BANGALORE SPEECH AND HEARING TRUST

# Journal of Hearing Language and Speech

ENGLISH HALF YEARLY

VOLUME I | ISSUE 1 | KARENG04986-BENGALURU | July-December 2022 | PRICE: Rs. 700/-

## Information about the journal

The JHLS is a biannual publication of the Bangalore Speech and Hearing Trust.

## Aims and Scope

JHLS publishes papers in both clinical and basic research related to hearing, balance, speech – language and swallowing. Articles accepted will be research articles, case studies, tutorials, perspective articles, policy and practice briefs and resource reviews. The articles selected will be peer reviewed. All articles are protected by copyright. Although care is taken in selection of articles, no legal responsibility for errors of omission will be accepted by either the author, editors, or publisher. No warranty is made for the content in the journal.

**Contact -** editor@jhls.src@speechear.org

# Editorial Board

# Editorial

After I was appointed as the editor, I wrote to several prominent researchers in the field requesting contributions. One of them asked me, and I quote "Starting a journal seems like a major undertaking especially given the many journals already in existence. What niche are you motivated to fill with the new journal?". A truly relevant question and one which I think I should address in the first issue. The field of "Speech and Hearing" in India has crossed 55 years. There are only 5 journals in the country catering to speech pathologists and audiologists. The two major journals, *the Journal of All India Institute of Speech and Hearing and the Journal of Indian Speech and Hearing Association* have existed for over 40 years and are recognized by the University Grants Commission. These journals were the mainstay of research for *most* generations till the end of the last century. The major reason being that the majority of professionals were in private practice; most of the publications were from four academic institutions. Presently there are over 65 academic institutions in the country recognized by the RCI, some of them being university departments and they do need avenues to submit their work.

University departments and institutions offering courses in Audiology and Speech Language Pathology have to better their performance every year. However, not all studies are of interest in the international arena. Some tests for example, that are of interest to the Indian population need to be published for cross-cultural research, diagnosis, and management. Some studies are unique to the Indian scenario and not of interest elsewhere, even if good work is done. This journal will fill that niche.

There is a cascade effect when a journal is started- there are more reviewers, more authors, and more ideas. The relationship between authors and reviewers (or must I say authoring and reviewing) is symbiotic, both grow with each other's support and increasing reach to other nations. The research environment is built by getting more people to participate in the process.

The "Speech, Language and Hearing" discipline in India, has reached a critical point now, a time when there are more reviewers of international standards available, and the climate is favorable for interdisciplinary research. There is a scope for constructive criticism and handholding (from anonymous reviewers) to get good ideas published. The reviewers, authors, editors, and future authors will have the same goals and meet on the same platform – that of the journal. This journal will provide perspectives and access to great research from senior researchers. In this process, new ideas are sparked. Authors, academicians, private practitioners, and students will be able to correspond to refine research proposals, build up nascent ideas or even drop those that are not feasible. The more the people participate in the exercise and accept corrections with humility, the better is the research.

This journal has been fortunate to get great associate editors and experts of international standards who agreed to be reviewers. The content of the journal planned are as follows –original research papers, case studies, exciting, invited papers in the form of perspectives, and tutorials relevant to the current scenario shortlisted for publication. Getting research input needs investment. Besides publishing, we plan to create resources in terms of seminars aimed at writing and planning research in specific areas for a start.

Is this going to be just another college journal? Definitely not! Even though this is a small beginning, international standards and transparency will not be compromised. This journal will meet the needs of the rapidly growing field – more access to published work, good reviewers, and high research standards. Just as sustained determination lead to the success of our in-house magazine, ISHLINK, I believe that goodwill and support along with sustained effort and the right ideas will lead to the success of this venture. We do have a lot to give.

**Madhuri Gore**
**Editor**
**Dr. S.R. Chandrasekhar Institute of Speech & Hearing**

# Advances in Speech, Language & Hearing in India - the next decade?

**Prathibha Karanth**
[1]The Com DEALL Trust
Bengaluru

Two decades ago, I contributed a brief article to Folia Phoniatrica titled 'Four decades of Speech-Language Pathology in India: Changing Perspectives and Challenges of the Future' (Karanth, 2002). In this brief overview of the discipline in India over the four decades since its inception in the 1960s, the major themes covered were the limited numbers of professionals trained (with a substantial brain drain) and its consequences in terms of limiting the discipline to academics and training, with neglect of clinical spread and impact, both in terms of scope and numbers served; as well as a nearly non-existent research stream. Two decades onwards the overall picture of the discipline of Speech, Language & Hearing in India, is much more robust; particularly as far as training programs and consequent increase in numbers of Speech and Hearing professionals trained and available in the country. With the opening of the Indian economy in the 1990s and an increase in the number of privately funded training institutions that were set up, there has been an expansion of clinical services which are now being made available on a much wider scale, at least in the metros and larger cities, as compared to the earlier constraints of being restricted to a couple of government-funded institutions. This is despite the continuing numbers that seek employment overseas. The corresponding enhancement of the clinical impact has in turn led to an increase in the visibility of the profession in the public eye.

Within the discipline too, in keeping with the growth of the profession across the globe, there has been an expansion in the range of services being offered with notable additions in the areas of cochlear implants, the range of neurodevelopmental disorders including children with autism spectrum disorders, dysphagia and swallowing disorders as well as adult neurogenic and cognitive disorders. What is yet to take off in the clinical arena are inventions in terms of indigenously developed programs, tools, and materials with innovations such as the Com DEALL early intervention program (The Com DEALL Trust, Bengaluru) and SHRESHT (SRMC, Chennai). On the other hand, thanks in part to the COVID pandemic, teleservices have recently received a boost and are likely to soon become an integral part of speech, language and hearing services.

It is in the research and publication areas that the discipline is still lagging. Despite our six-decade-long existence in this country our research and publication record is scant. We do not yet have focused, long-term research labs of excellence with publications of high impact, with rare note-worthy exceptions such as the Infant-Toddler Language Development and Intervention Lab (Lil, NIMHANS), the Facility for Advanced Auditory Research' (FAAR, AIISH), and the Spatial Hearing Lab at MAHE; that are now being established.

Except for a few journals published sporadically over the years (JAIISH, JISHA), there has been no concerted push at enhancing research and publication. It is noteworthy that during the last couple of decades, at least two other journals of international standards - Asia Pacific Journal of Speech-Language & Hearing (since1998) and the West Asian Journal of Speech-Language Pathology (since 2014) have been established in Asia. It is to fill this vacuum to some extent that this journal aims, by capitalizing on much that India has to offer to the world at large, given our large multilingual population with the world's largest number of children, access to high-quality technical support and an eager, young band of professionals ready to make their mark in the scientific domain of their chosen profession. It is to fill this niche that journals such as this endeavour.

## Reference

Karanth, P. (2002). Four decades of speech-language pathology in India: Changing perspectives and challenges of the future. Folia Phoniatrica et Logopaedica, 2002, 54, 69-71.

* * *

# Effect of ageing on oral confrontation naming in Telugu and English-speaking bilingual individuals

**Suma Raju[1] and Gajula Shravanaveena[1]**
[1]Department of Speech-Language Pathology
JSS Institute of Speech and Hearing, Mysuru

## Abstract

**Background & Purpose:** In bilingual individuals, the conceptual system may possibly be shared for all languages. When a bilingual person responds to a stimulus, numerous lexical nodes of two languages stay activated, irrespective of the language in which the task is performed. It is often reported that the activation of the non-target language is suppressed by an inhibitory process mechanism. Semantic errors associated with ageing can be due to an inadequate inhibition and/or selection process. Therefore, this study aimed to compare the oral confrontation naming between two age groups of bilingual individuals.

**Method:** A total of 60 typical bilingual individuals with native proficiency in Telugu and with professional working proficiency in English (as a non-native second language) participated in the study. The participants were divided into two age groups, Group 1 included 30 participants aged 25-35years, and Group 2 included 30 participants aged 55-65 years. Twenty-five standardized colour picture cards depicting nouns served as stimuli for confrontation naming and the participants had two tasks one in English and the other in Telugu.

**Results:** The response accuracy and reaction time measures were obtained for naming tasks in two languages and the data were subjected to descriptive and inferential statistics. The results showed a better response accuracy and shorter reaction time in the younger age group compared to the older age group.

**Conclusions**: The findings of the study can be attributed to the age-related impairments in a number of tasks caused by a weakening of inhibitory mechanisms in working memory as people get older. The findings of the study support the previous findings about the decline in the naming ability of older adults.

**Key words:** confrontation naming, bilingual, ageing, Telugu, English

Address correspondence and reprint requests to: Dr. Suma Raju, Professor, Department of Speech-Language Pathology, JSS Institute of Speech and Hearing, Mysuru; Email: sumaraju.mys@gmail.com

## Introduction

Confrontation naming tasks are often used in clinical language testing for aphasia to identify impairments in word-finding ability or anomia, in individuals with neurologic disorders that primarily damage the left hemisphere of the brain (Race et al., 2013). Confrontation naming includes choosing a particular label matching to a stimulus like an object, activity or picture perceived. Confrontation naming tests evaluate the capacity to retrieve several

word types, such as pictures of actions to test verb retrieval or pictures of objects to test noun retrieval (Raymer, 2011). The confronting naming may involve three steps that is conceptual preparation, lemma retrieval (lexical selection of appropriate names and their semantic and syntactic features), and lexeme retrieval (of phonological word-form information). Problems with confronting naming are often linked to the difficulties with the lexeme retrieval stage, and such difficulties are usually related to ageing in neuro-typical individuals (Ashaie & Obler, 2014).

The individuals are shown a picture of a noun and asked to name it in confrontation naming task. This task can be used to assess breakdowns in word access and retrieval. Because of their great reliability and also capacity to provide rich diagnostic information, such tasks are frequently utilized for evaluating naming problems in anomia (Herbert, Hickin, Howard, Osborne, & Best, 2008). Confrontation picture naming tasks are currently extensively utilized in both clinical and research settings as individual assessments and part of large assessment batteries (Kaplan, Goodglass, & Weintraub, 2001; Howard, Swinburn, & Porter, 2010).

A frequent finding among the language abilities of the elderly is naming deficits. This may be due to several factors. One such factor could be the normal ageing associated decline in overall cognitive ability. A few researchers (Albert, Heller, & Milberg, 1988; Goulet, Ska, & Kahn, 1994) have opined that the deficits in picture- naming skills associated with ageing can be linked to nonlinear changes in cognitive function caused by selective modifications in the brain evolving at different rates across the life span. It is also considered that in a bilingual individual, the conceptual system may be shared for two languages (based on the revised hierarchical model proposed by Kroll and Stewart (1994). Therefore, when a stimulus is perceived by a bilingual, numerous lexical nodes of two languages are activated, irrespective of the language in which the task is performed. Thus, these different activated nodes serve as competitors during the lexical selection.

As reported in the review of literature, bilinguals may have two distinct lexical representations in memory for each language respectively (Gollan & Kroll, 2001) and access a shared conceptual representation. Therefore, it is important to know the structure, relationship, and processing within and between bilinguals' adult lexicons to evaluate and treat naming problems (Weber-Fox & Neville, 1996). A study by Mitchel (2005) conducted on bilinguals' representation of two language systems in memory evidenced that bilingual individuals' two languages have access to a common semantic network (Francis, 1999). Further, the evidence also shows that bilinguals process linguistic information in both their first (L1) and second language (L2) at the same time (Dijkstra & van Heuven, 2002). Though one of the languages is applicable in a particular monolingual environment, one more language is active to a certain extent and may affect the processing of the respective language (Altarriba, 1992; Chen & Ng, 1989; Schwanenflugel & Rey, 1986).

Thomas, Sam, & Goswami (2013) studied the effect of ageing on oral and written confrontation naming in Kannada and English in bilingual individuals across age groups (25- 85years). The findings showed an overall decline in naming response accuracy with age. For both oral and written naming in both languages, semantic errors were more noticeable in the older age groups. A study by Laxman (2020) investigated oral and written confrontation naming in bilinguals aged 25-65years, and the results showed a decline in the accuracy of naming responses with respect to ageing.

In the case of healthy elderly, the problems in lexical-retrieval have usually been attributed to the weakening of the connections between the semantic and phonological levels of the mental lexicon. This may result in an omission, or a situation where the phonological form for the target (a tip-of-the-tongue state) or a phonologically related word-substitution error is exhibited. The failure to name a familiar word is the most significant cognitive problem associated with age (Burke & Shafto, 2004). Irrespective of the competition, an inhibitory process mechanism suppresses the activation of the non-target language words (Green, Hermans & Shreuder, 1998; Lee and Williams, 2001). An inadequate inhibition and/or selection process may be associated with semantic errors found in ageing. Therefore, it is important to study the effect of ageing on oral confrontation naming among bilingual individuals. Current study compared oral confrontation naming among bilingual individuals between two age groups. Further, there is a lack of literature in bilinguals on confrontation naming in normal ageing individuals across language groups in the Telugu English bilingual context. Thus, there is a need to study the effect of ageing in confrontation naming in this group of bilinguals. The study aimed to look at the accuracy and reaction time in oral confrontation naming in Telugu English bilingual adults, as well as the influence of ageing.

## Aim of the Study

This study aimed to analyze the effect of ageing on oral confrontation naming in Telugu-English speaking bilingual individuals.

## Method

The study was approved by the Institutional ethical committee of JSS Institute of Speech and Hearing, Mysuru. A group comparison research design was used in the present study and was carried out in the following phases.

## Selection of Participants

A total of 60 neuro-typical bilingual individuals with native proficiency in Telugu (as their mother tongue) and had professional working proficiency in English (as a non-native second language) as per English language proficiency tested using International Second Language Proficiency Ratings (ISLPR) scale (Wylie and Ingram, 2006) and all the participants belonged to middle socioeconomic status as per the Socio-Economic Status Scale of the National Institute for the Mentally Handicapped (Venkatesan, 2009). These participants belonged to two age groups, Group 1 included 30 participants from 25-35years, and Group 2 included 30 participants from 55-65 years. Each group had 15 males and 15 females. The mean age of participants of Group 1 was 27.43 years with a standard deviation of 2.25 years and of Group 2 was 58.89 years with a standard deviation of 2.58 years. A $X^2$ square test to measure interaction of gender and group revealed a P value of 1.00 which was not significant. Purposive sampling method was used to select the participants. Participants had Telugu as their mother tongue and acquired English as part of their formal education. A brief history of the participants was obtained, including education, details about general health, speech, hearing and psychological problems, if any. Participants had a minimum of twelve years of formal education. Individuals with any history of speech, hearing, neurological, and psychological problems were excluded from the study. All the participants belonged to Hyderabad and were tested at their homes in a quiet place. Informed consent was obtained before testing the participants.

## Stimulus Preparation

Twenty-five standardized colour picture cards depicting nouns were taken from the unpublished thesis 'Cognitive-linguistic skills in bilinguals' (Raju

& Nataraja, 2017). Pictures (15 cm x 10 cm) were loaded to a personal computer (DELL Inspiron, intel i5 processor) in jpeg format. In order to present the stimulus picture, record the responses and assess the reaction time of each picture response of the participants, the DMDX software version 6.1.6.4 was used. The duration of each picture presented on screen was 1500ms with a response time of five seconds.

## Procedure

The study incorporated two tasks in two different periods with a gap of one week between task 1 and task 2. Task 1 required the participants to name- the picture in their native language (Telugu) and simultaneously write the response in their non-native language (English) within a given duration of 5 s. Task 2 required the participants to name- the picture in their non-native language (English) and simultaneously write in their native language (Telugu) within 5 s. Response in the written mode while responding orally to the stimuls was considered. This was done in order to activate the responses in non-target language. This introduces competition between languages. The method predicts or assumes that the participant has greater inhibitory control to execute such a task. A score of 1 was given for each correct response in oral confrontation naming, and a score of 0 was given for each incorrect response (semantic errors, transfer errors and no response). Reaction time was measured as the duration between the presentation of the stimuli and the onset of response in milliseconds (ms). Responses were recorded using DMDX. Only correct responses were taken into account when calculating reaction time for naming responses.

## Statistical Analysis

The obtained data were statistically analyzed using SPSS (Social Science Statistical Package) Software (Version 20.0). Descriptive statistics were performed followed by an independent sample t-test to compare between two age groups.

## Results

The study aimed to analyze the effect of ageing on oral confrontation naming in Telugu-English bilinguals. Data were collected from 60 typical bilingual individuals, who were divided into two age groups: younger adults (25–35 years) and older adults (55–65 years).

**Table 1. Mean and standard deviation values of oral confrontation naming task**

| Age range | Task | Mean | Standard deviation |
|---|---|---|---|
| 25-35 years | TOCR | 22.76 | 1.45 |
| | TORT ( ms) | 1241.96 | 165.53 |
| | EOCR | 23.10 | 1.88 |
| | EORT (ms) | 1354.86 | 207.25 |
| 55-65 years | TOCR | 18.76 | 2.66 |
| | TORT (ms) | 1423.42 | 150.07 |
| | EOCR | 19.10 | 3.41 |
| | EORT ( ms) | 1525.15 | 160.49 |

TOCR- Telugu oral correct response, EOCR- English oral correct response, TORT-Telugu oral reaction time in ms, EORT-English oral reaction time in (ms).

Findings presented in Table 1 show that both younger and older adults performed better in oral confrontation naming task in English compared to Telugu. Findings also revealed that the reaction times for Telugu oral naming responses were faster compared to English. Further, the results also indicated that a better response accuracy and shorter reaction time was found for the younger age group compared to the older age group.

Independent sample t-test was carried out to find the difference between younger adults (25-35 years) and older adults (55-65 years) for Telugu oral correct response in the oral confrontation naming task. Results revealed that the difference was significant between the groups for Telugu oral correct response (t(58) = 7.22, /*p*/=0.00), where the younger group exhibited better scores. Independent sample t-test was carried out to find the difference between younger adults (25-35 years) and older adults (55-65 years) for English oral correct response in the English oral confrontation naming task. The test also revealed that there was statistically significant difference obtained between two age groups for English oral correct response (t(58) = 5.61, /*p*/=0.00) indicating significantly better performance by younger age group. The results of the independent sample t-test carried out to find the significant difference between younger adults (25-35 years) and older adults (55-65 years) for Telugu oral response reaction time in Telugu oral confrontation naming task revealed that the younger group were significantly faster compared to older group (t(58) = -4.4, /*p*/=0.00). Similarly, an independent sample t-test carried out to find the difference between younger adults (25-35 years) and older adults (55-65 years) for English oral response reaction time in the English oral confrontation naming task revealed a significant difference obtained between two age groups for English oral correct response reaction time (t(58) = -3.5, /*p*/=0.00).

## Discussion

The study indicated that English oral confrontation naming responses were better compared to Telugu oral confrontation naming in both age groups. This could be attributed to greater demand and usage of the second language, resulting in better activation and hence enhanced proficiency in both the younger and older age groups. From the results, it was evident that younger adults performed better than older adults for both English and Telugu oral confrontation naming tasks. These findings are similar to the inhibition hypothesis proposed by (Hasher & Zacks, 1988), who reported that age-related impairments in a number of tasks are caused by a weakening of inhibitory mechanisms in working memory as people get older.

Findings of the study are in consonance with the findings by Obler and Albert (1981), who reported that there is a progressive decline in the naming ability of older adults. Laxman, (2020) also reported similar findings. The findings can be supported by the transmission deficit hypothesis (Burke, 2002). According to this hypothesis, naming difficulties in older adults can be attributed to impaired information transmission across mental nodes. Impairment could occur at the semantic node, phonological node, or linkages between them. These impairments would cause under activation of the target node, resulting in word-finding difficulty. Thomas, Sam & Goswami (2013) studied the effect of ageing on oral and written confrontation naming in Kannada and English in bilingual individuals across age groups (25-85 years). They stated that naming responses differ depending on the modality used for an irregular language. Hence, various studies point to the fact that greater demand and usage of a particular language results

in better activation. Thus, the findings of the study, which showed that English written confrontation naming was better than Telugu written confrontation naming in both younger and older adults, can be attributed to the above factors.

There was also a decline in reaction time with ageing, i.e., younger adults had a faster reaction time than older adults in the oral and written confrontation naming task. These findings are consistent with the study by Tsang & Lee (2003), who examined accuracy and response latency as indices for reflecting the effect of normal ageing on confrontational naming. Other sensory and motor abilities may affect older adults' performance in a naming task, in addition to the cognitive decline which occurs with normal ageing.

Although the order of administration of tasks one and two were counterbalanced, the time gap between administrations of two tasks was one week which would have caused a learning effect. The error analysis in detail to tap the level of lexical or phonological breakdown in response execution was conducted in the present study. Further, to strengthen the findings about inhibitory control and its effect on ageing, the study did not include any cognitive tasks, especially tasks involving inhibitory control.

## Conclusion

The relation between the action of inhibitory mechanisms and normal ageing is still a source of contention. Positive and negative findings are reported. However, following this line of thought, the decline in naming accuracy and the increased latency of response could be related to the inhibition of irrelevant stimuli, which is an area worthy of future research.

**Conflict of Interest:** The authors report no conflicts of interest.

**Disclosure Statement:** No disclosures

**Patient consent statement:** All participants agreed voluntarily to participate in the study and signed an informed consent.

## References

Albert, M. S., Heller, H. S., & Milberg, W. (1988). Changes in naming ability with age. *Psychology and Aging*, *3*(2), 173–178. https://doi.org/10.1037/0882-7974.3.2.173.

Altarriba, J. (1992). The Representation of Translation Equivalents in Bilingual Memory. *Advances in Psychology*, *83*(C), 157–174.

Ashaie, S., & Obler, L. (2014). Effect of age, education, and bilingualism on confrontation naming in older illiterate and low-educated populations. *Behavioural Neurology*, *2014*. https://doi.org/10.1155/2014/970520.

Burke, D. M. (2002). Language Production and Aging. *Constraints on Language: Aging, Grammar, and Memory*, 3–27. https://doi.org/10.1007/0-306-46902-2_1.

Burke, D. M., & Shafto, M. A. (2004). Aging and Language Production. *Current Directions in Psychological Science*, *13*(1), 21–24. https://doi.org/10.1111/j.0963-7214.2004.01301006.

Chen, H. C., & Ng, M. L. (1989). Semantic facilitation and translation priming effects in Chinese-English bilinguals. *Memory & Cognition*, *17*(4). https://doi.org/10.3758/BF03202618

Dijkstra, T., & van Heuven, W. J. B. (2002). The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and Cognition*, *5*(3), 175–197. https://doi.org/10.1017/s1366728902003012

Francis, W. S. (1999). Cognitive integration of language and memory in bilinguals: semantic representation. *Psychology and Aging*.

Gollan, T., & Kroll, J. (2001). "Bilingual lexical access." *The Handbook of Cognitive Neuropsychology: What Deficits Reveal About the Human Mind*, 321–345.

Goulet, P., Ska, B., & Kahn, H. J. (1994). Is there a decline in picture naming with advancing age? Journal of Speech and Hearing Research, 37(3), 629–644. https://doi.org/10.1044/jshr.3703.629

Green, Hermans, & Schreuder. (1998). Producing words in a foreign language: Can speakers prevent interference from their first language? *Bilingualism: Language and Cognition*, *1*(3), 213–229. https://doi.org/10.1017/S1366728998000364.

Hasher, L., & Zacks, R. T. (1988). Working Memory, Comprehension, and Aging: A Review and a New View. *Psychology of Learning and Motivation - Advances in Research and Theory*, *22*(C), 193–225. https://doi.org/10.1016/S0079-7421(08)60041-9.

Herbert, R., Hickin, J., Howard, D., Osborne, F., & Best, W. (2008). Do picture-naming tests provide a valid assessment of lexical retrieval in conversation in aphasia? *Aphasiology*, *22*(2), 184–203. https://doi.org/10.1080/02687030701262613

Howard, D., Swinburn, K., & Porter, G. (2010). Putting the CAT out: What the Comprehensive Aphasia Test has to offer. *Aphasiology*, *24*(1), 56–74. https://doi.org/10.1080/02687030802453202

Kaplan, E., Goodlgass, H., & Weintraub, S. (2001). Boston Naming Test. In Encyclopaedia of Clinical Neuropsychology (pp. 430–433). https://doi.org/10.1007/978-0-387-79948-3_869

Kroll, J. F., & Stewart, E. (1994). Category Interference in Translation and Picture Naming: Evidence for Asymmetric Connections between Bilingual Memory Representations. *Journal of Memory and Language*, *33*(2), 149–174. https://doi.org/10.1006/JMLA.1994.1008.

Laxman, J. (2020). *Oral and Written Confrontation Naming in Bilinguals [Unpublished masters dissertation]. Mangalore University*

Lee, M.-W., & Williams, J. N. (2001). Lexical access in spoken word production by bilinguals: evidence from the semantic competitor priming paradigm. *Bilingualism: Language and Cognition*, *4*(3), 233–248. https://doi.org/10.1017/S1366728901000426

Mitchel, A. (2005). Do Bilinguals Access a Shared or Separate Conceptual Store? Creating False Memories in a Mixed-Language Paradigm. *English*.

Obler, L. K., & Albert, M. L. (1981). Language and aging: A neurobehavioral analysis. *Aging, Communication Process and Disorders*, (yes), 107–121.

Race, D. S., Tsapkini, K., Crinion, J., Newhart, M., Davis, C., Gomez, Y., & Faria, A. V. (2013). An area essential for linking word meanings to word forms: Evidence from primary progressive aphasia. *Brain and Language*, *127*(2), 167–176. https://doi.org/10.1016/j.bandl.2013.09.004.

Raju, R., & Nataraja, N.P. (2017). *Cognitive linguistic skills in bilinguals*, [unpublished thesis]. University of Mysore.

Raymer, A. M. (2011). Naming and word-retrieval impairments. *Aphasia and related neurogenic language disorders. 4th ed. New York, NY: Thieme*, 97.

Schwanenflugel, P. J., & Rey, M. (1986). Interlingual semantic facilitation: Evidence for a common representational system in the bilingual lexicon. *Journal of Memory and Language*, *25*(5), 605–618. https://doi.org/10.1016/0749-596X(86)90014-8

Thomas, P. T., Sam, S. A., & Goswami, S. P. (2013). Effect of aging on oral and written confrontation naming in Kannada and English. *Journal of the All-India Institute of Speech & Hearing*, *Vol. 32*, p108-113.

Tsang, H. L., & Lee, T. M. C. (2003). The effect of aging on confrontational naming ability. *Archives of Clinical Neuropsychology*, *18*(1), 81–89. https://doi.org/10.1016/S0887-6177(01)00184.

Venkatesan, S. (2009). Readapted from 1997 Version National Institute of Mental Health. (NIMH) socioeconomic status scale. National Institute for the Mentally Handicapped, Secunderabad.

Weber-Fox, C. M., & Neville, H. J. (1996). Maturational constraints on functional specializations for language processing: ERP and behavioral evidence in bilingual speakers. *Journal of Cognitive Neuroscience*, *8*(3), 231–256.

Wylie, E., & Ingram, D. E. (2006). International second language proficiency ratings (ISLPR): General proficiency version for English. Centre for Applied Linguistics and Language, Mt Gravatt Campus Griffith University.

* * *

# Functional Communication and language mixing in bilingual and trilingual individuals with Broca's aphasia

**Avanthi Paplikar[1,2] and Loraine K. Obler[2]**
[1] Department of Speech and Language Studies
Dr. S. R. Chandrasekhar Institute of Speech and Hearing, Bengaluru
[2] Program in Speech-Language-Hearing Sciences,
City University of New York Graduate Center, New York, New York

## Abstract

**Background & Purpose**: Assessment of areas of continued communication functionally in aphasia helps us to understand how individuals communicate which is known as functional communication. There is growing interest in investigating pragmatic functional communication in monolingual populations with aphasia. Conducting such studies in bilingual/multilinguals individuals with aphasia is limited and is extremely important to understand whether knowledge and use of multiple languages might provide with more options during communication than monolingual speakers have. In the current study we investigated the relationship between language impairment and functional communication and the extent to which language mixing is seen in formal and informal assessments.

**Methods**: Bilingual (n=4) and trilingual (n=4) participants with Broca's aphasia were recruited. The groups were matched for age, education, and aphasia severity. The Western Aphasia Battery (WAB), American Speech-Language-Hearing Association-Functional Assessment of Communication Skills for Adults (ASHA-FACS), and Scale of Language Mixing (SLM) were administered to all participants.

**Results**: A Spearman's correlation coefficient test revealed that as the severity of aphasia (measured via AQ score) increased, the amount of language mixing during functional communication also increased in individuals with aphasia (rho = -0.771, p = 0.025). There was no significant correlation between the scores of WAB and the ASHA-FACS in bilingual and trilingual groups with Broca's aphasia. There were no differences in the amount of language mixing during standardized testing (p = 0.886) and during functional communication (p = 0.343) between the two groups.

**Conclusions**: Our results suggest that individuals with Broca's aphasia with greater severity rely on language mixing as one of the successful functional communication strategies.

**Key words:** functional communication, language mixing, Broca's aphasia, bilingual aphasia, trilingual aphasia

Address correspondence and reprint requests to: Dr. Avanthi Paplikar, Associate Professor, Department of Speech and Language Studies, Dr. S. R. Chandrasekhar Institute of Speech and Hearing, Bengaluru, Ph: +91-8861-865580, Email: avanthi.niranjan@gmail.com

## Introduction

Aphasia is a language impairment acquired due to neurological insult to the areas of the brain responsible for language functions. For more than half a century, neurologists, speech-language pathologists and psychologists have developed different measures of aphasia testing. These include the *Minnesota Test for Differential Diagnosis of Aphasia* (MTDDA; Schuell, 1965), the *Porch Index of Communicative Ability* (PICA; Porch, 1971), the *Western Aphasia Battery* (WAB; Kertesz, 1982), *Boston Diagnostic Aphasia Examination* (BDAE; Goodglass & Kaplan, 1983), and many more. The primary focus of this work is to assess the characteristic aphasic phenomena in terms of deficits—that is, failures in communication of individuals with aphasia - rather than "residuals," or areas of continued functionality, which some have argued must be assessed as well (Sarno, 1965, p. 1).

The assessment of "residuals" or areas of continued communication functionality helps to define "how" individuals communicate rather than "what" they communicate; referred to as *functional communication*. For the purposes of this study, we rely on the ASHA definition of functional communication "the ability to receive or to convey a message, regardless of the mode, to communicate effectively and independently in a given [natural] environment" (ASHA, 1990, p. 2). In our study, we observed communicative interactions across various domains, including conversation with partners, daily planning and other daily-life activities such as communication of basic needs. The natural environments we considered were places such as the home, the grocery store, the park or the place of worship, or any other situation encountered by an individual with aphasia during their daily life.

Despite a long tradition of empirical research on language in aphasia, there is little emphasis on the importance of pragmatic, functional communication behaviors in individuals with aphasia in their daily lives as against communication during the standardized language assessment. In the past two-decades research on functional communication in individuals with aphasia has emerged using a set of tests that include: the *Functional Communication Profile* (FCP, Sarno, 1969), the *Communicative Activities of Daily Living-1* (CADL-1, Holland, 1980), the *Speech Questionnaire* (Lincoln, 1982), the *Communicative Effectiveness Index* (CETI, Lomas et al., 1989), the *Communicative Activities of Daily Living-2* (CADL-2, Holland, Frattali, & Fromm, 1998), and the *American Speech-Language-Hearing Association-Functional Assessment of Communication Skills for Adults* (ASHA-FACS, Frattali, Thompson, Holland, Wohl, & Ferketic, 1995).

To our knowledge, the growing interest in measuring pragmatic functional communication skills in individuals with aphasia and studying the relationship between functional communication and language impairment has been documented only in monolingual speakers of English with aphasia (Aftonomos, Steele, Appelbaum, & Harris, 2001; Bakheit, Carrington, Griffiths, & Searle, 2005; Fridriksson, Nettles, Davis, Leigh, & Montogomery, 2006; Fucetola et al., 2006; Humphrey, 1998; McCullough et al., 2006; Ravnaas, 1997; and Ulatowska et al., 2001). There is a limited understanding of functional communication in bilingual/multilingual individuals with aphasia. Conducting such studies is important to the understanding of this impairment, as functional communication might be better in bilingual/multilingual individuals with aphasia whose knowledge of multiple languages might provide them

with more options during communication than monolingual speakers have.

With respect to functional communication in bilingual/multilingual individuals with aphasia most of the bilingual aphasia studies, in general, have been carried out in English-Spanish, English-Russian, French-German, and Italian-German bilingual individuals. This approach, however, leaves the majority of the world's bilingual communities unstudied. There are many countries, such as Papua New Guinea, Nigeria, Democratic Republic of Congo, and India, where bilingualism/multilingualism is much more prevalent than in most Western and some European countries. We chose to carry out our research in India as it is considered one of the world's most linguistically diverse countries, with more than 180 languages spoken (e.g., Mahapatra, 1990). The last 50 years have seen significant increase in bilingualism/multilingualism in India (Chengappa, 2009). Despite India's linguistic background, very little research on functional communication and language mixing in bilingual and trilingual individuals with aphasia has been conducted there. The present study was conducted in the city of Mysuru, located in the southern part of India where daily use of only one language is uncommon.

One of the options to facilitate functional communication in multilingual speakers with aphasia is through language mixing. Language mixing is an intra- or inter-sentential phenomenon that occurs when, during communication in any one language, a bilingual/multilingual speaker mixes in various units (e.g., morphemes, words, phrases) from a second language (Chengappa, 2009). Language mixing occurs more often in bilingual/multilingual individuals with aphasia compared to neurologically normal bilingual/multilingual individuals (Perecman, 1985; Munoz, Marquardt & Copeland, 1999; Bhat & Chengappa, 2005; Chengappa, Daniel, & Bhat, 2004; Paplikar, 2016). This increased frequency of language mixing in individuals with aphasia might suggest dependence on all known languages for successful communication.

Chengappa et al. (2004) suggest that selective retrieval of a word in the base language of the sentence they are speaking can force the bilingual speaker with aphasia to switch between languages if the word is available in another language. Such mixing behavior would be considered pragmatically inappropriate when it occurs in a context where the interlocutors do not share the language that is mixed in (Ijalba, Obler, & Chengappa, 2004). Thus if a bilingual or a multilingual speaker mixes languages pragmatically appropriately this might enhance functional communication.

Due to lack in information regarding the extent to which language mixing contributes to functional communication in individuals with aphasia who spoke two or more languages, we assessed the frequency of language mixing during functional communication and traditional language testing in bilingual and trilingual individuals with matched severities of aphasia. We expected knowledge of more than one language to enhance functional communication. Therefore in the current study we observed the frequency of language mixing in various conditions in order to compare the amount of language mixing in natural situations (i.e., during functional communication) and in more formal situations (i.e., during standardized language assessment).

Bearing all the above factors in mind, this study focused on choosing bilingual and trilingual individuals with one classic type of aphasia - Broca's aphasia - matching severity and education level across the two groups, in order to determine the relationship between language impairment and functional communication and the extent to which

mixing is seen in formal and informal assessments. The objectives of the study are to investigate i) the relationship between performance on a standardized test of language impairment (WAB) and a measure of functional communication (ASHA FACS) in bilingual and trilingual individuals with Broca's aphasia with matched severity; ii) the differences in the amount of language mixing during standardized language testing and functional communication in bilingual and trilingual individuals with Broca's aphasia with matched severity; and iii) to study the impact of severity of aphasia on the amount of language mixing during functional communication and standardized language testing.

## Method

### *Participants*

Two groups (bilingual and trilingual) of four participants with Broca's aphasia were examined. The participants were recruited from two local institutions in Mysuru, India (JSS Institute of Speech and Hearing and All India Institute of Speech and Hearing). The participants were selected based on the eligibility criteria and their willingness to participate in the study. The eligibility criteria were: (a) aphasia subsequent to a single-unilateral left hemisphere infarct, at least 6 months post-onset; (b) no evidence of additional neurologic disorders (e.g., dementia, Parkinson's disease, etc.); (c) adequate sensory and motor abilities in at least one upper extremity for gesturing and writing; (d) right sided handedness premorbidly; and (e) no known hearing and uncorrected visual difficulties. The Graduate Center, City University of New York ethics committee approved the study and the participants gave consent to take part in the study.

Participants with aphasia in the bilingual group spoke Kannada as their first language and English as their second and the trilingual participants with aphasia spoke Kannada as their first language, English as their second, and Hindi as their third language.

### *Assessment of Bi/trilingualism*

Language proficiency and degree of bi/trilingualism were determined using a 5-point rating scale questionnaire (0: virtually nothing and 4: excellent). Participants were asked to rate themselves on how well they understood, spoke, read, and wrote Kannada and English (for the bilingual group) and Kannada, English, and Hindi (for the trilingual group) premorbidly. If participants were not able to provide the information, caregivers/family members assisted in filling the questionnaire.

For the purposes of this study, bilingual speakers were those individuals with an average proficiency score of 2 or more in Kannada and English and trilingual speakers were those with an average score of 2 or more in Kannada, English and Hindi. The bilingual and trilingual groups were matched for age ($p=0.981$), education ($p=1.000$), and aphasia severity ($p=0.097$). All the participants in this study were classified as moderate in severity on the WAB (AQ range: 43.2 – 56). The demographic details of bilingual and trilingual participants with Broca's aphasia are presented in Table 1.

### *Measures*

A battery of language impairment, functional communication, and language mixing tests and scales were administered to all participants. The Kannada version of WAB (Chengappa & Kumar, 2008), the ASHA-FACS, (Frattali et al., 1995), and a Scale of Language Mixing (SLM; developed by AP) were used (Appendices A and B). The participants gave consent for audio and video recording and the performance of

**Table 1.** **Demographic information of bilingual and trilingual individuals with Broca's aphasia**

| Participant | Age (years) | Sex | Education (years) | Age of L2 Acquisition | Age of L3 Acquisition | MOI | MPO |
|---|---|---|---|---|---|---|---|
| **Bilingual Aphasia Group** | | | | | | | |
| **P1** | 70 | M | 15 | 9.5 | - | K | 120 |
| **P5** | 28 | M | 14 | 5.5 | - | E | 12 |
| **P6** | 51 | M | 16 | 5.5 | - | E | 16 |
| **P7** | 48 | M | 13 | 8 | - | E | 15 |
| **Mean (SD)** | 49.25 (17.19) | | 14.5 (1.29) | 7.13 (1.97) | | | 40.75 (52.86) |
| **Trilingual Aphasia Group** | | | | | | | |
| **P2** | 44 | M | 15 | 15 5 | 21 | K | 16 |
| **P3** | 79 | M | 14 | 14.5 | 21 | K | 87 |
| **P4** | 28 | M | 17 | 4.5 | 4.5 | E | 7 |
| **P8** | 52 | F | 17 | 14.5 | 15 | K | 18 |
| **Mean (SD)** | 50.75 (21.31) | | 15.75 (1.5) | 12.25 (5.19) | 15.38 (7.78) | | 32 (36.98) |

Note: L2: Second language; L3: Third language; MOI: Medium of instruction; MPO: Months post onset; M: Male; F: Female; K: Kannada; E: English; SD: Standard deviation

participants on the WAB recorded using the 2005 MacBook.

The WAB is designed to evaluate various aspects of language, including spontaneous speech (information content and fluency), auditory comprehension, repetition, naming, reading, writing, praxis, and calculation. The aphasia, language, and cortical quotients were derived. The ASHA-FACS was used to assess communication skills in a natural environment. The test assesses 43 behaviors across four domains: social communication; communication of basic needs; reading, writing, and number concepts; and daily planning. The test contains two rating scales (see Appendix A): a 7-point Scale of Communication Independence (SCID) that rates the level of assistance or prompting needed by an individual with aphasia to complete a task, and a 5-point Scale of Qualitative Dimensions of Communication (SQDC) that rates an individual's communication on four dimensions (i.e., adequacy, appropriateness, promptness, and communication sharing). ASHA-FACS was modified according to the context and communication needs in India. One item that was inappropriate in the Indian context was item 43 "follows a map" was changed to "ability to make cardinal direction judgments (North, South, East, and West)." There were other test items where the task was retained, but the performance observed in the test items was changed (e.g., Item 28: Responds in an emergency ["calls 911" was changed to "calls 100", which is the emergency number in India]). The test items that required modifications are listed in Appendix A.

The first author (AP) observed the participants' daily life for a period of 10-12 hours on different domains and dimensions of ASHA-FACS. The observations occurred mostly in the participant's home, while further observations included trips to the temple and meditation centers, walks with the participant in the park, and other typical daily events by two certified trilingual SLPs, either in one day or on two days, depending on the schedule or availability of the participants.

The Scale of Language Mixing (SLM) was used to assess the frequency of language mixing on a 5-point rating scale (0: Never and 4: Always) qualitatively (See Appendix B) during functional communication and standardized language testing. The amount of language mixing during functional communication was rated for 16 items from the ASHA FACS and for spontaneous speech, naming, repetition, reading and writing domains of WAB during standardized language testing. Frequency of language-mixing during functional communication was rated using the SLM questionnaire every half hour in the 10-12 hours of observation by two SLPs, and language-mixing scoring during standardized assessment was done by a single SLP after the WAB assessment was completed.

To establish appropriate inter-rater reliability for ASHA-FACS, the scores of the two SLPs were compared. The criterion set for good inter-rater reliability for the 5-point and the 7-point rating scales was a difference of 2 points or less. The average inter-rater score difference for the 5-point SLM for functional communication was 0.085, for the 5-point SQDC was 0.1 and for the 7-point SCID was 0.25.

### *Statistical Analyses*

To calculate the correlation between language mixing and functional communication in the bilingual and trilingual groups with aphasia, two non-parametric tests (Spearman's correlation test and Mann-Whitney U test) were used. The non-parametric test statistics were used because of non-normal distribution of the data and the small N. A

Spearman's correlation test was used to study the relationship between: (a) the severity of aphasia (tested using AQ score) and the SLM, and (b) scales of ASHA-FACS and WAB. The Mann-Whitney U test was used to compare the amount of language mixing in the two groups.

## Results

The study focused on determining the relationship between language impairment and functional communication and the extent to which mixing is seen in formal and informal assessments in bilingual and trilingual individuals with one classic type of aphasia: Broca's aphasia.

### *Relationship between ASHA-FACS and WAB*

To study the relationship between ASHA-FACS and WAB, four categories of ASHA-FACS (social communication, communication of basic needs, reading/writing/number concepts, and daily planning) and eight subtests (spontaneous speech, auditory verbal comprehension, repetition, naming, reading, writing, apraxia, and construction, visuospatial and calculation) of WAB were employed. The WAB and ASHA-FACS scores of bilingual and trilingual groups with Broca's aphasia is presented in Tables 2 and 3. A Mann-Whitney U test revealed no significant differences in the AQ ($p = 0.343$), LQ ($p = 0.343$), CQ ($p = 0.200$), mean SCID ($p = 0.200$), and mean SQDC ($p = 0.886$) scores between the bilingual and trilingual groups.

A Spearman's rank correlation was conducted to study the relationship between WAB (AQ, LQ and CQ) and ASHA-FACS (SCID and SQDC) scores. There was no significant correlation between the scores of WAB and the ASHA-FACS in bilingual and trilingual groups with aphasia (Table 4).

### *Language mixing during WAB testing and functional communication*

The amount of language-mixing rated using scale of language mixing (SLM) during standardized testing (WAB) and functional communication (ASHA-FACS) is presented in Table 5. A Mann-Whitney U test showed no significant differences in the amount of language mixing during standardized testing ($p = 0.886$) and language mixing during functional communication ($p = 0.343$) between the bilingual and trilingual groups with Broca's aphasia. There was no correlation between language mixing during standardized testing and functional communication in bilingual ($\tilde{n} = -0.500$, $p = 0.500$) and trilingual groups ($\tilde{n} = 0.105$, $p = 0.895$).

### *Relationship between severity of aphasia (AQ Score) and language mixing*

The Spearman's correlation coefficient test revealed that as the severity of aphasia (measured via AQ score) increases, the amount of language mixing during functional communication also increases in bilingual and trilingual individuals with aphasia ($rho = -0.771$, $p = 0.025$). However, the same was not observed during standardized language assessment ($rho = -0.209$, $p = 0.620$) (see Table 6).

## Discussion

The purpose of this study was to determine (a) the relationship between a test of functional communication (ASHA FACS) and a standard test of language assessment (WAB), (b) the amount of language mixing during standardized testing (WAB) and during functional communication (ASHA FACS), and (c) the relationship between severity of aphasia (tested using the AQ score) and language mixing during standardized testing (WAB) and functional communication. The findings are as follows: (a) there was no significant relationship

**Table 2.** **Western aphasia battery (WAB) test scores of bilingual and trilingual individuals with Broca's aphasia**

| | Bilingual Aphasia Group | | | | | | | Trilingual Aphasia Group | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **P1** | **P5** | **P6** | **P7** | **Mean** | **SD** | **Range** | **P2** | **P3** | **P4** | **P8** | **Mean** | **SD** | **Range** |
| **Spontaneous Speech (20)** | 11 | 10 | 10 | 8 | 9.75 | 1.26 | 8-11 | 9 | 10 | 7 | 8 | 8.50 | 1.29 | 7-10 |
| **Auditory Verbal Comprehension (200)** | 118 | 133 | 92 | 127 | 117.50 | 18.08 | 118-133 | 155 | 122 | 148 | 114 | 134.75 | 19.82 | 114-155 |
| **Repetition (100)** | 44 | 27 | 62 | 52 | 46.25 | 14.80 | 27-62 | 58 | 59 | 26 | 41 | 46.00 | 15.68 | 26-59 |
| **Naming (100)** | 73 | 80 | 72 | 63 | 72.00 | 6.98 | 63-80 | 52 | 53 | 46 | 60 | 52.75 | 5.74 | 46-60 |
| **Reading (100)** | 50 | 66 | 68 | 0 | 46.00 | 31.71 | 0-68 | 53 | 60 | 2 | 62 | 44.25 | 28.43 | 2-62 |
| **Writing (100)** | 78 | 36 | 52.5 | 0 | 41.63 | 32.69 | 0-78 | 0 | 0 | 16 | 0 | 4.00 | 8.00 | 0-16 |
| **Apraxia (60)** | 56 | 56 | 58 | 48 | 54.50 | 4.43 | 48-58 | 60 | 50 | 48 | 51 | 52.25 | 5.32 | 48-60 |
| **Construction Visuospatial Calculation (100)** | 16 | 12 | 8 | 10 | 11.50 | 3.42 | 8-16 | 16 | 2 | 8 | 0 | 6.50 | 7.19 | 0-16 |
| **Aphasia Quotient (100)** | 55.2 | 54.7 | 56 | 51.7 | 54.40 | 1.88 | 54.4-56 | 55.5 | 54.6 | 43.2 | 47.6 | 50.23 | 5.87 | 43.2-55.5 |
| **Language Quotient (100)** | 60.1 | 54.4 | 56.7 | 32.2 | 50.85 | 12.65 | 32.2-60.1 | 46.1 | 45.4 | 36.2 | 41.9 | 42.40 | 4.52 | 36.3-46.1 |
| **Cortical Quotient (100)** | 58.3 | 54.73 | 47.6 | 41.9 | 52.32 | 7.59 | 41.2-58.3 | 52.40 | 47.9 | 39.6 | 44.2 | 46.03 | 5.44 | 39.6-52.4 |

**Table 3.** **Mean values on the two rating scales of ASHA-FACS (SCID and SQDC) in bilingual and trilingual individuals with Broca's aphasia**

| | Bilingual Aphasia Group | | | | | | | Trilingual Aphasia Group | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **P1** | **P5** | **P6** | **P7** | **Mean** | **SD** | **Range** | **P2** | **P3** | **P4** | **P8** | **Mean** | **SD** | **Range** |
| **Social Communication (7)** | 2.93 | 3.08 | 3.08 | 2.00 | 2.77 | 0.52 | 2.00-3.08 | 3.98 | 4.88 | 3.83 | 4.48 | 4.29 | 0.48 | 3.83-4.88 |
| **Communication of Basic Needs (7)** | 2.63 | 3.73 | 1.68 | 1.45 | 2.37 | 1.04 | 1.45-3.73 | 4.15 | 3.08 | 4.40 | 4.13 | 3.94 | 0.59 | 3.08-4.4 |
| **Reading, Writing and Numbers (7)** | 3.96 | 5.45 | 4.08 | 0.53 | 3.50 | 2.10 | 0.53-5.45 | 3.61 | 2.70 | 3.25 | 1.88 | 2.86 | 0.76 | 1.88-3.61 |
| **Daily Planning (7)** | 3.53 | 3.85 | 3.23 | 1.83 | 3.11 | 0.89 | 1.83-3.85 | 5.10 | 4.40 | 5.3 | 4.41 | 4.80 | 0.47 | 4.4-5.3 |
| **Mean Scale of Communication Independence (7-point scale)** | 3.26 | 4.03 | 3.01 | 1.45 | 2.94 | 1.08 | 1.45-4.03 | 4.21 | 3.76 | 4.19 | 3.72 | 3.97 | 0.27 | 3.72-4.21 |
| **Adequacy (5)** | 1.63 | 2.58 | 2.13 | 2.08 | 2.10 | 0.39 | 1.63-2.58 | 2.58 | 2.13 | 3.45 | 3.38 | 2.88 | 0.64 | 2.13-3.45 |
| **Appropriateness (5)** | 1.88 | 2.45 | 2.00 | 2.13 | 2.11 | 0.25 | 1.88-2.45 | 2.45 | 2.75 | 3.13 | 3.33 | 2.91 | 0.39 | 2.45-3.33 |
| **Promptness (5)** | 1.13 | 1.85 | 2.33 | 2.83 | 2.03 | 0.72 | 1.13-2.83 | 1.85 | 2.50 | 2.70 | 3.10 | 2.54 | 0.52 | 1.85-3.1 |
| **Communication Sharing (5)** | 2.13 | 2.70 | 1.38 | 2.00 | 2.05 | 0.54 | 1.38-2.70 | 2.70 | 3.10 | 3.25 | 3.38 | 3.11 | 0.29 | 2.7-3.38 |
| **Mean Scale of Qualitative Dimensions of Communication (5-point scale)** | 1.69 | 2.39 | 1.96 | 2.26 | 2.07 | 0.32 | 1.69-2.39 | 2.39 | 2.62 | 3.13 | 3.29 | 2.86 | 0.42 | 2.39-3.29 |

between performance on the ASHA FACS and on the WAB, (b) there was similar amount of language mixing during functional communication and standardized language testing and, (c) there was more language mixing during functional communication in patients with more severe aphasia.

### *Functional communication and language impairment*

The lack of correlation between the test of language impairment and the test of functional communication is consistent with some studies (McCullough et al., 2006 and Ulatowska et al., 2001) but not with others (e.g., Frattali et al., 1995; Fridriksson et al., 2006; Humphrey, 1998; and Ravnaas, 1997). This lack of correlation might be due to small sample size in the current study. The other studies had a sample size of at least 20 participants with aphasia. In addition, the other studies generally included a broader range of aphasia types and severity. As we studied a clear-cut group of patients with Broca's aphasia and no other study did, it is possible that in patients with Broca's aphasia, unlike patients with other types of aphasia, in fact do not show a correlation between functional communication and language impairment.

A more interesting reason for the lack of correlation between functional communication scores and language impairment scores in our study might be the participants' bilingual and trilingual status. It is plausible that the knowledge of more than one language contributes substantially to functional communication in a way that disrupts the correlation between functional and impairment scores in studies of monolingual individuals with aphasia.

### *Language mixing during the WAB testing and during functional communication*

In our study, there was no difference in the amount of language mixing between standardized testing and functional communication. Rossi, Denes & Bastiaanse (2003) reported "strong mutability" (during which there was "pathological mixing") in language mixing in a trilingual individual with fluent aphasia during spontaneous speech and "mild mutability" (during which there was "less mixing") during standardized testing, suggesting differences in language mixing in different contexts.

In the current study, language mixing was scored differently for the two test types. During functional communication, language mixing was rated every half hour in the 12-hour observation by two speech-language pathologists. However, the language mixing score during the WAB testing was a single score per participant by a single speech-language pathologist. This methodological difference might have resulted in no significant differences in the amount of language mixing functional communication and standardized testing. However, in a post-hoc analysis of the narrative and conversational subtests of the WAB, we found more mixing in both WAB picture description and conversation tasks than in other WAB subtests. Consequently, any type of narrative – whether in daily life or WAB testing is more likely to invite mixing than the single-word production tasks of the WAB.

### *Language mixing and severity of aphasia (tested via AQ scores)*

Our finding that patients with more severe aphasia mix more during functional communication than those with less severe impairment is consistent with the findings of researchers who reported that frequency of language mixing is greater in individuals with aphasia than in healthy control individuals (Muñoz et al., 1999; Chengappa, Daniel, & Bhat, 2004; Bhat & Chengappa, 2005; Paplikar, 2016). Literature suggests that language mixing in the bilingual or multilingual speakers with aphasia occurs in response to either lexical retrieval problems (Muñoz et al., 1999; Chengappa et al., 2004; Paplikar, 2016) or impaired inhibitory skills (Abutalebi et al., 2000; Bhat & Chengappa, 2014; Paplikar, 2016). Our study makes this hypothesis more likely as we find distinctions even among patients with aphasia, based on severity. In another study of

**Table 4. Correlation between the WAB (AQ, LQ and CQ scores) and ASHA-FACS (SCID and SQDC scores)**

| Tests | | WAB | | |
|---|---|---|---|---|
| | | AQ Score | LQ Score | CQ Score |
| ASHA-FACS | Mean SCID | rho = 0.381<br>p = 0.352 | rho = 0.095<br>p = 0.823 | rho = 0.238<br>p = 0.570 |
| | Mean SQDC | rho = -0.144<br>p = 0.734 | rho = -0.419<br>p = 0.301 | rho = -0.323<br>p = 0.435 |

Note: WAB: Western aphasia battery; AQ: aphasia quotient; LQ: language quotient; CQ: cortical quotient; ASHA-FACS: American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults; SCID: Scale of Communication Independence; SQDC: Scale of Qualitative Dimensions of Communication

**Table 5. Scores of language mixing during standardized testing (WAB) and functional communication (ASHA-FACS) in bilingual and trilingual participants with Broca's aphasia on a 5-point scale of language mixing (SLM)**

| Bilingual Aphasia Group | | | Trilingual Aphasia Group | | |
|---|---|---|---|---|---|
| Participants | LM during standardized testing | LM during functional communication | Participants | LM during standardized testing | LM during functional communication |
| **P1** | 0.6 | 1.28 | **P2** | 1 | 0.91 |
| **P5** | 0.8 | 1.50 | **P3** | 1 | 1.66 |
| **P6** | 1 | 1.09 | **P4** | 1.2 | 1.81 |
| **P7** | 0.6 | 1.09 | **P8** | 1.4 | 1.81 |
| **Average** | **0.75** | **1.24** | **Average** | **1.15** | **1.54** |

Note: LM: Language mixing

**Table 6. Correlation coefficients between severity of aphasia (aphasia quotient) and language mixing during functional communication and standardized testing**

| | Aphasia Quotient |
|---|---|
| Language mixing during functional communication | rho = - 0.771*<br>p = 0.025 |
| Language mixing during standardized testing | rho = - 0.209<br>p = 0.620 |

*Correlation is significant at 0.05 level (2-tailed)

a multilingual Indian patient (SC) (Sebastian, Dalvi and Obler, 2012), improvement in SC's communicative skills was noted when the SLPs encouraged him to mix languages while speaking. The findings of the present study are consistent with other literature.

There are a few limitations in the study: 1) the sample size of aphasia and control groups are very small, as the study was envisaged as a pilot research project. A larger number of control and aphasia individuals will be recruited to assess the relationship between functional communication and language mixing; 2) the process of language-mixing assessment used during functional communication and standardized testing were different, which might have influenced the results; and 3) a standardized questionnaire for proficiency assessment was not used. Future studies should focus on including higher number of patients and in other types of aphasia.

## Conclusion

The current study investigated functional communication and language mixing in individuals with aphasia which is first of its kind. Exploring the extent to which language mixing contributes towards functional communication in bilingual and trilingual aphasia is extremely important. Our results suggest that bilingual and trilingual individuals with Broca's aphasia with more severity of language impairment use more language mixing as a strategy for successful communication during functional communication but not during standardized testing.

## Acknowledgements

We are grateful to the participants and their family members, to colleagues at the All India Institute of Speech and Hearing and JSS Institute of Speech and Hearing who helped us locate the participants, to JungMoon Hyun for her suggestions for statistical analysis, to Amy Vogel-Eyny for editorial suggestions on the paper, and all our colleagues in the Neurolinguistics Lab at the CUNY Graduate Center.

**Conflict of Interest:** The authors report no conflicts of interest.

**Disclosure Statement:** No disclosures

**Patient consent statement:** All participants agreed voluntarily to participate in the study and signed an informed consent.

## References

Abutalebi, J., Miozzo, M., & Cappa, S. F. (2000). Do subcortical structures control 'language selection' in polyglots? Evidence from pathological language mixing. Neurocase, 6, 51–56.

Aftonomos, L. B., Steele, R. D., Appelbaum, J. S., & Harris, V. M. (2001). Relationships between impairment-level assessments and functional-level assessments in aphasia: Findings from LCC treatment programmes. *Aphasiology, 15 (10/11),* 951-964.

American Speech-Language-Hearing Association. (1990, May). *Functional communication measures project.* Rockville, MD: Author.

Bhat, S., & Chengappa, S. (2005). Code switching in normal and aphasic Kannada English bilinguals. Proceedings of the 4th International Symposium on Bilingualism, 306-316.

Bhat,S., & Chengappa, S. (2013). Language-mixing in bilingual aphasia: an Indian perspective. In H. Winskel., & P. Padakanayya, (Eds.), South and Southeast Asian Psycholinguistics, 372-380, Cambridge University Press.

Bakheit, A. M. O., Carrington. S., Griffiths. S., & Searle. K. (2005). High scores on the Western Aphasia Battery correlate with good functional communication skills (as measured with the communicative effectiveness index) in aphasic stroke patients. *Disability and Rehabilitation. 27 (6):* 287-291.

Chengappa, S., Daniel, K. E., & Bhat, S. (2004). Language mixing and switching in Malayalam-English bilingual aphasics. *Asia Pacific Disability Rehabilitation Journal, 15 (2),* 68-76.

Chengappa, S. K., & Kumar, R. (2008). Normative and clinical data on the Kannada version of Western Aphasia Battery (WAB-K). *Language in India, 8,* June 2008.

Chengappa, S. (2009). Bi/Multilingualism and issues in management of communication disorders with emphasis on Indian perspectives. *Language in India, 9,* August 2009.

Frattali, C. M., Thompson, C. K., Holland, A. L., Wohl, C. B., & Ferketic, M. M. (1995). *American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults.* Rockville, MD: American Speech-Language-Hearing-Association.

Fridriksson, J., Nettles, C., Davis, M., Leigh, M., & Montgomery, A., (2006). Functional communication and executive function in aphasia. *Clinical Linguistics & Phonetics, 20 (6):* 401-410.

Fucetola, R., Connor, L. T., Perry, J., Leo, P., Tucker, F. M., & Corbetta, M. (2006). Aphasia severity, semantics, and depression predict functional communication in acquired aphasia. *Aphasiology, 20 (5),* 449-461.

Goodglass, H., & Kaplan, E. (1983). *Boston Diagnostic Aphasia Examination,* (3rd ed.). Philadelphia: Lea & Febiger. .

Holland, A. L. (1980). *Communicative Abilities of Daily Living.* Austin, TX: Pro-Ed.

Holland, A. L., Frattali, C., & Fromm, D. (1998). *Communicative Activities of Daily Living (CADL-2).* Austin, TX: Pro-Ed.

Humphrey, R. (1998). A comparison of ratings on the ASHA functional assessment of communication skills for adults and scores on the Western Aphasia Battery for individuals with aphasia. *Unpublished dissertation,* Bachelor of Arts, University of Dakota.

Ijalba, E., Obler, L.K., & Chengappa, S. (2004). Bilingual aphasia. In T. Bhatia and Ritchie, Eds. *Handbook of Bilingualism.* MA: Blackwell Publishing.

Kertesz, A. (1982). *The Western Aphasia Battery.* New York: Grune & Stratton.

Lincoln, N. B. (1982). The Speech Questionnaire: An assessment of functional language ability. *International Rehabilitation Medicine, 4,* 114-117.

Lomas, J., Pickard, L., Bester, S., Elbard, H., Finlayson, A., & Zoghabib, C. (1989). The Communicative Effectiveness Index: Development and psychometric evaluation of a functional communication measure for adults. *Journal of Speech and Hearing Disorders, 54,* 113-124.

Mahapatra, A. (1990). A demographic appraisal of multilingualism in India. *Multilingualism in India.* Clevedon, England: Multilingual Matters.

McCullough, K, C., McCullough, G, H., Ruark, J, L & Rainey, J. (2006). Pragmatic performance and functional communication in adults with aphasia. *The Journal of Speech-Language Pathology and Applied Behavior.* 164-178.

Muñoz, M.L., Marquardt, T.P., & Copeland, G. (1999). A comparison of the codeswitching patterns of aphasic and neurologically normal bilingual speakers of English and Spanish. *Brain and Language, 66,* 249-274.

Paplikar, A. (2016). Language-mixing in discourse in bilingual individuals with Broca's aphasia (Doctoral Dissertation). City University of New York, Graduate Center, New York.

Perecman, E. (1984). Spontaneous translation and language mixing in a polyglot aphasic. *Brain and Language, 2,* 43-63.

Porch, B. (1971). *Porch Index of Communicative Ability.* Palo Alto, CA: Consulting Psychologists Press.

Ravnaas, S. R. (1997). A comparison of scores for adults with aphasia on the western aphasia battery and ratings on the functional assessment of communication skills for adults. *Unpublished dissertation,* Bachelor of Arts, University of Dakota.

Rossi, E., Denes, G., & Bastiaanse, R. (2003). A single case study of pathological mixing in a polyglot aphasic. *Brain and Language, 87,* 46-47.

Sarno Taylor, M (1965). A measurement of functional communication in aphasia. *Archives of Physical Medicine and Rehabilitation, 46,* 101-107.

Sarno, M. T. (1969). *Functional Communication Profile.* New York: Institute of Rehabilitation Medicine, New York University Medical Center.

Schuell, H. (1965). *Minnesota Test for Differential Diagnosis of Aphasia*. Minneapolis: University of Minnesota Press.

Sebastian, D., Dalvi., & Obler, L. K. (2012). Language deficits, recovery patterns and effective intervention in a multilingual 16 years post-TBI. In M. Gitterman, M. Goral, and L. K. Obler (Eds.), *Aspects of Multilingual Aphasia*. Bristol, UK: Multilingual Matters.

Ulatowska, H. K., Olness, G. S., Wertz, R. T., Thompson, J. L., Keebler, M. W., Hill, C. L., & Auther, L. L. (2001). Comparison of language impairment, functional communication, and discourse measures in African-American aphasic and normal adults. *Aphasiology, 15 (10/11),* 1007-1016.

* * *

# APPENDIX – A

## ASHA FACS, adapted from Frattali et al. 1995 (modified items are indicated by an asterisk preceding them)

| Sl. No. | Domains |
|---|---|
| **A.** | **Social Communication** |
| 1. | Refers to familiar people by name (e.g., family, friends, colleagues) |
| 2. | Requests information of others (e.g., "What's on TV?" "Where do you live?" |
| 3. | Explain how to do something (e.g., how to make a cup of coffee, set an alarm) |
| 4. | Expresses agreement/disagreement (e.g., nods yes, says "not really" |
| 5. | Exchanges information on the phone (e.g., answers questions, provides information) |
| 6. | Participates in a group conversation (e.g., with family at the dinner table) |
| 7. | Answers yes/no questions (e.g., "Are you cold?") |
| 8. | Follows simple verbal directions (e.g., "Get the mail") |
| 9. | Understands intent (e.g., "It's getting late", implying that it's time to go) |
| 10. | Smiles or laughs at lighthearted comments (e.g., "I'm not getting older, I'm getting better") |
| 11. | *Understands non-literal meaning and inference (culturally appropriate idiom) |
| 12. | Understands conversations when they occur in noisy or distracting situations (e.g., crowded cafeteria) |
| 13. | Understands what's heard on TV and radio (e.g., news headlines, sports, commercials) |
| 14. | Understands facial expressions (e.g., clenched teeth, smile) |
| 15. | Understands tone of voice (e.g., emphatic tone) |
| 16. | Initiates communication with other people |
| 17. | Adds new information on a topic in a conversation |
| 18. | Changes topics in conversation |
| 19. | Adjusts to a change in topic by conversational partner |
| 20. | Recognizes his/her own communication errors (e.g., shows awareness that he/she used the wrong word) |
| 21. | Corrects his/her own communication errors (e.g., corrects naming errors) |
| **B.** | **Communication of Basic Needs** |
| 22. | Recognizes familiar faces |
| 23. | Recognizes familiar voices |
| 24. | Makes strong likes or dislikes known (e.g., people, places, foods) |
| 25. | Expresses feelings (e.g., happy, sad) |
| 26. | Requests help when necessary (e.g., gestures that wheelchair is stuck) |
| 27. | Makes needs or wants known (e.g., to eat, to rest) |
| 28. | *Responds in an emergency (e.g., calls 100) |

| | |
|---|---|
| **C.** | **Reading, Writing, Number Concepts** |
| 29. | Understands simple signs (e.g., poison symbol, stop sign) |
| 30. | *Uses common reference materials (e.g., telephone book, south Indian holy book 'panchanga') |
| 31. | *Follows written directions (e.g., prescriptions) |
| 32. | Understands basic printed material (e.g., menus, headlines) |
| 33. | Prints/writes/types names |
| 34. | *Fills out short forms (e.g., filling out a form) |
| 35. | Writes messages (e.g., "Call your mother") |
| 36. | Understands signs with numbers (e.g., price tags, speed limit signs) |
| 37. | Makes basic money transactions (e.g., pays for items at grocery store, recognizes when given wrong change) |
| 38. | Understands simple unit of measurement (e.g., weights, distances, quantities in recipes) |
| **D.** | **Daily Planning** |
| 39. | Knows what time it is (i.e., tells time) |
| 40. | Dials telephone numbers (i.e., sequences numbers correctly) |
| 41. | *Keeps scheduled appointments (e.g., reminds spouse/caregiver about the appointment at doctor's office) |
| 42. | Uses a calendar for time-related activities (e.g., scheduling, planning) |
| 43. | * Ability to make cardinal direction judgments (North, South, East, and West) |

**Rating Key for Scale of Communication Independence**

**7 Does –** The client performs the communication behavior, needing no assistance and/or prompting.

**6 Does with Minimal Assistance** – The client performs the communication behavior, rarely needing assistance and/or prompting

**5 Does with Minimal to Moderate Assistance** – The client perform the communication behavior, occasionally needing assistance and/or prompting.

**4 Does with Moderate Assistance** – The client performs the communication behavior, often needing assistance and/or prompting.

**3 Does with Moderate to Maximal Assistance** – The client performs the communication behavior, very frequently needing assistance and/or prompting.

**2 Does with Maximal Assistance** – The client performs the communication behavior only with constant assistance and/or prompting.

**1 Does Not** – The client does not perform the communication behavior even with maximal assistance and/or prompting.

**N No Basis for Rating** – Circumstances in which a behavior cannot be observed nor is information available from other sources.

**Rating Key for Scale of Qualitative Dimensions of Communication**

**Adequacy** *(understands gist of message and gets point across)*

**5** Client always understands gist of message and always gets point across

**4** Client often understands gist of message and often gets point across

**3** Client understands gist of message and gets point across about half of the time

**2** Client seldom understands gist of message and seldom gets point across

**1** Client never understands gist of message and never gets point across

**Appropriateness** *(relevant and done under the right circumstances)*

**5** Communication is always relevant and is always done under the right circumstances

**4** Communication is often relevant and is often done under the right circumstances

**3** Communication is relevant and done under the right circumstances about half of the time

**2** Communication is seldom relevant and is seldom done under the right circumstances

**1** Communication is never relevant and is never done under the right circumstances

**Promptness** *(responds without delay and in an efficient manner)*

**5** Communication is always without delay and always efficient

**4** Communication is often without delay and often efficient

**3** Communication is without delay and efficient about half of the time

**2** Communication is seldom without delay and seldom efficient

**1** Communication is never without delay and never efficient

**Communication Sharing** *(burden on the communication partner)*

**5** Client and partner share equally in communication

**4** Partner carries little more than half of the communication burden

**3** Partner carries well over half of the communication burden

**2** Partner carries almost all of the communication burden

**1** Partner carries all of the communication burden

# APPENDIX – B

**Scale of Language Mixing** (The 16 items of the SLM were selected from the ASHA FACS that included some language production-either spoken or written-from the participants)

## Expression

| Sl. No. | Domains | Language Mixing |
|---|---|---|
| **A.** | **Social Communication** | |
| 1. | Requests information of others (e.g., "What's on TV?" "Where do you live?" | |
| 2. | Explain how to do something (e.g., how to make a cup of coffee, set an alarm) | |
| 3. | Expresses agreement/disagreement (e.g., nods yes, says "not really" | |
| 4. | Exchanges information on the phone (e.g., answers questions, provides information) | |
| 5. | Participates in a group conversation (e.g., with family at the dinner table) | |
| 6. | Answers yes/no questions (e.g., "Are you cold?") | |
| 7. | Initiates communication with other people | |
| 8. | Adds new information on a topic in a conversation | |
| 9. | Changes topics in conversation | |
| 10. | Corrects his/her own communication errors (e.g., corrects naming errors) | |
| **B.** | **Communication of Basic Needs** | |
| 11. | Expresses feelings (e.g., happy, sad) | |
| 12. | Requests help when necessary (e.g., gestures that wheelchair is stuck) | |
| 13. | Makes needs or wants known (e.g., to eat, to rest) | |
| **C.** | **Reading, Writing, Number Concepts** | |
| 15. | Writes messages (e.g., "Call your mother") | |
| **D.** | **Daily Planning** | |
| 16. | Knows what time it is (i.e., tells time) | |

**5 - Point Rating Scale**

0 - Never

1 - Rarely

2 - Sometimes

3 - Often

4 - Always

# Dissociation in priming for linguistic and non-linguistic stimulus: An investigation in persons with anomic aphasia

**Abhishek Budiguppe Panchakshari**[1,2]
[1] Nitte Institute of Speech and Hearing, Mangalore
[2] Centre of Speech Language Science, All India Institute of Speech and Hearing, Mysuru

## Abstract

**Background & Purpose**: Research in aphasia has taken a new dimension with the advent of real time processing studies. Priming is one such outcome of real time processing studies. The effect of priming was studied under two conditions i.e., linguistic and non-linguistic conditions in order to basically verify if there was any significant difference in the magnitude of priming between the two conditions in persons with Anomic Aphasia.

**Methods**: Six participants with anomic aphasia ranging between 45-65 years were considered for the study. Lexical decision task (LDT) and color priming task was administered on the participants. Performance on LDT was determined by extracting the difference in the reaction times for semantically related and unrelated stimulus, whereas the performance on color priming task was determined by computing the difference in reaction times for congruent and in-congruent trials.

**Results:** Wilcoxon's signed rank test showed that the difference in the reaction times of semantically related and unrelated conditions on the lexical decision was not significant statistically, while the difference in the reaction times for congruent and in-congruent conditions on color priming task was significant.

**Conclusions:** The results also suggested that the non -linguistic priming effect was robust compared to linguistic priming.

**Key Words:** Congruent, incongruent, reaction time, speed of processing, anomic aphasia, priming

Address correspondence and reprint requests to: Dr. Abhishek Budiguppe Panchakshari, Assistant Professor, All India Institute of Speech and Hearing, Mysuru, Email: abhiraajaradhya@gmail.com

## Introduction

Aphasia is an acquired language disorder caused by damage to the brain areas responsible for carrying out the corresponding linguistic functions. There are numerous classification systems proposed till date. Dichotomously aphasia can be classified as non-fluent aphasia and fluent aphasia. Persons with non-fluent aphasia exhibit difficulty in communicating orally. While persons with fluent aphasia manifest problems over understanding spoken and written language. Anomic Aphasia is a variant of fluent aphasia characterized with word

finding difficulties. It is also regarded as a mild variant of aphasia.

Language processing in persons with aphasia is explored by employing cognitive linguistic methods such as priming. The priming principle has been constantly employed to study the activation dynamics in persons with aphasia Priming is described as an implicit phenomenon. In priming, exposure to one stimulus facilitates the response to another stimulus. Semantic priming is variant under priming where the prime and target are presented in two conditions: semantically related and semantically unrelated. In semantically related condition, the prime either belongs to the same lexical category as the target or shares some overlapping features with the target. The prime shares no semantic relationship with the target in the semantically unrelated condition.

The priming task is often employed as a measure to understand linguistic processing in healthy individuals as well as persons with aphasia (Blumstein & Milberg, 2000; Marslen-Wilson & Tyler, 1997; Zurif, Swinney, Prather, Solomon, & Bushell, 1993). The priming can be used to tap the mechanism of lexical retrieval. Pertaining to the mechanisms of lexical retrieval, two mechanisms of lexical retrieval have been identified: facilitation and inhibition. Facilitation is when the prime facilitates the activation of the target and the term inhibition is used when the prime impedes the lexical activation of the target word. The presence of priming effect would suggest that linguistic system is intact, at least at some level (Knowlton, Ramus, & Square, 1992).

Anomia in persons with anomic aphasia can be attributed to defective lexical access (Butterworth, 1992; Lambon Ralph, Sage, & Roberts, 2000; McNeil, Odell, & Tseng, 1991; Tseng, McNeil, & Milenkovic, 1993). This claim is based on the two stepped activation model of lexical access (Dell, 1986). The model suggests the processing of linguistic information takes place in the form of nodes, or units of information. Each node is assumed to have a resting level of activation that varies due to a variety of factors. Fluent language processing is the result of activation spreading between these nodes, allowing accurate selection of the appropriate units of information at the appropriate time. In anomia the amount of spreading activation is assumed to vary or the connection between the nodes is assumed to be distorted (Silkes, 2009). Thus, the priming task can reflect the linguistic processing at the level of lexical access (Ferrand, Humphreys, & Segui, 1998).

Priming is a constantly explored domain in both neurologically healthy individuals and persons with aphasia. Many studies based on priming phenomenon in persons with aphasia are linguistic in nature and the absence of priming effect would be attributed to linguistic deficits seen in persons with aphasia. Thus, the present study aims to study the priming effect under two conditions i.e. linguistic and non-linguistic conditions, in order to basically verify if there is any significant difference in the magnitude of priming between the two conditions. It would enable the understanding of the mechanisms behind linguistic and non-linguistic priming and also determine the role of sensory motor system and attention processes on the performance of these two tasks.

## Method

Total of six male participants were considered for the study. The age of the participants ranged between 45-65 years. The six participants confronted cerebro-vascular accident and were diagnosed by a neurologist. The average post stroke duration was about 6 months and all the participants had received speech and language therapy for a minimum duration of 2 months (Table 1).

**Table 1. Details of the participants**

| Sl No | Age | Gender | Cause | Post stroke Duration |
|---|---|---|---|---|
| 1 | 47 | Male | CVA | 2 months |
| 2 | 53 | Male | CVA | 2 months |
| 3 | 58 | Male | CVA | 5 months |
| 4 | 62 | Male | CVA | 6 months |
| 5 | 63 | Male | CVA | 11 months |
| 6 | 65 | Male | CVA | 5 months |

Western Aphasia Battery carried out at the time of conduct of the present study revealed the participants to have anomic aphasia. Persons with anomic aphasia did not have any motor deficits thus the reaction time was considered. The participants were considered after obtained informed consent. Informed consent was also obtained from the caregivers in addition. Ethical consent was obtained from the institutional ethical committee where the current study was conducted. The study was carried out in a hospital-institution setup in Dakshina Karnataka district of Karnataka. Kannada was the native language of all the participants

In order to test the magnitude of priming in linguistic condition, the primed lexical decision task was employed. The stimulus for the lexical decision task was derived from a priming study. The stimulus comprised of 150 prime-target word pairs. Out of the 150-word pairs, 50 word pairs had semantically related primes, while 50 word pairs had semantically unrelated prime-target words and 50 word pairs had non-words as target words preceded by real words as primes. The word pairs were randomized and presented on DMDX software version 5.0.5. The presentation of the prime and target is schematically represented in Figure 1.

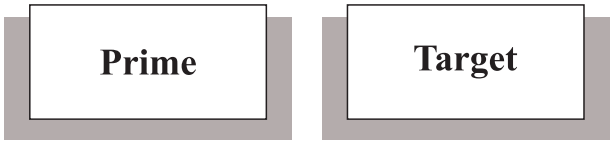


Figure 1: Illustration of prime and target stimuli

The participants had to decide if the target word was a true word (word which has meaning) or not by pressing button "1" on keyboard for a word and button "0" for a non-word. The participants were given a maximum duration of 4000 milliseconds to respond. The mean reaction time for semantically related and semantically unrelated prime-target trials was separated and used for analysis.

In order to test magnitude of priming in non-linguistic condition, color priming task was used. Before administration of this task, it was ensured that the participants knew the colors used for the test. A total of 100 color-priming trials were used. Primes were either circular "red', or "green dots", while the targets were either "red" or "green" annular rings. The prime and target stimuli were presented in 2 conditions (congruent and in-congruent). In the congruent condition, the prime and target were of the same color (green-green or red-red). In the in-congruent condition, the prime and target were different (green-red or red-green). The participant had to press button "1" if he perceived the target as "green" and press "0" if he perceived the target as "red". The mean reaction time for congruent and incongruent conditions was extracted separately.

## Results and Discussion

The mean reaction time for persons with anomic aphasia on semantically related stimuli was

**Table 2: Reaction time for the participants on linguistic task**

| | Semantically related prime-target pairs | Semantically unrelated prime-target pairs |
|---|---|---|
| Participant 1 | 1884.22 ms | 2008.27 ms |
| Participant 2 | 1902.28 ms | 1953.33 ms |
| Participant 3 | 1734.52 ms | 1873.56 ms |
| Participant 4 | 1722.34 ms | 1992.34 ms |
| Participant 5 | 1826.44 ms | 1944.36 ms |
| Participant 6 | 1903.55 ms | 2032.28 ms |

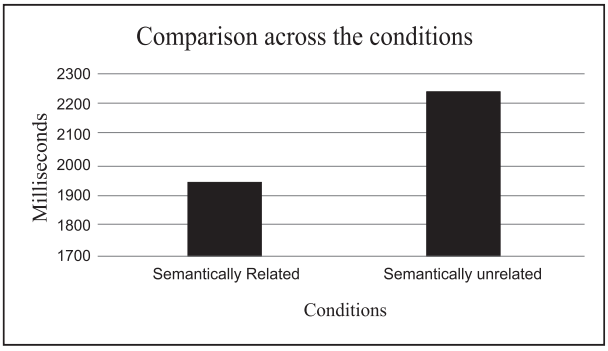


Figure 2: Mean reaction time for semantically related and unrelated conditions.

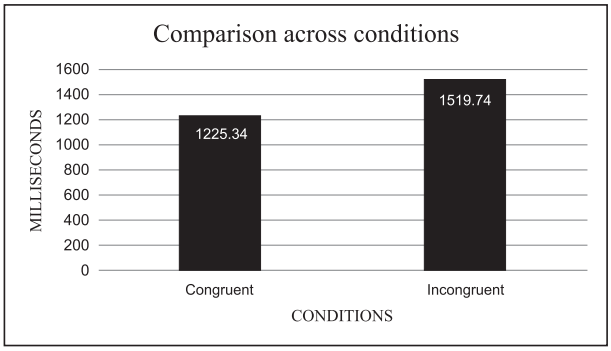


Figure 3: Mean reaction time for congruent and incongruent trials

1942.6 and for semantically unrelated stimuli, the mean reaction time was 2241.68 milliseconds (see figure 1). The mean reaction time was more for semantically unrelated compared to semantically related condition. This means that the reaction time was better for semantically related condition (In priming based studies it is assumed that lesser the reaction time is, better the performance) as an attribute to priming effect. The reaction time for the participants is shown in Table 2.

In order to verify if the difference between these two prime-target conditions was statistically significant, Wilcoxon's signed rank test was used, the |Z| score obtained on comparison was 2.8 ($p>0.05$) showed that there was no significant difference between semantically related and unrelated conditions.

In the same lines, the mean reaction time for persons with anomic aphasia on congruent and incongruent conditions of color priming was analyzed. The mean reaction time for congruent and incongruent conditions was 1226.34 and 1519.74 milliseconds respectively (see figure 2). The mean reaction time was better for congruent trials compared to incongruent trials, this can be attributed to the effect of priming. The mean reaction time for the participants is specified in Table 3.

Further Wilcoxon's signed rank test was used to verify if the difference between the two conditions was significant. The |Z| score obtained on comparison was 4.14 ($p<0.05$) depicting the difference in reaction times of congruent and incongruent conditions to be significant.

**Table 3. Reaction time for the participants on non-linguistic task**

| | related prime-target pairs | Unrelated prime-target pairs |
|---|---|---|
| Participant 1 | 1227.44 ms | 1433.51ms |
| Participant 2 | 1255.34 ms | 1366.34 ms |
| Participant 3 | 1309.24 ms | 1533.22 ms |
| Participant 4 | 1256.30 ms | 1307.22 ms |
| Participant 5 | 1322.53 ms | 1622.22 ms |
| Participant 6 | 1156.00 ms | 1403.28 ms |

The current study was carried out with the aim of assessing the magnitude of priming for linguistic and non-linguistic conditions as stated in the above-mentioned paragraphs. Anomic aphasia is a mild form of aphasia, though it is generally believed from the traditional classifications that the persons with anomic aphasia will possess word finding difficulties alone, absence of robust priming effect on linguistic conditions may be attributed to subtle disturbance in the organization of semantic fields. It is theoretically believed that the persons with aphasia in general would exhibit cognitive linguistic deficit. The quantum of this cognitive-linguistic deficit would be mild in persons with anomic aphasia in particular. Hence the research question tested the claim if only linguistic processing is affected in persons with anomic aphasia or is the general cognitive linguistic processing.

For the linguistic task, semantically related and unrelated stimulus was used. The priming effect was determined by comparing the reaction time for related and unrelated stimulus. The non-linguistic task on the other hand was based on color priming. The prime and target were presented under two conditions: congruent and non-congruent. The prime and target were the same for congruent while the prime and target were different for the non-congruent condition. The reaction time for congruent and non-congruent conditions were compared to determine the magnitude of priming for the non-linguistic task.

It was seen from the results that the difference in the reaction times of semantically related and unrelated conditions on the lexical decision was not significant statistically, while the difference in the reaction times for congruent and in-congruent conditions on color priming task was significant, indicating that the non-linguistic priming was more robust compared to linguistic priming in persons with anomic aphasia.

There is a dearth of studies regarding the same as far as studies in the past are concerned. However, the lexical retrieval deficits in persons with anomic aphasia is evident and has been explored in the past (Butterworth, 1992; Lambon Ralph, Sage, & Roberts, 2000; McNeil, Odell, & Tseng, 1991; Tseng, McNeil, & Milenkovic, 1993). The current study also was in consonance with the findings of these studies. The other dimension unveiled through the current study is that the general cognitive linguistic processing may be preserved in persons with anomic aphasia owing to which the priming on non-linguistic task would have been evident. The limitation of the current study is that the study had a very limited sample size. The study can be extended by considering the other variants of aphasia.

## Summary and Conclusions

The study was carried out with the aim of understanding the linguistic and non-linguistic priming mechanisms in persons with anomic aphasia. Linguistic priming was studied by employing lexical decision task and non-linguistic priming was studied through color priming task. It was observed that the non-linguistic priming effect was robust compared to linguistic priming implying that the deficits seen in persons with anomic aphasia was only linguistic in nature and the attention processes and sensory motor process related to non-linguistic mechanisms is intact in anomic aphasia likely.

**Conflict of interest:** The authors report no conflicts of interest.

**Disclosure statement:** No disclosures

**Patient consent statement:** All participants agreed voluntarily to participate in the study and signed an informed consent.

## References

Butterworth, B. (1992). Disorders of phonological encoding. Cognition, 42, 261 – 28.

Dell, G. S (1986) A spreading-activation theory of retrieval in sentence production, *Psychological Review*, *93*(3), 283–321. https://doi.org/10.1037/0033-295X.93.3.283

Ferrand, L., Humphreys, G. W., & Segui, J. (1998) Masked repetition and phonological priming in picture naming, Perception and Psychophysics, *Attention Perception & Psychophysics* 60(2):263-274DOI:10.3758/BF03206035

Knowlton, B. J., Ramus, S. J., & Squire, L. R. (1992). Intact artificial grammar learning in amnesia: Dissociation of classification learning and explicit memory for specific instances. *Psychological science*, *3*(3), 172-179.

Lambon Ralph, M. A., Sage, K., & Roberts, J. (2000). Classical anomia: A neuropsycho logical perspective on speech production. *Neuropsychologia*, 38, 186–202. doi:10.1016/S0028-3932 (99)00056-1.

Marslen-Wilson, W. D., & Tyler, L. K. (1997). Dissociating types of mental computation. *Nature*, *387*(6633), 592-594.

McNeil, M. R., Odell, K., & Tseng, C. H. (1991). Toward the integration of resource allocation into a general theory of aphasia. *Clinical Aphasiology*, 20, 21–39.

Milberg, W., & Blumstein, S. E. (1981). Lexical decision and aphasia: Evidence for semantic processing. *Brain and language*, *14*(2), 371-385.

Silkes, J. P., Parameters of implicit priming in aphasia (2009) Unpublished doctoral dissertation, University of Washington, Seattle,

Tseng, C. H., McNeil, M. R., & Milenkovic, P. (1993) An investigation of attention allocation deficits in aphasia. *Brain and Language*, 45, 276–296.

Zurif, E., Swinney, D., Prather, P., Solomon, J., & Bushell, C. (1993). An on-line analysis of syntactic processing in Broca2 s and Wernicke2 s aphasia. *Brain and language*, *45*(3), 448-464.

* * *

# Comparison of temporal parameters between noise adapted speech, clear speech and conversational speech: An exploratory study in Kannada speaking adults

**Suresh Suman[1] and SV Narasimhan[1]**
[1]Department of Speech & Language Pathology, JSS Institute of Speech & Hearing, Mysuru, India

## Abstract

**Purpose:** Differences in temporal characteristics between clear, noise adapted and conversational speech has been documented by the past studies especially among the English language speakers. The present study investigated some temporal parameters of noise-adapted speech and clear speech in Kannada speaking young adults. The objectives were to examine the temporal (rate of speech, pause rate, and pause duration) differences between clear speech, noise-adapted speech and conversational speech and gender-linked differences.

**Method:** Sixty adult participants (30 males and 30 females) between 25 and 30 years read a standard Kannada passage under three conditions. Condition 1 was conversational speech, condition 2 was clear speech, and condition 3 was noise-adapted speech. Various temporal parameters were extracted from the reading passage in all three conditions. The mean, standard deviation, median, and range were calculated for the temporal parameters in all three conditions, i.e., conversational speech, noise adapted speech, and clear speech conditions.

**Results:** The results showed a decrease in speech rate, increase in pause duration, and rate of pauses during clear speech and noise-adapted speech compared to conversational speech in both male and female participants. The results of the present study also revealed no gender differences in the rate of speech, pause duration and rate of pause.

**Conclusions:** It was inferred that the talkers could successfully modify the speech output from hypo-articulated (clear speech) to hyper-articulated (Noise adapted speech) in response to various communication challenges and conditions.

**Keywords:** Rate of speech, pause duration, rate of pause

Address correspondence and reprint requests to: SV Narasimhan, Associate Professor, Department of Speech & Language Pathology, JSS Institute of Speech & Hearing, Mysuru, India
Email: narasimhanslp@gmail.com; Tel. +91 99007 89918

## Introduction

Usually, people speak casually, without paying much attention to their pronunciation during everyday conversational speech. However, under certain conditions, people opt to talk with more care to make the speech clearer. An important situation in which this can be seen is when people cannot hear clearly when talking in a noisy subway or speaking to someone with a hearing loss. Another condition in which people try to talk more clearly is when

speaking to someone with low linguistic competence, such as when speaking to foreigners or young children (Chen, 1980). When attempting to speak clearly, or during clear speech conditions, people employ various techniques to make themselves more intelligible such as speaking loudly, speaking more slowly, changing other speech characteristics, or combining these techniques (Chen, 1980).

Clear speech is the style of speech where the speakers voluntarily alter their habitual or conversational speech to make the speech more intelligible for the listener (Smiljaniæ & Bradlow, 2007). Slowed speaking rate is probably the most widely reported characteristic of clear speech (Bradlow et al., 2003; Krause & Braida, 2004; Smiljaniæ & Bradlow, 2008). Earlier studies have revealed that a slower rate of articulation, increased duration of segments and increased frequency of pauses characterise clear speech (Krause & Braida, 2004; Mattys et al., 2012; Uchanski et al., 2002).

Noise-adapted speech refers to the style of speech where the speakers alter their habitual or conversational speech in the presence of background noise. Compared to conversational speech in a quiet environment, the noise-adapted speech also typically shows a longer vowel duration, an increase in intensity, a decrease in the rate of speech, a higher fundamental frequency, a higher peak fundamental frequency, and amplified high-frequency energy (Cooke & Lu, 2010; Van Summers et al., 1988; Vlaj & Kacic, 2011). Past studies have showed that both clear speech and noise-adapted speech differ from the conversational speech in terms of the acoustic parameters of speech (Smiljaniæ& Gilbert, 2017a, 2017b).

The most extensively studied temporal characteristic in speech perception is the speaking rate determined by words and pause durations. The typical speaking rate for clear speech (100 words per minute) is roughly half of conversational speech (Picheny et al., 1986). Both the number and duration of pauses dramatically increase in clear speech. Speakers automatically raise their voices (increasing their vocal effort) to overcome the increasing interference noise that induces a masking effect upon speech (Junqua, 1993). This phenomenon where the talkers try to improve their intelligibility of speech by increasing their vocal intensity in the presence of loud background noise is referred to as the Lombard effect (Bond et al., 1989; Dreher & O'Neill, 1958; Junqua & Anglade, 1990; Lombard, 1911; Van Summers et al., 1988).

Earlier studies have investigated the Lombard effect on the acoustic characteristics of speech. An increase in voice level, fundamental frequency, vowel duration, and a shift in formant centre frequencies were the main characteristic changes during Lombard speech (Junqua, 1996; Junqua & Anglade, 1990), with a decrease in the rate of speech (Hanley & Steer, 1949). The Lombard effect increases the duration of vowels while reducing the duration of unvoiced stops and fricatives. Studies have revealed that the background noise and the speaker's language influence the quality of Lombard speech (Junqua, 1996).

Perceptually, it is well established that noise-adapted and clear speech improves speech intelligibility (Cooke et al., 2013; Pichora-Fuller et al., 2010; Smiljaniæ, 2011). Although noise-adapted speech and clear speech share various acoustic-articulatory features, there are few differences between both (Cooke et al., 2013; Gilbert et al., 2014; Godoy et al., 2014). For illustration, the reliability distinctiveness between the vowel and consonant contrast is high in clear speech (Ferguson & Kewley-Port, 2002; Lu & Cooke, 2008; Maniwa et al., 2008; Smiljaniæ & Bradlow, 2005), whereas increased spectral energy in the range of formants is commonly found in the noise adapted speech

(Krause & Braida, 2004; Lu & Cooke, 2009; Van Summers et al., 1988). Past studies have also found a significantly slower rate of speech and broader fundamental frequency range in clear speech than in conversational speech but a limited fundamental frequency range in noise-adapted speech than in quiet speech (Gilbert et al., 2014).

Hence, the review of relevant literature shows that noise-adapted speech and clear speech share many acoustic–articulatory characteristics, and a few differences between the two adaptations have also been established. An increase in the distinctiveness of phonological vowel and consonant contrasts has been reported in both clear speech and noise-adapted speech (Cooke & Lu, 2010). However, these contrasts have been observed to be better in clear speech compared to noise-adapted speech. Thus, the analysis of clear speech and noise-adapted speech helps in understanding auditory and articulatory changes as a response to the noise or to increase their intelligibility by speaking clearly. On the other hand, most studies that have documented the acoustic characteristics of clear and noise-adapted speech have focused on western languages. A speaker's language can influence the changes in the characteristics of Lombard speech (Junqua, 1996) and clear speech. Only a handful of studies have attempted to document the effect of clear speech and noise-adapted speech in native speakers of Kannada language. The present study aimed at investigating the influence of clear speech and noise adapted speech and the effect of gender on few temporal parameters of speech in native Kannada speakers.

## Method

### Participants

Two groups of participants within the age range of 25 to 30 years were included in the present study. Group 1 included 30 female participants, and group 2 constituted 30 male participants. The number of participants was decided based on the statistical power analyses using G-Power (version 3) using the mean and standard deviation values reported by an earlier study on the acoustic analysis of clear speech (Shalini & Nataraja, 2013). All participants had a minimum qualification of PUC/12$^{th}$ grade. None of the participants had any oral structural/ motor impairments affecting speech. Hearing evaluation was carried out for all the participant and all the participants having normal hearing sensitivity were included in the present study. All the participants had normal voice with no history of vocal pathology. All the participants were native speakers of Kannada. Convenient sampling was used to recruit the participants for the study. Each participant was explained about the study, and informed consent was obtained from each participant. The institutional ethical committee approved the study (JSSISH/253 (a) 2022-23/14/06).

### Procedure

For the noise-adapted speech, multi-talker babble was generated. The voice recordings of seven speakers in the age range of 20-25 years were recorded using Sony IC digital Recorder (ICD-P320) voice recorder. The participants read various standardised Kannada passages, and all the recordings were superimposed to generate a speech babble using Adobe Audition software. The generated multi-talker babble was used as noise for recording speech samples in the noise-adapted speech condition.

Standard Kannada passage (a: u mat*u to:7a) was used to collect the data from the participants. Data collection was carried out in three conditions. Condition 1 was the conversational speech, where each participant was instructed to read the standard Kannada passage in their comfortable pitch,

loudness, and speaking rate. Condition 2 was noise-adapted speech, multi-talker babble noise of intensity 80 dBSPL (Smiljaniæ & Gilbert, 2017b) was presented to each participant through the headphones, and the participant was asked to read the standard Kannada passage under noise. Condition 3 was clear speech, where each participant was instructed to read the standard passage as if they were talking to someone who did not know the participant's native language (Smiljaniæ & Gilbert, 2017b) or as if talking to a hearing impaired listener (Shalini & Nataraja, 2013). All the speech samples were recorded with the headphones on in all the conditions to maintain uniformity in the recordings. The voice recorder was placed at a distance of 10 cm from the mouth. The speech recordings in all three conditions were analysed, and the temporal parameters of speech, namely the pause rate, pause duration rate and rate of speech rate were extracted using the similar protocol used by the earlier studies (Smiljaniæ & Bradlow, 2005; Smiljaniæ & Gilbert, 2017b).

## Statistical analysis

Mean, median, standard deviation and range were calculated for all the parameters across the participants of both groups. The normality of the data was checked using the Shapiro-Wilk test of normality. As the data were non-normally distributed, Friedman's test was carried out to check the significant difference in each parameter between all the three conditions across all four vowels. Wilcoxon's signed-rank test was carried out to note the significant difference between genders across all vowels and conditions. All the statistical analyses were carried out at an alpha value of 0.05 using SPSS software (version 20).

## Results

### Rate of speech

The speech rate was tabulated for all three conditions for both males and females. The mean, standard deviation, median and range were extracted as part of descriptive statistics and revealed in Table 1 and Figure 1.

Across males, the mean rate of speech was higher during condition 1, followed by condition 2 and condition 3. The standard deviation of the speech rate was higher during condition 3, followed by condition 1. The range was higher for both condition 1 and condition 2 compared to condition 3. Across females, the mean rate of speech was higher during condition 1, followed by condition 2 and condition 3. The standard deviation values were also observed to be higher during condition 3 and the lowest standard deviation was noted during condition 1. The highest

**Table 1. Mean, median, standard deviation, and range of rate of speech between conversational speech (Condition 1), noise adapted speech (Condition 2), and clear speech (Condition 3) for both genders.**

| Measures | Condition1 | | Condition2 | | Condition3 | |
|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female |
| Mean | 94.23 | 93.17 | 87.5 | 86.33 | 79.67 | 79.5 |
| SD | 15.44 | 15.37 | 15.31 | 15.43 | 16.91 | 16.78 |
| Median | 90 | 91 | 83 | 83 | 72 | 78.5 |
| Range | 66 | 67 | 66 | 67 | 63 | 68 |

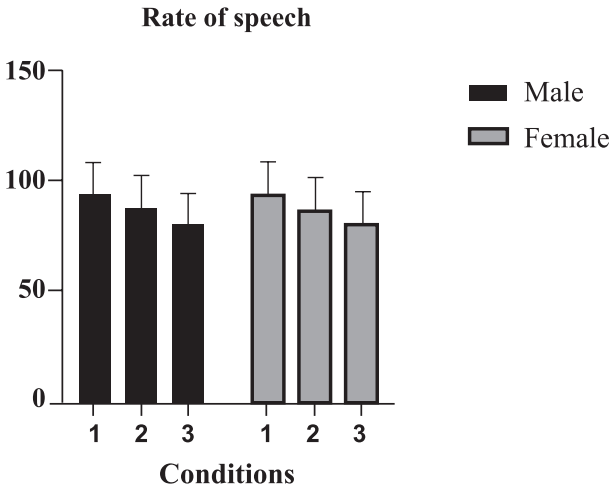


Figure 1. Mean and standard deviation of the rate of speech values in all three conditions for males and females.

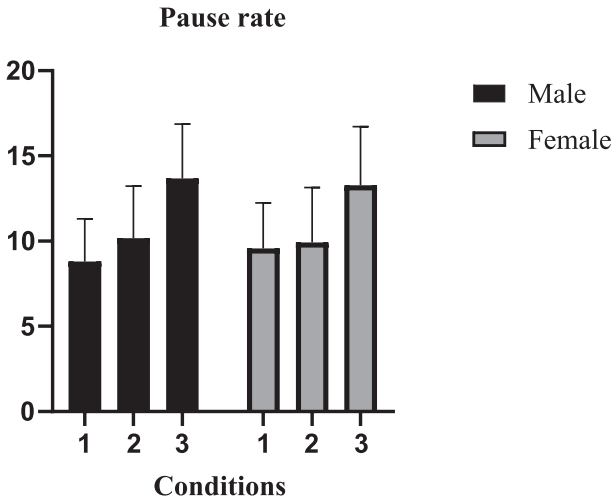


Figure 2. Mean and standard deviation of pause rate values in all three conditions for males and females.

range value was noted during condition 3 followed by both condition 1 and condition 2, both having similar values.

Wilcoxon's signed-rank test was carried out across each condition to check the significant difference in speech rate between the genders. The results showed that there was no significant difference between the genders across all three conditions. Friedman's test was carried out separately for each gender. The results showed a significant difference in speech rate between all three conditions for males ($\div^2$=49.47, /*P*/=0.00) and females ($\div^2$=51.78, /*P*/=0.00).

Wilcoxon's signed-rank test was carried out to determine the significant difference in speech rate between the three conditions. Results have been shown in Table 2. The results showed a significant difference in the rate of speech between conversational speech and noise-adapted speech, between noise-adapted speech and clear speech, and between clear speech and conversational speech. Thus, from the descriptive and inferential statistics results, it was concluded that conversational speech had a higher rate of speech values than noise-adapted speech and clear speech. Further, no significant differences in speech rate between male and female subjects were noted.

**Pause rate**

The pause rate was tabulated for all three conditions for males and females. The mean, standard deviation, median and range were extracted as part of descriptive statistics and shown in Table 3 and Figure 2.

**Table 2. Results of Wilcoxon's signed-rank test for speech rate for the difference between conditions for both genders.**

| Between condition 1 & condition 2 | | Between condition 2 & condition 3 | | Between condition 3 & condition 1 | |
|---|---|---|---|---|---|
| /Z/ value | /p/value | /Z/ value | /p/value | /Z/ value | /p/ value |
| -6.16 | 0.00 | -6.73 | 0.00 | -6.34 | 0.00 |

**Table 3. Mean, median, standard deviation, and range of pause rate between conversational speech (Condition 1), noise adapted speech (Condition 2), and clear speech (Condition 3) for both genders.**

| Pause rate | Condition1 | | Condition2 | | Condition3 | |
|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female |
| Mean | 8.8 | 9.57 | 10.17 | 9.93 | 13.67 | 13.27 |
| SD | 2.50 | 2.67 | 3.05 | 3.32 | 3.21 | 3.43 |
| Median | 9 | 9 | 9.5 | 9.5 | 13.5 | 13.5 |
| Range | 10 | 10 | 12 | 12 | 15 | 14 |

Mean values of pause rate were higher for males during condition 3 followed by condition 2, and females had higher values during condition 1 as it can be seen from figure 2. The standard deviation of pause rate was higher for females in all three conditions, with the highest value noted during condition 3, followed by condition 2 and condition 1. A similar trend was noted for males also. The median was highest during condition 3, followed by condition 2 and condition 1 for both genders. The range of pause rate was higher during condition 3 for males and females, followed by condition 2 and condition 1 having equal values for both genders as it can be witnessed from Table 3.

Wilcoxon's signed-rank test was carried out across each condition to check the significant difference in pause rate between the genders. The results showed that there was no significant difference between the genders across all three conditions. Friedman's test was carried out separately for each gender. The results showed a significant difference in pause rate between all the three conditions for males ($\div^2$=38.94, /*P*/=0.00) and females ($\div^2$=30.37, /*P*/=0.00).

Wilcoxon's signed-rank test was carried out to determine the significant difference in pause rate between the three conditions. Results have been shown in Table 4. The results showed a significant difference in pause rate between conversational speech and noise-adapted speech, between noise-adapted speech and clear speech, and between clear speech and conversational speech. Thus, it was concluded that clear speech had higher pause rate values than noise-adapted speech and conversational speech. Further, no gender differences in pause rate were evidenced.

**Pause duration**

Pause duration was tabulated for all three conditions for both males and females. Mean, standard deviation, median and range of pause duration were extracted and revealed in Table 5 and Figure 3.

**Table 4. Results of Wilcoxon's signed-rank test for pause rate for the difference between conditions for both the genders.**

| Between condition 1 & condition 2 | | Between condition 2 & condition 3 | | Between condition 3 & condition 1 | |
|---|---|---|---|---|---|
| /Z/ value | /p/value | /Z/ value | /p/value | /Z/ value | /p/ value |
| - 2.57 | 0.01 | - 6.59 | 0.00 | - 5.90 | 0.00 |

**Table 5. Mean, median, standard deviation, and range of pause duration between conversational speech (Condition1), noise adapted speech (Condition2), and clear speech (Condition3) for both genders.**

| Pause rate | Condition 1 | | Condition 2 | | Condition 3 | |
|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female |
| Mean | 0.9 | 0.87 | 0.93 | 1.03 | 1.2 | 1.43 |
| SD | 0.31 | 0.35 | 0.25 | 0.49 | 0.41 | 0.68 |
| Median | 1 | 1 | 1 | 1 | 1 | 1 |
| Range | 1 | 1 | 1 | 2 | 1 | 3 |

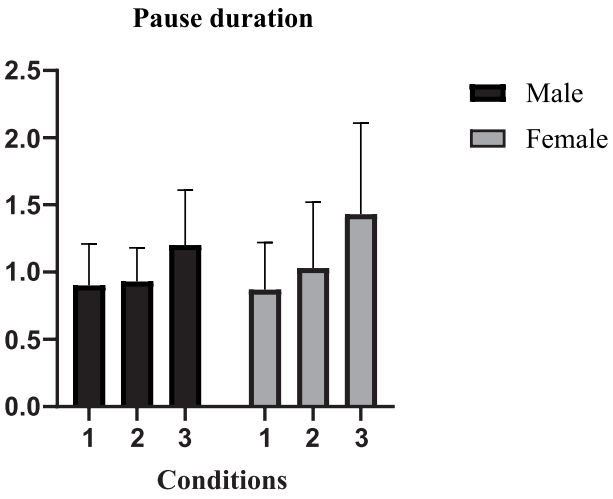


Figure 3. Mean and standard deviation of pause duration values in all three conditions for males and females.

Mean values of pause duration were higher for females during condition 3, followed by condition 2, and males had higher values during condition 1. Standard deviation was higher for females in all the three conditions, with a higher value noted during condition 3, followed by condition 2 and condition 1. The median value of pause duration was equal across all three conditions and genders. The range of pause duration was higher for females during condition 3, followed by condition 2, and during condition 1, both the genders had equal values.

Wilcoxon's signed-rank test was carried out to check the significant difference in pause duration between the genders. The results showed that there was no significant difference between the genders across all three conditions. The results of the Friedman's test showed a significant difference in pause duration between all the three conditions for males ($\div^2$=16.22, /*P*/=0.00) and females ($\div^2$=20.58, /*P*/=0.00).

Wilcoxon's signed-rank test was conducted to determine the significant difference in pause duration between the three conditions. Results have been shown in table 6. The results showed a significant difference in pause duration between conversational speech and noise-adapted speech, between noise-adapted speech and clear speech, and between clear speech and conversational speech. Thus, from the descriptive and inferential statistics results, it was concluded that clear speech had higher pause duration values than noise-adapted speech and conversational speech. Further, no significant gender differences were observed in pause duration values.

## Discussion

The results of the present study showed a decrease in the rate of speech during clear speech and noise-adapted speech compared to

**Table 6. Results of Wilcoxon's signed-rank test for pause duration for the difference between conditions for both the genders.**

| Between condition 1 & condition 2 | | Between condition 2 & condition 3 | | Between condition 3 & condition 1 | |
|---|---|---|---|---|---|
| /Z/ value | /p/value | /Z/ value | /p/value | /Z/ value | /p/ value |
| - 2.44 | 0.01 | - 4.73 | 0.00 | - 3.77 | 0.00 |

conversational speech. These results were in line with the results reported by Picheny et al. (1986). Picheny et al. (1986) also reported much higher speaking rates in conversational speech than those observed during clear speech and noise-adapted speech. In the Indian context, Durisala et al. (2011) noted a slower speaking rate in clear speech compared to conversational speech in Telugu speakers. The slower speaking rate during clear and noise-adapted speech may be attributed to greater articulatory precision in clear and noise-adapted speech, contributing to improved speech intelligibility (Durisala et al., 2011).

The results also showed an increase in pause duration and rate of pauses in clear speech compared to conversational and noise-adapted speech. According to Goldman-Eisler (1968), pauses (greater than 100ms) do not mark a syntactic boundary as the duration is quite large, and hence it would be an attempt by the speaker to enhance the intelligibility of the word-final and word-initial consonants. Goldman-Eisler (1968) also found that when a speaker was asked to decrease their speaking rate, they tended to insert more pauses than lengthening each word. Cutler and Butterfield (1990) reported that speakers paused before words for 150ms or more when asked to repeat the stimuli clearly and this suggested that the speakers were aware that listeners found it challenging to segment continuous speech and speakers deliberately marked the word boundaries by adding pauses or increasing its duration as a way of helping the listeners understand their speech better. Smiljaniæ and Gilbert (2017a) concluded from their study that intelligibility gain was higher for conversational speech in the presence of noise when compared to speech in quiet and during the clear speech, speakers used a reduced rate of speech, increase in 1-3kHz energy, vowel space area, increased mean F0 and harmonics to noise ratio to enhance intelligibility. Thus, the results of the present study were in consonance with that of the earlier study.

Thus, the present study found a decrease in speech rate and an increase in pause duration and rate of pauses during clear speech and noise-adapted speech compared to conversational speech in both male and female participants. These findings are on par with the study by Smiljaniæ and Bradlow (2008). Smiljaniæ and Bradlow (2008) suggested that their speakers achieved a decrease in the speaking rate through equal lengthening of consonant and vowel intervals in clear speech. Also, slowing down in clear speech resulted in increased pauses and a combination of individual segment lengthening. Thus, supporting the view that speech modifications majorly involve temporal restructuring. Further, the clear speech has been considered as a type of hypo-articulated speech and the noise adapted speech and the conversation speech has been considered as hyper-articulated speech (Smiljaniæ & Gilbert, 2017b). Therefore, it was inferred from the results of the study that the talkers could successfully modify the speech output from hypo-articulated (clear speech) to hyper-articulated (Noise adapted speech)

in response to various communication challenges and conditions.

The analysis of clear speech and noise adapted speech also has some real-world applicability other than the field of speech and language sciences. Such studies can help in developing technologies with artificial intelligence for the individuals or the conditions where the speech can be difficult to comprehend like in an aural rehabilitation programs (Huttunen et al., 2011) for adults or children with hearing loss or cochlear implant or for optimising the special training programs to use clear speech such as in the treatment of individuals with dysarthria (Beukelman et al., 2002). The studies on the analysis of clear speech might also have an applicability among the other disciplines such as the military aviation training programs (Huttunen et al., 2011) that can indirectly help to monitor the cognitive load and to manage stress levels in aviation personals.

Further, the results of the present study also revealed no gender differences in the rate of speech, pause duration and rate of pause. Both male and female participants were observed to have similar speaking rate, pauses rate and pause duration. These findings were in contradiction with the results reported by an earlier study. Bradlow and Bent (2002) reported that female speakers reduced their overall speaking rate compared to male speakers when asked to shift from conversational to clear speech. The study also reported that clear speech in female participants was significantly more intelligible than their male counterparts. Therefore, the study concluded that these changes in the speech rate among the female participants could be attributed to the increased articulatory effort by the modifications of the temporal characteristic of speech by female speakers. However, the differences in the results of the present study and earlier studies may be attributed to the differences in the selection of participants, the stimulus material used in the studies, and the differences in the speaker's native language.

## Conclusion

The current study investigated some temporal characteristics of clear speech and noise-adapted speech in young adults. The results showed that all three temporal parameters significantly differed between conversational, clear, and noise-adapted speech. No significant differences between the genders were also noted. Therefore, it was inferred from the results of the study that the talkers could successfully modify the speech output from hypo-articulated (clear speech) to hyper-articulated (Noise adapted speech) in response to various communication challenges and conditions. Therefore such studies have clinical implications in developing technologies or training programs in individuals such as in patients with dysarthria (Beukelman et al., 2002) or also the aural rehabilitation programs (Huttunen et al., 2011) for individuals with hearing loss. As the present study had considered the temporal parameters of speech, future research could be carried out to document the changes in both the spectral and temporal parameters. Further documentation on the effect of various types of noise on the temporal and spectral parameters of speech is also warranted. Investigations considering the analysis of consonants and vowels can be carried out to understand better the effect of clear speech and noise-adapted speech on the acoustic characteristics of speech.

**Conflict of interest:** The authors report no conflicts of interest.

**Disclosure statement:** No disclosures

**Patient consent statement:** All participants agreed voluntarily to participate in the study and signed an informed consent.

## References


Beukelman, D. R., Fager, S., Ullman, C., Hanson, E., & Logemann, J. (2002). The impact of speech supplementation and clear speech on the intelligibility and speaking rate of people with traumatic brain injury. *Journal of Medical Speech-Language Pathology*, *10*(4), 237–242.

Bond, Z. S., Moore, T. J., & Gable, B. (1989). Acoustic-Phonetic Characteristics Of Speech Produced In Noise And While Wearing An Oxygen Mask. *Journal of the Acoustical Society of America*, *85*(2), 907–912. https://doi.org/10.1121/1.397563

Bradlow, A. R., & Bent, T. (2002). The clear speech effect for non-native listeners. *The Journal of the Acoustical Society of America*, *112*(1), 272–284. https://doi.org/10.1121/1.1487837

Bradlow, A. R., Kraus, N., & Hayes, E. (2003). Speaking clearly for children with learning disabilities: Sentence perception in noise. *Journal of Speech, Language, and Hearing Research*, *46*(1), 80–97. https://doi.org/10.1044/1092-4388(2003/007)

Chen, F. R. (1980). *Acoustic characteristics and intelligibility of clear and conversational speech* (Issue 1980). University of Michigan.

Cooke, M., & Lu, Y. (2010). Spectral and temporal changes to speech produced in the presence of energetic and informational maskersa). *The Journal of the Acoustical Society of America*, *128*(4), 2059–2069. https://doi.org/10.1121/1.3478775

Cooke, M., Mayo, C., Valentini-Botinhao, C., Stylianou, Y., Sauert, B., & Tang, Y. (2013). Evaluating the intelligibility benefit of speech modifications in known noise conditions. *Speech Communication*, *55*(4), 572–585. https://doi.org/10.1016/j.specom.2013.01.001

Cutler, A., & Butterfield, S. (1990). Durational cues to word boundaries in clear speech. *Speech Communication*, *9*(5), 485–495. https://doi.org/https://doi.org/10.1016/0167-6393(90)90024-4

Dreher, J. J., & O'Neill, J. J. (1958). Effects of ambient noise on speaker: Intelligibility of words and phrases. *Laryngoscope*, *68*(3), 539–547. https://doi.org/10.1002/lary.5540680335

Durisala, N., Prakash, S. G. R., Nambi, A., & Batra, R. (2011). Intelligibility and Acoustic Characteristics of Clear and Conversational Speech in Telugu (A South Indian Dravidian Language). *Indian Journal of Otolaryngology and Head and Neck Surgery*, *63*(2), 165–171. https://doi.org/10.1007/s12070-011-0241-7

Ferguson, S. H., & Kewley-Port, D. (2002). Vowel intelligibility in clear and conversational speech for normal-hearing and hearing-impaired listeners. *The Journal of the Acoustical Society of America*, *112*(1), 259–271. https://doi.org/10.1121/1.1482078

Gilbert, R. C., Chandrasekaran, B., & Smiljaniæ, R. (2014). Recognition memory in noise for speech of varying intelligibility. *The Journal of the Acoustical Society of America*, *135*(1), 389–399. https://doi.org/10.1121/1.4838975

Godoy, E., Koutsogiannaki, M., & Stylianou, Y. (2014). Approaching speech intelligibility enhancement with inspiration from Lombard and Clear speaking styles. *Computer Speech and Language*, *28*(2), 629–647. https://doi.org/10.1016/j.csl.2013.09.007

Goldman-Eisler, F. (1968). *Psycholinguistics: Experiments in spontaneous speech.* (1st ed.). Academic Press.

Hanley, T. D., & Steer, M. D. (1949). Effect of level of distracting noise upon speaking rate, duration and intensity. *The Journal of Speech Disorders*, *14*(4), 363–368. https://doi.org/10.1044/jshd.1404.363

Huttunen, K., Keränen, H., Väyrynen, E., Pääkkönen, R., & Leino, T. (2011). Effect of cognitive load on speech prosody in aviation: Evidence from military simulator flights. *Applied Ergonomics*, *42*(2), 348–357. https://doi.org/10.1016/j.apergo.2010.08.005

Junqua, J. C. (1993). The lombard reflex and its role on human listeners and automatic speech recognizers. *Journal of the Acoustical Society of America*, *93*(1), 510–524. https://doi.org/10.1121/1.405631

Junqua, J. C. (1996). The influence of acoustics on speech production: A noise-induced stress phenomenon known as the Lombard reflex. *Speech Communication*, *20*(1–2), 13–22. https://doi.org/10.1016/S0167-6393(96)00041-6

Junqua, J. C., & Anglade, Y. (1990). Acoustic and perceptual studies of Lombard speech: Application to isolated-words automatic speech recognition. *ICASSP, IEEE International*

*Conference on Acoustics, Speech and Signal Processing - Proceedings*, *2*, 841–844. https://doi.org/10.1109/icassp.1990.115969

Krause, J. C., & Braida, L. D. (2004). Acoustic properties of naturally produced clear speech at normal speaking rates. *The Journal of the Acoustical Society of America*, *115*(1), 362–378. https://doi.org/10.1121/1.1635842

Lombard, E. (1911). Le signe de l'~l~vation de la voix. *Annales Des Maladies de L'Oreille et Du Larynx*, *37*, 101–119.

Lu, Y., & Cooke, M. (2008). Speech production modifications produced by competing talkers, babble, and stationary noise. *The Journal of the Acoustical Society of America*, *124*(5), 3261–3275. https://doi.org/10.1121/1.2990705

Lu, Y., & Cooke, M. (2009). The contribution of changes in F0 and spectral tilt to increased intelligibility of speech produced in noise. *Speech Communication*, *51*(12), 1253–1262. https://doi.org/10.1016/j.specom.2009.07.002

Maniwa, K., Jongman, A., & Wade, T. (2008). Perception of clear fricatives by normal-hearing and simulated hearing-impaired listeners. *The Journal of the Acoustical Society of America*, *123*(2), 1114–1125. https://doi.org/10.1121/1.2821966

Mattys, S. L., Davis, M. H., Bradlow, A. R., & Scott, S. K. (2012). Speech recognition in adverse conditions: A review. *Language and Cognitive Processes*, *27*(7–8), 953–978. https://doi.org/10.1080/01690965.2012.705006

Picheny, M. A., Durlach, N. I., & Braida, L. D. (1986). Speaking Clearly for the Hard of Hearing II: acoustic characteristics of clear and conversational speech. *Journal of Speech, Language, and Hearing Research*, *29*(3), 434–446. https://doi.org/10.1044/jshr.3203.600

Pichora-Fuller, M. K., Goy, H., & Van Lieshout, P. (2010). Effect on speech intelligibility of changes in speech production influenced by instructions and communication environments. *Seminars in Hearing*, *31*(2), 77–94. https://doi.org/10.1055/s-0030-1252100

Shalini, & Nataraja, N. (2013). *Acoustic Analysis of Clear Speech*. Master's Degree Dissertation submitted to University of Mysore.

Smiljaniæ, R., & Bradlow, A. R. (2007). Clear speech intelligibility: Listener and talker effects. *Proceedings of the 16th International Congress of Phonetic Sciences*, *August*, 661–664.

Smiljaniæ, R., & Bradlow, A. R. (2005). Production and perception of clear speech in Croatian and English. *The Journal of the Acoustical Society of America*, *118*(3), 1677–1688. https://doi.org/10.1121/1.2000788

Smiljaniæ, R., & Bradlow, A. R. (2008). Temporal organization of English clear and conversational speech. *The Journal of the Acoustical Society of America*, *124*(5), 3171–3182. https://doi.org/10.1121/1.2990712

Smiljaniæ, R., & Bradlow, A. R. (2011). Bidirectional clear speech perception benefit for native and high-proficiency non-native talkers and listeners: Intelligibility and accentedness. *The Journal of the Acoustical Society of America*, *130*(6), 4020–4031. https://doi.org/10.1121/1.3652882

Smiljaniæ, R., & Gilbert, R. C. (2017a). Intelligibility of noise-adapted and clear speech in child, young adult, and older adult talkers. *Journal of Speech, Language, and Hearing Research*, *60*(11), 3069–3080. https://doi.org/10.1044/2017_JSLHR-S-16-0165

Smiljaniæ, R., & Gilbert, R. C. (2017b). Acoustics of clear and noise-adapted speech in children, young, and older adults. *Journal of Speech, Language, and Hearing Research*, *60*(11), 3081–3096. https://doi.org/10.1044/2017_JSLHR-S-16-0130

Uchanski, R. M., Geers, A. E., & Protopapas, A. (2002). Intelligibility of modified speech for young listeners with normal and impaired hearing. *Journal of Speech, Language, and Hearing Research*, *45*(5), 1027–1038. https://doi.org/10.1044/1092-4388(2002/083)

Van Summers, W., Pisoni, D. B., Bernacki, R. H., Pedlow, R. I., & Stokes, M. A. (1988). Effects of noise on speech production: Acoustic and perceptual analyses. *Journal of the Acoustical Society of America*, *84*(3), 917–928. https://doi.org/10.1121/1.396660

Vlaj, D., & Kacic, Z. (2011). The Influence of Lombard Effect on Speech Recognition. *Speech Technologies*. https://doi.org/10.5772/17520

* * *

# Empowering persons with disabilities through providing assistive aids and appliances: A flagship programme of the Government of India

**Ashok Kumar Sinha**
Ex. Director, Ali Yavar Jung National Institute of Speech and Hearing Disabilities, Mumbai

## Introduction

United Nations proclaimed 1981 as International Year for the Persons with Disabilities. A major outcome of the International Year of Disabled Persons was the formulation of the World Programme of Action (WPA) concerning persons with disabilities. Not satisfied with empowerment of persons with disabilities, the United Nations General assembly adopted the resolution on Convention on the Rights of Persons with Disabilities (UNCRPD) in 2006. UNCRPD emphasized rights for the persons with disabilities specially women and children with disabilities. Disabilities were considered as part of human diversity. Government of India enacted the Rights of Persons with Disabilities (RPWD), Act in 2016 to give effect to the UNCRPD, 2006. The RPWD Act 2016, identified 21 categories of persons with disabilities.

Assistive devices (AD) are the products build to help people to make their daily work accomplished and technologies are means by which they can use those devices to accomplish their routine work. AD is needed by a variety of people to overcome their disabilities which can happen due to senile change, accidents, congenital malformations, or an outcome of some chronic disease in the form of loss of limb or any other organ. With an increase in the non-communicable diseases, an increase in the proportion of the population in the geriatric age group, and an increase in the life expectancy of human beings the need for AD has increased many folds. With the advancement in technology, the imagination of developing prototype devices has reached far but the production of the same on large scale to suffice the needs of the needy is a major challenge till now. The unmet need of assistive devices for those who require them is very high (90% as per WHO in 2019) and most of those who get it stops using it in the future because of problems with its design, adaptability, flexibility, maintenance cost or other related issues. Developing assistive devices and technologies should involve the novelty of reaching to the needy at an affordable cost in purchasing and maintenance and easy use technology. The government of India has taken many measures (policies, assistance schemes, research for generating knowledge) to meet the need for assistive devices in the country but a Assistive devices (AD) are the products build to help people to make their daily work accomplished and technologies are means by which they can use those devices to accomplish their routine work. AD is needed by a variety of people to overcome their disabilities which can happen due to senile change, accidents, congenital malformations, or an outcome of some chronic disease in the form of loss of limb or any other organ. With an increase in the

Address correspondence and reprint requests to: Ashok Kumar Sinha; Director (Rtd.), Ali Yavar Jung National Institute of Speech and Hearing Disabilities, Mumbai Email: sinhaat1983@rediffmail.com

non-communicable diseases, an increase in the proportion of the population in the geriatric age group, and an increase in the life expectancy of human beings the need for AD has increased many folds. With the advancement in technology, the imagination of developing prototype devices has reached far but the production of the same on large scale to suffice the needs of the needy is a major challenge till now. The unmet need of assistive devices for those who require them is very high (90% as per WHO in 2019) and most of those who get it stops using it in the future because of problems with its design, adaptability, flexibility, maintenance cost or other related issues. Developing assistive devices and technologies should involve the novelty of reaching to the needy at an affordable cost in purchasing and maintenance and easy use technology. The government of India has taken many measures (policies, assistance schemes, research for generating knowledge) to meet the need for assistive devices in the country but a Assistive devices are the products build to help persons with disabilities to make their daily work accomplished and technologies are means by which they can use those devices to accomplish their routine work and reduce or eliminate the impact of disability (Rana and Thappa, 2020). In many low-income and middle-income countries, only 5–15% of people who require assistive devices and technologies have access to them. One billion people need assistive products today and more than two billion people around the world are expected to need at least one assistive product by 2030 (WHO, 2021).

In India, there are 2.68 crore persons with disabilities (Male-55.89%, Female- 44.11%) and are 2.21% of the total population of the Country (Census, 2011). Coverage for the providing aids and appliances is low in spite of Government of India implementing scheme for distribution of aids and appliances to persons with disability since 1981, mostly body worn hearing aids, basic wheelchairs and crutches (Sinha, 2003). Government of India committed to improve the quality of life of persons with disabilities with modern assistive devises and created conducive environment for empowering persons with disabilities through enactment of the RPWD Act 2016, National Education Policy 2020 to provide inclusive education to all including persons with disabilities and revising Scheme of Assistance to Disabled Persons for Purchase/fitting of Aids and Appliances (ADIP) in 2022, with increased quantum of assistance, included modern assistive devices and digital system for implementation.

## Scheme of assistance to disabled persons for purchase/fitting of aids and appliances (ADIP) 2022

The objective of the ADIP Scheme is to provide durable, modern and scientifically manufactured aids and assistive devices to persons with disabilities for promoting their physical, social and psychological rehabilitation, thereby reducing the effects of disabilities and enhancing their educational and economic potential. The aids and assistive devices supplied under the scheme must have due certification. Few provisions for surgical correction are also made in the ADIP scheme, if required, before fitting of any aids and appliances.

ADIP scheme is being implemented mainly by the National Institutes, its Regional Centers and Composite Regional Centers for Skill Development, Rehabilitation and Empowerment of Persons with Disabilities and Artificial Limb Manufacturing Company of India (ALIMCO), Kanpur, under the Department of Empowerment of Persons with Disabilities, Ministry of Social Justice and Empowerment, (DEPWD-MSJE) and Institutes under Ministry of Health and Family Welfare. DEPWD-MSJE also funds Non-Government Organizations (NGOs), Hospitals of State

Government, Red Cross Societies and Nehru Yuva Kendra and any other organization deemed fit by DEPWD-MSJE.

No grants are given for the manufacturing or supply of the aids and appliances. DEPWD-MSJE while selecting the implementing agency gives priority to organizations who has infrastructure for distribution of aids and appliances including rehabilitation professionals having required qualification approved by Rehabilitation Council of India, New Delhi and enrolled in its Central Registration Register.

All ADIP implementing agencies may distribute the aids and appliances either through Institute or through conducting camps. While conducting camps, the implementing agency has to notify the respective place to the Collector and other local administration. After the distribution of aids and appliances, implementing agency must display the beneficiary on their website as well as on Management Information System of the DEPWD-MSJE, for having adequate transparency in implementing the scheme. Implementing agencies shall use 5% of the grant-in-aid as administrative/overhead expenses for conducting awareness, assessment, distribution and follow-up camps. For Mega Camps where the number of beneficiaries are 1000 and above and Camps are attended by Cabinet/State Ministers (SJ&E)/Chief Ministers, additional 5% administrative expenditure shall be allowable under the ADIP scheme.

## Who can avail the benefit of ADIP scheme?

Any Indian citizen, having a disability certificate of not less than 40% (benchmark disability as defined in the RPWD, Act 2016) is eligible to receive the aids and appliances subject to

i) His/her income from all resources must be within ₹ 30000/ per month

ii) In case of a dependent, parents/ guardian income should not exceed ₹ 30000/- per month.

iii) Not having received assistance during the last 3 years for the same purpose from any source.

However, for children below 12 years of age, the minimum time of assistance is one year. Central Government has liberalized the issue of income certificate for receiving the benefit of ADIP scheme. Income certificate may be issued by local revenue authority, public representatives, gram pradhan as well as notary. In case the person has a below poverty line card, Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) card or disability pension card, there will no need of income certificate. For children in orphanage, no income certificate is required except declaration by the person in-charge.

Under the ADIP-Samagra Shiksha Abhiyan (SSA), children's requirement of aids and appliances even if they do not have benchmark disability, are allowed. Department of School Education and Literacy, Ministry of Human Resource Development, supported the continuation of ADIP-SSA activity on 40:60 cost sharing basis with effect from 01.04.2020 to 31.03.2026.

## What is the quantum of assistance under ADIPscheme?

Government of India provides aids and appliances at 100% subsidy costing up to ₹ 15000. Aids and appliances costing between ₹ 15001 to ₹ 30000, Government of India will provide subsidy of ₹ 15000 only. There is also provision in the ADIP scheme for aids and appliances costing above ₹ 30001 to be distributed, but the Government of India will bear only 50% of the cost, the rest has been given by the beneficiary or by NGOs or the State

Government. There is provision for reimbursement of travelling cost, lodging and boarding cost as well, subject to restrictions. For providing modern assistive devices to all categories of persons with disabilities, the assistive devices will be decided by Expert Committees constituted in the MSJE-DEPWD. Government of India has made an exception for the quantum of assistance to persons with disabilities requiring motorized tri cycles which is distributed by ALIMCO, Kanpur and cochlear implants distributed by Ali Yavar Jung National Institute of Speech and Hearing Disabilities (AYJNISD), Mumbai.

## ADIP scheme: cochlear implant

ADIP scheme included cochlear implants for children with severe to profound sensorineural hearing in both ears in 2014 with quantum of assistance of ₹ 6.0 Lakhs per child. It included cost of cochlear implant, cost of surgery, and post-operative rehabilitation for two years. The quantum of assistance has been further raised to ₹ 7.0 Lakhs for children having pre lingual hearing loss in the age range of 1 year to 5 years and ₹ 6.0 Lakhs for children with post lingual hearing loss in the age range of 5 years to 18 years, in revised ADIP scheme in 2022.

To implement ADIP- Cochlear Implant scheme, AYJNISHD, Mumbai, is the nodal agency. Cochlear Implant surgery will be done at the hospitals empaneled by the DEPWD-MSJE. Cochlear Implant device will be procured by ALIMCO, Kanpur as per the specification recommended by the core committee. Beneficiaries are linked with Aadhar number. Parents/guardian having income from all sources up to ₹ 22500/- are provided 100% subsidy and for parents/ guardian having income of ₹ 22501/- to ₹ 30,000/- per month, must bear 50% of the cost of cochlear implant, surgery, and post-operative rehabilitation.

## Other aids and appliances in ADIP-scheme

DEPWD-MSJE expert committee recommends the type of aids and appliances required for persons with disabilities. List of assistive devices may be revised periodically by the DEPWD-MSJE, without seeking the approval of Expenditure Finance Committee/Cabinet Committee on Economic Affairs, within the financial ceiling prescribed by Expert committee constituted in the DEPWD-MSJE. The aids and appliances prescribed for various categories of persons with disability is given in Table 1.

## Transparency in implementing ADIP scheme

ADIP scheme has in-built component to make the implementation of the scheme more transparent. There is provision of conducting sample checking of beneficiaries regarding utilization of grant-in-aid by the Implementing Agency. The sample checking would cover at least 15% (in case of grant-in-aid up to ₹ 10.00 lakh) and 10% (in case of grant-in-aid exceeding ₹ 10.00 lakh). A Doctor of a Primary Health Centre/Block/Tehsil/ Tehsildar/Nayab Tehsildar/ Sub-Division Officer / Block Development Officer / level officer or Social Welfare Officer/ District Disability Officer/Women and Child Development Officer holding charge of Social Welfare/ any other officer authorized by District Collector may be the Test Checking Authority.

In ADIP scheme it is proposed to tie up with Community Service Centers set up by the Department of Electronics and Information Technology, Government of India, functioning all over country for registration of beneficiaries who need aids and assistive devices under the scheme. It is also proposed to launch mobile app for registration, replacement, functioning of aids and appliances so that central data is monitored for each beneficiary and the

**Table 1: Aids and appliances for different category of disabilities provided under ADIP scheme**

| Serial Number | Scheduled category of disability | Aids and appliances |
|---|---|---|
| 1 | Persons with Locomotor Disabilities | a. All prosthetic and orthotic devices, mobility aids, surgical foot wears, MCR chappals, all types of devices for ADL<br>b. High end Prosthesis (Below Knee, Above Knee, Below elbow and Above elbow)<br>c. Motorized wheelchair and tricycle for persons with 80% or more disability for age 16 and above. Replaceable after every 5 years. Extend of subsidy [1] 50000/- |
| 2 | Persons with Visual disability including Deaf Blind | a. Accessible mobile phone to visually impaired students aged 18 years and above, once in five years<br>b. Laptop, Braille Note Taker and Brailler to school going students with disability (class 10th and above),once in 10 years<br>c. Communication equipment<br>d. Low vision aids<br>e. Special mobility aids for persons with visual disability with muscular dystrophy or cerebral palsy like adapted walkers<br>f. Any suitable aids and assistive devices as recommended by Expert Committee from time to time |
| 3 | Persons with hearing disability | a. Behind the Ear Hearing Aids<br>b. educational kits<br>c. Assistive and Alarm devices<br>d. Any suitable aids and assistive devices as recommended by Expert Committee from time to time. |
| 4 | Persons with intellectual and developmental disabilities | a. Teaching and Learning Material (TLM) Kitsb. Multi-Sensory Inclusive Education Development (MSIED) Kitc. Any suitable device/kit/learning material as advised by Expert Committee from time to time. |
| 5 | Persons with cured leprosy | a. Assistive Daily Living Kits (ADL) for Leprosy cured persons<br>b. Any suitable device as advised by Expert |

organization implementing ADIP scheme. The implementing agency will obtain the required documents as stipulated in the ADIP scheme from the beneficiary at the time of assessment and distribute aids and assistive devices to eligible beneficiaries within six months from the date of such registration.

## Outcomes of ADIP scheme

Government of India has been increasing budget allocation for implementing ADIP scheme in recent years. Total of [1] 104,915.58 Lakh has been allotted in last seven years which is more than 185% higher than the previous seven years. Figure 1depicts the funds allotted year wise from 2014 -15 to 2020-21 under the ADIP scheme for distribution of aids and appliances in India for all disabilities through the NGOs and autonomous body of Government of India.

Higher fund allocation and coordinated efforts of National Institutes, ALIMCO, Kanpur, NGOs and State Governments, ADIP beneficiaries increased each year. Figure 2 depicts number of beneficiaries ADIP –Cochlear implant website of AYJNISHD, Mumbai show the number of Cochlear Implant beneficiaries for last six years.

Several studies have reported the outcomes of implementation of ADIP scheme. Dutta et al (2020) reported need for creating awareness among the beneficiaries regarding the ADIP scheme. Mehrotra (2020) reported 90% of 300 children underwent cochlear implant in Kanpur, showed significant improved hearing, 80% with significant speech benefit and 90% with improved quality of life. Outcome in terms of quality of life, auditory perception and rehabilitation was very good. The ADIP scheme of central government has been a blessing for lower socio-economic status children. Considerable improvement in hearing, speech and overall quality of life in almost 80% of children. Kirtan and Thappa (2020) concluded the need to strengthen the existing mutual partnerships among ministries of Social Justice, health, rehabilitation, education, transport, and employment as well as State Governments and non-governmental organizations to ensure the availability and use of assistive devices.

## Conclusion

ADIP scheme is the flagship program of Government of India being implemented through the nodal ministry of DEPWD-MEJE for the welfare and empowerment of persons with disabilities. Modern aids and appliances including high end products are being considered for distribution among persons with disabilities. On 16th March 2022, the Expert Committee recommendation for aids and appliances for the new categories of disability has been approved by the Government of India, including

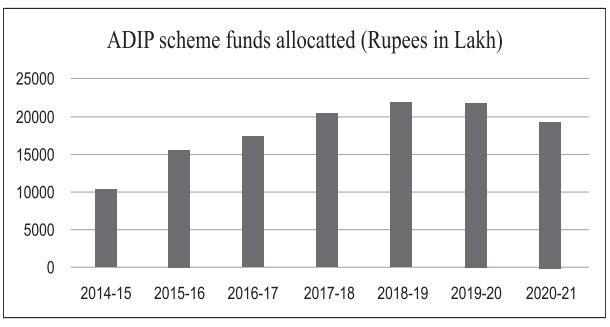


Figure 1. Funds allocated by Government of India for last seven years under ADIP scheme.

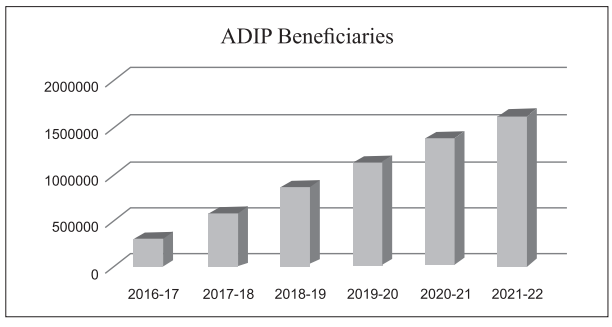


Figure 2. ADIP scheme beneficiaries.

Artificial Larynx (Electro Larynx) for the Speech and language disability and set of cards indicating sign language for deaf. Government of India is making all-out effort to create awareness among the general public regarding ADIP scheme. While celebrating 'Azadi ka Amrit Mahotsav', India must develop indigenous assistive devices and technologies which involve the novelty of reaching to the needy at an affordable cost in purchasing and maintenance and easy use technology. The Government of India has taken many measures (policies, assistance schemes, research for generating knowledge) to meet the need for assistive devices in the country. Access to appropriate assistive products can have a tremendous impact on community development and economic growth.

**Conflict of interest:** The authors report no conflicts of interest.

**Disclosure statement:** No disclosures

## References


Artificial Limbs Manufacturing Corporation of India. Retrieved July11, 2022, from https://www.alimco.in

Assistive Technology: World Health Organization (2020): Retrieved July 7, 2022 from https://www.who.int/health-topics/assistive-technology#tab=tab_1

AYJNISHD ADIP Cochlear Implant: Retrieved on 6 July, 2022 from http://adipcochlearimplant.in/index.aspx

Census of India: Disabled Population. Retrieved 12 July, 2022, from https://censusindia.gov.in/disabled-population.aspx

Dutta P, Dey S, Malakar I (2020). Parental knowledge and understanding of monitoring and maintenance of cochlear implant under ADIP scheme. J Indian Speech Language Hearing Association ;34:17-23

Mehrotra R, Anubhaw, Srivastav, P., Sharma R (2020). A Study of Outcomes Following Cochlear Implantation in Children under ADIP Scheme-an Indian Experience. On J Otolaryngol & Rhinol. 2(5)

Ministry of law and justice (1996). The Persons with Disabilities (equal opportunities, protection of rights and full participation) act, 1995. Retrieved on 12 July 2022 from https://legislative.gov.in

Ministry of Law and justice (2016).THE RIGHTS OF PERSONS WITH DISABILITIES :ACT,2016 Retrieved on 10 July 2022 from https://legislative.gov.in/sites/default/files/A2016-49_1.pdf

Rana K and Thappa P(2020). Status of Assistive devices and Technology in India. Journal of Research , vol.9, Issue 7 Mehrotra R, Anubhaw, Srivastav, P., Sharma R (2020). A Study of Outcomes Following Cochlear Implantation in Children under ADIP Scheme-an Indian Experience. On J Otolaryngol & Rhinol. 2(5) issue 7

Scheme of Assistance to Disabled Persons for Purchase/Fitting of Aids and Appliances (2022): Retrieved 10th July, 2022 from https://disabilityaffairs.gov.in/content/page/adip.php

Sinha A K (2003): Assistance to Disabled Persons for Purchase/fitting of Aids and Appliances (ADIP) Scheme, Optometry Today and Hearing Journal, vol 3, New Delhi

United Nation: Convention on Rights of persons with Disabilities (2006): Retrieved July 5, 2022 from https://www.un.org/en/rights%20of%20persons%20with%20disability


* * *

**Book Review:**

# Of Sound Mind: How Our Brain Constructs a Meaningful Sonic World.

Nina Kraus, Cambridge, Massachusetts: The MIT press 2021
ISBN 9780262045865, Available as hard copy (Rs1893), on Kindle (Rs.1023)
and a free trial as an Audio book, on Amazon

Reviewed by Madhuri Gore

The title is intriguing- explaining the effect of sound on the brain and what the brain does with it and how it affects the person. The book is a labour of love by an auditory neuroscientist Dr. Nina Kraus. Kraus writes with a mixture of personal as well as research observations mainly from the work in her lab, but also from other research. She gives a perspective of Tallal's, Merzenich's, Krishnan's, Peretz's, and Patel's research contribution among many. Draws liberally on metaphor, analogies illustrating her points with familiar real life musical experiences - Zakir Hussain, Lady Gaga, The Beatles, and Jazz musicians. The book gives a holistic picture on current knowledge of impact of sound on -to quote her- "our sonic selves". Kraus has placed the knowledge in a known construct with appropriate analogies. It begins with an introduction prior to the other chapters. There are footnotes to explain, provide details on concepts and there is a treasure trove of notes (67 pages) containing references for each chapter, a glossary, index and acknowledgements (10 pages). Illustrations though in black and white provide a composite picture. Kraus adopts a conversational tone and tells the story of our sound minds - chapters are arranged logically starting from a brief introduction about sound, to the processes of listening, bird song, bilinguals, noise and ageing. The meaning of Latin words (the bane for many) are explained and this adds to ease of reading.

The book is organized into two sections-The first section "How Sound Works" with 4 chapters and the second is a much larger section titled "Our Sonic Selves" consisting of 8 chapters. The first section deals with the basis of sound -or to put it as sound ingredients, our auditory system- sound within, sound merged, learning and the quest for the listening brain. The second section is about the different sounds of music, speech, noise and their impacts and the response to sound in mammals, birds, amphibians, insects and even plants (yes truly). The opening chapter gives a catchy introduction to sound and its ingredients. All questions that a beginner experiences are addressed -pressure changes with changes in the atmospheric pressure, pure tones, modulated tones, intensity, timing, pitch, timbre *and* speech. This is followed by an introduction to the essence of the auditory system explaining the anatomy from the ear to the brain, and functions of conduction, transduction, transformation. A dry topic is made interesting when she gives a perspective of the auditory system to the body as a whole. For example, she says the organ of Corti "just missed the title of smallest organ in the body (curse you pineal gland!)".

What is the world of sound? How does hearing engage other senses, our movement, emotions, and mirror neurons. The direction of information flow-Upstream and Downstream is a great analogy. The concept of sound outside and inside the head and merging those signals gives another perspective which will engage the thought processes innovatively. I loved the chapter on learning. It is interspersed with "stories" on animal experiments- owls, rabbits- how they learn- (and unlearn), attention and more. The quest for the listening brain -the "biological portal into sound processing" is one of the best. It addresses the question: How the brain deals with different time scales from microseconds to seconds, how are

auditory objects created? Section 1 paves the way for understanding the rest.

Section 2 begins with music and its perception. The chapter is aptly titled *'music is the jackpot'* since it engages the "cognitive, motor, reward and sensory networks" starting from musicians to music healers as a future. Is rhythm a part of us? Does it help to learn to speak, hear in noise and even to spell? Although music perception has gained so much interest, Kraus gives importance to *rhythm*. To me it suggests that it is the next area to explore. I am probably biased, but I think she was right to devote a whole chapter to it, from rhythm intelligences linked to brain rhythm, listening (with a mention of Martin Luther King's compelling rhythm in speech) and language learning. We also learn about "vocal learners", birds that imitate sounds and probably a capacity to predict future beats in rhythm. The reference to rhythm and socializing suggests mirror neurons. There is a third chapter dealing mainly with music. In this chapter, Kraus has addressed the questions of how does music help? What is its link to speech? How can sound processing be strengthened? Does strengthening processing through music alleviate effects of deprivation? Are the changes reflected in mis-match negativity (MMN)? In the chapter on the root of language is sound, Kraus explores the link between perceiving sound consistency to learn language and the information obtained from using the sound (the mighty) /da/ in evoked potentials. She has written elegantly about reading, language, and sound. There is a bit of history of language and spelling change (good to understand), FFR- explained the easy way. How timing was important to consistency in perception. A mention is made about language related giftedness. While bilinguals have many advantages, they appear to have a downside too. A bonus is one exclusively on bird song.

Aging is another aspect: how does auditory training help the older population? How long do they last? How is sound coded in the aging brain? The concept of neural noise and the lack thereof in musicians and athletes is explored in the chapter on Sound and Brain Health. The effect of concussion on sound processing is discussed. Although the chapter on noise seems a bit jarring, it fits well in the sound mind concept. The book ends with 'Our Sonic Minds' -past present and future- she explores how our perception may be rich or dulled by noise, how languages we speak help us understand each other, how ignoring sound and music might affect us. What choices must we make to use the power of the sound mind. The end is on a philosophical note.

As a book, it sparks the interest in our perception of sound and the "sound mind". One can of course read it in one go, but there is so much to read and think that one goes back again and again to find new ideas. Although easy to read, the treatment of each chapter is not superficial. In the chapter about sound and the brain you can read about neurotransmitters. She also introduces the binding principle. Every part of the research mentioned is linked to real life, related research in speech and language. Everything related to sound. What is unique to humans- and what is not. For example., how many of us know bird song has dialects? And that plants respond to buzzes and water flow sound (not I am Groot). Horses may not really "dance" to music, but birds can; Snowball the cockatoo on YouTube does. In the text, Kraus draws attention to important aspects "if you have not seen Snowball the cockatoo, look now", and I did.

The book is stimulating whether one is a layperson or a professional working with hearing. If the aim was to make "Of Sound Mind" accessible to a cross section of readers, I think it has definitely reached its goal. Has it given a new dimension to the phrase 'of sound mind"? yes it certainly has. This is a wonderful gift to the field. We needed a book on sound. A must read for every audiologist and speech language pathologist either in the making or a professional, a must for libraries and a great gift for friends.

* * *

**Guidelines for authors:**

Manuscripts should be submitted in word file-.doc/.docx. and follow the APA 7 format.

**Title page** should be separate with authors names, affiliations, and corresponding author details should be included.

**Abstracts:** Structured abstract with Background and Purpose, Methods, Results, and Conclusion. Abstract should be less than 300 words excluding references. Sufficient details in the abstract to be provided with respect to participants, testing, and procedure.

**Keywords:** Five to seven key words should be listed end of the abstract.

Short running title of less than 50 characters should be included.

**Main manuscript**

Introduction should lead to the need of the study and aims. Methods section must include study design, details of participants, materials used, rationale, procedure, and statistical analysis. Titles for figures and text must be clear and self-explanatory, providing information as a stand-alone structure. Stand-alone, high-quality figures and tables should be included in results section. Discussion section should provide understanding of results with support from literature. The manuscript should end with conclusion that brings out implication of the study.

All manuscripts should include acknowledgements, conflict of interest statement, ethical approval statement, participant consent statement, and funding statement at the end of the article.

Resolution for figures JPEG/PNG should be a minimum of 300 DPI. It is preferred that all content be original. If figures are taken from another source, the author(s) is/are responsible for taking the permission/paying from the authors of the figure.

Ethical approval of the study and informed consent should be mentioned at the time of submission. Figures that include identifiable information about participants need to have an informed consent that is provided by the author.

Spacing- Double spaced with continuous line numbers. Single spaces after the period. Page numbers should be provided.

Articles are peer reviewed. Authors are encouraged to suggest reviewers, though the final decision is made by the editorial board.

All effort will be made to review the articles within 4 weeks.

BANGALORE SPEECH AND HEARING TRUST
JOURNAL OF HEARING LANGUAGE AND SPEECH.
English Half Yearly MAG (3)/NPP/185/2021-22
July to December 2022

# Contents



**BANGALORE SPEECH AND HEARING TRUST JOURNAL OF HEARING LANGUAGE AND SPEECH - Printed and Published by V.V. Krishna Reddy on behalf of BANGALORE SPEECH AND HEARING TRUST. Printed at Geetanjali Graphics, # B-71, New No: 84, KSSIDC Indl. Estate, Rajajinagar, Bengaluru – 560 010. Published at Dr. S.R. Chandrasekhar Institute of Speech and Hearing, Hennur Road, Lingarajapuram, Bengaluru - 560084. Editor: Dr. Madhuri S. Gore**