word was incorrect.

What if I finish the work sooner than an hour?

That's no problem! If the child gets through the Training phase followed by 100 practice trials quicker than an hour, that's fine.

What if the child really can't do one of the words in the Training phase?

That's OK. Give the child some cues to help with the production, but if they can't say the word you can move on to another word. Keep the 'tricky' word in the set, use it in Practice, and try teaching it in the next Training block.

What if the child restarts and the second attempt is correct?

The word is counted as incorrect. Remind the child to wait until they are ready to start the word. This might be something to focus on in the next Training phase.

What if the child gets stuck on a word or a particular production and can't change it?

In the next Training phase, try teaching the child to practice the word in their head (silently and without moving their lips) before they say it. You could also ask the child to wait for a couple of seconds after they hear the word before they make an attempt. We use 'think then say' cues for this.

Can the child just read the word without hearing my model?

Many children with CAS also have difficulties reading aloud. We suggest that no children read aloud spontaneously for the first three sessions. If they are excellent readers, they can read the items from the fourth session. We don't want speech errors to be because of reading difficulties.

What if the child is getting very few right in Practice?

If the child gets fewer than 4/40 correct in the first two blocks of practice, insert another block of Training and then go on to the next 40 practice trials.

What if the child can only say the words very slowly or very softly?

The word is incorrect. In the next Training phase teach the child say the item quicker or louder. You can adjust your models to be quicker and faster to assist with this. Just before the start of the next block of Practice, remind the child that they need to do it at the same speed and/or volume as the model.

Can I include articulation therapy to correct poor sound production?

Yes, but only in a Training phase.

Some children with CAS have resonance problems, can we treat this in ReST?

Yes. The Murray, McCabe and Ballard (2015) stimuli deliberately have a /m/ and /n/ so you can teach oral versus nasal resonance as part of the therapy. You can add more nasal targets in the nonsense words you use to make this a major goal. Ideally, you would want some oral-only words as part of this.

Resonance can be taught in the Training blocks. You can teach oral versus nasal resonance, link this with the written sounds and help the child feel the difference between oral and nasal airflow (e.g. feeling where the air comes out using their hand or a tissue). Resonance errors in ReST are considered sound errors on your data sheet.

Lots of children with CAS have prosodic problems, can we treat this in ReST?

Yes, ReST specifically treats prosody as a major goal of therapy. All the stimuli address lexical stress – that is alternate stress across syllables in words. When you select treatment targets, you need 20 words: 10 will have strong-weak lexical stress and the other 10 weak-strong lexical stress. As a clinician giving models, you need to be clear on what lexical stress your treatment words have, and know how to say these accurately and consistently.

Children with CAS tend to make weak syllables strong or to delete weak syllables, so that stress across a word or phrase is all strong. Teaching in the Training phase helps children understand they need weak syllables also. Strong syllables are those that are longer, louder or higher pitched than those around it. Therefore you can teach children to make weak syllables ‘short’, ‘soft’ or ‘deep’ depending on their needs. Prosodic errors in ReST are considered beat errors on your data sheet. This means the beats of each syllable (their stress) did or did not match the model.

This is really hard. Typically developing children couldn’t do it either!

We tested ReST on typically developing children aged 4-12 and they learnt how to say the words in 3-5 sessions. So far none of the children with CAS have had normal speech after a short block of ReST but all have improved substantially.

Can you provide me with a premade list of words?

Yes, but it is really important for each child to use words which include sounds in their own sound inventory. You can use the lists on the website but please make sure the child can use the sounds in the lists or modify the lists. If you make new word lists, we’d love it if you email us the list and any supporting materials so we can add them to the site!

How do you keep children engaged in drill treatment without pictures?

Using a visual timetable is really helpful. Show the child how many blocks of Training and Practice they need to do. Other things we’ve found helpful are counting down how many items are left in a block, praising the child for their attention, and having a range of games for the child to choose from in the break time. The games can be anything that motivates the child, including active games such as star jumps and running races. School aged children respond really well to “gamification” – use the language of video games – personal best, game high. Older children respond well to being shown the changes in their scores from day to day and beating their own best score. They also love “levelling up” and understand that the new level will be harder.

Early on we used pictures of aliens with the nonsense words. However, learning 20 of them was too much to ask, so we were left with reading the words or imitating a spoken or recorded model.

Do you think that treatment effects might generalize better if you used real words rather than nonsense words?

The whole point of ReST is to avoid real linguistic forms – we believe ReST is associated with good generalisation BECAUSE the semantic system is not engaged in the nonsense words – the child is compiling a new and unexpected motor plan without the assistance or interference of the semantic system. No already learnt incorrect productions need to be corrected in the nonsense words. The phrases are real phrases except for the nonsense word(s). If you are interested in this topic, you could read the treatment journal articles on both ReST and on generalization of nonsense words to real words in other speech sound disorder treatment also (Gierut & Morrisette, 2010).

Is the goal of ReST only to teach prosodic variation, or can it include work on speech sound accuracy?

The goal of ReST is to address the three core features of CAS simultaneously. While it is a great treatment for prosody, it also works on sequencing of sounds and the production of the specific sounds selected in the nonsense words. If a sound (or sound class) needs attention, select it as one of the phonemes in the nonsense words. Ideally however, the sound you choose should be stimuable (produced accurately some of the time) otherwise it is difficult to treat all 3 aspects simultaneously.

If a child has two sessions of treatment but is then away for a week, does the program have to start afresh or pick up from where it left off?

It's best to schedule one block of ReST at a time when the child and parent can commit to regular intense treatment. School holidays are a good time for many school-aged clients. Even with the best planning, unforeseeable events and illnesses sometimes happen. If a child has missed several sessions in a week they are likely to need longer in the Training phase of the next session in order to re-orientate them to the treatment.

What instructions should parents be given about practice at home?

We have tried training parents to do therapy with limited success. Parents found the treatment difficult to do and felt that making the prosodic judgments was too hard. Most parents are immensely relieved about not having to do homework and value the opportunity just to be parents for a while.

In all the other research, we have achieved very good results **without** any parent/home practice, so there is no need for them to do it.

Do we need to complete 20 cards in every block of Practice? What if my client can do more than that?

20 words per block of practice is a minimum. For older children and adolescents you can increase the number of trials to 25 (we did this in the research) or up to 40 words per block (as per our clinical experience). This then reduces the number of blocks (and breaks) to four, which may make the session move slightly faster. You need to ensure that accuracy does not decrease if you increase the number of trials per block. If so, decrease it again to a number that allows the child to concentrate and produce the trials effectively.

Research Articles and recent Conference Presentations about ReST

(as at 1st January 2017)

- Ballard, K. J., Robin, D. A., McCabe, P., & McDonald, J. (2010). A treatment for dysprosody in childhood apraxia of speech. *Journal of Speech, Language, and Hearing Research*, 53(5), 1227-1245.
- McCabe, P., Macdonald-D'Silva, A. G., van Rees, L. J., Ballard, K. J., & Arciuli, J. (2014). Orthographically sensitive treatment for dysprosody in children with Childhood Apraxia of Speech using ReST intervention. *Dev Neurorehabil*, 17(2), 137-145. doi: 10.3109/17518423.2014.906002.
- McCabe, P. & Preston, J. (2016). *Comparing Treatments: An RCT contrasting Ultrasound and ReST Therapy for CAS*. Paper presented at the Childhood Apraxia of Speech Association of North America, July 2016, Chicago USA.
- McCabe, P., Preston, J. & Evans P. (2016). *Ultrasound or ReST? Which Treatment is better for older children with CAS? A pilot RCT – preliminary data*. Poster presented at the Speech Pathology Australia Annual National Conference, May 2016, Perth.
- Murray, E., McCabe, P., & Ballard, K. J. (2012). A comparison of two treatments for childhood apraxia of speech: Methods and treatment protocol for a parallel group randomised control trial. *BMC Pediatrics*, 12, 112. doi: 10.1186/1471-2431-12-112.
- Murray, E., McCabe, P. & Ballard, K.J. (2015). A Randomized Control Trial of Treatments for Childhood Apraxia of Speech. *Journal of Speech, Language and Hearing Research* 58 (3) 669-686. doi:10.1044/2015_JSLHR-S-13-0179.
- Murray E, McCabe P & Ballard KJ. (2014) A Systematic Review of Treatment Outcomes for Children with Childhood Apraxia of Speech. *American Journal of Speech Language Pathology* 23: 486-504.
- Thomas, D., McCabe, P. & Ballard, K. (2016). *Service delivery for Rapid Syllable Transitions (ReST) Treatment for Childhood Apraxia of Speech: A comparison of telehealth, lower frequency and parent-delivered treatment*. Paper presented to Speech Pathology Australia Annual National Conference, May 2015, Perth.
- Thomas D, McCabe P & Ballard KJ. (2014) Rapid Syllable Transitions (ReST) Treatment for Childhood Apraxia of Speech: The Effect of Lower Dose Frequency. *Journal of Communication Disorders* 51: 29-42.
- Thomas, D., McCabe, P., & Ballard, K. J. (2014). *Parent Training for Rapid Syllable Transitions Treatment for Childhood Apraxia of Speech: Fidelity of parent conducted treatment*. Paper presented at the Motor Speech Symposium, Sarasota, FL, USA.
- Thomas, D., McCabe, P., Ballard, K.J. & Lincoln, M. (2016). Telehealth Delivery of Rapid Syllable Transitions (ReST) treatment for Childhood Apraxia of Speech. *International Journal of Language & Communication Disorders*. 51 (6) 654–671 doi: 10.1111/1460-6984.12238.
- van Rees, L. J., Ballard, K. J., McCabe, P., Macdonald-D'Silva, A. G., & Arciuli, J. (2012). Training Production of Lexical Stress in Typically Developing Children with Orthographically Biased Stimuli and Principles of Motor Learning. *American Journal of Speech-Language Pathology*, doi: 1058-0360_2012_1011-0008. doi: 10.1044/1058-0360(2012/11-0008).

Other references

- ASHA. (2007). *Childhood Apraxia of Speech* [Position Statement]. www.asha.org/policy.
- Maas, E., Robin, D. A., Austermann Hula, S. N., Freedman, S. E., Wulf, G., Ballard, K. J., & Schmidt, R. A. (2008). Principles of motor learning in treatment of motor speech disorders. *American Journal of Speech-Language Pathology*, 17(3), 277-298. doi: 10.1044/1058-0360(2008/025)
- Schmidt, R.A. (1975). A schema theory of discrete motor skill learning. *Psychological review*, 82 (4), 225. doi: 10.1037/h0076770

Glossary

Term	Definition
ASHA	American Speech-Language Hearing Association
Beats	Term used to explain lexical stress (i.e. the relative stress pattern between syllables within a word)
CAS	Childhood Apraxia of Speech
Dyspraxia	Dyspraxia or Developmental Verbal Dyspraxia is another name for CAS
Internal reference of correctness	An understanding of how a movement should happen. It is thought to require a performance of a successful movement to acquire an internal reference of correctness.
KP	Knowledge of Performance feedback (i.e. information about what was right and what was wrong about an attempt, and may include instructions about how to improve the attempt)
KR	Knowledge of Results feedback (i.e. whether the production was right or wrong)
Lexical stress	The relative stress pattern between syllables within a word. Syllables which are relatively longer, louder and/or higher pitched are stressed syllables where syllables which are relatively shorter, softer or lower pitched are unstressed.
Practice	Practice is the phase of therapy where the child learns the movement through repeated attempts and self-correction. It ensures the skill is retained over time.
Prepractice	Is the training phase of ReST therapy. The term comes from the motor learning literature and is aligned with the idea that before you can practice you need to know what the movement feels like. The prepractice or training phase is where the child acquires the movement.
Prosody	The rhythm and melody of speech. It is language, dialect and accent specific.
Smoothness	Term used in ReST therapy to describe fluent speech without syllable segregation or other disruption to the flow of speech.
Sounds	Term used in ReST therapy to describe segments or sounds

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