INTRODUCTION
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Speech and language is unique to human communication. Speech is the most widely used means of communication. It is one modality for the expression of language. Speech has special importance because it is the primary, first learned modality for individuals with normal hearing. Speakers of a language produce words and sentences to express verbally the thoughts, feelings, and desires through a complex combination of sounds. Thus, the spoken language is a complex, multi-layered symbolic system. It comprises of speech sounds that are grouped into phonemes, syllables, morphemes and words, which in turn are grouped into phrases, clauses and sentences to convey meaning.

Language is a system of phonological, semantic and syntactic rules, which can be applied in an orderly manner for communicative purposes. Language is a rule-governed behavior. Linguists analyze speech and language in terms of various levels such as phonetics, phonology, morphology, lexis, syntax and semantics. One of the salient components of language, Phonology is a branch of Linguistics, pertains to the description of systems and patterns of phonemes that occur in a language. Edward and Shriberg (1983) (Cited in Hegde, 2000) define phonology as "the study of sound component of language". Phonology involves determining the language specific distinctive phonemes and the rule governed nature of these systems (Mackay, 1987) (Cited in Bauman-Waengler, 2004). Phonology also focuses on how the phonemes are organized to convey meaning within a language system. Such a description would involve how the phoneme can and cannot be analyzed to form meaningful words.
Sometimes the system of phonemes and phoneme patterns within the context of spoken language gets impaired, it is referred as phonological disorder. It represents an individual’s impairment of the representation and organization of phonemes within the language system. One of the conditions leading to phonological disorders is hearing loss.

Hearing loss (HL) or Hearing impairment refers to reduced hearing acuity. Hearing loss may be congenital (present from birth) or acquired. Depending on the extent (severity) of hearing problem, hearing loss is classified as mild, moderate, moderately-severe, severe and profound hearing loss. A person whose hearing loss falls between 16 to 90dB HL is considered hard of hearing or hearing-impaired. A person whose hearing thresholds are 90dB HL or higher is considered deaf.

Pathology or lesion in any part of the ear may lead to hearing loss. The hearing mechanism mainly has four parts, namely outer ear, middle ear, inner ear and the neural pathway. Depending on the site of lesion, hearing loss can be classified into different types. The most common types of hearing loss are conductive, sensory-neural and mixed. Conductive hearing loss is characterized by the interrupted transmission of sound to the inner ear. The interruption may occur in the outer ear or in the middle ear. Conductive hearing loss can be treated by medication or surgery. Sensory-neural hearing loss results because of the damage in the inner ear or neural pathway. This type of loss is permanent as the sensory hair cells of the inner ear and nerve fibres cannot be regenerated. A combination of conductive hearing loss and sensory-neural hearing loss leads to mixed hearing loss. In individuals where hearing loss cannot be
treated, they can be rehabilitated by the use of hearing aids. Hearing aid is an electronic device, which amplifies the surrounding sounds and makes the hearing-impaired hear the sound. An appropriate hearing aid is prescribed by the Audiologist after a battery of tests.

One of the most devastating effects of hearing loss at birth, is that the normal development of speech and language is disrupted. Failure to receive and understand speech and language results in failure to produce speech and language. The language-speech age often lag behind the chronological age by several years (Bernstein, 2000). Thus hearing loss leads to phonological disorders. Hearing is essential for normal acquisition of speech and language. Of all the senses, audition (sense of hearing) is the most important for the acquisition and maintenance of speech and language. When a child is severely hearing-impaired at an young age, speech and language disorders and specially, phonological disorders are seen.

Various recent investigations have shown that only about 20% of the speech output of the deaf is understood by inexperienced listeners (Brannon, 1964; John & Howarth, 1960; Markides, 1970; Smith, 1972) (Cited in Gold, 1980). The overall levels of speech intelligibility are utterly insufficient for oral communication (Hudgins & Numbers, 1942; Brannon, 1964; Smith, 1975) (Cited in Gold, 1980). This lack of intelligibility has been associated with some frequently occurring segmental and suprasegmental errors. These phonological errors should be investigated first in order to achieve improved speech intelligibility.
The speech of the individuals with hearing impairment is characterized by intelligibility problems, consonant errors, vowel errors, diphthong errors, suprasegmental errors and voice problems (Gold, 1980). Speech therapists routinely encounter clients who have virtually unintelligible speech, resulting from ‘multiple misarticulation’ (that is, severe pronunciation problems), which may or may not be associated with identifiable disorders or disabilities affecting speech production processes. In order to describe the characteristics of these pronunciation disorders from a communicative perspective a phonological framework of analysis and assessment is required. On the basis of such descriptions, the speech therapist can assess the relative severity in functional terms of each of the components that are present in the disordered pronunciation patterns and formulate a principled treatment program designed to enhance a client’s intelligibility, and hence communicative adequacy. Therefore, assessment of these phonological disorders is essential in order to diagnose whether a person has speech and language problem or not, to determine the type of errors and to correct the errors.

Linguists, Speech language pathologists and Psychologists have made an unique contribution to the assessment of verbal behavior through the development of phonological assessment instruments. There are screening, Diagnostic and Deep tests. These quantitative tests have the following disadvantages:

- Quantitative testing is standardized on a representative sample of normal speakers. This means that the scores assigned for particular areas of a test are
calculated so that the average scores are directly relatable to what the standardized population would produce on average.

- Most tests are generally restricted to particular aspects of the area of speech or language.

  Ex: Articulation tests often require the tester to transcribe particular consonants or consonant clusters – only rarely are vowels included in a set of test words uttered by the subject. In these circumstances, developing changes in patient’s usage is naturally lost. Also, the co-articulation that holds between words in connected speech cannot be investigated using one word utterance.

- The test situation is highly artificial. Picture naming task, one of the elicitation techniques, rely on the type of approach that is not capable of guaranteeing that the data collected are representative of the patient’s abilities.

- The standardized test may be useful in an initial assessment. It gives a score, which means presence of a speech language impairment can be known. However, it does not give an overview of the pattern of the disorder. Scores often obscure which part of the client’s phonology is actually impaired and which is not. These aspects are naturally vital if an effective program of remediation is to be planned. So, standardized quantitative tests are generally selective in the material that is investigated, leading to the lack of a comprehensive picture of the client’s abilities. Scores of tests aid in client classification but not with more detailed diagnosis nor with the development of treatment plans (Crystal, Fletcher & Garman, 1976; Muller, Munro & Code, 1981) (Cited in Ball & Muller, 1997).
Linguistic Profile

In western countries over the last 20 years, the use of linguistic profiles in the assessment of speech language impairments has grown considerably. The goal of the linguistic profile is to provide an assessment tool that avoids all the drawbacks of quantitative tests. Crystal (1982) (Cited in Ball & Muller, 1997) defines a profile as follows: "A linguistic profile is a principled description of just those features of a person's use of language which will enable him to be identified for a specific purpose". The aim of a linguistic profile is to provide an assessment tool that gives a total picture of the disorders. A profile is no more than a first approximation to an accurate description, but it does imply that the salient, identifying features of a problem area has been isolated. To be useful, a profile of linguistic behavior needs to be discriminating to indicate the main differences between normal and abnormal and to identify different categories of abnormality. The most useful profiles are those, which are based on an acquisitional dimension because these can then be used simultaneously for assessment and remediation by showing where a patient is on a profile chart. One can see immediately where he ought to be and perhaps see paths, which would enable to get him there. Profiles are comprehensive within one particular level of linguistic analysis i.e., syntax profile or phonological profile.

Profiles lay emphasis on recording of spontaneous speech and the use of questions and answers. According to people working with linguistic profiles, picture naming tasks or similar standardized methods of data elicitation should not be the sole method of gaining access to the speaker's linguistic repertoire. Profiles often suggest
long period of speech to be tape recorded, and all of it transcribed and/or analyzed and then put on to the profile chart. The data normally guarantees that most categories in the system will occur, and the most common will occur several times, allowing the analyst to investigate any inconsistent usages lost in the traditional test.

**Phonological profile**

Phonological profiles help in the phonological assessment of children. Children with hearing-impairment, mental retardation, autism, speech disorders, language disorders, speech and language disorders, apraxia and specific language impairment exhibit phonological disorders. Appropriate phonological assessment is required before any intervention is planned for these children.

**Need for the study**

A comprehensive and well structured assessment is extremely important for the diagnosis of phonological disorder. The clinician’s judgement about the presence or absence of a disorder and a description of the nature of a disorder lead to a clinical diagnosis. Performing the assessment, forms the first step in the diagnostic process. The phonologically based assessment tools provide information for planning treatment. One of the comprehensive and important assessment tools for phonological assessment is phonological profile.

In a multi-lingual country like India, phonological profiles need to be developed in various Indian languages. This enables to study the characteristic features of phonological disorders existing in children speaking different Indian
languages. So far, no phonological profiles have been developed in any of the Dravidian languages (Tamil, Kannada, Telugu, Malayalam and Tulu). Also the phonological profile provides total picture of the phonological assessment of normal children and children with phonological disorders. Hence, a great need was felt to develop a phonological profile in Kannada. Here, an attempt is made to develop a phonological profile in Kannada.

A review of the literature shows that there has been no presentation of a fine linguistic analysis of the phonological output of hard-of-hearing or deaf children. Typically studies of the speech of hard-of-hearing concentrated only on how their speech differs from that of normal hearing subjects, but they have not defined what their speech does express. Phonological profile provides phonological status of a child. It gives a detailed description of the production of all the sounds of the language, phonological processes occurring and suprasegmental features. Here an attempt is made to carry out phonological assessment using phonological profile, which would be developed as a part of the study. The assessment is done for both normal hearing and hearing-impaired children. The profile provides an in depth phonological assessment of Kannada speaking normal children and also children exhibiting phonological disorders. The study on normal children and on hard of hearing children, who exhibit phonological disorders throws light on the important characteristics of both the groups. Hence, an attempt is made to field test the developed phonological profile on children. This type of assessment helps in the method of rehabilitation to be adopted.
Now it is the era of computers. Computers have extended its veins to every field in the world. All children are fascinated by the use of computers. Computers keep the attention span of the children for a long duration. When the stimuli are shown on the computer monitors, children are less distracted by other stimuli in the test room. Thus overcomes the lack of concentration of children. Moreover it reduces the effort and time for its administration. Thus helping the tester a long way in achieving his goal. Hence, a computerized administration of the phonological profile is attempted. In coming years, there is a great need for the computerized administration of the phonological assessment tool.

The objectives of the study

1) To develop a phonological profile in Kannada (a Dravidian language, which is spoken in Karnataka, a southern state of India).

2) To carry out phonological assessment in Kannada speaking normal children and in children with hearing impairment using the phonological profile in Kannada.

3) To develop a computerized module for the presentation of stimuli in the administration of phonological profile in Kannada for phonological assessment.