A shift of treatment approach in speech language pathology services for children with speech sound disorders – a single case study of an intense intervention based on non-linear phonology and motor-learning principles

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A shift of treatment approach in speech language pathology services for children with speech sound disorders – a single case study of an intense intervention based on non-linear phonology and motor-learning principles

Inger Lundeborg Hammarström, Rose-Marie Svensson, and Karin Myrberg

Division of Speech Language Pathology, Audiology and Oto Rhino Laryngology Department of Clinical and Experimental Medicine, Linköping University, Linköping, Sweden; Centre for Research and Development (CFUG), Uppsala University, County Council of Gävleborg, Gävle, Sweden

ABSTRACT

Even though there are documented benefits of direct intensive intervention for children with speech sound disorders (SSDs), the intensity given at Swedish Speech Language Pathology services rarely exceeds once a week. Also, indirect therapy approaches are commonly employed.

The purpose of the present case study was to investigate the effects of an intensive specialist therapy, based on non-linear phonological analysis and motor learning principles. The participant was a boy aged 4:10 years with severe SSD, who previously had received indirect therapy from age 3 with, very limited results.

A single subject ABA design was used. At baseline, whole word match was 0%, Word shape CV match was 39% and PCC was 22%, 7%. He had no multisyllabic words, no consonant clusters and no established coronals.

Intervention was given 4 days weekly for 3 weeks in two periods with a 7-week intervening break and a post therapy assessment. Therapy was focused on establishing multisyllabic words, iambic stress pattern, clusters and coronals with the principle of using already established elements for targeting new elements.

At post therapy assessment, whole word match was 39%, word shape CV match was 71% and PCC 69.1%. Multisyllabic words (86%), coronals (82%) and word initial clusters (80%) were established. Without being targeted, back vowels were also present and segment timing improved.

The strong treatment effects of this study demonstrate that at least severe cases of SSD require the clinical knowledge and skills that only a SLP can provide and that frequent direct therapy is both beneficial and needed.

ARTICLE HISTORY

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KEYWORDS

Children with speech sound disorders; non-linear phonology; motor learning principles; treatment

Introduction

Children with speech sound disorders (SSDs) form a large part of Speech and Language Pathologist’s (SLP’s) caseloads (Joffe & Pring, 2008). SSD is an umbrella term covering both articulatory and phonological deficits. In some definitions the symptomatology is considered to be primary (idiopathic) and distinct from language impairment (Eadie et al., 2015), in others, the
full range of speech difficulties, both primary and secondary (of known origin) is included (multilingual-speech/position paper, www.csu.au/research/multilingual-speech/position-paper).

The clinician has an array of approaches to choose from when planning intervention for children with SSD. Some approaches are theoretically linked to the hypothesis that the child’s underlying system needs reorganization to improve phoneme use. Therapy is therefore focused on highlighting the contrastive function of speech elements and the child’s ability to reflect on it (Baker, 2010). Others are related to beliefs that the child’s disorder is a disorder of motor planning and/or programming with focus on speech movements (Maas & Farinella, 2012) and therapy based on motor learning principles. When applying motor learning principles in speech intervention, the emphasis is on modelling speech gestures, speech rate and a large amount of practice trials (Maas et al., 2008) In a study by Strand, Stoeckel, and Baas (2006), the outcome of an intensive treatment for four children with severe childhood apraxia of speech (CAS) was reported. The treatment approach used, dynamic temporal and tactile cueing (DTTC), which is emphasizing the shaping of movement gestures for speech production and continued practice, proved to be successful for three of the participating children. In a review study of treatments for CAS by Elisabeth Murray and co-workers (Murray, McCabe, & Ballard, 2014). The DTTC was judged to have convincing evidence to support its efficacy.

In a systematic review of intervention studies for children with SSD published 1979–2009, Elise Baker and Sharynne McLeod (2011) identified 134 studies. In 46 of them, distinct intervention approaches were found and 24 had no approach-specific teaching procedures. The 46 distinct approaches were each associated with varying levels of evidence. A majority (74%) of the 134 studies had relatively low levels of evidence. Thus, the choice of therapy approach is not entirely obvious and also, many children are not clear cut cases and can have a mixture of phonological problems and speech problems with motor involvement (McCauley & Strand, 1999). Perhaps this is the reason why eclectic approaches including both perceptually and linguistically based activities alongside oral motor activities are widely used. In a survey of clinical practice in the UK, a majority of the respondents used a variety of treatment approaches, whereof auditory discrimination, minimal contrast therapy and phonological awareness were widely used, often in combination. A large majority also involved caretakers in the process. (Joffe & Pring, 2008). In a review study on the effectiveness of different treatments, it is concluded that several different therapy methods are effective in modifying children’s phonology (Kamhi, 2006). This has led to researchers claiming that a careful target selection might be the relevant trigger of change (Gierut, 2005). Before determining the most appropriate intervention plan, a detailed analysis of the child’s speech sound repertoire must be made. In order to be able to make a comprehensive analysis, the full range of adult target speech must be sampled including prosody and stress, word and syllable shape and articulation. By using a nonlinear phonological analysis, all aspects of phonological form including different word structures, stress patterns, syllable shapes and segments in speakers off all ages and with different etiologies of speech difficulties can be captured (Bernhardt, Bopp, Daudlin, Edwards, & Wastie, 2010). Among the features of an analysis that Ball, Müller, and Rutter (2010) list as important to the clinician, is guidance in planning the intervention. This is further elaborated by Ball (2016). Nonlinear phonology is a theoretical framework, which provides not only a methodology for analysis, but also guides the clinician in goal selection and treatment strategies (Bernhardt et al., 2010; Bernhardt & Stemberger, 1998).

Even though underlying theoretical framework lays basis for overall intervention decision, preferably evidence-based, other factors such as target selection and service delivery in terms of
both techniques and the length and number of sessions and the number of teaching episodes per session must also be set. Studies have shown that more intensive interventions have better outcome. In a study of efficacy and intensity of intervention for children with SSD, the outcome of a therapy given three times per week for 8 weeks was significantly better than a therapy given once a week for 24 weeks (Allen, 2013).

Even if high-quality research help the overall intervention decision, other factors such as client values, service delivery considerations and clinical expertise also play an important role (Kamhi, 2006). Motivation is one key to the success of speech therapy and a way of maximizing motivation is by choosing target words that are functionally powerful, i.e. are frequently used by the child and its environment. One approach which emphasizes this is the core vocabulary approach (Dodd, Holm, Crosbie, & McIntosh, 2006, 2010) which focuses primarily on consistent word production rather than accuracy in children with inconsistent phonology. An inconsistent phonological disorder is characterized by at least 40% variability in three separately repeated picture naming tasks within one session and absence of other signs of CAS. It is hypothesized that children with inconsistent errors have difficulties in assembling a fully specified phonological template for the production of an utterance (Holm, Crosbie, & Dodd, 2005). In the core vocabulary approach, the focus is on teaching the child how to assemble word phonology first in single words and then in connected speech. The selection of target words is guided by how often the child uses the words in its functional communication and contributes to the use of consistent production (Dodd et al., 2006).

The social and economic costs that affect individuals with SSD and society at large emphasize the need for identifying the most effective and efficient treatment. A very important criterion is whether the treatment outcome is generalized in terms of transfer to untrained words, structures or sounds (Barbena, Keske-Soares, Cervi, & Brandão, 2014). Another criterion, linked to the former is whether intelligibility is improved by the treatment. However, only a few studies have used intelligibility measures to evaluate the effectiveness of phonological intervention (Lousada, Jesus, Hall, & Joffe, 2014). Due to frequently reported shortage of SLPs (Joffe & Pring, 2008; Lee, 2018), there is limited time and resources to assess and treat children. Therefore, indirect approaches are adopted where the SLP provides treatment through proxies such as caregivers or teachers. Caregivers tend to be actively engaged if the child is younger, but become less involved as the child grows older (Law, Dennis, & Charlton, 2017). There is evidence that even though parents are generally positive towards the games and activities carried out by the SLPs, they are rarely informed of the aim and the SLPs rationale for the intervention (Roulstone et al., 2015). If indirect approaches are to be adopted, an experienced SLP who gives thorough instructions is required and that the caregivers and/or teachers have both the time and the dedication and experience needed to follow the instructions.

In Sweden, indirect approaches have been increasingly employed and direct intervention is often restricted to more severe cases of SSD. When direct intervention is offered, the intensity in terms of dose frequency rarely exceeds once a week (Krögerström, Liljebäck, & Wuotila Isaksson, 2013).
The Swedish language

The typical word in Swedish consists of a stem of one or two syllables, often with additional inflectional affixes. (Hedlund, Pirkola, & Järvelin, 2001). The domain for stress in Swedish is the prosodic word and only one stress is permitted within the prosodic word. Stress in Swedish varies and there are minimal pairs where the placement of stress is distinctive for example in/ˈjɑːpɑːn/ (Japan) and/jɑːˈpɑːn/ (Japanese). However, the trochaic stress pattern is more frequent. Swedish has also a tonal word accent system with a phonological distinction between two tonal configurations of words, referred to as accent 1 (rising tone) in for example/ˈpɑːlɛn/ (Poland) and accent 2 (falling tone) in for example/ˈpɑːlɛn/ (the pile).

Consonant clusters occur in a fairly large number with 32 two-consonant clusters and 6 triconsonantal in word-initial position and innumerable word-final consonant sequences, in both monosyllabic and multisyllabic words (Eliasson, 2014).

Relevant to word structure is the length distinction for vowels. Swedish has nine distinctive vowel qualities, which contrast for length (long versus short) in stressed syllables (Table 1). Long vowels only appear in stressed syllables but short vowels are found both in stressed and unstressed syllables. Consonants following long vowels are short.

The consonant inventory consists of 18 phonemes (Table 2), which all, with the exception of/h/, can be realized as long or short, although this difference is not contrastive (McAllister, 1998).

The purpose of this study to evaluate the outcome (both retention of trained targets and possible generalization to other items) of an intensive SLP intervention for a monolingual Swedish speaking boy aged 4;10 with a severe SSD. The therapy was based on a nonlinear phonological analysis and aspects of motor learning principles were used.

Table 1. The Swedish vowel inventory.

<table>
<thead>
<tr>
<th></th>
<th>Front</th>
<th>Central</th>
<th>Back</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>i: y:</td>
<td>u:</td>
<td>u:</td>
</tr>
<tr>
<td></td>
<td>y I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid-high</td>
<td>e: o:</td>
<td>e: o:</td>
<td></td>
</tr>
<tr>
<td>Mid</td>
<td>e: oe</td>
<td>e:</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>a</td>
<td></td>
<td>ø:</td>
</tr>
</tbody>
</table>

Table 2. The Swedish consonants.

<table>
<thead>
<tr>
<th>Manner of articulation</th>
<th>Labial</th>
<th>Labiodental</th>
<th>Coronal</th>
<th>Dorsal</th>
<th>Laryngeal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Labial</td>
<td>Labiodental</td>
<td>Dental</td>
<td>Post-</td>
<td>Palatal</td>
</tr>
<tr>
<td>Stops</td>
<td>p</td>
<td>b</td>
<td>t</td>
<td>d</td>
<td>k</td>
</tr>
<tr>
<td>Nasals</td>
<td>m</td>
<td></td>
<td>η</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trill</td>
<td></td>
<td></td>
<td>r</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fricatives</td>
<td>f v</td>
<td>s</td>
<td>s</td>
<td>c j</td>
<td>f j</td>
</tr>
<tr>
<td>Laterals</td>
<td>l</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* the retroflexes, η, η, η, and l are often the result of assimilations between/r/and a coronal in Central Swedish, but are often regarded as separate consonant phonemes since they are used contrastively in word medial and word final position.
Method

Design

A multiple baseline single-participant design was used with two baseline assessments, two 3-week intensive therapy blocks, with a 7-week intervening break, and a post-therapy assessments, 1 week after therapy block II was completed. An overview of the procedure is given in Table 3.

Participant and case history

Alex, a boy, a monolingual Swedish speaking boy, was enrolled in the study when he was 4 years and 10 months. He lived together with his mother, father and a 4-year older sister in a middle socio-economic class area. He had no family history of SSD, but the older sister had recently been diagnosed with attention deficit hyperactivity disorder (ADHD), and the parents expressed some concern regarding suspected hyperactivity also in Alex. He had attended pre-school from 1;5 years of age. Alex was first referred to the Speech-Language pathology service from a child health care centre for a speech and language assessment when he was 3 years and 3 months.

He was found to have fairly good receptive language, but had great expressive difficulties. He mostly used gestures accompanied by onomatopoeia. The few words he expressed were very restricted in terms of word- and syllable structure and he mastered only a few places and manners of articulation. His syntax was very restricted and he used mainly single-word utterances. He was very frustrated by not being understood by others and he had begun to withdraw from the other children at pre-school. His parents also told how the neighbouring children occasionally made fun of his speech. Language comprehension assessment was administrated with the receptive subtest of the Reynell Developmental Language Scales, III (Edwards et al., 1997). The new SIT test (Hellqvist, 2011) and the TROG-2 Test for Reception of Grammar (Bishop, 2003). Alex’s results on SIT and TROG-2 not differ significantly from the Swedish standardization samples. The Swedish translation of the Reynell Developmental Language Scales III has not been standardized, however, the Swedish version of fourth version, the NRDLS has been standardized and the psychometric properties of the Swedish version are very similar to the original British test (Lundeborg Hammarström, Kjellmer, & Hansson, 2017). Aspects of expressive language other than phonology were not assessed.

Alex met other developmental milestones within the expected time frames. His medical history only included pneumonia at 2 months of age; he was a healthy boy with no concerns with hearing or vision. At 3;6 years of age, he was tested with the third edition of the Wechsler Preschool and Primary Scale of Intelligence, WPPSI-IV (2005) and found to be typically developed in all other respects than language. A magnetic resonance tomo-

Table 3. Time table of the study.

<table>
<thead>
<tr>
<th>December-January</th>
<th>February</th>
<th>March-April</th>
<th>May</th>
<th>June</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base-line assessments</td>
<td>Therapy block I</td>
<td>Intervening break</td>
<td>Therapy block II</td>
<td>Post therapy assessment</td>
</tr>
</tbody>
</table>

1The study was carried out in accordance with the ethical principles for medical research of the Helsinki Declaration as revised in 2008.
ography of the brain was also carried out and he was also examined by a paediatric neurologist. However, nothing atypical was noted.

In the period between the first visit at 3:3 years and the starting point for the present study at 4:10 years, SLP intervention was not given on a regular basis and very little progress was noted. The numbers of appointments at the clinic were summed up to 10, of which six were intervention sessions. Based on a hypothesis that Alex’s difficulties, to a large extent could be due to motor speech problems, the SLP worked with non-verbal oral motor exercises and speech sound and syllable production using pictures from the Nuffield Centre Dyspraxia Programme, NDP3. In the remaining four sessions, follow-up assessments were made. Moreover, the SLP was engaged in consultative activities such as advice to the family, collaboration with a communication aid center, introduction of Augmentative and Alternative Communication, AAC (simple signs) and advice to the pre-school teachers. Alex quickly adopted new simple signs that were used in the pre-school and used them alongside his limited expressive vocabulary and onomatopoeia words both at home and with friends. Consultative services were also given to a local language therapist (LT), a teacher with 1 year of additional training in speech disorders in children, who visited Alex’s pre-school and worked with him for a few sessions, mainly focusing on speech sound production.

Procedure

Baseline and post-therapy assessment

Two baseline assessments were made with 5 weeks in between, using the Swedish phonology test, Linus (Blumenthal & Lundeborg Hammarström, 2014), which samples across the full range of consonants, vowels, consonant clusters, stress patterns and word length of the adult Swedish language.

The post-therapy assessment was based on 45 words; a mixture of words practiced in the second therapy block and words elicited during story retelling (Bus Story Test). The full phonology test was not conducted in the post-therapy assessment, mainly due to a desire to check the target words, the matched probes and words in connected speech.

Pre-intervention assessment

Before the start of each intervention block, two assessments of the target words were made as a baseline for therapy with 1 week interval. Respectively, two separate post-treatment measures were made with 1 week interval after each therapy block was finished. The measures of the training words were then combined with assessments of matched probes, i.e. words used as a measure of generalization to untreated words.

All assessments were audio-recorded with Olympus Digital Sound Recorder.

Intervention

The overall aim of the therapy was to expand Alex’s phonology and thereby improved his intelligibility. He was treated for four sessions per week, twice by a specialist SLP (the third author) at the SLP clinic and twice by the LT in a separate quiet room at the pre-school.
The LT was introduced to the intervention by attending one training session at the SLP clinic and observed when the specialist SLP was working with Alex. She also received a written step-by-step instruction to the method and all the materials she used during her sessions. The therapy was divided into two 3-week blocks with a 7-week intervening break (Table 3).

Target words were chosen with inspiration from the Core Vocabulary approach (Dodd et al., 2006) with a list of words that both covered the targets and were functionally appropriate for Alex. Another source of inspiration was nonlinear phonological intervention with the principle of using established elements for targeting new elements (Bernhardt et al., 2010). The chosen approach was informed by integral stimulation, DTTC, (Strand et al., 2006). Therapy targets were multisyllabic words, words with iambic stress, and consonant clusters and words with coronals (Table 4).

The selected words, each symbolized by a picture, were delivered 30 times per session. Each word was trained in two blocks per sessions, thus delivered 15 times per block. The word order was not the same in the two blocks. The therapy technique used was imitation with emphasis on Alex being focused on the task by a “watch me-listen” strategy. This visual guidance was gradually reduced until Alex managed to say a target word correctly with no assistance. When Alex managed to say a word correctly in >90% of the trials in in two successive sessions, the target word was replaced by a new word and thereafter just practiced occasionally during the sessions. This occurred with two of the target words during the first therapy block and with four of the target words/short phrases during the second therapy block. In addition to the training sessions during therapy block II, Alex’s caretakers were instructed to ask Alex to repeat the target words from the first therapy block on a daily basis.

After the first therapy block Alex managed to say 5 of 7 target words correctly and 3 of 7 probes correctly at final evaluation. After the second therapy block, 7 of 10 targets were produced correctly alongside with 4 of 6 probes. It should be noted, that even if 100% correct production was not achieved for all target words and probes, production of all words improved.

Overall, Alex was happy and positive during treatment and managed to stay reasonably focused. Occasionally, he had some difficulties with maintaining attention, and there was an obvious connection between his performances and his ability to concentrate. His motivation improved when the SLP let Alex help out with ticking the last production of each block in the production sheet and thereby helped him to keep track of the course of the session. Alex was also very keen on choosing a sticker in the end of each session.

**Analysis**

The materials from the base-line and post-therapy assessment were transcribed narrowly by the first author using the transcription conventions of the International Phonetic Association (IPA, 1999). Percentage of correctly pronounced words (Whole Word Match, WWM), word shape CV match, and correct consonants (PCC) (Shriberg, Austin, Lewis, McSweeny, & Wilson, 1997; Shriberg & Kwiatokowski, 1982) Also proportion of word initial clusters and elicited coronals were calculated.
<table>
<thead>
<tr>
<th>Target words</th>
<th>Probes</th>
<th>Target words</th>
<th>Probes</th>
</tr>
</thead>
<tbody>
<tr>
<td>tupp* [tɔp] (rooster)</td>
<td>topp [tɔp] (top)</td>
<td>Klocka [ˈklɔka] (watch)</td>
<td>plocka [ˈplɔka] (pick)</td>
</tr>
<tr>
<td>napp [nap] (pacifier)</td>
<td>nål [noːːl] (needle)</td>
<td>Blomma [ˈblɔma] (flower)</td>
<td>blōda [ˈbːda] (bleed)</td>
</tr>
<tr>
<td>tåg* [tɔɡ] (train)</td>
<td>tak [tɔːk] (roof)</td>
<td>Pannkaka [ˈpaŋ kɔːka] (pancake)</td>
<td>badanka [ˈbːdaːrɔŋka] (rubber duck)</td>
</tr>
<tr>
<td>docka [ˈdɔːka] (doll)</td>
<td>data [ˈdɔːta] (data)</td>
<td>Sommarlov** [ˈsɔmaːrlˌvoː] (summer holiday)</td>
<td></td>
</tr>
<tr>
<td>ballong* [baˈlɔŋ] (balloon)</td>
<td>giraffe [ˈɡɪrəf] (giraffe)</td>
<td>ilpad [ˈilpɛd]</td>
<td>Adam [ˈɑːdəm] (Adam)</td>
</tr>
<tr>
<td>delfin [ˈdəlfiːn] (dolphin)</td>
<td>gitarr [ˈɡiːtar] (guitar)</td>
<td>Igelkott** [ˈiːɡɛlˌkɔt] (hedgehog)</td>
<td></td>
</tr>
<tr>
<td>kanin [ˈkɑːniːn] (rabbit)</td>
<td>orange [ʊˈraŋʂ] (orange)</td>
<td>jag vill ha [jɔː vː hɔː] (I want)</td>
<td>han är fin [hɑːn ɛː fiːn] (he is nice)</td>
</tr>
<tr>
<td>polis [ˈpɔliːs] (police)</td>
<td>fåtölj [ˈfɔːtɔlːj] (armchair)</td>
<td>jag vill sova** [joː vː soːva] (I want to sleep)</td>
<td></td>
</tr>
</tbody>
</table>

*were replaced by three words with iambic stress pattern (polis, ballong and kanin) **replaced the word/phrase immediate above. Replacements were done when the participant managed to say the target correctly in 90% of the trials.
Reliability

Reliability of the transcriptions were measured point-by-point as percentage exact agreement between the first author and an experienced colleague based on 10% of the recordings from one of the base-line assessments. The agreement was 87.5%

Results

Pre-therapy

Alex’s production at the two baseline assessments varied both in terms of which word he agreed to produce and how the words were elicited. Many words were elicited by repetition, but the words that were elicited by repetition were not the same at both assessments. He did not perform more accurately on repeated words in comparison with the spontaneously elicited words. No major change in his production was noted during the base-line period. Based on the total number of elicited words at the base-line assessments Whole Word Match (WWM) was 0%, Word Shape CV match (WSM) 39.5% and PCC 22.7%. Regarding word shapes Alex mastered CV-, CVC, CVCV and CVCVC words, but he had no words with iambic stress and no consonant clusters. Regarding the segments he had all manners of articulation except trills, but substituted almost all coronals with dorsals. He also had some problems with segment timing and back vowels, which tended to be centralized and some central vowels, which were substituted by front vowels. His pre-therapy phonological strengths and needs are displayed in Table 5.

Post-therapy

After therapy, 1 week after treatment block two was finished, WWM was 38%, and WSM 69%. The proportion of established multisyllabic words, was 86% and the proportion words with initial clusters was 80%. PCC was 69.1% with 68% coronals established. Without being targeted, back vowels were present and segment timing improved, see Figure 1 and Table 6.

Table 5. The participating boy’s phonological strengths and needs before therapy divided by word structure, single consonants by word positions* and features.

<table>
<thead>
<tr>
<th>Word structure</th>
<th>Word positions, single consonants</th>
<th>Features &amp; segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strenghts</td>
<td>2 syllabic words, trochaic stress pattern and the following CV word shapes: CV, CVC, CVCV, CVCVC, (VC)</td>
<td>WI:/p b m f l j k g h/ WMed/ b η/ WF:/l/ Manner: Plosive, nasal, fricative Place: labial (labiodental), palatal, dorsal Laryngeal: often matches</td>
</tr>
<tr>
<td>Inconsistent or often used as substitution or in assimilation</td>
<td>≥3 syllables, iambic stress pattern and all with CC</td>
<td>WI:/t d s (n l)/ WMd/p f t d r s l η s j/ WFd/v t d r n s l η t/ Place: Trill Manner: lateral Laryngeal: Voicing precision need</td>
</tr>
<tr>
<td>Needs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Discussion

The results of this study show that the motor-based high-intensity intervention delivered to the studied boy was successful both in terms of better performance on targeted structures and transfers to other structures, such as the vowels. One way of measuring performance after intervention is by the assessment of the production of probes. The percentage of whole word match was higher in the targets than in the probes for both therapy blocks. This could perhaps be an effect of the probes not being trained, but also that the choice of probes was only based on phonological resemblance with not as much consideration to whether the words were functionally appropriate to the boy. The overall aim was to expand the participant’s phonology and thereby make him more intelligible. However, intelligibility was not formally assessed. The perceptions of the parents and pre-

![Graph showing percentage of whole word match, word shape match, CCV-match, PCC and coronal match at baseline and one week after therapy.](image)

**Figure 1.** Percentage of whole word match, word shape match, CCV-match, PCC and coronal match at baseline and one week after therapy.

**Table 6.** The participating boy’s phonological strengths* and remaining needs** after therapy divided by word structure, single consonants by word positions.

<table>
<thead>
<tr>
<th>Word structure</th>
<th>Word positions, single consonants</th>
<th>Features &amp; segments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strenghts</strong></td>
<td>[3 syllabic words, both trochaic and iambic stress pattern and the following CV word shapes: CV, CVC, CVCV, CVCVC, VC, CCV]</td>
<td><strong>MI:</strong> / p b m t d n f v l j k g h s /  <strong>WM:</strong> / p b v k g n /  <strong>WF:</strong> / p f t n l s g /</td>
</tr>
<tr>
<td>Inconsistent or not elicited</td>
<td><strong>MI:</strong> / s /  <strong>WM:</strong> / d l /  <strong>WF:</strong> / d l /</td>
<td>Manner: Plosive, nasal, fricative Place: labial labiodental, palatal, dorsal, <strong>Coronal:</strong> dental Laryngeal often matches</td>
</tr>
<tr>
<td>Remaining needs</td>
<td><strong>MI:</strong> / r f j /  <strong>WM:</strong> / r s t d l n /  <strong>WF:</strong> / r s t d l n /</td>
<td>Place: retroflex Manner: Trill Place (coronal:dental) Laryngeal: Voicing precision</td>
</tr>
</tbody>
</table>

*Gains in bold **Not all sounds in all positions were elicited.
school teachers regarding intelligibility were obtained by asking them. According to both caretakers and pre-school teachers, Alex’s intelligibility improved considerably, and as a consequence, Alex opened up for more verbal interaction with peers.

The chosen treatment approach directly addressing speech movement patterns was not solely motivated by the hypothesis that the Alex’s SSD was due to CAS. He had some characteristics of CAS, although not confirmed and, thus, was not a clear candidate for a phonological diagnosis either. Also, the therapy used prior to this study had failed to help him. However, it could be argued that the amount of previous therapy was very limited.

There could be several reasons as to why the intervention in this study worked well. The DTTC is a highly structured approach with concentrated drill and a “watch me-listen” strategy (Strand & Skinder, 1999). This perhaps suited Alex, who had some difficulties concentrating.

Another explanation could be the very careful choice of targets. Functionally powerful words with targeted sounds and syllable shapes were chosen for two reasons. Firstly, single phonemes and syllable shapes seldom appear as separate communicative units. They appear in words, however in a more subtle sense than the words in a dictionary (Gussman, 2002). Secondly, the idea was that Alex’s self-esteem would benefit from becoming more intelligible and as a consequence of this made him more motivated. The positive outcome was perhaps also enhanced by the use of established elements for targeting new elements inspired by nonlinear phonological intervention (Bernhardt et al., 2010). Another important explanatory factor could be the high intensity in terms of both dose frequency and the high frequency of target word trials per session (dose). Intensive dose frequency has been shown to be more effective than lower treatment intensity for children with SSD (Allen, 2013; Kaipa & Petterson, 2016). Alex’s caretakers were highly supportive and wanted to help out. A home training program was therefore added in therapy block II. This could possibly have contributed to the outcome. Rvachev and Brosseau-Lapré (2012) showed in a study that an inclusion of home training was effective when being aligned to what was being done at the clinic.

Half of the therapy sessions were conducted by the LT at the pre-school. Thus, it could be argued that the boy didn’t have SLP therapy strictly. However, the LT worked according to the step-by-step instruction made by the specialist SLP and also got all training material from her.

In SLP education in Sweden, it has been emphasized for several years that the choice of therapy for children with SSD should be linked to diagnosis. Students have been taught that motor-based intervention approaches should be restricted to children diagnosed with a motor speech disorder and phonemic perception and awareness training should be offered to those assumed to have a deficit in the underlying phonological system. However, for many children the diagnosis is not crystal clear. These children may have symptoms that appear to be a mixture of a phonological disorders and CAS. For these children and perhaps for all children with SSD, other factors could guide the choice of treatment approach. Beside a comprehensive analysis of the child’s speech and a careful target selection, other characteristics of the child should also be taken into consideration. A clinical observation among SLPs is that many children with SSD have signs of other issues such as attention and concentration problems. Perhaps these children benefit more from structured training procedure with relatively high dose and dose frequency, regardless of assumption of underlying cause of the speech impairment.

The study was conducted in the clinical setting and there are several concerns about the methodology. At the post-therapy assessment, a check-up of all target words and their
corresponding probes and an assessment of connected speech was conducted. It was desired to also make a formal phonological assessment with the phonology test. However, for practical reasons Alex could not be scheduled for more than one visit and content had to be adjusted to his limited attention. Another concern could be the use of PCC as a measure of outcome of production of test words. The measure as originally proposed by Shriberg and Kwiatokowski (1982) was based on phonetic transcriptions of conversational speech. However, in a later publication (1997) Shriberg and co-workers stated that single-word material may be used provided that results are not to be related to severity of involvement.

**Conclusion**

This study only included one single case, which makes definitive conclusions premature. However, the results indicate that a highly structured and high-intensity DTTC therapy based on a careful target selection guided by the principle of using established elements for targeting new elements from Nonlinear phonology and the choice of functionally powerful words inspired by the core vocabulary approach could be cost effective in comparison to the indirect or low-intensity training given over longer stretches of time for children with SSD currently used in Sweden. Home exercises can be added, preferably clearly incorporated/aligned to the work done in the clinic. The positive outcome of the treatment argues for research on larger numbers of children.

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**References**


