DEVELOPMENT OF A MINIMAL PAIR MANUAL IN HINDI FOR THE INTERVENTION OF CHILDREN WITH SPEECH SOUND DISORDERS USING MINIMAL PAIRS

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CERTIFICATE

This is to certify that this dissertation entitled **"Development of a Minimal Pair Manual in Hindi for the Intervention of Children with Speech Sound Disorders using Minimal Pairs** "is a bonafide work submitted in part fulfillment for the Degree of Master of Science (Speech- Language Pathology) of the student (Registration No: 19SLP002). This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier for the award of any other Diploma or Degree to any other University.

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DECLARATION

This is to certify that this dissertation entitled **"Development of a Minimal Pair Manual in Hindi for the Intervention of Children with Speech Sound Disorders using Minimal Pairs"** is the result of my own study under the guidance of Dr. N. Sreedevi, Professor and Head, Department of Prevention of Communication Disorders (POCD), All India Institute of Speech and Hearing, Mysuru and has not been submitted earlier to any other University for award of any other Diploma or Degree.

Mysuru   *Registration number: 19SLP002*

September 2021

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Dedicated to **Maa and Baa**…..

Shingi, shejal special mention to you both for cooking me goooood food u guys made my hostel life better.

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And, dear readers, the value of this research lies in the way you see it. I trust you and thank you for the proper use in advance.

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INTRODUCTION

The development of a child's phonological system is an important phase of early childhood. Children may articulate some phonemes inaccurately as they learn to talk. They learn some phonemes earlier like /p/, /m/, or /w/. Other phonemes like /z/, /v/, or /θ/ take longer to learn. Most children can produce almost all phonemes accurately by the age of 4(ASHA, 2014).

According to Bharadwaj et al.(2010), Hodson and Paden (1981) typically developing children achieve 85 % intelligibility by the age of 3.3 years, and by four years of age, near 100 % intelligibility is evident even to strangers.

A child who does not produce phonemes correctly by an expected age is said to have a speech sound disorder (SSD). 'Speech sound disorders is an umbrella term referring to any difficulty or combination of difficulties with perception, motor production, or phonological representation of speech sounds and speech segments— including phonotactic rules governing permissible speech sound sequences in a language' (ASHA, 2014). Hence, the child with speech sound disorder can have a phonetic type or phonemic type of error.

According to Elbert (1992), the phonetic error would be those error sounds, which should occur in the phonetic inventory (but are not produced). In contrast, phonemic errors are errors that are produced, and those are part of the phonetic inventory as well (but are used inappropriately). In the first type of error, children either omit sounds or use substitutions for most sounds. In the second pattern, described as a phonemic error, the child can produce the sound, i.e., they have a complete phonetic inventory, but they use sound inappropriately. An example of inappropriate usage can

be a production of [ʧu] for "shoe" but produced [ʈ3ʧ] for "church"; in this case, the affricate /tʃ/ was included in the phonetic inventory but was used inappropriately.

Incidence and prevalence of SSD across the globe

Before knowing about the incidence and prevalence of speech sound disorders, it's helpful to have a quick overview of the prevalence of communication disorders in the Indian subcontinent as a whole. For the same Konadath et al. (2013) studied the prevalence of communication disorder in the Mandya district of Karnataka, where phase I of his study included a door-to-door survey of 15,441 people from 15 villages, regardless of their age or gender. The villages were chosen at random from a list of possibilities. Individuals at risk of communication difficulties were identified using a modified high-risk questionnaire. Those who were found to be at risk were referred to phase II of the study for a thorough audiological and/or speech and language evaluation. According to the survey, 6.07 % of people are at risk of developing communication difficulties. The prevalence of speech and language disorders was 9.42%. Moreover, he reported that phonological disorders were prevalent in 5.9% of the population who were at risk for communication disorders (age range3–15 years).

Many reports have suggested that SSD is highly prevalent in schools. A recent report by Shriberg et al. (1999) and Law et al. (2000) states that the prevalence of speech sound disorders (namely, articulation disorders or phonological disorders) in young children is around 8 to 9 %.

According to Eadie et al (2015) the epidemiology of preschool speech sound problem is poorly studied in Australia. One of their goals was to establish the incidence of idiopathic speech sound disorder. The study included 1,494 Australian participants,

and the prevalence of speech disorder in an Australian cohort was 3.4 %after 4 years of age. SSD was found to have a 40.8 % comorbidity rate.

Karbasi et al. (2011) investigated the prevalence of speech problems in primary school kids in Iran-Yazd, specifically stuttering, voice, and speech-sound disorders. 7881 primary school children in Yazd were assessed for speech abnormalities using. A total of 14.8 % of the population had speech abnormalities, with 13.8 % having a speech-sound disorder.

Researches mentioned above provided a better understanding of the incidence and prevalence of speech sound disorders around the world, there are some published reports present on the prevalence of SSD in India. According to Konadath et al. (2017), who performed a door-to-door survey in five islands of Lakshadweep (surveyed population: 22,558).There were 165 people who came to the evaluation camp with complaints related to speech and language, A total of 136 (82.42%) of these persons were found to have speech difficulties (i.e. Fluency, voice, and articulation). Articulation abnormalities were found in 16.91 % of people. One more survey by Prabhu et al. (2020) on 30,307 individuals from North and Middle Andaman and the Nicobar Islands, identified 1026 (3.38%) to be at risk for communication disorders, and among that, 15.62% were identified as having speech sound disorders (SSD).

Children with speech sound disorders will vary in nature, severity, types of error, and casual factors therefore various therapy approaches have been developed to intervene speech sound disorders. Many of these approaches are 'articulation based,' and literature presented not as much attention to 'language-based approaches.'

The intervention of children with SSD

Speech production ability varies considerably among children with SSD(Cabbage &DeVeney, 2020); making it difficult to determine the best strategy for each child, since SSD subtypes vary in severity and underlying etiology, such as those with motor planning deficits (e.g., childhood Apraxia of speech) or associated sensory or anatomic variations (e.g., SSD secondary to Hearing impairment or cleft palate), or a child with inadequate speech and language skills (e.g., SSD secondary to a spoken language disorder or intellectual disability), or a child with genetic abnormalities (e.g., SSD secondary to Down syndrome).

Other than the co-morbidity as a causal factor, there is a high possibility of gene sharing as speech sound disorder is associated with many speech and language deficits, including dyslexia, autism, Prader-Willi syndrome (PWS) Angelman's Syndrome (AS), hence raising the possibility. Stein et al. (2006) used SSD phenotype and replicated linkage, which revealed that locus of chromosome 15q14 region influenced oral-motor function, articulation, and phonological memory. The study results suggest shared genetic determinants in this chromosome region for SSD, autism, and PWS/AS.

Studies quoted above supports that most children with SSD have a varying etiology and have speech production problems, including those with articulation or phonological-based errors (Articulation errors involve substitution and distortion of a small number of phonemes without having a significant impact on a child's intelligibility, whereas phonological errors affect a large number of phonemes).

Multiple studies have classified intervention approaches for SSD. According to Wren et al. (2018) most intervention strategies are classified on the levels of processing, as illustrated in figure 1. It is primarily concerned with "input, storage, and output."

Figure1.

Intervention procedures for targeting speech-sound disorder
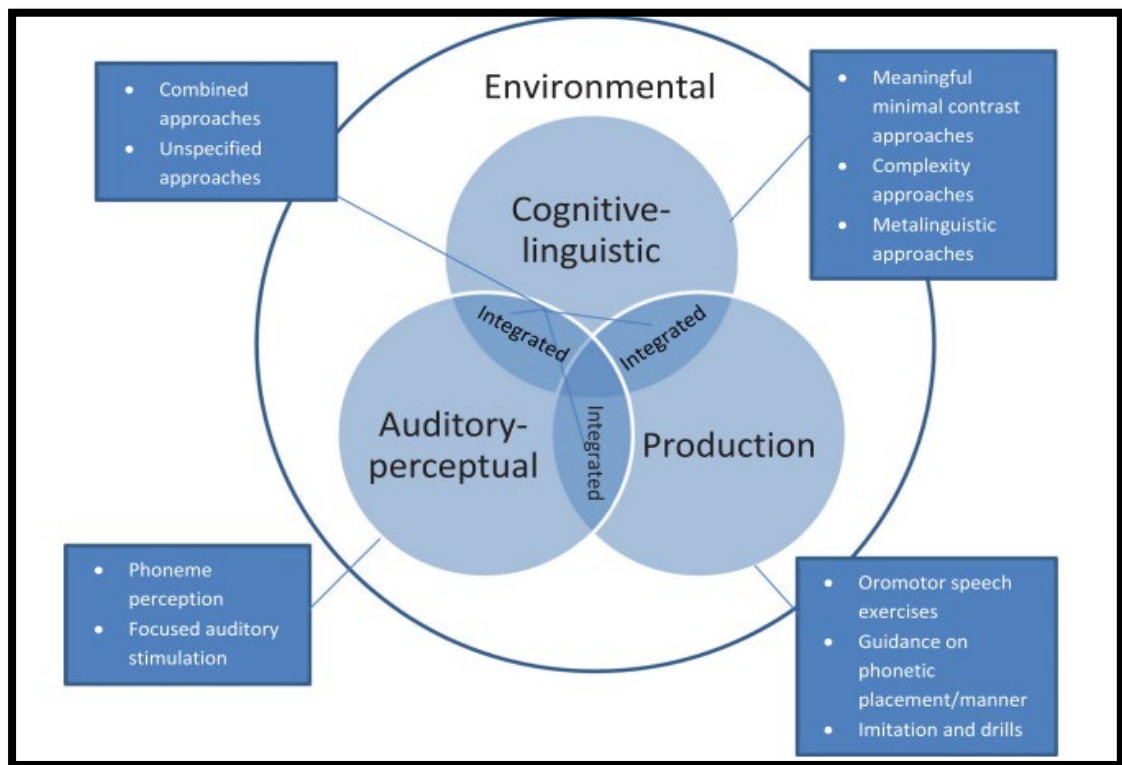
Note. Source: A systematic review and classification of interventions for speech-sound disorder in preschool children by Wren, Y., Harding, S., Goldbart, J., & Roulstone, S. (2018). *International journal of language & communication disorders*, *53*(3), 446-467.

When intervening 'input' level of processing, a child is required to respond on some auditory stimuli to effect change in their speech; at 'storage' level, child is made aware of their stored representations of words as a means to challenge existing inaccurate representations; or 'output,' which require the child to produce speech in response to imitation or some other stimuli. Wren et al. (2018) proposed a model of intervention for SSD and labeled five intervention categories: environmental, auditory–perceptual, production, cognitive-linguistic, and integrated.

1. **The environmental approach** is distinct from the others as it includes intervention approaches that use everyday interactions, rather than specific directed activities, to promote change in a child's speech-sound system. This would include procedures sometimes described as 'naturalistic intervention' as well as the modeling and recasting of a child's spontaneous productions (Camarata, 2010).

2. **Auditory perceptual interventions** targets child's perceptual skills which induces a change in speech output. It comprises of activities like focused auditory stimulation that try to enhance exposure to the sounds being targeted, as well as discriminating tasks that aim to improve phoneme perception skills. (Hodson&Paden, 1983)

3. Oro-motor activities, phonetic placement or style, imitation, and drills are all part of **production interventions**. A traditional motor-based approach is used for systematic intervention to increase the articulatory accuracy of children producing errors on a small number of phonemes. In the latter part of the twentieth century, a classic shift occurred in articulation therapy when researchers and clinicians realized the importance of attending to patterns of deficit occurring in children's speech rather than focusing only on individual phoneme errors. Such patterns are systematic, rule-governed, and affect the phonological structure of language (e.g., replacing all fricatives with stops). It became apparent that a systematic approach to speech production intervention may effectively remediate errors in an entire class of sounds, which was proven more effective for children producing erroneous phonological processes than focusing on remediating a child's speech errors one phoneme at a time (Hodson& Paden, 1983).

4. **Cognitive–linguistic interventions** engage the child in higher-level processing. The child's awareness of their speech is consciously addressed and used to promote change by either confronting a child with their reduced set of contrasts or increasing awareness of sounds in speech generally or to understand it in a better way, this approach was specifically designed to address the child's phonological system as a whole, rather than one phoneme at a time. The goal is to draw the child's attention to their current phonological production and make them aware that it is insufficient to distinguish meaning in their native language. For example, a child who fronts velar phonemes (i.e., the phonological process of fronting) produces the target /ʨ/ to represent both "tea" and "key," unaware that this production is ambiguous for listeners. Thus, cognitive-linguistic approaches seek to address how the child is thinking (cognitive) about how sounds in words affect meaning (linguistic). 'Minimal pair contrast therapy' is one of the cognitive linguistic based intervention programs that clinicians often practice in treating children with phonological delays and disorders (Barlow &Gierut, 2002). Various researchers have supported this approach since the 1980s (Barlow &Gierut, 2002; Saben & Ingham, 1991; Elbert et al. 1991; Tyler 1990; Monahan, 1986; Weiner, 1981).

5. **Integrated interventions** are simply those that combine two or more of the other four mentioned above or combining procedures into a program of multiple interventions consistent with a 'Cycles' approach to intervention (Hodson & Paden 1981).

Despite the fact that several approaches have been listed above by many authors, a gold standard for intervention for persistent speech sound errors has not

been established in the literature. It's been called "one of the most neglected areas in speech therapy" (Gibbon & Paterson, 2006). As a result, there is a need for evidence-based research on the treatment of speech sound disorders in the Indian context.

Need for the study

As India is a multilingual country, a large number of languages are prevalent here. Hindi is the national language of India and is spoken in seven more countries as the native language by a part of the population (Gusain, 2012). Hindi is written in a script named Devanagari and is the third-most spoken language in the world after Mandarin and English moreover, a total of about 560.9 million people worldwide speak Hindi as their mother tongue (Julian, 2020).

Communication disorders are high among India's rural population. Konadath et al. (2013) studied the prevalence of communication disorder. According to the survey, 6.07 % of people are at risk of developing communication difficulties. The prevalence of speech and language disorders was 9.42%. Recent survey by Prabhu et al. (2020) on 30,307 individuals from Andaman and the Nicobar Islands (India), 15.62% were identified as having speech sound disorders (SSD). Data mentioned in the study show a high prevalence of SSD in India, intervening the population is utmost important.

There are a variety of phonologic treatment options for individuals identified with speech sound disorders. The subject of which treatment approaches are more efficacious (i.e., produce better outcomes) is one for which there is little data and few answers in literature. Similarly, more data is needed to see if one subgroup of children with speech sound disorders responds better to one therapy technique or procedure than the other in our study.

According to Bernthal (2009) comparison studies of phonological treatment between the "conventional approach" and others are scarce. Moreover, there is also lack of a standard therapy manual for Speech Sound Disorders; many researchers developed numerous articulation drill materials in English (Goda, 1970; Hegde & Pena-Brooks 2006). However, such speech sound therapy material in Hindi is not available, especially ready to use minimal pairs for speech therapy.

Such ready-to-use therapy material would always be very beneficial for speech-language pathologists. Hence, there is a need for such a manual in Hindi, which is widely spoken in many states of India. Also, the studies in the Indian context have supported the use of 'minimal pair-based intervention' in eliminating speech sound errors relatively at a faster pace. Therefore, the present manual will fulfill the need for minimal pairs in Hindi and will also serve as evidence for the technique "minimal pair contrast" in native Hindi-speaking children with speech sound errors irrespective of the comorbid conditions. Also, such manuals provide ready speech therapy stimulus material reducing the time taken for material preparation by Speech-Language pathologists. Due to a lack of comparison research in the field as suggested by Bernthal (2009), the current study also compared the traditional approach to the minimal pair contrast approach using the developed minimal pair manual in Hindi.

Aim of the study

The current study aims to develop a minimal pair-based picture stimulus manual in Hindi for the intervention of native Hindi-speaking children with speech sound errors.

Objectives of the study

1. Identification of the most frequent error sounds in native Hindi-speaking children with different communication disorders.

2. Preparation of a manual consisting of minimal pair words with suitable pictures.

3. Assessing the efficacy of the developed manual by carrying out speech sound correction therapy using the developed manual through tele-mode on native Hindi speaking children with speech sound disorders.

4. Comparing the efficacy of the 'Traditional approach' with that of the 'Minimal pair contrast approach' using teletherapy

Implications of the study

a) The development of a 'Minimal pair - picture based manual in Hindi' will be useful in the intervention of children with speech sound errors.

b) The outcome of the current study will help budding SLP's to use cognitive-linguistic therapy approaches for the intervention of speech sound errors in the children.

c) The manual will reduce the amount of time required for SLPs in developing words and pictures for minimal pairs in Hindi.

d) Further, it will also encourage the usage of evidence-based approach which in turn can keep up the professional standards of the SLP's.

e) The minimal pair manual can facilitate improving the language component in children with SSD.

CHAPTER-2

REVIEW OF LITERATURE

An individual is said to have speech sound disorder (SSD) when there is difficulty producing specific speech sounds that continue past a certain age. The age of acquisition for every sound is different, *i.e.* by what age a child should produce the sound accurately.

According to DSM-5 (2013), SSD is a diagnostic label specific for individuals with difficulties in productive speech, which interferes with communication and produces impairment in functioning. Speech sound disorder can also be understood as an umbrella term that includes articulation and phonological disorders. For instance, deviant articulation of an individual from the norm can be diagnosed as an articulation disorder. An articulation disorder is a subcategory of a speech disorder. It is an atypical production of speech sounds characterized by substitutions, omissions, additions, or distortions that might interfere with intelligibility (ASHA, 2014). At the same time, a phonological disorder refers to impaired comprehension of the sound system of a language and the rules that govern the sound combinations (Bishop et al., 2014). There is a considerable amount of difference between articulation and phonological disorders, described in the table 2.1.

Table-2.1

Differences between articulation disorders and phonological disorders

ARTICULATION DISORDER	PHONOLOGICAL DISORDER

1. Phonetic errors.	1. Phonemic errors.
2. Problems in speech sound production.	2. Problems in the language-specific function of phonemes.
3. Difficulties with speech sound forms.	3. Difficulties with phoneme function.
4. Disturbances in relatively peripheral motor processes result in speech errors.	4. Disturbances are more central in nature concerning the phonological level of the organization of the language system.
5. Speech sound production difficulties do not typically impact other areas of language areas such as morphology, syntax, syntax, or semantics.	5. Phoneme difficulties may impact other areas of language areas such as development such as morphology, syntax, syntax, or semantics.

Note. Source: "*Articulatory and phonological impairments: A clinical focus*". Pearson/Allyn and Bacon by Bauman-Waengler (2008).

SSD and its effects on quality of life

Language components such as semantics, morphology, syntax, and pragmatics, according to Bauman-Waengler (2015), are strongly related to phonology. As a result, the phonological system of a child can never be considered functionally independent from the rest of the child's language development. Several research (e.g., Edwards et al.,2004; Edwards et al., 2002; Morrisette&Gierut, 2002; Munson et. al., 2005) have supported the idea that delayed phonological development is linked to delayed lexical and grammatical development in children. Although evidence in the literature of a direct link between phonological and grammatical acquisition is unknown.

Studies have suggested the long-term effect of speech sound disorder on literacy skills as well. A study by Peterson et al. (2009) evaluated literacy skills in 123 children of 7-9 years with a history of speech sound disorder (SSD). Two groups were recruited for this study: children with a history of childhood SSD (n = 86) and children with no speech or language disorder (controls; n = 37). After the recruitment, subjects were assessed in the following domains: speech production, language, nonverbal IQ, phonological awareness, rapid serial naming, and literacy. Results suggested that the SSD group demonstrated elevated rates of reading disability.

Not only do children with SSD feel upset, but their families frequently become frustrated in their attempts to interact with their own children, according to several studies (McCormack et.al, 2010). As a result, employing a cognitive linguistic strategy will aid these children in not just reducing speech sound errors but also improving their overall quality of life.

Moreover, Hall (1991) found that even mild articulation problems can lead to children and adolescents being viewed more negatively than their peers with age-typical articulation, posing a social and scholastic barrier. Furthermore, unintelligibility in

children with moderate to severe speech–sound disorders (SSD) can have a negative influence on functional communication and social involvement (Hustad, 2012). Henceforth multiple interventions have been developed to address speech sound disorder (SSD) in children in the past few decades. Children with SSD show abnormally high levels of different types of speech variability, which may require slightly different approaches to intervention.

Treatment of speech sound disorders

When dealing with speech sound disorders, the concern is never how many sounds are involved, but whether the errors are articulatory or phonological in nature, whether single or multiple. If they are articulation-based, a conventional phonetic approach may be the best therapy choice (Bauman-Waengler, 2015). Motor-based treatment approaches or traditional approaches focus on developing a child's phonetic performance, whereas linguistic treatment approaches focus on developing a child's phonological knowledge (Williams, 2003). Some prefer a more conceptual type of interventions targeting groups of sounds (Fey, 1985), whereas others prefer motor-based treatment approaches that focus more on manipulation of motoric skill of the articulators, typically for single target sound at a time (McDonald, 1964).

However, there are too many therapy approaches to improve children's speech sound errors, that often leads to controversies and uncertainty about which approach is appropriate to use: the traditional hierarchical (Van Riper &Emerick, 1984); the cycles approach (Hodson&Paden, 1983); a conventional minimal pair approach (Weiner, 1981), maximal oppositions (Gierut, 1990), multiple opposition (Williams, 2000) and metaphon therapy (Howell & Dean, 1994) or an eclectic approach.

Description of various approaches to phonological intervention is mentioned below:

1. **The Cycles Approach** (Hodson&Paden, 1983)

2. **Minimal Pair contrast training** (Weiner,1981)

   a. *Minimal and Maximal oppositions (Gierut,1989;1990)*

   b. *Multiple opposition (Williams ,2000;2003)*

   c. *Metaphon therapy (Howell & Dean, 1994)*

3. **The Traditional Hierarchical Approach** (Van Riper &Emerick, 1984)

1. The Cycles Approach (Hodson&Paden, 1983)

According to Hodson and Paden (1983) it is a language strategy for children who have multiple sound errors. This method uses sounds to teach phonological patterns, and moves through these goals in a sequential way without a criterion level of performance before going on to the next sound and pattern. Rather than focusing on helping children reduce incorrect patterns or deviations, the cycles method helps them develop correct phonological patterns. The following procedures are used in treatment sessions: (1) The client is asked to concentrate on the target sound's auditory characteristics (2) Production training; and (3) Participation in play activities involving picture and object that elicit a response from the child.

Therapy cycles can span anywhere from 5 to 16 weeks, depending on the number of deficient patterns and the number of stimulable phonemes within each pattern. The following are some of Hodson's (1989) proposals for addressing behaviors using a cycles approach:

- Each phoneme is addressed for about 60 minutes per cycle before moving on to the next phoneme in the pattern and then to other phonological patterns that are weak.

- A cycle is said to be complete when all phonological patterns selected for remediation at a certain point in time have been addressed.

- Following the completion of one cycle, a new cycle begins, this time covering the patterns that have yet to develop and require greater training.

According to Hodson (1989), a client with a disrupted phonological system will typically require 3 to 6 cycles of phonological remediation, each requiring 30 to 40 hours of instruction (40 to 60 minutes per week).

Strengths and Limitations: According to Bernthal (2009) this approach focuses on shifting and cycling remediation targets, as well as phoneme associated with a particular pattern is also focused on for a set amount of time rather than a set criterion level of performance. Although it was created for children who were unable to communicate; components of this method can be applied to individuals who are less severely disabled also.

2. Minimal pairs contrast training (Weiner, 1981)

According to Bernthal (2009) Minimal pair contrast, treatment is a well-known linguistic-based rehabilitation technique for children with speech sound errors. In this techniques, 2 phonemic contrasts are related either to sound feature differences (e.g., bag-back differs by voicing feature) or syllable shape

differences (e.g., bow-boat differs by presence or absence of the final sound; key-ski differs by presence or absence of the initial sound(s) in the syllable initiation-cluster vs. non cluster).

It should be noted that in cases where meaningful minimal pairings cannot be established to express a particular difference, "near minimal pairs" (e.g., van-shan) are occasionally used, in which one word may or may not have meaning. In this case, the clinician will point to an abstract chart and make a remark, "This is a shan". As a result, the client is taught a fictitious yet opposing term to use in the minimal pair task.

a. *Minimal and Maximal oppositions (Gierut,1989;1990)*

According to Bernthal (2009), working on contrasts between the target sound and one or more additional sounds that include multiple feature differences from the target might be beneficial. The sound contrasts may indicate a minimal or maximal sound opposition when picking such word pairings. When sound contrasts in minimal pairs contrast by a single feature; this is referred to as minimal opposition contrasts. On the other hand, a maximal opposition contrast reflects several feature contrasts between a target sound and the second sound.

For example, if a child replaces /ʃ/ with /t̪/, the target words might be shoe and moo rather than shoe and two. In this case, /ʃ/ and /m/ are more dissimilar than /ʃ/ and /t̪/, thus the phoneme contrasts reflect a greater number of feature differences (maximal opposition) rather than fewer feature differences (minimal opposition). The maximal contrast method is based on the premise that phonological oppositions with

higher disparity would enable more change in the client's learning of feature contrasts, and the contrast between word pairs will be more prominent and hence easier to notice (Bernthal, 2009).The same treatment methods that were used for minimum contrast therapy can be used for maximum contrast training.

Data from Gierut (1989, 1990) backs up the usage of maximum oppositions. According to her findings, maximum contrast training enabled a higher overall change in the phonological system than minimal contrast training for children with multiple errors. The sound that contrasted with the target sound in her study was a phoneme that was already in the child's phonological repertoire and didn't need to be taught before being utilized in the minimal pair. However, emphasis on maximum oppositions resulted in better generalization to other sounds than minimal opposition.

Another study by Alsaad et al. (2019) to see how effective and practical the maximal opposition method is for treating an Arabic-speaking child with a phonological problem. Utilizing a single-case experimental design, a 4.2-year-old Jordanian boy born and reared in Kuwait underwent phonological treatment using a maximal opposition method with major-class differences. The accuracy of the child's verbal output improved. Results suggested the   effectiveness of phonological contrast therapy specifically, a maximal opposition approach which could be utilized to treat additional Arabic-speaking children with phonological problems.

b. *Multiple Oppositions Therapy (Williams,2000;2003)*

The multiple oppositions technique is a therapy paradigm that is a variant of the minimal contrast therapy (William, 2003). Multiple oppositions is a therapy method that contrasts numerous target sounds with a comparison sound at the same time. This differs from the minimal oppositions, which handles sound collapses one at a time (i.e., includes either minimal or maximal oppositions). Children with many sound errors and severe to profound phonological deficits should be treated using multiple oppositions technique. The basic concept of this method is that multiple errors made by children are best handled using a "systematic" approach rather than individual sound emphasis. The objective is to assist a child with reorganizing his or her sound system by focusing on a large number of minimal contrast pairings that will enable the child to understand the nature of his or her phoneme collapses (Bernthal, 2009).

According to Williams (2000), clinicians were able to increase the number of phonemic contrasts by using the larger treatment sets contained in the multiple oppositions method with severe SSD children. She reasoned that by following this technique, clinician might achieve the largest amount of change in the shortest amount of time and with the least amount of effort.

c. *Metaphon therapy (Howell & Dean, 1994)*

According to Howell and Dean, (1994) Metaphon therapy focuses on sound characteristics such as duration (long-short), manner (noisy-whisper, stopping-flowing), and place in order to develop an awareness that sounds can

be classified by characteristics such as duration (long-short), manner (noisy-whisper, stopping-flowing), and place (front-back).The therapy starts with these fundamental principles, and then moves on to how these concepts relate to sounds in general. After that, the treatment focuses on detecting characteristics across target speech sounds, followed by word pairings that include targeted sound contrasts.

According to Howell and Dean (1994), children with phonological problems who do not react well to minimal pair therapy should be taught sound characteristics to help them establish sound contrasts in their phonological repertoire. This might help children acquire metaphonological abilities. Children with phonological problems do not do as well as their normally developing peers, according to researchers (Kamhi et.al., 1985).

Strengths and Limitations of Minimal pairs contrast training: According to Bernthal (2009), it's especially beneficial for children who have a lot of misarticulations or phonological rules that don't match the adult standard. It is suggested for use with any client who needs to develop phonemic contrasts, whether or not the errors are motoric in nature.

3. The traditional approach (Van Riper &Emerick, 1984)

The traditional approach of articulation therapy, sometimes referred to as the "Van Riper method," was developed by pioneering clinicians in the discipline in the early 1900s.It is distinguished by its sequencing of activities for (1) sensory-perceptual training, which focuses on identifying the target sound and discriminating it from its error through scanning and comparing; (2) varying and correcting the various productions of the sound until it is produced

correctly; and (3) enhancing and maintaining correct production; and, last but not least, (4) Using the newly acquired speech skill in everyday circumstances.

Production training is a key component of traditional approach, with the goal of teaching a client how to produce a sound on demand. A target sound is (1) produced in isolation (the sound is elicited in isolation or, in the case of stops and certain glides, in a CV context such as /pa/); (2) produced in syllables (the sound is produced in CV, VC, and VCV syllables); (3) produced in words (the target sound is produced in a word or lexical context i.e., phrases, sentences, conversational speech).

Strengths and Limitations. Bernthal (2009) claims that the traditional approach has been widely used over time and that it is the foundation for a variety of modern therapeutic choices because of the method's logical sequence of training activities, the success acquired through motor practice, and the method's flexibility and applicability. In contrast it might not be the best strategy for people who have multiple errors.

Many researchers have observed phonological changes in conjunction with this technique; nevertheless, comparison studies between the "conventional approach" and others are scarce. Hence, in the present study, we compared traditional approach with that of minimal pair contest approach using the developed minimal pair manual in Hindi.

Evidence for the effectiveness of Minimal Pair contrast therapy approach in comparison to other approaches

Speech therapy services are appropriate for any child with SSD; however, their treatment differs depending on their particular profiles. This is because children with SSD are heterogeneous. Similarly, there is variation in the intervention methods utilized. Choosing the optimal "match" between a client and an evidence-based intervention strategy requires not just a study of the best scientific data but also an examination of that evidence in the context of a professional's expertise and clinical abilities, client/caregiver's values, interests, and expectations (Dollaghan, 2004). The current EBP for the pediatric SSD intervention of minimal pair contrast therapy approach is addressed in this section of review.

The minimal pair approach contrasts an individual's error with the target sound by using pairs of words with the least amount of contrast (Weiner, 1981). This method compares word pairings that differ only by one phoneme (for example, tap – cap, tea – sea). One phoneme is often used correctly; whereas the other is not a part of an individual's contrastive phonological system selected. Traditionally, therapists compare minimally paired words (or near-minimal paired words) that differ in one place, manner, or voicing characteristic (e.g., car – tar, sea – tea, pin – bin) to address errors such "fronting," "stopping," and "voicing" (Grunwell, 1997).

Minimal pairs are also commonly used to target structural simplifications like "cluster reduction" and "final consonant deletion" (Dean & Howell, 1986). Cooper (1968) was the first to suggest use of minimal pair approach for intervention especially when error patterns are clearly evident, the minimal contrast approach is frequently used. It's a "conceptual method" that's "often used in the treatment of phonological problems caused by cognitive or language difficulties." (Gierut, 1998). Baker (2010) suggested that the minimal pair approach is one of the most popular and oldest

phonological interventions. The minimal pair technique has a lot of evidence because it has been around since the 1980s (McLeod & Baker, 2017). The efficacy of a minimal pair approach to therapy has been examined in several experimental investigations.

Klein (1996) conducted a comparison study to determine the relative efficacy of conventional and phonological methods in treating children with various articulation errors early in the literature. In the study, 19 children were evaluated and treated using a conventional paradigm, whereas 17 children were treated using a phonological approach. Compared to the other group, children who received phonological-based treatment demonstrated considerably higher progress in a shorter time. In contrast, a study by Bernthal and Bankson (2004) proposed that the traditional approach effectively treats children with speech sound disorder. However, various studies have proved that it may not effectively treat children with Phonemic type of error. Hence, cognitive-linguistic approaches came into existence for treating children with phonological disorders. Lately, Lousada et al. (2014) used intelligibility measures to compare the effectiveness of two treatment techniques (phonological therapy and articulation therapy) in single words and continuous speech. The intervention included fourteen children with phonologically based SSD. There was a significant improvement in intelligibility for the group receiving phonological therapy in both single words and continuous speech, but no differences in intelligibility for those receiving articulation therapies was reported.

In a study, Dodd et al. (2008) probed on the clinical effectiveness of minimal pair therapy on children between 3; 11 - 6; 5 years. A total of nineteen children received approximately 6 hours of minimal pair therapy from licensed SLPs. Results showed significant improvements in speech sound accuracy and a decline in the number of error

patterns. A comparison study by Crosbie et al. (2005) investigated the effect of phonological contrast and core vocabulary approach in individuals with consistent and inconsistent speech sound errors, respectively. A total of 18 participants were referred between the ages of 4-7 years with severe speech disorders by an SLP. Participants were recruited in the study based on the following inclusion criteria- standard score of 3 on the percent consonants correct (PCC) measure of the Phonology Assessment (DEAP — Diagnostic Evaluation of Articulation and Phonology), children were required to have either an inconsistent speech disorder or a consistent speech disorder, structurally and functionally normal oro- motor skills, adequate language skills and nonverbal IQ with normal hearing and lastly should be monolingual speaker of English. Following inclusion, children were allocated to one of the two therapies by referral; the study was conducted using multiple baseline designs with alternating treatments. Treatment 1 was implemented after the baseline period followed by a 4-week withdrawal period, followed by treatment 2 (core vocabulary followed by phonological contrast; phonological contrast followed by core vocabulary). Each child participated in 16 (30-minute) individual therapy sessions in each 8–9-week treatment block by the same SLP. Results suggest that all of the children increased their consonant accuracy during the intervention. Core vocabulary therapy resulted in a more significant change in children with inconsistent speech sound error, and phonological contrast therapy resulted in a more significant change in children with consistent speech sound errors, suggesting that the error patterns were suppressed in more than 90% of the probes. The previous study backs up Gierut's (1998) findings, which claim that the minimal contrast technique may be utilized when error patterns are consistent and can be used as a conceptual form of sound teaching for children with phonological disorders. Children with consistent phonological error respond better to minimal pair therapy than those

with inconsistent errors, which make little or no progress, according to Dodd and Bradford (2000).

Weiner (1981) treated three error patterns (e.g., gliding of fricatives, stopping, final consonant deletion) in two preschool children using minimal pair contrast. Each error was targeted with four sets of minimal pairs. Both participants received one-hour therapy sessions, weekly thrice. Out of 2 participants, one received 6 hours of therapy while the other received 14 hours. The results showed that the error patterns were suppressed in more than 90% of probes. Similar results suggested by Tyler et. al. (1987) who reported generalization using minimal pair contrast approach on 2 children receiving three 1-hour sessions per week for three error patterns using 5-10 minimal pairs. Whereas few studies provide limited evidence for change, one such study by Baker and McLeod (2004) reported differences in the outcome in response to minimal pair therapy on 2 children with similar phonological profiles receiving the same intervention program from the same SLP. Of the 2 children, one child needed over 12 sessions (7 weeks) to generalize the correct production of /s/ clusters to conversational speech, whereas the other child had 32 sessions (5 months); results were suggestive of considering individual differences in the management of phonological impairment in children.

In spite of the controversial literature, McLeod and Baker (2011) presented a review of 134 studies from 1979-2009 on evidence-based practice for children with speech sound disorder, out of 134 studies, 43 being on minimal pair contrast approach. Following training with minimal word-pair contrasts, researchers have also reported changes in children's phonological systems (Weiner, 1981; Gierut, 1989, 1990; Williams et al., 1991). Data also support the efficacy of contrast training (Weiner, 1981;

Gierut, 1989; Williams, 2000). The review ultimately showed that the minimal pair approach is quite effective in the intervention of phonological disorders.

Resource material of minimal pairs available for intervention in various languages

Workbooks, photo cards, line drawings, picture cards, and software programs are several materials used for minimal pair therapy. Very few instruments are using contrastive minimal pairs. Webber photo phonology minimal pair cards, articulation training, Webber photo phonology minimal pair cards fun sheets, read aloud minimal pair contrast stories with activities, line drawing sets of the minimal pairs that are freely available on the internet, the workbook of Scissors, Glue and phonological processes (Earl, 2011).

Recently Ardalan et al. (2020) did a preliminary study on developing a Minimal Pairs package in the Persian language for children with speech sound disorder. Two hundred fifty-six minimal pairs were developed, and it was validated on 45 monolingual Persian speaking children with SSD. Results suggested that the Minimal pairs package is a valid material for use in treating children with SSD.

Hegde and Pena-Brooks (2006) published a resource material called "Treatment protocol for articulation and phonological disorders," which uses English consonants as treatment targets and a list of words with these target consonants in initial and final position for the intervention of speech sound disorder. Protocol for using the resource material has been provided; it has been suggested that sound clusters should follow individual speech sounds to evoke the target phoneme. Authors have also published a separate stimulus book entitled "speech stimuli books", which includes stimuli for training speech sounds and sound clusters. This combination of the treatment protocol

and stimulus picture book will lighten the burden of the clinician for the treatment of children with speech sound disorder.

Many researchers developed numerous articulation drill materials in English (Goda, 1970; Hegde & Pena-Brooks, 2006). Moreover, numerous resources are also available for minimal pair intervention in English. Commercial pictures files like 'Remediation of the common phonological process (Monahan, 1986) is available that provides minimal pair cards for frequently occurring phonological processes. Other material includes Contrasts: The use of minimal pairs in articulation training (Elbert, et.al., 1980) contains picture files used to frame any type of minimal pair treatment exemplars.

Innumerable stimuli for the minimal pairs in English are freely available on the internet in the form of pictures and words (E.g. https://www.home-speech-home.com/minimalpairs.html,http://adventuresinspeechpathology.com/,https://www.speech-language-therapy.com/)

Other commercially available resources include:

1. Lingui systems (2007): Preschool phonology cards. East Molline. IL Lingui systems.

2. Daly (1999): Scissors, glue, and phonological processes, tool, East Molline, IL: Lingui systems.

3. Hall (2006): Have you ever…….? Eight interactive books for phonological processes. Greenville, SC: Super-duper publication.

4. Krupas (1995) Minimal contrast, story, Greenville. SC: Super-duper publication

5. Rippon (2001). Pairs in pictures Fronting, backing, gliding. Yorks, England: Black Sheep Press

6. A variety of word lists (e.g., Bleile, 1995) and treatment materials (e.g., Bird and Higgins, 1990; Palin, 1992) are available commercially to assist clinicians in finding contrasting word pairs and pictures for treatment.

Available Resource materials for children with speech sound disorders in Indian languages

In the Indian context also, researchers have attempted to develop intervention material for speech sound correction. However, the availability of minimal pair stimulus manual is scanty in Indian languages. To quote a few, Wishly (2011) and Prasad (2010) developed articulation drill books for the cleft palate population in Malayalam and Kannada, respectively. The stimulus drill book includes 90 paired words, 243 non-picturable words, 237 picturable words, and 45 sentences incorporating pressure consonants. Thus, a total of 65 stimuli words were developed for each pressure consonant. Whereas, the drill book by Prasad (2010) consists of 100 paired words, 232 non-picturable words, 309 picturable words, and 50 sentences with pressure consonants.

Rofina (2015) developed a minimal pair-based intervention manual in Malayalam language for children with speech sound errors. Following the content validation of the manual by 3 experienced native Malayalam Speech language pathologists. For standardization of the developed manual, the author took twelve participants with a variety of speech and language disorders who were divided randomly in two groups (experimental and control group). After taking the baseline for each participant, minimal pair-based intervention using the developed manual was given to 6 participants with speech sound errors of the experimental group. The control group included another 6 participants who received articulation therapy using the

traditional phonetic placement approach. After 3 sessions, both the groups were retested, using Malayalam Diagnostic Articulation Test-Revised. Results revealed considerable improvement in the production of consonants, both singleton, and clusters. Moreover, significantly improved articulation skills in the experimental group compared to the control group.

Similarly, Pooja (2016) developed and validated a minimal pair based intervention manual for children with speech sound errors in Kannada. The manual was used to provide therapy to 6 children with speech sound errors under different communication disorders in the age range of 5 to 12 years. In contrast, another 6 participants in the control group were treated with a traditional approach. Results were in consensus with the study of Rofina (2015) that is; a significant improvement was seen in the articulatory abilities of the children in the experimental group. Also, the number of error sounds reduced, and good maintenance and stabilization of the sounds were observed even at sentence level in all the participants.

There was also a significant reduction in the number of error sounds during the short span of minimal pair-based therapy for 6 participants of the experimental group when compared to the control group. This was on par with a study done by Weiner (1981) that minimal pair therapy was efficient in eliminating or reducing error patterns in children with multiple phonological disorders.

Research suggests that the minimal pair strategy to treat children with speech sound disorders is beneficial. In this therapy, the clinician must collect minimal pairs from various sources such as books, journals, manuscripts, and other sources to construct appropriate stimulus material, which can be a difficult and time-consuming task. So, if a speech-language pathologist has a single Manual for Minimal Pair Therapy

that includes minimal pair words for phonemes with appropriate visual stimuli, the time allotted for the intervention program can be successfully used with positive results.

As a result, the current research focuses on creating ready-to-use linguistically based stimulus material for the therapy of speech sound errors in Hindi-speaking children. This manual can be very valuable for practicing SLPs because it offers ready-to-use therapy material with illustrations, which cuts down on therapy material preparation time significantly.

CHAPTER-3

METHOD

The present study was implemented in 3 phases in order to develop a "Minimal pair manual in Hindi for the intervention of children with speech sound disorder". Phase I included the development of the intervention manual in Hindi. Inphase II, content validation of the developed manual was carried out, and in phase III, the developed manual was administered via tele speech therapy to establish its efficacy.

Phase 1: **Development of Minimal Pair Manual in Hindi**

Minimal pair manual in Hindi for the intervention of children with speech sound disorder was developed in 4 stages:

Stage1. Documentation of frequent speech sound errors in Hindi

Stage2. Preparation and validation of selected Minimal Pair word list

Stage3. Selection and rating of pictures for the Minimal Pair word list

Stage4. Preparation of the Minimal Pair Manual

Stage1. Documentation of frequent speech sound errors in Hindi

    i.   Details of speech sound errors from 30 children between the age range of 4-12 years having speech sound disorder with or without various communication disorders(e.g. "Cleft lip and palate, Intellectual disability, Phonological disorder, and Hearing impairment") was collected from AIISH-case files, where a thorough analysis was done, for noting the error sounds from the prerecorded transcribed data of 'The test of articulation in Hindi/ Hindi articulation test' {'HAT' (Kacker, 1989)}

   ii.   After analyzing case files in detail, frequent speech sound errors (substitution, omission, distortion, addition) exhibited by native Hindi speaking children with various communication disorders were listed out in descending order, from the most frequently occurring error phoneme to the least one. For example, fronting error i.e. if /t̪/ for /k/ occurred 8 times in a sample of 30 children with speech sound disorder over any other error than it was placed first.

Stage2. Preparation and validation of selected Minimal Pair word list

i. After listing the frequent sound errors, minimal pair words were collected from children's storybooks, comics, textbooks, poems and Hindi dictionary. Minimal pair words were selected based on the following criteria:

    a. Meaningful and simple

    b. Non-ambiguous and picturable

    c. Suitable for Indian context

    d. Commonly used by children

    e. Bisyllabic or trisyllabic

ii. The Minimal Pair words selected were such that, both error sound as well as the substituted sound was embedded in the minimal pair. For example, when child substitutes /t̪/ for /k/, minimal pair will be /t̪a: la/ (lock) for /ka:la/ (black). When minimal pair words were limited, near minimal pairs were considered. For example the word /tʃa;val/ (rice) and /tɔval/ (Towel) are near minimal pair as they are differing in vowel length also in addition to the consonant contrasts.

iii. The prepared word list was then validated by 3 judges (experienced speech language pathologists) who were native speakers of Hindi with atleast 3-5 year of experience in the field of speech language pathology. Judges were asked to rate the minimal pair word list based on the familiarity of the pairs on a 3-point rating scale where;

- 2 being very familiar

- 1 being familiar

- 0 being unfamiliar

Minimal pairs words rated as very familiar and familiar by at least 2 judges were selected and unfamiliar words were discarded.

Stage3.Selection and rating of pictures for the Minimal Pair word list

Following the validation of the minimal pair list, pictures from the internet browser (Google) that were easy to name, unambiguous, attractive, engaging, and culturally relevant were chosen. Three Hindi-speaking SLPs with at least 3 years of expertise in Speech Language Pathology rated the appropriateness of the pictures to the selected words. This was rated on a three-point rating scale by the judges (0-not appropriate; 1-appropriate; 2-most appropriate). Pictures were included in the manual only if they were rated as appropriate and most appropriate by two or more judges. Pictures rated as "inappropriate" were replaced with appropriate pictures.

Stage4. Preparation of the Minimal Pair Manual

The manual was developed with clear and detailed instructions, with a response sheet to comment on the progress (Appendix II). The target sounds in the manual are listed in decreasing order of frequency, with the most frequently substituted sound mentioned first.

Phase II: **Content validation of the developed manual**

The manual's content validity was assessed by providing appropriate questions from the feedback questionnaire of Manual for Adult Non-Fluent Aphasia Therapy in Kannada (Goswami et. al., 2010). In order to validate the manual, a total of ten questions were included and these questions were rated on a 5-point rating scale ranging from very poor to excellent. Three experienced SLPs with 3 years of experience, rated

the manual based on this feedback questionnaire. Following the rating, the manual was revised based on the suggestions.

Phase III: **Administration of the developed manual to establish its efficacy**

To validate the developed minimal pair manual, it was administered to the participants in the experimental group using minimal pair contrast therapy. The manual's administration began with discussion of the words, followed by training in perception and discrimination, production, and carryover. The developed minimal pair therapy manual's efficacy was determined by a statistical comparison of the traditional approach and the minimal pair approach.

Participants

The study comprised of 6 native Hindi-speaking children aged 4 to 12 years who had a provisional diagnosis of speech sound disorder (phonemic type). They were divided into two groups randomly, one control and the other experimental having 3 participants in each group. These 6 participants selected in the study were either availing preschool services or were willing to attend speech language therapy from AIISH. Written consent of agreement was taken from the caretakers of the participants before enrolling in the study. The control group was provided with traditional phonetic placement therapy whereas the experimental group received minimal pair contrast therapy.

Subject selection criteria were as follows:

1. The participants were native speakers of Hindi diagnosed as SSD (phonemic type).

2. The participants did not receive articulation or phonological intervention exclusively before the current treatment program.

3. Participants were matched for provisional diagnosis and age in the control and experimental groups.

4. Participants whose language age was 3 or above were selected for the intervention.

Ethical guidelines were followed in the selection process.

Material for Assessment and Intervention

For the assessment, materials used for all the participants were the Assessment Checklist for Speech-Language Skills (ACSLS) (Swapna et al., 2010), Hindi articulation test (HAT), a picture illustrating the story of Thirsty Crow (Appendix III), and the speech intelligibility rating scale (AYJNISHD) (Appendix IV). For intervention of the experimental group, the newly developed Minimal Pair manual was utilized as stimulus material.

Procedure for Data collection

Initially, the researcher used ACSLS to assess language skills and confirm the language age of the subjects via tele mode. Participants with a language age of three or above were chosen for the intervention. After the recruitment of the subjects in the study, the following tasks were performed via tele mode in pre-test and post-test stages to collect the articulation measures. The pre and post-test sessions were recorded for further analysis and documentation.

1. *Administrations of HAT (Single word elicitation task)* - In the tele-session each participant was instructed to produce the target word (a total of 111 words). The

instruction was "I am going to say some words and I want you to listen carefully and repeat after me one after the other" Responses were recorded and transcribed in order to identify the error patterns. When necessary, the caretaker of the participants assisted in the task. Following the administration of HAT, participants with speech sound errors (phonemic type) were chosen for further intervention.

2. *Connected speech elicitation task*-for this task a picture stimuli depicting the Thirsty crow story was selected, as it was culturally relevant, familiar and had plenty of opportunities for generating the frequently occurring error sound.

3. *Administration of Speech intelligibility rating scale*-Three experienced speech pathologists rated the connected speech elicited from picture description using the Ali Yavar Jung National Institute of Speech and Hearing Disabilities (AYJNISHD); Mumbai (2003) speech intelligibility rating scale for all the 6 participants.

After administering the tasks mentioned above for the pre-test, each participant in the study received a total of five 45-minute tele speech therapy session which was scheduled alternate days. Keeping the current situation in mind tele speech therapy services included a real-time audio and video connection for an in-person experience similar to that of a usual visit. The participants and caregivers were asked to sit comfortably facing the laptop computer screen in a quiet environment at their residence for the tele sessions.

Intervention protocol for the experimental group (minimal pair contrast therapy)

For the intervention of speech sound errors in the experimental group, selection of the target sound was made based on the following principle provided by Lowe (1994):

1. Selection of sound contrast to be trained was based on participant's phonological errors. For example, if the participant substitutes /t̪/ for /ʃ/ (stopping), researcher selected /t̪er/- /ʃer/ (which means "swim" and "lion" in Hindi) as target contrast words, reflecting the stopping pattern.

2. The number of differences between the target and the substituted sound were listed by the researcher. For example, if the participant demonstrates f/v and d/v substitution, the production features that primarily distinguish [f] from [v] are voicing; those that differentiate between [d] and [V] are manner and place.

3. The sound substitutions chosen for each participant in the experimental group reflected the most number of differences in production features. In the example mentioned above, [d] and [v] was selected first for the intervention over [f] and [v] because the former differed in two production feature that is place and manner whereas later contrast differed only in one production feature as suggested by Gierut, 2004.

4. The age of the participants and the developmental level of the child's phonemic and phonetic system were kept in mind. Earlier acquired sounds were considered as a priority for selection of the target sound. For example, when place, manner, and voicing characteristics are analysed, both t̪/s and p/b substitutions represent differences of one production feature. However, [b] is earlier acquired than [s]. Therefore, the [p]-[b] contrast was a better choice.

5. Sounds which are more frequently occurring in the native language had more effect on speech intelligibility. If two sounds demonstrate an equal number of differences in production features, priority was given to the sound that was frequently occurring in the native language as those impacts the child's intelligibility most.

6. For all participants, sounds which were stimulable had priority in selection as a target over those that are not stimulable.

After selecting the target sound, the researcher followed the intervention protocol (for experimental group) which was described by Blache (1982), using developed minimal pair manual. The minimal pair therapy involved four steps which are as follows:

Step1. Discussion of words

The target words were described to each participant to make them understand the meaning of the minimal pairs. This was confirmed by asking the participant to point to the picture and also by asking questions related to it. For example, if the word pairs are /ʈer/- /ʃer/ (which refers to "action of swim and lion" respectively), the researcher asked which one indicates an action of swim?" or "which of them roar?"

Step2. Perception and Discrimination training

In this step all participants were instructed like "I want you to point the pictures that I name. Point to____. This step was repeated until the target response was obtained.

Step3. Production training

Instruction was given to the participants to produce the target word (using the prepared minimal pair manual). Instruction was like "I want youto tell me which picture to point. Every time you say show____, I will point to the picture"). When participants had difficulty to produce the correct target,

phonetic placement was used, placement was shown to the participants as well as to the caretaker, and they were asked to follow the same. When the target phoneme was correctly produced in isolation, the respective minimal paired wordswere presented.

Step4. **Carryover training**

Participants were engaged in a task that requires them to incorporate each of the contrast words in a carrier phrase (e.g., I want you to point to a picture and name it by saying /muje ek ṭerṭa hua ʃerdikʰa:/. Carrier phrase task was continued, incorporating each of the contrasting words into the phrase.

Intervention protocol for the control group (traditional approach) by Van Riper (1978)

The steps suggested by Van Riper (1978) were followed for the intervention in the control group. Firstly, the target sound was identified, and discrimination training was given to each participant; secondly, productions were corrected using phonetic placement. Here participants were instructed like "look at me, listen to me and do as I do". This step was repeated until they produced the target sound correctly; thirdly, the correct production was stabilised (maintenance stage); and finally, the new articulation skill was transferred to everyday communication situations. The target sound was usually proceeded first in isolation, then in the syllable, then in a word, and ultimately in sentences.

Following 5 intervention sessions for both control and experimental groups, the post-test was administered to all 6 subjects using the same procedure as in the pre-test.

Data analysis

The following measures were obtained from the speech samples for all 6 participants during both pre and post-test sessions.

1. Whole Word Accuracy (WWA) was obtained for all words for each participant for all 111 target words of HAT and from the picture description task. To calculate the whole word accuracy (WWA) percentage for each participant, the formula used is shown below.

$$WWA= \frac{\text{Number of correctly produced words}}{\text{Total number of words produced}} \times 100$$

2. Percentage of Consonant Correct (PCC) was calculated from the connected speech sample using the following formula shown below.

$$PCC= \frac{\text{The total number of accurate consonants produced}}{\text{Total number of correct + in correct consonants in the target sample}} \times 100$$

3. Speech intelligibility was rated based on the picture description task.

Appropriate statistical tests were applied to determine the efficacy of the developed manual. Wilcoxon sign rank test was used to determine the differences in performance between pre and post therapy (within group). Mann Whitney U test was used to determine the differences in performance between traditional and minimal pair approach (between groups). In addition, the quality of speech intelligibility was rated. The findings are recorded and discussed.

CHAPTER-4

RESULTS

The aim of the current study was to develop a minimal pair-based picture stimulus manual in Hindi for the intervention of native Hindi speaking children with speech sound errors. The manual was prepared in three phases; Phase I included the development of the intervention manual in Hindi and phase II, content validation of the developed manual, and in phase III, the developed manual was administered via tele speech therapy to participants with SSD to establish the efficacy. The results of the study are discussed under the following headings:

1. **Development of Minimal Pair Manual in Hindi**

    A. *Documentation of frequent speech sound errors in Hindi*

    B. *Preparation and validation of selected Minimal Pair word list*

    C. *Selection and rating of pictures for Minimal Pair word list*

2. **Content validation of the developed Minimal Pair Manual**

3. **Administration of the developed manual to establish its efficacy**

Phase I. Development of minimal pair manual in Hindi

Manual was developed in the following steps:

A. *Documentation of frequent speech sound errors in children with various communication disorders in Hindi*

Results of a retrospective analysis of 30 case files in which the HAT was administered on children with five different types of communication disorders: SSD-phonemic type (21 No.), Hearing impairment with speech sound disorder (3 No.), Spoken language disorder with speech sound disorder (3 No.), Repaired cleft lip and palate (1 No.), and developmental fluency disorder with speech sound disorder (1 No.). Table 4.1 displays the target sounds and their most frequently to least frequently substituted sounds from the case files in a matrix format.

Table 4.1

The target sounds and it's most to least substituted sounds

Sl.No.	Target sound	Substituted sound															
		/ʈ/	/g/	/ɖ/	/ɖʰ/	/ʈʰ/	/t/	/d/	/b/	/v/	/m/	/ʧ/	/k/	/ʃ/	/s/	/l/	/kʰ/
1.	/k/	red	yellow														
2.	/kʰ/	red															
3.	/g/			red	yellow												
4.	/gʰ/	yellow		yellow	red												
5.	/ʈ/						red										
6.	/t/					red											
7.	/ʈʰ/	yellow				yellow											
8.	/ɖ/				yellow												
9.	/p/										yellow						
10.	/b/		yellow														
11.	/ʧ/	yellow		blue									blue	red			
12.	/ʧʰ/	blue												blue			blue
13.	/ʤ/			yellow								yellow		blue			
14.	/ʤʰ/			yellow									yellow	blue			
15.	/s/													red			
16.	/ʃ/														red		
17.	/ɖ/				blue												

18.	/dʰ/			🟨													
19.	/r/															🟥	
20.	/v/								🟨								

Note. 🟨 Least frequently substituted   🟥 Most frequently substituted
🟦 Less frequently substituted

To explain table 4.1 with an example, dental /t̪/ was frequently used to substitute the velar /k/. Similarly, voiced velar /g/ was most frequently substituted by dental /d̪/ followed by aspirated dental /d̪ʰ/.

B. *Preparation and validation of selected Minimal Pair word list*

For 15target phonemes a total of 168 minimal pairs which included 336 words were selected based on the error sound obtained from HAT. Near minimal pairs were also included as it was difficult to find minimal pairs for some of the target sounds.

🟦 Less frequently substituted   🟥 Most frequently substituted

Following the preparation of the minimal pair word list, it was validated by 3 native Hindi speaking speech language pathologists for familiarity. The judges were asked to rate the minimal pair word list on a 3-point rating scale (2 being very familiar, 1 being familiar, 0 being unfamiliar). Out of 168 minimal pairs, 80 were rated very familiar, 63 were rated as familiar, and 25 pairs as unfamiliar by the judges.The minimal pairs rated as very familiar and familiar were selected to be included in the minimal pair manual. Hence the final word list consisted of 143 minimal pairs (143X2 = 286 words) representing 15 target phonemes. The number of minimal pairs selected for each target phoneme is presented in table 4.2.

Table 4.2

Number of minimal pairs for each target sound

Sl. No	Target sound	Substituted sound	No. of minimal pairs
	/k/	/g/	5
1.		/t̪/	4
2.	/kʰ/	/t̪/	4
3.	/r/	/l/	13
4.	/g/	/ḍ/	7
		/t̪/	4
5.	/t̪/	/ḍ/	4
		/ṭ/	8
6.	/ḍ̪/	/ḍ/	4
7.	/p/	/v/	6
8.	/b/	/g/	7
		/m/	8
9.	/ʧ/	/t̪/	7
		/ṭ/	7
10.	/ʤ/	/ʧ/	7
11.	/ḍ/	/ṭ/	5
		/ḍ̪/	5
12.	/ṭ/	/k/	7
		/ḍ̪/	13
13.	/ʃ/	/ʧ/	3
		/s/	6
14.	/ʧ/	/s/	5
15.	/dʰ/	/ḍ̪/	4

c. *Selection and rating of pictures for Minimal Pair word list*

After the minimal pair list was finalized, pictures that were easy to name, unambiguous, attractive, engaging, and culturally relevant for the Indian context were selected from the internet browser (Google). The finalized word list and the picture chosen for validation were given to 3 judges who rated the appropriateness of the pictures to the selected word on a 3-point rating scale (0-not appropriate; 1-appropriate; 2-most appropriate). All three judges rated the appropriateness of pictures to minimal pairs as 2 (most appropriate). Except for one judge, who rated 30 pictures as 1 (appropriate) and 10 pictures as 0 (not appropriate).   Based on the judges' remarks, the pictures that were rated inappropriate were replaced with more appropriate pictures. The pictures that received two or more judges' rating as appropriate and most appropriate were considered for inclusion in the manual.

Phase 2. Content validation of the developed minimal pair Manual.

The content validation of the manual was done by 3 native Hindi speaking SLPs with 3 years of experience in the field. A total of ten questions were included from the feedback questionnaire of Manual for Adult Non-Fluent Aphasia Therapy in Kannada (Goswami et. al., 2010). These questions were rated on a 5-point rating scale ranging from very poor to excellent. The ratings are shown in table 4.3.

Table 4.3

Shows rating of the Minimal Pair Manual on feedback questionnaire

Sl. No	Parameter	Very Poor	Poor	Fair	Good	Excellent
1	Simplicity and iconicity				1	2
2	Familiarity				3	
3	Size of the picture				2	1
4	Color and appearance				2	1
5	Relevance			1	2	
6	Accessibility			2	1	
7	Flexibility			1	2	
8	Trainability			1	2	
9	Stimulability			2	1	
10	Generalization			2	1	

Note. Source: "Feedback questionnaire for aphasia treatment manuals. Field testing of manual for adult non-fluent aphasia therapy in Kannada (MANAT-K)" by Goswami,

S. P., Shanbal, J. C., Samasthitha, S., &Navitha, U., (2010). ARF Project, All India Institute of Speech and Hearing, Mysore, India.

It can be noted that the present developed manual in Hindi received a grading of excellent, good or fair from the judges. Hence it can be stated that the minimal pair content in the manual was appropriate.

Phase 3. Administration of the developed manual to establish its efficacy

A total of 6native Hindi speaking children with speech sound disorder (phonemic type) without any associated conditions of age 4-12 years were included in the study. All 6 participants recruited for the study were divided into two groups with 3 participants each to the experimental and control groups respectively. In order to determine the efficacy of the manual, the experimental group was intervened for speech sound correction using the developed manual in Hindi through a minimal pair contrast therapy approach, whereas the control group (n=3) received traditional articulation therapy. All the participants received a total of five 45-minute tele speech therapy sessions. Demographic details of the participants are provided in table 4.4.

Table 4.4

Demographicdetails of the experimental group (Minimal pair-based therapy) and the control group (Traditional therapy)

	Experimental Group (minimal pair-based therapy)	Control Group (traditional therapy)
Participant No.	Age/Gender	Age/Gender
1	4.11 years/M	5 years/F

2	8 years/M	8 years/M
3	12 years/M	11.5 years/M

Elicitation of single words using HAT and connected speech using picture description task were obtained for both groups during the pre and post-test, and the results are discussed below.

1. Single word elicitation task

For all 6 subjects, whole word accuracy (WWA) was obtained for all 111 target words through single word elicitation task using HAT. The pre- and post-WWA percentages are shown in Table 4.5. To determine the difference between pre- and post-therapy scores in WWA, the Wilcoxon sign rank test was used on both groups. In both groups, the statistical test revealed no significant differences in pre- and post-therapy scores. Despite the fact that there was no significant difference in pre and post test scores for both types of intervention, post-therapy scores in both experimental and control groups were higher, indicating an improvement after the intervention, as shown in figure 2.

Table 4.5
Pre- and post-therapy WWA percentage of single word elicitation task in both groups

Participant No.	Single word elicitation task (HAT)			
	Experimental Group (minimal pair-based therapy)		Control Group (traditional therapy)	
	Pre	**Post**	**Pre**	**Post**
1.	85% (94)	94% (104)	87% (96)	93% (103)

2.	84% (93)	90% (100)	85% (94)	86% (95)
3.	81% (90)	94% (104)	87% (96)	93% (103)

Note. Absolute Scores of WWA is given in bracket. Maximum score in HAT is 111.

Figure 2

Pre- and post-therapy WWA percentage of single word elicitation task in both groups
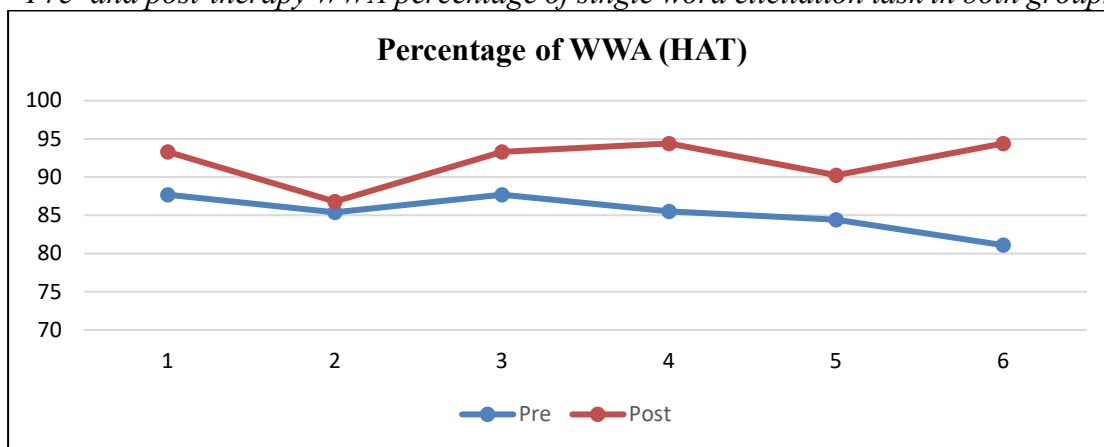
Note. Participants 1, 2 and 3 belong to the control group and participants 4, 5 and 6 belong to the experimental group.

The effectiveness of the traditional and minimal pair techniques was compared using the Mann Whitney U test. When the results of both groups' post-therapy scores were compared, there was no statistically significant difference (p= 0.261). Because there was no statistically significant difference between the groups on post-tests, the absolute difference between pre and post-test scores were used to compare the groups,

and the mean of the difference in pre and post-test scores is shown in table 4.6. Results showed a statistically significant difference (p = 0.046) with a higher score for the experimental group's WWA scores, as shown in Figure 3.
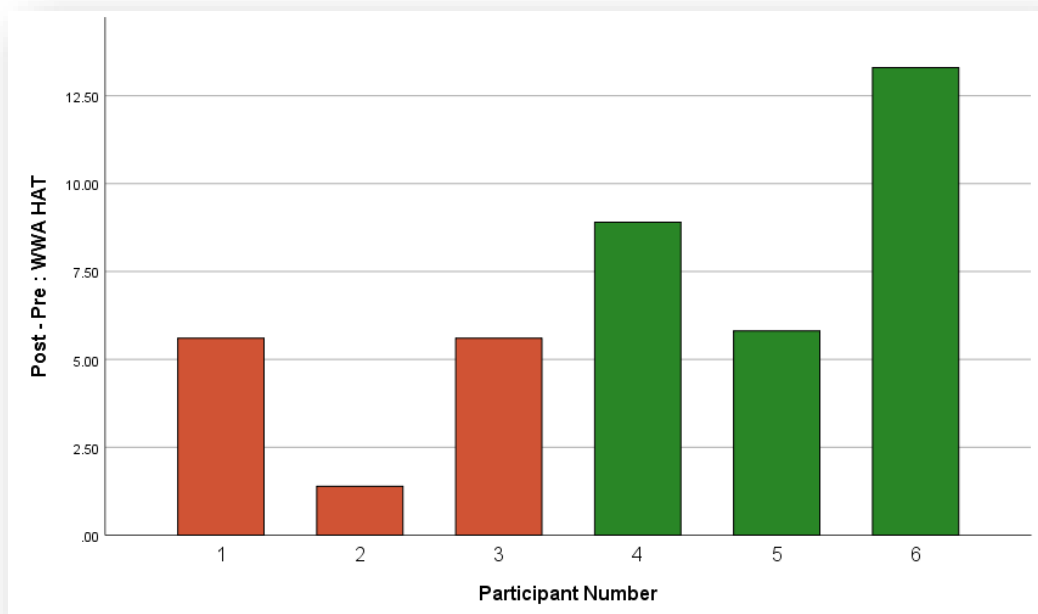
Table 4.6

Shows descriptive statistics of difference between pre- and post-therapy WWA scores in single word elicitation task

	Experimental group	**Control group**
Mean (SD)	9.3 ($\pm$3.7)	4.1($\pm$2.4)
Median	8.9	5.6

Figure 3

Performance differences in WWA on HAT between traditional and minimal pair approach

Note. Participants 1, 2 and 3 belong to the control group and participants 4, 5 and 6 belong to the experimental group.

    2.   Connected speech elicitation task

Percentage of consonant correct (PCC), whole word accuracy (WWA) and speech intelligibility was calculated from the connected speech elicitation task (picture description). The PCC and WWA scores before and after the intervention are shown in Table 4.7.

Table 4.7

Pre- and post-therapy WWA and PCC scores of connected speech elicitation task in both groups

Partici pant No.	Connected speech elicitation Task (Picture description task)							
	Experimental Group (minimal pair-based therapy)				Control Group (traditional therapy)			
	WWA		PCC		WWA		PCC	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1.	87.75	95.00	87.50	91.89	87.50	90.40	92.00	96.40
2.	80.31	91.52	76.92	95.45	82.75	86.20	88.00	90.00
3.	80.60	91.80	81.50	95.60	95.10	96.57	95.51	97.80

Table 4.8

Shows descriptive statistics of difference in pre- and post-therapy WWA and PCC score in connected speech elicitation task
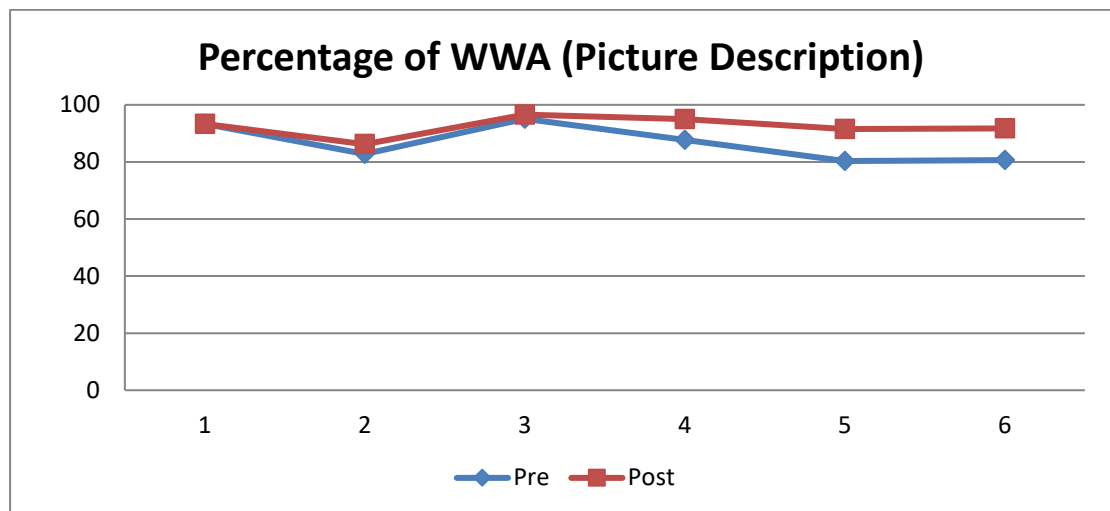
	Experimental group	Control group

	WWA	PCC	WWA	PCC
Mean (SD)	9.88 (±2.28)	12.34(±7.23)	2.6 (±1.02)	2.89(±1.3)
Median	11.2	14.1	2.9	2.29

Wilcoxon sign rank test was used to compare pre and post-therapy scores of WWA and PCC for both groups, and the results showed no statisticallysignificant difference (p >0.05).However, it can be deduced from figure 4 and figure 5 that the post-therapy scores of both the experimental and control groups for WWA and PCC were comparatively higher than pre therapy scores.
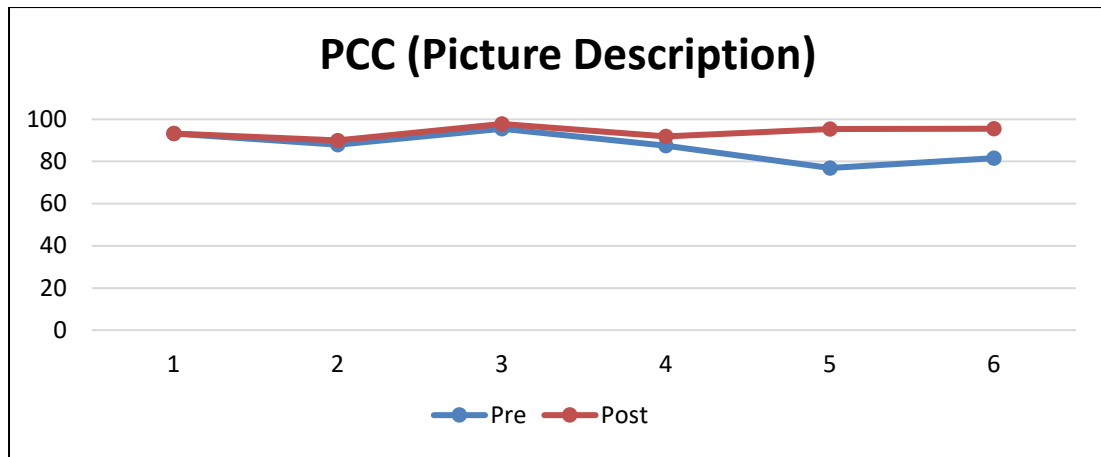
Figure 4

Pre- and post-therapy WWA percentage of connected speech elicitation task in both groups

Note. Participants 1, 2 and 3 belong to the control group and participants 4, 5 and 6 belong to the experimental group.

Figure 5

Pre- and post-therapy scores of connected speech elicitation task in both groups
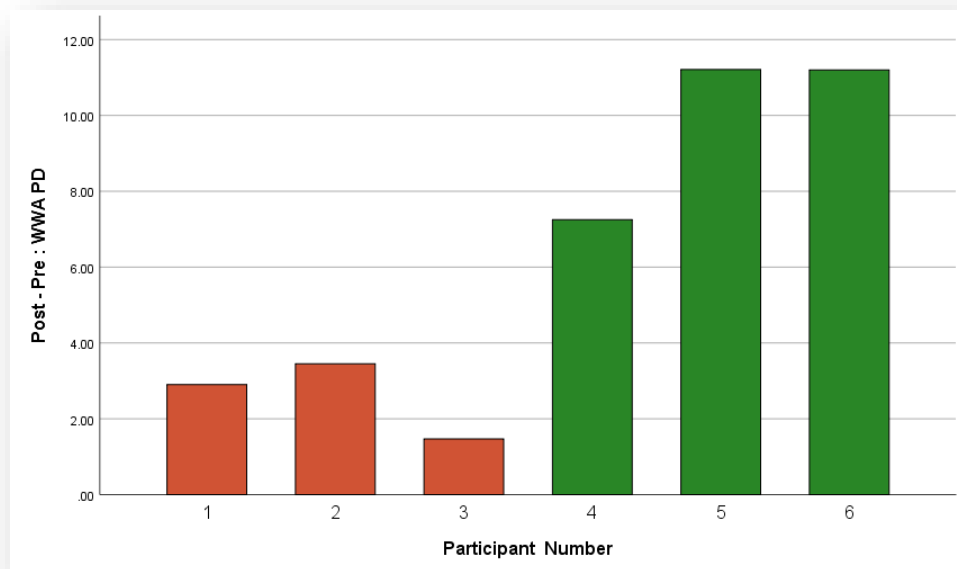
Note. Participants 1, 2 and 3 belong to the control group and participants 4, 5 and 6 belong to the experimental group.

The post-therapy performance between traditional and minimal pair approaches was compared using the Mann Whitney U test, which showed no statistically significant difference for WWA (P=.0.513) and PCC (P=.0.513) scores. As there was no significant difference between the groups on posttests, the absolute difference between the pre and post-test scores was used to compare the performance of the groups and mean of the difference (for WWA and PCC) is shown in table 4.8. Results showed a statistically significant better score (p = 0.05) for the experimental group's WWA scores, as shown in figure 6. However, PCC did not show any statistically significant difference (p=0.127). Nevertheless, when performance scores were subjectively evaluated for PCC, the experimental group that received minimal pair-based treatment using the developed manual outperformed the children who received traditional therapy, as shown in figure 7.

Figure 6

Performance differences in WWA (Picture description) between traditional and minimal pair approaches

Note. Participants 1, 2 and 3 belong to the control group and participants 4, 5 and 6 belong to the experimental group.

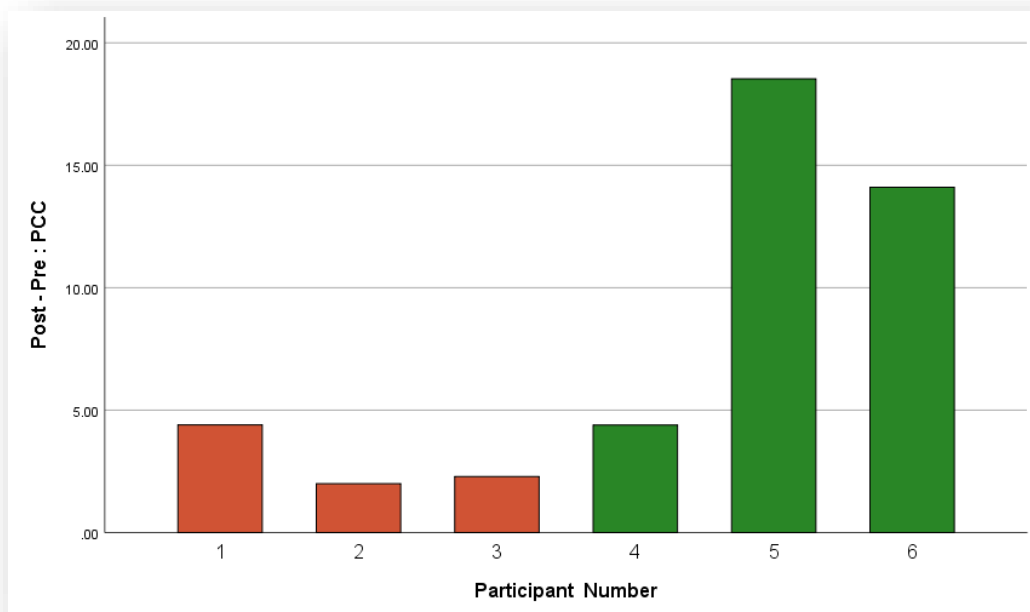**Figure 7**

Performance differences in PCC (Picture description) between traditional and minimal pair approaches

Note. Participants 1, 2 and 3 belong to the control group and participants 4, 5 and 6 belong to the experimental group.

In addition to WWA and PCC, each participant's speech intelligibility was assessed before and after treatment using the Ali Yavar Jung National Institute of

Speech and Hearing Disabilities (AYJNISHD); Mumbai (2003) speech intelligibility rating scale. Three speech-language pathologists (SLPs) participated as judges and rated speech intelligibility. For the pre and post tests, the three judges' average rating for each participant was considered. Following the intervention, all the children in both groups showed an improvement in speech intelligibility. The experimental group's post-therapy connected speech sample received higher ratings from two out of three judges than the control group's scores. The experimental group's improved speech intelligibility demonstrates that the developed manual is effective in treating speech sound disorders.

To summarize the findings of this study, the experimental group's improvement was found to be higher than the control group for WWA, PCC, and speech intelligibility using the developed minimal pair manual for intervention. This suggests that the developed manual is effective in intervening children with developmental speech sound disorders. However, in the current study, fewer participants were included due to several constraints such as time and the pandemic scenario; therefore, to standardize the manual, a similar study with larger sample of SSD is warranted.

CHAPTER-5
DISCUSSION

The present study aimed to develop and validate a minimal pair-based picture stimulus manual in Hindi- for the intervention of native Hindi-speaking children with speech sound errors. The findings indicated that the experimental group's improvement was higher than the control group for WWA, PCC, and speech intelligibility using the developed manual for intervention. This suggests that the developed manual is effective in intervening children with developmental speech sound disorders.

The study's first objective was to determine the most common error sounds in native Hindi-speaking children with various communication disorders. In Hindi, velar fronting was found to be the most common error pattern, followed by retroflex fronting. Researchers in Indian languages such as Kaur et al. (2017) in Hindi and Bailoor et al. (2014) in Kannada found fronting to be the most common error pattern, which is consistent with the findings of this study. Velar fronting is common in children with SSD, possibly due to the fact that it is the least visible. In English, Edwards (1992) also predicted that velars are often fronted to alveolars because alveolars are more common in the world's languages, and children learn them earlier.

Another objective of the study was to develop a manual with minimal pair words and appropriate pictures. A minimal pair word list was prepared for each target sound with a minimum of 3 and a maximum of 13 pairs. According to Blache et al. (1981), even3 minimal pair words were enough to show phonemic progress in children with phonological difficulties. The current study found comparable findings, with a significant reduction in error sounds utilizing as few as 2-3 minimal pairs. Pictures that were easy to name, unambiguous, attractive, engaging, and culturally relevant were selected in the manual. In the existing literature, different types of pictures were used for eliciting the target words. Some studies used a line drawing for displaying the target words, whereas others used colorful drawings for minimal pairs (Bowen &Cupples, 2006). Drennan (2005) reported that real photos are the best method to elicit the target words. Therefore, in the present study, real photos were used to elicit the target words. Moreover, picture stimuli in the developed manual gave children quick visual feedback to recall the meaningful minimal pair word and consistently produce the target sounds. Children might be encouraged to incorporate these concepts into their vocabulary to improve their communication skills, which will enhance their quality of life.

The current study used objective measures of speech accuracy to track changes in participant's speech over time. Subjective measures are unreliable and should be used with caution in clinical decision-making and research (Flipsen et al., 2005). As a result, objective measures like PCC and WWA were used in the current investigation. Combining PCC with WWA leads to a more accurate description of a child's phonological acquisition skills and a more sensitive assessment of phonological development (MacLeod et al., 2011). According to Lousada et al. (2014) improvements in PCC scores are insufficient to indicate any significant changes in overall intelligibility. The author went on to suggest that combining the two measures is crucial

(PCC and intelligibility). According to a survey conducted in the United States, more than half of SLPs assess intelligibility subjectively rather than objectively (Skahan et al., 2007). Despite the widespread use of objective measurements like PCC, they ignore vowel production, phonotactics, and suprasegmentals, all of which have an impact on intelligibility (Bowen &Cupples 2006).Considering the effect of intelligibility on communication, only a few researches have been reported in the literature (Flipsen 1995; Klein & Flint 2006; McLeod et al. 2012). As a result, speech intelligibility was chosen as one of the outcome measures in the current study. The outcome was determined using both subjective (speech intelligibility rating) and objective measures (WWA, PCC) for appropriate validation of the manual.

All participants in the present study received intervention via tele speech therapy, which has proven to be an effective paradigm of service delivery for audiologists and speech-language pathologists (ASHA, n.d.). In the current study, all participants received five 45-minute tele speech therapy sessions. Results showed a considerable reduction in the number of error sounds using the developed manual for the experimental group in a short span of 5 sessions. This observation is in agreement with the study by Weiner (1981). According to the author, minimal pair contrast treatment was extremely successful in reducing the frequency of phonological processes in 2 children in a short period compared to the traditional technique, which was instead time consuming. In the Indian context, Rofina (2015) and Pooja (2016), who developed a minimal pair-based intervention manual for children with speech sound errors in Malayalam and Kannada, respectively, used the manual for speech intervention on 6 children (experimental group). On the other hand, 6 participants in the control group underwent traditional articulation therapy. Their findings demonstrated that the experimental group developed considerably better articulation

abilities than the control group following 3 speech therapy sessions utilizing the manual. This improvement suggests that, compared to conventional treatment techniques, the time necessary to attain all target sounds in minimal pair-based intervention was as few as 3 sessions.

In addition to minimal pairs, the manual includes paired words with phonemes that differ the most in terms of place, manner, and voice characteristics. When these pairs were used with maximal contrast, the participants' performance improved. Because maximal contrast enables more change in the client's learning of feature contrasts. The results are consistent with those of Gierut (2004) and Dodd et al. (2008), who reported significant improvements in speech accuracy and a reduction in the number of error patterns when applying maximal contrast.

One of the objectives of our research was to compare the minimal pair technique to the traditional approach in terms of effectiveness. The post-therapy WWA, PCC, and speech intelligibility scores show that children who received intervention with the minimal pair approach outperformed those who received traditional intervention in single word and connected speech. The most likely explanation for this finding is that minimal pair treatment improves a child's understanding of how different sounds in a word affect the meaning, leading to more successful communication. Furthermore, factors beyond the researchers' control, such as the nature of the participants, the children's stimulability or their relative eagerness to improve their speech, may be the reason for improvement (Klein, 1996). The findings of Dodd and Bradford (2000) can explain the comparatively low performance of children in the current study who underwent traditional therapy. According to the authors, articulation therapy had a limited effect on children with phonemic type SSD because it emphasizes on speech–

sound production in isolation at a motoric level rather than reducing error patterns. Rofina (2015) and Pooja (2016) compared the performance of the minimal pair approach to that of the traditional approach using minimal pair manuals. The children in the minimal pair group showed a considerable increase in their articulatory ability, with a reduced number of error sounds. All of the participants had good sound maintenance and stabilization even at the sentence level, which was consistent with the current study's findings.

Children were able to generalize learned target sounds to untrained phonemes within the same class feature when intervention was given using the developed manual, as evidenced by improvements in single word and connected speech. For example, when fronting error was target for /t/-/k/, generalization was also seen in /d/-/g/. As the children were treated for a phonologically unfamiliar sound using a minimal pair approach, generalization was observed (Barlow &Gierut 2002; Tyler et al., 1990),

For the reasons indicated above, the newly developed minimal pair-based manual is helpful in treating Hindi speaking children with speech sound errors. This type of language-based therapy would help children with speech sound disorders to reduce error sounds while also saving time in terms of ready stimulus material for the SLP. It will also help children to naturally generalise the sounds they've learned to various situations in a short amount of time.

Despite the fact that a large body of evidence backs minimal pair treatment, it is not frequently utilized by clinicians due to the time-consuming and laborious process of identifying minimal pairs and picking pictures that are acceptable for them. As a result, this manual serves as a rapid reference and ready-to-use tool for SLPs dealing with children having speech sound disorders in Hindi. This eases the load of material

preparation for professionals and encourages them to utilize evidence-based techniques in their daily clinical practice.

CHAPTER-6
SUMMARY AND CONCLUSIONS

The purpose of this study was to develop and validate a minimal pair-based intervention manual for children with speech sound errors in Hindi. One of the most effective ways for treating speech sound errors in phonological disorders and many other communication disorders is minimal pair treatment. As a result, the study's goal was to develop a minimal pair treatment manual that was ready to use for SLPs. This would make speech language pathologists' job easier since they would no longer have to spend as much time gathering materials from various sources to develop minimal pair words.

The number of clinicians who use minimal pair therapy is relatively low when compared to traditional therapeutic procedures. Due to increasing caseloads, detailed report writing, and other clinical and academic duties, SLPs don't have enough time to create word lists and pictures for minimal pairs. Different articulation drill materials and minimal pair word lists have been developed in English. In Hindi, however, there is no such therapeutic manual for minimal pairs.

The commonly occurring speech sound errors in Hindi-speaking children with communication disorders were first identified in order to prepare the manual. For the target and the substituted sounds, a list of meaningful minimal pair words was prepared. On a three-point scale, 3 judges rated these words as most familiar, familiar, and unfamiliar. The words which were rated as very familiar and familiar were selected. There were 336 words in total, incorporating the target and error sounds. As it was

difficult to find minimal pairs with the required specifications for all the phonemes, near minimal pairs were also included.

The appropriateness of pictures for the minimal pairs selected was rated by 3 SLPs based on a 3-point rating scale as most appropriate, appropriate and not appropriate. Pictures rated as not appropriate were replaced with appropriate pictures. The final list consisted of 143 minimal pairs framed with 286words representing 15 target phonemes. Instructions to follow while selecting the target sounds and the sequence of steps involved in minimal pair treatment are also provided in the first section of the manual (Appendix I).

Further, the developed manual was assessed for its content validity by 3 SLPs based on simplicity, iconicity, familiarity, picture size, etc. The manual received a grading of excellent, good or fair from the judges.

The newly developed minimal pair-based intervention manual was used to provide therapy to 3 children with speech sound disorder (phonemic type) in the age range of 4 to 12 years. Pre and post therapy scores for all the participants were noted using WWA, PCC and speech intelligibility rating scale. There was improvement seen in the articulatory abilities of all the children in both groups. However, post therapy performance was comparatively better for the experimental group. Furthermore, a statistically significant difference was observed for WWA scores in the experimental group compared to the control group. The number of error sounds reduced even at sentence level in all the participants. Hence it can be concluded that this newly developed manual is helpful for the clinicians in effectively treating Hindi speaking children with speech sound errors in a shorter period.

Clinical Implications

The findings of this study will help Speech Language Pathologists in using language-based therapy approaches to treat children with speech sound errors. This manual will serve as a rapid reference for clinicians using the minimal pair therapy technique, allowing them to spend less time preparing therapy materials. It can also facilitate improving the language component in children with SSD.As a result; SLPs may be motivated to apply an evidence-based minimal pair approach to treat speech sound errors in children with communication disorders thereby improving both articulation and language components.

Limitations of the study

- Only the error sounds obtained from 30 case files of SSD were considered in the manual's preparation.

- The severity of the condition was not controlled for the participants in the study.

- The number of participants considered for the study was comparatively less.

- As fewer participants were recruited in the present study due to the current pandemic scenario, a wider age range could not be covered.

- Due to the current situation, it was challenging to recruit more number of participants with SSD for online speech therapy sessions.

- For the intervention in both groups, only 5 tele speech therapy sessions were provided.

- Inter judge reliability for speech intelligibility rating was not assessed.

- Dialects of Hindi were not considered in the preparation of the present treatment

manual.

Future directions

- Minimal pairs for all speech sounds in Hindi can be added in future studies.

- Participants can be grouped in terms severity of the problem.

- The manual can be validated on a large sample, diverse clinical population with SSD, and wider age range.

- The effectiveness of the manual can be assessed after more number of sessions in the future.

- In the future, the inter-judge reliability of speech intelligibility ratings on a larger population could be tested.

- It is also suggested that for ease of administration, a software package of minimal pairs can be developed.

- Minimal pair-based intervention manuals are also possible to create in other Indian   languages in future.

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