INVESTIGATING THE INFLUENCE OF AGE, GENDER, AND MODALITY IN SEMANTIC KNOWLEDGE OF NEUROTYPICAL ADULTS

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CERTIFICATE

This is to certify that this dissertation entitled **"Investigating the Influence of Age, Gender, and Modality in Semantic Knowledge of Neurotypical Adults"** is a bonafide work submitted as part of fulfilment of the degree of Master of Science (Speech-language pathology) of the student with Registration Number P01II24S123038. 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.

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CERTIFICATE

This is to certify that this dissertation entitled **"Investigating the Influence of Age, Gender, and Modality in Semantic Knowledge of Neurotypical Adults"** has been prepared under my supervision and guidance. It is also being certified that this dissertation has not been submitted earlier to any other university for the award of any other Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled **"Investigating the Influence of Age, Gender, and Modality in Semantic Knowledge of Neurotypical Adults"** is the result of my own study under the guidance of Dr. Abhishek B P, Assistant professor in language pathology, All India Institute of Speech and Hearing, Mysuru and has not been submitted earlier to any other university for the award of any other Diploma or Degree.

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List of Frequently Used Abbreviations

IQR-interquartile range

LSES-Low socioeconomic status

MoCA-Montreal Cognitive Assessment Malayalam

MSES-Middle socioeconomic status

SD-standard deviation

SES-Socioeconomic status

ABSTRACT

Background: *Word association tests have been utilized for psycholinguistic research as an effective means of exploring the structure and organization of the mental lexicon. In a word association study, individuals will be presented with a word and will be asked to say a word or words that come to their mind in response to the stimulus which can then be classified into different semantic categories with respect to the stimulus word.*

Aim and Objectives: *(1) to compare word association responses across different age groups, (2) to compare word association responses between male and female participants, and (3) to compare word association responses across auditory and visual modalities.*

Method: *A comparative group design was employed involving 90 neurotypical adults across three age groups. Participants were assigned to auditory and visual modalities cohorts. A word association task using concrete noun stimuli was administered, and responses were classified into taxonomic, thematic, subjective, and irrelevant categories.*

Results: *The findings revealed predominance of thematic responses across all age groups, with a gradual increase in taxonomic responses and reduction in subjective responses with age. Particularly no significant difference across gender or modality.*

Discussion: *The predominance of thematic responses across all age groups and the increase in taxonomic responses with age align with existing literature. The absence of gender differences, however, contradicts findings from the available studies. Modality-based differences showed both supporting and contradicting evidence in comparison with existing literature.*

Conclusion: *The effect of age was evident in the present study, whereas gender and modality did not show significant influence on the response categories. The findings contribute towards understanding lexical semantic organization across adulthood.*

Future studies may focus on larger sample sizes, different stimulus types, and varied modalities to improve generalizability and better understand semantic organization. Interpretation should be done cautiously by considering many variables, as the response type is prone to change due to many factors such as culture, language exposure, ethnicity, stimulus characteristics, etc

CHAPTER I

INTRODUCTION

Word association tests have been utilized for a long time in psycholinguistic research as an effective means of exploring the structure and organization of the mental lexicon. In a word association study, individuals will be presented with a word and will be asked to say a word or words that come to their mind in response to the stimulus (e.g., a stimulus “dog” can elicit responses such as “puppy,” “bone,” or “happy,” which can then be classified into different semantic categories with respect to the stimulus word). Thus, this will give insights into the lexical-semantic organization, and the responses elicited from a word association test can be analyzed according to which category they belong to, such as syntagmatic-paradigmatic, taxonomic-thematic, hypernymy-hyponymy, etc. There are different types of word association tasks, such as free word association, continuous word association, discrete word association, timed word association, cued semantic word association, etc. This would provide us with a way to study several different underlying cognitive processes, such as reaction speed, strength of associations, and type of associations, etc.

Responses can be influenced by a range of different factors, which can be broadly divided into extrinsic and intrinsic factors. Extrinsic factors refer to external influences on an individual and include cultural background, socioeconomic status, educational exposure, modality of stimulus presentation, and language environment, and intrinsic factors arise within the individual and encompass age, gender, cognitive capacity, and literacy skills. Together, these factors shape the richness, adaptability, and flexibility of human lexical networks.

Among these factors, the change in responses with age is widely studied, and the results of different studies suggest different trends. As children grow, the semantic

organization becomes increasingly based on co-occurrence patterns in the linguistic environment, and alongside there is a decline in the phonologically based associations (Fourtassi, 2020). In addition to this, younger children display more irrelevant responses and higher rates of non-responses, especially for abstract words; both of these decrease with age, indicating more structured semantic organizations (Krishnaswami & Rao, 2017). Studies have been conducted in school-age children, and the results were significant. Developmental research across grades 1 to 4 showed that children increasingly produced superordinate and paradigmatic responses, indicating category-based relationships that emerge as they grow (Palermo, 1971). Meanwhile, other studies reported that young children show a strong preference for thematic associations, producing context-based or event-linked responses, and taxonomic associations appear less frequently as they grow and then increase as individuals age (Bannur Nagaraj & Budiguppe Panchakshari, 2017; Wojcik & Kandhadai, 2020).

By adolescence and adulthood, response patterns are more stable; younger adults tend to produce more thematic associations (Burke & Peters, 1986; Ervin, 1961), whereas other studies suggest older adults show more taxonomic links and a comparatively stable amount of thematic associations (Belacchi & Artuso, 2018; Shao et al., 2014). Age-related changes can affect semantic retrieval, pattern of associations, or the strength of associations. These processes related to lexical-semantic organization and access can get weaker in older adults as age advances. These findings are in line with a normative study that established word association norms for older Mexican adults (n=114) and demonstrated that age is associated with increased variability and reduced cohesiveness in lexical-semantic responses, as indicated by a greater amount of idiosyncratic responses. Compared to younger adults, older adults showed a tendency to produce associations

across different grammatical classes; that is, they produced more syntagmatic associations (Arias-Trejo et al., 2022).

Research conducted across different age groups in children and adults revealed a common pattern: as children grow, their responses become less idiosyncratic and show stronger semantic associations, indicating that their lexical-semantic organization is strengthening. On the other hand, as older adults produced a greater number of idiosyncratic responses, this indicates weakening of the lexical-semantic organization. However, the nature of the semantic links (taxonomic-thematic and paradigmatic-syntagmatic) showed slight variations, which might be influenced by ethnicity, language proficiency, and cultural background (Arias-Trejo et al., 2022; Ervin, 1961; Goldfarb & Halpern, 1984; Reynolds et al., 1971).

In addition to age, other factors, such as gender and modality of stimulus presentation, can also have specific effects on word association responses. The general structure of lexical associations is essentially the same for both genders, and there is sparse research on gender influences in word association responses. Recent findings indicate that girls tend to produce more abstract and emotionally oriented associations than boys (Güçlü, 2024). This pattern might suggest a cognitive or social tendency among girls toward emotional or evaluative language.

The effect of the modality of stimulus presentation of word association test responses in second-language learners was studied by comparing written and aural-oral formats. The results of the study revealed that written administration elicited a greater proportion of meaning-based (semantic/paradigmatic) associations, and aural-oral administration resulted in more form-based and position-based responses (Linton & Joyce Brotsky, 1969).

In an experiment that was conducted using a word association task in native speakers of English and Japanese, non-native speakers of English revealed that non-native speakers showed a modality-specific effect: when words were presented aurally, they produced more phonologically related responses than when the same words were presented in written form. Native speakers, in contrast, showed no significant difference between written and aural presentations and maintained predominantly semantically related responses across both modalities (Racine, 2008). However, the majority of these studies do not show a significant difference in word association responses (Ohnmacht & Pacheco, 1972). The effect can also vary based on the interaction of the variables; this further warrants more studies exploring these variables, especially in the Indian context.

1.1 Need for the study

The body of studies on word association has focused on children as the target group, examining their developmental trends in word association patterns. There is a dearth of studies that involve adult participants, particularly in the Indian context. Existing word association tests are primarily adapted from Western populations, raising concerns about their cultural and linguistic applicability. Furthermore, there is only limited knowledge about word retrieval and semantic organization in neurotypical adults who are continuously exposed to two languages. While extensive research has explored semantic organization, questions remain about how ageing influences lexical retrieval, particularly in neurotypical adults.

Furthermore, the effects of gender and modalities (auditory or visual) on word association are underexplored, especially in regard to the Indian population. This necessitates the need for studying word association abilities in neurotypical adults and investigating how this ability varies as a function of age, gender, and stimulus modality.

The current study curbs the gaps in the literature and elicits deeper insight into cognitive-linguistic processing in neurotypical adults. Also, the current study is expected to serve as a valuable addition to the assessment of lexical semantic organization and access.

1.2 Aims:

The present study aims to examine the effect of age, gender, and modality on influencing semantic knowledge in neurotypical adults.

1.3 Objectives:

1. To compare the number of taxonomic, thematic, subjective, and irrelevant responses across different age groups in the word association task.

2. To compare the number of taxonomic, thematic, subjective, and irrelevant responses between male and female participants in the word association task.

3. To compare the number of taxonomic, thematic, subjective, and irrelevant responses for the two cohorts presented with visual and auditory stimuli in the word association task.

CHAPTER II

REVIEW OF LITERATURE

2.1 Lexicon and Mental Lexicon

Lexicon refers to the external set of words, whereas "mental lexicon" refers to the internalized, neurocognitive repository of an individual's linguistic knowledge. The mental lexicon deals with the internal and abstract cognitive organization that is stored within the brain. There is a vast amount of research in psycholinguistics that has focused on understanding the nature and organization of the lexicon in human beings, and many different computational and behavioral experiments have been employed to investigate the development of the lexicon over the developmental years and its variations in disorders (Stille et al., 2020). Psycholinguistics and neurolinguistics have explored the lexicon and mental lexicon and provided dimensions to explain how words are stored and accessed. Thus, the organization and arrangement of the mental lexicon is explained through the psycholinguistic and neurolinguistic measures.

"Lexical access" is the term used to refer to the retrieval of the most appropriate word from the lexicon; in other words, the stored words are retrieved from the lexicon based on the contextual need, and this phenomenon reflects the lexical access.

2.2 Theories and Models of Lexical Semantic Organization

In order to understand the process involved in lexical activation, understanding the principles governing storage and activation becomes important. These concepts related to lexical access, lexical storage, activation, and interconnectivity have been explained through foundational theories and models like the hierarchical network model, semantic network theory, dual-coding theory, etc. These theories and models have contributed to the

current understanding of the lexicon and its constituents (Collins & Loftus, 1975; Collins & Quillian, 1969).

The hierarchical network model proposes that semantic memory is organized as a hierarchy, where concepts are stored in nodes that are connected by semantic relationships. The organization is in such a way that the more general associations will be at the top and the specific ones will be at the bottom, which forms a pyramidal structure (Collins & Quillian, 1969). Thus, each node has more general and more specific nodes connected to it, and also the common attribute will be linked to the word, which will prevent repetition of the attribute for each subtype (e.g., a peacock will inherit the attributes such as 'has feathers,' 'can fly,' 'lay eggs,' etc.). This shows how the semantic memory is organized in a general-to-specific pattern and how it is arranged in a hierarchy. But this model doesn't efficiently explain why subordinate-level facts or words are retrieved faster than superordinate ones; thus, to address these limitations, the Semantic network theory & the spreading activation model (Collins & Loftus, 1975) were introduced; this model suggested that the mental lexicon consists of interconnected nodes. When a node is activated (e.g., "dog"), the activation spreads to related nodes (e.g., "cat," "bark," "pet"), allowing rapid access to related words, thus rejecting the hierarchical structure explained in the hierarchical network model.

Distributional Semantic Models (DSMs) are a group of models that explain that semantic knowledge is organized based on statistical co-occurrence patterns observed in a particular language during an individual's developmental period (Harris, 1954; Landauer & Dumais, 1997). According to this framework, words are represented as vectors in a high-dimensional space, and the similarities between these vectors reflect the semantic relationships between them (Budanitsky & Hirst, 2006). On the other hand, feature-based models organize concepts according to shared properties or attributes. Words are

represented as collections of features such as perception or functional attributes, and the degree of similarity is determined by feature overlap. For example, a bird might share features like “has wings” and “can fly,” which helps in structuring semantic similarity based on perception and functional properties (Smith et al., 1974). The prototype model explains how the meaning of a word is mentally organized and structured around a central or typical example of it (the prototype), rather than relying on a fixed, necessary feature to be included in a category like that of feature-based models. Each category has a graded structure where some members that closely resemble the prototype represent the category more than others (e.g., “crow” more closely resembles the prototype of a bird than “ penguin”), thus the latter modified version says that the prototype is a bundle of correlated features that are usually, but not necessarily, present in all category members (Coleman & Kay, 1981).

The Exemplar model, on the other hand, proposes that word meanings are represented not by abstracted prototypes or fixed sets of features, but rather by specific instances or examples stored in memory. It suggests that humans categorize new items by directly comparing them to many previously encountered individual examples; these stored exemplars reflect the variability found in real-world concepts, allowing more detailed and context-sensitive classification. This approach accounts for the diversity and richness of the category members, as it preserves detailed information about individual cases, making semantic categorization dynamic and flexible based on the range of exemplars stored in the mental lexicon (Croft, 1998).

Connectionist models of lexical semantic organization provide a biologically inspired framework for understanding how word meanings are represented and processed in the brain through neural network-like structures. These models depict lexical and semantic information as distributed patterns of activation over networks of interconnected

units, simulating cognitive processes of activation over networks of interconnected units, this system also accommodates the cognitive processes developed through learning from experiences (Ursino et al., 2018). Semantic features are represented as activations across sensory-motor areas organized topographically to implement similarity principles, while lexical items correspond to activations in a different network layer. Additionally, the models incorporate excitatory and inhibitory synapses to differentiate shared and distinctive features, explaining semantic priming and category formation effects. The connectionist model also supports grounded cognition by demonstrating that conceptual knowledge involves modality-specific brain regions rather than amodal symbolic representations. This can be applied in the case of local lesions and synaptic weakening associated with different neurological conditions (Ursino et al., 2018).

Dual-coding theory is another influential theory put forth in explaining the lexical semantic organization (Paivio, 1991) that postulates two interconnected but distinct systems for the representation of information: verbal and imagery. The verbal system that processes linguistic information and the non-verbal or imagery system that handles sensory and visual representations. These two systems would work independently and together; thus, the information will be encoded in two ways: independently and integrated. This type of dual-representational system will help in generating both a verbal label and a mental image together; e.g., the word “dog” activates not only its verbal label but also the mental image of the animal. Thus, when presented with new material, individuals can encode it as words (linguistic information) and as images (visual or sensory information). The aforementioned theories explain the basis of lexical semantic organization in adjuncts, and understanding the principles governing lexical semantic organization also becomes important.

2.3 Principles of Lexical Semantic Organization

Lexical semantic organization refers to a systematic way in which words and their relationships are structured in the mental lexicon. This organization is not random and is governed by principles that help us retrieve, understand, and use language efficiently. Words are clustered and accessed based on semantic relationships, forming a dynamic network in the mind, thus forming semantic fields, which are groups of related words such as those for colours (e.g., red, blue, and green) or emotions (e.g., angry, happy, and sad); thus, these fields allow for better lexical access. The interconnected structures are organized through various semantic relationships such as taxonomic, thematic, paradigmatic, syntagmatic, etc. These relationships govern how words are grouped and associated in the mind. Taxonomic relations group words based on shared categorical features; for example, “dog” and “cat” are both members of the group of domestic animals, whereas thematic relationships, on the other hand, connect words that are often used together in the same event or situation, like “chef” and “pan” when cooking (Collins & Loftus, 1975; Lin & Murphy, 2001).

While thematic and taxonomic relationships focus on meaning-based or category and context, another important way to understand how words relate is through syntagmatic and paradigmatic structures. Paradigmatic relations refer to the words that belong to the same grammatical and semantic category and can be substituted for one another in a sentence (e.g., dog, cat, and horse when talking about pets). These words are linked in a vertical, category-based way. Syntagmatic relationships, by contrast, refer to the way words combine sequentially to form grammatically and semantically coherent structures; for example, in the sentence “the dog barked loudly,” each word contributes to a meaningful and well-formed linguistic unit (de Saussure, 1916/1983).

The semantic relationship can also be explained in terms of synonymy, antonymy, hyponymy, hypernymy, and meronymy. Words with similar meanings (such as “happy” and “joyful”) are said to be synonyms, and antonyms are words that have opposite meanings (like “hot” and “cold”). Hyponymy and hypernymy are types of semantic relationships that show how things are related in a hierarchy. A hyponym is a more specific example of a broader category (for example, “rose” is a hyponym of “flower”). Holonymy represents the whole of an object, whereas meronymy represents parts of an object (e.g., “wheel” is a meronym of the whole that is “car,” which is a holonym) (Murphy, 2003).

2.4 Tasks used to tap lexical-semantic organization

There is a wide range of experimental and observational tasks that are used to examine the storage and access of words in the lexicon. These tasks are broadly categorized into production-based and competence-based measures. Verbal fluency, picture naming, word definition, and word association are examples of production-based tasks that demand active lexical retrieval and demonstrate the dynamic accessibility of semantic networks. Competency-based tasks, on the other hand, such as priming experiments, category verification, feature verification, and lexical decision, concentrate on evaluating the fundamental structure of semantic knowledge without requiring a lot of output (Aitchison, 2012; Spivey et al., 2012).

Verbal fluency tasks are among the most widely used, which require participants to retrieve as many words as possible within a given time limit, either from the semantic category (e.g., fruits) or based on a starting phoneme (e.g., tell the words starting with the letter “F”). These tasks will provide details about the semantic field, and this will also reveal how efficiently lexical networks are accessed under time constraints, whereas picture naming involves naming images as quickly and accurately as possible and is

frequently used to measure lexical retrieval speed and semantic competition, especially in neurolinguistic contexts.

A study was conducted using verbal fluency tasks, picture naming, and executive control tasks in 82 older Dutch-speaking adults to examine their lexical-semantic organization and retrieval. Results showed that category fluency relied mainly on semantic organization and lexical access, while letter fluency depended more on executive control (working memory and updating). While reviewing the overall results, it implied that semantic organization remained active with age, though lexical retrieval slowed when they attempted picture naming (Shao et al., 2014).

Word definition tasks can be utilized to assess how effectively individuals can access, retrieve, and articulate the meanings of words, reflecting their underlying conceptual and semantic knowledge. This task can reveal the structure and organization of the mental lexicon by showing how word meanings are stored, related, and accessed within semantic networks. The examiner will be able to analyze the accuracy, completeness, and qualitative nature of the responses, which can give insights into how hierarchical relationships, thematic connections, etc, are present in an individual's brain.

A study had examined how healthy young adults, elderly controls, and probable Alzheimer's disease (pAD) defined 24 words differing in frequency and typicality. Younger adults gave more detailed and better definitions for low-frequency and atypical words, which were chosen as stimuli; it included many key semantic features, but on the contrary, the pAD group produced more vague or irrelevant responses. Though some showed retained knowledge, the study concluded that Alzheimer's disease weakens semantic specificity rather than fully erasing the meaning, and other factors like typicality

and frequency of the word strongly affected the lexical-semantic retrieval (Astell & Harley, 2002).

Similarly, word association tasks (and their variants like free and controlled association) are used to explore associative strength and the structure of semantic fields. In free association tasks, participants are prompted with a stimulus word and asked to respond with the first word or words that come to mind. The responses should be unrestricted and spontaneous and should not be guided by any rules (cake-cream or cake-cream, birthday, happy, etc.); this typically reflects natural, spontaneous links based on personal experiences or cultural norms.

In contrast, controlled association tasks require participants to generate a specific kind of response, such as a synonym, antonym, certain number of responses, or a category member, based on an instructed semantic relationship (e.g., hot:- cold for antonym). These tasks not only help uncover taxonomic relationships (e.g., categorical structures like dog:-animal) and thematic relationships (e.g., situational co-occurrence like knife:-fork), but also associative strength (how strongly concepts are linked in memory). Relationships such as synonymy, antonymy, syntagmatic relationships, and paradigmatic relationships can be deduced through word associations. Thus, they offer a rich window into the mental lexicon and its organizational principles (Aitchison, 2012). Among controlled word association tasks, which obtains certain number of responses can be termed as discrete word association, this task can capture a single strongest association or associations which have weaker vs stronger links, this was used in several studies to establish norms, to study the type of associations, and to study developmental trends.

In a behavioral study using free word association, Goldfarb & Halpern, (1984) examined responses from 316 undergraduates and found that the majority of associations

were paradigmatic (48.1%) or syntagmatic (41.6%), with variations influenced by grammatical class and level of abstraction. These findings are supported by Smith et al. (1974), who investigated adult word-object and action-object associations using a cross-situational learning paradigm. Their findings demonstrated that learners combined co-occurrence statistics from different referential contexts to create powerful semantic mapping, demonstrating the importance of both object-based and action-based associations in the development of semantic organization (Smith et al., 1974).

Another study has utilized the largest existing U.S. free-association database originally gathered from different studies, which contained more than 6000 participants in total who were asked to map how people naturally link words in semantic memory. The archive, which they analyzed, contained 5019 cue words such as “book,” “dinner,” “table,” etc. For each cue-response pair, they computed forward (the proportion of participants who gave a particular response) and backward (the probability that the response also cues back to the original word) strengths, and they also evaluated the network measures, such as set size and connectivity, that reveal how densely or sparsely a word is embedded in the semantic network (Burke & Peters, 1986). The norms they provided were a way to map the lexical knowledge that is commonly shared among speakers of a language. Word association tasks can be used for studying the lexical semantic organizations of different pathological conditions.

In a preliminary investigation done by (Spiteri, 2005), a pilot study involved ten student participants who were asked to produce free associations for fifteen stimulus terms and then describe the reasoning behind each association. This had generated a substantial set of associations along with explanatory notes that revealed the conceptual facets underlying participant’s responses. The work aimed to determine whether the method could effectively capture meaningful inter-term relationships and categorize them into

distinct facets. Analysis of the resulting data confirmed that the procedure yielded rich associative patterns and clear facet indicators, demonstrating its suitability for organizing related concepts into a coherent, hierarchical thesaurus structure.

de Groot (1988) introduced a new corpus of Dutch free, discrete word association norms examined how grammatical form class, word frequency, and imageability shape associated patterns and response latencies in the mental lexicon. In this research, they had used a total of 240 nouns and an additional group of adjectives and verbs. Out of the 240 nouns, 160 were arranged in a 2×2 design varying in imageability (high vs low) and frequency (high vs low), while the remaining nouns, adjectives, and verbs formed a separate design manipulating grammatical form class and frequency. All the participants were asked to perform a discrete word-association task in which each cue word appeared once, and they wrote the first related word that came to their mind (as per the instruction given). Researchers had recorded both the associations and their response latencies. This found some trends such as; adjectives produced slightly higher primary response frequencies than nouns, largely trending because mainly high-frequency adjectives elicited antonyms, high-frequency cue words produced more varied associates than low-frequency words, and imageability showed stronger effects, like it eliciting stronger, more dominant primary responses, faster reaction times, and fewer alternative responses, whereas low-imageability words triggered slower responses and a wider range of associations. Authors stated that highly imageable words occupy denser, more strongly interconnected regions of the mental lexicon. By analyzing all the results, a conclusion can be made that lexical properties influenced automatic semantic retrieval (de Groot, 1988).

Minto-García et al. investigated Alzheimer's disease individuals and used a free word association task (WAT) with a total of 24 participants, in which 12 were individuals with Alzheimer's disease (AD), and 12 were age-matched adults with typical ageing (TA).

Participants responded orally to 234 high-frequency Spanish nouns, providing the first word that came to mind. Responses were analysed for paradigmatic, syntagmatic, and anomalous relations as well as semantic, wide, and signifier-based associations. Paradigmatic responses were most frequent in both groups, while the AD group produced significantly more anomalous and unclassifiable responses. TA participants showed higher thematic-contextual co-occurrence and semantic relations, whereas participants with AD exhibited altered lexical retrieval, including increased coordination and non-answers (Minto-García et al., 2022).

Bello Lepe (2022) applied distributional semantic models to storytelling discourse in aphasia. This study revealed that individuals with fluent aphasia showed greater semantic vectorial distances between words than controls, suggesting weaker or less coherent semantic associations. This can be due to the effect of degradation in lexical-semantic organization. Thus, these studies support the findings of word association paradigms, which indicate that the underlying structure and disruption of semantic memory, especially in mild cognitive impairment or aphasic populations, are revealed by abnormal associative responses.

Priming tasks are also essential tools in studying lexical-semantic organization because they reveal how words and meanings are connected in the mental lexicon. The examinee would be presented with a prime word and then followed by a target word, and then the examiner can measure the speed and accuracy of the response to see if the semantic connection would facilitate the processing (e.g., when a prime word is “doctor,” it can lead to a related target word like “nurse” compared to any unrelated word like “tailor”). This demonstrates that semantically related words are linked within the lexicon and activate each other automatically (McNamara & Holbrook, 2003; Neely, 1977).

Arias-Trejo & Plunkett (2009) had examined lexical-semantic organization in infants using a semantic priming paradigm with the Intermodal Preferential Looking (IPL) task. Infants (18 and 21 months) heard word pairs that contained prime and target words (related or unrelated) followed by images, and afterwards, the looking preferences were measured, and the results showed that 21-month-olds displayed semantic priming effects; this indicates the already established word associations, while 18-month-olds did not exhibit the same as the 21-month-olds. There were further silence-controlled experiments that confirmed the results that were observed; thus, the overall findings suggested that semantic associative links in the mental lexicon begin emerging around 18 months and become organized by 21 months.

Lexical decision tasks, often conducted with semantic priming, require participants to decide whether a letter string is a real word. When used with semantic priming, faster responses to semantically related word pairs (e.g., “bread” and “butter”) support the spreading activation model of semantic processing (Collins & Loftus, 1975; Hutchison, 2003). Howard et al. (1981) utilized a lexical decision task and free recall paradigm to examine age- related changes in lexical-semantic organization. The study included 24 young adults (mean age = 28 years) and 24 older adults (mean age = 70 years). Participants demonstrated faster lexical decisions for semantically related word pairs across both age groups, indicating preserved automatic semantic priming with ageing. However, older adults recalled fewer words and exhibited reduced categorical clustering, suggesting a decline in controlled retrieval processes with age.

Category and feature verification tasks ask participants to confirm if an item belongs to a category or possesses a specific attribute (e.g., “Is a crow a bird?” or e.g., “Is a crow black?”), thus tapping into semantic hierarchies and categorical knowledge ((Collins & Quillian, 1969). Empirical evidence from priming experiments (semantic or

phonological) and lexical decision tasks supports the view that the mental lexicon is highly organized, allowing rapid access to related words in both typical and impaired populations.

Both types have their own advantages and limitations; production-based tasks can be strongly affected by an individual's mood, anxiety, fatigue, or lack of engagement. Sometimes it can lead to incomplete responses, which would limit the interpretation of the results. Task instructions can highly influence the results and can create bias in participant's responses rather than getting the natural lexical-semantic organization. Whereas competence-based tasks would reveal only surface-level or automatic associations, and while this will not give clear, deeper, context-sensitive semantic relations, e.g., priming experiments and lexical decision tasks can reflect rapid responses to familiar items but may not accurately measure the full richness or flexibility of an individual's semantic network. Even though these tasks have limitations, they are widely used in standalone or in combination to study different psycholinguistic processes. These tasks would help to tap the associative strengths, taxonomic-thematic, and paradigmatic-syntagmatic structures, which will offer valuable insights into how the mental lexicon is organized (Aitchison, 2012; Collins & Loftus, 1975). These tasks are used to study lexical-semantic organization, both in normals and in different pathological conditions.

Apart from behavioral measures, there are many electrophysiological measures used to tap the lexical semantic organizations; the most commonly used are event-related potentials (ERPs). An ERP that is commonly used to study semantic processing in different research is N400. N400 is a negative-going ERP peaking around 400 ms after stimulus onset and is sensitive to semantic processing and integration during word recognition; it gives us an idea about the ease or difficulty of the semantic access and integration process (Lau et al., 2009). It indexes lexical semantic processing in the brain. Longer latencies and

higher amplitudes may indicate delayed or less efficient lexical-semantic access and integration processes (Junge et al., 2021; Kutas & Federmeier, 2011).

A study had recorded event-related potentials while participants read sentences that ended with meaningful words. They found that the amplitude of the N400 component was inversely related to how predictable the final word was, measured by cloze probability. The study also found that semantically related but unexpected words for completions produced smaller amplitude in N400 than the words that were unexpected but unrelated; thus, N400 reflected the process involved in semantic activation or priming during comprehension (Kutas & Federmeier, 2011).

2.5 Factors affecting semantic organization

Semantic organization is far from being static and is dynamically and hierarchically structured and is an experience-sensitive network that evolves in response to multiple influences (Aitchison, 2012; Carroll, 2008). These influences or factors can be broadly divided into extrinsic and intrinsic factors. Extrinsic factors refer to the external influences on an individual and include cultural background, socioeconomic status, educational exposure, and language environment. On the contrary, intrinsic factors arise within the individual and encompass age, gender, cognitive capacity, and literacy skills. Together, these factors shape the richness, adaptability, and flexibility of lexical networks, influencing the representation and access throughout the lifespan. These interconnected elements impact the lexical network's richness, adaptability, and flexibility across life span, in addition to how words are accessed and represented in our minds.

Age has a clear influence on how semantic information is organized and accessed. Young adults tend to form thematic associations between words (e.g., dog-bone), which reflect flexible and contextually responsive lexical networks. On the other hand, older

adults more commonly generate taxonomic associations (e.g., dog-animal), which suggest a shift towards abstract, hierarchically structured processing as cognitive priorities change with age (Shao et al., 2014). Another study indicated that adults tend to respond with words from the same grammatical class (paradigmatic responses) with very short reaction times; the reason for this was said to be that words share meaning, morphology, or appear in similar past verbal contexts (contextual similarity). The author put forward two models of how associations are formed, one based on repeated phrase patterns and the other based on shared contextual environments (Ervin, 1961).

Fourtassi (2020) studied the development of free word associations in children between ages 3 and 8, examining how co-occurrence-based similarity, phonological distance, word frequency, and length influenced responses. Normalized entropy was used to measure the individualized variability, and mixed-effects models assessed predictor effects and developmental changes. Results showed that as age advances, the responses given become more guided by co-occurrence patterns in the linguistic environment, and the reliance on phonological similarity decreased; hence, it can be to inferred that as age increases, a greater number of thematic responses than taxonomic responses can be expected.

This pattern was contrasted in different studies; for example, in a study, younger and older adults were given a rapid free-association task: a single stimulus word (nouns, verbs, adjectives, or adverbs) was presented. When the responses were analyzed, it showed that both groups had almost the same proportions of paradigmatic (same grammatical class as the stimulus, stimuli (noun) - response (noun)) and syntagmatic (different grammatical class as the stimulus, stimuli (noun) - response (verb)), with a larger number of paradigmatic responses than syntagmatic ones. Thus, this shows that there is no reliable age-related shift (Burke & Peters, 1986). Another study that utilized a word recall task

examined adults aged 18 to 85 years. The task given was to memorize 60 words arranged to encourage either taxonomic associations (category-based), thematic associations (context-based), or no semantic link at all, and the finding was that the accuracy declined more sharply with age for taxonomic lists, whereas performance on thematic lists remained relatively stable. This suggests that the hierarchical or category-driven part of the semantic network is more vulnerable to age-related change, while everyday contextual connections continue to function well even in older age (Belacchi & Artuso, 2018)

Cronin (2002)reported that first-grade children demonstrated a significant increase in paradigmatic responses over the course of the school year, and this increase was closely associated with reading acquisition and word comprehension rather than with chronological age alone. Importantly, syntagmatic responses remained relatively stable, whereas paradigmatic responses increased, indicating qualitative restructuring of lexical-semantic networks during early literacy development.

Another study examined the development of children's free word associations between ages 3 and 8 and adults of the age range of 18 to 43 years and focused on the shift from thematic (syntagmatic) to taxonomic (paradigmatic) associations, which was happening in childhood. The study evaluated sixty children and sixty adult participant's responses in a task in which they were asked to say the first word that came to their mind. The analysis of the responses revealed that taxonomic associations were present even in early childhood, but this increased with age, while younger children gave more variable and idiosyncratic responses, indicating less structured lexical-semantic networks (Wojcik & Kandhadai, 2020)

Even though semantic knowledge generally improves across the lifespan, reduced spontaneous word generation, more frequent tip-of-tongue states, and slower retrieval

speed are found in older adults (Hutchison, 2003); these changes can be linked to declines that they face in executive function and processing speed. The spreading activation model proposed by (Collins & Loftus, 1975) explains these effects by suggesting that activation may decline, requiring more deliberate and controlled retrieval. This shift is more evident in verbal fluency tasks, where older adults tend to perform better in semantic fluency (category-based recall) than in phonemic fluency (letter-based recall), indicating deeper semantic structures remain resilient even when the access mechanism weakens (Shao et al., 2014).

Some studies in the Indian context have used word association tasks and support these developmental trends. Studies by (Bannur Nagaraj & Budiguppe Panchakshari, 2017; Krishnaswami & Rao, 2017) has probed lexical semantic organization in children; the age groups that were studied were 4-7 year old children in the first and 6-9 year old children in the second. Both of the studies used free word association tasks; the results of the first study showed a clear developmental progression in how the children connect meanings. Younger children mainly produced thematic associations (everyday situations/event-based relationships); with increasing age, there was a strong rise in the taxonomic associations. This indicated category-based or hierarchical organization of the mental lexicon in the age group of 6-7 years, and also the unrelated responses decreased steadily, which shows better lexical access and organization as we grow older (Bannur Nagaraj & Budiguppe Panchakshari, 2017). In the second study, the results centered on how the children responded to concrete and abstract word stimuli. Concrete words produced almost no non-responses, especially in the younger group (6-7 years). Abstract words, however, resulted in considerably more missed responses, suggesting that abstract concepts are harder for children to respond to. Responsiveness improved consistently with age. Across all age groups, girls gave fewer non-responses than boys. The study showed

that the children got better at retrieving words as they got older, and there was a persistent gap between their ability to use concrete versus abstract vocabulary (Krishnaswami & Rao, 2017)

While age-related patterns in semantic processing are well documented, gender-related differences are more subtle. Although many studies do not find any clear distinction in lexical-semantic organization based on biological sex, recent evidence suggests that girls tend to produce more abstract and emotionally oriented associations than boys (Güçlü, 2024). Despite the fact that the general structure of lexical associations is essentially the same for both genders, this pattern might suggest a cognitive or social tendency among girls toward emotional or evaluative language.

Many extrinsic factors can also affect the word associations given by participants. A study had investigated the effect of the cultural background of individuals in word association tasks. The study utilized the Kent-Rosanoff list of 100 stimulus words and administered it on two groups: 60 participants in Belarus and another 60 participants in Minneapolis, with an equal number of men and women in each group. Participants were asked to read the stimulus word and write down the first word that came to their mind. The results indicated a clear cultural effect on associative patterns. Belarusian participants, coming from a more collectivistic and higher-context culture, produced a larger number of person-related associations, used to describe people in terms of appearance, qualities, and personal states. In contrast, American participants showed more individualistic and action-oriented cultural orientations and offered more associations linked to activities, roles, and professions. These patterns were consistent with established descriptions of the two cultures, and this provides support for the hypothesis that cultural background shapes semantic associations (Korshuk, 2005).

In another study, differences in word association patterns across Korean native speakers, language learners, and teachers were explained through extrinsic factors like the external language environment. Native speakers are extensively exposed to Korean language naturally in daily communication, media, and different social settings, which gives them a wide pool of associations. However, learners and teachers had relied heavily on structured educational materials, graded vocabulary lists, and classroom interactions. This limits their associative choices to textbook meaning. Teachers are additionally shaped by occupational routines, repeatedly using beginner-level vocabulary in instruction, which further narrows the range of associations they generate. Cultural immersion also separates native speakers from the other groups, since they depend on culturally embedded meanings that learners and teachers may not have fully internalized. These extrinsic influences collectively account for why native speakers showed the richest associations, learners and teachers showed more overlapping textbook-driven responses, and teachers produced the fewest associations overall (Shin, 2024).

Another factor influencing the semantic organization is literacy. Exposure to reading and formal education can significantly enhance the vocabulary size and depth. Conversational speech usually tends to rely on a core set of high-frequency words; a literate adult may know and recognize over 150,000 words, allowing for more elaborate and nuanced associations (Budiguppe Panchakshari & Shantanu Mahajani, 2024). Literacy also promotes abstract and decontextualized meanings, especially through exposure to professional, literary, and academiclanguage. This capacity enhances semantic organization and more complex semantic networks.

Socioeconomic status is another factor that affects lexical semantic organization. Many studies have investigated socioeconomic status and its effect on semantic learning, organization, and performance. In a study of semantic fluency in Kannada-English

sequential bilingual children. The study included 50 third-grade students from low (LSES) and middle (MSES) SES backgrounds. Using an animal category fluency task in Kannada (L1) and English (L2) and analyzing scores, the authors found that LSES children produced significantly fewer correct words than MSES peers in both languages. This finding indicated that SES is a meaningful predictor of semantic fluency performance, which reflects the difference in linguistic exposure and experiential vocabulary groups (Mohan et al., 2017).

Another study had examined how socioeconomic status influences word-learning ability in school-aged children, and reported that vocabulary knowledge specifically mediated the relationship between SES and word-learning performance, with higher-SES children showing stronger vocabularies and consequently better learning of novel words from context (Maguire et al., 2018). Many studies suggest that SES can have effects on the quantity of vocabulary and also the structure of lexical semantic organization.

Cognitive mechanisms such as redundancy and semantic diversity, along with properties like word frequency, also shape how the mental lexicon is structured and accessed. Words that are encountered in varied contexts develop richer and more flexible meanings, which is known as semantic diversity. Repeated exposure or redundancy strengthens memory traces, in turn improving recall. This principle explains why high-frequency words are stored in a more accessible and efficient manner, facilitating rapid lexical retrieval (Adelman et al., 2006). The multi-layered lexical access pathway, which is arranged morphologically, phonologically, and semantically, is where these mechanisms function (Aitchison,2012).

Synonymy, antonymy, and hypernymy are examples of semantic relations that facilitate effective activation spread, enabling quick and context-sensitive retrieval. Words are incorporated into pre-existing networks according to their associative strength,

which varies with how frequency and usage patterns evolve (Pranoto & Afrilita, 2019). These factors (both extrinsic and intrinsic) have not been explored through plenty of studies; in other words, there is a clear dearth of literature on the investigation of extrinsic and intrinsic factors about word association. Furthermore, the same thing applies to Indian studies related to word association, necessitating more studies in this direction.

Chapter 3

METHODS

3.1 Research design

The study employed a comparative group design (between-group) to study the effect of age, gender, and modality on word association responses of the participants.

3.2 Participants

Ninety neurotypical adults were divided into three age groups in the study:

Group 1: 18.00–35.11 years

Group 2: 36.00 to 50.11 years

Group 3: 51.00–65.00 years

Two cohorts were formed from each age group, and the modality of stimulus presentation was different for each of these cohorts.

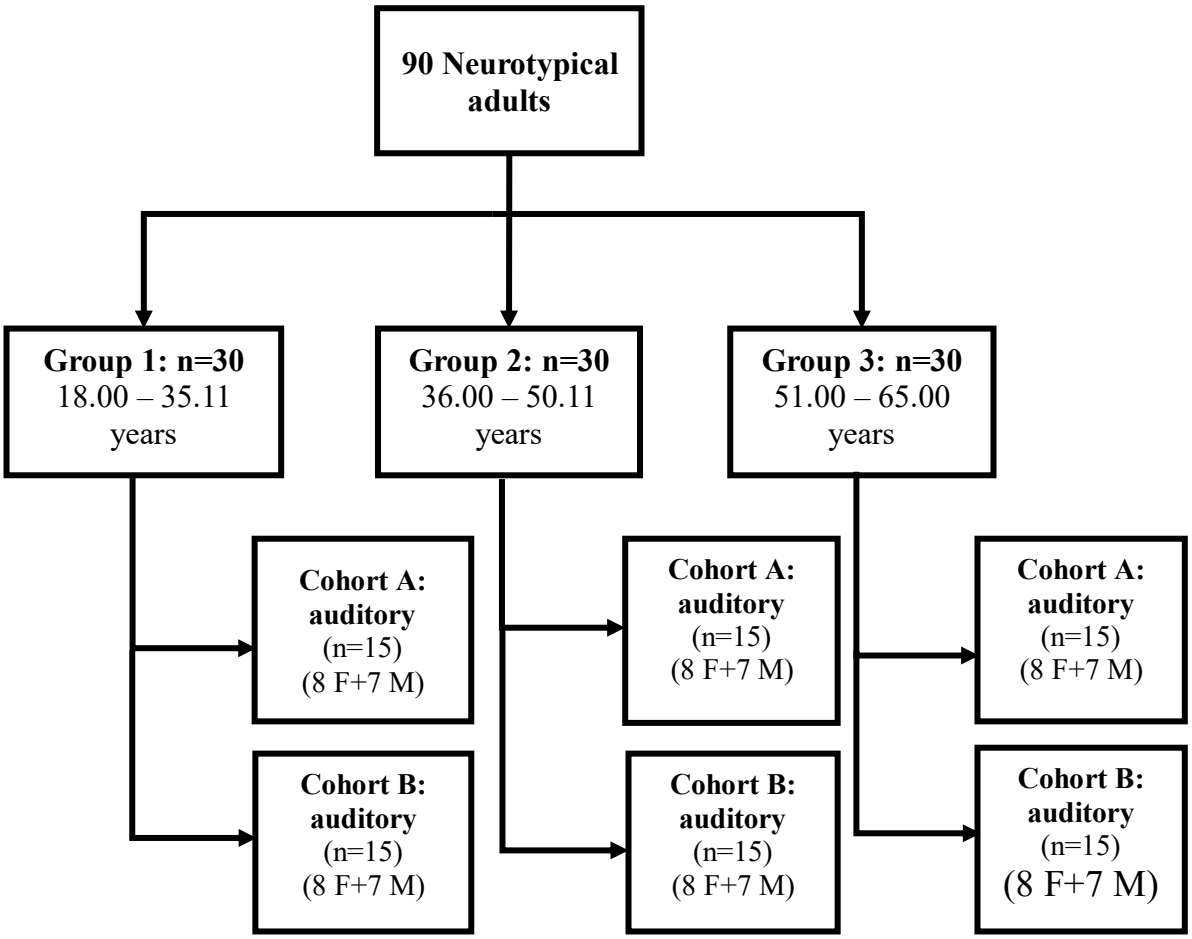
Cohort A: The stimulus was presented in auditory modality for each of the age groups mentioned above.

Cohort B: The stimulus was presented in visual modality for each of the age groups mentioned above.

Thus, each cohort consisted of 45 participants (15 in each age group mentioned above, with a balanced gender distribution of eight females and seven males within each age group). Participants were neurotypical individuals with no history of speech, language, hearing, or cognitive disorders, ensuring that the findings reflect typical cognitive-linguistic processing in the Indian context.

Figure 3.1

Pictorial representation of the group division and cohort assignment



Note. F = Females; M = Males

Table 3.1

Group1 participants demographics and self-rated language proficiency.

Sl. No	Age/Gender	Education	Occupation	L1			L2		
				U	S	R	U	S	R
1	18/Female	UG	Student	10	9	9	9	9	9
2	19/Female	UG	Student	10	9	9	9	9	9
3	20/Female	UG	Student	10	9	9	9	8	8
4	22/Female	PG	Student	10	9	10	9	8	8
5	22/Female	UG	Student	10	9	9	9	8	8
6	23/Female	PG	Student	10	10	9	9	8	9
7	24/Female	PG	Student	10	9	9	9	9	9
8	26/Female	PG	Student	10	10	10	9	8	9
9	26/Female	Diploma	House Wife	10	9	9	8	7	7
10	26/Female	PG	Student	10	10	9	9	9	9
11	26/Female	PG	Student	10	10	9	9	8	9
12	27/Female	PG	Project Engineer	10	9	9	9	9	9
13	27/Female	PG	Student	10	9	8	9	9	9
14	30/Female	UG	Software Engineer	10	10	9	9	9	8
15	31/Female	PG	Student	10	10	10	10	9	9
16	33/Female	PG	Housewife	10	10	10	9	8	8
17	19/Male	UG	Student	10	10	10	9	9	9
18	20/Male	UG	Student	10	10	10	9	9	9
19	20/Male	UG	Student	10	9	9	9	9	9
20	21/Male	UG	Student	10	9	9	9	10	10
21	23/Male	PG	Student	10	10	10	9	9	9
22	23/male	UG	Student	10	10	10	10	9	9
23	25/Male	PG	Audiologist	10	9	9	9	9	9

24	25/Male	UG	Engineer	10	10	10	9	8	8
25	25/Male	PG	Student	10	10	10	9	9	9
26	26/Male	MBBS	Doctor	10	10	10	9	9	9
27	27/Male	UG	Software Engineer	10	9	8	10	9	10
28	28/Male	PG	Student	10	8	9	10	10	10
29	29/Male	UG	Software Engineer	10	10	10	9	9	9
30	33/Male	Diploma	Concept Artist	10	9	9	9	8	8

Table 3.1, presents information for 30 adult participants, including age, gender, occupation, and self-rated language proficiency. The sample comprises 16 females and 14 males. With an age range from 18 to 35.11 years (mean=24.8). Participants represented a variety of occupations, all participants were highly proficient in their first language (L1), while their proficiency in the second language (L2) varied. Language proficiency was self-rated on a 0-10 scale, across three domains: R = Reading, U = Understanding, and S = Speaking. Scores of 0-5 indicated lower proficiency and scores of 6-10 indicated higher proficiency.

Table 3.2

Group2 participants demographics and self-rated language proficiency.

Sl. No	Age/Gender	Education	Occupation	L1			L2		
				U	S	R	U	S	R
1	36/Female	PG	Housewife	10	10	10	9	9	9
2	36/Female	12th grade	House wife	10	10	10	7	6	4
3	36/Female	PG	Medical Officer	10	10	10	10	9	9
4	37/Female	10th grade	Housewife	10	9	9	5	4	4
5	39/Female	PG	House wife	10	9	9	7	6	5
6	41/Female	UG	Accountant	10	9	9	7	6	6
7	43/female	PG	Software Test Engineer	10	10	10	10	8	9
8	45/Female	12th grade	House-wife	10	10	9	7	6	6
9	46/Female	UG	House wife	10	9	9	6	6	5
10	47/Female	UG	Teacher	10	10	10	6	5	5
11	47/Female	PG	Teacher	10	9	9	8	7	7
12	48/Female	Diploma	Housewife	10	9	8	6	4	4
13	49/Female	PG	Teacher	10	9	9	8	7	7
14	49/Female	PG	Teacher	10	10	10	7	6	7
15	50/Female	PG	Teacher	10	9	9	7	6	6
16	50/Female	12th grade	House wife	10	9	9	7	5	5
17	38/Male	PG	Associate Professor	10	10	9	9	9	9
18	40/Male	PG	Speech-language pathologist	10	9	9	10	8	9
19	41/Male	UG	Hospital Counselor	9	9	9	7	7	7
20	42/Male	10th grade	Driver	10	8	8	6	4	4

21	42/Male	12th grade	Office attender	10	9	9	7	5	5
22	42/Male	UG	Manager	9	9	9	8	7	7
23	44/Male	UG	Civil servant	10	9	8	9	9	9
24	44/Male	12th grade	Business	10	9	9	5	4	4
25	45/Male	Diploma	IT Professional	10	9	9	8	8	8
26	46/Male	UG	Marketing	10	9	9	8	7	7
27	47/Male	PG	Event Consultant	10	9	9	9	8	9
28	48/Male	UG	Teacher	10	9	9	5	4	5
29	48/Male	PG	Automobile Agent	9	9	9	8	7	7
30	50/Male	PG	Accountant	10	9	9	9	9	9

Table 3.2, presents information for 30 adult participants, including age, gender, occupation, and self-rated language proficiency. The sample comprises 16 females and 14 males. With an age range from 36 to 50.11 years (mean=43.87). Participants represented a variety of occupations: all participants were highly proficient in their first language (L1), while their proficiency in the second language (L2) varied. This was done using a scale of 0-10 as mentioned above in the description of Table 3.1.

Table 3.3

Group 3 participants demographics and self-rated language proficiency.

Sl. No	Age/Gender	Education	Occupation	L1			L2		
				U	S	R	U	S	R
1	51/Female	UG	Housewife	10	9	10	6	6	6
2	51/Female	UG	Assistant information officer	10	9	9	7	7	5
3	51/Female	10th grade	House wife	9	9	9	4	4	4
4	52/Female	Diploma	UP teacher	10	10	10	7	7	5
5	52/Female	12th grade	House wife	10	9	8	4	4	4
6	53/Female	UG	Teacher	10	9	9	7	4	5
7	54/Female	PG	Teacher	10	10	10	8	6	5
8	54/Female	UG	Teacher	10	9	9	6	6	5
9	56/Female	PG	Lecturer	10	9	9	8	7	7
10	57/Female	Diploma	House Wife	9	9	8	5	4	4
11	57/Female	10th grade	House wife	9	9	8	4	3	3
12	60/Female	UG	House Wife	10	9	9	6	5	4
13	60/Female	12th grade	House wife	10	9	9	4	4	4
14	60/Female	UG	Housewife	10	9	9	6	5	6
15	62/Female	10th grade	House wife	9	9	9	4	4	4
16	64/Female	10th grade	Housewife	10	9	9	4	3	3
17	51/Male	PhD	Librarian	10	10	10	9	8	9
18	53/Male	UG	Nurse	9	9	9	6	6	6
19	56/Male	12th grade	Retired from the military	10	10	10	7	7	5
20	56/Male	PG	Senior Intelligence Officer	10	10	10	8	7	8
21	57/Male	UG	Medical Rep	10	9	9	8	7	6
22	59/Male	UG	Dentist	10	10	10	8	6	7

23	59/Male	PG	Retired principal	10	10	10	7	6	7
24	60/Male	UG	Farmer	10	9	9	6	5	5
25	61/Male	UG	Ret. Govt. servant	10	9	9	8	7	7
26	61/Male	UG	Ret. Teacher	10	9	9	7	6	6
27	63/Male	10^{th} grade	Farmer	10	9	8	5	4	4
28	64/Male	UG	Teacher	10	10	9	7	6	6
29	65/Male	UG	Farmer	10	9	9	6	4	4
30	65/Male	PG	Ret. Govt officer	10	10	10	6	6	6

Table 3.3, presents information for 30 adult participants, including age, gender, occupation, and self-rated language proficiency. The sample comprises 16 females and 14 males. With an age range from 51 to 65 years (mean=57.5). Participants represented a variety of occupations; all participants were highly proficient in their first language (L1), while their proficiency in the second language (L2) varied. This was done using a scale of 0-10 as mentioned above in the description of **Table 3.1.**

3.3 Inclusion Criterion:

1. All participants had Malayalam as their native language (L1) and had maximal proficiency in the understanding and speaking domains.
2. Participants had at least 10 years of formal education in their native language (Malayalam).
3. The neurotypical participants included bilinguals with Malayalam as their native language, and their proficiency in Malayalam, as mentioned above, was also included

4. Participants were fully functionally literate in Malayalam. This entailed the ability to read fluently, comprehend written text accurately, and effortlessly recognize and interpret Malayalam script.

5. A score of 26 or above on the Montreal Cognitive Assessment (MoCA)-Malayalam (Iype et al., 2024) was required for all participants in Group 3 (51–65 years), ensuring normal cognitive functioning.

6. Individuals had normal or corrected hearing. Hearing ability was assessed informally through conversational interaction and the detection and repetition of the Ling Six Sounds (/m/, /ah/, /oo/, /ee/, /sh/, /s/) at a distance of approximately 3 to 6 feet (1 to 2 meters) in a quiet testing environment.

7. Individuals had normal or corrected vision (e.g., through the use of glasses or contact lenses). Visual acuity was assessed informally by having participants read printed material at a comfortable reading distance. Additionally, they were also able to identify randomly presented letters or pictures at the same distance.

8. Participant's reading and speaking abilities in different languages will be documented through an informal interview; however, bilingual proficiency will not be formally assessed or classified, as it falls outside the scope of this study.

9. All participants scored 3 under the domain of monthly family income in the Modified Kuppuswamy Scale (Mandal & Hossain, 2025).

3.4 Exclusion Criterion:

1. Presence of speech and language disorders, neurological disorders, hearing disorders, visual disorders, psychological problems, or cognitive deficits.

2. Use of medications that affect cognitive function (e.g., sedatives, antipsychotics).

3.5 Stimulus-related factors

The investigator (researcher) had selected 30 high-frequency, familiar, and highly concrete Malayalam nouns as stimuli. These words were chosen to represent a broad range of lexical categories, ensuring coverage of major semantic domains relevant to everyday experiences. This ensured getting sufficient data points for statistical analysis. All the stimuli that were selected were from the same grammatical category, which is nouns. The stimulus words ranged from approximately 1 to 5 syllables in length. All the stimuli were reviewed by 5 native Malayalam-speaking experts, all of whom were proficient in Malayalam. There were three criteria against which each of the experts evaluated the stimuli: familiarity, concreteness, and contextual appropriateness. A 3-point rating scale was used for each criterion (3 = high, 2 = medium, 1 = low). Only the stimuli that had a rating of 3 or 2 on all the domains mentioned above were shortlisted for inclusion. If any word failed to meet the criteria, it was replaced with another word from the same semantic category, which underwent the same validation process.

Following the validation process, the finalized list of stimuli was used for experimental administration. This ensured that the number of stimuli considered would be 30 in total. The mode of stimuli presented was auditory for cohort A and orthographic for cohort B, and both groups were presented with the same words but in different formats. Participant's responses were audio-recorded for subsequent analysis. This modality-specific presentation was designed to examine the influence of stimulus format on the consistency, structure, and nature of word association responses.

3.6 Procedure

The study was executed in two sequential phases; the first phase involved shortlisting and finalization of noun stimuli, as detailed under stimulus-related factors. This included selection, which was based on predefined criteria such as familiarity, concreteness, and contextual appropriateness, and then expert review.

The second phase mainly focused on data collection as described in the participants section; individuals were divided into three groups based on their age, and they were also randomly assigned into cohorts where the modality of stimulus presentation varied (Cohort A: auditory and Cohort B: visual). This resulted in 6 distinct cohorts. Informal hearing (informally through conversational interaction and the detection and repetition of the Ling Six Sounds (/m/, /ah/, /oo/, /ee/, /sh/, /s/) at a distance of approximately 3 to 6 feet) and visual screenings (participants read printed material at a comfortable reading distance, and they identified randomly presented letters or pictures at the same distance) were conducted to confirm sensory adequacy for each modality. All the participants obtained a score of 3 in the Modified Kuppuswamy Scale in the total per capita domain (Mandal & Hossain, 2025), and participants aged 51–65 years were screened using MoCA-Malayalam (Iype et al., 2024) to screen cognitive status.

3.6.1 Testing environment

The administration was conducted in a quiet room with comfortable seating arrangements, this ensured minimal distractions. The distance between the examiner and the participants was maintained at approximately 3 feet, which was comfortable for both reading the visual stimuli and hearing the auditory input clearly.

3.6.2 Verbatim of instructions

For the auditory modality, participants were instructed using the following standardized instructions:

/ɲaːn kuɾət͡ʃːʊ ʋaːkːugaɭ oɾonːaːji paɾajum | aː ʋaːkːugaɭ keːɭkːumboːɭ aṯu niŋgaːɭ aːʋaɾṯikkuka | penːe aṯumaːji bənḏhapːeṯṯe manasːil ʋaɾunna aːḏjaṯe aṉḏ͡ʒu ʋaːkːugaɭ paɾajuka/

For the visual (orthographic) modality, the following instruction was provided:

/ɲaːn kuɾət͡ʃːɯ ʋaːkːugaɭ skriːnɪl kaːɳikkum | aṯu ʋaːjit͡ʃaṯinu ɕeːʃam aṯumaːji bənḏhapːeṯṯe niŋgaɭuḍe manasːil ʋaɾunna aːḏjaṯe aṉḏ͡ʒu ʋaːkːugaɭ paɾajuka/

3.6.3 Stimulus Presentation

Each of the target stimuli was presented individually in its designated modality, with participants divided into two cohort groups: Auditory Cohort and Visual Cohort. In the Auditory Cohort, stimuli were delivered verbally by the investigator herself with natural intonation, speech rate, and conversational loudness. In the Visual Cohort, stimuli were displayed using PowerPoint slides in standard Malayalam orthography, formatted in bold with a font size of 100 on a plain white background to ensure uniformity and visual clarity. All participant responses were audio-recorded using an audio recorder for detailed analysis.

3.6.4. Task of the Participant

Participants were instructed to respond immediately after the stimulus presentation by verbally producing the first five words that came to their mind. This task was designed to elicit spontaneous lexical associations. To support this without influencing the content of responses, the examiner used only finger-counting gestures to indicate the number of responses given nonverbally. No other form of feedback, like verbal, visual, or corrective, was provided during the

task, thereby preserving the ecological validity and spontaneity of lexical access, and to ensure that the participant had registered the stimulus correctly, the participants in the auditory cohort were asked to repeat the stimulus, and the participants in the visual cohort were asked to read the stimulus.

3.7 Scoring

3.7.1 Analysis and Tabulation

Following the data collection, all verbal responses were analyzed in detail and were classified into four semantic association types:

- **Taxonomic** – Category-based associations (translative and variants) (e.g., “dog” - “cat”, പാൽ(pa:l) (milk) - വെള്ളം (ʋeɭ:am) (water)
- **Thematic** – Contextual associations (derivative, associative, function-based, and superoordinate) (e.g., “dog” - “bone”, പാൽ (pa:l)(milk)- വെണ്ണ (ʋeɳ:a) (butter)
- **Subjective** – Personal or experience-based associations (e.g., “dog” - “Bruno” a pet’s name, പാൽ (pa:l) (milk) - രാമു (ra:mu) (milk man’s name) .
- **Irrelevant** –Unrelated responses with no clear semantic or contextual link (e.g., “dog” - “pants,” പാൽ (pa:l) (milk) - ഷർട്ട് (ʂaɻʈ) (shirt))

The examiner had performed categorization independently for each of the responses given by the participant, which were listed in a structured table, with each response labeled according to its corresponding category: taxonomic, thematic, subjective, or irrelevant.

This was done by placing a tally mark against each category when each of the responses was evaluated. The total number was then tallied separately for each category type across all stimuli. This ensured an accurate tabulation and calculation of the total number of taxonomic, thematic, irrelevant, and subjective responses of each participant. The total tally mark calculation was used to analyze the distribution and frequency of response types among participants.

3.7.2 Frequencies and Percentages

Word association patterns were analyzed through frequencies and percentages of each lexical association type, such as taxonomic, thematic, subjective, and irrelevant, which were calculated. These quantitative measures were calculated across three variables such as age group (18–35, 36–50, and 51–65 years), gender (male and female), and stimulus modality (visual and auditory). The percentage for each category was calculated as the total number of responses in the category divided by the total number of responses, multiplied by 100. For every lexical association, this calculation was done separately so that all three objectives were addressed, and it enabled direct comparisons to know whether any one type of association was more pronounced in any particular age group, gender or presentation modality. In addition to quantitative analysis, a qualitative analysis was also conducted. Under the qualitative analysis, cultural associations and responses produced in English were analyzed.

3.8 Statistical Analysis

Data obtained from the 90 participants were organized according to age group (18.00-35.11 years, 36-50.11 years), gender, and modality of stimulus presentation (auditory and visual). Responses were tabulated separately for taxonomic, thematic, subjective and irrelevant associations for each participant. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS), version 26. The data was first subjected to test of normality using Shapiro-Wilk's test of normality, and the statistic revealed that the p values were less than 0.05 indicating that the data was non-parametric in nature. Further, the median and interquartile range were computed and analysed in accordance with the coined objectives. In adjunct, the mean and standard deviation was also computed to verify if it was in the same direction as that of the median and interquartile range.

To examine the first objective Kruskal-Wallis test was utilized. When the overall test indicated a statistically significant difference, post hoc pairwise comparisons were performed using the Mann-Whitney U test in order to verify specific differences within the groups. The effect of gender on word association responses was analyzed using the Mann-Whitney U test, as gender comprised two independent groups (males and females). Comparisons were performed both for the total sample and separately within each age group to explore age-specific gender effects. Similarly, the effects of stimulus modality (auditory vs visual presentation) were examined using the Mann-Whitney U test. Analyses were conducted on the overall sample, as well as within each age group, to identify any modality-related differences across age ranges. In addition to the preset objectives, qualitative analysis was also carried out specify on every qualitative analysis done.

Chapter 4

RESULTS

The primary aim of the present study was to examine the effect of age, gender, and modality on word association responses in Malayalam-speaking, neurotypical adults. The responses produced by the participants were categorized as taxonomic, thematic, subjective, and irrelevant responses. Furthermore, the typology of responses was analyzed across the age groups (18.00-35.11 years, 36.00-50.11 years, and 51.00-65.00 years), gender, and modality. The results obtained in the study are reported under the following headings.

4.1 Content Validation

The present study aimed to find out the nature and differences of word association responses with respect to each variable, rather than to develop a standardized test; therefore procedures such as test-retest reliability and inter-rater reliability were not undertaken. Instead, content validation and item validation were used ot ensure the appropriateness and relevance of the stimuli.

The content validation procedure consisted of Item validation, Scale content validity index (S-CVI), and Inter-rater agreement (Fleiss Kappa). Rating was done by a total of 9 raters across 3 domains, which are familiarity, concreteness, and contextual appropriateness, and all of them had more than 10 years of formal education in Malayalam and had high proficiency in Malayalam. Out of the 9 raters, 4 were practicing speech-language pathologists, and 5 were post-graduate students in speech-language pathology. The rating of proficiency was based on self-rating, which was done on a scale

of 0 to 10, and participants who rated 8 or above were considered highly proficient.

Table 4.1

Demographic and proficiency details of raters.

Rater	Education (years of formal education)	Designation	Proficiency
1	10	MSc SLP student	High
2	12	MSc SLP student	High
3	12	Speech-Language Pathologist	High
4	12	Speech-Language Pathologist	High
5	12	MSc SLP student	High
6	12	MSc SLP student	High
7	12	MSc SLP student	High
8	12	Speech-Language Pathologist	High
9	12	Speech-Language Pathologist	High

4.1.1 Item Validation

A total of nine expert raters evaluated 30 stimuli for content validation across three dimensions, like familiarity, concreteness, and contextual appropriateness. The complete list of items is listed in Table 4.2 for easy readability.

Table 4.2

Results of item validation done by nine expert raters for each item, for a total of thirty stimuli.

Stimulus	IPA	Familiarity CVI	Concretenes CVI	Contextual Appropriateness CVI
1	/kaːkka/	1	1	0.89
2	/ʈakːaːɭi/	1	1	1
3	/koːɻi/	1	1	0.78
4	/uɭːi/	1	1	1
5	/suːrjan/	0.8	1	0.78
6	/peʈːi/	1	0.83	0.89
7	/puːt͡ʃːa/	1	1	1
8	/t͡ʃemparaʈːi/	0.8	1	0.87
9	/meːgam/	0.8	1	0.89
10	/uɾuɭakkiɻaŋ/	0.8	1	0.89
11	/aːna/	1	1	1
12	/kaseːɾa/	1	1	0.89
13	/simham/	1	1	0.78
14	/mala/	1	0.83	0.56
15	/paʃu/	1	1	1
16	/maːŋːa/	1	1	1
17	/mullapuːv/	1	0.83	0.78
18	/paɻam/	1	1	0.89
19	/ʈaʈːa/	0.8	0.83	0.89
20	/t͡ʃakːa/	1	1	0.78
21	/ʋiːʈ/	0.8	1	1
22	/ʋeɭːam/	1	1	0.89
23	/kai/	1	1	1
24	/t͡ʃeɾupːɨ̆/	1	1	1
25	/doːʃa/	1	1	1
26	/toːrtt/	0.8	0.83	0.78
27	/praːʋ/	0.8	1	0.78
28	/bʌs/	1	1	1
29	/meːʃa/	0.8	1	0.89
30	/kaɖal/	0.8	1	0.89

The results showed consistently high agreement for familiarity and concreteness, with most of the items achieving a CVI of 1.0. A few items had a score less than 1, such as in familiarity 0.8 for items 5, 8, 9, 10, 21, 26, 27, 29, 30, and in concreteness 0.83 for items 6, 14, 17, 19, 26, but still these remained above the acceptable cut-off, which confirmed that all the stimuli are sufficiently familiar and concrete. In the case of contextual appropriateness, it showed comparatively slightly more variability, with most of the items still falling within the acceptable CVI levels. Eleven items (2, 4, 7, 11, 15, 16, 21, 23, 24, 25, 28) had a score of 1, ten of the items (1, 6, 8, 9, 10, 12, 18, 22, 29, 30) scored between 0.86 and 0.89, seven items (3, 5, 13, 17, 20, 26, 27) scored 0.77, and only one item (item 14) obtained a comparatively lower score of 0.55. This item corresponded to mountain (/mala/). Five raters marked this item as “2” (medium) on a 3-point rating scale for contextual appropriateness.

However, the word “mala” is culturally appropriate within the Kerala context, but considering contextual appropriateness, the raters would have rated the items based on their immediate environment and day-to-day exposure rather than broader cultural relevance.

4.1.2 Scale content validity index (S-CVI)

Scale-level content validity outcomes across familiarity, concreteness, and contextual appropriateness are: 0.93, 0.97, and 0.88, respectively. The results of this scale indicate that the scores were high for all three domains, which indicates strong agreement among raters on the relevance of each item.

4.1.3 Fleiss Kappa (Inter-rater Agreement)

The Fleiss Kappa values were slightly negative: -0.07 for Familiarity, -

0.02 for Concreteness, and 0.01 for Contextual Appropriateness, which suggests that there was minimal inter-rater agreement difference.

Table 4.3

Scale content validity index (S-CVI) and Fleiss Kappa (Inter-rater agreement).

Scale	Scale Content Validity Index (CVI)	Fleiss' Kappa (Inter-rater Agreement)
Familiarity	0.93	-0.07
Concreteness	0.97	-0.02
Contextual Appropriateness	0.89	0.01

The inter-rater agreement parameters (Item Validation, Scale Content Validity, Fleiss' Kappa, and Inter-rater Agreement) showed high values; hence, no changes were made with respect to the stimulus, and this stimulus was administered to the participants.

4.2 Statistical Analysis

4.2.1 Objective 1

To compare the number of taxonomic, thematic, subjective, and irrelevant responses across different age groups (18.00-35.11 years, 36.00-50.11 years, and 51.00-65.00 years) in the word association task. The participant's responses were categorized into taxonomic, thematic, subjective, and irrelevant responses. As the irrelevant responses accounted for zero, it was not subjected to statistical analysis.

The total number of responses varied across participants and stimuli, and the data demonstrated considerable dispersion. The Shapiro-Wilk's test indicated that the distribution of taxonomic, thematic, and subjective responses significantly deviated from normality ($p < 0.05$). Therefore, the responses were analyzed based on their distributional characteristics, and appropriate descriptive measures of central tendency and dispersion were used.

Table 4.4

Descriptive statistics of different responses across the three age groups.

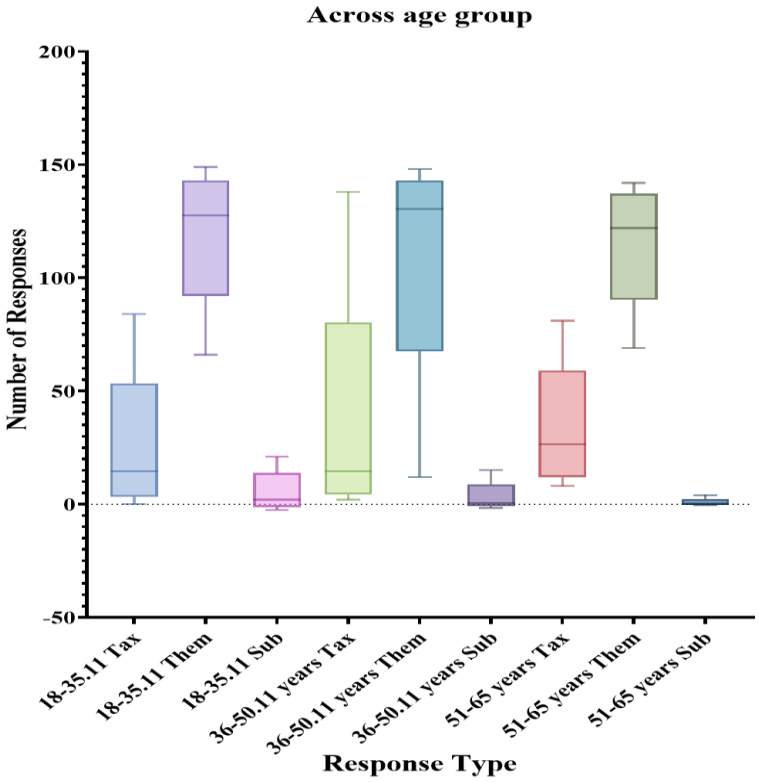
Age Group (Years)	Response Type	Mean	SD	Median	IQR
18.00–35.11	Taxonomic	17.70	16.80	14.50	16.25
	Thematic	127.27	17.05	127.50	19.00
	Subjective	5.03	6.05	2.00	9.00
36.00–50.11	Taxonomic	20.10	24.71	14.50	16.00
	Thematic	127.07	24.35	130.50	15.00
	Subjective	2.83	4.28	0.50	4.25
51.00–65.00	Taxonomic	33.17	18.93	26.50	21.25
	Thematic	116.10	18.65	122.00	20.75
	Subjective	0.73	1.23	0.00	1.00

Table 4.4 presents the median and interquartile range (IQR) of taxonomic, thematic, and subjective responses across the three age groups. As the distribution of the data deviated from normality, central tendency was interpreted primarily using the median. The interquartile range was considered to understand the dispersion of scores within each age group. In addition, the mean and standard

deviation values were examined to determine the overall directional pattern of the data and to assess whether both measures of central tendency demonstrated a consistent trend across age group

Figure 4.1

Median values of responses across the three age groups.



Note. Tax = Taxonomic; Them = Thematic; Sub = Subjective.

In Figure 4.1, participants in the 18.00-35.11 years group had the highest median (127.50) for thematic responses, followed by taxonomic (14.50) and subjective responses (2.00), indicating a predominance of thematic associations. The variability was moderate for thematic (IQR=19.00) and taxonomic responses (IQR=16.25). Although subjective responses had a lower median (5.03) and a noticeable variability (IQR = 9.00).

Among participants aged 36.00-50.11 years, thematic responses again had the highest median (130.50), while taxonomic responses remained at the same median (14.50), and the median of subjective responses decreased (0.50). Compared to the youngest group, variability in thematic responses was slightly lower (IQR=15.00), and subjective responses showed reduced variability (IQR=4.25), suggesting a narrowing range of subjective associations with increasing age.

In contrast, for the 51.00-65.00 years age group, the median value for taxonomic responses increased to 26.50, indicating a higher central tendency for category-based associations compared to the younger age groups. In contrast, the median for thematic responses declined (122.00), and subjective responses further reduced (0.00). The interquartile range for taxonomic responses (21.25) was greater, followed by thematic responses (20.75) and then subjective responses (1.00).

Overall, the median values indicated an age-related increase in taxonomic responses, a relative decline in thematic responses in later adulthood, and a steady reduction in subjective responses across age groups. The IQR values suggested that variability in taxonomic responses became more pronounced in the oldest group, while subjective responses progressively narrowed with age.

This overall pattern aligned with the mean and standard deviation values obtained. Mean scores for taxonomic responses increased across age groups, paralleling the upward trend observed in medians. Similarly, the mean of the thematic response declined in the oldest group, similar to that of the pattern of median. The mean of subjective responses decreased steadily, similar to that of

the reduction observed in the median. The direction of standard deviation broadly corresponded with IQR patterns; the variability in taxonomic responses was higher in later adulthood, while variability in subjective responses decreased markedly with age.

Inferential statistics was done to determine whether there was any significant difference in word association responses across the three age groups; the Kruskal-Wallis test was performed. Statistically significant differences were observed for taxonomic responses ($\chi^2 = 18.979$, $p < 0.05$), and thematic responses ($\chi^2 = 12.359$, $p < 0.05$). Since significant differences were obtained, pairwise comparisons were carried out using the Mann-Whitney U test. In comparing the 18.00-35.11 years and 36.00-50.11 years age groups, no statistically significant difference was observed for taxonomic responses ($U = 427.00$, $|Z| = 0.341$, $p > 0.05$) and thematic responses ($U = 406.00$, $|Z| = 0.651$, $p > 0.05$). This suggested a comparable response pattern between early and middle adulthood for these categories of responses.

However, subjective responses differed significantly between these two groups ($U = 302.50$, $|Z| = 2.225$, $p < 0.05$), reflecting a decline in subjective associations from the youngest to the middle-aged group. The comparisons involving the 51.00-65.00 age group revealed a different pattern; it was found that between the 18.00-35.11 and 51.00-65.00 age groups for taxonomic ($U = 185.50$, $|Z| = 3.915$, $p < 0.05$), thematic ($U = 277.00$, $|Z| = 2.559$, $p < 0.05$), and subjective responses ($U = 171.50$, $|Z| = 4.277$, $p < 0.05$), indicating substantial shifts in response type in later adulthood. Similarly, when the 36.00-51.00 groups were compared, significant differences emerged for taxonomic ($U = 207.50$, $|Z| = 3.588$, $p < 0.05$) and thematic responses ($U = 221.00$, $|Z| = 3.388$, $p < 0.05$). But

subjective response did not differ significantly (U = 341.50, |Z| = 1.794, p > 0.05).

Thus, the Kruskal-Wallis test demonstrated marked differentiation in the taxonomic and thematic responses, primarily in the oldest age group, distinguishing individuals in the last age group (51.00-65.00 years) from the two younger cohorts. Whereas, subjective responses demonstrated significant differences mainly between the youngest group and the other age groups. These results indicated that age-related changes in word association patterns are most pronounced in later adulthood, particularly in terms of taxonomic and thematic responses.

4.2.2 Objective 2

The second objective of the study was to compare the number of taxonomic, thematic, subjective, and irrelevant responses between male and female participants in the word association task.

The total number of responses varied across participants, and the data demonstrated considerable dispersion. The Shapiro-Wilk's test indicated that the distribution of taxonomic, thematic, and subjective responses significantly deviated from normality ($p<0.05$). Therefore, the responses were analyzed based on their distributional characteristics, with the median used to represent central tendency and the interquartile range to describe variability. In addition, the mean and standard deviation were also examined to compare the overall directional pattern. Accordingly, non-parametric statistical tests were employed for inferential analysis.

Table 4.5

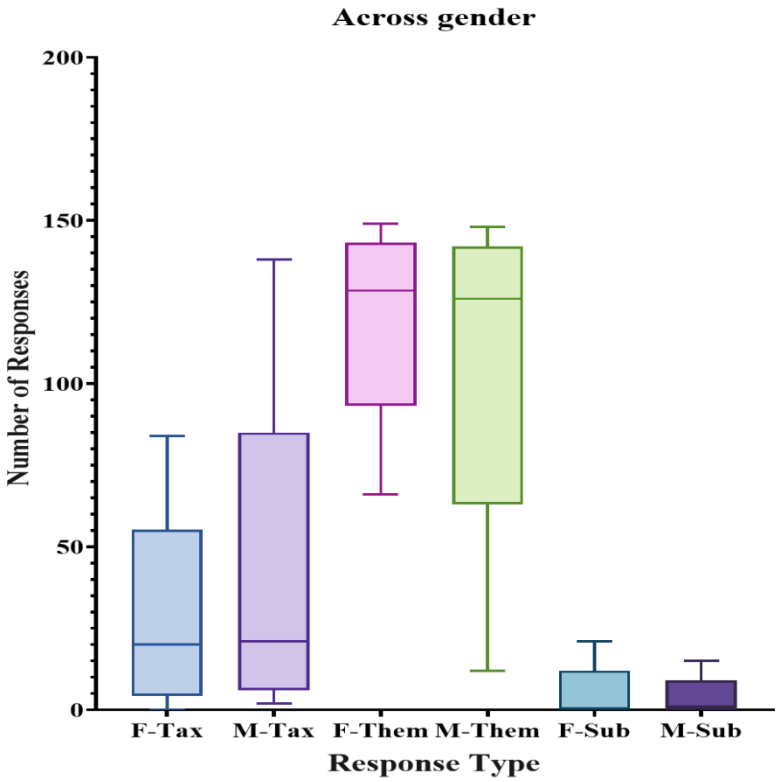
Descriptive statistics of responses across gender, irrespective of the age group.

Response Type	Gender	Mean	SD	Median	IQR
Taxonomic	**Female**	20.85	16.62	20.00	19.00
	Male	26.86	25.50	21.00	22.00
Thematic	**Female**	126.10	16.27	128.50	18.00
	Male	120.48	24.70	126.00	22.00
Subjective	**Female**	3.04	5.23	0.50	3.00
	Male	2.67	3.91	1.00	3.00

Table 4.5 presents the median and interquartile range (IQR) of taxonomic, thematic, and subjective responses for male and female participants irrespective of age group, and it is used primarily to describe the central tendency and dispersion. In addition, the mean and standard deviation values were examined to determine the overall directional pattern of the data. When examining the distribution of the responses across the participants, there was a predominance of thematic responses, followed by taxonomic responses, whereas subjective responses were comparatively very few. The performance of female and male participants was initially done without subjecting them to specific groups.

Figure 4.2

Median values of responses across gender, irrespective of the age group.



Note. F = Female; M = Male; Tax = Taxonomic; Them = Thematic; Sub = Subjective.

As shown in the Figure 4.4, for taxonomic responses, males demonstrated a higher median (21.00) compared to females (20.00), indicating that males tend to produce a greater number of category-based associations than females. The interquartile range was also higher in males (IQR = 22.00) than in females (IQR = 19.00), which suggested that there was a slightly higher variability in taxonomic responses among participants.

For thematic responses, females showed slightly higher median (128.50) compared to males (126.00), indicating a slight predominance of thematic associations among females than males. The variability for thematic responses was similar to the trend of taxonomic responses, where males showed a slightly

larger variability (IQR = 22.00) than females (IQR = 18.00). This suggests that although thematic responses were dominant in both genders, male participants exhibited slightly greater variability in the range of thematic associations.

For the subjective responses, both males showed the same median (1.00), compared to females (0.50), indicating a small difference in the central tendency for subjective associations across genders. However, both groups showed similar values of variability measure (IQR=3.00) for both males and females, suggesting comparable variability in subjective responses.

The mean and median of taxonomic, thematic, and subjective responses clearly aligned with each other; thus, the overall pattern observed showed a similar directional trend for both the central tendencies across the response categories. The standard deviation values showed patterns that were largely consistent with the interquartile range (IQR) for each of the responses.

Thus, the median values indicated that taxonomic responses were relatively higher among males, whereas thematic responses were slightly higher among females, while subjective responses remained relatively similar across both genders.

Inferential statistics were carried out using the Mann-Whitney U test to determine whether there was any significant difference between male and female participants. The results indicated that there was no statistically significant difference between genders for taxonomic responses ($U = 881.50$, $|Z| = 1.024$, $p > 0.05$), this suggested comparable responses between males and females. Similarly, thematic responses did not differ significantly between genders (U =

876.00, |Z| = 1.068, p > 0.05). Subjective responses also showed no statistically significant difference between genders (U = 888.00, |Z| = 1.014, p > 0.05).

Table 4.6

Descriptive statistics of responses across gender and age group.

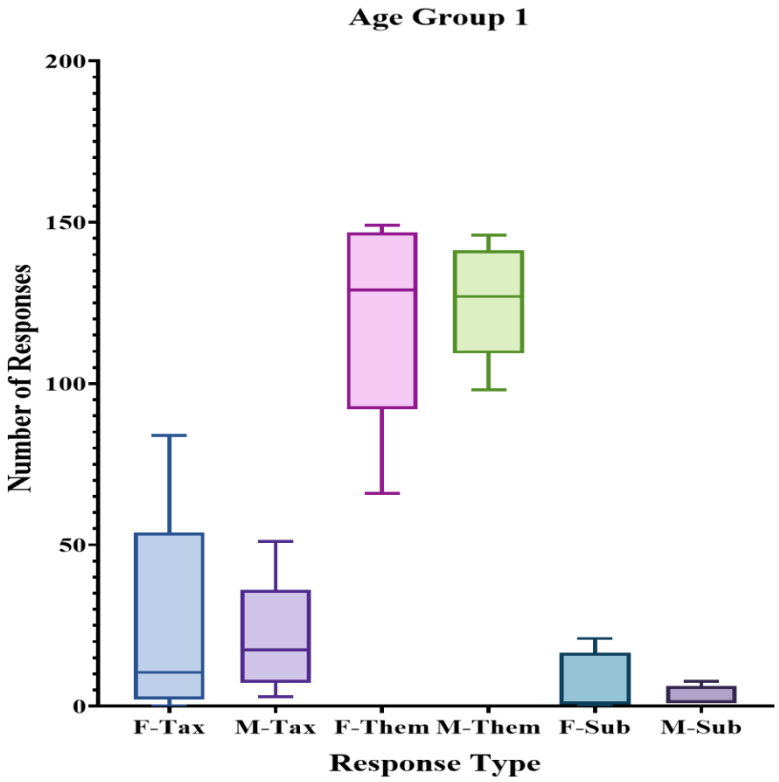
Age Group (years)	Gender	Response Type	Mean	SD	Median	IQR
18.00–35.11	**Female**	Taxonomic	17.06	20.72	10.50	20.00
		Thematic	127.38	20.62	129.00	27.00
		Subjective	5.56	7.15	1.00	11.00
	Male	Taxonomic	18.43	11.54	17.50	10.00
		Thematic	127.14	12.56	127.00	16.00
		Subjective	4.43	4.69	2.00	7.00
36.00–50.11	**Female**	Taxonomic	16.75	9.84	19.50	15.00
		Thematic	130.13	11.26	130.00	14.00
		Subjective	3.13	4.41	0.50	7.00
	Male	Taxonomic	23.93	34.95	11.00	26.00
		Thematic	123.57	33.94	133.50	23.00
		Subjective	2.50	4.26	0.50	3.00
	Female	Taxonomic	28.75	15.47	23.50	22.00
51.00–65.00		Thematic	120.81	15.11	125.50	21.00
		Subjective	0.44	1.03	0.00	0.00
	Male	Taxonomic	38.21	21.73	29.50	27.00
		Thematic	110.71	21.30	119.50	29.00

Subjective	1.07	1.39	0.50	2.00

In the previous section, the descriptive statistics of responses for male and female participants were presented as a whole. The current section describes descriptives of the responses obtained from females and males with respect to each age group. Table 4.6 presents the median and interquartile range (IQR) of taxonomic, thematic, and subjective responses for male and female participants across the three age groups, and it is used to describe the overall central tendency and dispersion. In addition, the mean and standard deviation values were examined to determine the overall direction pattern of the data and to assess whether both measures demonstrated a consistent trend across genders within each age group.

Figure 4.3

Median values of responses across gender in the first age group (18.00–35.11 years).



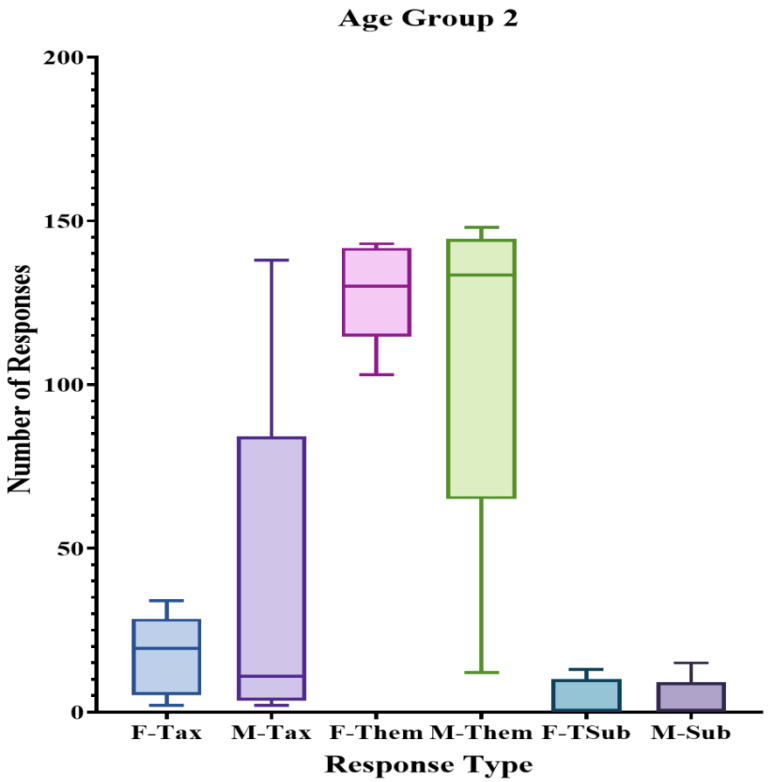
Note. F = Female; M = Male; Tax = Taxonomic; Them = Thematic; Sub = Subjective.

As specified in the Figure 4.3, in the 18.00-35.11 years age group, females had a median of (10.50) for taxonomic responses, whereas males showed a slightly higher median of (17.50). The interquartile range was higher among females (IQR=20.00) compared to males (IQR=10.00). Both females and males demonstrated a predominance of thematic responses. Among both genders, females demonstrated a slightly higher median (129.00), while males showed a slightly lower median (127.00). The variability of thematic responses was also greater among females (IQR=27.00) compared to males (IQR=16.00). In the case of subjective responses, females showed a median of (1.00), whereas males

demonstrated a slightly higher median (2.00). However, both females and males had similar variability values (IQR=7.00).

Figure 4.4

Median values of responses across gender in the second age group (36.00–50.11 years).



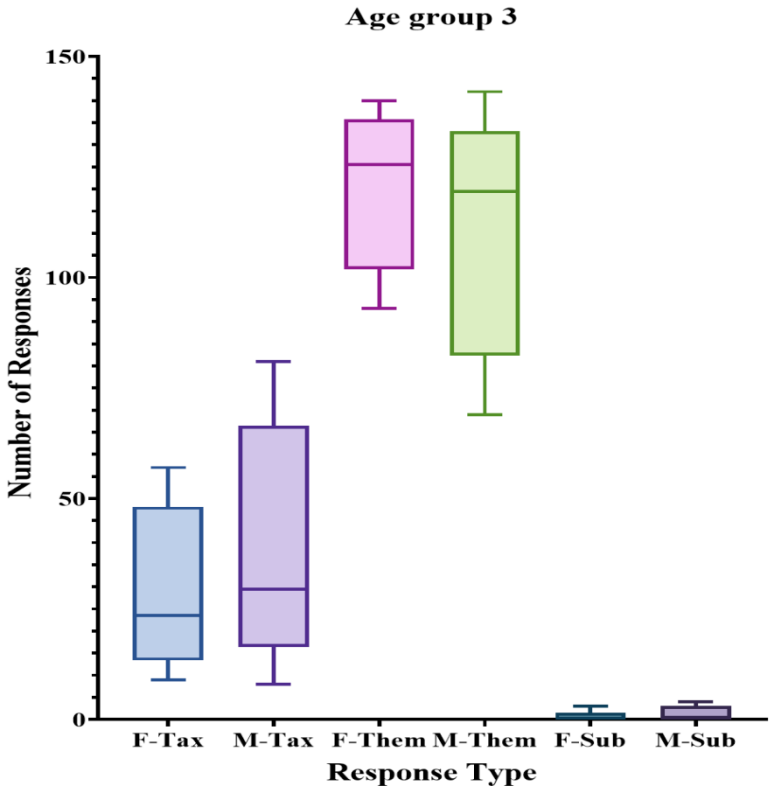
Note. F = Female; M = Male; Tax = Taxonomic; Them = Thematic; Sub = Subjective.

As shown in Figure 4.4, among participants in the 36.00-50.11 years age group, females showed a median of (19.50) for taxonomic responses, and males had a median of (11.00). The interquartile range was higher among males (IQR=26.00) compared to females (IQR=15.00). The median value for thematic responses was (130.0) for females and (133.50) for males. The variability for thematic responses showed a similar trend, where males demonstrated slightly higher dispersion (IQR=23.00) compared to that of females (IQR=14.00). For subjective responses, both females and males showed the same median value

(0.50), with females showing a higher interquartile range (IQR=7.00) compared to males (IQR=3.00).

Figure 4.5

Median values of responses across gender in the third age group (51.00–65.00 years).



Note. F = Female; M = Male; Tax = Taxonomic; Them = Thematic; Sub = Subjective.

In Figure 4.5, the participants in the 51.00-65.00 years age group, females demonstrated a median value of (23.50) for taxonomic responses, whereas males showed a higher median of (29.50). The interquartile range was also higher among males (IQR=27.00) compared to females (IQR-22.00). For thematic responses, females had a median of (125.50), while males showed a slightly lower median (119.50). The variability for thematic responses was higher among males (IQR=29.00) compared to females (IQR=21.00). In the case of subjective responses, females showed a median value of (0.00), whereas males showed a value of (0.50);

thus, minimal subjective responses were observed for both genders. The interquartile range was (IQR=0.00) for females and (IQR=2.00) for males.

Across the three age groups, the mean and median followed the same overall direction for both genders, which indicated that the pattern of responses remained consistent across the two measures. In each age group, thematic responses were the ones that showed the highest mean and median values, followed by taxonomic responses, while subjective responses consistently showed the lowest values. Variability measures such as standard deviation (SD) and interquartile range (IQR) showed comparable patterns across the response categories. Response types with higher SD also showed wider IQR, thus both of the measures showed a similar trend across genders in different age groups. Thus, mean-median and SD-IQR values were consistent across the three age groups between the two genders.

Overall, across the three age groups, the median values indicated that thematic responses were consistently higher than taxonomic and subjective responses in both genders, thus there is a clear evidence of the predominance of thematic responses regardless of age. Males showed slightly higher median values in the first (18.00–35.11 years) and last (51.00–65.00 years) age groups, while females showed higher median values in the second (36.00–50.11 years) age group. Subjective responses showed relatively similar median values between males and females across all age groups. The interquartile values suggested that males have slightly wider variability in taxonomic and thematic responses, while subjective responses generally showed lower variability, particularly in the older age group.

In order to verify if there was any significant difference between the two genders across specific age group Mann-Whitney U tests were conducted for the

18.00-35.11 years, 36.00-50.11 years, and 51.00-65.00 years groups. In other words, the performance of females and males was compared for each of the groups divided on the basis of age. Across all three age groups, no statistically significant differences were observed between male and female participants for taxonomic, thematic, or subjective responses. In the 18.00-35.11 years age group, taxonomic ($U = 87.50$, $|Z| = 1.024$, $p > 0.05$), thematic ($U = 102.50$, $|Z| = 0.395$, $p > 0.05$ and subjective responses ($U = 98.50$, $|Z| = 0.576$, $p > 0.05$) did not differ significantly between genders.

In the 36.00-50.11 years age group, no significant differences were observed for taxonomic ($U = 105.50$, $|Z| = 0.271$, $p > 0.05$), thematic ($U = 107.00$, $|Z| = 0.208$, $p > 0.05$), or subjective responses ($U = 107.00$, $|Z| = 0.222$, $p > 0.05$). Similarly, in the 51.00-65.00 years age group, taxonomic ($U = 77.00$, $|Z| = 1.45$, $p > 0.05$), thematic ($U = 73.50$, $|Z| = 1.69$, $p > 0.05$) responses also showed no statistically significant differences between male and female participants.

4.2.3 Objective 3

The third objective of the study was to compare the number of taxonomic, thematic, subjective, and irrelevant responses between the two cohorts presented with visual and auditory stimuli in the word association task. As mentioned in the methodology section, the stimuli were presented in two modalities, namely auditory and visual.

The total number of responses varied across participants, and the Shapiro-Wilk's test indicated that the distribution of taxonomic, thematic, and subjective responses significantly deviated from normality ($p < 0.05$). Therefore, the median and interquartile range were analyzed to understand the central tendencies and

dispersion, and mean and standard deviation were also computed to compare the directional trend. Accordingly, appropriate non-parametric statistical tests were employed for further analysis.

Table 4.7

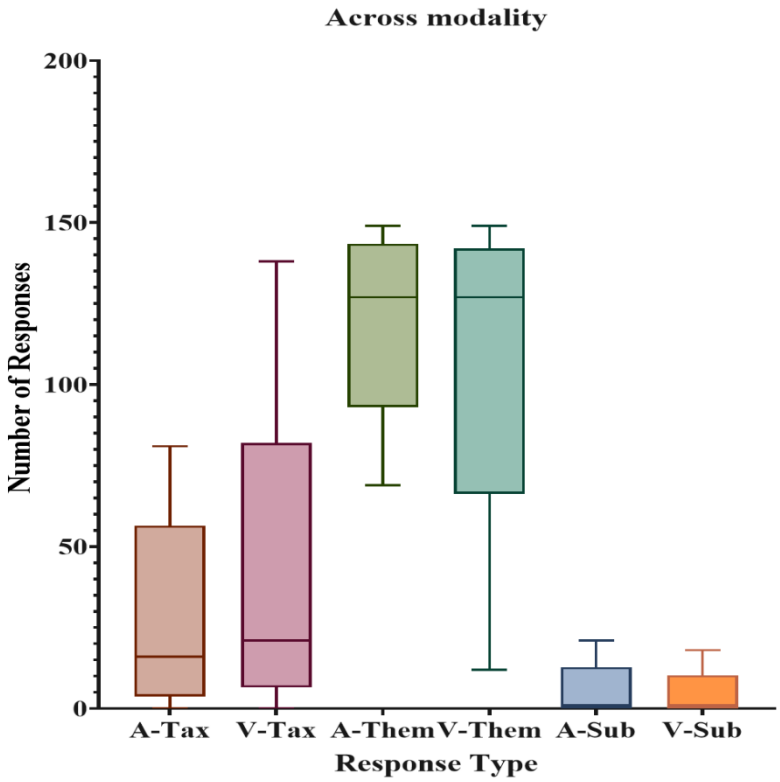
Descriptive statistics of responses across modality, irrespective of age group.

Response Type	Modality	Mean	SD	Median	IQR
Taxonomic	**Auditory (A)**	22.04	18.66	16.00	25.00
	Visual (V)	25.27	23.79	21.00	13.00
Thematic	**Auditory (A)**	124.47	17.80	127.00	22.00
	Visual (V)	122.49	23.41	127.00	15.00
Subjective	**Auditory (A)**	3.49	4.97	1.00	5.00
	Visual (V)	2.24	4.24	1.00	3.00

Table 4.7 presents the median and interquartile range (IQR) of taxonomic, thematic, and subjective responses across auditory and visual modalities, and it is used primarily to describe the central tendency and dispersion. In addition, the mean and standard deviation values were examined to determine the overall directional pattern of the data. When examining the distribution of the responses across the participants, there was a predominance of thematic responses, followed by taxonomic responses, whereas subjective responses were comparatively very less. The performance of participants was initially analysed without differentiating them based on age group.

Figure 4.6

Median values of responses across modalities, irrespective of the age group.



Note. A = Auditory; V = Visual; Tax = Taxonomic; Them = Thematic; Sub = Subjective.

As shown in Figure 4.6, taxonomic responses, the visual modality demonstrated a higher median value (21.00) compared to the auditory modality (16.00). This indicated that the visual modality of stimulus presentation brought more category -based responses in the participants. The interquartile range was higher in the auditory modality (IQR=25.00) than in the visual modality (IQR=13.00), which suggested that there was a slightly higher variability in taxonomic responses under the auditory condition.

For thematic responses, both auditory and visual modalities showed the same median value (127.00), this indicated a similar predominance across both

modalities. Variability was higher in the auditory modality (IQR=22.00) compared to the visual modality (IQR=15.00) for thematic responses.

In the case of subjective responses, both modalities showed the same median value (1.00). However, the auditory modality showed a higher interquartile range (IQR=5.00) compared to the visual modality (IQR=3.00), suggesting slightly greater variability in subjective responses under the auditory condition.The mean and median values of taxonomic, thematic and subjective responses clearly aligned with each other; thus, the overall pattern observed showed a similar directional trend across both modalities. The standard deviation values showed patterns that were consistent with the interquartile range for each of the responses.

Overall, taxonomic responses were observed more in the visual modality compared to the auditory modality, while variability was higher in the auditory condition. For the thematic responses, similar levels of responses were observed in both modalities; however, variability was slightly higher in the auditory modality. In the case of subjective responses, both modalities had similar median values, but the variability of the responses was slightly higher in the auditory modality.

To determine whether there was any significant difference in word association responses across modalities, the Mann-Whitney U test was performed. No statistically significant difference between modalities was found for taxonomic ($U = 922.00, |Z| = 0.731, P > 0.05$), thematic ($U = 996.50, |Z| = 0.129, p > 0.05$) and subjective responses ($U = 835.00, |Z| = 1.496, p > 0.05$).

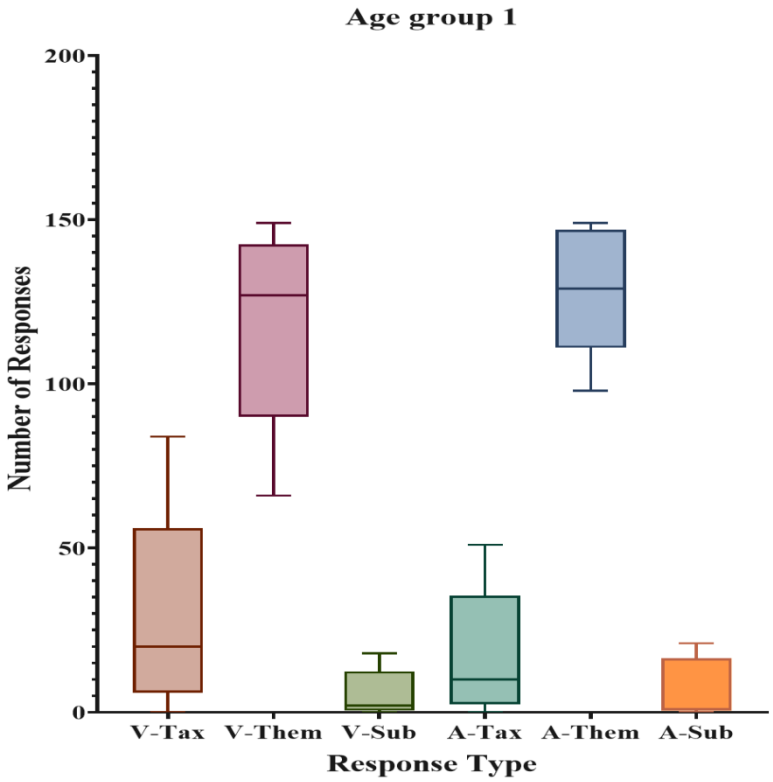
Table 4.8

Descriptive statistics of responses across 3 age groups in different modalities.

Age Group (years)	Modality	Response Type	Mean	Median	SD	IQR
18.00–35.11	Visual	Taxonomic	21.93	20.00	19.58	16.00
		Thematic	123.40	127.00	19.54	22.00
		Subjective	4.67	2.00	5.51	6.00
	Auditory	Taxonomic	13.47	10.00	12.76	15.00
		Thematic	131.13	129.00	13.72	21.00
		Subjective	5.40	1.00	6.72	11.00
36.00–50.11	Visual	Taxonomic	24.60	20.00	33.03	15.00
		Thematic	124.13	130.00	32.49	15.00
		Subjective	1.27	0.00	3.85	1.00
	Auditory	Taxonomic	15.60	12.00	11.43	25.00
		Thematic	130.00	135.00	12.41	22.00
		Subjective	4.40	3.00	4.22	8.00
51.00–65.00	Visual	Taxonomic	29.27	24.00	16.57	9.00
		Thematic	119.93	125.00	16.58	7.00
		Subjective	0.80	0.00	1.37	1.00
	Auditory	Taxonomic	37.07	32.00	20.87	31.00
		Thematic	112.27	117.00	20.35	28.00
		Subjective	0.67	0.00	1.11	1.00

Figure 4.7

Median values of responses across modalities in the first age group (18.00–35.11 years).



Note. A = Auditory; V = Visual; Tax = Taxonomic; Them = Thematic; Sub = Subjective.

As shown in Figure 4.7, in the 18.00 - 35.11 years age group, the visual modality showed a median of (20.00) for taxonomic responses, whereas the auditory modality showed a lower median of (10.00). The interquartile range was slightly higher in the auditory modality (IQR=15.00) compared to the visual modality (IQR=16.00), indicating comparable variability across both modalities.

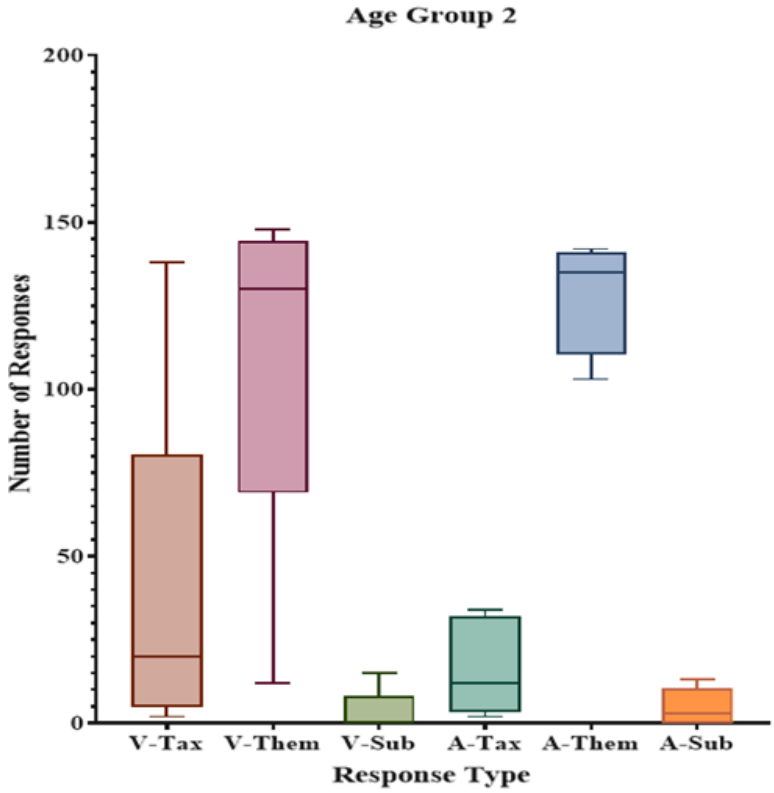
Both the auditory and visual modalities demonstrated a predominance of thematic responses. Among both modalities, the auditory modality showed a slightly higher median (129.00), while the visual modality showed a median of (127.00). The variability of thematic responses was also comparable across modalities, with the

visual modality showing slightly more variability (IQR=22.00) compared to the auditory modality (IQR=21.00).

In case of subjective responses, the visual modality showed a median value of (2.00), whereas the auditory modality demonstrated a slightly lower median (1.00). The auditory modality demonstrated greater variability (IQR=11.00) compared to the visual modality (IQR=6.00), indicating a wider spread of subjective responses under the auditory condition

Figure 4.8

Median values of responses across modalities in the second age group (36.00–50.11 years).



Note. A = Auditory; V = Visual; Tax = Taxonomic; Them = Thematic; Sub = Subjective.

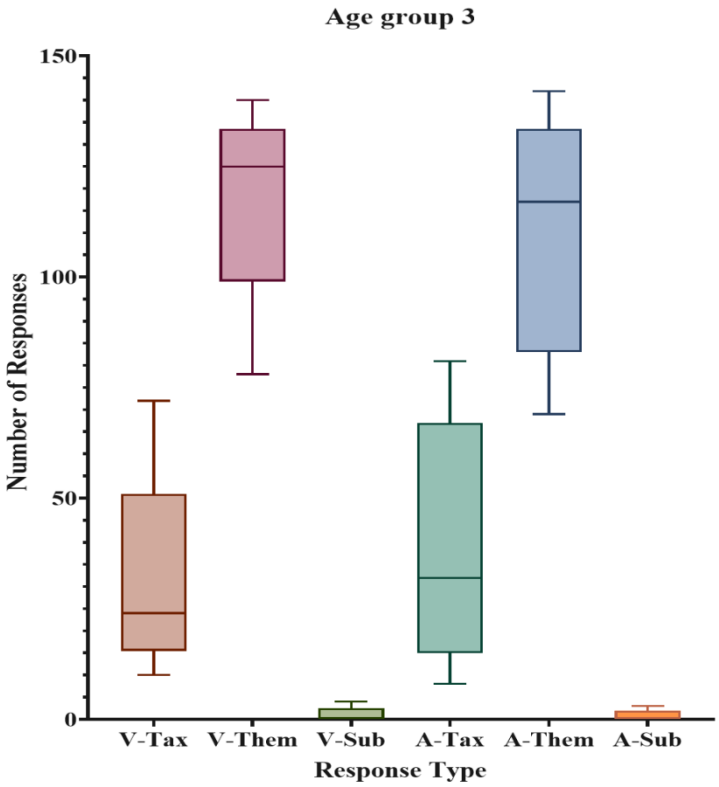
As specified in the Figure 4.8, in the 36.00 -50.11 years age group, the visual modality showed a median of (20.00) for taxonomic responses, whereas the auditory modality showed a lower median (12.00). This indicated that participants produced more category-based responses when the stimuli were presented visually. The interquartile range was higher in the auditory modality (IQR=25.00) compared to the visual modality (IQR=15.00), suggesting greater variability in taxonomic responses under the auditory condition.

Both auditory and visual modalities demonstrated a predominance of thematic responses. Among both modalities, the auditory modality showed a slightly higher median (135.00) compared to the visual modality (130.00), indicating a slight increase in thematic associations under the auditory condition. The variability for thematic responses also followed a similar trend, where the auditory modality showed greater variability (IQR=22.00) compared to the visual modality (IQR=15.00).

In the case of subjective responses, the auditory modality showed a higher median value (3.00) compared to the visual modality (0.00), indicating the subjective responses were more frequent under the auditory condition. The interquartile range was also higher in the auditory modality (IQR=8.00) compared to the visual modality (IQR=1.00), suggesting greater variability in subjective responses under auditory presentation.

Figure 4.9

Median values of responses across modalities in the third age group (51.00–65.00 years)



Note. A = Auditory; V = Visual; Tax = Taxonomic; Them = Thematic; Sub = Subjective.

In the Figure 4.9, the 51.00 - 65.00 years age group showed a higher median value of (32.00) for taxonomic responses in the auditory modality, whereas the visual modality showed a lower median of (24.00), indicating that participants produced more category-based responses when the stimuli were presented auditorily. The interquartile range was also higher in the auditory modality (IQR=31.00) compared to the visual modality (IQR=9.00), suggesting greater variability in taxonomic responses under the auditory condition.

Both auditory and visual modalities demonstrated a predominance of thematic responses. Among both modalities, the visual modality showed a slightly higher median (125.00) compared to the auditory modality (117.00), indicating that thematic associations were higher under the visual modality. The variability for

thematic responses was higher in auditory modality (IQR=28.00) compared to visual modality (IQR=7.00), suggesting greater dispersion in thematic responses under auditory presentation.

In the case of subjective responses, both modalities showed the same median value (0.00). The interquartile range was also similar for both modalities (IQR=1.00), suggesting comparable variability in subjective responses. Across the three age groups, the mean and median followed a similar directional pattern across both auditory and visual modalities, indicating consistency in the central tendency of responses. Thematic responses remained the highest, followed by taxonomic, while subjective responses were the least across modalities. Similarly, the standard deviation showed patterns consistent with the interquartile range. Overall, the auditory modality tends to show slightly higher variability compared to the visual modality, while subjective responses consistently showed lower variability across both modalities.

In order to verify whether modality-based differences existed within specific age groups, separate Mann-Whitney U tests were conducted for the 18.00-35.11 years, 36.00-50.11 years, and 51.00-65.00 years groups. Across the 18.00-35.11 years age group, no statistically significant differences were observed between auditory and visual modalities for taxonomic responses ($U=75.50$, $|Z| = 1.543$, $p > 0.05$), thematic responses ($U = 85.00$, $|Z| = 1.142$, $p < 0.05$), and subjective responses ($U = 104.00$, $|Z| = 0.362$, $p < 0.05$). In the age group of 36.00-50.11 years age group no statistically significant differences were observed between auditory and visual modalities for taxonomic responses ($U = 110.00$, $|Z| = 0.104$, $p > 0.05$). However, statistically significant difference was observed for subjective responses ($U = 50.50$, $|Z| = 2.753$, $p < 0.05$). In the 51.00-65.00 years age group, no

statistically significant differences were observed between auditory and visual modalities for taxonomic ($U = 82.00$, $|Z| = 1.266$, $p > 0.05$), thematic responses ($U = 77.50$, $|Z| = 1.453$, $p > 0.05$), and subjective responses ($U = 110.00$, $|Z| = 0.124$, $p > 0.05$).

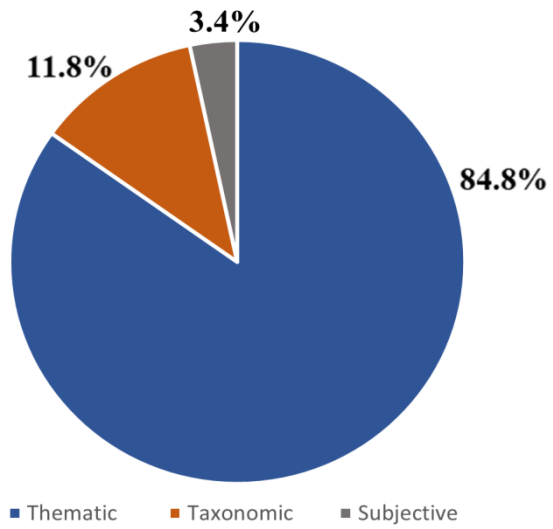
4.3 Additional Analysis

4.3.1 Distribution of responses

It was observed that all the participants had a tendency to produce more thematic responses than any other types, which makes thematic responses predominant and followed by taxonomic responses, while subjective responses were comparatively fewer. Variations were noticed in the proportion of taxonomic and subjective responses across age groups, which suggests a subtle shift in the response types with age. Thus, there was a general trend observed, which is that the taxonomic responses increased, and subjective responses decreased with age. It was also noticed that no irrelevant response was given by any of the participants. The distribution of response types across the three age groups was examined by calculating the percentage of each response out of the total number of responses ($n = 4500$ per age group).

Figure 4.10

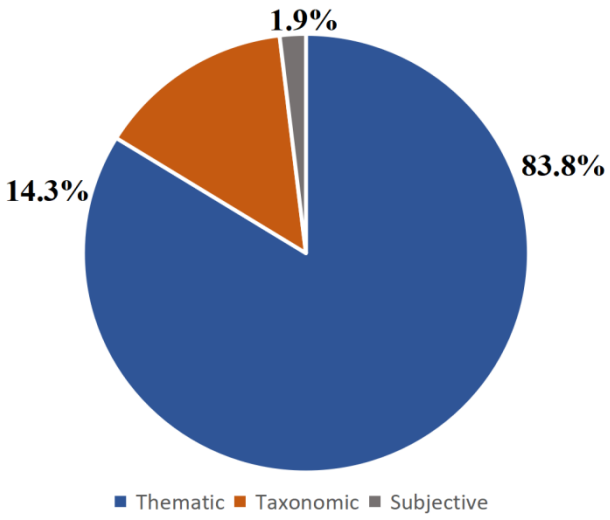
Percentage distribution of taxonomic, thematic, and subjective responses in the first age group (18.00 - 35.11 years).



As shown in Figure 5.1, in the first age group, taxonomic responses were (11.8%; n = 531), thematic responses, which constituted the highest proportion (84.8%; n = 3818), while subjective responses were minimal (3.4%; n = 151).

Figure 4.11

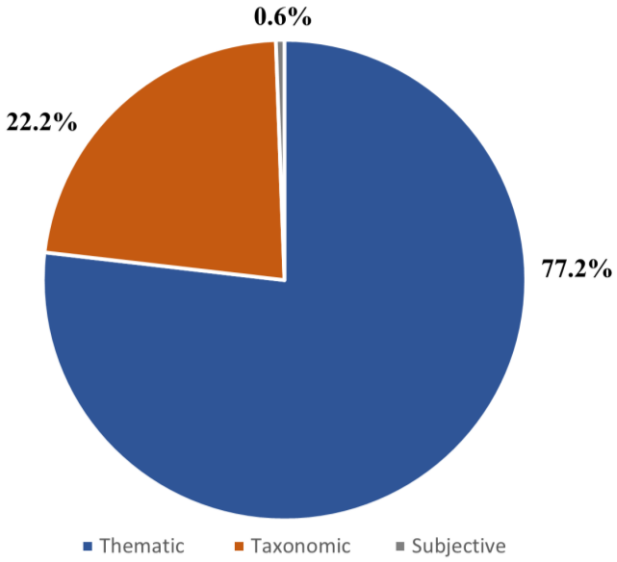
Percentage distribution of taxonomic, thematic, and subjective responses in the first age group (36.00 - 50.11 years).



As shown in Figure 5.2, in the second age group, taxonomic responses constitute (14.3%; n = 644), thematic responses (83.8%; n = 3772) were the highest in proportion, while subjective responses were minimal (1.9%; n = 85).

Figure 4.12

Percentage distribution of taxonomic, thematic, and subjective responses in the first age group (51.00 - 65.00 years).



As shown in Figure 5.3, in the third age group, the taxonomic responses were (22.8%; n = 1025), thematic responses again constituted the highest proportion (77.5%; n = 3488), while the subjective responses were minimal (0.6%; n = 26). The analysis of the distribution of responses revealed the thematic dominance regardless of the age group, this was followed by taxonomic and subjective responses.

4.3.2 Cros -language responses

The percentage of English language responses was computed for each of the age groups. In the 18.00-35.00 years age group, a total of 623 responses were produced in English, accounting for 13.84% of the total responses (n = 4500). In the 36.00 - 50.11 years age group, 518 responses 11.15% (n = 4500) were in English. In

contrast, the 51.00 - 65.00 years age group showed a lower proportion, with 307 responses accounting for almost 6.82% (n = 4500) of the total responses. Thus, this analysis revealed there was an overall decrease in the number of English responses with age.

In summary, three objectives were considered in the present study. The first objective was to compare the number of taxonomic, thematic, subjective, and irrelevant responses across different age groups (18.00 - 35.11 years, 36.00 - 50.11 years, and 51.00 - 65.00 years) in the word association task, for which the Kruskal-Wallis test followed by the Mann-Whitney U test was employed. The findings indicate that there were statistically significant differences in taxonomic and thematic responses across age groups, with notable changes observed particularly in the third age group (51.00 - 65.00 years) when compared to the first (18.00 - 35.11 years) and second (36.00 - 50.11 years) age groups, whereas the first and second age groups showed comparable response patterns. Subjective responses also demonstrated significant differences between the first and the third age groups, while no significant difference was observed between the second and the third age groups.

The second objective of the study was to compare the number of taxonomic, thematic, subjective, and irrelevant responses between male and female participants in the word association tasks, for which the Mann-Whitney U test was used. With respect to gender, no statistically significant differences were observed between male and female participants for taxonomic, thematic, or subjective responses, and this pattern remained consistent across all groups, indicating that gender did not influence the word association responses.

The third objective of the study was to compare the number of taxonomic, thematic, subjective, and irrelevant responses between two cohorts presented with visual and auditory stimuli in the word association task, for which the Mann-Whitney U test was employed. Similarly, no statistically significant differences were found between auditory and visual modalities for taxonomic, thematic, or subjective responses overall. When across age groups are considered, modality-based differences were observed only in the second age group for subjective responses, while taxonomic and thematic responses did not have statistically significant differences; thus, this can be attributed to a chance factor. However, there was no statistically significant difference observed in the first and last age groups in taxonomic, thematic, and subjective responses.

The percentage distribution also indicated predominantly thematic responses, followed by taxonomic responses and then the subjective responses across all three age groups. When considering the responses in English, an overall decreasing trend in their use was observed with increasing age.

Chapter V

DISCUSSION

The aim of the study was to examine the effect of age, gender, and modality on influencing semantic knowledge in neurotypical adults. The first objective of the study was to compare the number of taxonomic, thematic, subjective, and irrelevant responses across three age groups (18.00-35.11 years, 36.00 - 50.11 years, and 51.00 - 65.00 years) in the word association task.

Findings showed that thematic responses had the highest median values across all three age groups, indicating their predominance even in later adulthood (51.00 - 65.00 years). Although the number of responses varied across individuals, the overall pattern remained consistent, with thematic responses followed by taxonomic and then subjective responses in the three age groups. It was also important to note that there were no irrelevant responses given by any of the participants in the current study. The terminologies used across studies differ. In the present study, the terms taxonomic and thematic responses are used, while the former is known as paradigmatic and the latter is exchanged with syntagmatic responses in different studies (for example, a free association study by (Burke & Peters, 1986) classified the responses into paradigmatic and syntagmatic categories). On comparing the median values across age groups, a clear pattern can be observed. There is a progressive increase in taxonomic responses and a decrease in subjective responses with age. At the same time, thematic responses continue to remain predominant across all age groups. This predominance can be explained through the semantic activation theory (Collins & Loftus, 1975) where associations based on contextual relationships are more readily accessed compared to structured category-based responses.

With respect to the statistical findings (Kruskal -Wallis followed by Mann - Whitney), statistically significant differences in taxonomic and thematic responses were observed across age groups ($p < 0 .05$). Specifically, significant differences were found between the first and third age groups and between the second and third age groups, whereas no statistically significant difference was observed between the first and second age groups. This indicates that the typology of response changes in later adulthood (51.00 - 65.00 years). For subjective responses, statistically significant differences were observed between the first and second and between the first and third age groups, whereas no significant difference was observed between the second and third age groups.

Corroborating the findings with the existing literature, similarities and differences can be evidenced. Traditionally, age has been considered an important factor influencing lexical - semantic organization, with developmental studies showing a shift from thematic (syntagmatic) to taxonomic (paradigmatic) associations as age increases (Bannur Nagaraj & Budiguppe Panchakshari, 2017; Wojcik & Kandhadai, 2020). However, studies conducted in recent decades showed a different pattern. In a study by Lawson et al. (2017) participants (range: 17-73 years) were given a free sorting task, which reflects the broader structure of semantic relationships. However, it is noteworthy that direct parallels cannot be drawn from this study to the current study as the task was different in nature, but we can correlate the present study findings of thematic associations being predominant. The inference which can be drawn from this is that thematic associations are readily accessible within the semantic network. Thus, unlike the clear shift reported in the former studies, thematic responses continued to remain predominant across all age groups in the present study. The increase in the taxonomic associations with age, in the present study, was contrary to the study, which reported a decline in taxonomic associations with age, whereas

thematic associations remained relatively stable, which aligns with the current study (Belacchi & Artuso, 2018).

(Cronin, 2002) conducted a longitudinal study of developmental changes in free word association responses in young children aged 5 to 6 years; the findings revealed a significant increase in paradigmatic (taxonomic) responses, particularly among the older group, while syntagmatic (thematic) responses remained relatively stable, a comparable trend is also observed in the existing study, where taxonomic responses increased across age groups, whereas thematic responses showed relative predominance. Although different studies reported the predominance and shifts in the type of responses, there are studies that reported no significant age-related shift between paradigmatic and syntagmatic responses, suggesting the stable nature of lexical organization across adulthood (Burke & Peters, 1986)

In the existing literature, subjective responses were not explicitly classified or analyzed in the same manner as in the present study. In a recent study by (Aleknavičiūtė, 2025) reported that younger participants produced more varied, diverse and negatively connoted associations, whereas older participants showed more stable and less emotionally loaded responses. This observation can only be indirectly correlated with the results of the existing study of decreasing subjective responses with age, as the typology of responses was different.

With respect to changes in response types with age, the findings of the present study indicate that thematic links remain the most predominant form in the lexical - semantic organization across all age groups. At the same time, the number of taxonomic responses increases with advancing age, whereas subjective responses are higher in younger individuals and reduces in the older age group. These findings can be correlated

with the similar patterns from previous studies, which report the strength of thematic links, an increase in taxonomic responses, and a higher occurrence of emotionally driven and varied responses in younger individuals than in older adults.

The second objective was to compare the number of taxonomic, thematic, subjective, and irrelevant responses between male and female participants in the word association task. With respect to gender, the descriptive analysis based on median values indicated minimal differences in response patterns both overall and across age groups. Overall, males showed relatively higher taxonomic responses, whereas females showed slightly higher thematic responses, while subjective responses remained comparable across both genders. A similar pattern was also observed between males and females in all three age groups. Males showed relatively higher taxonomic responses in the first and third age groups, whereas females showed relatively higher taxonomic responses in the second age group. For thematic responses, females generally showed slightly higher values across age groups, while subjective responses remained comparable across both genders. However, these variations were minimal.

Inferential analysis further confirmed that these differences were not significant, with no significant differences observed between male and female participants for taxonomic, thematic, or subjective responses ($p > 0.05$). This pattern was consistently observed across all three age groups, where no significant gender-based differences were identified in any of the response types. These findings suggest that lexical - semantic organization, as reflected through word association responses, remains largely unaffected by gender, hence both male and female participants demonstrated similar response types.

It is noteworthy that relatively few studies have specifically examined gender differences in word association responses, specifically, with a similar typology of the

responses as used in the present study. (Güçlü, 2017) probed word association as a function of gender in young adults (19-21 years) using a free word association task with colour term stimuli, reported gender - based differences in the type of responses, with females producing more adjectives, verbs, abstract concepts, and relatively higher tendency towards paradigmatic associations, while males showed a higher use of proper nouns. Findings can be only indirectly related to the present study, where paradigmatic tendencies may correspond to taxonomic responses, and abstract responses can be associated with the subjective responses seen more in females. However, the response types which the male participants cannot be correlated to a specific response type in the present study.

Another study carried out by the same proponent (Güçlü, 2024) probed word association in children (11 years) using free word association task. It was reported that both boys and girls showed more paradigmatic responses (no difference in paradigmatic vs syntagmatic classification) and gender differences were reported with girls producing more abstract associations than boys, suggesting a greater tendency towards emotionally driven and conceptual processing. Unlike the findings of Güçlü's study, there was no statistically significant response type difference with respect to gender when it comes to the present study. This can be due to the variations in the category of stimuli and task demands (associations should be made within a fixed time). Additionally, considering the age group of the participants in the second study, a direct comparison may not be appropriate, as the lexical - semantic network in children is still developing, and the cognitive strategies employed may differ from those of adults. Furthermore, variations in cultural and linguistic backgrounds between Güçlü's adult and child studies may also influence response patterns. Although the objective of both the present study and Güçlü's study is to examine gender differences, the above mentioned differences limit direct comparability.

Overall, it is important to note that even though there were significant age - related differences in the responses given by participants, the gender differences are not clearly reported in the current study as well as in the previous studies (on the basis of taxonomic, thematic, subjective and irrelevant responses).

The third objective of the study is to compare the number of taxonomic, thematic, subjective, and irrelevant responses for the two cohorts presented with visual and auditory stimuli in the word association task. The descriptive analysis based on median values indicated only minimal differences in response patterns between auditory and visual conditions. Slightly higher taxonomic responses in the visual modality and slightly higher subjective responses in the auditory modality were present. In the first and the second age groups, there was a relatively slightly higher taxonomic response in visual modality, whereas thematic responses were slightly higher in auditory modality. But, subjective responses were comparable in both groups in the first group, whereas in the second group, subjective responses were much higher in the auditory modality. In the third age group, a reversal in pattern was observed; taxonomic responses were relatively higher in the auditory modality, and thematic responses were higher in the visual modality, while subjective responses still remained comparable in both groups.

With respect to the statistical findings, no statistically significant differences were observed between auditory and visual modalities for taxonomic ($p > 0.05$), thematic ($p > 0.05$) or subjective responses ($p > 0.05$), as a whole and with respect to age group, except the second group, which showed a statistically significant difference in only subjective responses ($p < 0.05$). This difference could be because of a chance factor, since no other age group showed a difference, and moreover, only subjective responses demonstrated this difference. Findings from earlier studies examining the effect of stimulus modality on word association responses showed mixed results.

Reynolds et al. (1971) in a study involving participants from multiple age groups, including adolescents, junior high school students, and primary school children (n = 194), using oral and visual presentation of stimuli (nouns), reported that the oral mode elicited more paradigmatic (taxonomic) responses compared to the visual mode in all groups except the junior high - school group. In contrast, the present study did not reveal any statistically significant differences between auditory and visual modalities. This difference may be attributed to the age group of both studies; Reynold et al. included a wide range of developmental age groups, whereas the current study focused on adults. However, Ohnmacht & Pacheco (1972), in a study involving undergraduate students (n = 114) using aural and visual modes of stimulus presentation of 12 abstract conceptual nouns stimuli drawn from educational psychology, found that there was no significant difference between the responses given for both the modalities of stimulus presentation. Similar findings were obtained in the present study, where there was no significant difference found with respect to the modality of presentation, except for the second group (which can be attributed to a chance factor).

In addition to the stated objectives, a few other findings are also notable. There were some cultural references produced by participants. For instance, stimulus such as /mulːapːuːʊ/ (Jasmine) were commonly associated with culturally significant concepts like /oːɳam/ (a festival in Kerala), /kaljaːɳam/ (marriage) and /uʈ̪saʊam/ (a temple festival in Kerala), while stimulus /aːna/ (elephant) elicited responses such as /puːɾam/ (a temple festival in Kerala) and /uʈ̪saʊam/ (a temple festival in Kerala), this indicated shared cultural knowledge across participants. Similarly, the stimulus /tʃemparaʈ̪ːi/ (hibiscus) was frequently associated with /puːkːaɭam/ (flower carpet), reflecting culturally embedded representations. Some culturally specific responses were more prominent among participants in the middle and older age groups. For example, responses such as /meʈ̪ijaɖi/

(traditional wooden footwear) for the stimulus /tʃɐrupː/ (slippers) and /t̪aːɭi/ (herbal cleanser) for /tʃembaɾat̪ːi/ (hibiscus) were predominantly observed in the second and third age groups, suggesting age-related differences in cultural familiarity and experiential knowledge. These indicate that cultural influences play a role in shaping the word association responses.

Overall, the findings of the present study indicate that, although thematic responses were predominant across all age groups, taxonomic responses showed a progressive increase with age. This pattern is consistent with the existing semantic network model, which proposes that lexical-semantic organization becomes increasingly structured and category - based with maturation (Collins & Loftus, 1975; Collins & Quillian, 1969). With respect to gender and modality, the present study did not reveal any statistically significant differences, suggesting that these factors may have a limited effect, especially when the stimuli are concrete nouns.

The recommended protocol for tapping lexical semantic organization using word association tasks will be as follows:

Sample selection

The test should be standardized in neurotypical individuals representing different age groups, ranging from children to older adults, educational backgrounds, and linguistic profiles. Participants included in the normative development should be recruited by considering all the inclusionary and exclusionary criteria mentioned in this current study. For a valid normative data, sample sizes are recommended to be approximately 50-85 participants per subgroup to obtain a relatively stable mean and standard deviations, although larger samples are preferred for more robust normative development (Piovesana & Senior, 2018).

Stimulus preparation

The stimuli used in the test should be carefully selected because the semantic and grammatical characteristics of stimuli significantly influence response patterns. Concrete noun stimuli are preferable during initial development because they minimize confounding variables associated with grammatical complexity and abstractness, and can also be compared with the current study since it used the same concrete nouns as the stimuli. Stimuli should be controlled for familiarity, frequency, imageability, and cultural appropriateness. Emotionally loaded, ambiguous, or culturally unfamiliar stimuli should generally be avoided unless specifically being investigated. The number of stimuli included in the test material should be standardized according to the objective of the study, the feasibility of administration, and participant fatigue, etc.

Modality of stimulus presentation

The modality of the stimulus presentation can be auditory, visual or multimodal presentation. In auditory modality, the stimulus words should be presented with adequate clarity, appropriate intensity, and a controlled speaking rate. Pronunciation should be consistent across all stimuli, and background noise should be minimized during presentation. In the visual modality, orthographic stimuli should be displayed using an adequate font size, spacing, a white background and good legibility to ensure ease of reading. If the picture stimuli are utilized, they should be culturally appropriate, visually clear, appropriate orientation, have appropriate colour grading, and with good imageability.

Instruction and administration

Clear and standardized instructions should be provided before administration. Participants should be informed that they must produce the first word (free word

association) or a specified number of words (discrete word association) that come to mind immediately after hearing or seeing the stimulus. They should be informed that there are no right or wrong answers. The participant's response can also be written or orally produced. The administration should be done individually in a quiet and distraction-free environment. One stimulus should be presented at a time. The examiner should avoid providing semantic cues or examples, as this will influence the response patterns. Repetition of stimuli may be permitted only if the participant fails to hear or perceive the stimulus clearly. Responses can be audio recorded for later analysis, or real-time tallying can also be done.

Response analysis and scoring

Responses generated during the task should be categorized systematically based on semantic relationship, syntactic relationship, emotional content, phonological similarity, etc. As used in the present study to understand the lexical semantic organization, semantic relationship based classification would be ideal. The frequency count of each response category and the percentage distribution of responses can be computed. Initially, responses should be classified into the selected category based on classification (eg; taxonomic, thematic, subjective, and irrelevant). The frequency count of each response category should then be calculated by counting the total number of responses belonging to that specific category for each participant. The percentage distribution of responses should subsequently be calculated to determine the relative predominance of each response category.

This may be calculated using the formula;

Percentage = (Total number of valid responses) ÷ (Number of responses obtained in that specific category×100)

Group-wise percentage distributions may also be calculated by combining the responses of all participants within a group and computing the proportion of each response category relative to the total number of responses generated within that group.

Future development of the word association test should focus on expanding the linguistic, cultural, and clinical applicability of the tool. Semantic associations are influenced by language exposure, sociocultural experiences, education, the nature of the stimuli, etc. Future versions of the test can incorporate specific modifications to obtain the effect of each variable on the responses.

Chapter VI

SUMMARY AND CONCLUSIONS

Lexical- semantic organization refers to the manner in which words, concepts, and meanings are stored, connected, and accessed within the mental lexicon. Different processes get affected according to the specific conditions, like normal aging, mild cognitive impairment, or dementia. One of the most widely used methods to examine lexical - semantic organization is the word association task, as it provides insights into the structure and organization of semantic networks through the spontaneous responses generated by individuals. Word association tasks are considered effective in tapping lexical - semantic processing because the responses produced are believed to reflect the associative links and semantic relationships existing within the mental lexicon. Thus, word association tests have been utilized for a long time in psycholinguistic research as an effective means of exploring the structure and organization of the mental lexicon.

The present study aimed to investigate lexical - semantic organization using a discrete word association task by examining the influence of age, gender, and stimulus modality. The comparative group design was utilized for understanding the effect of three different age groups, gender, and modality. Ninety neurotypical adults participated in the study and were divided into three age groups: Group 1 (18.00 - 35.11 years), Group 2 (36.00 - 50.11 years), and Group 3 (51.00 - 65.00 years). Two cohorts were formed within each age group based on the modality of stimulus presentation. Cohort A received stimuli in the auditory modality, whereas Cohort B received stimuli in the visual modality. Each cohort consisted of 45 participants in each age group and balanced gender representation, comprising eight females and seven males. Participants included in the study had no reported history of speech, language, hearing, neurological, psychiatric, or cognitive

disorders, thereby ensuring representation of typical cognitive - linguistic functioning. The stimuli used in the study consisted of concrete noun stimuli (Malayalam) presented through auditory and visual modalities which was presented in the respective cohorts (Cohort A: auditory and Cohort B: visual). Responses obtained during the word association task were categorized into taxonomic, thematic, subjective, and irrelevant response types. Both descriptive and inferential statistical analyses were carried out.

The first objective of the study was to compare the number of taxonomic, thematic, subjective, and irrelevant responses across different age groups. The findings revealed statistically significant differences in taxonomic and thematic responses across age groups. Significant differences were particularly observed between the third age group (51.00 - 65.00 years) and the first (18.00 - 35.11 years) and second (36.00 - 50.11 years) age groups, whereas the first (18.00 - 35.11 years) and second (36.00 - 50.11 years) age groups, whereas the first and second age groups demonstrated relatively similar response patterns. Subjective responses also demonstrated significant differences between the first and third age groups. Overall, thematic responses remained predominant across all age groups, while taxonomic responses demonstrated a gradual increase with age, and subjective responses showed a decreasing trend.

The second objective of the study was to compare word association responses between male and female participants. The findings indicated that there were no statistically significant differences between male and female participants for taxonomic, thematic, or subjective responses. Similar response patterns were observed across all age groups, suggesting that gender did not significantly influence lexical - semantic organization when concrete noun stimuli were employed.

The third objective of the study was to compare responses across auditory and visual modalities. No statistically significant differences were observed between auditory and visual modalities for taxonomic, thematic, or subjective responses overall. However, when analyzed across age groups, modality - based difference were observed in the second age group for subjective responses, whereas no significant modality - related differences were identified for taxonomic or thematic responses. No statistically significant modality - based differences were observed in the first and third age groups.

There were also other notable observations, such as the use of culturally related words and the reduction of usage of English responses with increasing age. Both of them reflect the influence of sociocultural and linguistic experience in a person.

Merits of the study

The present study demonstrates several advantages when compared to different studies in the existing literature on word association studies as it includes an equal number of participants across clearly defined age groups, this ensures a balanced and systematic representation of the age range. Many studies in the existing literature rely on broadly defined age groups (eg: 18-63 years as one age group) or unevenly distributed age categories, such as grouping participants as “junior high school students” or “undergraduates”, etc. Also in contrast to studies that employ broad or less clearly defined classifications of responses, the present study adopts a clearly structured classification of semantic categories (taxonomic, thematic, subjective, and irrelevant) for the responses given by the participants. Furthermore, unlike many previous studies that primarily focus on a single variable, the present study examines the influence of age, gender, and stimulus modality. The stimuli list of the present study was restricted to nouns in order to minimize

confounding variables, as the semantic and grammatical nature of stimuli is known to significantly influence the type of responses produced.

Limitations of the study

Although the present study provides many important insights into lexical semantic organization, there are a few limitations. The results cannot be treated as a normative as it is restricted to a specific linguistic (Malayalam) and cultural group. Although the present study included balanced representation across clearly defined age groups, the sample size may still limit the broader applicability of the findings. It has a restricted stimulus set and does not address variability and shows differences which comes in responses due to the change in the stimulus category. The present study, being a cross-sectional design, limits its ability to reflect true developmental changes; a longitudinal study design is more suitable to track the shift in thematic to taxonomic response typology.

Clinical Implications

The obtained results can serve as a yardstick for future studies involving priming and cueing. Results can give us an insight into the comparison of typical and atypical response patterns, and also allow the tracking of changes such as an increase in irrelevant responses or a reduction in thematic association, which may indicate cognitive decline. This approach is particularly useful for assessing semantic memory and diagnosing deficits in cognitive abilities, especially in neurocognitive disorders such as mild cognitive impairment and dementia. This can give clinicians a picture of the dominant response pattern that they can expect from normals.

Future Directions

Future studies aiming to tap lexical semantic organization using word association tasks should adopt a comprehensive approach to response classification. Future studies should include larger and more diverse samples to establish the normative data and improve the generalizability of findings across different populations, since the specific sociocultural and linguistic backgrounds can have a significant impact on the responses provided by the participants. Cross-linguistic adaptation and translation of the test should be carefully considered during future modifications. While translating or selecting stimuli, the examiners should ensure linguistic equivalence, semantic familiarity, frequency of usage, cultural relevance, and imageability of the stimuli, and it should be validated. Future studies can investigate the effect of bilingualism and multilingualism in responses given by the participants.

Another important variable to investigate is reaction time or response time during word association tasks as a function of age. This probes into the lexical access difficulties resulting form ageing or other pathological conditions.

Researchers are encouraged to include multiple response types, such as taxonomic, thematic, and subjective categories, rather than relying on a single or broad classification system. It is also notable that irrelevant responses are least likely to be obtained from an adult with normal cognitive function. Gender may not significantly influence lexical - semantic organization when responses are analyzed in terms of taxonomic and thematic relations when purely concrete nouns are taken as a stimulus. However, gender differences may emerge in responses if we examine stimuli such as coloured terms or abstract words; the dimensions of abstraction and emotional valence can differ between male and female participants. Varying the stimulus types and response classifications can reveal several

intricacies of lexical semantic organization. Picture based vs orthography-based stimuli sets can be compared to understand how the perceptual processing differences have an effect on the elicited response type that are obtained, and how it could affect the response categories, thus the relationship between stimulus and response can be deduced.

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APPENDIX I

ETHICAL CLEARANCE CERTIFICATE

All India Institute of Speech and Hearing
(An autonomous Institute under the
Ministry of Health and Family Welfare, Govt. of India)
Center of Excellence - Assessed & Accredited by NAAC with 'A' Grade
ISO 9001:2015 Implemented Institute
Manasagangothri, Mysuru-570006

ಅಖಿಲ ಭಾರತ ವಾಕ್ ಮತ್ತು ಶ್ರವಣ ಸಂಸ್ಥೆ
ಮಾನಸಗಂಗೋತ್ರಿ, ಮೈಸೂರು-570006
अखिल भारतीय वाक् श्रवण संस्थान
मानसगंगोत्री, मैसूरु - 570 006

INSTITUTE REVIEW BOARD (IRB) APPROVAL FOR BIO-BEHAVIOURAL RESEARCH PROPOSAL INVOLVING HUMAN SUBJECTS AT AIISH

AIISH Institute Review Board (IRB)

Ref: SH/IRB/M.5/SLP.36/2025-26 **Date: 11.03.2026**

Title of the Dissertation	: Investigating the Influence of Age, Gender, and Modality in Semantic Knowledge of Neurotypical Adults.
Name of the Student	: Ms. Samritha Sanjay
Guide	: Dr. Abhishek B. P
Co-Guide (if any)	: Nil
Proposed Duration of the Project	: 06 months
Source of funding	: Non-funded Master's dissertation
Estimated budget	: Nil
Reference Number of the Project	: Nil
Date on which the IRB meeting was held	: 05.03.2026
A clear statement of the decision reached IRB meeting (In the event of the proposal is not APPROVED, a statement of reasons for the same must be indicated)	**: APPROVED**
Advice & suggestions (if any)	: NIL

Signature & Name of the Member Secretary-IRB
Dr. Animesh Barman
Professor of Audiology
All India Institute of Speech and Hearing, Mysuru-570006

सदस्य सचिव / Member Secretary
संस्थागत समीक्षा बोर्ड
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APPENDIX II

STIMULI LIST

Sl.no	Malayalam	English	IPA
1	കാക്ക	Crow	/kaːkka/
2	തക്കാളി	Tomato	/t̪akːaːɭi/
3	കോഴി	Hen	/koːɻi/
4	ഉള്ളി	Onion	/uɭːi/
5	സൂര്യൻ	Sun	/suːrjan/
6	പെട്ടി	Box	/peʈːi/
7	പൂച്ച	Cat	/puːt͡ʃːa/
8	ചെമ്പരത്തി	Hibiscus	/t͡ʃemparaʈ̪ːi/
9	മേഘം	Cloud	/meːgam/
10	ഉരുളക്കിഴങ്ങ്	Potato	/uɾuɭakkiɻaŋ/
11	ആന	Elephant	/aːna/
12	കസേര	Chair	/kaseːɾa/
13	സിംഹം	Lion	/simham/
14	മല	Mountain	/mala/
15	പശു	Cow	/paʃu/
16	മാങ്ങ	Mango	/maːŋːa/
17	മുല്ലപൂവ്	Jasmine	/mullapuːv/
18	പഴം	Banana	/paɻam/
19	തത്ത	Parrot	/t̪aʈ̪ːa/
20	ചക്ക	Jackfruit	/t͡ʃakːa/
21	വീട്	House	/ʋiːʈ/
22	വെള്ളം	Water	/ʋeɭːam/
23	കൈ	Hand	/kai/

24	ചെരുപ്പ്	(Footwear)	/t͡ʃɛrupːɨ̆/
25	ദോശ	Dosa	/doːʃa/
26	തോർത്ത്	towel	/toːrtt/
27	പ്രാവ്	Pigeon	/praːʋ/
28	ബസ്സ്	Bus	/bʌs/
29	മേശ	Table	/meːʃa/
30	കടൽ	Sea	/kaɖal/

APPENDIX III

INFORMED CONSENT FORMS

2.a. Informed Consent in English

Dissertation

Title: Investigating the Influence of Age, Gender, and Modality in Semantic Knowledge of Neurotypical Adults

Information for the participants

I, Samritha Sanjay, have undertaken the research study entitled **"*Investigating the Influence of Age, Gender, and Modality in Semantic Knowledge of Neurotypical Adults*"** under the guidance of Dr. Abhishek B. P. The study will involve a non-invasive procedure in which 30 words will be presented, and you will be requested to provide five appropriate words that come to mind in response to each. The total duration of the study will be around 15 minutes (in one sitting). The responses will be audio-recorded for further analysis. Your participation in the study will be kept confidential. Your identity and any other personally identifiable information will remain anonymous, and all such details will be removed during data analysis and publication. The study will involve audio recordings of the responses for all the participants. These audio recordings will be securely stored and accessible only to the research team. You will have complete autonomy in deciding whether to take part in the study. There will be no coercion, influence, or pressure on the participants to participate in the study. By adhering to these ethical considerations, the study ensures fairness, transparency, and participant welfare, while respecting the principles of beneficence, non-maleficence**,** autonomy, and justice in research involving human subjects. I kindly request you to participate in the present study, your cooperation in the study will be duly acknowledged.

Informed Consent

I have been informed about the aims, objectives, and procedures of the study. The possible risks and benefits of my participation as a human subject in the study are clearly understood by me. I understand that I have a right to refuse to participate as a subject of the study. I have had the opportunity to ask questions about it, and any questions that I have asked have been answered to my satisfaction. I understand that I have the freedom to write to the head of the institute in case of any violation of these provisions without the danger of my being denied any rights to secure the clinical services at this Institute. I consent voluntarily to participate in this study.

I _____ the undersigned, give my consent to be a participant in this investigation. I have no objection to participating in this study.

Name and signature of the Participant/Caretaker:

Name and signature of the Investigator (student):
Date:

2.b. Informed Consent in Malayalam

ഡസർട്ടേഷൻ

ശീർഷകം: ഇൻവെസ്റ്റിഗേറ്റിംഗ് ദ ഇൻഫ്ലുവൻസ് ഓഫ് ഏജ്, ജെൻഡർ, ആൻഡ് മോഡാലിറ്റി ഇൻ സെമാന്റിക് നോളജ് ഓഫ് ന്യൂറോടിപ്പിക്കൽ അഡൾട്ട്സ്

പഠനത്തിൽ പങ്കെടുക്കുന്നവർക്കുള്ള വിവരങ്ങൾ

ഞാൻ സമൃത സഞ്ജയ്, ഡോ. അഭിഷേക് ബി. പി. യുടെ മാർഗനിർദേശത്തിൽ "ന്യൂറോടിപ്പിക്കൽ പ്രായപൂർത്തിയായ വ്യക്തികളിലെ സെമാന്റിക് അറിവിൽ പ്രായം, ലിംഗഭേദം, മോഡാലിറ്റി എന്നിവയുടെ സ്വാധീനം" എന്ന വിഷയത്തിൽ ഗവേഷണം നടത്തുന്നു. ഈ പഠനത്തിൽ 30 വാക്കുകൾ അവതരിപ്പിക്കും. ഓരോ വാക്കിനും മനസ്സിൽ വരുന്ന അഞ്ച് അനുയോജ്യമായ വാക്കുകൾ പറയേണ്ടതാണ്. മുഴുവൻ നടപടിക്കും ഏകദേശം 15 മിനിറ്റ് സമയം വേണ്ടിവരും. മറുപടികൾ പഠന ആവശ്യങ്ങൾക്കായി ഓഡിയോ ആയി റെക്കോർഡ് ചെയ്യും. പങ്കെടുക്കുന്നവരുടെ വിവരങ്ങൾ പൂർണമായും രഹസ്യമായി സൂക്ഷിക്കുന്നതാണ്. വ്യക്തിപരമായ വിവരങ്ങൾ പുറത്തുവിടുകയില്ല. ഈ പഠനത്തിൽ പങ്കെടുക്കുന്നത് പൂർണമായും നിങ്ങളുടെ ഇഷ്ടാനുസൃതമാണ്; യാതൊരു നിർബന്ധവും ഉണ്ടായിരിക്കുന്നതല്ല. ഈ പഠനത്തിൽ സഹകരിക്കണമെന്ന് വിനീതമായി അഭ്യർത്ഥിക്കുന്നു.

വിവരമറിയിച്ച സമ്മതപത്രം

പഠനത്തിന്റെ ലക്ഷ്യങ്ങളും, നടപടിക്രമങ്ങളും എന്നെ അറിയിച്ചിട്ടുണ്ട്. പഠനത്തിൽ പങ്കെടുക്കുന്നതിന്റെ സാധ്യമായ അപകട സാധ്യതകളും നേട്ടങ്ങളും ഞാൻ വ്യക്തമായി മനസ്സിലായിട്ടുണ്ട്. പഠനത്തിൽ പങ്കെടുക്കുന്ന ഒരു വ്യക്തിയെന്ന നിലയിൽ , പങ്കെടുക്കുന്നതിൽ വിസമ്മതിക്കാൻ എനിക്ക് അവകാശമുണ്ടെന്ന് ഞാൻ മനസ്സിലാക്കുന്നു. ഇതിനെക്കുറിച്ച് ചോദ്യങ്ങൾ ചോദിക്കാൻ എനിക്ക് അവസരം ലഭിച്ചു, ഞാൻ ചോദിച്ച എല്ലാ ചോദ്യങ്ങൾക്കും എനിക്ക് തൃപ്തികരമായ ഉത്തരം ലഭിച്ചു. ഈ വ്യവസ്ഥകൾ ലംഘിക്കപ്പെട്ടാൽ, ഇൻസ്റ്റിറ്റ്യൂട്ടിന്റെ മേധാവിക്ക് എഴുതാൻ എനിക്ക് സ്വാതന്ത്ര്യമുണ്ടെന്ന് ഞാൻ മനസ്സിലാക്കുന്നു. ഈ പഠനത്തിൽ പങ്കെടുക്കാൻ ഞാൻ സ്വമേധയാ സമ്മതിക്കുന്നു.

താഴെ ഒപ്പിട്ടിരിക്കുന്ന_____ എന്ന ഞാൻ, ഈ അന്വേഷണത്തിൽ പങ്കാളിയാകാൻ എന്റെ സമ്മതം നൽകുന്നു. ഈ പഠനത്തിൽ പങ്കെടുക്കുന്നതിൽ എനിക്ക് ഒരുതരത്തിലും എതിർപ്പില്ല.

പങ്കെടുക്കുന്ന ആളുടെ/കെയർടേക്കറുടെ പേരും ഒപ്പും:

അന്വേഷകന്റെ (വിദ്യാർത്ഥി) പേരും ഒപ്പും:
തീയതി