

## Chapter 13

# Rhythmic Speech Cueing (RSC)

Stefan Mainka and Grit Mallien

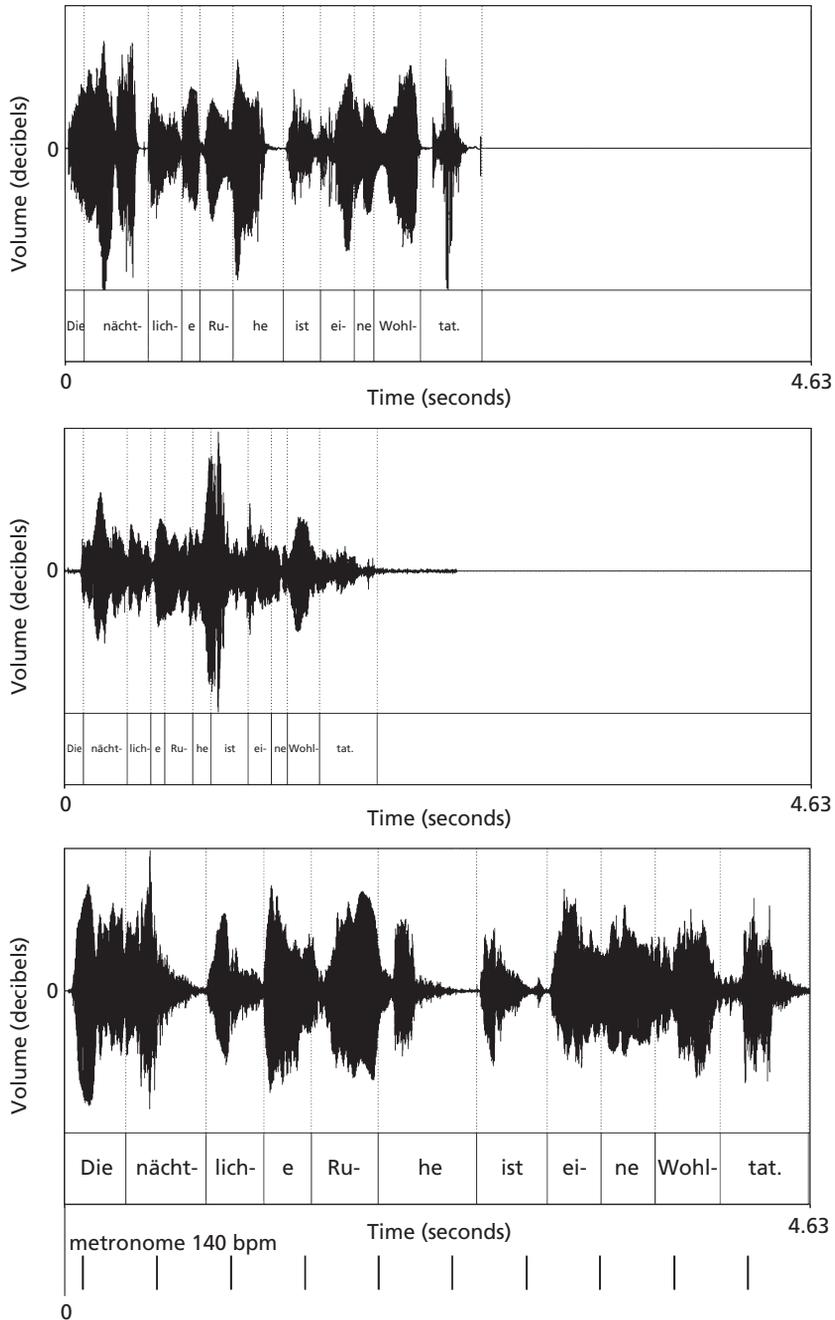
### 13.1 Definition

In *rhythmic speech cueing (RSC)*, speech rate control via auditory rhythm is used to improve temporal characteristics such as fluency, articulatory rate, pause time, and intelligibility of speaking. Speech rate can be the primary therapeutic focus as in fluency disorders like stuttering, or the tempo of speech can take on a mediating role for articulatory precision and thus speech intelligibility. In RSC the patient speaks to an auditory stimulation. This is presented as a metronome pulsed signal, a rhythmic pattern (played live with an instrument or synthesizer), or in the form of a more complex musical piece. Tempo is the most important factor for the therapeutic power of the technique. It has to be set precisely according to available research data and the specific therapeutic goal.

There are two modes of acoustically cueing speech production, namely metric and patterned cueing. In metric cueing a pulsed auditory stimulation is used (usually produced by a metronome). The patient is asked to match either one syllable or one full word to one beat. In patterned cueing the patient reproduces a pre-structured rhythmic sentence at a given tempo (e.g. as a rhyme or as in singing a song). In contrast to metric cueing, the syllables (and pauses) here are not of equal duration. There can be longer and shorter syllables, as in the song *Oh When the Saints go Marching in*.

### 13.2 Target populations

The main clinical indication for RSC is dysarthria. This is a neurological motor speech impairment characterized by slow or hastened, weak, uncoordinated movements of the articulatory muscles. It results in reduced speech intelligibility and leads to communicative difficulties. Social isolation and depression can develop as a consequence. RSC has been shown to be effective for patients with Parkinson's disease, in which dysarthria is a very common feature. Speaking in patients with Parkinson's disease often becomes soft (hypophonia), with monotone prosody, harsh voice, and a disturbed articulation. In patients with left-sided symptom dominance an additional tendency toward speech hastening can be observed (Flasskamp et al., 2012; Hammen et al., 1994; Yorkston et al., 1990). This phenomenon is also called *festination of speech*, and is associated with festination of gait (smaller shuffling and accelerating steps) (Moreau et al., 2007) (see Figure 13.1). The festination of speech in Parkinson's disease can be worsened by deep brain stimulation



**Figure 13.1** Temporal distribution of syllables in reading speech, comparing (a) normal speech in a healthy 74-year-old woman, (b) dysarthric speech in a 69-year-old woman with Parkinson’s disease, and (c) dysarthric speech under the influence of rhythmic stimulation in the same patient as in (b). Please also listen to  Audio Samples 13.1, 13.2, and 13.3.

(Tripoliti et al., 2011). It is noteworthy that the patients themselves are frequently unaware of their acceleration in speech rate and their slurred unclear speech. This lack of awareness is so profound that the neuropsychologist George Prigatano classified it as anosognosia (Prigatano et al., 2010).

The combination of hypokinetic dysarthria, speech hastening, and unawareness, and thus inability to correct or compensate for the speech problems, often leads to extremely poor levels of intelligibility in this patient group (compare normal speech and Parkinsonian dysarthric speaking in  Audio Samples 13.1 and 13.2). This can be effectively treated with RSC, which spontaneously leads to much slower and more intelligible speech (Hammen et al., 1994; Thaut et al., 2001; see Figure 13.1 and listen to  Audio Sample 13.3). When festination of speech is absent or subsidiary, the dysarthria in Parkinson's disease would be better treated with vocal intonation therapy (VIT) (see Chapter 15).

Other forms and etiologies of dysarthria can also be considered for RSC, namely ataxic and spastic dysarthria or mixed dysarthria (for clinical descriptions, see Duffy, 2005). These can occur after traumatic brain injuries and degenerative neurological diseases. Even though speech rate is often already reduced in these dysarthrias, speech rate control techniques work best in slowing down these patients (Pilon et al., 1998; van Nuffelen et al., 2010; Yorkston et al., 1990).

A third indication for RSC is in people with stuttering. Stuttering often occurs as a problem of disturbed fluency where articulation is mostly undisturbed. It has been shown that singing can overcome disfluency in people with stuttering (Glover et al., 1996). Just as effective as other rate control techniques is metric cueing (Ingham et al., 2009, 2012).

Finally, there is evidence from one randomized controlled trial for a solid therapeutic effect on apraxia of speech (AOS) (Brendel and Ziegler, 2008).

### 13.3 Research summary

There is class III evidence for severe dysarthria in Parkinson's disease. Michael Thaut and colleagues conducted an experimental trial with 20 patients with Parkinson's disease who had severe to mild forms of dysarthria. They found a significant improvement among initially poorly intelligible participants (with intelligibility of less than 60%).

Cueing was most efficient at 60% of the habitual speaking rate. The best cueing modus was one syllable per beat (listen to  Audio Sample 13.4). Furthermore, the study results indicated that in patients with Parkinson's disease who had mild to moderate dysarthric symptoms, RSC seemed to give a limited benefit (Thaut et al., 2001).

Several studies on different rate control techniques have demonstrated that slowing down is effective for various types of dysarthria (ataxic, spastic, and mixed type), despite the fact that nearly all of these forms exhibit a reduced speech rate. Furthermore, it has been shown that mildly to moderately impaired speakers do not benefit from a rate control technique (Hammen et al., 1994; Pilon et al., 1998; van Nuffelen et al., 2010; Yorkston et al., 1990). So far there are only limited data available comparing RSC and other types of rate control techniques.

Pilon and colleagues conducted a study of three traumatic brain injury patients with mixed dysarthria. They compared RSC (metric cueing word by word at the reduced pacing rate of 80%) with singing at an equally reduced pace and the pacing board (a small board with five marked sections for the patient to tap with each word). In this small study, RSC caused the largest improvements in intelligibility.

Although the advantages and disadvantages of RSC in the treatment of ataxic, spastic, and mixed dysarthria remain unclear, it should be considered an effective therapeutic option in this patient group.

For people with stuttering it has been shown that RSC is as effective as other fluency-inducing techniques in the form of metric cueing (one syllable per beat) to improve fluency. Cueing rate was set at the self-chosen tempo in the range of 90–180 bpm (Ingham et al., 2009, 2012). These stimulation frequencies most probably led to a slowing down in speech rate. Normal speech rates in reading are in the range of 200–360 syllables per minute (Breitbach-Snowdon, 2003).

Singing is also effective for people with stuttering. Glover et al. (1996) demonstrated a reduction in dysfluency after the instruction to sing. However, those authors point out that there was no confirmation that the participants were actually singing. Clearly, though, the instruction to sing had an impact on speaking behavior. This worked equally well when comparing a normal rate with a fast rate. Thus for singing it might not be essential to slow down the tempo when practicing with people with stuttering.

Brendel and Ziegler (2008) were able to show a significant effect on AOS. In a randomized controlled trial, 10 post-stroke patients with mild to severe AOS trained in a cross-over design with RSC. The control intervention consisted of various established AOS techniques. RSC was performed as metrical cueing with stimulation rates ranging from 60 to 240 syllables per minute. The RSC tempo was set according to the patients' speaking capacity, and started at a very low value and was eventually speeded up, if the progress of the patient allowed this. The metrical pacing showed superior improvements in speech rate, fluency, and segmental accuracy (Brendel and Ziegler, 2008).

### 13.4 Therapeutic mechanisms

When considering the therapeutic mechanisms for RSC, a distinction should be made between the treatment of dysarthria and dysfluency. In dysarthria, slowing down is clearly the main impact in terms of functional gains in intelligibility. In Parkinson's disease, RSC seems to compensate for the lack of ability to precisely perceive and regulate the speaking pace. The rhythmic stimulus serves as a stable time anchor to which the patient can adjust. Secondly, as speaking is a very complex sensorimotor function of numerous muscles, the rhythmic structure facilitates better coordination of the articulatory muscles. In that sense the speech motor function shows the same sensitivity to rhythmic entrainment as can be seen in gross or fine motor functions. In other words, acoustic rhythm seems to facilitate a better motor programming in the process of speaking. This certainly holds for all forms of dysarthria in which muscle functions are impaired.

There are several hypotheses as to why slowing down in particular is so effective for dysarthria. Apart from the sharpness of articulation due to optimized speech motor performance, it could also be that there is more time for listeners to analyze the somewhat unclear speech.

In patients with dysfluency, especially in stuttering and AOS, RSC might lead to an optimal coordination of breath and voice, due to the temporal regulation of the speech act. Furthermore, the acoustic rhythmic stimulation (even in a purely mental condition and in uncued singing) seems to stabilize the fluency of speaking.

## 13.5 Therapy procedure

### 13.5.1 Start with diagnosis and assessment

Before starting the training it is essential to define the speech pathology. Measuring the extent of dysarthria or dysfluency is a complicated matter. Several assessments are available, such as the Frenchay Dysarthria Assessment (Enderby, 1983), the UNS (Breitbach-Snowdon, 2003), and the Munich Intelligibility Profile (MVP) (Ziegler and Zierdt, 2008). However, the majority of clinicians use a descriptive form and estimate the severity of the symptom.

It is also important to look at the etiology and thus at the process and the perspective of the clinical symptom.

Then the therapist should take into account the views of the patient. How do they experience their speech pathology? Do they want to improve their speech? That is, having assessed the objective needs for therapy we need to look at the subjective aspects and also the personal communicative resources (i.e. the social environment) of the patient. When starting exercise therapy, the therapist needs to ensure that the patient is willing and able to participate in this treatment, as it is crucial to establish a high degree of compliance with the treatment. For this purpose it can be effective to record the speech of the patient and to play it back to them. This gives the patient an opportunity to perceive their own speaking more objectively.

When the symptoms have been thoroughly assessed, the therapeutic goal can be decided according to the clinical symptom.

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### Clinical example

A 67-year-old man has been suffering from Parkinson's disease for 12 years with left-sided dominant motor symptoms. He notices that his wife and close relatives often do not understand him straight away, so that they have to ask him to repeat what he has said. His voice is a little monotonous, and his speech rate is considerably increased, with slurred unclear articulation. When confronted with a recording of his own speech he is startled by how fast and unclear it is. After this experience he is willing to try out speech training with RSC in order to slow down his speaking to improve its intelligibility. (A similar problem of reduced intelligibility due to Parkinsonian dysarthria was experienced by the woman in  Audio Sample 13.2.)

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When assessing speech problems, three questions need to be addressed.

- 1 *Is it a form of altered speech due to a neurologic disease?* Although there is an abnormal speaking rate or fluency, it is possible that this is the unaltered natural manner of speech of this person.
- 2 *Does the altered speech pattern cause any objective or subjective problem for the patient?* Does the patient want to change their way of speaking or are they experiencing communication problems (even though they might not relate these to their way of speaking)?
- 3 *Does the prognosis of the symptom justify initiating therapy?* In terms of etiology and assessment, how would we expect the phenomenon to develop? Is it expected to become worse, will it merely stay the same, or is it intermittent and therefore likely to resolve without any treatment?

If all three questions can be answered in the affirmative, the patient should be referred for therapy.

### 13.5.2 Define the goal

Once the speech pathology has been thoroughly described, the goal has to be determined. We know from research data that RSC can be used merely to improve intelligibility, sharpness of articulation, and speech fluency. So in this step, according to the findings of the assessment, we define a clear and realistic aim. This step must involve the patient, as we want to adjust the aim to their needs and wishes.

### 13.5.3 Assess the natural speech rate and/or fluency

Having defined the therapeutic goal we need to look at the actual temporal characteristics of the patient's speech. The only reliable way to assess a person's habitual speech rate is to record their free and consecutive speaking for 1 minute and then count the syllables while listening to the recording. However, in most cases this procedure is unsuitable for clinical practice. It is quite difficult to get a patient to speak freely and without pauses for 1 minute. Of course it is possible to assess speech rate by giving the patient a reading task. However, reading is from a functional perspective quite different to free speaking. There is no intention during the act of reading, but instead there is a visual stimulus that can influence speech rate to a large extent, whereas it is the rate of free speaking that has to be addressed by RSC, and it is this that needs to be assessed. The same is true for fluency, so both the rate and fluency of free speaking should be thoroughly observed and described. Eventually a recording could be made to support and provide a record of this observation (and subsequently monitor compliance.)

### 13.5.4 Decide whether RSC is an effective means of achieving the therapeutic goal

During the first two RSC sessions it should be ascertained whether RSC can be effectively applied to treat the speech pathology. Here again it is essential to take into consideration



After finding the optimal mode of stimulation, the cueing frequency or tempo of stimulation should be adjusted to identify the optimal stimulation rate.

The key question remains whether free speaking can be effectively altered according to the therapeutic goal (see Figure 13.1). Only when this has been established beyond doubt and the stimulation frequency has been defined can we start systematic RSC training. If there is no significant therapeutic change in speaking, an alternative rate control technique should be applied (e.g. pacing board, alphabet board, delayed auditory feedback).

## 13.6 Five-step training scheme

A systematic training scheme is recommended. This is derived from an evidence-based hierarchical training scheme, and it builds up from cued reading to free speaking in every session (Ramig et al., 2001).

### 13.6.1 Preliminary practice: tapping to rhythmic stimulation

The patient taps with their better hand to rhythmic stimulation. Here rhythmic entrainment is initiated. The patient can experience the effect of rhythm on their movement. As always in auditory–motor coupling, it is important not to synchronize every tap to every beat, but rather to let the movement become entrained to the given tempo. This should be already set to the RSC training frequency. This training step can be omitted if initiation of rhythmic entrainment is not an issue.

### 13.6.2 Read pre-structured material to rhythmic cueing

The patient is asked to read in the defined tempo and mode text material that is optimally structured for their speaking ability. Accordingly, a poem, rhyme, or song text could be used in which the phrases are fairly short and easy to reproduce with RSC. If appropriate, the patient can maintain tapping with the stimulation.

### 13.6.3 Read routine phrases to rhythmic cueing

At this stage the patient is still reading, but is now practicing phrases and sentences that occur as part of their normal daily routine. The lists used here can be individually designed for the patient's needs. If appropriate, the patient can maintain tapping with the stimulation.

### 13.6.4 Speak freely to rhythmic cueing

The patient should speak freely to rhythmic stimulation. This usually works best when the therapist is asking very simple questions (e.g. “What time did you get up this morning?”, “What is the weather like today?”, “What did you have for breakfast?”). If possible the patient can also give a monologue on a chosen topic. Another option is to read out headlines from a newspaper and ask the patient to comment on them. For the majority of patients this is the most important step in RSC training. Therefore it should be given more time than the other training steps in the session.

### 13.6.5 Transfer of the functional change

The patient is asked to speak freely without rhythmic stimulation, but maintaining the improved quality of speaking according to the therapeutic goal. The therapist should also suggest some transfer exercises to be carried out after therapy (e.g. the patient could be instructed to go to the nurse and ask for a cup of tea while maintaining the good speech quality).

### 13.7 General tips and tricks

- 1 Usually a metronome is used for RSC, as it allows accurate control of the tempo. The metronome should have a pleasant and loud sound. The loudness is important because the therapist also wants the patient to speak loudly (in most cases), so the stimulation should be clearly audible throughout. A mechanical metronome is also acceptable. In general, “seeing the beat” is an advantage, due to sensory integration. However, sound and loudness are more important and should be given priority.
- 2 In the patterned cueing mode the overall speaking rate will be higher than in metric cueing, due to the number of short syllables. Therefore the tempo of stimulation needs to be slower than in the metric cueing mode.
- 3 For the patterned cueing mode the idea of *sing-song* can be helpful. Usually when people are asked to do sing-song by themselves they achieve some kind of steady rhythmic pattern, such as ‘ / ’ / or ‘ // ’ // . Often this steady pattern is carried out with a fixed prosodic interval (usually a fourth or a third). Through the idea of sing-song the patient can be enabled to engage in free speaking with a steady patterned cueing.
- 4 If hand tapping is continued during Steps 2 and 3, note that this should be done rather silently. The sound of tapping should not confound the rhythmic stimulus.
- 5 Look at the patient’s capacity to do self-training. Only for Steps 4 and 5 might a training partner be needed. Ideally the training partner should be introduced to the RSC procedure by the therapist.
- 6 If no partner is available for self-training, the patient can read out the headlines from a newspaper and then freely comment on them.

### 13.8 Therapeutic application in patients with Parkinson’s disease

It has already been mentioned that for patients with Parkinson’s disease we mainly use RSC to improve intelligibility. For this, Parkinsonian patients need to be slowed down to at least 60% of their habitual speech tempo. Due to their impaired self-perception (e.g. “My wife doesn’t understand me anymore, but I don’t really know why”) it seems to be essential to exaggerate all aspects of speaking, so we practice extra slowly, even slower than we want the patient to speak in daily routine. Usually the loudness improves to a similar extent while practicing RSC. Furthermore, the training must be intense (Farley et al., 2008; Fisher

et al., 2008); 5 days a week for at least 15 minutes is essential. This high training frequency can usually only be achieved through extra home training, so self-perception and compliance are of great importance. Frequent audio recordings can help the patient to work on these aspects. As Parkinson's disease is a degenerative disease, it is recommended that the patient has therapy holidays (of 1 to 2 months) between these ongoing intense training periods.

### 13.9 Therapeutic application in patients with spastic, ataxic, or mixed dysarthria

As mentioned earlier, RSC can be effective in spastic or ataxic dysarthria by slowing these patients down, even though their speech might be slowed already. In order to establish good compliance, the goal of treatment must be carefully explained to the patient, as there is a risk that they may feel that they are in fact getting worse because of the additional slowing of their speech. A training frequency of three to four sessions a week is recommended.

#### 13.10 Therapeutic application in patients with stuttering

The mode and tempo of cueing are not clearly indicated by research data, so it is worth trying out several frequencies (even up to the patient's habitual speech rate, which might be around 240 syllables per minute). The training mode should be one syllable per beat initially (metric cueing), but might be altered to one word per beat to achieve the optimal effect on fluency.

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