

Relationship Between Age and Lexical Access

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Abstract. Lexical access refers to the retrieval of the word considered to be appropriate from the lexicon. The related lexical items are assumed to be arranged in a specific pattern. When the related items are presented in succession, it may evoke facilitation or inhibition. When one lexical item facilitates the activation of other lexical items, the term facilitation is used. On the other hand, if one lexical item impedes the lexical activation of the other lexical items, the term inhibition is used. The study aimed to explore lexical-semantic activation patterns in younger and older adults. Continuous naming paradigm was employed to probe the lexical-semantic activation. 40 participants in the age range of 18-25 years; 40 individuals in the age range of 55-70 years served as participants after informed consent. The participants were divided into two groups based on age and they were asked to name pictures. A total of 120 pictures were used (60 related pictures and 60 unrelated pictures were used.). The stimulus was presented in 6 blocks. Each block had 10 semantically related pictures and 10 semantically unrelated pictures. The reaction time and accuracy of scores for related and unrelated pictures did not show statistically significant differences for younger individuals. A statistically significant difference between related and unrelated pictures was seen for older individuals, the reaction time was slower and accuracy was

poorer for semantically related pictures. Greater reaction time and poor accuracy scores on semantically related pictures in this group suggested inhibition.

Keywords: *inhibition, facilitation, reaction time, accuracy*

Ісса Саддам; Алфархан Абдула, Авадг Фарес; Арадг'я Абгішек. Залежність лексичного доступу від віку.

Анотація. Лексичний доступ стосується пошуку слова з лексику, яке вважається відповідним до контексту. Передбачається, що лексичні одиниці в пам'яті розташовані за певним патерном. Коли пов'язані елементи представлені послідовно, це може викликати фасилітацію або гальмування. Коли одна лексична одиниця сприяє активації інших лексичних одиниць, використовується термін "фасилітація". З іншого боку, якщо одна лексична одиниця перешкоджає лексичній активації інших лексичних одиниць, використовується термін "гальмування". Це дослідження мало за мету вивчити лексико-семантичні моделі активації в осіб молодого та середнього й старшого віку. Для дослідження лексико-семантичної активації було використано неперервну парадигму йменування. 40 осіб у віці 18-25 років та 40 осіб у віці 55-70 років були учасниками після інформованої згоди. Учасників було розподілено на дві групи за віком, їх попросили назвати те, що вони бачать на зображенні. Загалом було використано 120 зображень (використано 60 пов'язаних зображень і 60 непов'язаних зображень). Стимул був представлений у 6 блоках. Кожен блок мав 10 семантично пов'язаних зображень і 10 семантично непов'язаних зображень. Час реакції та точність балів для пов'язаних і непов'язаних зображень не показали статистично значущих відмінностей для молодших людей. Статистично значущу різницю між пов'язаними та непов'язаними зображеннями було зафіксовано у старших людей, час їхньої реакції був повільнішим, а точність була гіршою для семантично пов'язаних зображень. Більший час реакції та низька точність семантично пов'язаних зображень у цій групі свідчили про наявність процесу гальмування.

Ключові слова: *гальмування, фасилітація, час реакції, точність.*

Introduction

Semantics is an integral component of language. It mainly deals with the study of word meaning. Lexical semantics is a subfield of semantics. Lexical semantics mainly deals with the storage of words in the lexicon and how these words are retrieved based on the need of the linguistic context. The mental lexicon derives its root from psycho-linguistics and is often a dictionary, hence the mental lexicon is also synonymously called as mental dictionary. The mental lexicon is assumed to comprise information pertaining to a word's form and meaning (Levelt, 1989). The retrieval word deemed appropriate the context is termed as lexical access. The phenomenon of lexical access is best explained through Spreading Activation Theory. The picture naming task is used a referent to explain the spreading activation theory. In a naming task, the participant is expected to name a picture. While naming a picture, the person has to recognise the lexical item. This recognition takes place on the basis of conceptual/semantic features. In other words, the conceptual features which would aid the recognition. Eventually lexical nodes are activated. During the process of activation of lexical nodes, the nodes matching the semantic representation would be activated. During the process, competitor lexical nodes are also activated. These competitor lexical nodes would share semantic representations with the target picture. For example, if a person is shown a picture of 'brush, other lexical

items/nodes like 'paste' and 'soap' are also activated. However, the threshold of activation would be higher for target picture 'brush' in this case enabling activation.

The related lexical nodes are assumed to offer competition to the target. These lexical nodes will cooperate or facilitate the activation of the target words hence it is called lexical cooperation. While few others negate this view by claiming that the lexical nodes would delay the activation of the target by excreting inhibitory action. Researchers in the past have used a variety of tasks to test these two claims. Priming studies favour the former while word picture interference paradigm and blocked naming tasks favour the latter. Picture word interference paradigm is a task where a word (presented in orthographic form) precedes semantically related and unrelated target words. Based on the naming latencies of the given target, the mechanism of lexical activation is speculated. Blocked naming on the other hand is a task where the participants are asked to name pictures presented in succession. Pictures are presented in semantically related and unrelated blocks. Continuous naming paradigm is a slight variation of this task, where the semantically related items are interspersed with the semantically unrelated items, in case if interference is operational the naming latencies for semantically related items would be delayed and the visa versa.

The cyclic blocked naming paradigm is assumed to tap lexical semantic activation. It has gained popularity over the years (Belke et al., 2005; Damian & Als, 2005; Navarrete et al., 2012). In this paradigm, participants are asked to name pictures alike other naming tasks. The difference is that the pictures are presented in a series or block (Kroll & Stewart, 1994). The block may comprise of pictures belonging to the same category (homogenous blocks) or pictures belonging different lexical category (heterogeneous blocks). The basic premise would remain the same in a cyclic block naming paradigm, but here the pictures within a block are repeated multiple times. Each repetition of a set of pictures within a block is termed a 'cycle'. Studies employing the cyclic block naming paradigms is assumed to tap the pattern of lexical semantic activation i.e. if the performance on heterogeneous block would be better compared to homogenous block, it would indicate inhibition and the visa versa may indicate facilitation (Biegler et al., 2008).

The mechanism of lexical semantic activation in children, adults and aging individuals has been studied by many researchers employing priming based tasks and word picture interference paradigm have been used to investigate and the findings derived from most of the studies favour inhibition over facilitation (Brown, 1981; Burke, 2010; Barr et al., 2013; Baayen et al., 2008) especially in persons with aging.

The facilitation effect or inhibition effect may not be consistent through the cycles of the naming test. In other words, the first few cycles may show a particular pattern (for ex facilitation with a better performance on homogenous block for first few pictures of the cycle while the remaining cycles may favour the other pattern of lexical semantic activation (inhibition in this case, with better naming for unrelated block compared to related block) (Rahman & Melinger, 2007).

The first study in this direction was reported by Brown (1981). Brown used blocked naming task for studying lexical semantic activation in older adults. Pictures were presented in the form of semantically related and semantically unrelated blocks.

The reaction time for these blocks were computed and compared. The reaction time was more for semantically related block indicating inhibition. Similar findings was reported by Burke in 2010.

A study conducted by Barr et al. (2013) used cyclic naming task to study lexical access. The pictures were presented in cycles. In cyclic naming task, the protocol would remain the same as blocked naming task, where the pictures are presented as semantically related and unrelated blocks. However, the difference is that the pictures are repeated at regular intervals. The authors again reported inhibition for semantically related picture blocks. The current study was in consonance with these studies signifying inhibition.

Navarrete et al. (2014) were of the opinion that first cycle of a cyclic naming task would favour a facilitation effect while the subsequent cycles may show an inhibition effect. The reason could be that the highest activated word is selected and this activation is assumed to not be affected by the levels of activation words not related to the target. This leads to a speculation that semantic interference in the subsequent blocks only emerges due to repetitions of the pictures within the block. This can be attributed to a lower activation in related blocks compared to unrelated blocks.

The picture-word interference paradigm may not be sensitive to predict the mechanism of lexical semantic activation as the word or pre cursor, as termed in experiments, are presented in orthographic form and the target is presented is presented as picture.

Significance of the study. This study is a preliminary attempt in exploring the mechanism of lexical semantic activation in older individuals by employing a continuous naming task. The continuous naming task is assumed to provide a holistic picture about the mechanism of lexical semantic activation. The present study aimed to probe the lexical-semantic activation in elderly individuals.

Objectives:

- To study the pattern of lexical semantic activation as a function of age by using continuous naming paradigm.
- To compare the reaction time and accuracy scores for semantically related pictures with semantically unrelated pictures within group 1 and group 2.

Method

Participants

The total number of participants was 80. The participants were selected through convenient sampling. The participants were divided into two groups comprising of 40 participants each. First group consisted of 40 younger individuals in the age range of 18-30 years, the second group also consisted of 40 individuals with the age range of 55-70 years. The groups had same number of male and female participants. The exclusionary criterion was that the participants in both the groups should not have any history of cognitive, communication and sensory deficits.

Stimulus

120 pictures from 6 different lexical categories (Birds, vegetables, fruits, animals, common objects and vehicles) were considered. 10 pictures from the same lexical category were presented in succession followed by 10 pictures from different lexical category i.e. pictures pertaining to a particular lexical category was presented, followed by pictures from the other 5 lexical categories presented in a random order.

Procedure

Pictures were presented as line drawings and were presented by using DMDX (Arizona, Auto mode 6.2). DMDX is a software used to record the reaction time and accuracy of response (check vocal allied feature of the software was used for the same). The task of the participant was to name the picture as early as possible. The reaction time and accuracy scores for participants in both the groups were tabulated and analysed.

Results and Discussion

The reaction time (naming latency) and the accuracy of responses for semantically related and unrelated picture blocks were determined. The reaction time for semantically related picture blocks was 1664.33 ms (SD : 267.33 ms) for younger individuals and 2180 ms (SD: 187.22ms) for older individuals. The reaction time for semantically unrelated pictures was 1570.71 ms for group 1 individuals (SD: 566.38ms) and 1882.33ms (SD: 322.40ms) for group 2 individuals.

Figure 1

Reaction time for group 1 and group 2 for semantically related pictures

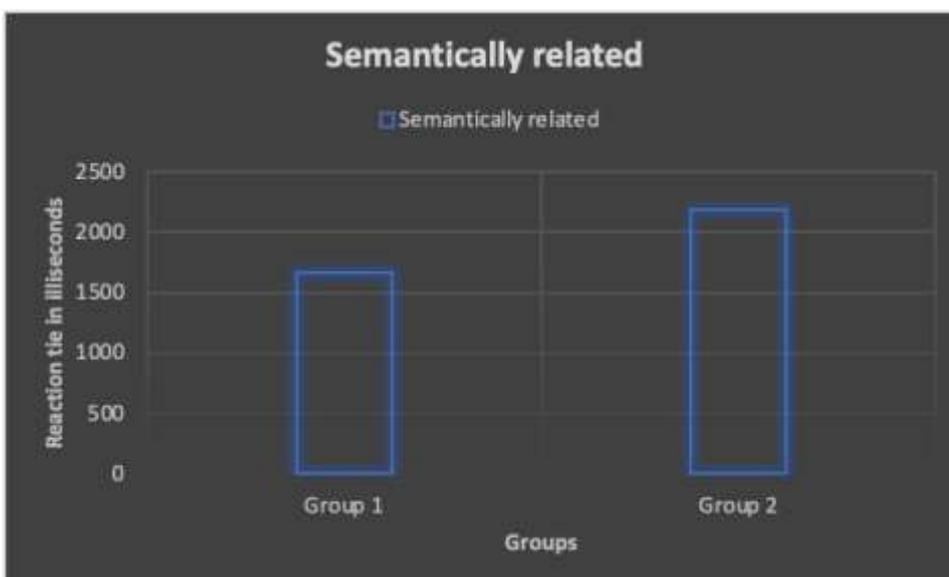
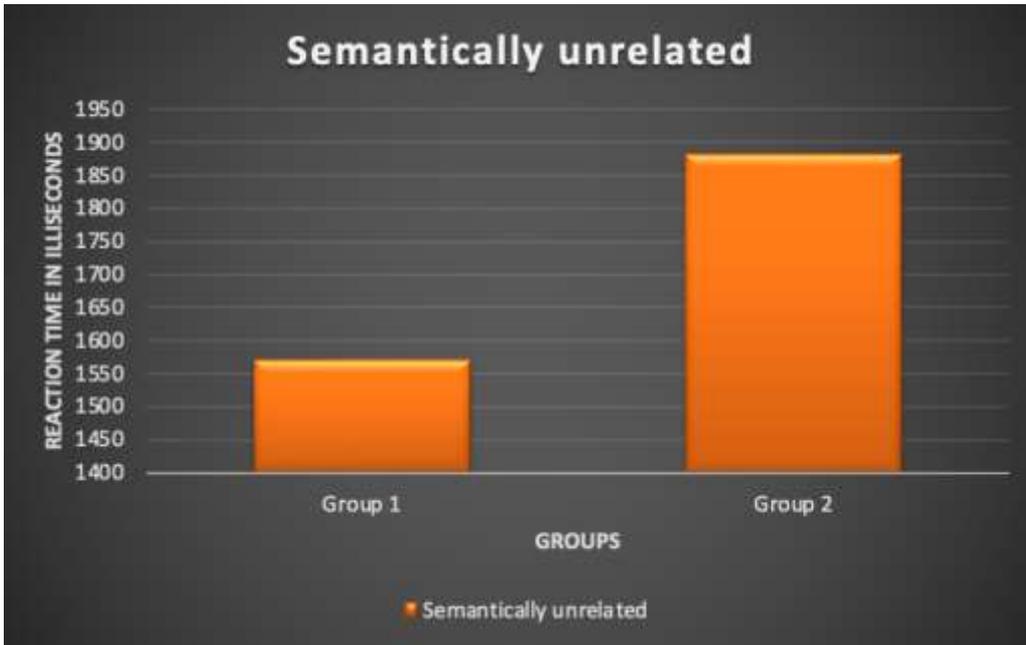


Figure 2

Reaction time for group 1 and group 2 for semantically unrelated pictures



The accuracy for both the groups was 86% and 79% respectively for semantically related pictures (SD: 7.63 and 12.27 respectively) The accuracy scores were 89% and 85% (SD: 4.16 and 11.22 respectively) for the two groups respectively for the semantically unrelated pictures (see Figure 4).

Figure 3

Accuracy scores for group 1 and group 2 for semantically related pictures

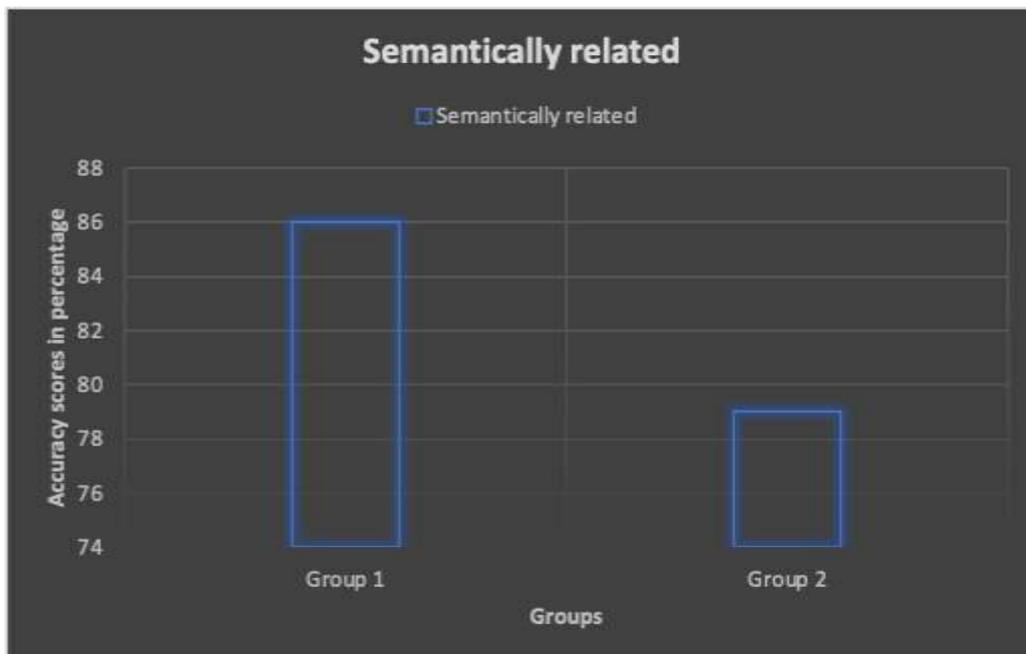
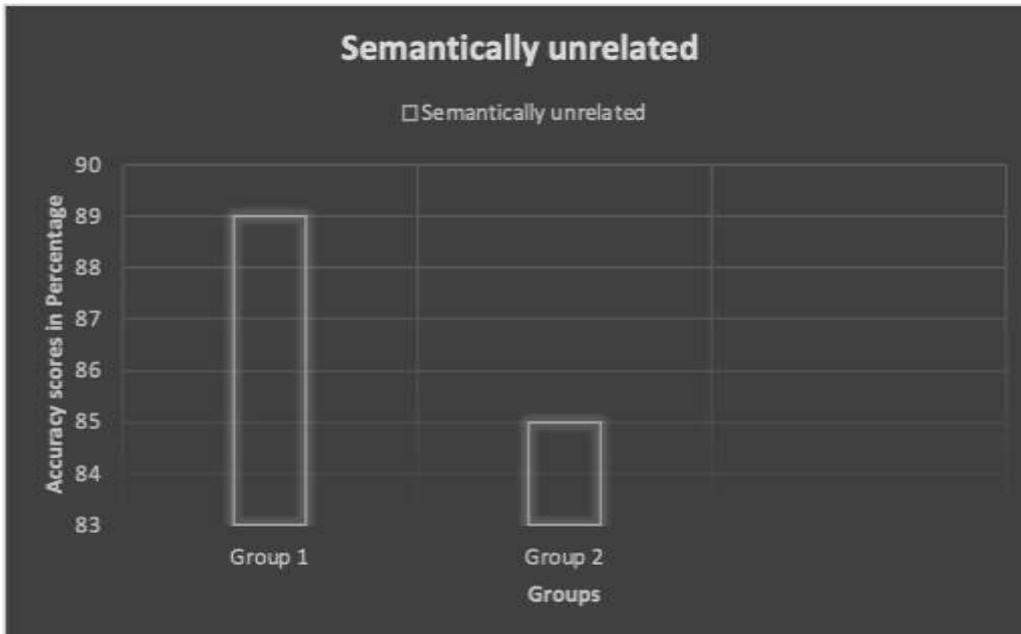


Figure 4

Accuracy scores for group 1 and group 2 for semantically unrelated pictures



In order to verify if there was any significant difference between the reaction time for semantically related and unrelated picture blocks with each group, Wilcoxon's signed rank test was used. Between group analysis was not carried as it was not in par with the motive of the study. The Z score for group 1 was 1.98 and for group 2, it was 3.72. The corresponding p value showed significant difference only for group 2.

Facilitation and inhibition related to lexical retrieval has been explored by researchers. Priming studies, cyclic naming blocked naming tasks and word picture interference paradigm have been used in deriving experimental evidence regarding these two mechanisms of lexical retrieval. The priming task favours facilitation while cyclic naming, blocked naming and word picture interference paradigm favour inhibition.

The current study used continuous naming task. In the continuous naming task, participants would be asked to name pictures presented in different a series or contexts or blocks. Each series/ block would contain pictures belonging to the same lexical semantic category or a different lexical category (Kroll & Stewart, 1994). The blocks can be divided into homogenous and heterogeneous block based on the pictures and its sequence. The performance on homogenous and heterogeneous block would be compared to delineate details about lexical retrieval. If the performance on homogenous block is better, the results would be suggestive of facilitation and the visa versa (performance better for heterogeneous block compared to homogenous block) is suggestive of inhibition.

In younger individuals statistically significant difference between semantically related and unrelated picture blocks was not seen indicating that both facilitation and inhibition would be operational or neither of it was operational in this population. For

elderly individuals, the mean reaction time was better for semantically unrelated picture block compared to semantically related picture block and the accuracy scores also adhered to the same pattern indicating that inhibition was operational in this population. When pictures belonging to particular lexical items were presented in succession, the naming latencies were delayed indicating that the competitor lexical node would offer competition to the target lexical nodes during activation. Age wise difference in lexical access is in lines with an earlier study carried out by Carroll et al. (2016).

In older individuals, the reaction time was more for semantically related blocks compared to semantically unrelated blocks. This finding was in consonance with the findings reported by earlier studies which used priming task (Brown, 1981; Burke, 2010; Barr et al., 2013; Baayen et al., 2008). The studies were in agreement with studies which using blocked and cyclic naming tasks also (Burke 1987; Barr et al., 2013).

Conclusions

The study was carried with the aim of investigating the pattern of lexical semantic activation in younger and older adults. Continuous naming paradigm was employed to probe the lexical semantic activation. Younger and older adults served as participants. The participants were asked to name presented in the form of semantically related and unrelated blocks. The reaction time and accuracy of scores for related and unrelated pictures were almost the same for younger individuals and the difference was not significant statistically, while for older individuals, the reaction was slower and accuracy was poorer for semantically related pictures indicating inhibition.

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