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Effect of Phonological Priming on Word Recognition abilities in typical aging population

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Abstract

Introduction: *A word is the smallest sequence of phonemes that can be uttered in isolation with objective or practical meaning in spoken language. Word recognition is the process of seeing a word and recognizing its pronunciation without having to think about it. One of the most important requirements for decoding in word identification is phonological awareness (Snow et al., 1998). Priming is one of the most significant concepts in word recognition. It entails presenting material to which a reaction must be given before the word is spoken. To test word recognition skills, phonological priming exercises are frequently used. Phonological priming investigates how words are prioritised in the mental lexicon over similar-sounding words based on their phonological form (Dufour & Peereman, 2003; Goldlinger et al., 1989).*

Need For The Study: *In the present scenario, there are not many studies available on the effect of priming words on cognitive linguistic abilities in the Malayalam language, especially in typically aging population. Hence this study will be beneficial in assessment and planning intervention programs for the management of individuals with language impairments secondary to cognitive issues*

Aim: *To compare the impact of aging on recognition of phonologically primed and phonologically nonprimed word pairs based on reaction time and task completion time.*

Methods: *A total of 150 healthy aging adults in the age range of 31-80 years participated in the current study. The participants were further divided into five subgroups with 30 participants in each age group i.e 31-40, 41-50, 51-60, 61-70, and 71-80 years.*

This section was aimed at developing 20 phonologically primed word pairs, 20 phonologically non primed word pairs to assess the recognition ability

Results and Discussion: *The results revealed that activation of brain regions during the detection of phonologically primed and nonprimed words were differed. This can be justified by the fact that the second word of a phonologically primed word pair needs merely partial activation during word recognition as it is preceded by a phonemically similar word. As a result, the activation path for phonologically primed word pairs is shorter and requires less neural activity resulting in better reaction time and task completion time compared to phonological non primed word pairs. Due to the lack of contextual information and additional cognitive effort, phonologically nonprimed words have a slower reaction time and task completion time. Furthermore, phonologically nonprimed words go through a series of intricate interaction stages of brain activation. These results are in consonance with the findings of Frost et al., (2003), that priming is greater for phonological primes*

Summary and Conclusion: *It can be concluded that due to lack of contextual information and additional cognitive effort, phonologically nonprimed words have a slower response than phonologically primed words.*

Introduction

Word recognition is the process of seeing a word and recognizing its pronunciation without having to think about it. One of the most important requirements for decoding in word identification is phonological awareness (Snow et al., 1998). Priming is one of the most significant concepts in word recognition. It entails presenting material to which a reaction must be given before the word is spoken. Words with similar perceptual qualities prime each other, according to a variety of behavioral experiments. When a sound is uncertain, your brain does the best it can, to fill in the gaps. The results of priming can then be employed, which is known as top-down processing. Some sounds, such as speech, are recognised first by our brains. Our brains then use context cues to figure out what these speech sounds represent.

The priming effect is a phenomenon in which the identification of a word is aided by past exposure to a related word. Priming is not the same as memory, which is based on retrieving information directly. Priming has also been proven to influence the decision-making process (Jacoby, 1983). Priming can affect word recognition in two ways: it can speed up or slow down target word processing. If a prime speeds up word processing, it is referred to as facilitation; if it slows down processing, it is referred to as inhibition. The word frequency effect is also present in most priming studies. As the frequency of use of words in a language grows, so does the degree of automaticity and processing speed (Macleod & Kampe, 1996)

To test word recognition skills, phonological priming exercises are frequently used. Phonological priming investigates how words are prioritised in the mental lexicon over similar-sounding words based on their phonological form (Dufour & Peereman, 2003; Goldlinger et al., 1989).

Aim

To compare the impact of aging on recognition of phonologically primed and phonologically nonprimed word pairs based on reaction time and task completion time.

Method

The study was carried out in two phases.

Phase 1

- Development of material
- Programming of the stimulus
- Subject Selection

Phase 2

- Administration
- Data analysis
- Statistical analysis

Development of Assessment Material

This section was aimed at developing 20 phonologically primed word pairs, 20 phonologically non primed word pairs. The words were taken from the speaking vocabulary of adults. 30 phonologically primed and 30 phonologically non primed word pairs were given to three Malayalam teachers, and 20 most appropriate phonologically primed and 20 non primed words were selected. Finally the selected words were then evaluated by administering in ten qualified Speech Language pathologists.

After finalizing the words, a pilot study was done to fix the presentation duration. The duration for each experiment was determined by running DMDX software at different time intervals such as a 5-second trial, a 10-second trial, 15-second, and 20- the second trial on ten adults in each age group to choose the best duration for obtaining appropriate response. Pilot results revealed that a duration of 8 seconds was most appropriate. This was done across the age group 31 to 80 years.

Experiment was conducted in such a way that the words were shuffled together and were presented through DMDX software – Auto mode (Forster & Forster 2003). The phonologically primed and non-primed were shuffled initially and responses were recorded.

Programming of Stimulus

The appropriately formulated words were mixed up and presented with DMDX software Auto mode (Forster & Forster 2003) in LENOVO IDEAPAD 330 with a resolution of 1366x768 pixels. The TIME DX was installed to record the reaction time and task completion time.

Participant Selection

Participants

A total of 150 right handed healthy adults in the age range of 31 to 80 years with 30 individuals from each group participated in the current study i.e. 31-40 years old, 41-50 years old, 51-60 years old, 61-70 years old, 71-80 years old. The participants were selected from different localities in the Thrissur district of Kerala. Candidate selection was based on the following criteria.

Inclusion Criteria

- Participants should not have any history of neurological, speech-language, and psychological problems.
- Participants should have Malayalam as their mother tongue.
- Participants should have normal ACE score indicating absence of dementia.
- Participants should have an education of at least 10th standard.
- Participants should be able to speak, read and write Malayalam.
- Participants should be physically fit to carry out the test.
- Participants should have normal/ corrected vision and hearing.

Administration

The test administration began with obtaining consent from participants and caregivers. Participants were informed about the purpose and nature of the evaluation prior to the test. The informal screening was done to check the presence of hearing loss. The demographical data of the participants were taken initially.

A silent environment with minimum distractions was selected. The eyesight and the screen of the laptop were at the same height. Following this, the designed stimulus was presented. Then reaction time and task completion time were recorded.

The list of phonologically primed and phonologically nonprimed words was presented one by one to the selected participants by using DMDX software – Auto mode (Forster & Forster 2003). During administration, the subjects were instructed to press the left shift key if the presented stimulus is a primed word pair, if not then press the right shift key).

The reaction time (duration between the appearance of the stimulus and the pressing of the key) was automatically recorded by the software in the units of milliseconds. If any participant fails to complete the task (not pressing any shift key), then a score of -4000.00msec was automatically set by the software. The total time taken for administration was 2 minutes and 37 seconds

Instructions

"You are going to see some words one by one. Your task is to press the left shift key if the word pairs sounds similar or press the right shift key if it's not. Listen carefully, because the words will be presented only once and the words will change automatically even though the response is not made. Here comes the first word". The lists of test items were presented. The total time taken for administration was 2 minutes and 37 seconds. The participants were given verbal reinforcements as a token of appreciation for their efforts.

Data Analysis

The reaction time and errors were recorded and analyzed automatically by the DMDX software. The reaction time was measured as the time from when the target stimulus appeared on the screen until the participant pressed the shift key (left shift key if the presented stimulus is phonologically primed, and right shift key if the presented stimulus is phonologically non primed. The total reaction time in each age group was obtained for analyzing task completion time.

Statistical Analysis

The obtained data from all the age groups were approximately tabulated and subjected to statistical measures. SPSS software (version 21.0) packages were used for statistical analysis

Results and Discussion

Reaction time and task completion time obtained for recognition of phonologically primed and phonologically nonprimed word pairs across each age group were analysed.

Table: Mean, standard deviation, ANOVA results on recognition of phonologically primed and non primed words obtained across all age groups

Age Group		Mean	S.D	p
31-40	**Phonologically Primed**	713.05	491.74	.003
	Phonologically Non Primed	872.98	330.04	
41-50	**Phonologically Primed**	1070.33	267.85	.049
	Phonologically Non Primed	1188.16	366.81	
51-60	**Phonologically Primed**	1494.97	354.09	.002
	Phonologically Non Primed	1722.61	338.89	
61-70	**Phonologically Primed**	1839.44	616.00	<0.01
	Phonologically Non Primed	2306.72	468.78	
71-80	**Phonologically Primed**	2617.81	863.20	.001
	Phonologically Non Primed	3001.66	746.28	

The above table shows the mean reaction time, standard deviation, and ANOVA results of phonologically primed and nonprimed words across all age range (31-80 years) in healthy adults. There were significant difference between phonologically primed and non primed words across the age group except at 41-50 years as determined by ANOVA ($p<0.05$).

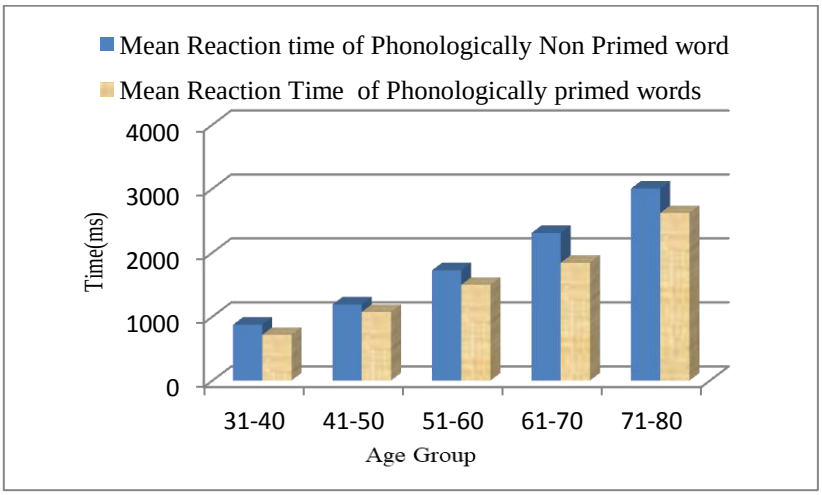

Fig 1: Mean Reaction time of phonologically primed and nonprimed words recognition obtained across all age groups

The above figure showed the mean reaction time taken for phonologically primed and nonprimed words across all age range (31-80 years) in healthy adults.

Table: Average task completion time on recognition of phonologically primed and nonprimed words obtained across all age groups

Age Group		Task Completion
31-40	**Phonologically Primed**	14261
	Phonologically Non-Primed	17459.6
41-50	**Phonologically Primed**	21406.6
	Phonologically Non-Primed	23763.2
51-60	**Phonologically Primed**	29,899.4
	Phonologically Non-Primed	34452.2
61-70	**Phonologically Primed**	36788.8
	Phonologically Non-Primed	46134.4
71-80	**Phonologically Primed**	52356.2
	Phonologically Non-Primed	60033.2

The above table showed the task completion time of phonologically primed and nonprimed words across all age range (31-80 years) in the healthy adults.

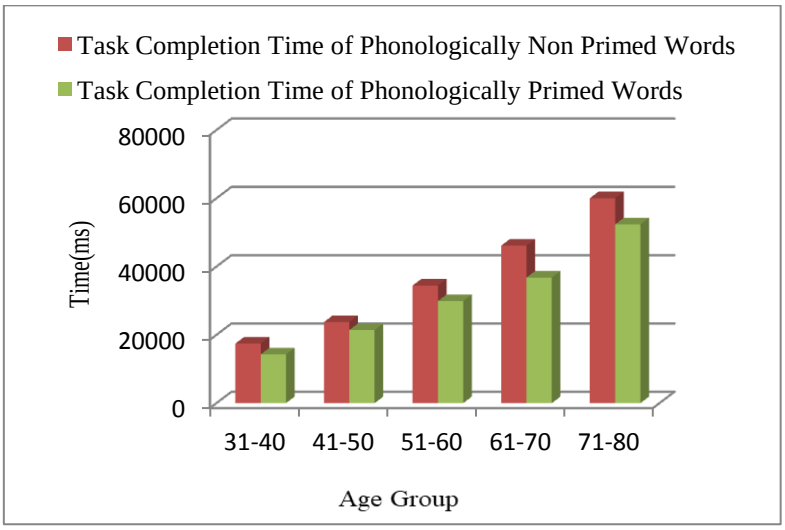

Fig 2: Average task completion time of phonologically primed and nonprimed words recognition obtained across all age groups

The above figure showed the task completion time taken for phonologically primed and non-primed words across all age range (31-80 years) in the healthy adults

The study compared the performance of participants on recognition of phonologically primed and phonologically nonprimed word pairs. According to the findings, participants obtained better reaction time and task completion time for the recognition of phonologically primed word pairs compared to phonologically nonprimed word pairs across all age groups. The results also revealed that as age advances the reaction time and task completion increased for both the word pairs.

Our findings demonstrate that activation of brain regions during the detection of phonologically primed and nonprimed words were differed. This can be justified by the fact that the second word of a phonologically primed word pair needs merely partial activation during word recognition as it is preceded by a phonemically similar word. As a result, the activation path for phonologically primed word pairs is shorter and requires less neural activity resulting in better reaction time and task completion time compared to phonologically non primed word pairs. Due to the lack of contextual information, an additional cognitive effort is required for recognition of phonologically nonprimed word pairs and thus leads to increased reaction time and task completion time. Furthermore, phonologically nonprimed words go through a series of intricate interaction stages of brain activation. Additionally it can also be stated

that there is a role for syllables in visual word recognition, syllables are computed serially from a printed word and constrain the process of matching the orthographic input with a semantic interpretation. Frost et al (2003) reported that, that priming is greater for phonologically primed word pairs.

Figure 1 and 2 demonstrates that as age advances reaction time and task completion time increases for recognition of phonologically primed and non primed words. Facilitation of phonologically primed word recognition requires certain prerequisite skills such as adequate visual attention, semantic processing, phonological encoding, decision making, executive function, working memory, motor coordination, and integration. To perform this, there should be an active and intact functioning of bilateral superior temporal gyri, middle temporal gyri and angulargyri. Furthermore, executive function necessitates a high level of frontoparietal functional connection.

During the process of aging, neurobiological alterations such as cortical atrophy particularly in the prefrontal region, synaptic changes, reduced conduction velocity, decreased brain weight and volume, and thinning of cortical and subcortical regions dedicated to memory processes will reduce the rate of mental processing speed, an individual's ability to utilize attentional resources for identifying stimuli, formulating strategies for encoding, and decision making.

Another noteworthy element observed in this study was that older persons' proclivity to read the paired words during phonologically primed word recognition tasks. This could be another factor contributing to longer reaction time and task completion time.Juncos-Rabadán et al., (2010) reported that older speakers have more difficulty with phonological access than younger speakers.

Similarly for recognition of phonologically non-primed word pairs, older individuals had a tendency to read the target word before reacting, which led to longer reaction times and task completion time. As phonologically non primed word pairs lack partial activation of the initial phoneme and contextual information during recognition, an additional cognitive effort is required, thereby it necessitates the recruitment of more brain areas.

Due to age-associated neurobiological changes,the fundamental skills required to perform the task are hampered; resulting in increased reaction time and task completion time in elderly adults compared to younger adults.

Summary and Conclusion

The present study aimed at comparing the effects of aging on recognition of phonologically primed and phonologically nonprimed word pairs based on reaction time and task completion time

A total of 150 healthy aging adults in the age range of 31-80 years participated in the current study. The participants were further divided into five subgroups with 30 participants in each age group i.e 31-40, 41-50, 51-60, 61-70, and 71-80 years.

The recognition of phonologically primed word pairs and aging has shown a negative correlation. This is because of the reason that aging reduces the rate of mental processing speed, an individual's ability to utilize attentional resources for identifying stimuli. Furthermore, recognition of phonologically nonprimed word pairs and aging has also shown a negative correlation. The reason for this can be attributed to age-associated neurobiological changes in the structures that impair the functioning of areas responsible for recognizing phonologically unrelated primes. As a result, age-related atrophical alterations can explain the higher reaction time and task completion time in elderly persons compared to younger adults in both recognition tasks

Outcome of the study substantiates that aging has significant impact on recognition of phonologically primed and non primed word pairs. Participants has shown better performance with phonologically primed word pairs.

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Appendix

List of Phonologically Primed Paired Words

തല – മല	മരണം – വരണം
തള – വള	പാൽ - വാൽ
വാല് – കാല്	ഫലം – കലം
ചായ -പായ	തേൻ - പേൻ
പണം -മണം	ചേന – പേന
കണ്ണ് – മണ്ണ്	വലി – കലി
വരം – മരം	ധനം – മനം
കാരണം – മാരണം	വടി – അടി
തറ -പറ	നര – വര
വനം – മനം	നരി – കരി

List of Phonologically Non Primed Paired Words

തവണ – പലക	മുന്തിരി –കഴുത്ത്
കരൾ - അച്ഛൻ	വിമാനം – സഫലം
മുട്ട – പച്ച	സ്വരം – പുഴു
ചെടി – മാനം	പുരുഷൻ - പേടിച്ചു
ലോകം – മുത്ത്	പുറം – ചന്ദ്രം
പഴം – ഗണം	തേങ്ങ – ചൂട്
ചുവപ്പ് – നിഴല്	തൂവൽ - ചോര
ചെവി – വാള്	വർഷം – വയർ
മയിൽ - വഴി	വലുത് – തളിക
വെളിച്ചം – വേദന	മുറിവ് – ഉറക്കം

Appendix -2

Informed Consent Letter

Title of the study

Analysis of Effect of Priming Words in Typical Aging Population

We are seeking your permission to include you as a participant in a research study. This study will involve asking you produce and to press right or left shift key on the keyboard for indicating phonologically primed, phonologically non primed, semantically primed high frequency, semantically primed low frequency word pairs to assess the priming word generation and recognition abilities. There is no other risk involved in this study.

Informed consent

I have been informed about the aim, objectives, and the procedure of the study. I understand that I have a right to refuse participation as participant or withdraw my consent at any time.

Consent

I have read the above information and agree to participate in the study titled:

ANALYSIS OF EFFECT OF PRIMING WORDS IN TYPICAL AGING POPULATION

NAME:_____

SIGNATURE:_____

DATE: _____

EXAMINER:_____