Brain Activation Related to Recall of Vocabulary from a Second Language

Huda I. Albalawi

Supervised by: Dr. S. Alnajashi

College of Education

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INTRODUCTION

Word acquisition is a daily activity for people who are learning a second language. However, learning words does not guarantee efficient use of them.

Age of acquisition might influence the accessibility of acquired words. In fact, recent studies denoted the differences in processing early vs. late acquired words, for native speakers, using different paradigms (e.g., Belke et al., 2005).

In a recent study by Fragier & Lagnaro (2017) two paradigms were compared to examine the differences in processing early and late acquired words in French speakers. Their results of this study revealed effects of age of acquisition in both tasks, shown in larger reaction time for late acquired words.

Key words

BCI : Brain-computer interfaces, acquire brain signals, analyze them, and translate them into commands that are relayed to output devices that carry out desired actions (Shih et al., 2012).

ERP signals: Event-related potentials (ERPs) are very small voltages generated in the brain structures in response to specific events or stimuli (Sur & Sinha, 2009).

N400: a negative-going voltage occurring approximately 400 ms after a meaningful stimulus onset) (Amoruso et al., 2013).

Picture naming: In this task the speaker transforms a concept corresponding to a depicted object or action into articulated words or sentences.

Word definition: In this task speaker has to find and produce a word corresponding to a given definition.

OBJCTIVES

- To investigate the differences between recalling early and late acquired words from a second language, in different retrieval tasks (picture naming and word definition).
- To examine whether there are differences between ERP-signals from brain regions when recalling early and late acquired words in picture naming and definition tasks.

Hypothesis

- We assumed that the two sets of words (early and late-acquired words) are not equivalent in terms of speed of processing and accessibility.
- We assumed that differences in accuracy of recalling early-acquired words will increase in word definition compared to picture naming.

We assumed that differences in reaction time for recalling early-acquired words will increase in word definition compared to picture naming.

MATERIALS & METHODS

Participants

Participants were 24 healthy females, age ranged between (19-24). They were recruited from the psychology department at King Saud University. All participants were monolingual native Arabic speakers, and they were speaking English as a foreign language.

Materials & apparatus

Word sets: There were 30 early-acquired and 30 late-acquired words.

Pictures and definitions: Pictures were collected from a picture database, and definitions were created by the researchers. Twenty participants judged the definitions in a preliminary study.
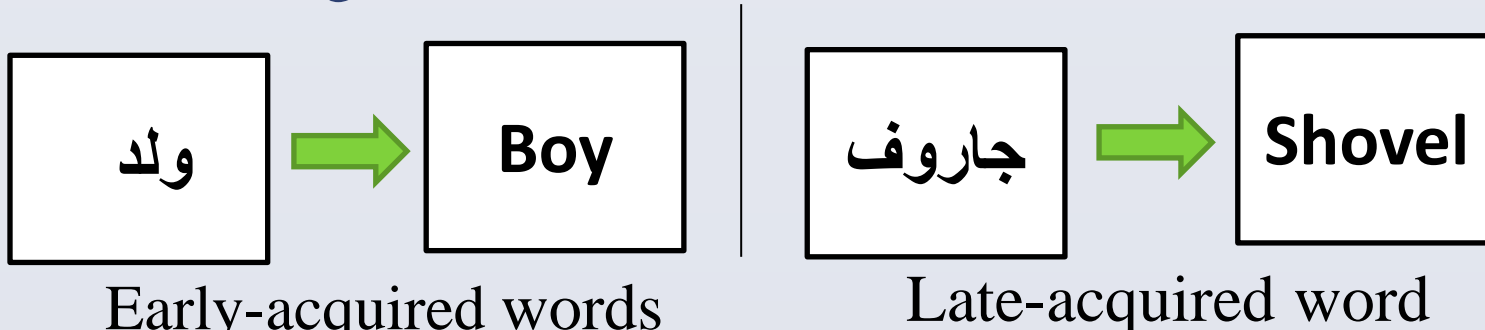
16-channel BCI

Emotiv BCI was used to record EEG data via EmotivPro software.

Design & Procedures

The experiment involved attending 2 sessions in the psychology department labs.

Know judgement – Short term recall-long term recall- picture naming – word definition

1-Learning session

Early-acquired words   Late-acquired word

2-Testing session
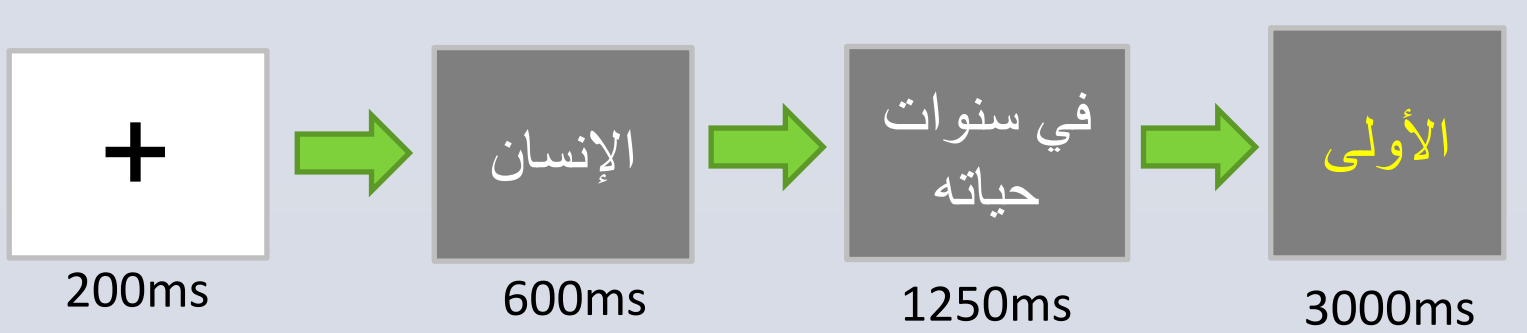
24 hours separated the learning and testing session.

A-Participants were asked to recall the words in the recall paradigm used in the learning session.

B-EEG recording

B-1-Picture naming task


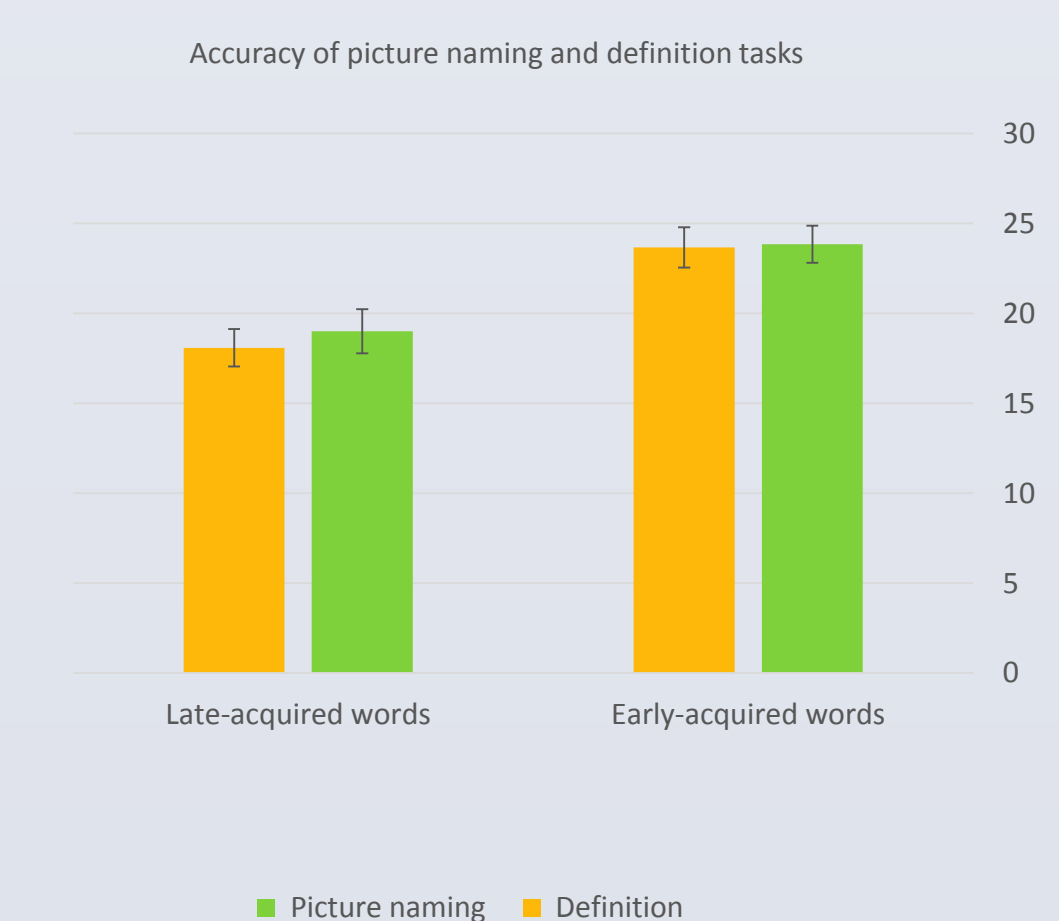
B-2-Word definition task

RESULTS

Repeated measures ANOVA showed the following results:

1. A significant main effect of age of acquisition. When collapsing across short and long term recall, accuracy in recall of early acquired words was higher than late acquired words. Similarly, there was a significant main effect of a time of recall. When collapsing across early and late acquired words, accuracy in short term recall was higher than long term recall.
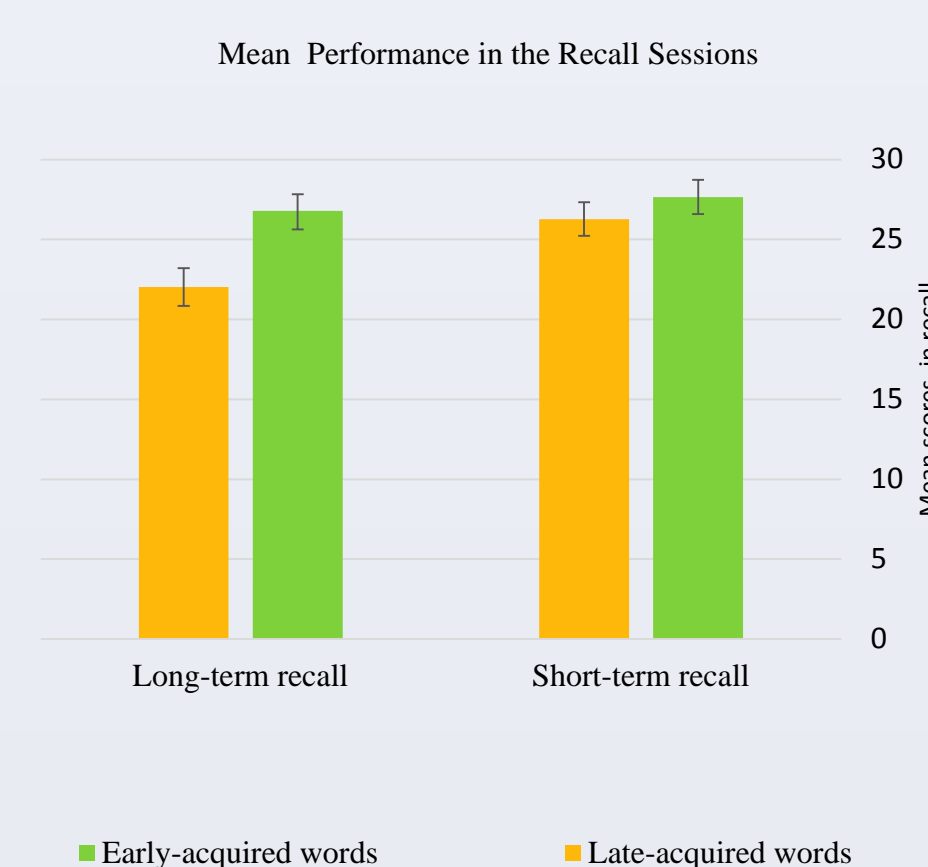
2. A significant main effect of age of acquisition. Accuracy of recall of early acquired words was higher than recall of late acquired words. In contrast, there was a nonsignificant main effect of method of recall. The interaction between age of acquisition and method of recall was nonsignificant

3. The reaction time for the definition task was significantly longer than the reaction time for the picture naming task .The interaction between the age of acquisition and the method of recall was nonsignificant.
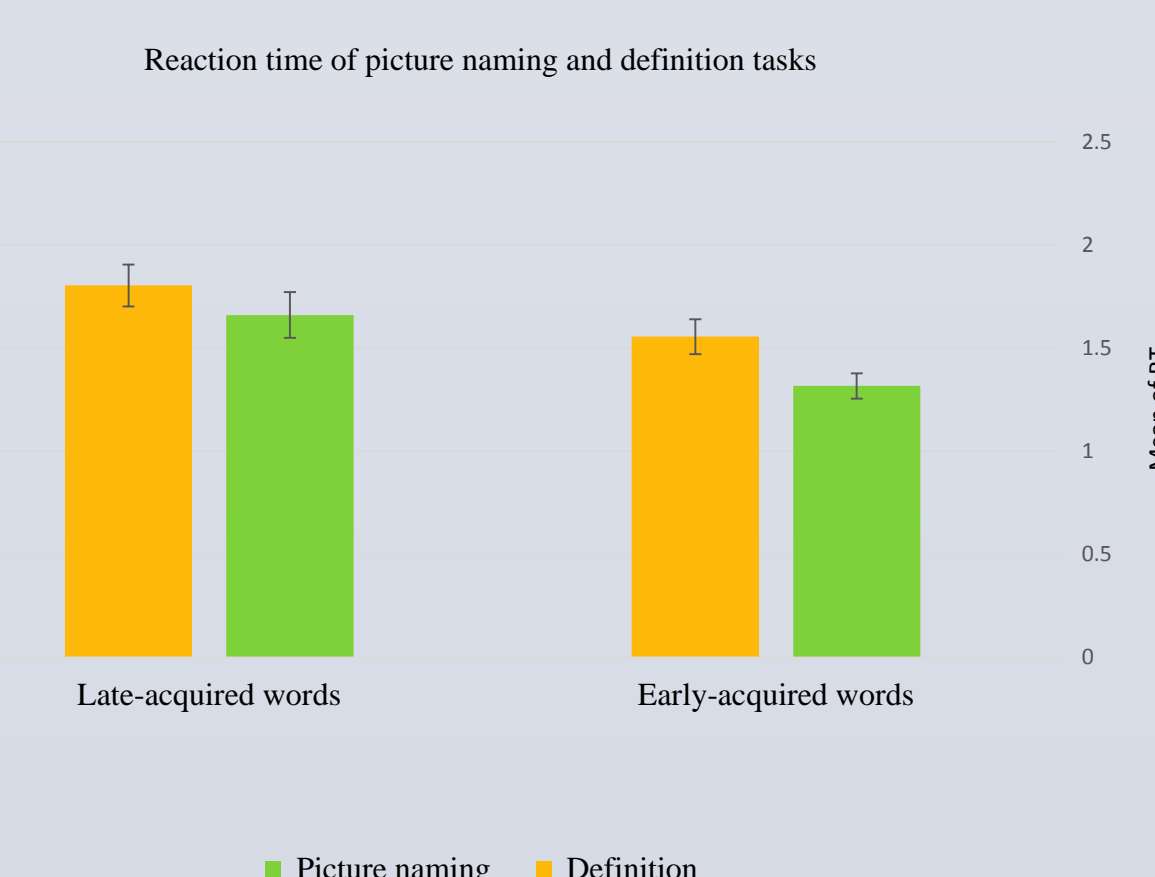
EEG results

The N400 signals from six channels corresponding to the frontal, and temporal brain regions (F3,F4,FC5,FC6,T7 ,T8) did not show significant differences between word types and recall methods, An exception to this is the significant interaction found in F3 (corresponding to the left frontal lobe) signals between age of acquisition and method of recall.

Discussion

1. Our assumption was confirmed in the short term and long term recall sessions. This indicate that early acquired words are more accessible compared to late acquired words.

2. When comparing the two methods of recall (picture naming vs. definition), it appears that there was no significant differences in accuracy depending on the method of recall .However, the reaction time was significantly shorter for the picture naming compared to word definition task. Additionally, although the interaction was not significant, the differences between reaction times for the two sets of early and late-acquired words was larger in the definition task, compared to that of the picture naming task.

3. The participant in the picture naming task will go through two stages, the visual perception and the object recognition. And these processing does not take the same duration of time compared to the word of definition task, where the participant has to recognize(semantic processing) the word then combined the words of the sentence, and finally produce the target word.

4. 4.Although behavioral data do not show significant interactions between method of recall and age of acquisition, N400 show higher activation when recalling late acquired words in the word definition task. This highlights the weakness of semantic associations established for late acquired words.

CONCLUSION

The current study aimed to examine the semantic associations in the mental representations for early and late acquired words from a second language.

The results of the current study indicate that late acquired words have semantic associations compared to early acquired words. Additionally, it indicates that recalling words from a second language is facilitated via the use of pictures.

Further studies should examine this aspect in school children, where applications can be used to adapt the method of teaching English vocabulary to pupils.

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