METHOD
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From the review of literature, it is evident that there are several procedures for phonological assessment in children. Some procedures are based on articulation tests and some on individual profiles. Reports given by various authors, indicate that profiles focus on individual’s phonological problems, which are exceptions as a rule. The assessment tool throws light on the appropriate management techniques to be adopted for a particular child. Hence, an attempt was made to carry out the objectives of the study. Its detailed method is described here.

The study has been carried out in three levels:

Level 1: Development of Phonological profile in Kannada language

Level 2: Phonological assessment of Kannada speaking normal children and in children with hearing impairment using the Phonological profile

Level 3: Development of the computerized module for the presentation of stimuli in the administration of phonological profile in Kannada

Level 1: Development of Phonological profile in Kannada language

The level 1 has two parts:

Part I. Development of the test material

Part II. Development of the phonological profile
**Part I: Development of the test material**

The test material developed constitutes the following:

1. Stimulus cards - Set A
2. Stimulus word list - A
3. Stimulus cards - Set B
4. Stimulus word list - B
5. Story charts - Set C

**1. Stimulus cards - Set A**

Set A has ninety-two pictures, one picture on each card (stimulus 1, S1). Pictures are line drawings drawn on the cards of 6” x 4”. Most of the words chosen are familiar, easily picturable, unambiguous and pictures elicit a single response. However, a few non-familiar and ambiguous words are included due to the lack of picturable words with a particular target phoneme. At the bottom of each card written word (using Kannada graphemes) of the picture (stimulus 2, S2) can be presented, when needed and at all other times it is covered with paper or a scale. The profile is designed to test the production of ten vowels (a, aa, i, ii, u, uu, e, ee, o & oo), two diphthongs (ai & au), two glides (y & v), and thirty consonants (k, kh, g, gh, c, ch, j, jh, T, Th, D, Dh, N, t, th, d, dh, n, p, ph, b, bh, m, r, l, sh, s, s, h & L). Stimulus cards - Set A is illustrated in the Appendix I. In the Appendix, four picture cards are accommodated in one sheet for the sake of convenience.

A pilot study was done on five normal hearing children and five children with hearing-impairment matching their age and sex in order to see if any modification is
needed in the picture stimuli utilized in the Set A. The list of stimuli words and the
drawing of the pictures were finalized based on the result of the pilot study. The
modified test material was used for the main research work.

2. Stimulus word list - A

Stimulus word list - A has ninety-two words. It is used along with the Set A
to record the responses. The list has words, where vowels are tested in initial, medial
and final position. Long vowels (/ii, ee, aa, oo, uu/) usually do not occur in the word
final position in Kannada. Hence, these are not tested in the final position. Production
of diphthongs are tapped in all three position of the word. Consonants are tested in
initial and medial positions in which they occur naturally. In some borrowed words,
consonants may occur in the final position. However, occurrence of a consonant in the
final position is not a feature in Kannada. Hence, consonants are not tested in the final
position. A few aspirated consonants such as /ch/, /j/ and /Dh/ are not tested in the
medial position as they occur very rarely in the language. Also retroflex nasal /N/ and
retroflex lateral /L/ are not tested in the initial position as they do not occur in the
word initial position.

In the word list, there are two response columns against each word. In the first
column, responses are recorded on the presentation of the stimulus 1. In the second
column, responses are recorded on the presentation of the S1+S2, which is presented
when failed to obtain a correct response for the stimulus 1. In case, an incorrect
response is obtained for the picture stimulus 1, one of the clues may be provided as
stimulus 2: a) the subject may be asked to repeat the word uttered by the examiner, or
b) the subject may be asked to read the written word of the picture shown. If the child has not acquired reading skills, repetition task can be employed.

In the stimulus word list - A sheet, a note is also made regarding speech mechanism, voice, prosody and other factors affecting speech intelligibility of the subject. Stimulus word list - A is given in Appendix II.

3. Stimulus cards - Set B

It has one hundred and three words written clearly using Kannada graphemes, one word on each card of 6" x 4". Each word has a cluster in different word position. An attempt was made to cover all the possible consonant clusters in Kannada language given by Upadhyaya (1972) and Ramachandra (1999). The test is constituted to tap the production of clusters. Emphasis is given to the production aspects and not on the meaning aspects of cluster words. The task may be carried out, by asking the child to repeat the words uttered by the tester or to read the words shown. If the child has acquired reading skills, any one of the options may be used. When reading skills are not achieved, repetition may be employed. Stimulus cards - Set B is in the Appendix III.

4. Stimulus word list - B

The word list has one hundred and three words in it. The words have

(i) Geminated clusters (CC/C1C1) in the medial position.
(ii) Non-Geminated clusters (CC/C1C2) in the initial position
(iii) Non-Geminated clusters (CC/C1C2) in the medial position.
(iv) Non-geminated clusters (CCC/C₁C₂C₃) in the initial position
(v) Non-geminated clusters (CCC/C₁C₂C₃) in the medial position.

It is used along with the Set B to record the responses. There is a column to record the responses against each word. Stimulus word list - B is illustrated in the Appendix IV.

5. Story charts - Set C

Set C comprises of a set of stories. Each story is depicted in the picture form, which is accommodated in a single page. These story charts are used to elicit spontaneous speech. These are illustrated in Appendix V.

Ex: a) The thirsty crow b) Monkey and capseller c) The clever fox d) The Lion and the rat e) The clever crow f) Unity is strength g) The golden egg.

Part II. Development of the Phonological profile

The profile has the inventory of vowels, diphthongs, consonants and clusters.

The Phonological profile has five sub sections:

- Subsection 1. Consonant Analysis
- Subsection 2. Cluster Analysis
- Subsection 3. Vowel and Diphthong inventory and their processes
- Subsection 4 has two parts. These are
  a) Speech Intelligibility scale
  b) Factors affecting intelligibility
- Subsection 5. Phonological summary
Subsection 1. Consonant Analysis

The consonants are analysed in five ways:

a) according to position in the word
b) according to place of articulation
c) according to manner of articulation
d) according to phonological processes involved
e) according to the developmental model

The analysis of position in the word is divided into initial and medial positions, as consonants do not occur in the final position in Kannada language. The place and manner analysis is accomplished through the use of consonant grouping for manner and color coding for place. The profile has separate sections for recording substitution processes, assimilation processes and syllable structure processes.

The inventory of Kannada phonemes is divided into developmental stages. It allows an assessor to see whether or not the child is following a normal hearing developmental pattern. A pilot study was carried out to study the normal phonological processes occurring in children. Eight subjects, who were Kannada native speakers with normal intelligence and who had no speech and hearing problems were selected. Two subjects, one male and one female in each range of 2 years, 3 years, 4 years and 4+ years were chosen. Stimulus cards - Set A and Stimulus word list - A were used. The responses were transcribed simultaneously and the responses were also tape recorded. The transcribed material was confirmed with tape recorded material. The responses were qualitatively analyzed for phonological processes.
The processes which were occurring in both the subjects in each age group were considered as the most probably occurring phonological processes. The results obtained are given in the Table 14.

**Table 14: Phonological processes occurring in normal children**

<table>
<thead>
<tr>
<th></th>
<th>Stage 1 2 years</th>
<th>Stage 2 3 years</th>
<th>Stage 3 4 years</th>
<th>Stage 4 &gt; 4 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Fronting of</td>
<td>Fronting of</td>
<td>Fronting of</td>
<td>h deletion</td>
<td></td>
</tr>
<tr>
<td>Retroflex</td>
<td>Retroflex</td>
<td>Retroflex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Stopping</td>
<td>Stopping</td>
<td>Cluster reduction</td>
<td>Deaspiration</td>
<td></td>
</tr>
<tr>
<td>3 Fronting of</td>
<td>Devoicing</td>
<td>h deletion</td>
<td>Cluster reduction</td>
<td></td>
</tr>
<tr>
<td>palatals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Metathesis</td>
<td>h deletion</td>
<td>Deaspiration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Initial</td>
<td>Lateral replacing</td>
<td><strong>Disappearing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>consonant</td>
<td>flap</td>
<td><strong>processes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>deletion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 h deletion</td>
<td>Deaspiration</td>
<td>Lateral replacing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 r deletion</td>
<td>Cluster reduction</td>
<td>Devoicing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Cluster</td>
<td>Assimilation</td>
<td></td>
<td>Stopping</td>
<td></td>
</tr>
<tr>
<td>reduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Devoicing</td>
<td>Nasalization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Deaspiration</td>
<td>Voicing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The information given in the Table 14 guides in dividing the inventory of Kannada phonemes into developmental stages. These stages are not discrete but grouped as such for ease of usage. The approximate age (+/- 6 months) for normal hearing child is as follows:

Stage 1 - 2 years; Stage 2 - 3 years; Stage 3 - 4 years; Stage 4 > 4 years
Subsection 2. Cluster Analysis

The clusters are classified into geminated and non-geminated clusters and two and three consonant cluster categories. The cluster analysis is also divided into initial and medial positions.

Subsection 3. Vowel and Diphthong inventory and their processes

Vowels are classified into front, central and back vowels. They are seen in initial, medial and final positions. Long vowels do not usually occur in the final position. Diphthongs are also analysed in initial, medial and final positions. The boxes in the profile allow to record the phonological process affecting vowels, diphthongs and consonants against each of the phonemes.

Subsection 4. Speech Intelligibility

a) Speech Intelligibility scale reflects the number of words which could be understood out of the total number of words spoken. Speech intelligibility may be measured from the recorded continuous speech sample and analyzed. The percentage of words understood is transferred to the scale in the profile.

b) Factors affecting intelligibility are voice (in terms of pitch, volume, nasality and tongue position), prosody (in terms of stress, intonation, pausing and rating) and others such as listening skills, use of aids, etc. All these aspects are evaluated from the continuous speech sample and are noted in stimulus word list A sheet in the space provided for the same.
Subsection 5. Phonological summary

The phonological summary helps the assessor to examine the various views of the data that the profile provides. The examiner can find out the stage the child is at. He can determine the vowels, consonants, clusters the child has acquired and what needs to be worked upon. The color coded aspect of the profile helps the assessor to examine if any specific place of production is causing difficulty. Similarly, the examiner can see whether different grouping of consonants reveals any pattern of error in the manner of production. The process section encompasses all the processes involved. The layout of the vowel information allows for a high/low and front/back examination of error pattern. The clusters are examined separately. The assessor considers the developmental stage the child is at, before setting any goals that address cluster production. The phonological summary also provides information about the developmental stage of the child and its speech intelligibility. Phonological profile developed in Kannada is illustrated in Appendix VI.

Level 2: Phonological assessment of Kannada speaking normal children and children with hearing impairment using the Phonological profile

Test material

The material contains

1. Stimulus cards - Set A
2. Stimulus word list – A
3. Stimulus cards - Set B
4. Stimulus word list – B
5. Story charts
6. Tapecorder
Subjects

Sixty subjects were taken for the study. The sixty subjects belong to two groups (Group-1 & Group-2). Both the groups consist of thirty children in the age range of 5+, 6+, 7+, 8+ and 9+ having six in each age group with equal gender distribution. Children having Kannada as their mother tongue with normal intelligence quotient (IQ) were chosen. A psychological test, namely Seguin form Board (SFB) test was administered to choose children with normal IQ.

One group having 30 normal hearing children (Group-1) and another group having 30 congenital hearing-impaired children (Group-2) with severe or more than severe sensori-neural hearing loss (i.e., =70 dB or >70 dB HL ) in both the ears were taken. The criteria adopted for the selection of subjects is detailed in Table 15.
Table 15: Details of the subjects selected

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Group-1</th>
<th>Group-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of subjects</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Age</td>
<td>5+, 6+, 7+, 8+ &amp; 9+ six in each age group</td>
<td>5+, 6+, 7+, 8+ &amp; 9+ six in each age group</td>
</tr>
<tr>
<td>Gender</td>
<td>3-Males; 3-Females in each age group</td>
<td>3-Males; 3-Females in each age group</td>
</tr>
<tr>
<td>Mother tongue</td>
<td>Kannada</td>
<td>Kannada</td>
</tr>
<tr>
<td>Intelligence</td>
<td>Normal (Psychologist’s report)</td>
<td>Normal (Psychologist’s report)</td>
</tr>
<tr>
<td>ENT evaluation</td>
<td>Normal as per report (Otologist’s report)</td>
<td>Normal as per report (Otologist’s report)</td>
</tr>
<tr>
<td>Hearing levels</td>
<td>20 db HL or less (Audiologist’s report)</td>
<td>70 db HL or more in both ears (Audiologist’s report)</td>
</tr>
<tr>
<td>Hearing aid</td>
<td>Not applicable (NA)</td>
<td>Fitted with hearing aids</td>
</tr>
<tr>
<td>Speech &amp; Language intervention</td>
<td>NA</td>
<td>Minimum of one year</td>
</tr>
<tr>
<td>Reading and writing skills</td>
<td>Learnt</td>
<td>Trained</td>
</tr>
</tbody>
</table>

Procedure

Phonological assessment involves three tasks. The test was carried out in a quiet, undisturbed environment.

Task 1 – Elicitation of picture naming

The subject was shown one picture (S1) at a time using Set A covering the word written at the bottom of the page. The subject was instructed to name the picture shown. The examiner would ask, what is this? What is he doing? or What is it doing? depending on the target word to be elicited. If a correct response was obtained, a √ was put, if an incorrect was obtained, it was simultaneously transcribed.
using broad transcription in the first response column against the stimulus word, in the
stimulus word list A. For the incorrect response, a clue was provided, written word of
the picture (S2) was shown by uncovering the written word. If a correct response was
obtained, then a √ was put or if an incorrect was obtained, it was simultaneously
transcribed using broad transcription in the second response column against the
stimulus word. Then, the next picture was shown covering the written word. In the
stimulus word list A, two columns are provided to record the responses in two
conditions. One of the conditions (S1) was, only when picture was shown and the
second condition (S1+S2) was, when both picture and written word were shown. The
inclusion of the second stimuli in the picture naming task enhances the elicitation of
the phoneme production as per the results of the study carried out by Ramadevi and
Prema (2002). The bold letter indicates the target phoneme but focus was on the whole
word. Each word transcribed was analyzed later for the phonological processes
involved.

**Task 2 – Elicitation of words having clusters**

The subject was asked to read the written word as each card was shown from
the Set B. If a correct response was obtained then a √ was put or if an incorrect
response was obtained, the whole word was simultaneously transcribed in the response
column of the stimulus word list B. The bold letters indicate the target clusters.

**Task 3 – Elicitation of spontaneous speech**

Story charts were shown to obtain spontaneous speech sample. The subject
was asked to narrate the stories looking at the pictures. When failed he was asked to
narrate any incident or story. Whenever the subject failed to narrate, he was involved in a conversation to elicit a continuous speech sample. A sample of 15-20 utterances was taken. The responses obtained for all the three tasks were tape recorded.

**Transcription**

The whole-word broad transcription method was employed. The client’s entire production was recorded. The focus of transcription was not the production of a target sound in a specific position, but the production of the whole word. All sounds in the word were considered. This method of transcription has many advantages, since some children may produce a target sound correctly but misarticulate another sound within the word. This error would not be depicted if the correct/incorrect scoring method or type of error systems (identifying error productions as substitutions, omissions or distortions) were used.

The symbols used in the present study are given by Schiffman (1979) for Kannada phonology illustrated in Appendix VII. While making transcriptions, assessor relies primarily upon auditory perceptual judgments. For most aspects of clinical phonology, auditory perceptual judgments form the basis for assessment and the intervention decisions. Hence, it is important for the clinicians to establish the reliability of their perceptual judgments. Therefore Intrajudge reliability method was employed.
Transference of information to the profile

1. The patient identification details were filled first.

2. The voice and suprasegmental information on the cover page of the profile was completed.

The following aspects were noted from stimulus word list - A, which has been obtained from task - 3:

- Positioning and use of the lips (exaggerated or normal), the tongue (body of the tongue too far retracted or advanced), the nose (nasal quality) the larynx (throat too tense or lax) and larynx (raised or lowered)
- Quality of the voice in terms of breathy, creaky, too high pitch, too low pitch, too loud, too soft or restricted volume range
- Suprasegmental aspects

The spontaneous sample was used to note the rate of speech (too fast, too slow, highly variable), duration aspects (words/word segments lengthened) and intonation contours (appropriately used to convey meaning, restricted range of intonation contours, same small body of intonation contours used repeatedly).

3. Phonological Details

Each word transcribed in the wordlists A and B were analyzed for phonological processes involved. Phoneme and process information were transferred to the phonological analysis section of the profile. Information about every target phoneme would appear on the profile. A tally of the occurrence of each sound
production was included. For ex: Child has produced initial /k/ as: /t/ (4 times), /d/ (once), /g/ (twice) and /p/ (twice) in the nine examples of intended /k/ from the data. The information is entered in the profile as follows: k → t (4) or k > t (4) or t 1111; k > d; k > g (2); k > p (2). All of this needs to be noted on the inventory by putting the number of frequencies in the bracket or by putting tally marks. This tally marking is done when frequency of occurrence of a particular process is more than once.

Whilst filling out the inventory, the processes sections were also completed. Symbols such as ✓ for correct response, NR for no response and φ for phoneme deletions were used. The consonant inventory includes a line for each consonant’s substitution processes. If a consonant production was correct a ✓ was put against the consonant in the appropriate column of initial (I) or medial (M). When an inappropriate production was obtained, the process involved was listed on the line. For ex: the student who produces /s/, 5 times as /t/ and 3 times as /ʃ/ is showing the processes of both stopping and palatalization for the phoneme /s/ both of which are noted on the relevant line. Assimilation was noted in the assimilation section. Consonant syllabic changes was noted in the syllabic processes section. In the vowel and diphthong inventory for the correct phoneme production a ✓ was put. For incorrect responses vowel and diphthong processes were noted and transferred to the processes affecting vowels and diphthongs section. When the production of clusters in the word was correct, a ✓ is put, against the target cluster in the cluster section. If the cluster production was faulty, the resultant form was recorded against the target cluster.
The percentage of words understood in the spontaneous speech sample was transferred to the Speech Intelligibility rating scale. A case study of a five-year-old child with hearing impairment is included in the Appendix VIII to illustrate the transference of information to the profile.

**Level 3: Development of the computerized module for the presentation of stimuli in the administration of Phonological profile in Kannada**

Microsoft Powerpoint was utilized to develop computerized presentation of stimuli for the administration of the phonological profile. This module was designed to carry out phonological assessment. The stimuli, which were presented in the study through the Set A and Set B and Set C, can be presented on the monitor of the PC with the model developed. This has many advantages a) The children will be cooperative for the testing as it is very interesting and appealing. b) It is less time consuming. c) Less effort involved on the part of the examiner. However, the examiner needs to transcribe simultaneously the responses obtained. This mode of stimuli presentation holds the attention of children for a longer duration. The assessment tool is brought in the form of a compact disc (CD) enclosed in Appendix IX. The 92 pictures of Set A, 103 words of Set B and 7 story charts of Set C were scanned and these were stored in the power point presentations as slides. The stimuli material was obtained in the form of a CD. When the CD is fed into a computer and played, three icons namely Task 1, Task 2 and Task 3 appear on the monitor. When the task 1 is clicked and the slide show and view show are selected, 92 pictures appear on the computer monitor, one at a time by using the enter button. The subject is asked to name the picture shown (S1).
The responses are manually transcribed in the first column of the stimulus word list - A using broad transcription. When a correct response is obtained for the picture itself, can move to second picture by pressing the “Enter” button thrice. If correct response is not obtained for the picture, “Enter” button is pressed once, then the written word is displayed (S2). Now the response obtained is recorded in the second column of the same word list. The display of the written word or uttering the picture name by the examiner, which the subject has to repeat (namely repetition task) may be employed as S2. Written word display may be ignored when repetition task is employed. The display on the monitor is sequenced as shown in the Table 16 for all the three tasks.

**Table 16: Sequence of the display items on PC**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Movement from one slide show to another slide is by pressing the ‘Enter’ button or by clicking the right button of the mouse.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>First picture</td>
<td>First written word</td>
<td>First story</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>First written word is added</td>
<td>Blank screen</td>
<td>Second story</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Blank screen</td>
<td>Second written word</td>
<td>Third story</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Second picture</td>
<td>Blank screen</td>
<td>Forth story</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Second written word is added</td>
<td>Third written word</td>
<td>Fifth story</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Blank screen</td>
<td>Blank screen</td>
<td>Sixth story</td>
<td></td>
</tr>
</tbody>
</table>

The procedure to be followed to carry out task1, task 2 and task 3 are same as when stimulus cards are used. The only difference is that the stimulus presentation here is through the computer monitor. Transcribing the responses in the stimulus word lists and audio recording the elicited responses are to be done as in the procedure for all the three tasks. The results for all three tasks are presented and discussed in detail in the next chapter.