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Phonological Contrast Therapy in a Child with Consistent Deviant Phonological Disorder
A Case Study of Assessment, Intervention, and Outcomes

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Abstract:

This case study examines the speech and language development of MS, a 6;9-year-old boy presenting with consistent deviant phonological disorder, particularly affecting fricatives, affricates, and approximants. MS's early medical history of recurrent otitis media and delayed speech milestones contributed to his phonological impairments. Phonological contrast therapy targeting /f/, /s/, and /ʃ/ was administered through 11 individual sessions, utilizing minimal pairs and triplets to enhance his phoneme realization and generalization to spontaneous speech. Therapy resulted in significant improvement, with MS achieving correct production of target phonemes across various linguistic contexts, boosting his intelligibility and confidence. Residual errors in voiced fricatives and affricates suggest the need for continued therapy. The study underscores the importance of early intervention, parent involvement, and tailored therapeutic strategies in addressing phonological disorders.

Keywords: speech therapy, phonological disorders

الملخص :
، البالغ من العمر ٦ سنوات و٩ أشهر، والذي MS تتناول هذه الدراسة حالة تطور النطق واللغة للطفل يعاني من اضطراب فونولوجي مستمر، يؤثر بشكل خاص على الأصوات الاحتكاكية، والتراكيب، يشير إلى إصابته بعدوى الأذن الوسطى المتكررة MS التاريخ الطبي المبكر لـ .ɹ/ والصوت التقريبي وتأخره في تحقيق معالم النطق، مما ساهم في مشكلاته الفونولوجية. تم تطبيق علاج يعتمد على التباين من خلال ١١ جلسة فردية، باستخدام أزواج ʃ/ و /s/ و /f/ الفونولوجي مع التركيز على الأصوات وأطياف متقاربة من الأصوات لتحسين إدراكه للأصوات وتعميمه على الكلام التلقائي. تؤكد الدراسة على أهمية التدخل المبكر، ومشاركة الوالدين، واستراتيجيات العلاج المخصصة في معالجة .الاضطرابات الفونولوجية

الكلمات المفتاحية: : تأهيل نطق و لغة ، اضطراب صوتي منحرف

1. Introduction

MS is a 6:9 year old boy displaying delayed and deviant phonological processes in his speech. He was most specifically impaired in the realisation of fricatives, affricates and the approximant /ɹ/.MS received phonological contrast therapy targeting the phonemes /f / /s/ and /ʃ/ in word initial medial and final position. At the end of the episode of care these fricatives were produced correctly in all word positions, in individual words and within phrases, sentences and spontaneous speech.

2. Case History

2.1 Medical and developmental history

During his early childhood MS had frequent otitis media (ear infection) resulting in referrals to ENT doctors. Glue ear (also called otitis media with effusion) means the middle ear contains a build-up of sticky fluid (or glue). Grommets were fitted during his 4th year. A grommet is a small ventilation tube inserted into the eardrum to allow air into the middle ear and prevent a build-up of fluid. By the time of this therapy episode hearing was unimpaired. Despite this extended period of fluctuating hearing acuity MS's family had no concerns about MS's language comprehension. However, MS did begin to use his first words slightly late, at 18 months and produced only 2- and 3-word sentences at 3:9 years, slightly below normal limits for his age Goldman & Fristoe (2000) provide modern developmental norms for speech sounds, offering insights into articulation and phonological processes across different age groups

2.2 Speech and language therapy history

MS was initially referred for Speech and Language Therapy at 3:8 years, attending group therapy at 4:2 years of age. However, speech therapy was deferred until MS's hearing impairments had been resolved. He attended the group therapy at 4:7 years but was discharged following failure to attend subsequent therapy groups. MS was re-referred at 6:1 year. At this time, he was reported to ask questions, hold conversations, and use short sentences and there were no concerns about his use or understanding of language. However, he was reportedly only understood by family or familiar adults. When reassessed, impairments in the production of speech sounds remained.

2.3 Family and personal relationships

At school MS is reported to be neither confident or sociable, and fortunately is not bullied because of his poor intelligibility. MS was extremely shy and showed low self-esteem at the beginning of therapy, possibly a consequence of the speech disorder. MS's family are concerned about MS's speech and are keen to take an active role in therapy. MS was observed to have a good relationship with his mother.

2.4 Educational achievements

MS's speech impairments may be adversely affecting his reading and spelling abilities. At school he is in the lower set groups for literacy and numeracy. MS's spelling errors tend to be governed by his phonological processes. Therefore, eliminating MS's phonological processes should reduce his spelling impairments. Research shows that children with speech sound disorders (SSD), especially those with deviant phonological processes, are more at risk for reading and spelling difficulties (Treiman et al., 2016) (Brosseau-Lapré & Roepke, 2022). Phonology impairments may also lower the expectations adults have of MS's academic progress (Tambyraja et al., 2022). However, MS's unimpaired phonological awareness skills suggest a positive prognosis for literacy development as the ability to segment words into their sounds which is very important for spelling and reading (Kilpatrick, 2016).

3. Data collection

3.1 Summary of initial assessments and observations

Language: MS's understanding and use of spoken language were assessed through informal conversations (not using standardized assessments of language skills). And the results showed that he had age-appropriate language.

Speech: MS was assessed using the DEAP diagnostic screen, phonology, articulation and oromotor subtests. The Diagnostic Evaluation of Articulation and Phonology (DEAP) is a comprehensive, individually administered, norm-referenced battery designed to provide differential diagnoses of speech disorders in children. MS was extremely aware of his own difficulties and was very shy in the initial assessment. He initially refused to do the articulation assessment in clinic but co-operated when a game was agreed as a reward.

MS's speech included both delate developmental and deviant phonological processes. Consistent Deviant Phonological Disorder are Errors that are consistent patterns, but SHOULD NOT be seen by any child at any age. E.g., deleting all syllable-initial consonants. Briefly, it was found that MS omitted or substituted /f/ /s/ /ʃ/ /θ/ /ð/ /tʃ/ and /ɻ/ in single word productions. Non age-appropriate developmental processes included stopping, cluster reduction, deaffrication, and gliding. The stopping phonological process is when a child produces a stop consonant /p, b, t, d, k, or g/ in place of a fricative /f, v, th, s, z, sh, ch/ or an affricate sound /j/. Cluster reduction is a common phonological process in children's speech development, where a child simplifies a cluster of consonant sounds into a single sound or a more manageable combination of sounds. Deaffrication is a pattern of substitution where an affricate, like "ch" or "j", is replaced with a fricative or stop like "sh" or "d". Gliding is a common phonological process in young children's speech development, where they replace sounds like "l" and "r" with smoother sounds like "w" or "y". In normally developing children stopping is acceptable until 3:5 years, deaffrication and cluster reduction until 4;0 years and gliding until 6;0 years.

Deviant processes displayed by MS included glottal replacement, medial consonant deletion and nasalization. Other patterns may have been attributable to accent features. However, as this impairment is also located in the fricative system it may not be a feature of accent but of overall impairment of fricative production, especially as MS does not articulate /θ/ correctly in isolation. He had difficulty articulating the following sounds in isolation: /f/ /s/ /z/ /ʃ/ /dʒ/ /θ/ /ð/

and /ɻ/ By 6:9 years all phonemes except /θ/ and /ɻ/, which are not consistently produced correctly in normally developing children until 7:0 years or above, should be present in his speech. The phonemes /f/, /s/, and /z/ typically emerge by 3:0 to 3:5 years, aligning with modern findings from McLeod & Crowe (2017) and the Vancouver Coastal Health (2021) speech development chart.

Speech processing profile: Following the recommendations of Brosseau-Lapré and Roepke (2022), a speech processing profile was created to assess the locus of MS's speech production impairment. Phonological awareness was unimpaired and he had accurate representations for the sounds he could not produce correctly. He could reject inaccurate productions of these phonemes in single words and locate the error in the word but when asked to produce the correct form of the word, he was unaware that he had produced the inaccurate form. This suggests the locus of impairment is in the realisation of specific phonemes and not in the representation of these phonemes.

4. Data analysis (linguistic diagnosis)

Using Dodd's (2009) model of speech production, which has also been adopted and extended by Brosseau-Lapré & Roepke (2022) and Tambyraja et al. (2020), MS was diagnosed with consistent deviant phonological disorder. This diagnosis includes both non-age-appropriate developmental patterns and deviant patterns, reflecting a mismatch between typical phonological development and the child's speech patterns. The locus of this impairment is in the realisation rules for the sounds which allow us to set up a phonological plan. Thus he has the correct representation for the sound in the lexicon but is unaware that he is realising it incorrectly in his speech. MS articulates the fricatives correctly in some words/positions but not others, rejecting a diagnosis of articulation disorder, Dyspraxia, or apraxia of speech.

It is hypothesised that speech sounds with the lowest phonetic salience (i.e. those with similar intensity-frequency characteristics to the hearing loss associated with otitis media with effusion) may be difficult to acquire in children with fluctuating hearing loss (Dobie & Berlin, 1979; Shriberg, Friel-Patti & Brown, 2000). This may partly explain why MS's speech errors and omissions are concentrated around the fricative and affricate system. However, this is a

tentative hypothesis that is only partially supported by empirical evidence. Although fluctuating conductivity loss may be a factor in phonological disorders it cannot be the sole cause (Brosseau-Lapré & Roepke (2023).

5. Summary of therapy

5.1 Status at the beginning of therapy

MS's phonological impairment for fricatives was probed further using a set of 6 initial /s/ /f/ and /ʃ/ words. MS produced one initial /f/ and /ʃ/ target correctly and no initial /s/ targets correctly. The remaining targets were produced with the initial fricative substituted as /j/. Although MS could auditorily discriminate between plosives and fricatives he had difficulty discriminating between /f/ /s/ and /ʃ/ suggesting his perception of the acoustic and articulatory differences between these phonemes is impaired.

5.2 Ultimate goals

Age-appropriate speech is the ultimate goal of therapy because MS's impairments are localized to the realisation of phonemes. Although informally assessed, MS's age-appropriate language comprehension and production suggest that his impairment is one of phonology and not an overall delay in language.

5.2.1 Long term goals

The long-term goal is 100% correct production of /f/ /s/ and /ʃ/ in word initial, medial and final position in treated and non-treated words in isolation, phrases, sentences and in spontaneous speech.

The target sounds were chosen because they were occasionally produced, suggesting they were emerging in MS's sound system and were amenable to change. The phonemes /f/ and /s/ are often targeted first because they emerge early in the speech development of typically developing children. The acquisition of these sounds generally occurs between 3:0 to 3:5 years, as confirmed in more recent studies of typical phonological development (McLeod & Crowe, 2018; McCarthy et al., 2022). Additionally, gliding of fricatives, a process where sounds like /s/ or /ʃ/ are replaced by glides (e.g., /w/), is considered a deviant process that should be prioritized in speech interventions

over typical developmental processes. This has been supported by recent studies that emphasize the significance of addressing a typical phonological processes like gliding early in treatment (Trofimov et al., 2022; Roepke & Brosseau-Lapré, 2023).

5.2.2 Short-term goals: Summary of therapeutic intervention

MS received 11 individual sessions of phonological contrast therapy with additional homework each week. Phonological contrast therapy usually directly contrasts the error form with the target form (Trofimov et al., 2022) but was not possible for MS's phonological process, necessitating the use of /f/ /s/ and /ʃ/ minimal triplets. These triplets highlighted the difference between each phoneme and its realisation. It encouraged MS to actively generate his own solutions to his phonological processes because it highlighted the fact that his old productions created nonsense words and homonyms. This realisation can also be applied to other processes in future therapy. Minimal triplets also avoid overgeneralisation to a rule that all initial-fricative words begin with /f/ or /s/ (Roepke & Brosseau-Lapré, 2023) and (Trofimov et al., 2022). Minimal pairs and triplets are sets of words that differ by only a single sound in initial, medial, or final position.

Phonological contrast therapy makes the articulatory and acoustic differences salient and meaningful by using concrete, easily understandable words. However, the creation of /f/ /s/ triplets meant that some targets were not highly imageable (e.g. shame/sin). Although initially difficult to learn these words proved successful at highlighting the need for contrasts. However, such words are too abstract to be meaningful to younger children. A letter card from "Letterland" represented each sound (Roberts & Sadler (2018) Letter sound associations were used because they were developmentally appropriate and allowed the creation of a pictorial and concrete referent.

Therapy targeted the correct production of these sounds in word initial position in 18 words. These words were elicited on their own, in phrases and in sentences. Once MS had mastered the correct production of initial /f/ /s/ and /ʃ/ targets, the same procedure was repeated for word medial and word final targets.

Word initial position was first targeted because it is easiest to produce and most salient to perceive.

Minimal triplets were not possible for word medial or final target words. Instead, three-word sets were produced for each but were not used contrastively. Therapy more closely resembled articulation therapy in which the target production was modeled and imitated until correct. He was taught a strategy of breaking down targets into syllables, articulating each segment, and gradually blending them until a fluent production was reached. This increased his metalinguistic knowledge of how the word was produced and why it was difficult to produce for him. It was hoped that teaching strategies and increasing metalinguistic awareness would aid generalisation to novel words.

Before the phoneme could be organised into phonological realisation rules for words ease of articulation had to be established. MS received guidance on how to articulate each fricative in isolation and in nonsense words using flash cards highlighting the differences in how the phonemes felt, looked and sounded. Using visual, tactile and kinaesthetic feedback encouraged selfmonitoring, ensuring greater generalisation outside of clinic and to untreated words (Trofimov et al., 2022; Roepke & Brosseau-Lapré, 2023). However, therapy focused on how phonemes felt and sounded as MS refused to look in a mirror. These strategies raised his awareness of both the difference between sounds and also the difference between his productions and the target production.

The procedure of phonological therapy is outlined below:

Table 1: Phonological Contrast Therapy Procedure

step	Procedure
1	Auditory discrimination of /f/ /s/ and /ʃ/ in a. Isolation b. VC, CV, VCV nonsense words c. Targets words
2	Production of /f/ /s/ and /ʃ/ in a. Isolation b. VC, CV, VCV nonsense words c. Targets words
3	Correct production of target words in a. Isolation b. VC, CV, VCV nonsense words c. Targets words
4	Generalisation of correct /f/ /s/ /ʃ/ production in novel words a. Isolation b. VC, CV, VCV nonsense words c. Targets words

Due to MS's shyness and awareness of his problems turn taking games were used where mother and therapist made mistakes. This diverted attention away from MS and demonstrated that mistakes are a natural part of learning, reducing the negative implications of making mistakes. It also allowed the therapist to develop a rapport with MS. Games are also fun and involve active/kinaesthetic learning. Children may learn kinesthetically, visually and auditorily or show a preference to one type of learning that is beneficial to them (Kirschner, 2017) and (Kavale & Forness, 1987). All three methods were used with MS to maximize his learning potential.

A positive reinforcement schedule was used during therapy. Initially immediate praise and rewards of 'ant stamps' in his workbook were used to increase confidence. However, as MS progressed, the amount of ant stamps became too large to constitute a meaningful reward, it became more difficult to use these rewards to demonstrate progress. Therefore, a star chart was introduced on which a picture of the target word was added when the word was produced with 100% accuracy and consistency. This provided a tangible reference point for improving MS's confidence, maintaining gains and continuing progress. Alternating the reinforcement schedule from instant and consistent praise to intermittent and delayed praise encouraged communication not praise to be the goal of language production aiding generalisation by making it more similar to real life (Hanley et al. (2014).

Once a rapport was gained, MS was encouraged to take responsibility for his own learning by asking him which target words he found most difficult and thinking about why they were difficult using guided questioning and metacognitive modeling. Such discussion allowed MS to feel that he was gaining advice not receiving criticism. It also encouraged acceptance of those goals promoting generalisation to other settings. It was also emphasized that MS needed to practice difficult sounds and words daily to improve. Encouraging planning, self-evaluation and reflection are important for carry-over to other settings. MS's awareness of his own errors was encouraged to aid generalisation using phrases such as "you said X is that right?" and "what did you say?" As MS progressed, an incorrect production was marked by an exclamation such as "ah" and the use of facial expression, to elicit self-correction. However, MS already had a great awareness of the sounds he had difficulty producing and once targets were acquired, needed little prompting to recognise his own errors and attempt to self-correct.

Generalisation to home was enhanced by involving the mother in a joint exploration of the problem (Schertz et al., 2018). Her understanding of MS's problem was explored, and therapy techniques modelled for her to do at home following the recommendations of the transplant model (Kersner & Wright, 2021). Regular homework emphasised the need to change productions at home. Also, his teachers at school were informed of what was happening in therapy and the words being targeted, further emphasising the need to change

productions at school. MS's mother was continuously updating his teachers with his progress in therapy, rising the school awareness and involvement. This collaborative practice allayed parental anxieties because they felt that MS was receiving a coordinated rather than fragmented input.

Trofimov et al. (2022) and Brosseau-Lapré & Roepke (2023) discuss the value of using multiple exemplars and realistic contexts (such as both home and clinic environments) to improve the generalisation of speech skills. These approaches are particularly effective when targeting skills under different contextual strains, helping children adapt their speech production skills to varying challenges and settings. MS and his parents were encouraged not to stop training a word even after MS appeared to have mastered it. This extended training ensures MS's realisation rules are strengthened and automatized, therefore resistant to interference from the burdens of speech production in novel communicative settings or partners. Although parental report indicated fricative production had generalised to the home setting, no formal assessment was taken due to time constraints.

6. Results (Outcomes of therapy)

At the end of therapy MS correctly produced the target words with /f/ /s/ /ʃ/ in initial, middle and final position. These words were elicited on their own, in phrases and sentences and in spontaneous speech. MS also produced these sounds in words not used in therapy and also produced /s/ correctly in /s-/ cluster words such as 'سبيدرو'. Furthermore, it was noted that he had some difficulty with the grammatical form of irregular plural (جمع تكسير) in nonsense words. This possible immaturity in MS's language needs further investigation and, if found to be an area of difficulty, will require further intervention to ensure that MS is not disadvantaged in his language or literacy.

6.1 Efficacy of results

It is important to determine whether the gains made in therapy were due to therapeutic intervention, spontaneous improvement in MS's system or 'charm' effect. In order to assess this an efficacy measure was devised. At the beginning and end of the therapy episode MS was given a set of 10 initial /tʃ/ words which he could not produce at the beginning of therapy. MS produced 2/10 correctly and 8/10 with initial /j/ If improvements were due to the effects of intervention,

initial /tʃ/ production should not improve. However, at the end of the episode, MS produced the initial /tʃ/ set with 100% accuracy. As therapy targeted fricatives, gains may have generalised to /tʃ/ which is an affricate comprised of a plosive /t/ and the fricative /ʃ/. In hindsight, a sound not related in manner of articulation should have been used as an efficacy control, such as the approximant /ɹ/ which MS glided to /w/. When used as an informal measure of efficacy it can be seen that MS continued to glide /ɹ/ to /w/ at the end of the episode, suggesting the gains in fricative production were due to phonological contrast therapy targeting the fricative system. However, this is an invalid measure of efficacy as it was chosen retrospectively.

6.2 Results of Reassessment

MS was reassessed using the DEAP phonology and articulation subtest. On assessment, it was noted that MS had made significant progress in his speech sound system since the last assessment. Intelligibility as measured by percent phonemes correct had risen from 86% to 92%. Correct /f/ /s/ and /ʃ/ productions in all word positions and in words within sentences generalised to a non-targeted set of words. Improvements also generalised to the voiced counterpart of /f/. However, they did not generalise either to the voiced counterpart of /s/, /z/ in final or medial position, /θ/, /ð/ in initial or medial position or /dʒ/ word initially. MS continues to produce some speech sounds incorrectly. Briefly, MS continues to front the fricatives /θ/ and /ð/ but also nasalised /ð/ to /n/ word initially. There was one incident of deaffrication of /dʒ/. Although he stopped /z/ to /d/ word medially, he substituted /z/ for /ts/ word finally, suggesting /z/ is emerging. Gliding /ɹ/ to /w/ was the most common process.

7. Conclusions and Recommendations

As a result of therapy MS's speech is more intelligible and it is reported that his confidence in speaking in public (e.g. school assembly) has increased. MS's family has participated fully and successfully as agents of therapy. It is therefore felt that MS would benefit from a home program targeting the remaining speech sound errors. Research has shown that parents can be successful agents of phonological therapy (Schertz et al., 2018). Advice and suggested activities will be given to MS's parents and school.

It is recommended that MS receive phonological therapy continuing with the fricative system. Fronting of /θ/ and /ð/ will be targeted before stopping of /z/ or deaffrication of /dʒ/. This is because the fronting of fricatives occurred with greater frequency, is not a developmental process, and is likely to have a greater effect on intelligibility. Although the fronting of fricatives may be an accent feature, in this case it is likely to be part of the realisation impairment for fricatives because MS failed to articulate /θ/ or /ð/ in isolation. Targeting /z/ and /dʒ/ after /θ/ and /ð/ disrupts the natural order of phoneme emergence However, as /z/ and /dʒ/ did occur in some words it is assumed that they are emerging in MS's speech and may not need direct therapy. As gliding is the last developmental process to disappear in the speech of normal children it would be targeted last (Trofimov et al., 2022). Furthermore, MS did articulate /ɻ/ correctly in isolation, suggesting this sound is emerging as his speech develops.

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