# Development of Bilingual Ambiguity Resolution

**Amirtha Varshini M.J[*], Ramkarthik M[**], Maria J[*]**

[*]MERF Institute of Speech and Hearing, Chennai
[**] MEDHELP Speech and Hearing clinic, Tirupur

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***Abstract***- Bilingualism is a striking feature of all expanding cultures. In such bilingual environment, ambiguity in language is crucial and inevitable part that must be resolved to understand the given sentence. This study is aimed at understanding the development of ambiguity resolution in sentence level in Bilingual children. Knowing the developmental paradigm helps a clinician to understand normative and target their intervention strategies age appropriately. The present study investigated 120 typically developing bilingual subjects in the age range of 4 to 15.11 years (Native language being Tamil and second language being English). They were classified into 6 groups. Sixteen sentences in Tamil incorporating various types of ambiguity such as phonological, lexical and structural ambiguity served as the experimental stimuli. The responses obtained were analyzed both qualitatively and quantitatively. Results showed that phonological and lexical ambiguity starts developing at the age of 4. Phonological ambiguity is mastered around 15.11 years whereas; lexical ambiguity is continuing to develop even after 16 years. Structural ambiguity was observed to develop around 8 to 9.11 years and the performance was observed to reach maximum at around 15.11 years. The order of acquisition of Tamil speaking bilingual typically developing children is similar to that of western population.

***Index Terms***- Bilinguals, development, ambiguity resolution, phonological ambiguity, lexical ambiguity, structural ambiguity

## I. Introduction

We are born in a linguistic condition, where each individual are only exposed to two or more languages (Bilingualism and Multilingualism). As world becomes more interconnected, it is increasingly apparent that bilingualism is the rule and not the expectation. For people of any age or profession, knowing a second language boosts cross-cultural awareness and understanding.

Language comprehension involves the integration of different linguistic input and the configuration of mental models. Whether they do so consciously or not, learners pay attention to and integrate specific linguistic information in order to become competent speakers of their native language. The acquisition of metalinguistic skills, especially ambiguity detection has long been an important area of research.

Ambiguity in language is an important part of language; it is often a hitch to be unnoticed or a problem to be solved for people to understand each other. It can be agreed as an illustration of the complexity of language itself. The child's ability to address the form of language as distinct from its content was viewed as a specific effect of a general perceptual flexibility that develops in middle childhood.

Ambiguity in a language occurs whenever a given sentences possess two or more distinct semantic interpretations. The ambiguity aspect is of particular interest to language researchers because it allows us to explore how the mind first activates multiple representations and then selects or settles on one particular representation. While it is true that there is plenty of ambiguity within single language, entirely new layer is introduced when there is an additional language within the same cognitive system, as seen in the case for bilinguals.

Developmental changes in sentence interpretation strategies within monolingual children may stem from increased language proficiency, enhanced cognitive processing associated with maturation or the combination of both **(Pham and Ebert, 2016)**. Bilingual children face greater challenges in sentence interpretation than monolingual speakers.

There are several researches done on ambiguity resolution in Western countries. **Schultz and Pilon (1973)** assessed children between the age ranges of 6 to 15 years of age and documented that ability to detect various types of linguistic ambiguity develops at different rates depending on types of ambiguity. The phonological ambiguity was observed to be developing first, followed by lexical ambiguity and the structural ambiguity did not occur until the age of 12.

**Prasitha et al., (2008)** conducted a study on lexical ambiguity in sentences on ten monolingual (Tamil) and bilingual (Tamil and English) children in the age range of 8 to 10 years and found that the lexical ambiguity in this age range was at a developing stage. Also, they reported that bilinguals performed better than the monolinguals. **Ramkarthik et al., (2010)** investigated the perception of the lexical ambiguity in sentence processing in school going children who were monolinguals (Tamil) and Bilinguals (Tamil and English) in the age range of 11 t0 13 years of age. With the use of ten ambiguous sentence prepared in Tamil, they concluded that the ability to interpret ambiguity was better in bilinguals, which may be due to second language input, more exposure from the environment and cognitive flexibility as compared to monolinguals. The results also indicated that the 12 and 13 year olds were able to perform better than the 11 years old children which can be contributed to the fact that cognition improves with age.

India being a country with wide multilingualism, there definitely exist a need to do various researches on bilingualism and multilingualism to understand their cognitive ability to perceive information from the environment. There are high chances that a

bilinguals or multilinguals can get confused with the meanings of words or sentences as they may be ambiguous.

## II. NEED FOR THE STUDY

Though few research is done to study various types of ambiguity in Tamil Speaking bilingual children, there is no evidence on when an individual start resolving the ambiguity and when they develop it. Thus, there definitely exists a need to identify whether children are able to resolve ambiguity like an adult and also at what age a child starts resolving the ambiguity of the words to avoid the communication breakdown.

## III. AIM

The current study aimed to explore the developmental continuum of ability to disambiguate in sentence processing in Tamil speaking bilingual typically developing children.

## IV. METHODOLOGY

To uncover the development of various types of ambiguity among typically developing Tamil speaking bilingual children, a list of sentences in Tamil were prepared incorporating the major types – phonological, lexical and deep structure ambiguity. Children across the age range of 4 to 15.11 years categorised into 6 groups were included in the study. Bilingual children who are exposed to the second language (English) since 2 years of chronological age with a continuous exposure till 16 years of age with good academic performance and with no other associated problems were selected. The children were grouped into six (Table 1)

**Table 1**

*Age range of children selected for the study and their respective group and grades*

| ***S.No.*** | ***Age Range*** | ***Group*** | ***Respective Grades*** |
|---|---|---|---|
| *1* | 4 - 5.11 | I | UKG & I |
| *2* | 6 - 7.11 | II | II & III |
| *3* | 8 - 9.11 | III | IV & V |
| *4* | 10- 11.11 | IV | VI & VII |
| *5* | 12 - 13.11 | V | VIII & IX |
| *6* | 14 - 15.11 | VI | X & XI |

**Preparation of Experimental stimulus**

**Experimental stimuli selection criteria:**

The sentences were selected on the familiarity, those most occurring in their environment and in their school text books. Sentences with phonological, lexical (homophones and homonyms) and structural (surface and deep) ambiguities ranging from simple to complex in semantic as well as syntactic structure were framed. 27 sentences were shortlisted after the opinion from Linguist. 23 sentences were selected during the second phase of validation with 5 experienced Speech- Language Pathologists.

A pilot study was carried out with 12 typically developing bilingual children between the age range 4 to 16 years and 16 sentences were finalized for the study based on the results. Among the 16 stimuli, 4 were to evaluate phonological ambiguity, 4 were to evaluate structural ambiguity and the rest 8 were to evaluate the lexical ambiguity. (**Appendix 1**)

**a) Phonological Ambiguity:**

It can be defined as the presence of two or more possible meanings within a single word. Experimental stimuli: 1, 6, 7 and 16 were phonologically ambiguous stimuli.

**Table 2**

*Example of phonologically ambiguous stimuli and possible Interpretation in English and Tamil*

| **Stimulus No.** | **Stimuli** | **Possible interpretation** | **Language** |
|---|---|---|---|
| 16 | */a:rantʃu/* | *1. Fruit* | *Tamil & English* |
| | | *2. Color* | *Tamil & English* |
| | | *3. Number* | *Tamil* |
| | | *4. Time* | *Tamil* |

**b) Lexical Ambiguity:**

The lexical ambiguity of a word or a phrase pertains to its having more than one meaning to which the word belongs. Sentences were framed using homophone as well as homonym.

Homonyms are those words that share the same spelling and same pronunciation but different meaning. Experimental stimuli: 3, 4, 11, 13, and 15 contained homonyms.

**Table 3**

*Example of lexically ambiguous stimuli (Homonym) and possible Interpretation in English and Tamil*

| **Stimulus No.** | **Stimuli** | **Possible interpretation** | **Language** |
|---|---|---|---|
| 4 | */avanidam/ /mani/ /ketten/* | *1. Time* | *Tamil* |
| | | *2. Money* | *English* |
| | | *3. Bell* | *Tamil* |
| | | *4. Name* | *Tamil* |
| | | *5. Beads* | *Tamil* |

Homophones are those words that share pronunciation regardless of their spelling. Experimental stimuli: 5, 10, and 11 contained homophones.

**Table 4**

*Example of lexically ambiguous stimuli (Homophone) and possible Interpretation in English and Tamil*

| **Stimulus No.** | **Stimuli** | **Possible interpretation** | **Language** |
|---|---|---|---|
| | | *1. River bank* | *Tamil* |

| | | | |
|---|---|---|---|
| 5 | */iŋgu/ /karai/ /uḷḷaḍu/* | *2. Stain* | *Tamil* |

**c) Structural Ambiguity:**

Ambiguity that arises from the fact that two or more different meanings can be assigned to one string of words is structural ambiguity. Experimental stimuli: 2, 8, 9 and 4 were structurally ambiguous stimuli.

**Table 5**

*Example of structurally ambiguous stimuli and possible Interpretation in English and Tamil*

| Stimulus No. | Stimuli | Possible interpretation | Language |
|---|---|---|---|
| 5 | */ikkaraikku/ /akkarai/ /paʧai/* | *1. Other bank of the river looks greener* | *Tamil* |
| | | *2. Other side will always be better when you are this side* | *Tamil* |

***The Main study***

The study was carried out in Chennai, Tamil Nadu. The selection criteria were strictly followed in selecting each child for the study. 20 participants in each group with a total of 120 children were selected for the study. The ability to process the ambiguity in sentences were examined. The sentences were presented in audio verbal mode. Children were assessed individually by seating them comfortably in a quite environment.

Response time to disambiguate was observed. The children were instructed to tell how many possible meanings they can understand from that word or sentence with explanation.

A score of zero was given when the subject fails to interpret at least one meaning of the sentence. A score of one was given for every correct interpretation of the sentence. A child can obtain a maximum score of 39 if they interpret all the meanings correctly.

The raw scores obtained for each child was then computed and subjected to qualitative and quantitative statistical analysis. The data were analysed using statistical package for Social Sciences (SPSS) 17.0 version software. The data was described using the statistical mean and standard deviation using ANOVA. The difference between the groups and across the groups was obtained using the post hoc tests. The correlation values were obtained using 2-tailed Pearson correlation coefficient tests

## V. RESULTS AND DISCUSSION

The results obtained after the statistical analysis are discussed based on the age at which the development of disambiguation occurs incorporating various types such as phonological, lexical and structural ambiguities into account.

***Phonological ambiguity:***

The ability to phonologically disambiguate a sentence was observed to start developing at the age of 4 years. It is the only type of ambiguity that develops early in a child compared to other types. As age increased, the performance also increased significantly (Table 6, figure 1).

It was observed that among Group VI, 14 – 15 year olds could perform 70.1% whereas, 15 – 15.11 years disambiguated 100%. Hence, could conclude that phonological ambiguity is mastered at around 15 – 16 years of age.

**Table 6**

***Performance score of various groups for Phonological ambiguity***

| | *Qualitative Analysis* | *Quantitative Analysis* | |
|---|---|---|---|
| ***Groups*** | ***% Score*** | ***Mean score*** | ***Std. Deviation*** |
| I | 17.8 | 2.50 | 1.235 |
| II | 26.7 | 3.75 | 0.910 |
| III | 40.7 | 5.70 | 1.455 |
| IV | 53.5 | 7.50 | 1.821 |
| V | 71.7 | 10.05 | 1.276 |
| VI | 85 | 12.85 | 3.066 |

Across group analysis were done using post-hoc tests. The results revealed significant difference between all the groups except for Group II (Table 7). The reason for this finding could be that subjects in Group II were still in the developmental phase with regard to phonological ambiguity. ANOVA analysis was carried out to determine the difference across groups and the level of significance was found to be 0.000.

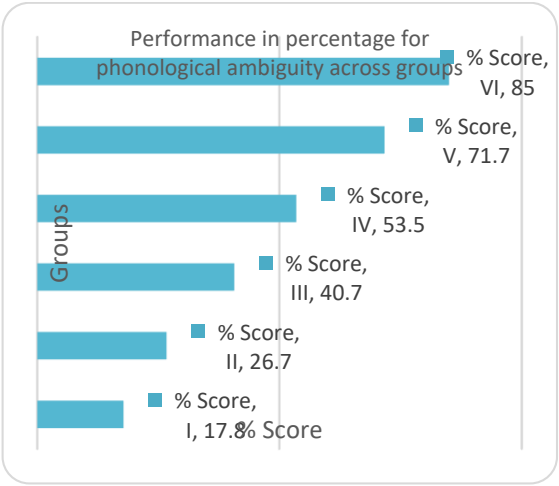


***Figure 1*** Performance in percentage for Phonological ambiguity across groups

**Table 7**
***Results of across group analysis for Phonological ambiguity***

| | *G I* | *G II* | *G III* | *G IV* | *G V* | *G IV* |
|---|---|---|---|---|---|---|
| ***Level of significance*** | 0 | 0.231 | 0 | 0 | 0 | 0 |

These results are in correlation with the study done by **Schultz and Pilon, 1973**. They reported that the ability to detect phonological ambiguity appeared first and with largest improvement occurring between 6 and 9 years of age.

***Lexical Ambiguity***

The results indicated that the ability to disambiguate lexical ambiguity also starts to develop simultaneously with phonological ambiguity. Group I and Group II identified only the dominant meaning of the simplest stimuli and the most frequently occurring homophone / homonym. Group II performed comparatively better than the Group I in interpreting, which can be due to their language exposure. Group III interpreted at least the dominant meaning of all the stimuli presented. Most of the children failed to interpret the subordinate meaning of a homonym compared to sentences having homophones in it. On observing, Group IV showed a significant leap in their performance compared to Group III. Group V and VI performed almost equally in disambiguating the dominant and subordinate meanings of all the stimuli but they fail to reach the maximum score of certain stimulus interpretation. Even though there was no statistically significant difference in between these two groups. Group VI performed better (Table 8, Figure 2).

**Table 8**
***Performance score of various groups for Lexical ambiguity***

| | *Qualitative Analysis* | *Quantitative Analysis* | |
|---|---|---|---|
| ***Groups*** | ***% Score*** | ***Mean score*** | ***Std. Deviation*** |
| I | 17.05 | 2.90 | 0.912 |
| II | 31.1 | 5.40 | 1.536 |
| III | 62.3 | 10.60 | 2.303 |
| IV | 90.8 | 15.45 | 1.504 |
| V | 98 | 16.80 | 0.894 |
| VI | 98.2 | 16.70 | 0.801 |

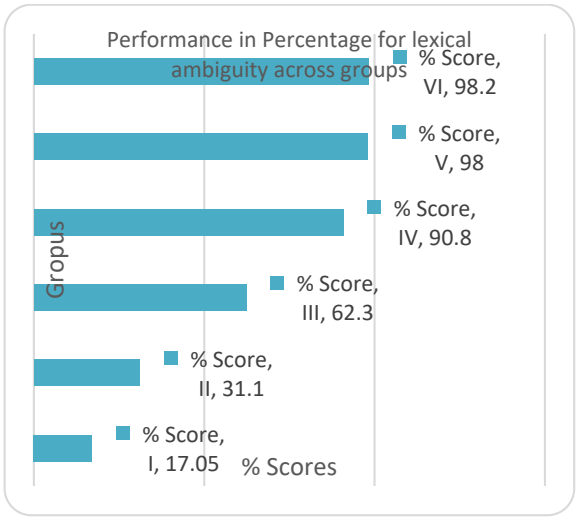


***Figure 2*** **Performance in percentage for Lexical ambiguity across groups**

Across group analysis were analysed using post-hoc tests. The test result reveals significant difference across groups for lexical ambiguity Analysis to determine the variability between groups and across groups was done using ANOVA and the value was found to be 0.000.

To conclude, the ability to disambiguate lexical ambiguity develops at around the same time as that of phonological ambiguity but the performance improved when they are in Grade IV and V. Significant improvement in scores were observed in Grade VI and VII and reached stability from Grade VIII to XI. This result is supported by the findings of Ramkarthik et al (2010) who reported that lexical ambiguity in bilingual children developed significantly between 12 to 13 years and continues to improve with age.

***Structural Ambiguity***

The results obtained indicated that the ability to structurally ambiguate a sentence starts developing only around 8 – 9.11 years of age. In Group IV, most of the children interpreted at least the surface structure. But a major leap was seen for Group V and VI in interpreting deep structure ambiguity indicating the complexity of cognitive processing (Table 10, figure 3). This ability to quickly activate semantic information is a critical component of sentence comprehension.

**Table 9**
***Performance score of various groups for Structural ambiguity***

| | *Qualitative Analysis* | *Quantitative Analysis* | |
|---|---|---|---|
| ***Groups*** | ***% Score*** | ***Mean score*** | ***Std. Deviation*** |
| I | 0 | 0.00 | 0.000 |
| II | 0 | 0.10 | 0.447 |
| III | 10 | 0.85 | 1.089 |
| IV | 58.70 | 4.70 | 1.867 |
| V | 96.20 | 7.70 | 0.733 |
| VI | 100 | 8.00 | 0.000 |

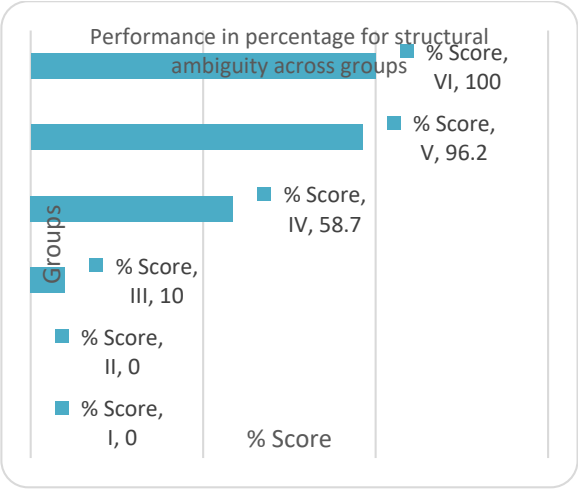


***Figure 3*** **Performance in percentage for Structural ambiguity across groups**

Across group analysis was done using Post-hoc test to determine the variability in performance with structural ambiguity. The results revealed the presence of significant difference (Table 11). The ANOVA analysis determining the difference between groups and within groups revealed significant difference with a value of 0.000

**Table 10**
***Results of across group analysis for Structural ambiguity***

| | ***G I*** | ***G II*** | ***G III*** | ***G IV*** | ***G V*** | ***G IV*** |
|---|---|---|---|---|---|---|
| ***Level of significance*** | 0.060 | 0.060 | 0 | 0 | 0 | 0 |

**Schultz and Pison (1973)** reported that the detection of surface and deep structure ambiguities did not occur until the age of 12. But in this current study it was observed that around 10 - 11.11 years, children detected surface structure forms and at around 12 – 13.11 years, children were able to detect even the deep structure.

The performance of Group V and VI could be reasoned with their learning through environmental experience. As **Felser et al., (2003)** reported, the cross linguistic differences between the ways in which the structural ambiguities are resolved indicate that some parsing strategies are language specific rather than universal and thus must be learned through experience.

***Developmental Continuum***

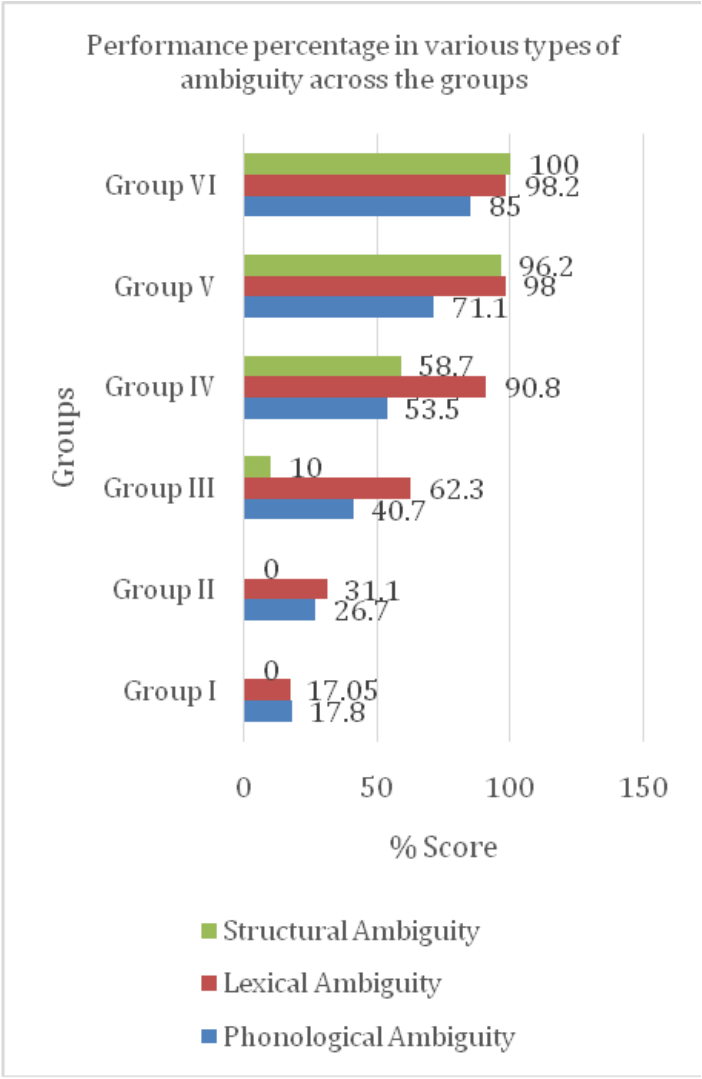


***Figure 4*** **Performance percentages for various types of ambiguity across the groups.**

On comparison of the development to detect phonological, lexical and structural ambiguity in all the six groups, the scores showed that the acquisition of phonological ambiguity and lexical ambiguity resolution starts in parallel with group I and as age increased, the children were able to resolve ambiguity more efficiently compared to phonological ambiguity. This can be attributed to the fact that as the age increases the vocabulary also increases. Another factor is that the number of experimental stimuli for lexical ambiguity was more compared to the other two types of ambiguity. There is a steady increase in the scores of resolving the phonological and lexical ambiguity as the age increases.

The ability to resolve structurally ambiguous sentences was observed to be starting to acquire from the age range of 8 to 9.11 years and completely mastered at the age range of 14 to 15.11 years. Hence, it can be concluded that Tamil speaking typically developing bilingual children acquire ambiguity resolution in a defined pattern as that of children of other countries. The order of acquisition to disambiguate is observed to be phonological, lexical

and followed by structural. All three types are acquired by around 15 – 15.11 years and still learning to resolve the complexity as the age increases.

## VI. SUMMARY AND CONCLUSION

It can be concluded that Tamil speaking children also follow the same trend as that of other western population reported by various researchers. The relationship between ambiguity detection in sentences and reading comprehension are well documented. As reported by **Zipke** in 2007, training in ambiguity detection ultimately improves reading comprehension score. Hence, knowing the developmental paradigm helps a clinician to understand normative and target their intervention strategies age appropriately. This view is been supported by **Oakhill et al., 1998**. They reported that children can be trained to accelerate Linguistic, Metalinguistic and Psycholinguistic processing skills within the zone of proximal ambiguity development, that resulted in improved reading skills.

## APPENDIX

| Stimuli No | Experimental Stimuli in IPA | Number of interpretations |
|---|---|---|
| 1. | /u:ɖa:/ /paɳɖu/ | 2 |
| 2. | /iḳkaraıḳku/ /aḳkaraı/ /paʧaı/ | 2 |
| 3. | /ıɖu/ /ka:lıl/ /pa:ɖı/ | 2 |
| 4. | /avanıdam/ /manı/ /keṭṭen/ | 4 |
| 5. | /ıŋgu/ /karaı/ /uḷḷaɖu/ | 2 |
| 6. | /na:lu/ /irubaɖu/ | 4 |
| 7. | /a:du/ /kalam/ | 4 |
| 8. | /paḻaga/ /paḻaga/ /pa:lum/ /pulıḳkum/ | 2 |
| 9. | /adı/ /mel/ /adı/ /veıṯa:l/ /aṃmıjum/ /nagaraum/ | 2 |
| 10. | /ɛṇna/ /vendum/ | 2 |
| 11. | /na:n/ /paṭṭam/ /va:ŋgınen/ | 2 |
| 12. | /unaḳku/ /araı/ /venduma:/ | 2 |
| 13. | /oru//adı/ /poɖum/ | 2 |
| 14. | /va:namɛ/ /yɛḻlaı/ | 2 |
| 15. | /ma:laıyıl/ /malargal/ /malarnɖaɖu/ | 2 |
| 16. | /a:ranʤu/ | 4 |

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## AUTHORS

**First Author** – Amirtha Varshini M J, M. Sc (Speech and Hearing), M. Sc (Psychology), Professor & Vice Principal, MERF Institute of Speech and Hearing, Chennai; varshinimj@gmail.com
**Second Author** – Ramkarthik M, MASLP, MEDHELP Speech and Hearing clinic, Tirupur, mrkarthik006@gmail.com
**Third Author** – Maria J, MASLP, M. Sc (Linguistics), Assistant Professor, MERF Institute of Speech and Hearing, Chennai; maria.aslp@gmail.com
**Correspondence Author:**
Prof. Amirtha Varshini M J, Professor & Vice Principal
MERF Institute of Speech and Hearing, Chennai
Contact No. 08825885873
varshinimj@gmail.com