INVESTIGATING THE PATTERNS OF LEXICAL SEMANTIC ACTIVATION IN NEUROTYPICAL YOUNGER, MIDDLE AND OLDER AGED ADULTS

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MAY- 2019

CERTIFICATE

This is to certify that this dissertation entitled "**Investigating the Patterns of Lexical Semantic Activation in Neurotypical Younger, Middle and Older Aged Adults**" is a bonafide work submitted in part fulfillment for the Degree of Master of Science (Speech-Language Pathology) of the student (Registration No: 17SLP021). This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier for the award of any other Diploma or Degree to any other University.

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May, 2019

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CERTIFICATE

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

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DECLARATION

This is to certify that this dissertation entitled "**Investigating the Patterns of Lexical Semantic Activation in Neurotypical Younger, Middle and Older Aged Adults**" is the result of my own study under the guidance of aDr. Abhishek B P, Lecturer, Department of Speech-Language Sciences, All India Institute of Speech and Hearing, Mysuru and has not been submitted earlier for the award of any Diploma or Degree to any other University.

Mysuru **Register No: 17SLP021**

May, 2019

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY

Block: A set of pictures grouped together on a particular basis (generally a homogenous or heterogenous context). No repetitions of pictures within each set.

Cyclic Block: All the pictures within a block are repeated multiple times and each repetition of a set of pictures within a block is termed a 'cycle'.

Facilitation: It is the increase in the ease of retrieval of a target item, when the target (word) preceded by an item (prime) related or unrelated to the target item.

Frequency: Number of times a word in a particular language occurs during normal usage of that language.

Inhibition: It occurs when the presence of a semantically related item before the target item delays the naming latencies due to an interference effect.

Lexical Access: Lexical access refers to the activation and retrieval of information from the mental lexicon.

Lexical Entry: Each word that is known to an individual is represented in the mental lexicon as a lexical entry.

Lexical Semantic Activation: It is the retrieval of the most appropriate word or lexical entry from the mental lexicon.

Lexical Semantic Organization: It is a network of links existing to a target word and their accessibility from that target word to other word entries in the mental lexicon.

Mental Lexicon: It is a systematically organized mental dictionary that contains information regarding a word's form and meaning.

Priming: It refers to an implicit memory effect in which exposure to one stimulus influences the response to a subsequent stimulus.

Taxonomic: Items belonging to a particular category.

Thematic: Items belonging to a particular theme (having a similar feature)

CHAPTER I

INTRODUCTION

The lexicon of a language is a collection of all words existing in that particular language. In psycholinguistics, the mental lexicon is defined as a systematically organized mental dictionary. It contains information regarding a word's form and meaning. This is in terms of its pronunciation, syntactic and semantic features. Hence, the mental lexicon of an individual is their internalized knowledge of the properties of words.

Each word known to an individual is represented in the mental lexicon as a lexical entry. Appropriate selection of lexical entries is necessary for successful language production. The activation and retrieval of these lexical entries is termed as lexical access.

In order to investigate the patterns of lexical access, naming paradigms have been predominantly employed. Of these paradigms, picture naming tasks are most commonly used. The responses obtained could be influenced by a number of variables. These variables can be classified as patient and stimulus variables. Patient variables include age, attention, motivation, and education to state a few. The stimulus variables include factors such as relatedness or frequency of occurrence of the target items. These parameters determine the thresholds of activation for the target items. Items with lower thresholds of activation are accessed faster than those of higher thresholds of activation. Hence, the patterns of lexical semantic activation could follow two trends: facilitation or inhibition.

If an item (prime), preceding the target item, increases the ease of retrieval of the target item, facilitation is said to have occurred. This prime could be semantically related or unrelated to the target item. Brown (1998), reported a boost in naming latencies when the two consecutive items were semantically related. On the other hand, no such facilitatory effect was seen for consecutively unrelated items. For example, subjects respond faster to the word "doctor" when it was preceded by "nurse" than when it is preceded by an unrelated word like "carrot". This is supported

by authors who postulate a degree of independence between the nodes. Here the level of activation of a particular node determines the time required for its retrieval.

Inhibition occurs when the presence of a semantically related item before the target item, delays the naming latencies for that item. This occurs due to an interference effect. Monsell (1994), observed that latencies were delayed in semantically related contexts when compared to semantically unrelated contexts. Here, it was postulated that the levels of activation of the adjoining related nodes delayed the selection of the source node. Hence, resulting in longer naming latencies.

Extensive research has been carried out employing various methods to understand the spreading activation patterns for lexical access with studies supporting either view. However, there is no overall consensus in literature evidencing any one type of activation pattern for lexical access. Hence, necessitating the present study.

NEED FOR THE STUDY

1. Earlier studies have not targeted investigating the pattern of lexical semantic activation as a function of age. Hence, the present study is designed to understand the changes, if any, in the pattern of activation across younger, middle and older adults age groups.
2. Few researchers have reported slower naming latencies for related blocks than unrelated blocks, in accordance to lexical selection by competition. Few others, on the other hand, have argued that semantic interference only emerges due to repetitions within the block, attributed to lower priming effect in related blocks than unrelated blocks. Hence, there lies a discrepancy amongst researchers about this notion which necessitates the present study.
3. Research in the past have primarily focused only on semantic and not thematic blocks. The present study aims to study the patterns of activation in both semantically and thematically related and unrelated blocks.
4. In earlier studies, cyclic block naming and priming paradigms have been employed. The present study intends to investigate lexical semantic activation using a block naming paradigm to avoid within block repetitions and the possibility of confusion in the elderly that might arise from unimodal priming.

AIM OF THE STUDY

The aim of the present study is to investigate the pattern of Lexical Semantic Activation as a function of age, in neurotypical native Kannada speaking younger, middle-aged and older adult age groups.

OBJECTIVES OF THE STUDY

1. To compare the performance (in terms of reaction time and accuracy) of younger adults with middle-aged adults and older adults.
2. To compare the reaction time and accuracy scores for the pattern of activation for semantically related and unrelated frequent and infrequent blocks.
3. To compare the reaction time and accuracy scores for the pattern of activation for thematically related and unrelated frequent and infrequent blocks.

CHAPTER II

REVIEW OF LITERATURE

2.1 Lexical Semantics

Lexical semantics is a subfield of semantics that is concerned with the 'study of word meaning'. The mental lexicon is a construct used in psycholinguistics that refers to a mental dictionary containing information pertaining to a word's form and meaning (Levelt, 1989). Each word known to an individual is represented in the mental lexicon as a lexical entry.

2.2 Lexical Semantic Organization

Lexical–semantic organization is the number of links existing to a target word and their accessibility from that target word to other word entries in a semantic network (Sheng & McGregor, 2010). To help understand the organization of lexical items in the mental lexicon, Silverman (1983) introduced the concept of paradigmatic and syntagmatic relationships. The paradigmatic relation is explained as a vertical relationship that works on the principle of similarity. For example, the word 'cat' is paradigmatically related to the words 'animal' and 'dog', while the word 'animal' becomes the superordinate of the word 'cat', the word 'dog' becomes a category coordinate. The syntagmatic relation, on the other hand, is a relationship on the horizontal axis, that works on the principle of contiguity or co-occurrence. Words can be accessed from the lexicon using either of these two relationships, depending on the nature of the task at hand.

2.3 Lexical Access

The production of speech requires the intended meaning to provide access to the phonological form of the word that underlies its articulatory output. The activation and retrieval of this information, as sound meaning relationships of the lexical entries in the mental lexicon, is termed as lexical access. The three main cognitive processes

involved in lexical access are lexical semantic activation, competition and selection. In activation, the individual searches their semantic memory for lexical entries that have semantic features related to the target item. Such lexical entries are excited and compete to be chosen. The lexical entry is chosen at a uniqueness point, where that lexical entry with the highest level of activation is finally selected as the most appropriate target.

2.3.1 *Stages of lexical access*

Lexical access implies that the word has a singly located representation in the mental lexicon called a lexical entry, which can be sought out actively. This lexical access is hypothesized to occur in two stages: Stage of lemma access and stage of phonological access. The first stage involves the selection of lexical representations as syntactic and semantic entities. The second stage involves the selection of its corresponding phonological representations (Dell & O'Seaghdha, 1992; Caramazza, 1997). The three-step activation model includes an additional conceptual node. This represents the conceptual knowledge of an individual. Wrongful activation of this node could lead to the retrieval of a lexical entry unrelated to the target item. This model is called an interactive model as it postulates a bidirectional cascaded view between the three stages, with each pool of items competing for activation.

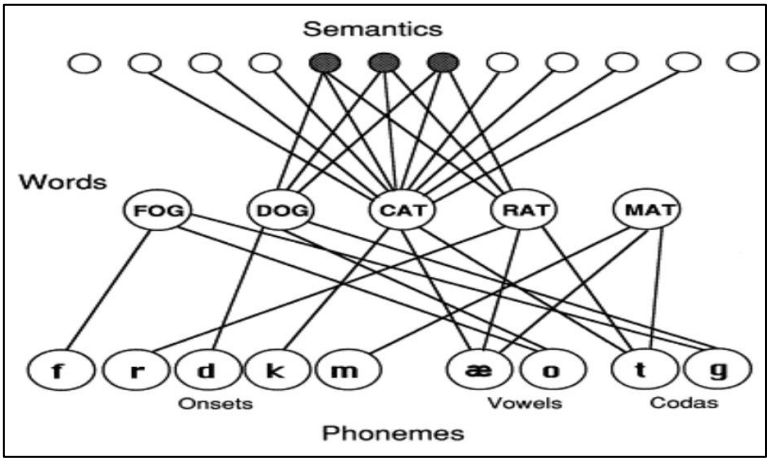

Figure 2.1: Three Step Interactive Activation Model

There is much debate, however, regarding the notion of direct and indirect activation for visual confrontational naming tasks. It is often claimed that there is a possibility of name phonology being activated directly. Thus, it is free from the activation of syntactic-semantic associates and occurs simply upon recognition of the target. Few researchers on the other hand (Levelt, 1989), opine that naming involves mediation of some portion of the lexical semantic network for features associated with the object. Hence, there lies a discrepancy in the number of substages involved. Attempts have been made to explain this phenomenon using various models of lexical access.

There are predominantly two classes of models that attempt to explain the process of lexical access: The serial search models and the parallel access models or the activation models. These models hypothesize that lexical access occurs by conducting a series of comparisons between the mental representations of lexical items and the target itself. This comparison is terminated once a satisfactory match has been found.

The serial search models postulate that a lexical item could only be in one location in the mental lexicon and retrieval is a step by step process. However, several categories could be used to determine its location. The autonomous search model (Foster, 1976), is one such serial search model that views word recognition process as having three separate parts: orthographic (visual), phonological (sound) and semantic/syntactic (meaning). Input from any modality can be accessed one at a time and all the information is stored in the lexicon and not in the individual 'files'. The master lexicon is organized into three bins, with the frequent entries being stored on top. Entries are hypothesized to be searched in these bins, in a serial manner, until a relevant lexical entry is found. This is then cross referenced against the input to ensure accuracy for an exact perceptual match. Search is terminated once the correct lexical entry has been located. Hence, high-frequency words that are placed on top are said to be accessed much faster than lower placed low frequency words.

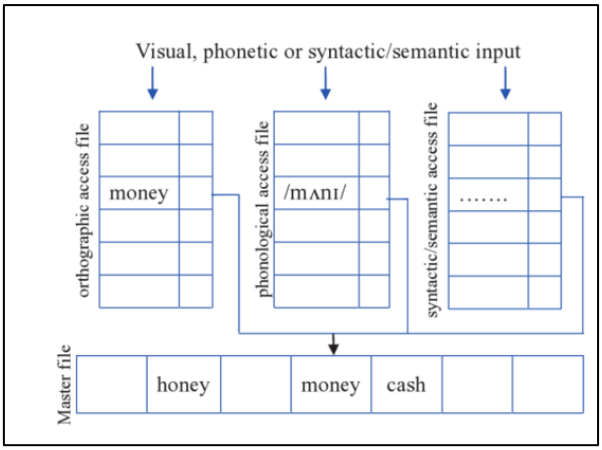

Figure 2.2: Foster's Autonomous Serial Search Model

The parallel access models on, the other hand, postulate that it is not the location but the level of activation of a lexical item that enables its retrieval. This would be a simultaneous process of activation wherein the item with the highest activation level is selected. Morton (1969), proposed the logogen model which postulated that each lexical entry has its own logogen. This logogen tracks the number of features the lexical entry has in common with the target. Input from all modalities is used to activate logogens, where the number of common features is summed up in each logogen and some may reach their pre-determined thresholds. Words are accessed when their threshold reaches a high enough energy level to access that particular lexical entry. Hence, the lexical entry with the highest feature count is selected, as it has the most similarities to the target input. This framework also assumes that frequemcy of a word is reflected in the order in which items are searched for or in their threshold for activation. The high frequency or more familiar words are searched earlier or require a lower activation threshold as compared to words of low frequency or less familiar words.

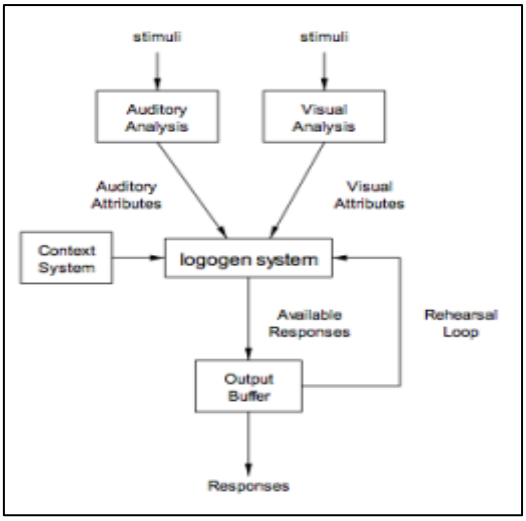

Figure 2.3: Morton's Logogen Model

The spreading activation theory (Collins & Loftus 1975), postulates that there exist nodes representing each of the lexical entries in the mental lexicon and numerous connections and interconnections between these nodes. The search process for lexical access is initiated by labelling a set of source nodes. The features of the target item are matched with that of the lexical entry and the source node with the highest similarities is selected. This theory postulates that along with the activation of the source node, there is a 'spreading' of activation to other nodes linked to the source node. This spreading activation network can be represented as a web diagram with the length of the line or the distance between the nodes, indicating how closely they are related. Closer the relation, higher the chance of activation. This can work either in favour of or against the ease of lexical access. Hence, the patterns of lexical access across these nodes can be classified as facilitatory or inhibitory.

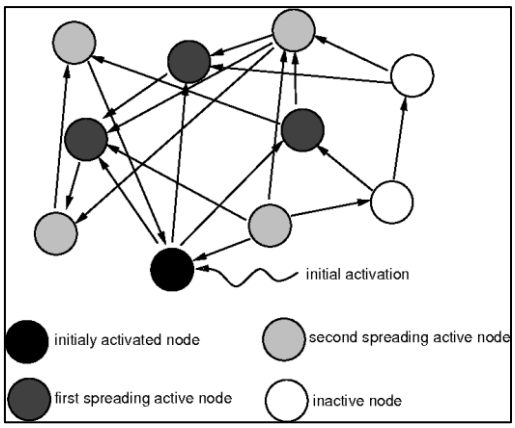

Figure 2.4: Spreading activation model

2.3.2 Methods to study lexical access

When a target item is preceded by another item semantically related or unrelated to that target item, a facilitatory or inhibitory effect can occur. Various methods based on different underlying theoretical principles have been proposed to tap the patterns of lexical semantic activation. ERP studies, judgment tasks, and naming tasks are some such methods employed. However, research has been extensively carried out using priming studies and cyclic block naming paradigms.

***2.3.2.1** Priming studies*

Studies based on the priming principle are used frequently, owing to the procedural simplicity. Priming refers to an implicit memory effect in which exposure to one stimulus influences the response to a subsequent stimulus. The first item presented is called the prime and the item to which a response has to be made is called the target. Semantic priming refers to the observation that there is an increase in the speed and/or accuracy of a participant's response to a target when exposed to a related as compared to an unrelated prime. Several such studies have shown reduced response time for semantically related stimuli, when the target has been preceded by a semantically related item than an unrelated item, hence predominantly reporting a facilitatory effect (Swinney, 1979). The more similar the stimuli, the larger the priming effect (de Groot, 1984).

***2.3.2.2** Cyclic block naming studies*

Studies employing a cyclic blocked naming paradigm have gained popularity over the years. In this paradigm, participants are asked to name a series of pictures in two contexts presented as two different blocks: homogenous and heterogeneous blocks (Kroll & Stewart, 1994). The homogenous block (related contexts), would consist of all pictures from the same lexical category (e.g., Animals: 'cat', 'dog', 'horse', 'cow'). The heterogeneous block (unrelated contexts), would consist of all pictures from different categories (e.g., 'car', 'tiger', 'pant', 'mango', 'table'). In a cyclic block naming paradigm, all the pictures within a block are repeated multiple times. Each repetition of a set of pictures within a block is termed a 'cycle' (Damian, 2001).

Studies employing the cyclic block naming paradigms have reported an overall semantic interference effect observed in related blocks as compared to unrelated blocks (Biegler, Crowther, & Martin, 2008; Belke, 2008).

2.3.3 Patterns of Lexical semantic activation: Facilitation and Inhibition

Several factors have been identified that might exert an influence on lexical access, such as the word/non-word effect, the length effect, the word superiority effect, the frequency effect and the priming effect. The ease of lexical access is influenced by the level of activation in the entry prior to access. This pre-access level of activation depends predominantly on two aspects: The resting level of activation of the lexical entry. This is influenced by the frequency of occurrence of the target item. The second aspect is context, in terms of the lexical entries that have just been accessed in prior and their relationship with the current target. Hence, stimulus frequency and stimulus relatedness (Whitney, 1998; Field, 2003) are two factors that are popularly considered to influence the patterns of lexical activation.

2.3.3.1 Studies supporting inhibition pattern

Heij (1988), conducted a study employing a picture-word variant of the Stroop task. 17 college-going students were recruited for the study and were instructed to name the picture presented to them. Three different conditions were examined. Results indicated that firstly, distractor words that were part of the response set had a larger interference effect than those that were not (condition 1). Secondly, distractor words denoting members of a relevant semantic category induced a larger interference effect than those that belonged to irrelevant categories (condition 2). Thirdly, words belonging to an irrelevant category induced a significant interference effect when the distractor was not part of the response set (condition 3).

To understand the processes underlying inhibition, a study was conducted by Ikeda (1996), comparing the interference effect in modally pure tasks (picture-picture task) and modally mixed tasks (word-picture task). Participants were instructed to ignore the distractors and name the targets. Analysis of results revealed that a larger interference effect was observed for the modally pure rather than the modally mixed

task. A significant interreference effect was observed for the word-picture task, only when the distractor word was in the same set as the target picture to be named.

Heji, Dirkx and Kramer (1999), conducted a study employing a word-picture priming paradigm. They found a trend in the inhibitory and facilitatory effects of semantic relations between context words and target pictures. This was attributed to changes in the stimulus onset asynchrony (SOA). Their results indicated a categorical interference effect at SOA values close to zero but a facilitation effect for categorically related items for longer SOAs. Hence, facilitation effect decreases with a decrease in post exposure of the context word.

Relatedness in terms of semantically and associatively related conditions were explored using a word-picture priming paradigm (Alario, Segui & Ferrand, 2000). These performances were compared with the performance in unrelated conditions. 40 graduate students were recruited for the study. They were initially familiarized with the word-picture pairs and hence were instructed to name the pictures as they appeared on the screen. Results indicated that semantically related co-ordinate primes produced an interference effect but performance with the associated primes did not differ significantly from that with the unrelated primes.

Howard and Nickels (2006), conducted an experiment employing a picture naming paradigm. The participants were instructed to name the 120 pictures presented from 24 different categories. They found an interference effect for words retrieval by prior retrieval of a word from the same sematic category. This was indicative of cumulative semantic inhibition. They attributed this to three properties of the spoken word system- competition, priming and semantic activation.

A study was conducted to examine selective inhibition by manipulating the degree of competition in picture naming (Shao, Meyer & Roelofs, 2013). This was done by presenting targets with distractors belonging to the same semantic category or unrelated semantic categories. Results indicated that the reaction time was longer for targets in the related than unrelated conditions. Their analyses revealed that participants with smaller mean semantic interference effects employed selective inhibition more effectively than did participants with larger semantic interference effects.

Several studies employing cyclic block naming paradigms have reported an interaction between the cycles and their semantic content such that, there is an initial semantic facilitation effect in the first cycle, but a semantic interference effect in all the subsequent cycles (Rahman & Melinger, 2007). The data from a blocked naming task is typically not broken-down cycle by cycle, thereby indicating an overall interference effect. This is manifested as slower naming latencies in semantically related blocks as compared to semantically unrelated blocks (Belke, 2008).

Considering lexical selection by competition, it has been argued that the spreading activation for mental representations of lexical items within a related block would be more highly activated than for the representations of items within an unrelated block (Rahman & Melinger, 2007, 2011). Hence, this could be attributed to more vigorous competition for activation in homogenous than heterogenous sets.

Crowther and Martin (2014), conducted a study to explore the degree of semantic interference in a cyclic block naming task as a function of age, across younger (18-43) and older (45-80) age groups. Results revealed no main effect of age, indicating a similar performance in the naming task across the two age groups.

2.3.3.2 Studies supporting facilitation pattern

Taking into account the frequency effect, researchers have reported that the more frequently a lexical item is exposed to, the faster it is recognized. Studies have also suggested that longer decision times for low frequency lexical items result in their slower access as compared to high frequency items (Balota & Chumbley, 1984). This is based on the principle of least effort, which draws a relationship between frequency and probability of usage. It states that the participants always tend to choose the path with the least resistance (Zipf, 1949).

Ferrand, Grainger and Segui (1994), conducted a study employing a masked priming paradigm. A picture naming experiment was carried out with the primes being presented briefly enough to prevent prime identification. Results indicated that prior presentation of the same word prime facilitated picture naming, independent of the frequency of occurrence of the target.

With respect to relatedness, several researchers have reported that picture naming is facilitated if the item named on the trial previous to the current target is related rather than unrelated to the target item (Tydgat, Diependaele, Hartsuiker, & Pickering, 2012). The reaction time was reduced when the target word or a picture was preceded by a semantically related target than one that is unrelated to the target word. This occurs as a result of semantic priming (Meyer & Schvaneveldt, 1971; Swinney, 1979). This could be explained using Collins and Loftus's Spreading Activation Model (1975).

A study was conducted employing a simple naming paradigm using the 260-picture naming test (Alario, Ferrand, Laganaro, New, Frauenfelder & Segui, 2004). 46 University students were recruited for the study and were instructed to name the picture as it appeared on the screen. Results indicated that age of acquisition and frequency of usage of target both played an important role in determining ease of picture naming. The earlier the age of acquisition and the higher the frequency of usage, the easier the retrieval. They also found that concept familiarity however, did not play a significant role in influencing naming latencies.

To explore the possibility that lexical selection is not by competition, a study employing a picture-word interference paradigm was carried out (Mahon, Costa, Peterson, Vargas & Caramazza, 2007). Two experiments were conducted. Results revealed that in experiment one, shorter reaction times for targets (Ex. Bed) coupled with semantically related distractors (Ex. Sleep) than semantically unrelated distractors (Ex. Run). The second experiment revealed faster reaction times for within category, semantically close distractors (Zebra-Horse) than semantically far distractors (Zebra-whale).

Barry (2011) stated that repetition priming strengthened the connections between a target’s lemma and lexeme. Francis (2014), conducted a study to investigating repetition priming in picture naming tasks. Compilation of results indicated that repetition priming provided a facilitation effect to picture naming. Hence supporting the previous statement, she concluded that this phenomenon could be attributed to speeded completion of component processes of picture naming.

Python, Fargier and Laganaro (2018), conducted a study employing a picture word interference paradigm and event related potentials. Two types of semantic relationships were explored – categorical and associative, in a word priming and double word priming paradigm. Relatively late modulations of waveform amplitudes and shorter naming latencies was observed for both categorical and associative primes as compared to unrelated primes. Thus, indicative of a semantic facilitation effect for both priming conditions.

Navarrete, del Prato, Peressotti, and Mahon (2010, 2012) conducted a study employing a cyclic block naming paradigm. Upon analysis of results, the authors emphasized that first cycle of a cyclic naming task displays a facilitation effect even though an interference effect is observed in the subsequent cycles. Here, the highest activated word is selected and the time for this selection is not affected by the levels of activation of the nontarget words. They hence argued that this semantic interference in the subsequent blocks only emerges due to repetitions within the block and attributed it to a lower priming effect in related blocks than in unrelated blocks. The authors hypothesized that this resultant pattern was observed due to weaker repetition priming in homogenous sets than heterogenous sets and was not as a result of increased lexical competition. They further demonstrated that when homogenous sets were presented in alternate combination with unrelated sets and not immediately repeated, semantic relatedness induced a facilitation rather than an inhibition effect.

Another study carried out to explore patterns of activation involving employed cyclic and non-cyclic block naming paradigms (Navarrete et al.,2014). 20 participants were recruited for the study, and were instructed to name the pictures presented as quickly and as accurately as possible. 50 black and white photographs, belonging to 6 different categories were presented. Two experiments were carried out. The first was designed such that items did not repeat within the block and the second in which items occurred repeatedly within the same block. Semantically related and unrelated conditions were explored in both blocks. Results revealed that semantic facilitation was observed when items were not repeated within the same block.

Similar findings were replicated by Belke, Shao and Mayer (2017), where they postulated that there is a strategic origin to facilitation in the cyclic block naming paradigm. They found that it was easier for participants to name the items when the

sets/blocks were separated by pauses. This they claimed helped the participants appreciate the relatedness within some sets and predict the upcoming items using the same. This effect was observed to disappear with the elimination of pauses. The authors hence concluded that semantic facilitation does not form evidence against competitive theories of lexical selection but can be accounted for within any framework when the strategic influences are taken into consideration in a cyclic block naming paradigm.

A study was carried out by Eliza and Abhishek (2017), to investigate the pattern of lexical semantic activation in younger adults, by employing word-picture and picture-picture interference paradigms. 40 native Kannada speaking individuals were recruited for the study and were instructed to name the pictures presented in their native language. Primes and targets that were related and unrelated were randomized and presented. The study showed that facilitation was more evident compared to inhibition, possibly owing to the use of a priming paradigm. However, the cumulative effect was not studied. The incremental pattern was not taken into account. The study was done only on younger neuro-typical adults and lexical semantic activation was not studied as a function of age.

There hence exists a discrepancy in literature regarding the facilitatory and inhibitory patterns of lexical access for picture naming. This combined with the limited knowledge available regarding the trend in the activation patterns as a function of age, necessitates the present study.

CHAPTER III

METHOD

The present study was an attempt to investigate the pattern of lexical semantic activation in native Kannada speaking individuals as a function of age. Lexical semantic activation was studied across three age groups: younger adults (designated as Group 1), middle-aged adults (denoted as Group 2) and older adults (designated as Group 3). A block naming paradigm was designed and employed to facilitate the study of patterns of lexical semantic activation.

In order to obtain information regarding facilitation and inhibition, the block naming paradigm was further divided into six blocks: Taxonomically related block-containing items belonging to a particular category; Taxonomically unrelated block-containing items belonging to various different categories; Thematically related block-containing items pertatining to a particular theme; Thematically unrelated block-containing items that do not adhere to a particular theme; Two Mixed blocks were included - one containing items that were taxonomically related and unrelated and the other containing thematically related and unrelated items respectively.

All the stimulus items were subjected to a familiarity check. They were presented to three judges upon which they were classified as frequent and infrequent items. Each block comprised of both frequent and infrequent stimuli. Responses were measured in terms of reaction time and percentage of accuracy of responses.

2.1 Hypotheses

i. There is no statistical difference between the lexical semantic activation patterns, measured in terms of reaction time and accuracy scores across the three groups included in the study.

ii. (a) There is no statistical difference between the reaction time for the taxonomically related and taxonomically unrelated blocks in the block naming paradigm across the three groups included in the study.

(b) There is no statistical difference between the accuracy scores for the taxonomically related and taxonomically unrelated blocks in the block naming paradigm across the three groups included in the study.

iii. (a) There is no statistical difference between the Reaction time for the thematically related and thematically unrelated blocks in the block naming paradigm across the three groups included in the study.

(b) There is no statistical difference between the accuracy scores for the thematically related and thematically unrelated blocks in the block naming paradigm across the three groups included in the study.

iv. (a) There is no statistical difference between the reaction time for the Frequent and Infrequent stimuli in the block naming paradigms across the three groups included in the study.

(b) There is no statistical difference between the accuracy scores for the Frequent and Infrequent stimuli in the block naming paradigms across the three groups included in the study.

2.2 Design

The study employed a mixed-group repeated measure design.

2.3 Participants

Three groups of native Kannada speaking individuals were recruited for the study. Group 1 comprised of 'Younger adults' with participants aged between 18-25 years. Group 2 comprised of 'Middle-aged adults' with participants aged between 45-59 and Group 3 comprised of 'Older adults' with participants aged between 60-79 years (Forman, Berman, McCabes, Baim & Wei, 1992; as specified by the United Nations' guidelines, 2010). Each group comprised of 15 individuals. The study hence involved a sum total of 45 participants.

Owing to the sparsity of monolingual speakers, individuals having their second language as English were considered for the study. Individuals were screened using the "WHO ten Questionnaire", to eliminate the presence of any significant disability. Individuals with normal/corrected visual acuity and normal dexterity were considered for the study while those with any currently persisting or history of communicative, cognitive or psychological disorder were excluded from the study. All the participants had received a minimum education up to the higher secondary level. Informed consent was obtained prior to enrolment.

Table 3.1

Participants included for the study

Group	Sl.No.	Age/Gender	Qualification	Languages Known
Group 1	1.	23/F	Student	Kannada / English
	2.	22/F	Student	Kannada / English
	3.	18/F	Student	Kannada / English
	4.	20/F	Student	Kannada / English
	5.	18/M	Student	Kannada / English
	6.	20/F	Student	Kannada / English
	7.	19/F	Student	Kannada / English
	8.	21/M	Student	Kannada / English
	9.	18/M	Student	Kannada / English
	10.	20/M	Student	Kannada / English
	11.	21/F	Student	Kannada / English
	12.	24/F	Student	Kannada / English
	13.	18/M	Student	Kannada / English
	14.	25/M	Student	Kannada / English
	15.	19/M	Student	Kannada / English
Group 2	16.	47/F	Housewife	Kannada / English
	17.	54/F	Housewife	Kannada / English
	18.	45/F	Housewife	Kannada / English
	19.	47/F	Teacher	Kannada / English

	20.	45/F	Engineer	Kannada / English
	21.	55/F	Accountant	Kannada / English
	22.	46/F	Housewife	Kannada / English
	23.	59/F	Retired Banker	Kannada / English
	24.	58/M	Engineer	Kannada / English
	25.	48/M	Engineer	Kannada / English
	26.	45/M	Doctor	Kannada / English
	27.	51/M	Engineer	Kannada / English
	28.	59/M	Manager	Kannada / English
	29.	53/M	Engineer	Kannada / English
	30.	57/M	Banker	Kannada / English
Group 3	31.	79/F	Retired teacher	Kannada / English
	32.	61/F	Housewife	Kannada / English
	33.	62/F	Retired Engineer	Kannada / English
	34.	63/F	Housewife	Kannada / English
	35.	71/F	Housewife	Kannada / English
	36.	72/F	Housewife	Kannada / English
	37.	75/F	Retired Accountant	Kannada / English
	38.	68/F	Housewife	Kannada / English
	39.	79/M	Retired teacher	Kannada / English
	40.	69/M	Retired Engineer	Kannada / English
	41.	62/M	Retired Banker	Kannada / English
	42.	78/M	Retired Manager	Kannada / English
	43.	73/M	Retired Officer	Kannada / English
	44.	68/M	Retired Engineer	Kannada / English
	45.	67/M	Retired Engineer	Kannada / English

2.4 Stimulus

A total of 100 items were shortlisted from the 260-picture naming test given by Ahmed and Krishnan (2008), developed based on Snodgrass and Vanderwart's standardized 260-picture list (1980). These items were black and white line drawing

picture stimuli. In order to label pictures as ‘frequent and ‘infrequent’, these items were subjected to a familiarity check. Three judges were asked to label each item as ‘frequent’ or ‘infrequent’ and the inter-agreement between the judges was taken into consideration.

The shortlisted 100 items were further classified into taxonomic and thematic domains, with 40 items in each section. The taxonomically related block included items belonging to the categories of ‘animals’ and ‘objects’. The thematic block included items pertaining to the theme ‘size’ - ‘big’ and ‘small’. The taxonomically and thematically unrelated blocks, on the other hand, included items pertaining to various different categories and themes respectively. Each of the two mixed blocks included a total of 10 items each. These were taxonomically (related and unrelated) and thematically (related and unrelated) items respectively.

Each related block comprised of two categories/themes having 10 items each. These items were further divided as frequent (5) and infrequent (5) picture stimuli. For each of the two categories/themes in the blocks, the first five items presented were ‘frequent’ and the next five items presented were ‘infrequent’ picture stimuli. The two unrelated blocks comprised of the first 10 items as ‘frequent’ and the next 10 items as ‘infrequent’ picture stimuli each.

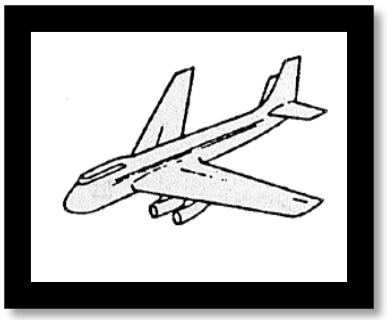

Figure 3.1: An example of the Line drawing picture stimulus with a white background

Table 3.2

Stimulus list (100 items)

BLOCKS			FREQUENT (F)	INFREQUENT (IF)
Block 1	Taxonomically Related (20 Items)	Animals	Dog, Cat, Elephant, Cow, Fish	Squirrel, Rhino, Leopard, Camel, Fox
		Objects	Book, Clock, Cup, Apple, Doll	Needle, Saw, Hammer, Axe, Button
Block 2	Taxonomically Unrelated (20 Items)		Dog, Book, House, Comb, Sun, Shirt, Apple, Ear, Hen, Potato	Raddish, Lobster, Truck, Spider, Bell, Table, Flag, Watermelon, Star, Cannon
Block 3	Thematically Related (20 Items) (*Size)*	Big	Airplane, Elephant, House, Table, Mountain	Crocodile, Fridge, Window, Well, Pumpkin
		Small	Ant, Ear, Flower, Key, Ring	Fly, Clip, Ring, Caterpillar, Knob
Block 4	Thematically Unrelated (20 Items)-*(Shape)*		Banana, Table, Pencil, Hill, Book, Apple, Kite, Wheel, Doll, Cup	Pear, Eagle, Swan, Heart, Trumpet, Bear, Finger, Capsicum, Flag, Iron box
Block 5	Mixed Block (10 Items)	Taxonomic	Dog, Ear, Flower, Key, Ring	Well, Hammer, Button, Turtle, Window
Block 6	Mixed Block (10 Items)	Thematic	Apple, Clock, Cow, Fish, Doll	Saw, Ring, Top, Squirrel, Watermelon

2.5 Instruction

Each participant was instructed in either Kannada or English depending on their language of preference.

Instructions in English was provided as follows:

‘On the computer screen in front of you, you will be seeing some pictures appearing one after the other. First, there will be an “XXX” mark, followed by a set of pictures. Please look at each picture that is displayed and name it in your native language. Please name the pictures as quickly as possible’

Instructions in Kannada was provided as follows:

/nimma/ /munde/ /iruva/ /computer/ /paradenalli/ /chitragalu/ /ondu/ /admele/ /ondu/ /baruvuthadde/. /modalu/ /ondu/ ‘XXX’ /chinhe/ /kanisuthade/. /neevu/ /adara/ /nanthara/ /baruva/ /prathi/ /ondu/ /chithravannu/ /nodi/, /kannadadalli/ /hesarisabeku/.

2.6 Instrumentation

The testing was carried out in a well light, relatively silent environment. The stimuli were displayed on a Dell Inspiron laptop with a 15-inch display screen, placed at a distance of about two feet from the participant. The ‘DMDX’ software was employed in order to program and present the picture stimuli for the study. The verbal responses of the participants along with the voice reaction times were recorded and analysed using check vocal, an allied software to DMDX (5.0).

2.7 Procedure

The naming paradigm was divided into six blocks such that: ‘Block 1’ contained taxonomically related items, i.e. items belonging to a particular category. ‘Block 2’ contained taxonomically unrelated items, i.e. items belonging to various different categories. ‘Block 3’ contained thematically related items, i.e. items pertaining to a particular subject or theme. ‘Block 4’ contained thematically unrelated items, i.e. items pertaining to various different subjects or themes. ‘Block 5’ was a mixed block containing taxonomically related and unrelated items, and ‘Block 6’ was another mixed block containing thematically related and unrelated items.

Each of the blocks comprised of 10 frequent and 10 infrequent items, with a total of 20 items in each block. The six blocks were presented in a randomized order and the items in each block were in turn presented in a randomized order within that particular block.

The participant was instructed to press the spacebar to commence the task. A vigilant stimulus "XXX" was presented at the beginning of each block for a duration of 500 milliseconds, before the presentation of the first target item (picture) to be named in that block.

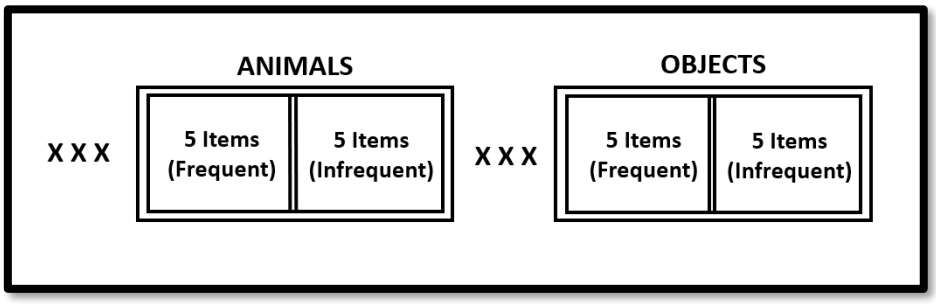

Figure 3.2: Schematic representation of Block 1

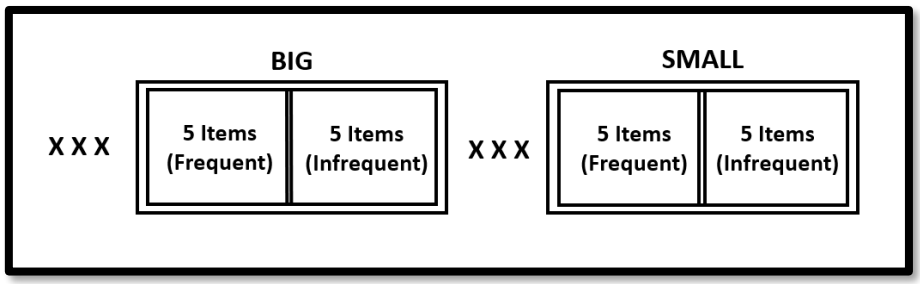

Figure 3.3: Schematic representation of Block 3

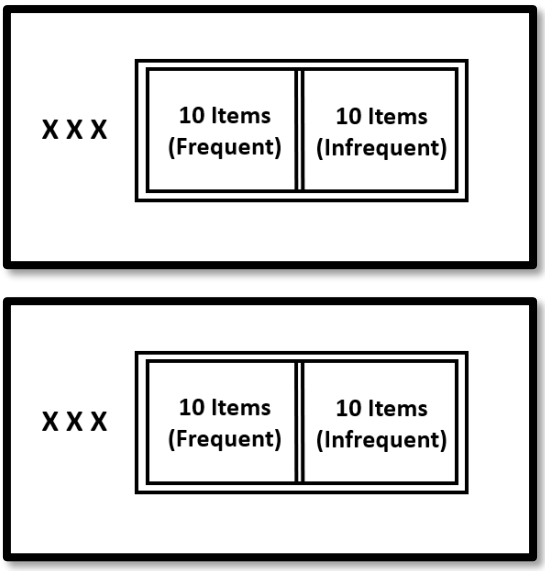

Figure 3.4: Schematic representation of Block 2 and 4

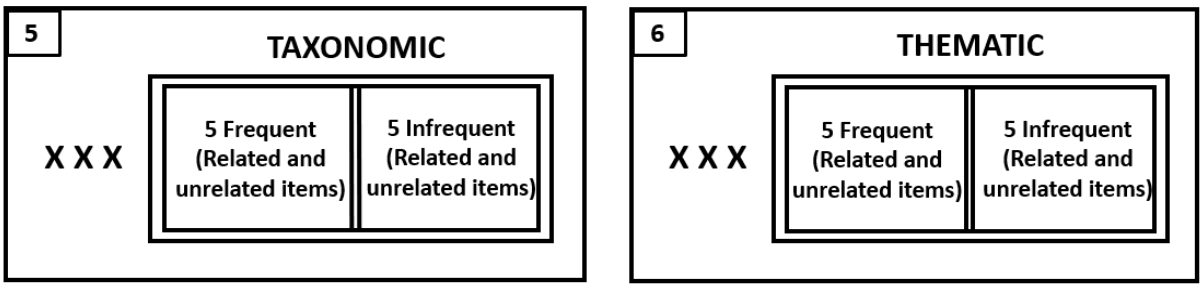

Figure 3.5: Schematic representation of Block 5 and Block 6 respectively

Each target item was presented for a duration of 1600 milliseconds (Campanella and Shallice, 2011), after which, the participant was given another maximum duration of 3000 milliseconds to name the target item presented. Once the participant successfully attempted to name or failed to name the current target item, the next target item was presented automatically. This was after 3000 milliseconds following the offset of the target item (Froster & Froster, 2003).

The participants' verbal responses were recorded for accuracy measures and the time between the onset of the stimulus and the onset of the correct response was recorded as the reaction time for each item. Incorrect responses were discarded for reaction time measures.

2.8 Analysis

Reaction Time and Accuracy measures were analysed employing appropriate statistical analyses to study the pattern of lexical semantic activation.

i. Reaction time (RT) and Accuracy scores (AS) were analyzed across each of the three groups included in the study, in order to investigate the pattern of lexical semantic activation as a function of age.

ii. (a) Reaction time was analyzed for the taxonomically related (TAR) and taxonomically unrelated (TAUR) stimuli in the block naming paradigm across the three groups included in the study.

(b) Accuracy scores were assessed for the taxonomically related (TAR) and taxonomically unrelated (TAUR) stimuli in the block naming paradigm across the three groups included in the study.

iii. (a) Reaction time was analyzed for the thematically related (THR) and thematically unrelated (THUR) stimuli in the block naming paradigm across the three groups included in the study.

(b) Accuracy scores were assessed for the thematically related (THR) and thematically unrelated (THUR) stimuli in the block naming paradigm across the three groups included in the study.

iv. (a) Reaction time was analyzed for the frequent and infrequent stimuli in the block naming paradigms across the three groups included in the study.

(b) Accuracy scores were assessed for the frequent and infrequent stimuli in the block naming paradigms across the three groups included in the study.

v. Reaction time for the first four stimuli was compared against the for the last four stimuli, in order to track incremental learning.

Please Note the List of Abbreviations Used:

TAR : Taxonomically related

TAUR : Taxonomically unrelated

THR : Thematically related

THUR : Thematically unrelated

TAM : (Taxonomically) Mixed

THM : (Thematically) Mixed

RT : Reaction Time

AS : Accuracy scores

CHAPTER 1V

RESULTS AND DISCUSSION

The present study aimed to understand the pattern of lexical semantic activation as a function of age. Literature has indicated that either a shortening or delay of naming latencies when a target in preceded by a related or unrelated item. This boost in naming latencies is termed as a facilitation effect. The delay in naming latencies is termed as an inhibitory effect. Various paradigms have been employed to investigate these effects. However, there is no consciences in literature regarding the pattern of activation elicited by presenting either related or unrelated items preceding the target item.

A total of 45 native Kannada speaking neurotypical adults served as participants. The participants were further divided into three groups: Group 1 (younger adults aged 18-25 years), Group 2 (middle aged adults, aged 45-55 years) and Group 3 (older adults aged 60-79 years). Thus, each group constituted of 15 individuals.

Lexical semantic activation was tapped through blocked naming paradigm. The black and white picture stimuli were sorted into 6 blocks: Taxonomically related (frequent and infrequent), taxonomically unrelated (frequent and infrequent), thematically related (frequent and infrequent), thematically unrelated (frequent and infrequent), taxonomically and thematically mixed blocks.

The taxonomically and thematically related blocks contained items belonging to the same category or theme respectively. The unrelated blocks contained items belonging to various different categories or themes. These blocks had items of either frequent or infrequent occurrence. The mixed block on the other hand, had items both related and unrelated items and comprised of both frequent and infrequent stimuli.

The picture stimuli were programmed using the DMDX 5.0 version software and were presented on a laptop screen of 15.6 inches. The participants were instructed to name the picture stimuli presented to them as fast and as accurately as possible. The verbal audio responses were recorded using the Check vocal software.

The independent variables taken into consideration were: The age of the participant, the classification of the block as taxonomic or thematic, the frequency of occurrence and the relatedness of the stimuli. The dependent variables taken into consideration were reaction time, measured in milliseconds and the accuracy of the responses, measured in percentage. The data obtained was subjected to statistical analysis employing the Statistical Package for social sciences (SPSS) software version 21.0.

The objectives of the study were as follows:

1. To compare the performance (in terms of reaction time and accuracy) of younger adults with middle-aged adults and older adults.
2. To compare the reaction time and accuracy scores for the pattern of activation for semantically related and unrelated frequent and infrequent blocks.
3. To compare the reaction time and accuracy scores for the pattern of activation for thematically related and unrelated frequent and infrequent blocks.

Objective 1

To compare the performance in terms of reaction time (RT) and accuracy scores (AS) of younger adults with middle-aged adults and older adults.

Hypothesis: There is no statistical difference between the lexical semantic activation patterns, measured in terms of reaction time (RT) and accuracy scores (AS) across the three groups included in the study.

The hypothesis is set to investigate the changes in reaction time (ms) and accuracy scores (%) across the three age groups. This is examined considering three aspects: The frequency of the stimulus (frequent and infrequent); The condition applied in terms of relatedness (related or unrelated) and the classification of the blocks (taxonomic or thematically related).

In order to verify the hypothesis, the mean and standard deviation measures for the above-mentioned stimulus variants were compiled. This was done for each of the three groups included in the study.

Table 4.1

Reaction time and accuracy results obtained for Taxonomic Blocks

BLOCKS		GROUP 1		GROUP 2		GROUP 3	
		RT (ms)	AS (%)	RT (ms)	AS (%)	RT (ms)	AS (%)
TARF	Mean	920.20	100	958.74	98.66	1007.80	93.33
	SD	86.20	0.0	117.67	5.16	99.60	10.46
TARIF	Mean	1449.41	93.33	1643.91	91.33	1798.51	73.33
	SD	238.65	11.62	164.04	12.20	213.90	19.88
TAURF	Mean	939.19	100	997.48	98.66	1040.01	86.66
	SD	102.60	0.0	159.14	3.51	134.28	9.75
TAURIF	Mean	1478.44	87.33	1561.25	89.33	1773.77	71.33
	SD	221.67	8.16	267.92	8.33	294.13	15.52

Note:

TARF: Taxonomically related frequent TAURF: Taxonomically unrelated frequent

TARIF: Taxonomically related infrequent TAURIF: Taxonomically unrelated infrequent

Table 4.2

Reaction time and accuracy results obtained for Thematic Blocks

BLOCKS		GROUP 1		GROUP 2		GROUP 3	
		RT (ms)	AS (%)	RT (ms)	AS (%)	RT (ms)	AS (%)
THRF	Mean	979.65	100	1004.32	99.33	1089.58	90.66
	SD	45.96	0.0	120.34	2.58	135.52	9.61
THRIF	Mean	1649.28	93.33	1719.80	84.66	1903.86	67.33
	SD	174.94	10.0	160.85	9.15	382.37	12.45
THURF	Mean	1014.02	96.66	1052.57	98.66	1097.41	87.33
	SD	125.21	4.80	102.63	3.51	151.91	10.32
THURIF	Mean	1586.29	88.00	1649.50	84.00	1855.70	64.66
	SD	153.61	10.14	178.31	11.83	259.84	15.33

Note:

THRF: Thematically related frequent THURF: Thematically unrelated frequent

THRIF: Thematically related infrequent THURIF: Thematically unrelated infrequent

As shown, by Table 4.1 and Table 4.2, better reaction times and accuracy scores were obtained by Group 1 (younger individuals) followed by group 2 (middle aged individuals) and hence by Group 3 (older individuals). This trend was seen for all the parameters except one (accuracy scores for taxonomic unrelated infrequent stimulus was better for group 2 than group 1). Hence, an overall better performance was exhibited by Group 1 for all the tasks.

Also, better reaction times and accuracy scores were observed for the frequent (920.20-1097.41ms) than infrequent (1449.41-1855.70ms) and for related (920.20-1903.86ms) than unrelated (939.19-1855.70ms) parameters for all three groups. Participants across all three groups performed better for taxonomic (920.20-1798.51ms) than thematic (979.65-1903.86ms) blocks. Hence, the trend for lexical semantic activation was observed to be similar in each of the three groups included in the study.

In order to verify any significant difference in the performance across the three groups, statistical analysis was carried out. The data was first subjected to Shapiro Wilks test for normality. The results revealed that the data follows normal distribution for reaction time measures ($p>0.05$) but not for accuracy measures ($p<0.05$).

Therefore, a parametric Mixed ANOVA was carried out for the reaction time measures to check for the main effect of task (taxonomic or thematic), frequency (frequent or infrequent), condition (related or unrelated) and group (group 1, group 2 and group 3). Also, the interaction effects between the following were checked for: group and frequency, group and task, group and condition, task and frequency, task and condition, condition and frequency. The results revealed a Main effect for group and frequency ($p<0.05$). Also, a positive interaction effect between the frequency and group and the condition and frequency parameters was found to be present.

As a main effect of group was observed, MANOVA was carried out to check for the effect of group in all the tasks. Results revealed a significant difference ($p<0.05$) between the performance of Group 1 and Group 3, Group 2 and Group 3 but not Group 1 and Group 2.

As the data for accuracy scores did not satisfy the criteria for normal distribution, a non-parametric Kruskal Wallis test was carried out to check for the group effect on accuracy scores for the tasks (Refer table 4.3). As a significant difference ($p<0.05$) was observed, Man Whitney U test was carried out for pairwise comparisons of the three groups. Results revealed a similar trend to the reaction time measures. A significant difference ($p<0.05$) was observed between the performance of Group 1 ($|Z|$ scores ranging from -0.7 to -1.2) and Group 3, Group 2 ($|Z|$ scores ranging from -1.6 to -3.9) and Group 3 ($|Z|$ scores ranging from -1.7 to -3.8) but not Group 1 and Group 2. Hence, it can be concluded that Group 1 and Group 2 performed significantly better than Group 3 for all the parameters taken into consideration. However, no significant difference was obtained between the performances of Group 1 and Group 2.

Table 4.3

Chi-square and p-values of Kruskal Wallis test for accuracy scores

	Blocks	Chi-Square	df	p
1.	TARF	23.73	2	0.00*
2.	TARIF	6.73	2	0.35*
3.	TAURF	8.73	2	0.13*
4.	TAURIF	18.57	2	0.00*
5.	THRF	25.07	2	0.00*
6.	THRIF	22.94	2	0.00*
7.	THURF	7.05	2	0.02*
8.	THURIF	13.50	2	0.01*

*Significant difference

In summary, taking into account the reaction time and accuracy score measures, it can be concluded that group 1 and 2 performed significantly better than group 3 for all the parameters taken into consideration. Hence, the hypothesis for objective 1, stating that there is no statistical difference between the lexical semantic activation patterns, measured in terms of reaction time and accuracy scores across the three groups included in the study, may be rejected.

Objective 2

Comparison of the reaction time (RT) and accuracy scores (AS) for the pattern of activation for taxonomically related and unrelated frequent and infrequent blocks, for the three age groups.

Hypothesis: (a) There is no statistical difference between the reaction time (RT) for the taxonomically related (TAR) and taxonomically unrelated (TAUR) blocks in the block naming paradigm across the three groups included in the study.

(b) There is no statistical difference between the accuracy scores (AS) for the taxonomically related (TAR) and taxonomically unrelated (TAUR) blocks in the block naming paradigm across the three groups included in the study.

The hypothesis is set to understand the differences in reaction time (ms) and accuracy scores (%) compared across two frequencies (frequent and infrequent) and two conditions (related and unrelated) for taxonomic blocks. These differences can be indicative of a facilitatory or inhibitory pattern of lexical semantic activation.

In order to verify the hypothesis, the descriptive values were computed for the performance on the frequent and infrequent counterparts: (Taxonomically Related Frequent (TARF), Taxonomically Unrelated Frequent (TAURF), Taxonomically Related Infrequent (TARIF) and Taxonomically Unrelated Infrequent (TAURIF) conditions). The overall mean and standard deviation measures were calculated.

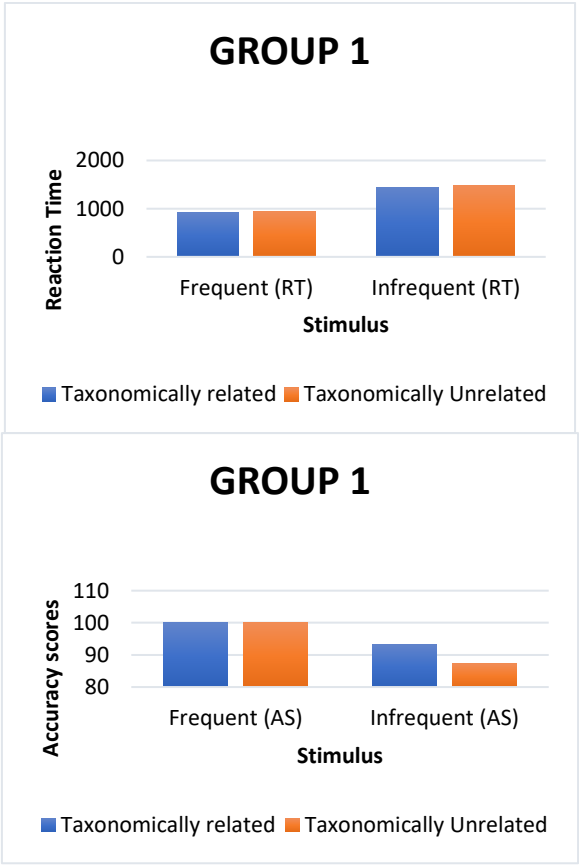

Figure 4.1: Reaction time and accuracy score results for Group 1

As indicated by Table 4.1 and Figure 4.1, for group 1, the mean reaction times were shorter for Taxonomically Related Frequent items (Mean=920.20) than for Taxonomically Related Infrequent items (Mean=1449.41).

Similarly, the mean reaction times were shorter for Taxonomically Unrelated Frequent items (Mean=939.19) than for Taxonomically Unrelated Infrequent items (Mean=1578.44).

Considering the conditions, the mean reaction times for group 1, were shorter for Taxonomically Related Frequent items (Mean=920.20) than for Taxonomically Unrelated Frequent items (Mean=939.19). A similar trend was followed, wherein the mean reaction times were shorter for Taxonomically Related Infrequent items (Mean=1449.41) than for Taxonomically Unrelated Infrequent items (Mean=1578.44).

Apart from the reaction time, accuracy measures were also taken into consideration. For group 1, the accuracy scores for Taxonomically Related Frequent items (Mean=100) were better than that of Taxonomically Related Infrequent items (Mean=93.33). Also, the accuracy scores for Taxonomically Unrelated Frequent items (Mean=100) were higher than that of Taxonomically Unrelated Infrequent items (Mean=87.33).

Examining the conditions, the accuracy scores for group 1 were found be to equal for both Taxonomically Related and Unrelated Frequent conditions (Mean=100). However, the accuracy scores were higher for Taxonomically Related Infrequent items (Mean=93.33) than for Taxonomically Unrelated Infrequent items (Mean=87.33).

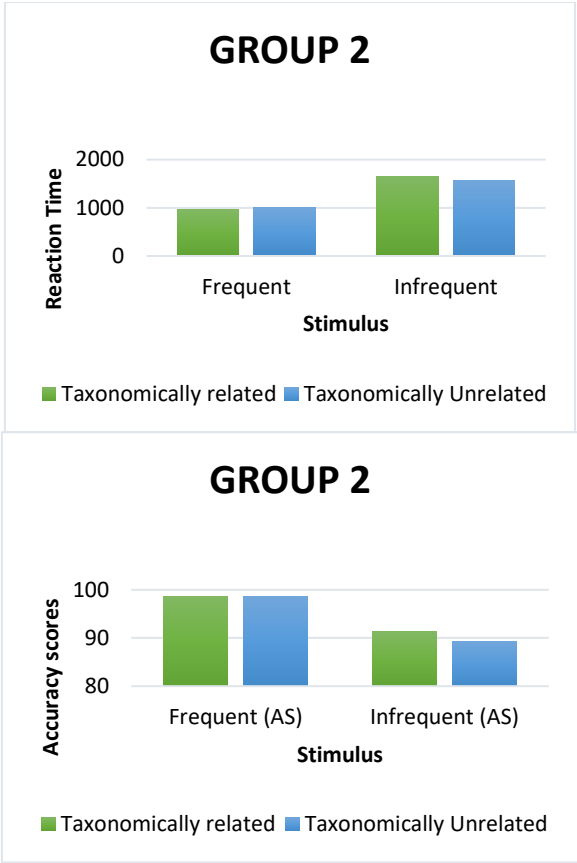

Figure 4.2: Reaction time and accuracy score results for Group 2

As depicted by Table 4.1 and Figure 4.2, for group 2, the mean reaction times were found to be shorter for Taxonomically Related Frequent items (Mean=958.74) than for Taxonomically Related Infrequent items (Mean=1643.91). Similarly, the mean reaction times were shorter for Taxonomically Unrelated Frequent items (Mean=997.48) than Taxonomically Unrelated Infrequent items (Mean=1561.25).

Taking into account the conditions, the mean reaction times for group 2, were shorter for Taxonomically Related Frequent items (Mean=958.74) than for Taxonomically Unrelated Frequent items (Mean=997.48). The mean reaction times were also found to be shorter for Taxonomically Related Infrequent items (Mean=1643.91) than for Taxonomically Unrelated Infrequent items (Mean=1561.25).

Similarly, the accuracy scores for group 2 were higher for Taxonomically Related Frequent items (Mean=98.66) than for Taxonomically Related Infrequent items (Mean=91.33). Likewise, the accuracy scores for Taxonomically Unrelated Frequent

items (Mean=98.66) were higher than that of Taxonomically Unrelated Infrequent items (Mean=89.33).

Considering the conditions, the accuracy scores for group 2 were found be to equal for both Taxonomically Related and Unrelated Frequent conditions (Mean=98.66). However, the accuracy scores were higher for Taxonomically Related Infrequent items (Mean=91.33) than for Taxonomically Unrelated Infrequent items (Mean=89.33).

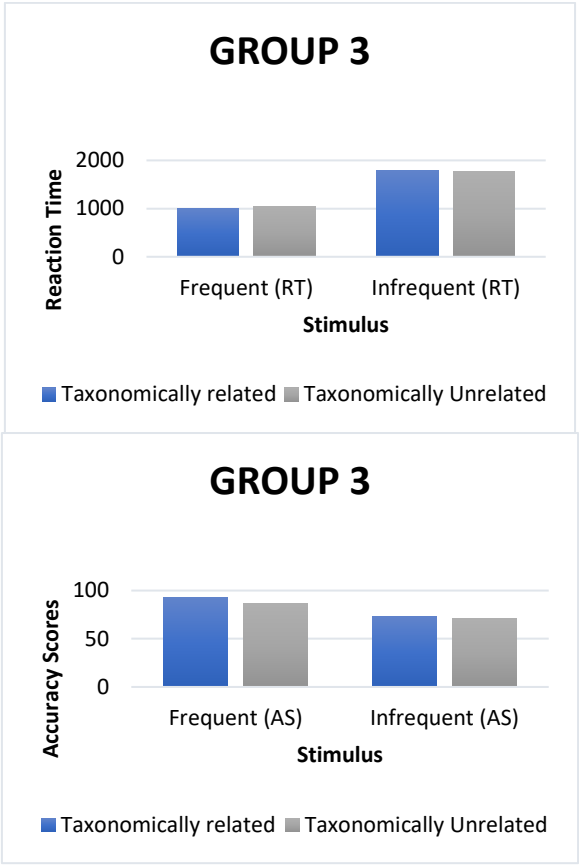

Figure 4.3: Reaction time and accuracy score results for Group 3

As indicated by Table 4.1 and Figure 4.3, for group 3, the mean reaction times were found to be shorter for Taxonomically Related Frequent items (Mean=1007.80) than for Taxonomically Related Infrequent items (Mean=1773.77). Likewise, the mean reaction times were shorter for Taxonomically Unrelated Frequent items (Mean=1040.01) than Taxonomically Unrelated Infrequent items (Mean=1798.51).

Considering the conditions, the mean reaction times for group 3, were shorter for Taxonomically Related Frequent items (Mean=1007.80) than for Taxonomically Unrelated Frequent items (Mean=1040.01). A similar trend was followed, wherein the mean reaction times were shorter for Taxonomically Related Infrequent items (Mean=1773.77) than for Taxonomically Unrelated Infrequent items (Mean=1798.51).

The accuracy scores for group 3 were also observed to be better for Taxonomically Related Frequent items (Mean=93.33) than for Taxonomically Related Infrequent items (Mean=73.33). Similarly, the accuracy scores for Taxonomically Unrelated Frequent items (Mean=86.66) were higher than that of Taxonomically Unrelated Infrequent items (Mean=71.33).

Taking into account the conditions, the accuracy scores for group 3 were found to be better for Taxonomically Related Frequent (Mean=93.33) than Unrelated Frequent conditions (Mean=86.66). A similar trend was followed wherein, the accuracy scores were higher for Taxonomically Related Infrequent items (Mean=86.66) than for Taxonomically Unrelated Infrequent items (Mean=71.33).

In summary, in the taxonomic blocks, participants from all three groups performed better for frequent than infrequent stimuli and better for related than unrelated conditions.

As there was an interaction effect observed between condition and frequency, the data for Reaction Time measures was subjected to a Paired sample t-test. Pairwise significant difference of condition and frequency was verified. Bonferrine alpha corrected significant values (alpha=0.0125) were used. As the data for accuracy scores did not follow normal distribution, the data was subjected to Wilcoxon Signed Ranks test. Results revealed the following outcome (Table 4.4).

Table 4.4

Pairwise comparisons of the Reaction times and Accuracy scores for the condition and frequency parameters for the taxonomic blocks

Groups	**Comparison**			**t**	**df**	**P**	**|z|**	**P**
				Reaction Time			**Accuracy Scores**	
Group 1	TRF	&	TRIF	-10.08	14	0.00*	-2.83	0.005*
	TURF	&	TURIF	-14.17	14	0.00*	-2.82	0.005*
	TRF	&	TURF	-0.562	14	0.583	0.00	1.000
	TRIF	&	TURIF	-0.413	14	0.686	-1.55	1.200
Group 2	TRF	&	TRIF	-18.58	14	0.00*	-2.81	0.004*
	TURF	&	TURIF	-12.67	14	0.00*	-2.88	0.003*
	TRF	&	TURF	-1.146	14	0.271	0.00	1.000
	TRIF	&	TURIF	1.197	14	0.251	-0.60	0.546
Group 3	TRF	&	TRIF	-16.45	14	0.00*	-2.74	0.004*
	TURF	&	TURIF	-13.93	14	0.00*	-3.44	0.003*
	TRF	&	TURF	-1.092	14	0.293	-1.97	0.048
	TRIF	&	TURIF	0.374	14	0.714	-0.55	0.581

*Significant difference

In summary, a significant difference was observed only for the frequency and not the relatedness parameters for the taxonomic blocks. Hence, the hypothesis for objective 2, stating that there is no statistical difference in the reaction time and accuracy scores for taxonomically related and taxonomically unrelated blocks across the three groups included in the study, may be accepted.

Objective 3

Comparison of the reaction time (RT) and accuracy scores (AS) for the pattern of activation for thematically related and unrelated frequent and infrequent blocks, for the three age groups.

Hypothesis: (a) There is no statistical difference between the Reaction time (RT) for the thematically related (THR) and thematically unrelated (THUR) blocks in the block naming paradigm across the three groups included in the study.

(b) There is no statistical difference between the accuracy scores (AS) for the thematically related (THR) and thematically unrelated (THUR) blocks in the block naming paradigm across the three groups included in the study.

The hypothesis is set to understand the differences in facilitatory or inhibitory patterns of lexical semantic activation for naming of thematic blocks. This was done by comparing the differences in mean reaction time (ms) and accuracy scores (%) across two frequencies (frequent and infrequent) and two conditions (related and unrelated).

In order to verify the hypothesis, the overall mean and standard deviation measures were computed for the performance on the frequent and infrequent counterparts: (Thematically Related Frequent (THRF), Thematically Unrelated Frequent (THURF), Thematically Related Infrequent (THRIF) and Thematically Unelated Infrequent (THURIF) conditions).

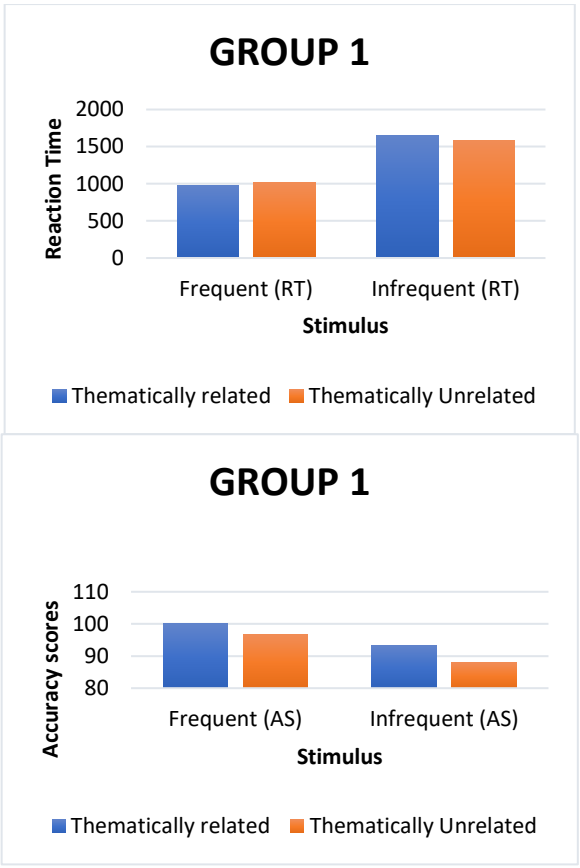

Figure 4.4: Reaction time and accuracy score results for Group 1

As indicated by Table 4.2 and Figure 4.4, for group 1, the mean reaction times were shorter for Thematically Related Frequent items (Mean=979.65) than for Thematically Related Infrequent items (Mean=1649.28). Similarly, the mean reaction times were shorter for Thematically Unrelated Frequent items (Mean=1014.02) than Thematically Unrelated Infrequent items (Mean=1586.29).

Taking into account the conditions, the mean reaction times for group 1, were shorter for Thematically Related Frequent items (Mean=979.65) than for Thematically Unrelated Frequent items (Mean=1014.02). However, the mean reaction times were longer for Thematically Related Infrequent items (Mean=1649.28) than for Thematically Unrelated Infrequent items (Mean=1586.29).

Considering the accuracy measures, for group 1, the accuracy scores for Thematically Related Frequent items (Mean=100) were better than that of Thematically Related Infrequent items (Mean=93.33). Also, the accuracy scores for Thematically Unrelated

Frequent items (Mean=96.66) were higher than that of Thematically Unrelated Infrequent items (Mean=88.00).

Examining the conditions, the accuracy scores for group 1 were found to be higher for Thematically Related Frequent (Mean=100) than for Thematically Unrelated Frequent conditions (Mean=96.66). The accuracy scores were also found to be higher for Taxonomically Related Infrequent items (Mean=93.33) than for Thematically Unrelated Infrequent items (Mean=88.00).

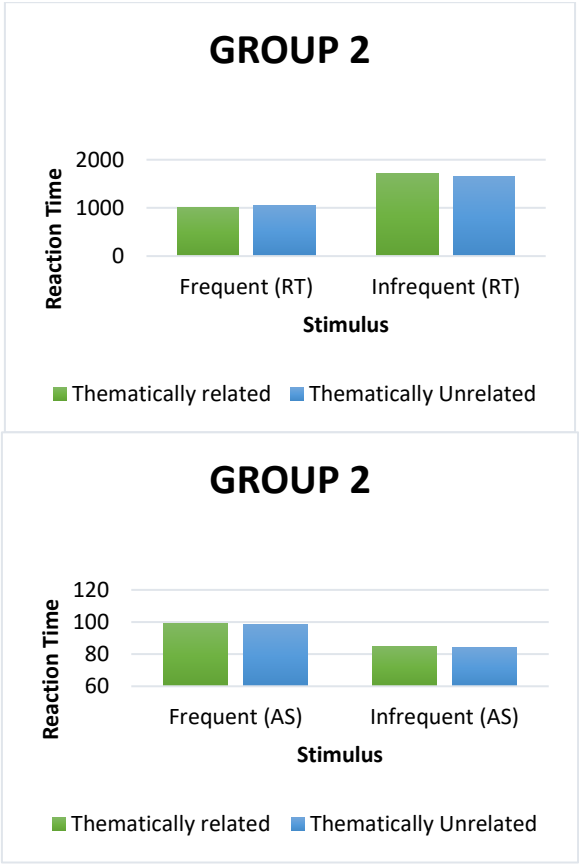

Figure 4.5: Reaction time and accuracy score results for Group 2

As depicted by Table 4.2 and Figure 4.5, for group 2, the mean reaction times were found to be shorter for Thematically Related Frequent items (Mean=1004.32) than for Thematically Related Infrequent items (Mean=1719.80). Similarly, the mean reaction times were shorter for Thematically Unrelated Frequent items (Mean=1052.57) than for Thematically Unrelated Infrequent items (Mean=1649.50).

Taking into account the conditions, the mean reaction times for group 2, were shorter for Thematically Related Frequent items (Mean=1004.32) than for Thematically Unrelated Frequent items (Mean=1052.57). The mean reaction times were however found to be longer for Thematically Related Infrequent items (Mean=1719.80) than for Thematically Unrelated Infrequent items (Mean=1649.50).

Taking into account the accuracy scores for group 2, they were found to be higher for Thematically Related Frequent items (Mean=99.33) than for Thematically Related Infrequent items (Mean=84.66). Likewise, the accuracy scores for Thematically Unrelated Frequent items (Mean=98.66) were higher than that of Thematically Unrelated Infrequent items (Mean=84.00).

Considering the conditions, the accuracy scores for group 2 were found to be higher for Thematically Related Frequent (Mean=99.33) than for Thematically Unrelated Frequent conditions (Mean=98.66). The accuracy scores were also found to be slightly higher for Thematically Related Infrequent items (Mean=84.66) than for Thematically Unrelated Infrequent items (Mean=84.00).

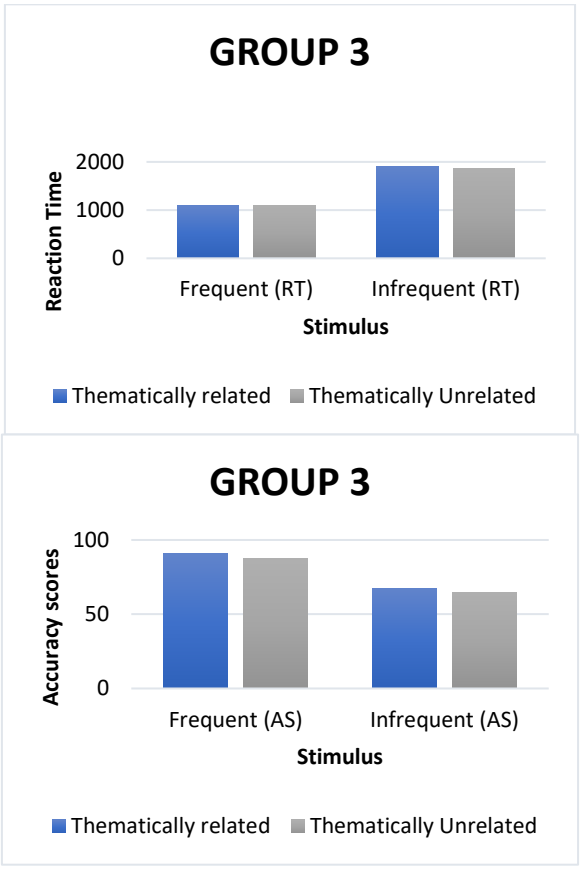

Figure 4.6: Reaction time and accuracy score results for Group 3

As indicated by Table 4.2 and Figure 4.6, the mean reaction times were found to be shorter for Thematically Related Frequent items (Mean=1089.58) than for Thematically Related Infrequent items (Mean=1903.86). Likewise, the mean reaction times were shorter for Thematically Unrelated Frequent items (Mean=1097.41) than Thematically Unrelated Infrequent items (Mean=1855.70).

Considering the conditions, the mean reaction times for group 3, were shorter for Thematically Related Frequent items (Mean=1089.58) than for Thematically Unrelated Frequent items (Mean=1097.41). However, the mean reaction times were longer for Thematically Related Infrequent items (Mean=1903.86) than for Thematically Unrelated Infrequent items (Mean=1855.70).

Taking into account the accuracy scores for group 3, they were also observed to be better for Thematically Related Frequent items (Mean=90.66) than for Thematically Related Infrequent items (Mean=67.33). Similarly, the accuracy scores for Thematically Unrelated Frequent items (Mean=87.33) were higher than that of Thematically Unrelated Infrequent items (Mean=64.66).

Taking into account the conditions, the accuracy scores for group 3 were found to be better for Thematically Related Frequent (Mean=90.66) than Thematically Unrelated Frequent conditions (Mean=87.33). A similar trend was followed wherein, the accuracy scores were higher for Thematically Related Infrequent items (Mean=67.33) than for Thematically Unrelated Infrequent items (Mean=64.66).

In summary, participants from all three groups performed better for frequent than infrequent stimuli. Shorter reaction times were obtained for related than unrelated frequent conditions. However, a better performance was observed for unrelated than related infrequent conditions for the Thematic blocks in terms of reaction times. Taking into account the accuracy scores, participants from all three groups performed better for frequent than infrequent stimuli and better for related than unrelated conditions in the Thematic blocks.

As there was an interaction effect observed between condition and frequency, the data was subjected to a Paired sample t-test. Pairwise significant difference of condition and frequency was verified. Bonferrine alpha corrected significant values (alpha=0.0125) were used. As the data for accuracy scores did not follow normal distribution, the data was subjected to Wilcoxon Signed Rank test. Results were indicative of the following (Table 4.5):

Table 4.5

Pairwise comparisons of the Reaction times and Accuracy scores for the condition and frequency parameters for the thematic blocks

Groups	**Comparison**			**t**	**df**	**P**	**|z|**	**P**
				Reaction Time			**Accuracy Scores**	
Group 1	TRF	&	TRIF	-15.48	14	0.00*	-2.91	0.004*
	TURF	&	TURIF	-20.68	14	0.00*	-2.91	0.004*
	TRF	&	TURF	-1.04	14	0.313	-2.23	0.025
	TRIF	&	TURIF	0.94	14	0.363	-0.55	0.580
Group 2	TRF	&	TRIF	-24.47	14	0.00*	-3.11	0.004*
	TURF	&	TURIF	-20.67	14	0.00*	-2.96	0.003*
	TRF	&	TURF	-2.82	14	0.013	-0.57	0.564
	TRIF	&	TURIF	1.72	14	0.106	-0.12	0.903
Group 3	TRF	&	TRIF	-09.74	14	0.00*	-3.32	0.001*
	TURF	&	TURIF	-18.87	14	0.00*	-3.40	0.001*
	TRF	&	TURF	-0.319	14	0.754	-1.50	0.048
	TRIF	&	TURIF	0.407	14	0.690	-6.80	0.581

*Significant difference

In summary, similar to the taxonomic blocks, a significant difference was also observed only for the frequency and not the relatedness parameter for the thematic blocks. Hence, the hypothesis for objective 3, stating that there is no statistical difference in the reaction time and accuracy scores for thematically related and thematically unrelated blocks across the three groups included in the study, may be accepted.

As discussed above, the facilitation effect was seen for the frequent items as compared to the infrequent items. This effect was equally observed for both thematic and taxonomic conditions and for both related and unrelated conditions. It was also observed across all the three age groups included in the study. This finding showed that the frequency of the stimulus will have a more important role in predicting the pattern of activation in neurotypical individuals, irrespective of age. This finding is supported by a number of studies in literature, employing both priming (Brown, 1998; Alario et al., 2004; Eliza & Abhishek, 2017) and cyclic block naming paradigms (Navarrete et al., 2010, 2012).

Statistically no significant difference was observed for the related conditions and unrelated conditions. This holds good for both taxonomic and thematic blocks. Therefore, the pattern of activation for neurotypical individuals did not show a significant facilitation nor inhibition effect as a function of relatedness. This observation was consistent across all three age groups. There is strong evidence indicated by priming studies for the relatedness of the stimuli inducing a facilitatory effect (Swinney, 1979; Caramazza et al., 2007; Francis, 2014; Python et al., 2018). However, this facilitation effect was found to be eliminated in the block naming paradigm. Considering relatedness, the block naming paradigm would give a neutral pattern of lexical semantic activation, unlike the priming studies that indicate facilitation.

Considering relatedness, the cyclic block naming paradigms indicate a change in the trend from a facilitation effect in the first cycle to an inhibition effect in the next consecutive cycles (Belke, 2008; Rahman & Melinger, 2007, 2011). This change in trend is also eliminated using the block naming paradigm.

The above findings could be attributed to two factors. The first factor could be the inclusion of the frequency parameter. Than relatedness, the frequency of occurrence of the stimuli played a dominant role in influencing the pattern of lexical semantic activation. The second factor could be the method of presentation of the stimulus. The pairwise prime-target presentation of the priming paradigm and the repetitions of the cyclic block naming paradigm were eliminated in the block naming paradigm. Parallelly, the relatedness effect was also observed to disappear. This was observed for all neurotypical adults, irrespective of age.

Considering the relatedness parameter alone, or employing the same paradigm on the disordered population might reveal different results. Therefore, in the present study, for all neurotypical adults, frequency when compared to relatedness, played a more important role in predicting the pattern of lexical access.

As discussed, the parameters were analysed individually for the thematic and taxonomic blocks. In addition to this, these parameters were hence compared with the reaction times and accuracy scores of the taxonomic and thematic mixed blocks respectively.

Table 4.6

Reaction time and accuracy results obtained for Mixed Blocks

BLOCKS		GROUP 1		GROUP 2		GROUP 3	
		RT (ms)	AS (%)	RT (ms)	AS (%)	RT (ms)	AS (%)
TAM	Mean	994.49	97.33	1237.47	88.66	1340.47	74.66
	SD	104.02	4.57	172.18	8.83	273.63	15.05
THM	Mean	1112.03	97.33	1207.66	84.66	1323.51	76.66
	SD	224.40	4.57	168.48	13.0	249.65	11.75

Note:

TAM: Taxonomically mixed block THM: Thematically mixed block

As indicated by table 4.1 and 4.6, for participants of all three groups, a better performance was observed for the taxonomically related blocks than the taxonomic mixed block. However, a better performance was noted for the mixed block as compared to the taxonomically unrelated infrequent blocks.

As depicted in table 4.2 and 4.6, for participants of all three groups, a better performance was observed for the thematically related blocks than the thematic mixed block. Similar to the taxonomic blocks, a better performance was noted for the mixed block as compared to the thematically unrelated blocks. Statistical analysis employing a Paired sample t-test was carried out for the above data comparisons.

As indicated by table 4.7, a significant difference was observed only between the taxonomic and thematic related and unrelated infrequent blocks and the mixed blocks, where better performance was noted in the mixed block.

Table 4.7

Pairwise comparisons of conditions and frequency variants of the thematic blocks

	Comparison	**t**	**Df**	**P**
1.	TAMRT - TARFRT	2.404	14	.031
2.	TAMRT - TARIFRT	-7.604	14	.000*
3.	TAMRT - TAURFRT	2.098	14	.055
4.	TAMRT - TAURIFRT	-9.392	14	.000*
5.	THMRT - THRFRT	2.140	14	.050
6.	THMRT - THRIFRT	-6.296	14	.000*
7.	THMRT - THURFRT	1.914	14	.076
8.	THMRT - THURIFRT	-9.643	14	.000*

Note:

TARF: Taxonomically related frequent — TAURF: Taxonomically unrelated frequent

TARIF: Taxonomically related infrequent — TAURIF: Taxonomically unrelated infrequent

THRF: Thematically related frequent — THURF: Thematically unrelated frequent

THRIF: Thematically related infrequent — THURIF: Thematically unrelated infrequent

TAM: Taxonomically mixed block — THM: Thematically mixed block

*Significant difference

Furthermore, the reaction times and accuracy scores were compared between the taxonomic and thematic related blocks for each of the three groups. This was done in order to observe any differential patterns of lexical activation across the above-mentioned blocks.

Comparing tables 4.1 and 4.2, a better performance, in terms of reaction times and accuracy scores, was observed for taxonomic blocks than thematic blocks. This trend was followed by all the three groups included in the study.

The better reaction times and accuracy scores for the taxonomically related blocks compared to thematic blocks and unrelated blocks could be reflective of a higher facilitation effect. Hence, it can be concluded that taxonomically related contexts provide a larger facilitation effect than thematically related contexts. Though only a smaller number of studies have compared naming latencies between these two contexts, the strength of taxonomically related stimulus set is evident. However, this finding can be supported by studies that indicate differences in an individual's strengths of taxonomic and thematic relations (Daniel & Kristen, 2012). This may be reflected as differential neuronal representation, recall, sorting abilities or as this study indicates, differential naming latencies.

Additionally, the reaction times for the stimuli across each block were tracked in order to predict the presence of any incremental learning effect (Refer table 4.8). This would help explain the patterns of activation observed across each block included in the study.

Table 4.8

Trends of Reaction Time Measures for items across each block

Blocks	**Group 1**	**Group 2**	**Group 3**
TARFRT	Decrease	Decrease	Decrease
TARIFRT	Slight Decrease	Slight Decrease	Slight Decrease
TAURFRT	No evident pattern	No evident pattern	No evident pattern
TAURIFRT	No evident pattern	No evident pattern	No evident pattern
THRFRT	Decrease	Decrease	Decrease
THRIFRT	Slight Decrease	Slight Decrease	Slight Decrease
THURFRT	No evident pattern	No evident pattern	No evident pattern
THURIFRT	No evident pattern	No evident pattern	Increase
TAMRT	No evident pattern	No evident pattern	No evident pattern
THMRT	No evident pattern	No evident pattern	No evident pattern

Therefore, a decrease in the reaction times across items within a block was observed for taxonomically and thematically related frequent and infrequent blocks. However, this decrease in reaction time was more evident for frequent than infrequent blocks. No evident pattern was observed for the other blocks included in the study. The same trend was observed for all three groups included in the study. Only for group 3 (older adults), an increasing reaction time pattern was observed for the thematically unrelated infrequent block. This indicates that the unrelated blocks do not provide room for predictability and may even cause an interference effect with older individuals.

An incremental learning effect was observed for related and frequent stimuli in both taxonomic and thematic contexts. This is supported by a study that suggests a facilitation effect for related conditions (Navarrete et al., 2012). It can be concluded that individuals can better predict the pattern for blocks comprising of related and frequent items, owing to the ease of retrieval. A trend of increasing reaction times was observed for infrequent and unrelated items in the thematic context. Hence, it can be concluded that this combination of parameters induces the most difficult context for naming. Literature in the past has indicated a possible interference effect in unrelated stimuli that can influence cognitive control and learning (Crowther & Martin, 2014). As this was observed only for the older adults, it indicates that along with frequency, age is also a contributing factor that allows for naming difficulties across conditions. This is supported by various studies in literature that conclude that a condition difference affecting naming in older adults may not have the same effect in younger neurotypical individuals.

To summarise the overall results obtained, group 1 and group 2 outperformed group 3 for all the parameters taken into consideration, both in terms of reaction times and accuracy measures. However, no significant difference was observed between group 1 and group 2. A significantly better performance was seen for frequent than infrequent stimuli. This was observed for both taxonomic and thematic blocks. Similarly, a better performance was observed for related than unrelated blocks however, a significant difference was not observed. Only for group 3, better reaction times were obtained for unrelated infrequent than related infrequent blocks. Participants performed better on related blocks than mixed blocks. However, a better performance was seen on mixed blocks as compared to unrelated blocks.

Reaction time measures were observed to be better for taxonomic as compared to thematic blocks. Considering the learning effect, it was notable only for related frequent items more than related infrequent items. This was not observed for unrelated items. These above-mentioned trends were shown by all three groups included in the study.

CHAPTER V

SUMMARY AND CONCLUSIONS

The mental lexicon is a collection of representations of all the words known to an individual. It is defined in psycholinguistics as a systematically organized mental dictionary. This lexicon contains information regarding both the word's form and meaning. Each word known to an individual is represented in the mental lexicon as a lexical entry. Lexical access in the activation and retrieval of information from this mental lexicon.

There are a number of factors that can influence the ease of lexical access. This can be reflected in the patterns of lexical semantic activation. There are predominantly two such patterns: Facilitation and Inhibition. Facilitation is said to occur if the conditions of stimulus presentation increase the ease of retrieval of the target item. Inhibition on the other hand, is said to occur when these conditions delay the naming latencies for the target items. Two such stimulus parameters that are believed to influence naming latencies are: Relatedness of the stimuli, in terms of taxonomic or thematic conditions and the Frequency of occurrence of the stimuli. Age is one important participant parameter that can affect the naming latencies.

The present study aimed to investigate the patterns of lexical semantic activation as a function of age. 45 Native Kannada speaking individuals were recruited for the same. They were further divided into three age groups: Younger adults designated as Group 1 (18-25y), Middle-aged adults denoted as Group 2 (45-55y) and older adults designated as Group 3 (60-79y). A block naming paradigm was employed to explore the facilitatory and inhibitory patterns of lexical semantic activation. The stimuli were divided into six blocks: Taxonomically related block-containing items belonging to a particular category; Taxonomically unrelated block-containing items belonging to various different categories; Thematically related block-containing items belonging to a particular theme; Thematically unrelated block-containing items that do not adhere to a particular theme and two Mixed blocks-containing items from taxonomically and thematically related and unrelated items respectively. Each block comprised of both frequent and infrequent stimuli.

The participants were instructed to name each target item as quickly and correctly as possible. Their responses were recorded in terms of reaction times measured in milliseconds and accuracy scores measured in percentages. The data was tabulated and analysed using the Statistical Package for Social Sciences (SPSS) Version 21.0 software.

The first objective of the study was to compare the performance (in terms of reaction time and accuracy scores) of the younger adults with that of the middle-aged and older adults. The overall means and standard deviations were calculated. This was done for the performance in all the parameters under study. The data was initially subjected to test of normality by employing Shapiro Wilk's test. The results showed that the data for reaction times was parametric while the data for accuracy scores showed a non-parametric distribution. Hence parametric tests were used for the former and non-parametric tests were used for the later. The data for reaction time subjected to a Mixed ANOVA in order to find the main effect and interaction effect between the parameters. Results revealed a main effect of age and frequency of the stimulus. An interaction effect was observed for group and frequency and frequency and condition (taxonomic and thematic) parameters. The data for reaction time measures was then subjected to a MANOVA. The results revealed a significant difference ($p<0.05$) between the performance of Group 1 and Group 3, Group 2 and Group 3 but not Group 1 and Group 2. The data for accuracy scores did not follow normal distribution. Hence, it was subjected to a non-parametric Kruskal Wallis Test, which revealed a significant difference ($p<0.05$). Therefore, a Man Whitney U test was further carried out for pairwise comparisons. This revealed the same results as the reaction time data. Hence, it can be concluded that group 1 and 2 performed significantly better than group 3 for all the parameters taken into consideration.

The second objective of the study, was to compare the reaction times and accuracy scores for the pattern of activation for taxonomically related and unrelated frequent and infrequent blocks. The overall means and standard deviations were calculated. The performance of the participants from all three groups was better for frequent than infrequent stimuli and better for related than unrelated conditions in the taxonomic blocks. This was observed both in terms of Reaction Times and Accuracy Scores. The results for reaction time (tested through Paired sample t-test) and accuracy scores

(tested through Wilcoxon Signed Ranks Test) showed a significant difference ($p<0.05$) only for the frequency parameter and not for relatedness.

The third objective of the study, was to compare the reaction time and accuracy scores for the pattern of activation for thematically related and unrelated frequent and infrequent blocks. The overall means and standard deviations were calculated. Based on the normal distribution, the data for reaction time was subjected to paired sample t-test whereas, the data for accuracy scores was subjected to Wilcoxon Signed Ranks Test. The results obtained revealed that the participants performed better for frequent than infrequent and related than unrelated conditions. However, a significant difference was observed only for the frequency and not the relatedness parameter for the thematic blocks. This pattern was similar to the taxonomic blocks.

The performance of the individuals on taxonomic blocks was also compared with that of the thematic blocks and hence mixed blocks. This trend revealed a better performance for taxonomic than thematic blocks, both in terms of reaction times and accuracy scores. This was observed for all three age groups included in the study. Therefore, better overall reaction times were observed for the taxonomic as compared to the thematic conditions.

Furthermore, these parameters were compared with the reaction times and accuracy scores of the taxonomic and thematic items in the two mixed blocks respectively. This was done in order to observe any differential patterns of lexical activation across the above-mentioned blocks. It was observed that the related blocks elicited shorter reaction times than the mixed bocks and the mixed blocks received shorter reaction times than the unrelated blocks. The data for reaction time and accuracy scores were subjected to a Paired sample t-test and a Wilcoxon Signed Ranks Test. Results revealed a significantly better performance for the mixed blocks than the unrelated infrequent blocks only. This was observed for both taxonomic and thematic conditions. The same trend was followed by all the three groups included in the study.

In addition, the reaction times for the stimuli across each block were tracked in order to predict the presence of any incremental learning effect. This would explain the patterns of activation observed across each block included in the study. No particular statistical analysis was carried out for the same. Upon observation, the reaction times successively reduced across items within a block. Thus, an incremental learning effect

was observed only for the related frequent and infrequent blocks. However, this decrease in reaction time was more evident for frequent than infrequent blocks. The same trend was observed for both taxonomic and thematic blocks and was followed by all three groups included in the study. However, for group 3 (older adults), an increasing reaction time pattern was observed for the thematically unrelated infrequent block. Hence, an incremental learning effect was observed for related and frequent stimuli in both taxonomic and thematic blocks.

As shown by past research, the overall performance in naming decreases with age. Older adults exhibit longer naming latencies and have a lesser accuracy of responses for naming. Literature also suggests that there is an increase in the ease of retrieval for frequent than infrequent items. Lower thresholds of activations for items that are more frequently accessed can account for this observation (Balota & Chumbley, 1984). The facilitatory effect of relatedness seen in priming paradigms (Mahon et al., 2007) and the overall inhibitory effect of relatedness observed in cyclic block naming paradigms (Rahman & Malinger, 2011) can be nullified by employing a non-cyclic block naming paradigm. Taxonomic conditions provide a better environment for naming than thematic conditions. Therefore, mixed blocks (comprising of related and unrelated, frequent and infrequent items) may be employed to neutralize the learning effect.

Implications of the study:

The study aided in understanding the patterns of lexical access, taking into consideration the relatedness and frequency of the stimuli for naming.

1. To track the pattern of lexical semantic activation

   It is often believed that shorter reaction times for semantically related items result in facilitation. On the other hand, if the reaction times for the semantically unrelated items would be better, it would result in inhibition. Several tasks are employed to tap these two mechanisms of lexical semantic activation. The priming task is one of the most commonly used method. This task favors facilitation than inhibition. The block naming paradigm as employed in the current study may be regarded as a neutral task in tracking the patterns of activation.

2. To investigate variables related to lexical semantic activation

   Aging as investigated through many studies, if found to be an important variable influencing lexical semantic activation. The stimulus variables are also found to have an effect on lexical semantic activation. The current study tries to investigate the cumulative effect of the participant and stimulus variables. All the participants experienced difficulty in naming infrequent items. This difficulty is more for older individuals.

3. Modifications for blocked naming paradigm

   In order to overcome the learning effect and retain the ease of retrieval, mixed blocks may be employed. The mixed block counters the individual's ability to predict the pattern of occurrence of the stimuli, while still employing related and unrelated frequent stimuli. This enables easy retrieval of the stimuli without the incremental learning effect and the facilitation effect observed in pure related frequent blocks. Thus, the number of blocks to be used in such studies can be minimized in future research.

4. Implication in development of test materials for naming

   The sequence of pictures to be used can be inferred from the findings of the current study. If related items are presented in succession, the naming latencies could decrease. Hence, related and unrelated items should be randomized and presented in the naming task. The frequency of the picture stimulus should be taken into consideration while formulating the naming task. These provide a neutral ground for naming.

5. Implication in intervention for word retrieval

   The use of frequent stimuli for word retrieval intervention, helps increase the ease of naming. This could slowly progress to the use of both frequent and infrequent items and finally infrequent items for graded complexity. The use on taxonomically related items than thematically related items, increases the ease of naming. Hence, reducing the demand on the individual.

Limitations of the Study:

1. A More number/variety of blocks were presented with a lesser number of stimuli in each block
2. A prominent pattern of activation could not be traced with respect to the relatedness of the stimuli
3. The number of participants in each group were limited to 15

Future Directions for the Study:

1. The present study employed a block naming task where the items were presented only once. The pattern of activation may differ if the items may be repeated (cyclic block naming paradigms). Thus, the pattern of activation can be compared across the two tasks.
2. The other stimulus variables such as syllable length and imageability can be taken into consideration in the future studies.
3. The study could be conducted considering only the relatedness parameter, without the dominant frequency parameter at play. This might help obtain a more robust relationship between naming latencies and stimulus relatedness.
4. The study can be extended to children for investigating the pattern of lexical semantic activation in children
5. The study can be extended on disordered population such as aphasia and learning disability to examine the pattern of lexical semantic activation.

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Appendix

Material used as stimuli for the blocks

The black and white picture stimuli were shortlisted from Snodgrass and Vanderwart's Standardized set of 260 pictures (1980), Appendix A (Page numbers: 197-204).

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