LEXICAL SEMANTIC ORGANIZATION IN NEUROTYPICAL ADULTS

Jyotsna K
Register No: 16SLP012

A Dissertation Submitted in Part Fulfilment of Final Year

Master of Science (Speech-Language Pathology)

University Of Mysore

Mysore

ALL INDIA INSTITUTE OF SPEECH AND HEARING

MANASAGANGOTHRI, MYSORE-570 006

April, 2018

CERTIFICATE

This is to certify that this dissertation entitled **"Lexical Semantic Organization in Neurotypical Adults"** is a bonafide work submitted in part fulfillment for degree of Master of Science (Speech-Language Pathology) of the student Registration Number: 16SLP012. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysore
April, 2018

Dr. S.R. Savithri
Director
All India Institute of Speech and Hearing
Manasagangothri, Mysore-570006

CERTIFICATE

This is to certify that this dissertation entitled **"Lexical Semantic Organization in Neurotypical Adults"** has been prepared under my supervision and guidance. It is also been certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Guide
Dr. Abhishek.B.P

Mysore
April, 2018

Lecturer in Speech Sciences
Department of Speech Language Sciences
All India Institute Of Speech and Hearing
Manasagangothri , Mysore

DECLARATION

This is to certify that this dissertation entitled **"Lexical Semantic Organization in Neurotypical Adults"** is the result of my own study under the guidance of Dr. Abhishek B. P, Lecturer in Speech Sciences, Department of Speech Language Sciences, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysore,
April, 2018

Registration No. 16SLP012

THIS WORK IS

DEDICATED

TO APPA AND MA

ACKNOWLEDGEMENT

I am truly grateful to have had the guidance of Dr. Abhishek B.P.! Thank you for being an incomparable mentor, sir! Words would fail to describe the amount of gratitude I'm filled with, for the astounding amount of knowledge shared and the humility with which it was bestowed.

Thank you appa and mum! The thought of putting your names here, kept me striving to make this work worthy of it. Thank you for always pushing me to be the best version of myself!

I thank all the participants of the study who volunteered their time to be of help.

I am very thankful to Dr. Vasanthalakshmi for her statistical guidance.

I thank Dr. Prema for her valuable inputs, and in general, for being an inspiration!

I'm very grateful to Nithya di and Niharika di for their valuable time.

My sincere thanks to the Teachers at AIISH who have helped shape me academically and otherwise since the time of my Bachelor's degree.

I am very thankful to all the library staff, the non-teaching staff, the staff at the electronics department for their help, all through the year

I am a big fan of brevity of content, but there were too many wonderful people involved in helping me throughout the way: Thanks a ton Radha and Sumathi mami, Ram, Manni, Raju and Ramesh mama, Kaushi, and Manni as well as Spoo for all the help with the data collection. I thank my folks in Kalpakkam for their prayers.

Soumya di! I'm so very grateful all of your help and the timely support and encouragement. This dissertation is yours as well!

For being all the support, I needed and then some, thanks a ton Vyass!

This acknowledgement would not be complete without a mention of my constants-AdiMoo, Sam, Lulu, Prassu, Chinj, thanks a ton! <3
Thank you guys for being of so much help with the Tech support, and with everything else: Praads, Biks, Pri, Prinks, Kavi for the encouragement.

My 'JASRRA' girls: Akri, Mum and Sass; for all the great times. Deika! For being my Data collection partner and helping me pull through! Amazing people like Barj, Jum, Pathu, Ruch, Naayi, Reshli- Thank you for making hostel life what it is! ☺

I’m very lucky to have amazing seniors like Pavi akka, Jagh, and Rajith Sir, who’ve been constantly motivating me.

I thank Bunty for being a great support and Animan, for tech support with playlists.

Special thanks to the ‘Sustainers’, ‘Lunatics’ and ‘Phoenix’ for the memories made.

I would like to thank everybody that directly or indirectly helped me through the course of the study!

My sincere thanks to the Director of AIISH, for giving me the opportunity to carry out this research.

Above all, I thank the Almighty.

Table of Contents

List of Tables

List of figures

CHAPTER I

Introduction

Communication may take place through many primitive modes such as non-verbal gestures, blinking, vocalizations, etc. *Language is the use of a sophisticated set of symbols for communication.* The human language is a highly evolved code that functions through the coordination of intricate systems that originate from the neural network. A vital part of any language is the words. The humans have an astounding amount of vocabulary in their store, in order to use these languages effectively. Thus, comes about a substantial question regarding where it is all stored, and the way in which it is organized in this storage is. In order to inspect this, we would need to have an understanding of the formal aspects of language:

Language is inclusive of the following aspects- Phonology, Morphology, Syntax, Semantics, and Pragmatics. Semantics is the branch of language concerned with the study of meaning. (Breal, 1897) Study of the meaning of language may be further branched to include lexical semantics, grammatical semantics, and logical semantics. Grammatical semantics relates syntactic aspects to the meaning. Logical semantics links the logical systems to language while; lexical semantics is the study of association of word to meaning. The current topic is centered on the lexical semantic relations shared by the words in the lexicon. The study of the lexical semantic organization is an indispensable part of a study of language because words are not stored in isolation, but in relevance to each other, based on various properties they share, concepts, contexts in which they are linked, etc. Hence this is an important aspect in order to decipher the lexicon.

According to Fasold.R & Connor-Linton (2006), the sense of relation between the words in the lexicon may be studied in broader terms of **three major classes**, namely: **paradigmatic, syntagmatic, and derivational**. Paradigmatic relations are found between words that belong to one category. These may also be termed as taxonomic associations or linear relationships, example: category co-ordinates (cat- dog- goat). Syntagmatic relationships are thematic associations or horizontal relationships, example: co-occurrence based (dog- leash- bone). Paradigmatic relationships may be exercised under syntagmatic relationships. Derivational relations are a third class of association in lexical semantics, where word classes or families are a common point of origin, example: Cook, cooker, cooking, etc. These words maybe separated by the use of affix amidst them. Among the three classes of relations mentioned above, paradigmatic and syntagmatic relations have been widely explored. Borghi, Caramelli and Setti (2016), in their study of the lexical semantic organization in the developmental population, further proposed an inclusion of two broader categories to classify the semantic relationships; namely: Attributive and Evaluative responses.

Attributive relations refer to perceptual/ physical characteristics and part-whole relationships shared between words. Eg: Pillow- Cotton, Cotton- white/ soft, etc.

Evaluative relations refer to experience or thoughts that are internalized, generalized sayings, idioms, etc. Eg: Candy – Really like/ bad health. The semantic relations listed above may be inspected through various perspectives including neurolinguistic and psycholinguistic realms. The literature has

mentions of these two methods, a majority slightly tilted toward the psycholinguistic aspects. This brings us to the need for the current study.

1.1 Need for the study

The lexical semantic organization has witnessed a wide array of developmental trends through the existing literature. The focus for many years has been studying lexical semantic organization in children. Consequently, there is a *dearth of literature* concerning the lexical semantic organization in adults and aged individuals. The implications of the proposed study will have great bearing in gaining theoretical knowledge of the lexical semantic organization through the *most common response, in typical adults and the effects of senescence on the same.* This study will be a preliminary attempt to investigate the lexical semantic organization in neurologically healthy adults and *compare the responses* to those of younger and middle-aged and older individuals.

There have been no prior attempts made to compare the variance in response over *different modalities* of stimulus presentation in free word association task. Thus, the difference between visual and auditory mode of presentation, need to be examined, warranting the need for this study.

1.2 Aim

The aim of the present study is to compare the adult lexical semantic organization across age groups, through a discrete association task.

1.3 Objectives of the study

To investigate the responses of a Discrete Association Task in neurologically healthy individuals, to study:

1. Lexical semantic Organization as a function of aging and gender.
2. Lexical semantic Organization with respect to the modality of stimulus presentation
3. To determine the Most Common Responses (MCR) for visual and auditory word list.

1.4 Hypotheses

Null hypotheses- H_0

i. There is no difference in the lexical semantic organization as a function of aging or gender

ii. There is no difference in lexical semantic organization with respect to the modality of stimulus presentation

iii. There is no difference in the response category of most common responses across visual and auditory stimuli.

The next chapter in this dissertation presents an outline of the existing views in literature, by summarizing past research in this area. The chapters to follow describe the methodology (Chapter 3) followed in order to inspect the above-mentioned hypotheses, followed by a detailed report of the results (Chapter 4) and summary (Chapter 5) of the findings.

CHAPTER II

Review of Literature

The lexical semantic organization has been extensively studied over the course of decade's worth of literature in the developmental population, as previously established. This also proposes a trajectory of the shift in dominance of one kind of organization, through the course of childhood, but very few instances are available of this trend being tracked over the course of adulthood. To begin with, a profound appreciation of storage of the concepts in the lexicon is necessary, this is provided by models of Semantic organization. In an attempt to gain insights into lexical semantic organization, here are a few models that have been proposed to explain how this organization takes place in the mental lexicon:

According to a study by Prarthana and Prema, (2012), on the façade, theories of mental lexicon may be viewed as representing a holistic front, or the attributes of the words.

2.1 Attribute/ Feature-based models include: semantic feature comparison model.

2.2 Holistic models may include: Hierarchical Network model, spreading activation model, Adaptive character of thought model, Compound cue model, Distributed Memory model, WordNet model, Statistical models, etc.

2.1 Feature-based Models

2.1.1 Semantic Feature Comparison Model.

This was proposed by Smith, Shoben and Rips (1974) to predict the lexical semantic organization. It proposed that words are stored based on their features. They maybe of two kinds: defining and characteristic. The defining features are those that are absolutely essential in order to be classified (Giving birth to young ones- mammals), whereas characteristic features are those that may or may not be present, and are the unique features (egg laying mammal-platypus). Thus, this model was seen to be successful in predicting the ways of organization of the mental lexicon, but could not account for lack of feature based output.

2.2 Holistic Models

2.2.1 Hierarchical Network Model.

It was put forth by Collins and Quillian (1969), to explain the storage and retrieval mechanisms in Lexical storage. It proposed the existence of a network of words related by commonly shared concepts, put as nodes. This model proposed three tiers of relationships:

The connection was said to happen in two logical ways, namely: category membership relation and property relation. In the former relation, an outline of how as to the words were linked is suggested, and in the latter, the attributes of that are shared by items in a hierarchy are suggested.

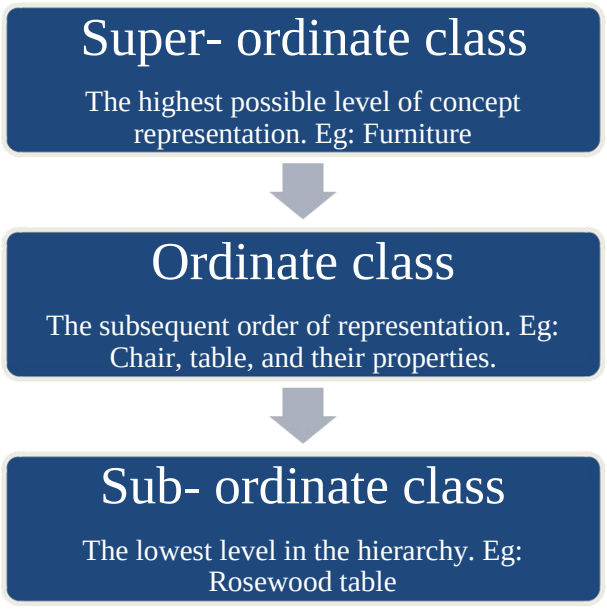


Figure 1 Schematic representation of Hierarchical Network model

The base of this model is rooted in the principle of cognitive economy. This postulates that common information (property) is stored at only at one level (the highest level). Many subsequent behavioral investigations (Conrad, 1972) negated the validity of this principle, as it failed to explain many aspects including that of familiarity effect. Thus, this theory could not stand to explain all the aspects of a functioning mental lexicon.

2.2.2 Spreading Activation Model.

The spreading activation model (Collins and Loftus, 1975) designates words to be organized in an interconnected nodal network. It works on the principle of familiarity and relatedness i.e., more commonly recognized and closely related words are activated more strongly. The above mentioned nodes have networks and are activated based on strength of the relatedness and distance amongst words. Thus, when one node is activated, many nodes are triggered in parallel; but only the strong nodes remain intact. The strongest nodes that are triggered

are said to be primed. Hence, the relationships that words share become significant. This model is effective, as it helps in projecting the **storage and processing** aspects of Semantic Memory. The connected nodes in the model help in deciphering association and explain associative priming, better.

This model is widely accepted as it can account for a number of events including- familiarity effect, typicality effect, etc.

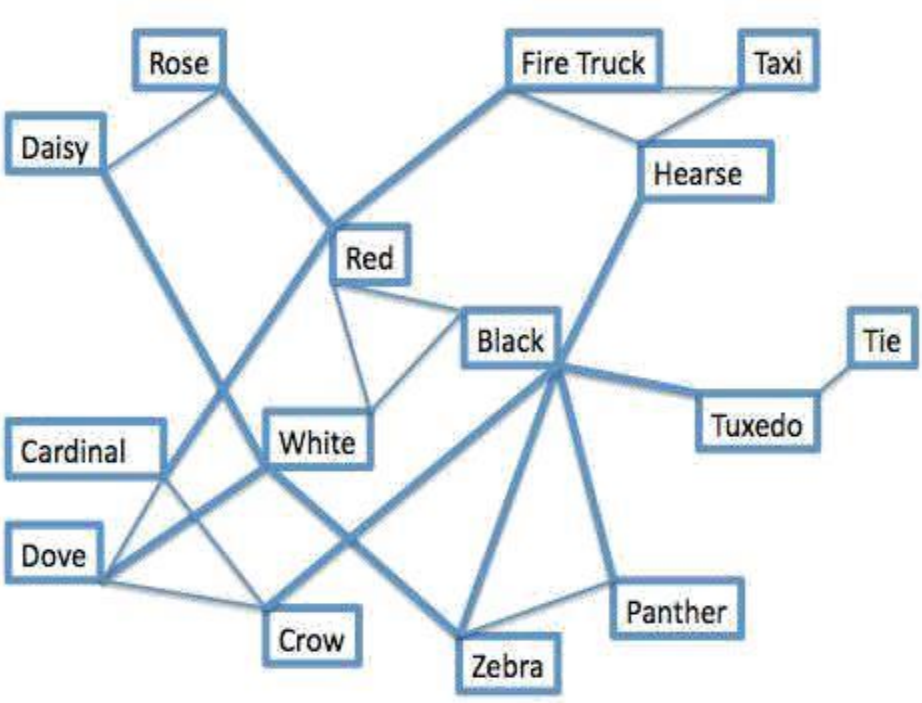


Figure 2 Schematic representation of the spreading activation model (Source: Collins and Loftus, 1975)

2.2.3 Adaptive Character of Thought (ACT) Model.

This computational model was proposed by Anderson (1976), and it includes aspects of the Spreading activation model linked to an execution system for production. The model proposes that concepts are stored in isolation, unrelated

to words, but words are associated to concepts in their storage, thus stating that contextual and environmental influence of words in the storage.

2.2.4 Compound Cue Model (Ratcliff & McKoon, 1988).

The **compound cue model** describes lexical semantic activation as a comparison that occurs between cues in the Short Term Memory vs. the Long Term Memory. As soon as a word (prime) say X, is delivered, a compound cue (Y) is generated in the Short term memory. The prime and the generated cues (X-Y) are subsequently compared to those that previously exist in the Long term memory. Hence, in the Long term memory, X-Y, as a pair would generate stronger associations than R-S or X-R, etc. Thus, this model also relies on familiarity and relatedness of previously learned associations. The difference between the Spreading activation model and the current is the inclusion of Short term memory processing.

2.2.5 Distributed Memory Model (Masson, 1991, 1995).

Distributed Memory Model proposed by Masson, 1991, was originally derived from the Hopfield net (Hopfield, 1982). This model proposes that storage occurs in terms of a network of concepts, interlinked to each other, and assumes only one level of processing as opposed to the connectionist principles (Input- hidden layer- Output). The stronger linkages are said to be triggered in a simple yes/ no format, and these linkages are further fortified by learning because of the additive nature of its functioning. After repeated triggering by a particular prime, learning is complete and stabilization occurs.

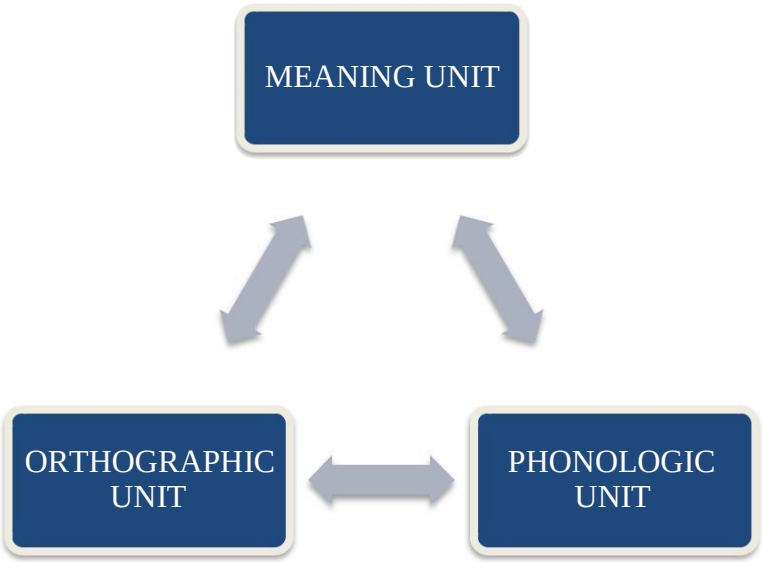


Figure 3 Schematic representation of modules in distributed memory model

2.2.6 WordNet Model.

In 1995, Miller proposed an electronic database based on the principles of the Hierarchical network model. This functions by storing the words in the form of synonyms knows as- Synsets, and when to rectify the fact that not all words may share the same synonyms, the concepts of hyponymy and hypernymy were suggested, to further expand the organization. The drawbacks of this model include the fact that it can't account for the use of lexicon at the discourse level.

The above described semantic models of lexical semantic organization don't account for all the functions of the lexicon; hence this gave rise to statistical models, listed below:

2.2.7 Featural and Unitary Semantic Space Model.

This model was put forth by Vigliocco, Vinson, Lewis and Garrett (2004). This gives importance to organization being modality based and feature- wise representation of concepts. It assumes that concepts are linked to other linguistic aspects (Phonology, morphology, syntax) through the lexical semantic association.

Thus, lexical semantic organization maybe partly understood through the above mentioned prominent models. The conceptual structuring of the lexicon, maybe viewed in the following manner i.e.; through hierarchical/ context based/ egoistical/ feature- based, affiliations. The samples provided in the available works of literature suggest that majority of it has assessed the hierarchical and context based mode of organization.

The above established relationships between words and conceptual organization of the same in the lexicon maybe viewed through various perspectives. A few of them have been summarized:

A few *neurolinguistic investigations* that suggest the dominant views of organization are summarized below:

The neuro-anatomical correlates of taxonomic and thematic responses have been studied by Sachs et al. in 2008, using fMRI. They employed a lexical decision task with short stimulus onset asynchrony (200ms), across four conditions- thematically related, taxonomically related, unrelated and nonsense words, and made use of the imaging data to predict the neuro-anatomical correlates of the related words. They concluded that thematic associations

activate cortical areas such as: left inferior frontal, middle temporal and occipital regions, while taxonomic associations activated right middle frontal gyrus, left precuneus and left thalamus. A recent neurolinguistic study was conducted through Magnetoencephalography, while employing a taxonomically and a thematic based priming task. Its findings suggested that the Anterior Temporal Junction is linked to taxonomic association, while thematic associations activate Temporo-Parietal Junction. (Lewis, Poeppel, & Murphy, 2015).

Inference: Hence, thematic and taxonomic associations may be viewed as *two different facets,* because several neurolinguistic studies suggest varied neural activation pathways for the two.

A few works of literature in this context have addressed the modality based differences that exist in lexical semantic organization:

Holcomb and Neville (1990) explored the above using an Event-related Potential (N400), and found that auditory modality has an early onset latency, and is more persistent over the visual modality.

Fischer, Daltrozzo, and Zumbusch, A. (2011) gave support to the above findings through a lexical decision task.

The available literature concerned with exploring *developmental aspects* of lexical semantic organization is in abundance. There are studies that support the occurrence of a "shift hypothesis" in children.

At a younger age, taxonomic and thematic associations are present, (Waxman & Gelman, 1986). Younger aged children prefer thematic relations (event-based co-ordinates) over taxonomic connections (category co-ordinates) on cued and serial recall tasks. The taxonomic associations are bolstered by the

fast development of vocabulary at that age. Owing to the expansion of vocabulary in the pre-school period, children have a change in the tendency to prefer taxonomic over thematic associations. This phenomenon has been termed as the *shift hypothesis*. As the child's vocabulary develops, the words are organized hierarchically and stronger relationships amongst certain concepts emerge over time.

In the Indian context, notable studies suggest the plausibility of the shift hypothesis in developmental aspects.

Chithra and Prema, 2008, investigated the lexical semantic organization in bilingual children of age 6-8 years. Repeated word association task with thematic and taxonomic examples was administered, and the results of the study indicated that children at 6 years of age dominantly associated thematically, and in the developing years, a paradigmatic (taxonomic) shift was noticed.

Thus, this is in support of the association shift paradigm in children.

A few studies have attempted to investigate the *lexical semantic organization in children and compare the results with those of adults:*

In an investigation by Smiley & Brown in 1979, where they employed a match-to-sample task, in which the participants were forcibly asked to match the given stimuli to either a taxonomically or a thematically related item, found that *children and the elderly prefer thematic relationship*, whereas *adults* have a preference towards *taxonomic matches*. In contrast to the above study, Radeau in 1983 compared the semantic organization between adults and children, through a lexical decision task. The method employed used

semantically related and unrelated word pairs to verify the effects of semantic priming. Through the findings, he concluded that the semantic organization in children beyond 6-7 years of age could be equated to that of adults'. This is in a continuum with the shift hypothesis mentioned in children there have been few mentions in the literature about the preferential associations in adults.

Thus, there have been very few attempts in the past to establish the semantic associations *beyond the developmental frame,* and those that exist are *inconclusive.* Further, the methods frequently used to study the associations have been a *closed set task* including matching, sorting or recall tasks. This has the potential to *bias* the participants and affect the results.

A study by Murphy in 2001 has proven this by comparing tasks involving stimuli that were strongly taxonomically organized with stimuli that were strongly thematically organized, and the participants were asked to perform a sorting task. The adult participants preferred taxonomic association in the former task and thematic associations in the latter. Hence, the method of testing and the stimuli have always played a major role in identifying the associations under test.

Landrigan and Mirman, (2016) conducted an online survey wherein the participants were supplied with a questionnaire that contained 659-word pairs and they were asked to rate them as being taxonomically or thematically related with two different set of instructions. The results revealed that the participants rated the stimuli as being dominantly taxonomic/ thematic, based

on the instructions given before each task, thus affecting the outcome of the data.

Inference: Thus, it is seen that closed set task may cause bias.

A new approach will aid in gaining another perspective in the adult lexical semantic organization, as the current literature has but modest answers. Hence *open set association* tasks will serve the purpose of establishing the lexical semantic organization. These include free word associations, discrete word association tasks etc. These terms may be defined as:

Free word association task- Participants are asked to list as many words that come to their mind, as soon as they are presented with stimuli.

Discrete word association task - Participants are asked to list as many words that come to their mind, in relevance to the presented stimuli, as it is being presented.

There have been attempts to make word association norms for children and adults (e.g.: Palermo & Jenkins, 1964), but very rarely in older. Some of the earliest views comparing the elderly with the younger demographic, on word association task, stated: "They are represented better by hierarchies of association principles that differ in the probability of use, rather than by hierarchies of specific word-word affinities" (Moran & Swartz, 1970). In 1982, Lovelace and Cooley studied free association in older adults and revealed that the *associations were affected by vocabulary, irrespective of the age.*

One of the early views to oppose the above findings included those of Riegel and Riegel (1964), and Bolton and Hamison (1975), who employed a free association task, to compare the younger and elder population, where they concluded that word relationships in the semantic memory affects the association to a given word, and this may be affected with increased age.

In 1979, Perlmutter compared younger and older adults, with mean ages 20 and 63, respectively, in a free association task, and found that the *elderly participants produced less commonly associated responses, with less consistent responses in repeated trials*, as opposed to their younger counterparts. Thus, suggesting *differences across age groups.*

Since then, there have been more support from works of literature, such as *Burke and Peters* **(**1987), made an attempt at making word association norms for younger (mean age- 21.7 years) and older adults (mean age – 71.6 years). The two groups were asked to give out relevant words to the stimuli presented, which included verbs, nouns and adverbs. The auditory stimuli presented were simultaneously augmented with visual stimuli on a card.

The participants were not restricted in terms of the number of responses for each word. The results took into account three most common responses in each group under investigation.

The study revealed that the three most popular responses had a *high variability index* of *39.5%,* which further strengthens the impression that there may be a variation in responses between the younger and the older population, which are yet to be explored. In 2014, a study by *Zortea et al.,* aimed to investigate age-related differences among children, adults and the elderly through a word association task. Graphical analysis of the responses obtained suggested that

the there was an increase in the connectivity of the network across age, reaching its peak in young adults and a slight decline was witnessed in the elderly.

The existing literature illustrates that a few attempts have been made at comparing the *typical and atypically aging population.* The typically aging individuals are shown to have a mild increase in multi word responses to lexical naming tasks due to word finding difficulty. (Loon-Vervoorn &Willemsen,1987). Fitzpatrick, Playfoot, Wray and Wright in 2015 compared word association responses between the elderly population with and without dementia and reported that the elderly tended to give multi-word responses and blank response. These findings further fortify the plausible shift in word association due to word finding and retrieval difficulty due to aging.

In the context of Indian literature, a few studies in the recent years have made use of *free association task in order to explore the semantic organization in developmental population.* These include:

Nithya and Prema, 2017, who compared children across 6-9 years of age using free association task on a set of abstract and concrete word stimuli and the results were suggestive of a dominant attributive, relationship, followed by the taxonomic, introspective and thematic relation in the case of concrete words.

Ashwini and Abhishek, 2017- Employed the same methodology to compare nouns, in children of 4-7 years of age, and found a more dominant thematic relationship, as opposed to taxonomic.

A noteworthy attempt to explore the lexical semantic organization in Indian adults through word association task was made by Prarthana and Prema

(2013). The study aimed to determine the mental lexicon for nouns and verbs in adult speakers of Kannada. The participants were given concrete and abstract nouns and verbs. They were asked to give out words which came to their mind as soon as the target stimulus is presented. The responses were analyzed and a set of possible words associating with the target word were determined.

In summary, the past research has established many views on the organization of the mental lexicon in the developing population, with an auxiliary role played by the Indian literature. There have been very few works that focus beyond the developmental frame. To add to this, in the available reports of adults, there have been rare employments of open set tasks to investigate the Lexical semantic organization. In addition to the existing need to explore the domain, there have been very few mentions of open set stimuli based association task to explore the lexical semantic organization in typical adults, *in the Indian scenario.* Thus, the current study will serve as a preliminary attempt to explore the lexical semantic organization in typical adults and compare it to aged individuals.

CHAPTER III

Method

In reference to the review ensconcing the need to study the lexical semantic organization in adults, the present study aimed to investigate lexical semantic organization in four groups of participants, ranging between the ages of **20- 60** years. Henceforth, the participants from -20- 30 years, 30- 40 years, 40 to 50 years, 50 to 60 years; will be referred to as – Group I, Group II, Group III, and Group IV, respectively. This categorization will facilitate the study of Lexical semantic organization in terms of aging.

The task was carried out using auditory and visual stimuli, in order to explore the diversity in responses through the two modalities. 20 words each were used to elicit responses through both the modalities. The test was counterbalanced by exposing the participants alternately to auditory and visual stimuli in different order for different participants. The responses were categorized based on the semantic relationship to the stimulus.

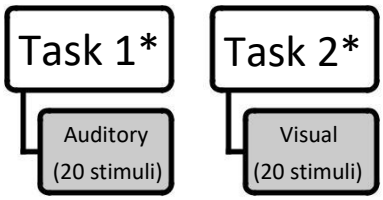


Figure 4 Schematic representation of Task 1 and 2

*The order of Task 1 and 2 will be interchanged to facilitate counterbalancing.

3.1 Hypotheses

Null hypotheses- H_0

i. There is no difference in the lexical semantic organization as a function of aging or gender
ii. There is no difference in lexical semantic organization with respect to the modality of stimulus presentation
iii. There is no difference in responses across visual and auditory stimuli.

3.2 Study design

The study design used was standard group comparison.

3.3 Participants

A group of 80 neurologically healthy individuals, who were native speakers of Kannada, between the ages of 20- 60 years, served as participants in the study. A total of 20 participants (10 male and 10 female) were included through *convenience sampling* under each age group. All the participants were enrolled in the study through prior informed consent.

Table 1a *Participant details of group I*

Participant Number	*Age (Years) / Gender*	*Education*
1.	***20/M***	***Higher secondary***
2.	***21/M***	***Bachelor's degree***
3.	***22/M***	***Bachelor's degree***
4.	***23/M***	***Bachelor's degree***
5.	***24/M***	***Bachelor's degree***
6.	***24/M***	***Bachelor's degree***
7.	***25/M***	***Higher secondary***
8.	***26/M***	***Master's degree***
9.	***27/M***	***Master's degree***
10.	***29/M***	***Higher secondary***

11.	***20/F***	***Bachelor's degree***
12.	***22/F***	***Higher secondary***
13.	***23/F***	***Bachelor's degree***
14.	***23/F***	***Bachelor's degree***
15.	***24/F***	***Higher secondary***
16.	***25/F***	***Bachelor's degree***
17.	***25/F***	***Master's degree***
18.	***27/F***	***Bachelor's degree***
19.	***27/F***	***Bachelor's degree***
20.	***28/F***	***Bachelor's degree***

Table 1b *Participant details of group II*

Participant Number	*Age (Years) / Gender*	*Education*
1.	***30/M***	***Bachelor's degree***
2.	***32/M***	***Bachelor's degree***
3.	***32/M***	***Bachelor's degree***
4.	***33/M***	***Master's degree***
5.	***34/M***	***Bachelor's degree***
6.	***35/M***	***Master's degree***
7.	***35 /M***	***Bachelor's degree***
8.	***36/M***	***Master's degree***
9.	***36/M***	***Bachelor's degree***
10.	***39/M***	***Higher secondary***

11.	***30/F***	***Master's degree***
12.	***30 /F***	***Bachelor's degree***
13.	***31 /F***	***Bachelor's degree***
14.	***32 /F***	***Higher secondary***
15.	***32/F***	***Bachelor's degree***
16.	***34 /F***	***Bachelor's degree***
17.	***36/F***	***Bachelor's degree***
18.	***37 /F***	***Higher secondary***
19.	***38 /F***	***Bachelor's degree***
20.	***39/F***	***Higher secondary***

Table 1c *Participant details of group III*

Participant Number	*Age(Years)/ Gender*	*Education*
1.	***40/M***	***Bachelor's degree***
2.	***41 /M***	***Bachelor's degree***
3.	***42 /M***	***Bachelor's degree***
4.	***43 /M***	***Bachelor's degree***
5.	***43 /M***	***Higher secondary***
6.	***44 /M***	***Higher secondary***
7.	***45 /M***	***Higher secondary***
8.	***46 /M***	***Bachelor's degree***
9.	***46 /M***	***Bachelor's degree***
10.	***49/M***	***Higher secondary***
11.	***41/F***	***Master's degree***

12.	***41 /F***	***Bachelor's degree***
13.	***42 /F***	***Bachelor's degree***
14.	***43 /F***	***Bachelor's degree***
15.	***44 /F***	***Higher secondary***
16.	***45 /F***	***Higher secondary***
17.	***46 /F***	***Higher secondary***
18.	***46 /F***	***Bachelor's degree***
19.	***47 /F***	***Bachelor's degree***
20.	***49/F***	***Higher secondary***

Table 1d *Participant details of group IV*

Participant Number	*Age(Years)/ Gender*	*Education*
1.	***51/M***	***Bachelor's degree***
2.	***52 /M***	***Higher secondary***
3.	***52 /M***	***Higher secondary***
4.	***53 /M***	***Higher secondary***
5.	***54 /M***	***Bachelor's degree***
6.	***56 /M***	***Bachelor's degree***
7.	***56 /M***	***Higher secondary***
8.	***58 /M***	***Higher secondary***
9.	***59 /M***	***Bachelor's degree***
10.	***60/M***	***Bachelor's degree***
11.	***51/F***	***Bachelor's degree***

12.	***51 /F***	***Higher secondary***
13.	***52 /F***	***Bachelor's degree***
14.	***53 /F***	***Higher secondary***
15.	***54 /F***	***Bachelor's degree***
16.	***55 /F***	***Higher secondary***
17.	***56 /F***	***Higher secondary***
18.	***57/F***	***Higher secondary***
19.	***59 /F***	***Higher secondary***
20.	***60/F***	***Bachelor's degree***

3.3.1 Inclusion criteria

The inclusion criteria of the participants were as follows:

Initially, **demographic details** of the participants in terms of age, gender, education, occupation, were collected to verify their criteria to be categorized in a group for the study.

Table 2 *Inclusion criteria for participants*

Cognitive status*	Intact, no history of cognitive communicative deficits
Literacy **	More than or equal to 10 years of education
Physical status	Intact
Mother tongue	Kannada

*Cognitive and general health status was determined by Physical Health Questionnaire.

*Literacy level in the inclusion criteria was set as mentioned above as it has been sourced through literature that children with more than six years of education perform more closely to adults in association tasks, than adults who lack literacy. (Cole, 1990; Nelson, 1977)

3.4 Stimuli

All the participants were given a **discrete association task**, wherein they were asked to list five words, relevant to the presented stimulus.

The experiment consisted of two tasks: One task had twenty visual stimuli; the other included twenty auditory stimuli.

The words for both the tasks were included after referring to the Snodgrass picture list (1980). Words appropriate to the Indian context were chosen by two Kannada speaking Speech-language pathologists. All the words are

concrete, picture-able, **nouns**, across various lexical categories -animals, common objects, food items; in order to elicit responses.

The **visual stimuli** were colour photographs, sourced from Internet web pages and presented on a laptop (HP Pavilion g6) with 15.6" monitor. They were presented at a comfortable distance of 15" from the participants.

Example:

Figure 5 Examples of Visual stimuli representing: /mara/ , /koduglu:/

The **auditory stimuli** were presented using recorded samples of the stimuli. A few words include:

1. Shirt /angi/
2. Eagle /hadu/

3.5 Procedure

The study included neurologically healthy individuals aged between 20- 60 years and organized as four groups. The participants were instructed to list **five** words relevant to the presented stimulus. The stimuli consisted of twenty pictures presented through visual modality, presented through Microsoft PowerPoint (version 2010), and twenty auditory stimuli presented using recorded samples of the stimuli, by the investigator.

3.5.1 Task.

Each participant was presented with a total of twenty visual and twenty auditory stimuli. They were instructed to name five words relevant to each presented stimulus, and instructed to do so in Kannada.

3.5.2 Instructions.

3.5.2.1 Instructions for visual stimuli.

“Now I will show you a few pictures, as soon as you see a picture, I want you to name it and then list five words related to it, in Kannada. Example: (shows a picture of a flower) flower– tree, water, rose, hibiscus, garden. Similarly, I want you to name five things relevant to the picture, as soon as you see it.”

/Iga na:nu nimge kelu chitragaluna torsti:ni, a:ga ond chitrana noditakshana adana hesaru heli, aamele ad bage, kanadadalli aidu pada helbeku. Example: hu:vu- mara:, ni:ru,:, gula:bi, da:sva:la, udyana. Ade tara, nimge a: chitrana noditakshana en anstaidiyo, aduna helbo:du/

3.5.2.2 Instructions for auditory stimuli.

“Now I’ll play a few words, one by one. As soon as you listen to a word, I want you to list five words related to it, in Kannada. Example: flower– tree, water, rose, hibiscus, garden. Similarly, I want you to name five things relevant to the word, as soon as you hear it.”

/Ivag na:nu nimge ond- onda:gi padagalna play ma:dti:ni. Ondu padana kelitakshna, adubage aidu padana, Kanadalli helabeku. Example- hu:vu anta bandre- mara:, ni:ru,:, gula:bi, da:sva:la, udyana. Ade tara, nimge a: padana kelitakshana en anstaidiyo, aduna helbo:du/

The participants were given examples as mentioned above with the instructions only in Task one. The participants were **not** restricted by time, for either of the tasks. They were **not** provided with cues during the procedure. The order of presentation was visual mode followed by auditory mode, in some, and vice versa in the others. The participants were familiarized with the task and provided with **repeated instructions** to provide single word responses, despite this a **few participants** were seen to give **multiword responses**.

3.5.3 Test Environment.

The testing was carried out in a well-ventilated room with minimal intrusion from noise or light. The participants were seated comfortably throughout the duration of testing.

The responses were recorded by the investigator using a voice recorder, at the time of testing, for convenience. It was later be transcribed for analysis at a later period.

3.6 Analysis of data

The responses obtained from the aforementioned procedure were analyzed to compare:

The responses obtained from the participants were entered as being one of the following categories: Thematic, Taxonomic, Attributive, or, Evaluative, in relation to the stimuli. This method of analysis has been previously carried out in a study to discern the lexical semantic organization in the population by Nithya and Prema, 2017.

The inclusionary criteria as to what each of the categories would include have been put forth by Borghi, Caramelli and Setti, 2016:

Thematic relation- This encapsulates the following:

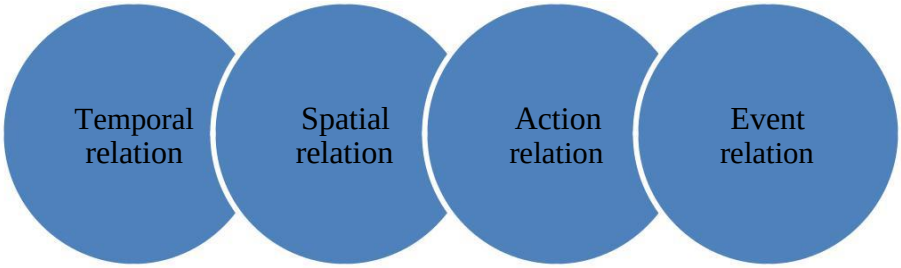


Figure 6a Components of thematic relation

Temporal relation- such as Leaf: autumn

Spatial relation – such as Chair: house

Action relation – such as Chair: sit

Event relation – such as Chair- coronation

Taxonomic relation- The following may be included:

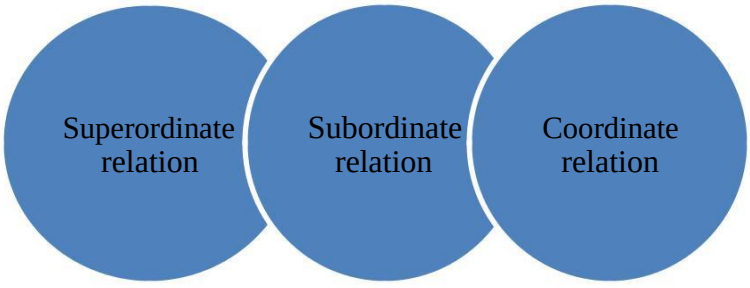


Figure 6b Components of taxonomic relation

Superordinate relation- such as Owl- bird

Subordinate relation- such as Owl- barn owl

Coordinate relation – such as Owl- pigeon

Attributive relation- The following conditions may be included:

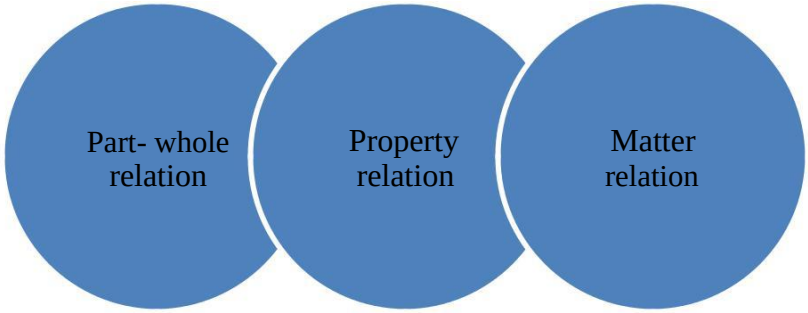


Figure 6c Components of attributive relation

Part- whole relation - such as Flower- garland

Property relation – (colour/ shape/ size) such as Flower- green/ round Matter relation – such as Chair- wood

Evaluative relation- The following were included:

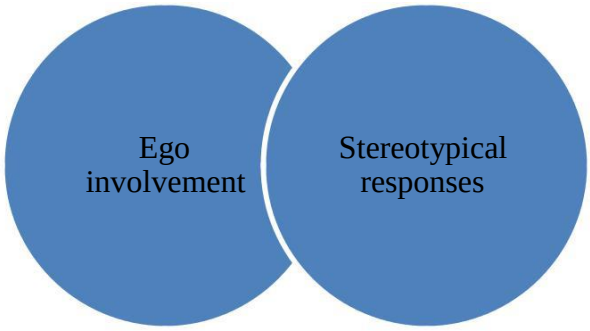


Figure 6d Components of evaluative relation

Ego involvement – such as Porcupine- I think that it's scary

Stereotypical responses – such as Owl- It is believed that it brings bad luck

When any of the above rules were satisfied, the response was classified under any of the four respective categories.

In the available literature, this classification has been employed for analyzing lexical semantic relations in the developmental population; but as the data was

apt and included all the aforementioned relations, the classification was deemed appropriate for a more elaborate analysis.

The data was thus analyzed by the primary investigator and initially transcribed to Microsoft Excel- 2010, where it was categorized into the most appropriate response categories. This was further verified by two other speech-language pathologists and the following was noted:

a. Variations across the four age groups or between the two genders considered, and the differences in them, if any.
b. To determine the relation of the lexicon to the stimuli, and were classified based on semantic associations, as being thematically/ taxonomically related
c. Variations in the auditory and visual presentation of the stimuli, if any.

3.7 Statistical analysis

The data was subjected to the following statistical procedures:

I. Descriptive statistics for the computation of Mean, Median and Standard deviation, and test of Normality (Shapiro Wilk test and Kolmogorov-

II. Non- parametric statistical tests:

1. Kruskal- Wallis test- To investigate the age-based differences
2. Mann- Whitney U test- To investigate gender-based differences and pairwise comparison of age groups, in case of significant differences
3. Friedman’s test and Wilcoxon Signed Ranks test- To investigate the modality- wise variation

4. Qualitative analysis- In order to ascertain the Most Common Responses, across response categories.

CHAPTER IV

Results & Discussion

The present study aimed at investigating the adult lexical semantic organization. The main objective of the study was to investigate the lexical semantic organization as a function of aging and gender. The secondary objectives included studying the lexical semantic organization with respect to the modality of stimulus presentation and third objective was to determine the Most Common Responses (MCR) for visual and auditory word list. The first step towards the objectives described was to classify the responses obtained in one of four categories: Thematic, Taxonomic, Attributive, and Evaluative. The responses were classified based on the definitions given by Borghi, Caramelli and Setti (2016); by the investigator.

The independent variables included in the current study were: age, gender, modality of task presentation and the dependent variables included the categories of lexical semantic organization (Thematic, Taxonomic, attributive, and evaluative)

The number of responses in each of the categories was calculated, and the number of responses given by each participant was different, in spite of repeated instructions given while obtaining the responses, due to lack of adherence to the word limit (5 words). Thus, percentages of the same were calculated in order to facilitate comparison of the four categories of responses mentioned above.

A standard group comparison was carried out with the data. Gender differences were calculated with age as an independent variable and age differences were calculated with gender as an independent variable. Further, task differences within each modality, according to the age and gender, were calculated in order to find the dominant pattern of lexical semantic organization.

Statistical analysis was carried out with SPSS software 20.0. Test of normality was initially carried out using Shapiro Wilk test of normality and Kolmogorov- Smirnov test. The data failed to follow normality with four significant outliers that affected the median value, hence the outliers were removed and further analysis was carried out using non- parametric tests.

The objectives of the study were in the following order:

To investigate the responses of a Discrete Association Task in neurologically healthy individuals, to study:

i. Lexical semantic Organization as a function of aging and gender.
ii. Lexical semantic Organization with respect to the modality of stimulus presentation
iii. To determine the Most Common Responses (MCR) for visual and auditory word list.

The following analysis was done in order to address the above-mentioned objectives:

i. Comparison across age and gender- with the use of descriptive statistics and specific statistical tests.
ii. Comparison across modality of stimulus presentation
iii. Most common responses

4.1 Objective 1

To investigate the lexical semantic organization as a function of aging and gender:

4.1.1 Comparison across age, gender and modality of stimuli.

In order to compare the above, the following tables have been displayed:

Descriptive values- for all age groups

The mean, Standard deviation and median values are displayed below:

Table 3a *Descriptive values for Group I*

AGE GROUP	RESPONSE CATEGORY	MALE			FEMALE		
		MEAN	S.D.	MEDIAN	MEAN	S.D.	MEDIAN
20- 30	ThA_P	83.70	7.81	82.50	68.44	10.40	69.00
	ThV_P	71.50	10.09	71.00	62.11	10.49	59.00
	TA_P	10.30	6.05	8.50	18.33	8.06	19.00
	TV_P	9.90	4.38	9.50	17.00	8.52	18.00
	AA_P	4.50	5.10	2.00	10.88	6.47	11.00
	AV_P	7.60	5.10	6.00	17.00	8.57	20.00
	EA_P	1.80	2.25	1.00	1.88	2.42	1.0000
	EV_P	10.80	9.11	8.50	4.00	3.74	3.0000

Table 3a contains the descriptive values for Males and Females of 20- 30 years of age. The mean values in *males* display a trend of highest to lowest values from Th- T- A- E, with the exception of Evaluative visual (10.8) which was higher than Attributive visual category.

Percentages of the following responses were calculated: ThA- Thematic Auditory, ThV- Thematic Visual, TA- Taxonomic Auditory, TV- Taxonomic Visual, AA- Attributive Auditory, AV- Attributive Visual, EA- Evaluative Auditory, EV-Evaluative Visual

The median followed the same trend as that of the mean. In *females*, the order of mean of the response categories was same as in males (Th- T-A-E), and the median followed the same direction as that of the mean. The numerical values greatly differed across genders, and modalities.

The following Table (3b) gives the following information regarding the males and females of 30- 40 years. The mean values in *males* display a trend of highest to lowest values from Th- T- E- A in the auditory modality, and Th- A- E- T, in the visual modality.

Table 3b *Descriptive values for Group II*

AGE GROUP	RESPONSE CATEGORY	MALE			FEMALE		
		MEAN	S.D.	MEDIAN	MEAN	S.D.	MEDIAN
30- 40	ThA$_P$	74.10	9.19	75.50	69.88	4.781	70.00
	ThV$_P$	64.60	12.57	69.00	57.55	15.51	57.00
	TA$_P$	12.10	6.69	12.50	11.88	4.22	13.00
	TV$_P$	9.90	4.43	9.50	10.11	4.85	12.00
	AA$_P$	3.10	2.84	2.50	2.77	2.38	2.00
	AV$_P$	15.20	11.52	14.50	17.44	15.96	13.00
	EA$_P$	10.20	12.31	6.50	15.66	5.52	15.00
	EV$_P$	10.30	8.21	9.50	15.00	4.76	15.00

Percentages of the following responses were calculated: ThA- Thematic Auditory, ThV- Thematic Visual, TA- Taxonomic Auditory, TV- Taxonomic Visual, AA- Attributive Auditory, AV- Attributive Visual, EA- Evaluative Auditory, EV-Evaluative Visual

The median followed the same trend as that of the mean. In *females*, the order of mean of the response categories was Th-E-T-A in the auditory modality, with a difference in order of Taxonomic and Attributive in the visual modality, and the median followed the same direction as that of the mean. The values differed across genders, and modalities.

Table 3c *Descriptive values for Group III*

AGE GROUP	RESPONSE CATEGORY	MALE			FEMALE		
		MEAN	S.D.	MEDIAN	MEAN	S.D.	MEDIAN
40- 50	ThA_P	77.20	17.31	80.50	55.20	14.33	53.50
	ThV_P	66.10	9.67	67.00	57.80	5.61	57.00
	TA_P	13.40	17.90	7.00	12.90	14.487	9.00
	TV_P	12.50	4.95	10.00	10.70	5.186	10.50
	AA_P	2.30	2.31	2.50	4.70	4.87	3.50
	AV_P	8.60	5.05	7.50	4.90	1.66	5.00
	EA_P	7.10	6.15	7.00	27.30	11.85	28.50
	EV_P	12.90	7.63	11.50	26.80	6.66	25.50

Percentages of the following responses were calculated: ThA- Thematic Auditory, ThV- Thematic Visual, TA- Taxonomic Auditory, TV- Taxonomic Visual, AA- Attributive Auditory, AV- Attributive Visual, EA- Evaluative Auditory, EV-Evaluative Visual

The Table 3c gives the following information regarding males and females of 40- 50 years: The mean values in *males* display a trend of highest to lowest values from Th- T- E- A in the auditory modality, and Th- A- E- T, in the visual modality. The median followed the same trend as that of the mean. In *females*, the order of mean of the response categories was Th- E-T-A in the auditory modality, with difference in order of Taxonomic and Attributive in visual modality, and the median does not follow the same direction as that of the mean. The values differed across genders, and modalities, but findings are similar to those in the age group II across genders, and group I- males.

Table 3d *Descriptive values for Group IV*

AGE GROUP	RESPONSE CATEGORY	MALE			FEMALE		
		MEAN	S.D.	MEDIAN	MEAN	S.D.	MEDIAN
50- 60	ThA_P	66.80	32.26	79.00	72.12	12.42	72.00
	ThV_P	54.10	18.74	56.00	63.25	8.55	59.50
	TA_P	24.00	30.71	9.50	13.87	12.99	9.50
	TV_P	20.70	25.76	11.00	10.12	2.58	10.50
	AA_P	4.10	3.90	4.00	3.12	2.16	3.00
	AV_P	11.00	11.10	7.50	7.87	5.79	7.50
	EA_P	4.90	7.46	2.00	10.75	8.84	9.50
	EV_P	14.10	12.26	11.00	18.62	5.40	17.00

Percentages of the following responses were calculated: ThA- Thematic Auditory, ThV- Thematic Visual, TA- Taxonomic Auditory, TV- Taxonomic Visual, AA- Attributive Auditory, AV- Attributive Visual, EA- Evaluative Auditory, EV-Evaluative Visual

The Table 3d, gives the following information for males and females of 50- 60 years: The mean values in *males* display a trend of highest to lowest values from Th- T- E- A in the auditory modality, and Th- A- E- T, in the visual modality. The median did not follow the same trend as that of the mean. In *females*, the order of mean of the response categories was Th- T- E- A in the auditory modality, with a difference in order of in visual modality as Th- E-T-A, and the median did not follow the same direction as that of the mean. The values differed across genders, and modalities.

Considering the total median values, (I- 77.00, 67.00, II- 72.00, 62.00, III- 67.50, 59.50, IV- 72.00, 59.00) it becomes evident that a *thematic dominance* across both the modalities was followed by all ages and gender. In order to see the pattern in thematic category, the statistical values may be compared.

Comparing across the findings from the above listed tables, variability existed across the gender, with males exhibiting similar findings across ages and modalities than females. Thus further comparison across the gender, age and modalities through statistical tests is necessary.

The high values of Standard deviation throughout the data and the lack of normality lead to the inference that the median values are of importance, and non-parametric tests using the same were carried out.

In order to further elucidate *objective 1*, non-parametric tests including Kruskal-Wallis- to find age wise differences, and Mann-Whitney U test to look for significant gender-wise differences were carried out. Further pairwise comparisons in the gender that revealed a significant difference (Female) were carried out through Mann-Whitney U test. The differences between the modality of stimulus

presentation (Auditory and visual) were calculated separately across the genders and age groups using Friedman's test.

The comparison of the four age- groups was done with gender as an independent variable, through Kruskal- Wallis test. This revealed significant differences in females across the age groups, thus the data from this group was further subjected to pair-wise comparison through Mann- Whitney U test.

The results of Kruskal- Wallis test, to see the age-based variability, have been presented below:

Male

In males, this comparison across age groups revealed no statistically significant differences ($p > 0.05$) in any of the response categories. Thus, the results suggest that no age related differences exist in males.

Female

Table 4 *Comparison across genders through Kruskal- Wallis test*

	ThA_P	ThV_P	TA_P	TV_P	AA_P	AV_P	EA_P	EV_P
/z/	**8.377**	2.033	6.974	5.885	**7.986**	**9.586**	**21.17**	**26.405**
P value	**.039**	.566	.073	.117	**.046**	**.022**	**.000**	**.000**

In females, this comparison facilitated the revelation of significant differences ($p<0.05$) in all the response categories except the following: Taxonomic-auditory and visual, Thematic- visual. Thus, in females, there were significant differences across age groups in ThA_p, AA_p, AV_p, EA_p, and EV_p, with /z/ values of 8.37, 7.98, 9.58, 21.17, and 26.40, respectively. Thus, the results are suggestive of *age based differences in female gender*.

This led to the need for pairwise comparison of the data through Mann- Whitney U test.

Table 5 *Significant differences in female gender across various response categories*

	I & II	I & III	I & IV	II & III	II & IV	III & IV
ThA_P	-	+	-	+	-	+
AA_P	+	+	+	-	-	-
AV_P	-	+	+	+	-	-
EA_P	+	+	+	+	-	+
EV_P	+	+	+	+	-	+

Thus from the above comparison facilitated through the Mann- Whitney U test, all the response categories marked '+' are significantly different. Out of the 30 pairs compared, 19 are seen to be significantly different ($p<0.05$) from one another. The results reveal: TA is significantly different in group III, AA is significantly different in group I, AV is significantly different in group III, I ; EA and EV are significantly different in all the conditions except groups II and IV. Thus, the age-wise differences are *significantly present in female gender across all categories of responses.*

The results indicate the presence of *age-wise difference that is statistically significant in the female gender.* The age related differences in lexical semantic organization have been studied in the available literature in the context of free association task. The current finding on the age-related differences finds support in studies by Riegel and Riegel (1964), Hamison (1975), and Perlmutter (1979) which have previously proposed age related differences, stating that association for concrete nouns varies with age, across adults. The most recent study available in this

context, done by Burke and Peters (1987) also portrayed 39.5% variability across the ages from adults to geriatrics. Thus, this change in the organization as a function of aging finds support through the existing literature, although gender-based comparisons of this change have not been previously explored.

Since variability was seen to exist in the groups, the between-group differences in modality of stimulus presentation have also been compared:

4.1.2 Auditory Modality.

Friedman's test was used in order to compare the differences in auditory modality across age groups and gender. The chi- square values obtained have been displayed below:

Table 6 Comparison between groups in auditory modality

Test Statistic	Group I M	Group I F	Group II M	Group II F	Group III M	Group III F	Group IV M	Group IV F
Chi square	24.827	21.933	21.720	23.697	22.273	23.400	17.289	18.600
P value	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000

The results revealed a statistically significant difference ($p<0.05$) across all the groups. The chi- square values for all the groups ranged from: 17.289 to 24.827. Since the significant difference was affirmed by the Friedman's test, the data was further subjected to Wilcoxon signed ranks test to compare pairwise differences across various response categories in auditory modality.

Table 7 *Results of Wilcoxon signed ranks test for auditory modality*

Group	TA_P- ThA_P	AA_P- ThA_P	EA_P- ThA_P	AA_P- TA_P	EA_P- TA_P	EA_P- AA_P
I M	+	+	+	-	+	-
I F	+	+	+	-	+	+
II M	+	+	+	+	-	-
II F	+	+	+	+	-	+
III M	+	+	+	+	-	+
III F	+	+	+	+	-	+
IV M	-	+	+	-	-	-
IVF	+	+	+	+	-	-

The '+' sign indicates the presence of a significant difference. Out of 48 pairs compared 34 revealed between group differences. The Pairwise comparison through Wilcoxon signed ranks test indicated that within the auditory modality all the response categories showed a significant difference ($p< 0.05$) except for EA and TA. The between group comparison was carried out in visual modality similarly.

4.1.3 Visual Modality.

Friedman's test was used in order to compare the differences in Visual modality across age groups and genders.

Table 8 *Comparison between groups in visual modality*

Test Statistic	Group I M	Group I F	Group II M	Group II F	Group III M	Group III F	Group IV M	Group IV F
Chi square	18.394	20.056	20.235	15.886	19.485	28.052	16.939	20.250
P value	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000

The results revealed a statistically significant difference ($p<0.05$) across all the groups.

The data was further subjected to Wilcoxon signed ranks test to compare pairwise differences across various response categories in Visual modality. The chi- square values for the groups ranged from: 15.886 to 28.052. Further, pairwise comparison through Wilcoxon Signed Ranks test was carried out.

Table 9 *Results of Wilcoxon signed ranks test for visual modality*

Group	TA_P- ThA_P	AA_P- ThA_P	EA_P- ThA_P	AA_P- TA_P	EA_P- TA_P	EA_P- AA_P
I M	+	+	+	-	-	-
I F	+	+	+	-	+	+
II M	+	+	+	-	-	-
II F	+	+	+	-	-	-
III M	+	+	+	-	-	-
III F	+	+	+	+	+	+
IV M	-	+	+	-	-	-
IVF	+	+	+	-	+	-

The '+' sign indicates the presence of a significant difference. Out of 48 pairs compared 29 revealed between group differences. The comparison of the response categories within the visual modality unveiled a significant difference ($p<0.05$), especially in comparisons with TV_P, across all age groups. Thus, there *exists significant variability between groups in auditory and visual modalities*. This was seen to exist primarily in Taxonomic responses in Visual modality, amongst other categories, and in all groups except Evaluative and Taxonomic in the auditory modality.

4.1.4 Comparison across gender.

In par with the above stated objective 1, comparison between the two genders, with age as an independent variable was carried out using Mann-Whitney U test.

The following graphs display a comparison of the median values of percentages of various response categories within the four age groups considered to facilitate comparison across the two genders:

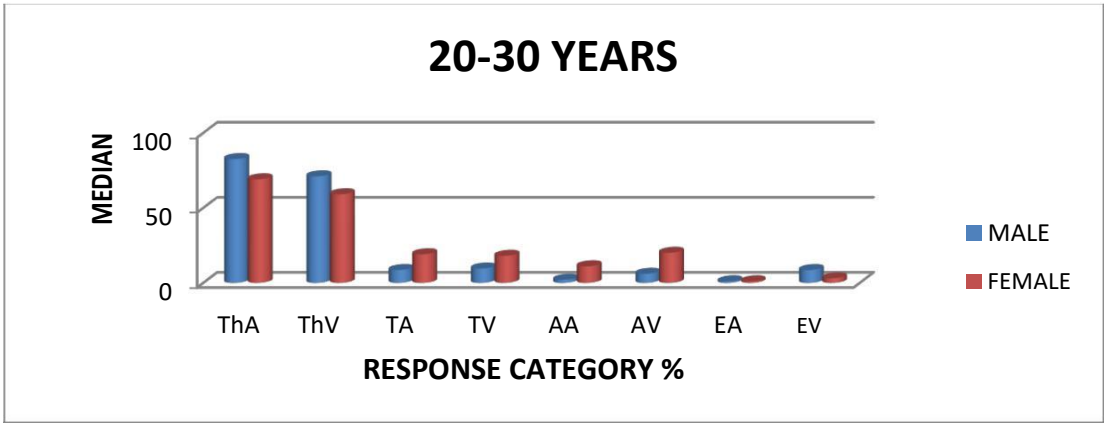


Figure 7a Median values of Group I

The median values of the two genders reveal apparent gender-wise differences in group I, which have been further analysed using Mann- Whitney test. The test revealed a statistically significant difference ($p<0.05$)in four response categories, namely, ThA_P, TA_P, TV_P, AV_P, in this age group, with z values: 3.189, 2.414, 2.003, and 2.29, respectively.

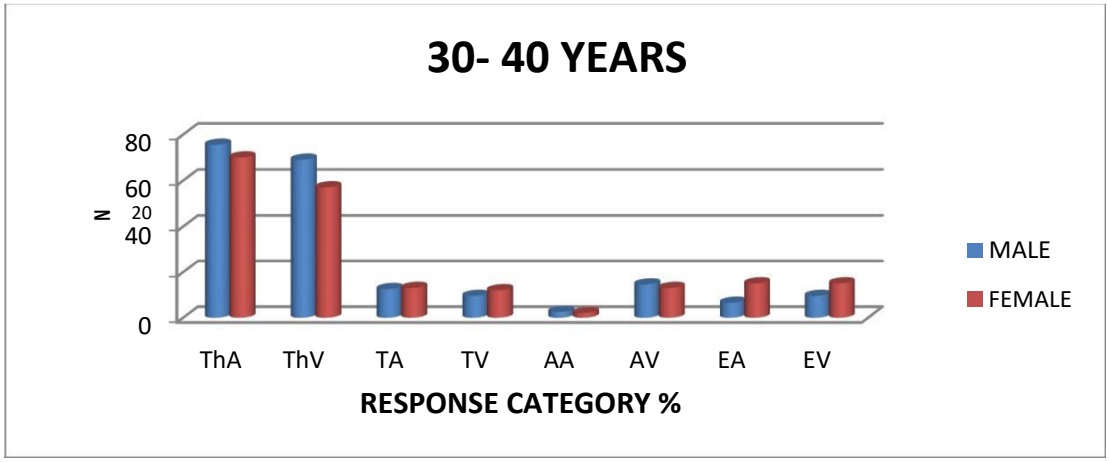


Figure 7b Median values of Group II

The median values of the two genders reveal statistically insignificant ($p>0.05$) gender-wise differences in group II, through Mann-Whitney U test.

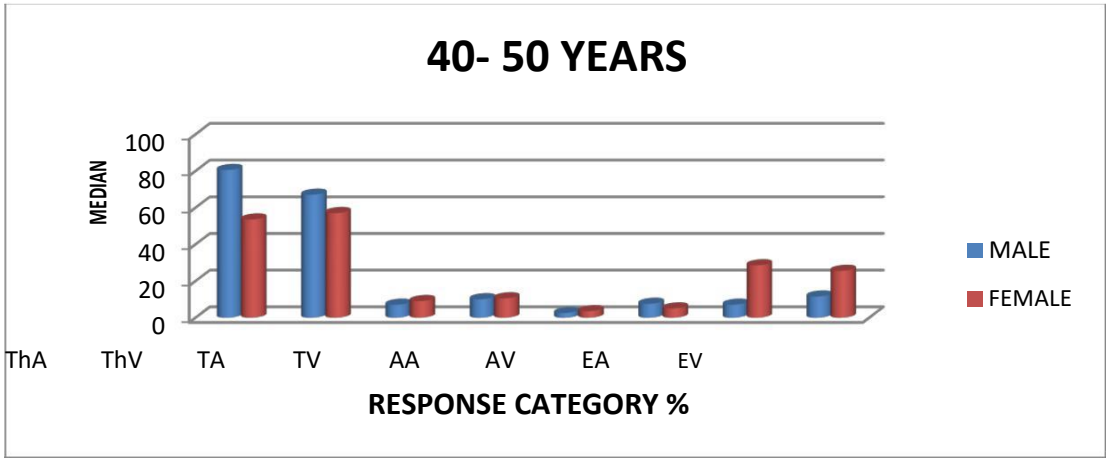


Figure 7c Median values of Group III

The median values of the two genders analysed through Mann- Whitney U test revealed a statistically significant difference ($p<0.05$) in group III. The following

response categories: ThA$_P$, ThV$_P$, EA$_P$, EV$_P$with the z values: 2.496, 2.086, 3.48, 3.25, respectively, showed significant differences.

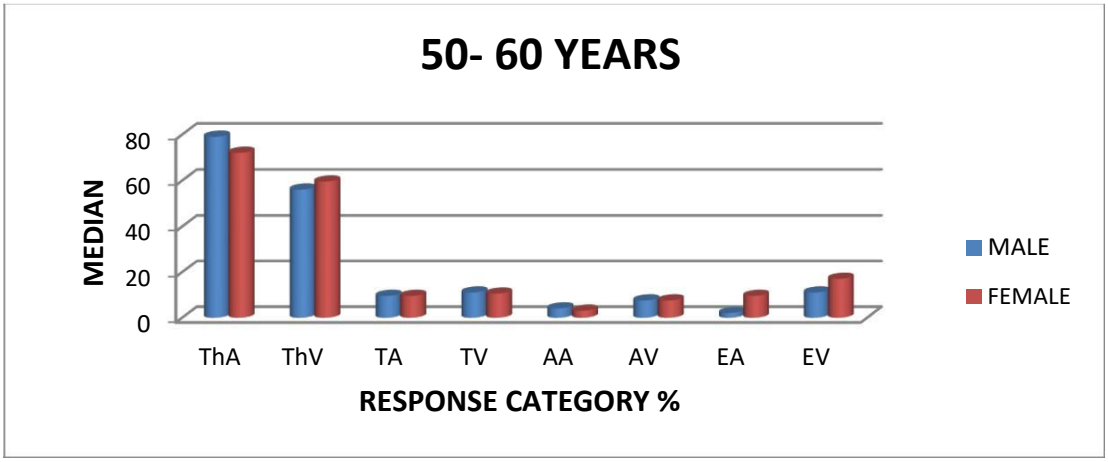


Figure 7d Median values of Group IV

The median values of the two genders analysed through Mann- Whitney U test revealed a statistically insignificant difference ($p>0.05$) in group IV

The results of the Mann-Whitney U test were suggestive of gender wise differences in Gp I (for Thematic Auditory, Taxonomic- auditory and visual, and Attributive visual) and III (for Thematic- auditory and visual and Evaluative- auditory and visual). Thus, four of the eight measured response categories showed significant differences in group I and III, suggestive of gender-wise difference, hence the two genders were considered separately for the age wise comparison, stated earlier.

The gender difference in lexical semantic organization is indicated to exist in *Group I and Group III, in the present study.* This is an aspect that has been rarely studied in the past. In the developmental population, studies including Nithya and Prema, 2017, have indicated the presence of gender difference in certain parameters in the developmental population. But, since the adult population in this study *did not show a continuous difference across the gender in age groups*, and descriptively, all four

age groups did not show a very significant deviance in their response pattern, this gender difference could be attributed to the heterogeneity of the sample considered.

4.2 Objective 2

To investigate the Lexical semantic Organization with respect to the modality of stimulus presentation:

In order to fulfill objective 2 of the study, a cross modality comparison was carried out:

4.2.1 Auditory Modality compared to Visual Modality.

The comparison in differences across the two modalities was done across age groups and genders. Visual representations contrasting the two modalities have been presented to showcase the differences across age groups:

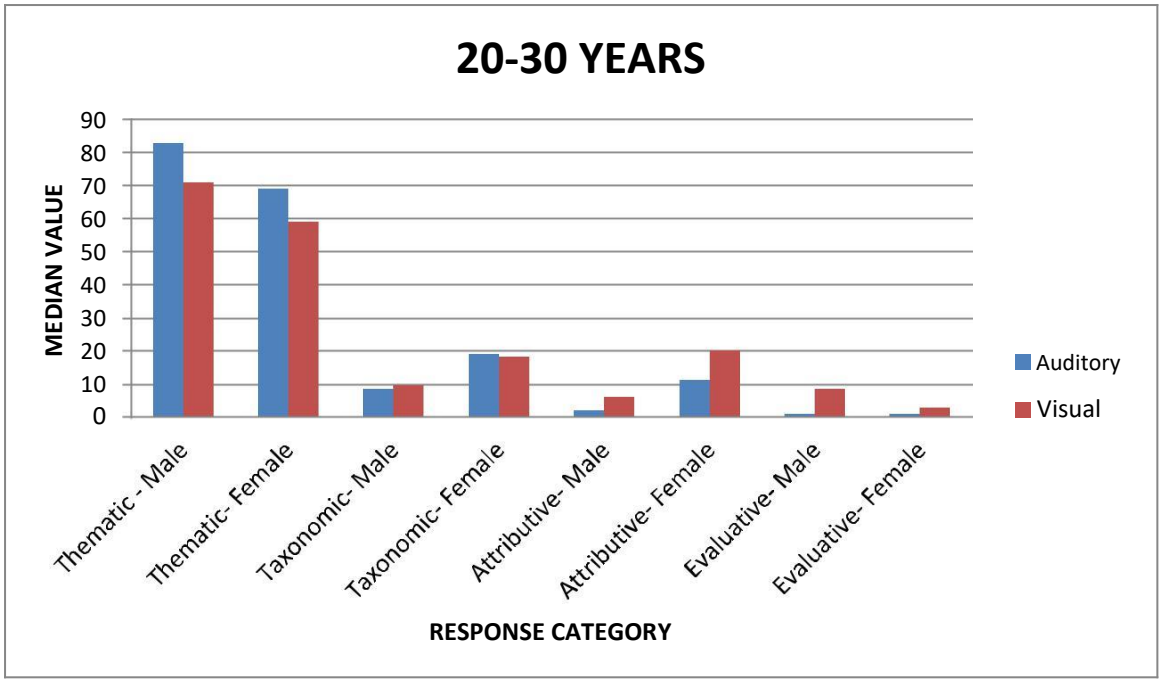


Figure 8a Auditory and visual modality compared in group I

A preliminary comparison across the median values in group I show a trend where the Visual responses are dominant across all the response categories except the Thematic responses.

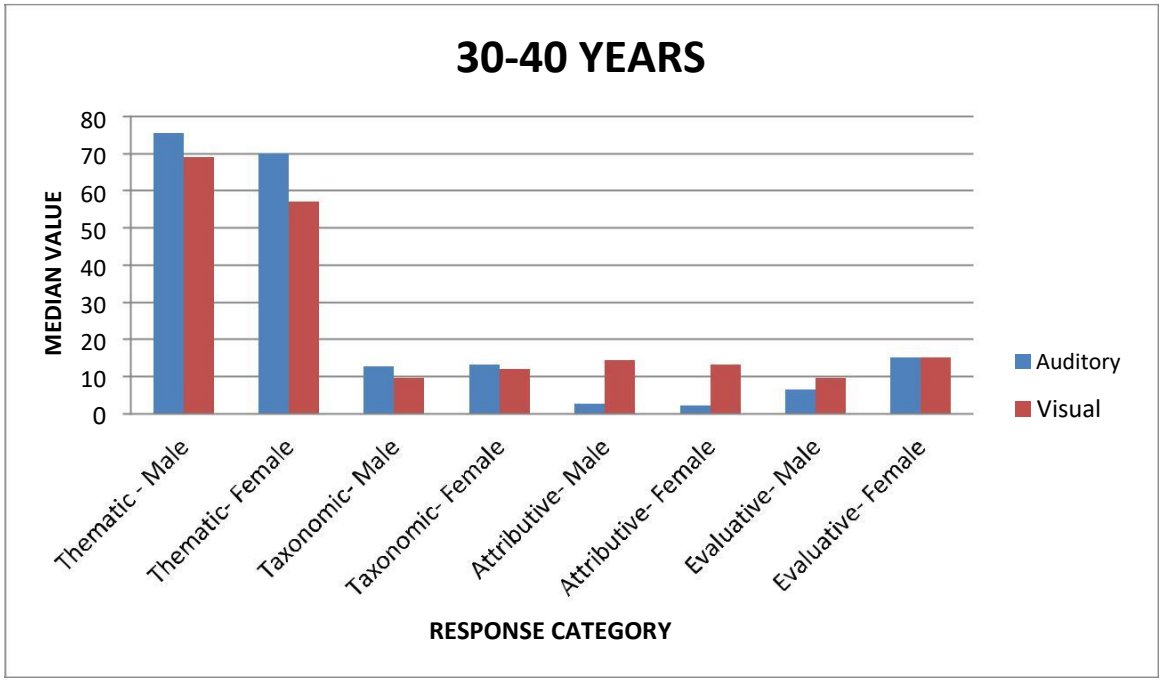


Figure 8b Auditory and Visual modality compared in group II

In this group, the auditory modality is seen to dominate clearly in Thematic and Taxonomic response categories, with a change in this pattern in Attributive and Evaluative category.

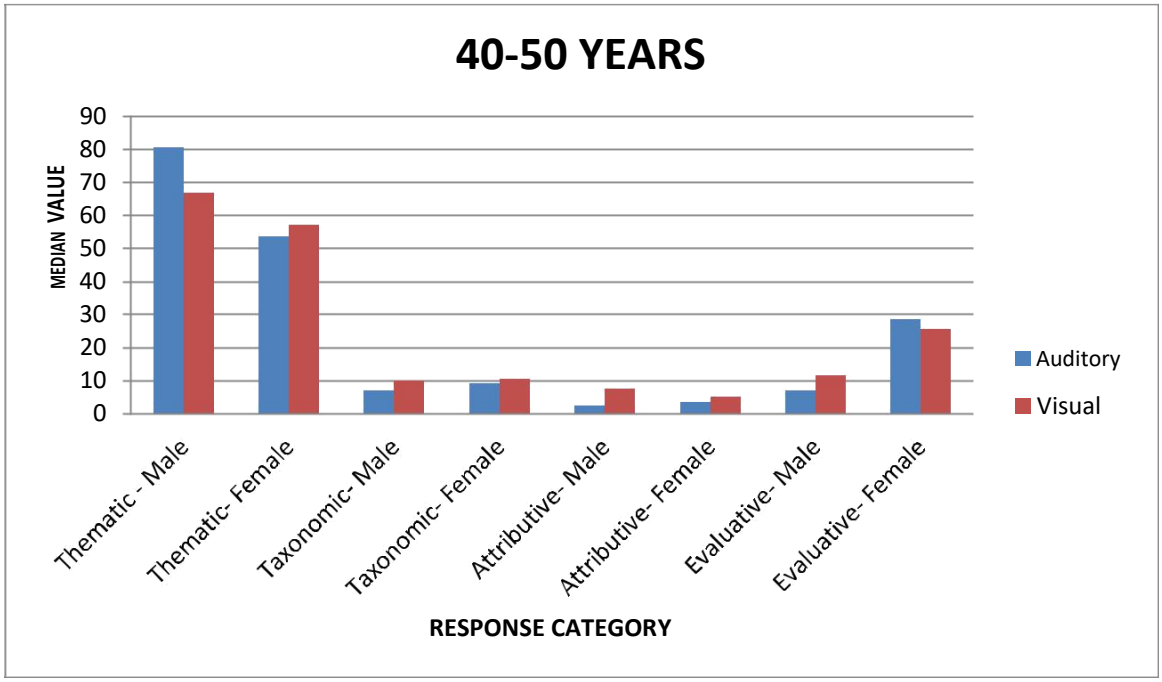


Figure 8c Auditory and Visual modality compared in group III

A variable pattern of results are indicated in this group with males having auditory dominance and females showing a visual dominant pattern in thematic response category. The other categories present with a visual dominance excluding Females in Evaluative category, with an auditory dominance.

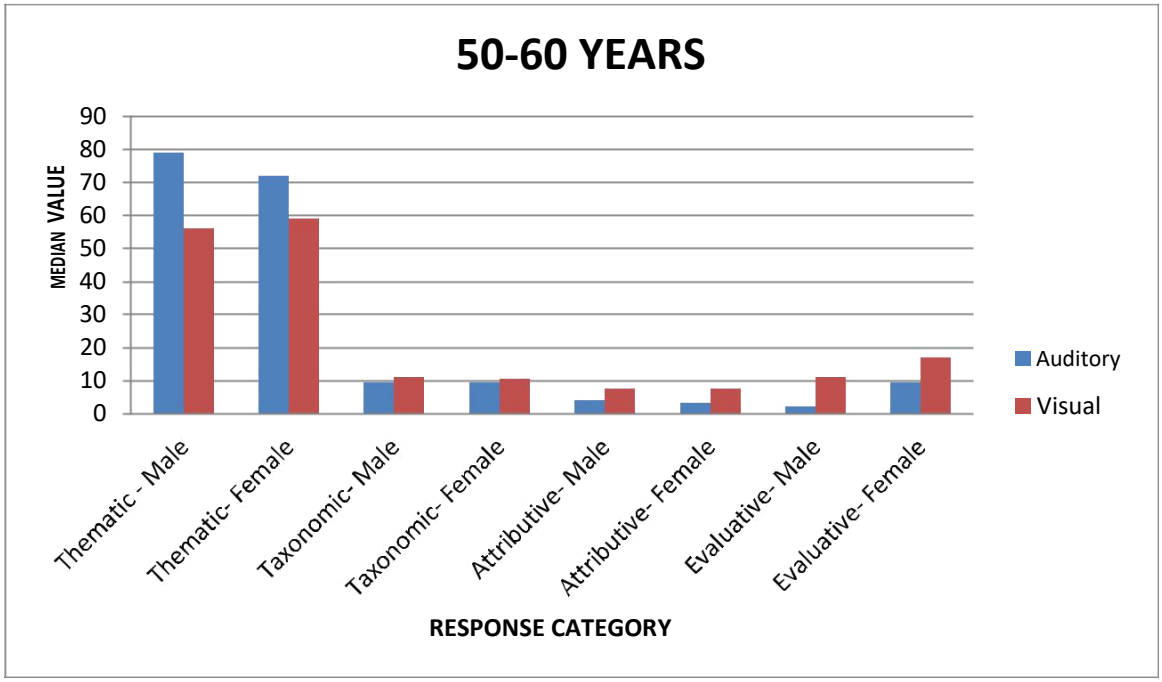


Figure 8d Auditory and Visual modality compared in group IV

The median values compared across this age group reveals Visual dominance in all three categories of responses, except in thematic category, were the participants revealed an auditory dominant pattern of responses. This trend is similar to that seen in group I.

Thus, the overall results are suggestive of a visual dominance in a majority of the categories of responses, but since thematic responses, as previously established, are the dominant category of response given, and the *auditory mode* facilitates its dominance, more than the visual modality, across all the groups compared.

In order to inspect the pairwise differences that exist across the modalities, Wilcoxon Signed Ranks test was employed. The results of which are tabulated below:

Table 10 *Comparison between modalities*

Age Groups	Gender	ThV_P– ThA_P		TV_P– TA_P		AV_P– AA_P		EV_P– EA_P	
		/z/	P value	/z/	P value	/z/	P value	/z/	P value
I	M	**2.608**	**.009**	.534	.593	1.689	.091	**2.490**	**.013**
	F	1.543	.123	.357	.721	**2.100**	**.036**	1.876	.061
II	M	**2.143**	**.032**	.870	.384	**2.668**	**.008**	.178	.859
	F	**2.194**	**.028**	.340	.734	**2.313**	**.021**	.351	.725
III	M	1.376	.169	.654	.513	**2.668**	**.008**	**1.956**	**.050**
	F	.663	.507	.562	.574	.476	.634	.059	.953
IV	M	.756	.444	.255	.799	1.689	.091	**2.075**	**.038**
	F	1.542	.123	.491	.623	1.781	.075	**2.103**	**.035**

The results revealed a statistically significant difference ($p<0.05$) in Thematic responses in Groups: I male, II male and female, the /z/ values of which are: 2.608, 2.143, and2.194, respectively.

Attributive responses in Groups: I male, II male and female, and III male were seen to be significantly different, with /z/ values of 2.100, 2.668, 2.313, 2.668, respectively, as were Evaluative responses of Groups: I male, III male and IV male and female, with /z/ values of 2.490, 1.956, 2.075, and 2.103, respectively.

Only taxonomic responses were seen to exhibit no statistically significant modality based differences in all four of the age groups of adults included.

The current findings suggest that *significant modality based differences exist in three out of four response classes* taken into account in the study including *Thematic, Attributive, and evaluative response classes*, especially in the *younger age group*.

Comparing the median values, as done in the earlier part of this section, revealed that thematic category responses significantly higher in auditory rather than the visual modality, and varying dominance existed in the other response categories. The current finding of the existing difference across the modalities have been previously studied in closed set tasks by Holcomb, and Neville,1990, and Daltrozzo et al., 2011. They state that there exist subtle differences across the two modalities and the existence of an earlier onset for the auditory modality. Correlating with the current findings, where *auditory modality is seen to facilitate the thematic class of responses, which is the most dominant category across all the age groups compared*, constituting a major share of all the responses. *Thus, this study supports the modality based difference through the free word association task.*

4.3 Objective 3

To determine the Most Common Responses (MCR) for visual and auditory word list:

Most common responses

Most Common Responses maybe defined as the most frequently used words across all participants for a given stimulus. Before observing the specific trend of MCR, a broader comparison across the median to ascertain the hierarchy of response categories will provide a general trend followed:

4.3.1 Response Category Comparison.

The following table represents the median values of auditory mode of responses across all ages and response category included.

Table 11 *Comparison across response category in auditory modality*

Age Group/ Gender	Values	ThA_p	TA_p	AA_p	EA_p
I M	Median	82.5	8.50	2.00	1.00
	RANK	1	2	4	3
I F	Median	69.00	19.00	11.00	1.00
	RANK	1	2	3	4
II M	Median	75.50	12.50	2.50	6.50
	RANK	1	2	4	3
II F	Median	70.00	13.00	2.00	15.00
	RANK	1	3	4	2
III M	Median	80.50	7.00	2.50	7.00
	RANK	1	2	4	2
III F	Median	53.50	9.00	3.50	28.50
	RANK	1	3	4	2
IV M	Median	79.00	9.50	4.00	2.00
	RANK	1	2	3	4
IV F	Median	72.00	9.50	3.00	9.50
	RANK	1	2	4	2

The table portrays the pattern of responses obtained across ages, where *thematic responses are seen to be the most dominant category* followed by taxonomic, evaluative and attribute response categories respectively.

A similar pattern of responses with *thematic dominance* is also displayed in the following table in the visual modality:

Table 12 *Comparison across response category in visual modality*

Age Group/ Gender	Values	ThV_p	TV_p	AV_p	EV_p
I M	Median	71.00	9.50	6.00	8.50
	RANK	1	2	4	3
I F	Median	59.00	18.00	20.00	3.00
	RANK	1	3	2	4
II M	Median	69.00	9.50	14.50	9.50
	RANK	1	3	2	3
II F	Median	57.00	12.00	13.00	15.00
	RANK	1	4	3	2
III M	Median	67.00	10.00	7.50	11.50
	RANK	1	3	4	2
III F	Median	57.00	10.50	5.00	25.50
	RANK	1	3	4	2
IV M	Median	56.00	11.00	7.50	11.00
	RANK	1	2	4	2
IV F	Median	59.50	10.50	7.50	17.00
	RANK	1	3	4	2

In the visual modality, the overall dominance remained the same, but the order of responses was: Thematic > Evaluative> Taxonomic> Attribute.

4.3.2 Most Common Responses.

The most common responses (MCR) for each category, tabulated for all the age groups and the two genders. The three most common responses for each word, along with the number of times the responses occurred in each group have been displayed, and this has been attached to the Appendix 2.

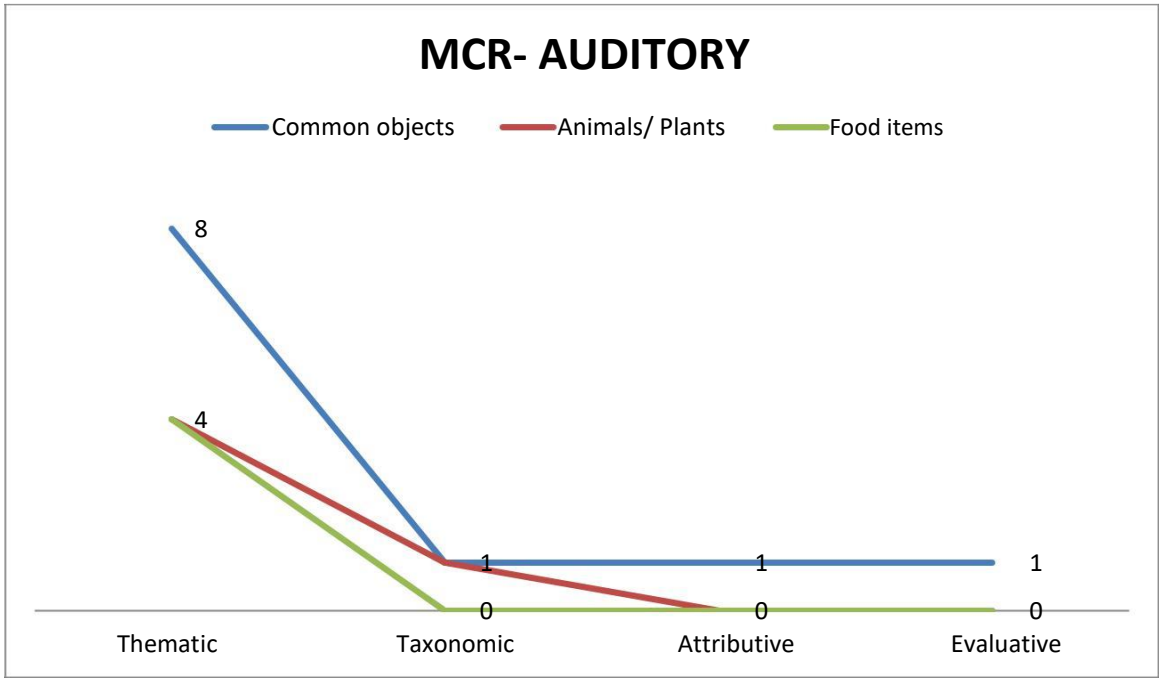


Figure 9a Representation of the 1st MCR in the auditory modality

The calculation facilitated comparison of various lexical categories including common household objects (11), animals/ plants (5) and food items (4), in each modality.

The above figure is a visual representation of the number of times the 1st MCR in the auditory modality along with the response category (Thematic, Taxonomic, Attributive, and Evaluative) each of them belong.

The MCR, in line with the most dominant class of responses cited previously in the results, constitute primarily of the thematic category. (Example- /ungu:ra /- /maɖvɛ/,

/gu:bɛ/- /ra:tri/, /mɛnsu- /kemmu/). This was the trend seen in all three lexical categories included in the study.

The other responses class included one each in Taxonomic (/kurtʃi/-/medʒu/) attributive (/mara/- /hasiru/), and evaluative (/manɛ/- /ʃa:nti/) in the common objects category, and one taxonomic MCR seen in animals was (/gu:bɛ/- /pakʃi/).

The comparison across various lexical categories in the visual modality included the following: common household objects (10), animals/ plants (5) and food items (5).

The following is a visual representation of the number of times the 1st MCR in the visual modality along with the response category (Thematic, Taxonomic, Attributive, and Evaluative) each of them belongs.

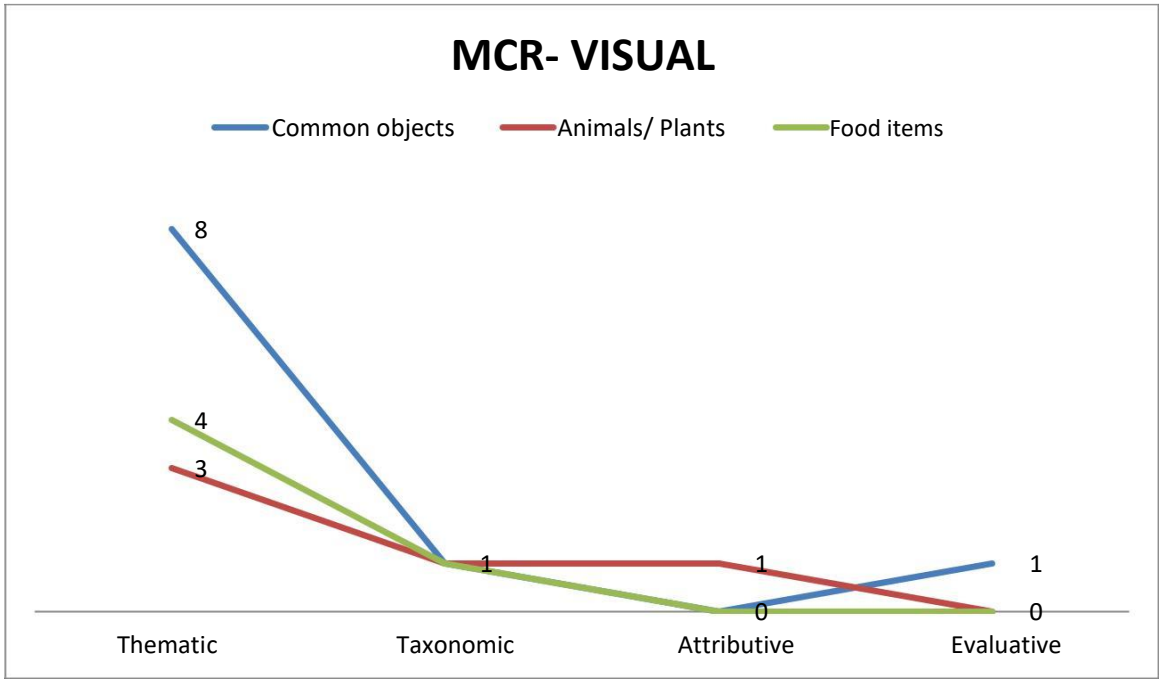


Figure 9b Representation of the 1st MCR in the visual modality

The comparison also yielded similar results to that of auditory modality, where the 1st MCR was primarily thematic across all the lexical categories (Example: /hoḍikɛ/- /tʃaLi/, /mi:nu/- /ni:ru/, /i:ruLi/- /kaNiru/). This trend holds good across all three lexical categories of responses.

The other MCR in case of common objects and animals included, one each in taxonomic and attributive and evaluative categories. (/haɖu/- /pakʃi/, /hasu/- /biLi/,)./koLalu/- /kriʃna/).

Thus, the most common responses obtained across all the ages and genders compared, imply *thematically dominant pattern* for all the lexical categories included i.e.; common household objects, animals/plants, and food items. This is in line with the *trend exhibited by the responses of being dominantly thematic, across modalities.*

A previous attempt to compile the MCR in Kannada language was done by Prarthana and Prema, 2012, where the study suggests the existence of various feature based relations for concrete nouns, which are not arbitrary in nature. The verbs, on the other hand, had very few feature based relations. The current study has included only concrete nouns, and has witnessed a concrete feature based relation for the 1ST MCR. The succinct version of the present findings also suggests a *high thematic incidence* of the relationship to the word, across all age groups. Note:

The inter-rater reliability for the classification of responses as belonging to one of the four response categories was obtained. Operational definitions of Thematic, Taxonomic, Attributive and Evaluative responses were circulated to two Speech Language Pathologists with a Master's degree qualification. 10% of the obtained responses were subjected to this reliability check. The obtained percentages of responses belonging to each of the categories were subjected to comparison using Cronbach's Alpha (α) test of reliability. A value of (α) 0.906, was obtained through this, suggesting high reliability.

General discussion

The present study aimed at investigating the lexical semantic organization in adults. It attempted to examine four categories of responses across age groups, gender, and modality of responses. The study also aimed at giving out most common responses for the same. The study employed a discrete word association task, an open set task, in order to facilitate this comparison across the categories of comparison stated above. It was implemented through 20 words presented in auditory modality and 20 words presented in visual modality. The participants were required to respond verbally to each of the words presented with 5 words, related to the stimuli. The responses obtained were transcribed in broad IPA and categorized as belonging to thematic, taxonomic, attributive, or evaluative, class of responses (Borghi, Caramelli, &Setti, 2016) and the number of responses belonging to each category was calculated and processed through SPSS version 20.0.

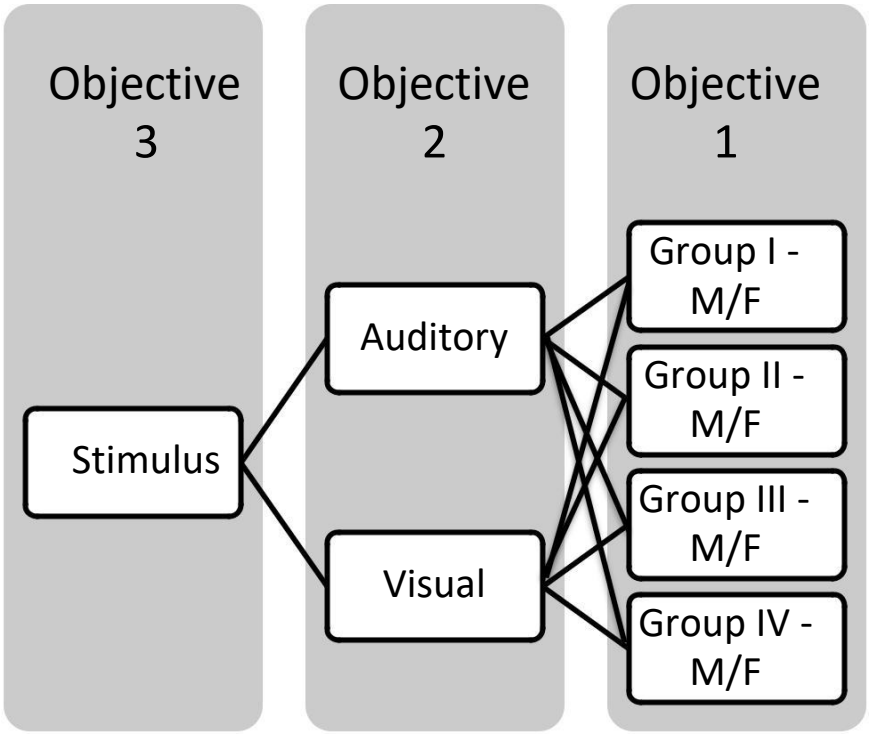


Figure 10 Schematic representation of the Objectives

The results were analyzed as per the objectives and presented as follows:

4.1.1, 4.1.2, 4.1.3, 4.1.4, Comparison across age and gender, and between modality

4.2 Comparison across auditory and visual modalities

4.3 Most common responses

The results thus compiled revealed the following points of significance:

i. The medians compared across the response classes revealed that the thematic responses were the most dominant, attributive responses, the least dominant, in all the participants compared.

ii. Significant differences ($p<0.05$) existed between the two genders in Group I, III; comparison of age groups revealed significant differences across many categories in females, and none in males. *Thus, null hypotheses 1 is rejected, since differences exist across age and gender.*

iii. The differences within each modality were found to be significant across all ages and both genders; when compared across modalities, differences were seen across Thematic, attributive and evaluative categories of responses. *This leads to the rejection of null hypotheses 2, since there exists modality based differences.*

iv. A list of MCR was compiled and 1st MCR was seen to primarily belong to thematic category across all the lexical categories, included in the study, irrespective of the age and gender. *Null hypothesis 3 is not rejected, as there is a clear command of one class of responses, across both the modality of stimuli presentation.*

The first objective of the study stated the comparison of lexical semantic organization as a function of gender and aging, in accordance to this, gender wise comparison across ages revealed a significant difference ($p<0.05$) in 4 of 8 category of responses in groups I (percentages of: ThA, TA, TV, AV) and III (percentages of:

ThA, ThV, EA, EV). Since there is seen to be a discontinuity of the gender wise differences, this may be attributed to heterogeneity of the population included as the sample.

The age wise comparison across the two genders revealed a significant difference ($p<0.05$) in females (in all categories except, % of: ThV, TV, TA), as opposed to no significant ($p> 0.05$) age wise differences in males. The literature is not extant in this perspective as the current contributions to literature have been relating to the age related differences primarily across the developmental population. Gender related differences have not been previously studied in the context of an open set association task to explore the semantic organization.

The second objective of comparing modality wise differences between auditory and visual modality have positively indicated a significant difference ($p<0.05$) amongst the various groups, especially with regard to Thematic, attributive and evaluative categories. The existence of modality based differences find support in works of Holcomb & Neville,1990, and Daltrozzo et al., 2011, who employed lexical decision tasks to explore the same. Owing to lack of studies that have compared across this difference, this is a notable finding.

The third objective of the study was to compile the most common responses across the auditory and visual stimuli. These have been compiled and further fortify the thematic dominance in the results obtained. The MCR was compared across the lexical categories (common objects, animals/plants, food items) included in the study and the 1^{ST} MCR across the categories were seen to be primarily belonging to the thematic class of responses.

The available literature in the developmental population supports gender and age based variability in lexical semantic organization. (Nithya, 2017) This finding is

accounted for by the developmental changes, which may not be cited in the population under the present study; hence further research in this area is necessary to reaffirm the current findings.

CHAPTER V

Summary and Conclusions

Language maybe defined as the use of a sophisticated set of symbols for communication. Lexical-semantics is a prime aspect of language, and it is impracticable to study its facets without them holding a relationship to another. There have been very few studies in the existing literature that have attempted to investigate this relationship in the adult population, and even fewer, that have employed an open set task for the same. Thus, the present study was centered on exploring the lexical semantic organization in neurotypical adults using a discrete word association task.

The objectives of the study were as follows:

I. To study lexical semantic organization as a function of aging and gender
II. To study lexical semantic organization with respect to the modality of stimulus presentation
III. To determine the Most Common Responses (MCR) for visual and auditory word list

The primary aim of the current study was to investigate the lexical semantic organization with respect to age, gender. The study included four groups of participants ranging from 20 to 60 years of age. Each group consisted of 10 males and 10 females. The methodology employed in the study was a discrete association task, where the participants were asked to give out responses relevant to the stimuli presented. The stimuli were divided into two sets, with 20 words presented via auditory modality and 20, through visual modality. The differences with respect to

the modalities of stimuli presentation were also compared. The study also aimed at compiling the most common responses across the modalities, and the response category to which they belonged. In the present study, the responses obtained were categorized as having one of the following associations with the stimuli: Thematic (syntagmatic), Taxonomic (Paradigmatic), Attributive (Feature based), or Evaluative (Ego-based).

The statistical analysis of the responses obtained was carried out with the software- SPSS version 20.0. The data obtained failed to follow normality according to the Shapiro Wilks test; and the descriptive statistics revealed high standard deviation values, hence non- parametric median based tests were performed in order to inspect the objectives.

The first objective in the study, as cited above was to investigate the variation in the lexical semantic organization with respect to age and gender, in accordance to this, the mean; median and standard deviation were taken into account. An important inference was obtained through comparison across the median of responses across the age groups and the two genders, revealed that thematic associations were dominant in all participants.

Further, Kruskal- Wallis test and Mann- Whitney U test, were employed to look into the age and gender variations, respectively. The results of the above tests were:

There were statistically significant differences in age groups- I and III across the genders, and Female gender was seen to show significant differences across the age groups. The results of gender based variability maybe attributed to the heterogeneity of the sample included, but the age based variability found support in the existing

literature. Due to the results, the null hypothesis corresponding to this objective was rejected.

The second objective of the study aimed at inspecting the differences across auditory and visual modalities of stimulus presentation. Friedman's test was used to report the between group variations, and Wilcoxon Signed Ranks test was employed to compare across the two modalities. This revealed significant differences across both genders, and auditory modality was seen to give more thematic responses, which as cited above, was the most dominant response category. Thus, the second null hypothesis, with respect to this objective was also rejected.

The third objective of the study, to compile the Most Common Responses (MCR) across the participants considered was tackled by a qualitative approach, where the responses with the highest frequency of occurrence were calculated across all the participants involved. These findings have been tabulated and may be found in the appendix. An important inference was obtained initially where comparison across the median of responses across the age groups and the two genders, revealed that thematic associations were dominant in all participants. The 1st MCR has been seen to be in agreement to the finding of overall dominance, as it was seen to be thematically dominant across all the groups of participants compared. This was seen to hold good for all the lexical categories considered (Common objects, Animals/ Plants, Food items). Thus, null hypothesis 3, proposed in accordance with this objective was not rejected.

5.1 Implications of the study

i. This research contributes to the existing literature about word association in elderly individuals and has attempted to elucidate if age is a determinant for degradation in associations.

ii. The study helps establish thematic association as being dominant across all the age groups, in accordance to the currently existing sparse literature.

iii. The differences found across the responses with respect to different modalities and age groups help us realize the need for further development of *age and gender specific norms.*

iv. The study has contributed to *developing cues*, through the MCR, which serve as markers for enabling production of certain words in assessment and intervention of individuals.

v. The current findings of Most Common Responses may be used in priming based studies.

5.2 Limitations of the study

i. The current study had a limited number participants belonging to each age group.

ii. Only concrete nouns were included in the study

iii. The heterogeneity of the sample considered may have influenced the findings; hence it is necessary to reaffirm them.

5.3 Future implications

i. This study may serve as a stepping stone with respect to the neurotypical adults, and this may be used to promote further research in the clinical population (such as studying lexical semantic organization in persons with aphasia).

ii. Future studies may include a larger sample size, and more response categories to classify the lexical semantic organization.

iii. Comparison across frequently used and infrequently used words in the same context may be explored.

iv. More grammatical entities such as verbs, adjectives, maybe studied and compared to the present findings on nouns.

References

Anderson, J. R. (1996). ACT: A simple theory of complex cognition. American Psychologist, 51(4), 355.

Ashwini.B.N. (2016). Lexical semantic organization in children. (*Masters dissertation, University of Mysore).*

Borghi, A., Caramelli, N., & Setti, A. (2016). How abstract is risk for workers? Expertise, context and introspection in abstract concepts. Reti, saperi, linguaggi, 3(1), 95-118.

Bréal, M. (1897). Une science nouvelle: la sémantique. Revue des deux mondes, 141, 807-36.

Burke, D., & Peters, L. (1987). Word Association Norms for Young and Older Adults. (*dissertation, National institute of aging).*

Bolton, M., & Haimson, H. (1975). Hierarchical effect of semantic memory on verbal learning. *Perceptual and Motor Skills, 41(3), 843-846.*

Chithra.R. (2008). Lexical- semantic organization in bilingual children. (*Masters dissertation, University of Mysore).*

Collins, A. M., & Quillian, M. R. (1969). Retrieval time from semantic memory. *Journal of verbal learning and verbal behavior, 8(2), 240-247.*

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological review, 82(6), 407.*

Conrad, C. (1972). Cognitive economy in semantic memory. Journal of Experimental Psychology, 92(2), 149-154.

Cruse, A. (2004). *Meaning in language.* Oxford University press.

Deyne, S. & Storms, G. (2008). Word associations: Network and semantic properties. *Behavior Research Methods, 40*(1), 213-231.

Fasold.R & Connor-Linton (Hg.). 2006. An Introduction to Language and Linguistics. Cambridge: Cambridge University Press.

Fischer, G. M., Daltrozzo, E., & Zumbusch, A. (2011). Selective NIR chromophores: bis (pyrrolopyrrole) cyanines. Angewandte Chemie International Edition, 50(6), 1406-1409.

Fitzpatrick, Playfoot, Wray & Wright (2015). Establishing the reliability of word association data for investigating individual and group differences. Applied Linguistics, 36(1), 23-50.

Hashimoto N McGregor K Graham A. (2007). Conceptual Organization at 6 and 8 Years of Age: Evidence From the Semantic Priming of Object Decisions. *Journal of Speech Language and Hearing Research, 50*(1), 161.

Holcomb, P. J., & Neville, H. J. (1990). Auditory and visual semantic priming in lexical decision: A comparison using event-related brain potentials. Language and cognitive processes, 5(4), 281-312.

Landrigan, J.& Mirman, D. (2016).Taxonomic and Thematic Relatedness Ratings for 659 Word Pairs. *Journal of Open Psychology Data*, *4*(1).

Loon-Vervoorn, W. & illemsen, I.(1989).Selective disturbance in lexical knowledge in the elderly with or without dementia. Tijdschrift voor gerontologie en geriatrie, 20(2), 59- 65.

Lovelace, E. & Cooley.(1982). Free Associations of Older Adults to Single Words and Conceptually Related Word Triads. *Journal of Gerontology, 37*(4), 432-437.

Masson, M. E. (1995). A distributed memory model of semantic priming. Journal of Experimental Psychology: Learning, Memory, and Cognition, 21(1), 3.

Miller, G. A. (1995). WordNet: a lexical database for English. Communications of the ACM, 38(11), 39-41.

Mirman, D. & Graziano, K. (2012). Individual differences in the strength of taxonomic versus thematic relations. *Journal of Experimental Psychology: General*, *141*(4), 601 609.

Mirman, D., Landrigan, J. & Britt,A. (2017). Taxonomic and thematic semantic systems. *Psychological Bulletin, 143*(5), 499-520.

Murphy, G. (2001).Causes of taxonomic sorting by adults: A test of the thematic-to taxonomic shift. Psychonomic Bulletin & Review ,8(4), 834-837.

Nithya,K. (2017). Mental Lexicon.in children. (*Masters dissertation, of Mysore). University*

Perlmutter, M. (1979). Age differences in adults' free recall, cued recall, and recognition. Journal of Gerontology, 34(4), 533-539.

Pietro, M. & Goldfarb, R. (1985). Characteristic patterns of word association responses in institutionalized elderly with and without senile dementia. *Brain and Language, 26*(2), 230-243.

Prarthana.S. & K.S.Prema. (2012).Role of Semantics in the Organization of Mental Lexicon. Language in India. Volume 12. ISSN No: 1930-2940.

Prarthana, S., & Rao, P. K. S. (2015). Mental lexicaon for nouns and verbs. (Doctoral thesis, University of Mysore)

Ratcliff, R., & McKoon, G. (1988). A retrieval theory of priming in memory. Psychological review, 95(3), 385.

Riegel, K. F., & Birren, J. E. (1965). Age differences in associative behavior. Journal of gerontology, 20(2), 125-130.

Sachs, O., Weis, S., Krings. T., Huber, W., & Kircher, T. (2008). Categorical and thematic knowledge representation in the brain: Neural correlates of taxonomic and thematic conceptual relations. *Neuropsychologia, 46*(2), 409-41.

Snodgrass, J. G., & Vanderwart, M. (1980). A standardized set of 260 pictures: norms for name agreement, image agreement, familiarity, and visual complexity. Journal of experimental psychology: Human learning and memory, 6(2), 174.

Santo Pietro, M., & Goldfarb, R.(1985). Characteristic patterns of word association responses in institutionalized elderly with and without senile dementia. Brain and language, 26(2) , 230-43.

Sharp, D., Cole, M., Lave, C., Ginsburg, H., Brown, A. & French, L. (1979). Education and Cognitive Development: The Evidence from Experimental Research. *Monographs of the Society for Research in Child Development, 44*(1/2), 1.

Sheng, L., McGregor, K., & Marian, V. (2006). Lexical–Semantic Organization in Bilingual Children: Evidence From a Repeated Word Association Task. *Journal of Speech Language and Hearing Research, 49*(3), 572.

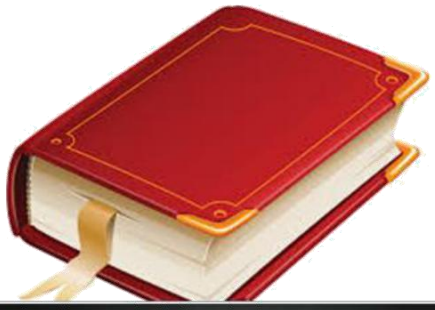
Smith, E. E., Shoben, E. J., & Rips, L. J. (1974). Structure and process in semantic memory: A featural model for semantic decisions. Psychological review, 81(3), 214.

Swartz J Moran L Cleland C. (1980). Cognitive dictionary structure of the elderly. *Bulletin of the Psychonomic Societ, 16*(5), 383-384.

Vigliocco, G., Vinson, D. P., Lewis, W., & Garrett, M. F. (2004). Representing the meanings of object and action words: The featural and unitary semantic space hypothesis. Cognitive psychology, 48(4), 422-488.

Zortea, M., Menegola, B.,Villavicencio, A., & Salles, J.(2014). Graph analysis of semantic word association among children, adults, and the elderly. *Psicologia: Reflexão e Crítica, 27(1), 90-99. doi: 10.1590/S0102-79722014000100011*

APPENDIX I
A. VISUAL STIMULI



I B. AUDITORY STIMULI

1. /kanadaka/
2. /angi/
3. /hadu/
4. /mane/
5. /kolalu/
6. /ha:le/
7. /hodike/
8. /mi:nu/
9. /kumbalkai/
10. /tSila/
11. /mo:te/
12. /vima:na/
13. /gula:bi/
14. /nali/
15. /sa:bunu/
16. /hasu/
17. /ne:ralu/
18. /benkipatna/
19. /iruli/
20. /kape/

APPENDIX II A- MOST COMMON RESPONSES FOR THE VISUAL STIMULI

STIMULI	Group I		Group II		Group III		Group IV	
	M	F	M	F	M	F	M	F
MARA	Neralu- 5	Hasiru-5	Hasiru-6	Ele-5	Hannu-6	Pakshi-5	Gida-5	Hannu-4
	Hasiru-4	Hannu-4	Hannu-4	Hasiru-4	Hasiru-4	Neralu-5	Hasiru-4	Neralu-4
	Hannu-3	Hu:vu-3	Ele-3	Neralu-3	Ele-4	Hasiru-4	Belsu-3	Ga:li-3
MULHANDI	Ka:du-6	Ka:du-7	Pra:ni- 5	Ka:du-4	Ka:du-7	Pra:ni-7	Pra:ni-5	Pra:ni-5
	Pra:ni-5	Mullu-4	Ka:du-4	Mullu-3	Pra:ni-4	Ka:du-4	Ka:du-3	Ka:du-4
	Mullu- 4	Pra:ni-3	Mullu-3	Bhaya-3	Mullu-4	Mullu-4	Mullu-3	Mullu-3
BELI	Rakshane- 6	Surakshe-5	Mullu-5	Surakshe-5	Surakshe-5	Surakshe-5	Surakshe-4	Surakshe-4
	Surakshe- 4	Mullu-4	Surakshe-4	Kabinna- 5	Sutha:-3	Mane-4	kabinna-4	kabinna-4
	Be:ku- 4	Mane-4	Kabbina-3	Gida-3	Mane-3	Manushya-3	Manushya-3	rakshane-3
UNGU:RA	Madve-5	china-7	Ratna-6	Chinna- 5	Chinna-5	Engagement-4	Madve-4	China-6
	Engagement-5	Belli- 4	Chinna-4	Madve-4	A:barna-4	Manushya-3	A:barna-4	Vajra-4
	China- 3	Madve-5	Madve-2	Ishta-2	Madve-4	Ishta- 2	Vajra-3	Engagement-3
ANA:NAS	Tinnu- 4	Hannu-5	Hannu-6	Haladi-6	Sihi-5	A:rogya-6	Ruche-4	Sihi-4
	Hannu-4	Tinnu-4	Tinnu-4	Hannu-4	Hannu-5	Hannu-5	Katrisadu-3	Haladi-4
	Sihi- 3	Haladi-4	Sihi- 3	Sihi-4	Tinnu-3	Olledhu-4	A:rogya/sihi-3	Hannu-2
CHAMACHA	U:ta- 4	Tinnu-7	Maklu-4	Belsakke-4	Tinnu-4	Adige-5	U:ta-4	U:ta-5
	Tinnu-4	Balsu-7	Steel-3	Tinnake-4	Belsu-3	U:ta-4	Sakre-3	tinnu-2
	Balsu- 3	Lo:ta-4	U:ta-3	U:ta-3	Tinnu-3	Tinnu-3	Belsu-3	Belsu-2
BA:LE	A:rogya- 5	Hannu- 6	A:rogya-5	Hannu-9	Hannu-8	Hannu-6	A:rogya-4	Tinnu-6
	Upyoga- 4	Sippe-4	Hannu-4	Olledu- 5	Sippe-5	A:rogya-6	Poshtika-3	Hannu-5
	Tinnu- 3	Haladi- 4	Sippe-3	Haladi-5	Tinnu-4	Tinnu-4	Hannu-3	Beku-3
BELL	Pu:je- 6	Pu:je-5	Pu:je-5	Shabda-5	Devru-5	Shabbda-4	Devasta:na-5	Sha:le-5
	Devasta:na-5	Sha:le-4	Devasta:na-4	Tambre-4	Pu:je-5	Pu:je-4	Devru-4	Devasta:na-4
	Devru- 5	Shabda-4	Mane-4	Pu:je-4	Devasta:na-4	Devru-4	Sha:le-3	Ta:mbre-3
PUSTAKA	O:du- 7	O:du- 5	Sha:le-4	O:du-5	O:du-4	Upyoga-5	Bari-4	O:du- 6

	Bari-5	Gna:na-4	O:du-4	Bari-5	Bari-4	Diary-3	Vidya-4	Bari-5
	Dictionary-4	Bari-4	Kempu-4	Sa:le-4	Gna:na-4	Gna:na-3	Gna:na-3	Gna:na-3
MENIDABATTI	Belaku- 4	Belku-4	Benki-5	Katlu-5	Di:pa-4	Belku-6	Belku-5	Current-5
	Katle-3	Benki-4	Belku-5	Belaku-4	Katle-4	Katlu-5	Katle-4	Belku-5
	Benki-3	Di:pa-4	Current ilde-3	Di:pa-4	Belku-3	Upyoga-3	Di:pa-3	Be:ku-4
KODAGALU	Mara- 4	Katrisadu -6	Tarka:ri-5	Kattrisadu-5	Raitaru-5	Raitaru-6	Raitaru-4	Kathrisadu-6
	Raitaru- 3	Hullu-6	Katrisadu-4	Halli-4	Katrisadu-4	Belle-4	Mechu-3	Hullu-4
	Katrisadu -3	Tenginkai-4	Raitar-4	Mara-3	Tarka:ri-3	Kathrisadu-3	Katti-3	Mechu-4
GU:BE	Ra:tri- 5	Ratri-8	Ra:tri-6	Ra:tri-6	Hakki-3	Ra:tri-7	Ra:tri-7	Pakshi-7
	Pakshi-5	Mara-3	Pakshi-5	Pakshi-4	Kattu-3	pakshi-5	Kannu-4	Ratri-5
	Nisha:chari-3	Katle-3	Nishacha:ri-3	Lakshmi va:hana-3	Mara-3	Echre-2	Mara-4	Mara-3
KURCHI	Ku:tko- 7	4-ka:lu-4	Ku:tko-5	Ku:tko-7	Ku:tko-6	Ku:tko-6	Ku:tko-6	Ku:tko-5
	Mara- 4	Ku:tko-4	Table-4	A:ramu-4	A:ramu-4	A:ramu-4	Plastic-3	Mara-4
	Mane- 4	Mane- 3	Vastu-4	Mara-4	Be:ku-3	Ishta-3	4-ka:lu-3	Mane-4
MENISU	Kemmu- 6	Kappu-4	Ka:ra-5	A:rogya-5	Ka:ra-5	A:hara-5	Ka:ra-4	Adige-6
	Adige- 5	Ka:ra-4	Adigemane-4	Masala-3	Kemmu-4	Ka:ra-4	A:rogya-3	Ksheetha-4
	Ka:ra-4	Masa:le-3	Sambar-3	Adige-3	Adige-4	Ksheetha-3	Adige-3	Ka:ra-4
DIMBU	Malugu-7	Malagu-4	Malagu-4	Malgu- 6	A:ramu-5	A:ramu-6	Nidde-4	Malugu-5
	Nidde- 6	Medaku-3	Hasige-4	A:ramu-4	Nidde-3	Nidde-34	A:ramu-4	Nidde-5
	A:ramu- 4	Nidde-3	Nidde-3	Nidde-4	Beku-3	Malgu-4	Bennu-3	A:ramu-4
BA:CHANIGE	Tale:- 6	Ba:chu-5	Tale-6	Tale- 8	Tale- 7	Tale-5	Tale-7	Tale-5
	Ba:chu- 5	Tale-4	Ba:chu-4	Ba:chu-5	Ba:chu-5	Ba:chu-5	Ba:chu-6	Ba:chu-5
	Ku:dlu- 4	Ku:dlu-4	Upyoga-4	Upyoga-4	Upyoga-3	Je:bu-3	Je:bu-4	Dina nitya-3
KOKARE	Ni:ru- 6	Pakshi-5	Kere-4	Ni:ru-6	Ni:ru-7	Ni:ru-6	Pakshi-5	Ni:ru-4
	Mi:nu-4	Kere-4	Ni:ru-3	Kere-5	Pakshi-7	Kere-4	Kere-4	Mi:nu-4
	Pakshi-4	Billi-4	Mi:nu-2	Pakshi-4	Mi:nu-3	Ninthko-4	Mi:nu-4	Pakshi-4
LA:TINU	Power- 4	Ra:tri-5	Belku-7	Belku-5	Current ilde-4	Mombathi-5	Current ilde-4	Hale ka:la-5
	Katle-4	Belaku-5	Katle-6	Current ilde- 4	Seeme enne- 4	Belku-5	Seeme enne-4	Halli-4

	Belku-3	Benki-4	Candle ilde-3	Katlu-3	Belku-3	Di:pa-3	Belku-3	Belku-4
BI:GA	Surakshe- 7	Mane-6	Mane-5	Surakshe-7	Surakshe-8	Mane-5	Mane-5	Surakshe-6
	Mane-4	Bi:gadkai:-3	Surakshe-4	Mane-5	Mane-5	Surakshe-5	Surakshe-5	Mane-4
	Bi:gadkai:-3	Ba:gilu-3	Be:ku-4	Horage- 2	Bi:gadkai:-3	Ka:pa:du-3	Hittale-3	Be:ku-4
BALLOON	Me:le- 6	Me:le-5	Me:le-5	A:kasha-7	Me:le-4	A:kasha-5	Ha:ru-5	Ha:ru-4
	A:kasha-6	Maklu-4	Akasha-4	Me:le-4	Ha:ru-4	Me:le-3	A:kasha-5	Akasha-4
	Ha:ru-4	A:kasha-4	Ishta- 3	Banna-3	Ishta-3	Banna-3	Ja:tre-3	Banna-3

II B. MOST COMMON RESPONSES FOR THE AUDITORY STIMULI

STIMULI	**Group I**		**Group II**		**Group III**		**Group IV**	
	M	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Kanadaka	Kannu-6	Kannu-8	Kannu-5	Power-5	Kannu-7	Drishti-5	Kannu-6	No:du-5
	Surakshe-4	mukha-5	Drishti-5	Kannu-5	Drishti-5	Kannu-4	Ka:nu-5	Kannu-5
	Shoki -3	size-6	Power- 4	Drishti-3	Shoki-4	Upyoga-3	Drishti-5	Drishti-5
Angi	Batte-5	banna-5	Deha:- 5	Batte- 4	Surakshe-5	Surakshe-4	Batte-5	Si:re-3
	Surakshe-4	Batte-4	Angdi-4	muchkoladhu-3	batte-4	Be:ku-4	Hatti- 4	Batte-3
	Bere type-2	surakshe-3	Batte-3	surakshe-2	-	Sho:ki-3	De:ha- 3	Angdi-2
Hadu	Pakshi-4	Ha:ru-6	Pakshi-6	Pakshi-7	Pakshi-6	Pakshi-7	Ha:ru-5	Pakshi-5
	Mele-4	Mele-5	A:ka:sha-4	Ha:ru-4	Mele-4	Kannu-3	Pakshi-4	Mele-4
	Kannu-3	Pakshi -3	Ha:ru-4	A:ka:sha-3	Ha:ru-4	Ha:ru-3	Mele-4	Ha:ru-5
Mane	Sha:nthi-3	Adigemane-5	Va:sa-5	Surakshe-4	Surakshe-4	Kutumba-4	Sha:nthi-3	Nimmdi -4
	Nimmdi-3	Kutumba-4	Kutumba -3	Sha:nthi-3	Kutumba-4	Nimmdi-3	Beku- 4	Kutumba-4
	Ottige-3	Va:sa-4	kudisalu-3	Va:sa-3	Beku-3	Maklu-3	Kutumba-3	Makklu-4
Kolalu	Sange:tha-6	shabda-6	Krishna-7	Krishna-6	Sange:tha-6	Krishna-6	Sange:tha-6	Sange:tha-7
	Krishna-5	Mathura-5	Sa:dhane-4	Shabda-5	Sa:dhane-4	U:du-4	Na:da-5	Swara-6

	U:du-4	Krishna-5	impu -4	Sangeetha-4	Krishna-3	Impu- 4	Krishna-5	Krishna-4
Ha:le	Bari-6	Billi-6	Bari-7	Bari-7	Bari-5	Billi-5	Bari-7	Bari-5
	Pustaka-4	bari-5	O:du-4	O:du-5	O:du-4	O:du-4	Pustaka-3	Kavitha-4
	O:du-4	Pencil-3	Pustaka-4	Billi-6	Pustaka-3	Bari-3	O:du- 3	Pustaka-4
Hodike	Challi-7	Challi-6	Challi-7	Challi-8	Malugu-5	Challi-8	Challi-4	Challi- 8
	Malugu-5	odhko-6	odhko-5	odhko-5	Challi-5	Be:ku-4	Maugu-4	Odhko-5
	-	Nidde-4	Surakshe-4	Maugu-3	Odhko-4	Odhko-3	Nimdi- 3	Nidde-3
Mi:nu	Ni:ru-6	Kere-6	I:ju-4	Ni:ru-6	Ni:ru-7	I:ju-5	Ni:ru-6	I:ju- 5
	Kere-3	Ni:ru-6	Ni:ru-4	Kere-3	Tinnu-3	A:ha:ra-5	Jalachara-4	Ni:ru-4
	Tinnu-3	I:ju-4	tinnu-3	Tinnu-3	I:ju-3	Ni:ru-4	Tinnu-3	Tinnu-3
Kumbalkai:	Palya-5	Tarka:ri-5	Tarka:ri-5	Tarka:ri-6	Tarka:ri-7	Palya-5	Palya-5	Sihi-4
	Pu:je-4	Palya-4	drishti-3	drishti-4	drishti-4	Pu:je-4	Adige-3	Pu:je-4
	Sambar-3	Sihi/ dodda-4	Palya-3	olledhu-3	palya-3	Sambar-3	Pu:je-3	Dodd- 3
Chila	Togoladu-6	Sa:man-6	Kai: chila-5	Go:ni:-4	Vastu -6	Togoladu-6	Sa:man- 5	Dina nitya-5
	Kai: chila -3	Tarka:ri-6	Go:ni:-3	Upayoga-3	Go:ni- 3	Kai:-3	Akki- 3	Kai: chila-4
	Go:ni-3	Pustaka-4	Sa:man-3	-	Togoladu-3	Go:ni-3	Beku- 3	Beku-3
Mo:te	Omelette-4	Haladi-5	A:ha:ra-5	A:ha:ra-6	A:rogya-4	Omelette-4	Ko:li-4	Omelette-3
	Tinnu-3	Billi-5	Ko:li-4	Billi-5	Ko:li-5	Tinnu-3	Omelette-3	Tinnu- 3
	Ko:li-3	Ko:li-4	A:rogya-4	A:rogya-4	Tinnu-4	Ko:li-3	Tinnu- 2	Adige- 2
Vima:na	A:kasha-5	A:kasha-6	Ha:ru-5	Va:hana-5	Ha:ru-4	A:kasha-5	Me:le-4	A:kasha-5
	Me:le-4	Rekke-5	Bere desha-4	Ha:ru-4	Praya:na-4	Me:le-4	Be:re desha- 3	Ha:ru-3
	Ha:ru-4	Ha:ru-3	Praya:na-4	Be:ga-3	A:kasha-3	Ha:ru-4	Ha:ru-4	Do:ra-2
Gula:bi	Mullu-5	Hu:vu-6	Hu:vu-5	Hu:vu-6	Hu:vu-5	Hu:vu-6	Hu:vu-5	Hu:vu-6
	Kempu-4	Kempu-5	banna-4	banna-5	Kempu-4	Kempu-4	Va:sne- 4	Kempu-4
	Ishta-3	Banna-4	Pre:ma-3	Va:sne-3	Va:sne-4	Ishta-3	Ishta-2	Pri:ti-3
Nalli	Ni:ru-6	Ni:ru-6	Ni:ru-7	Ni:ru-8	Ni:ru-6	Ni:ru-6	Ni:ru-5	Ni:ru-4
	Sna:na-4	Mane-4	Sna:na-5	Plastic-5	Control-3	Sna:na-4	Sna:na-4	Batte- 3
	Batte-4	Sna:na-4	Be:ku-4	Beku-3	Sna:na-4	Batte-4	Mane- 3	Upyoga- 3
Sa:bunu	Batte-5	Sna:na-6	Batte-6	Batte-6	Swachthe-	Batte-5	Batte-4	Batte-5

					5			
	Mukha-4	Ni:ru-4	Sna:na-4	Sna:na-4	Mukha-4	Mukha-3	Sna:na-3	Sna:na-4
	Tolli-3	Va:sne-4	Swachthe-2	Dina-nitya-4	Batte-3	Tolli-3	Tolli-2	Swachthe-3
Hasu	Ha:lu-7	Ha:lu-6	Ha:lu-7	Ha:lu-6	Pra:ni-5	Ha:lu-6	Ha:lu-7	Ha:lu-7
	Devru-4	Billi-4	Pra:ni-5	hullu-4	Ha:lu-4	Devru-3	Karu-4	Pu:je-4
	Pu:je-3	De:vru-4	Pu:je-4	Pra:ni-5	Devru-4	Pu:je-3	Devru-4	Hullu-3
Neralu	Bisilu-7	Kappu-5	Bisilu-7	Pra:ni-5	Manushya-5	Bisilu-5	Bisilu-5	Hinde- 4
	Pra:ni-4	Belaku-4	katle-5	bisilu-5	Bisilu-4	Mara:-4	Hinde-4	Bhaya- 2
	Hinde-4	Pratibimba-3	-	Hinde-3	Pra:ni-4	Manushya-4	Pratibimba-3	Beku- 2
Benkipatna	Belaku-4	Bisi-5	Benki-4	Di:pa-5	Belaku-5	Belaku-5	Benki-5	Benki-4
	Benki-4	Benki-5	Beku-3	Benki-5	Benki-4	Hachi-3	Di:pa-4	Devru- 4
	Hachi-3	Di:pa-4	Dina-nitya-3	Olledhu-4	Di:pa-4	Benki-3	Hachi-2	Hachi-3
I:ruli	Kanniru-8	Kanniru-7	A:hara-5	Tarka:ri-6	Kanniru-8	Adige -7	Kanniru-8	Adige-6
	Adige-5	Adige-6	palya-4	Adige-5	Adige-5	Tarka:ri-5	Adige-5	Kanniru- 5
	Be:ku-4	Sippe-4	adige-4	Kanniru-8	Tarka:ri-5	U:ta- 5	Be:ku-3	Be:ku- 4
Kape	Shabda-6	Shabda-7	Ni:ru-6	Shabda-7	Bu:mi-6	Shabda-7	Shabda-6	Shabda-7
	Ni:ru-6	Ni:ru-5	Bu:mi-5	Pra:ni- 5	Ni:ru-6	Ni:ru-6	maLe- 4	Ubayava:si-3
	Bu:mi-4	Ubayava:si-4	Ubayava:si-5	Ni:ru -5	Shabda-5	Ubayava:si-4	Ni:ru- 4	Bu:mi-3