

Cognate Facilitation Effect in Norwegian English Bilinguals

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1 Introduction

Bilingual lexical access is a field of psycholinguistics that concerns about the activation or retrieval process of the mental lexicon for bilingual people. The primary question in this field is how bilinguals access words in their two languages (Assche et al. 2020). There are two opposing views that address this issue. One is language-selective access hypothesis that claims that bilinguals only activate representations from the contextually relevant language (Gerard & Scarborough 1989). The other opposing view is language-nonselective access hypothesis, which claims bilinguals always activate words from both of their languages (Peeters et al. 2013). However, in recent years, many researchers collected evidence in favor of the language non-selective access (Brenders et al. 2011, Dijkstra et al. 2010, Groot et al. 2000, Poort & Rodd 2017, Vanlangendonck et al. 2019). These researches mostly rely on three types of words, such as, interlingual homographs, homophones, and cognates (Assche et al. 2020, Groot et al. 2000). In this study, an experiment was done based on the cognate facilitation effect so this paper will discuss how processing of cognates can identify the selective or non-selective access of mental lexicon among bilinguals. Cognates are the words that share forms and meaning among two languages (Poort & Rodd 2017). For example, the word *problem* in English and Norwegian means the same. If a bilingual participant reacts faster to cognates in a lexical decision task, it means that cognates have facilitating effect and that implies that the mental lexicons are intertwined, suggesting non-selective access. If the reaction time for cognates vs. non-cognates is similar it means that the lexicons of the two languages are not activated simultaneously, suggesting language selective access (Seim 2018).

The three central research questions for this study are; i) Whether bilingual lexical access is selective or non-selective among Norwegian English bilinguals? ii) Do the participants process cognates faster than non-cognates? And iii) Do they process Norwegian words (non-words for this study) process slower than the true non-words? If the participants process cognates faster and Norwegian words (non- words for this study) are processed slower than true non-words (that do not exist in either languages), will provide some evidence in favor of the general non-selective theory (De Groot & Nas 1991).

2 Methodology and data collection

2.1 Experimental design The target language for this experiment is English, which means that participants have to identify words that only exists in the English language. The experiment type is two univariate experiments combined in one, one is for RT (reaction time) for words, and one is for RT for non-words. In this experiment there is one dependent variable and that is the reaction time, which will be dependent on two independent variables, namely words and non-words. Under words we have two categories: one is cognate and the other is non-cognate. Similarly, under non-words we have Norwegian words and true non-words. It is within-subject design that means each subject is measured for each level of the independent variables (words and non-words). The paradigm or task of this experiment is lexical decision task. In this task, participants are presented with written letter sequences and are asked to determine if each sequence is a word, where response times and/or accuracy are recorded. In this experiment, it is the 'yes' response must be only given to the words from the target language.

* We thank AJL7 for giving us the opportunity to present our work in their conference.

2.1.1 Subject There were 27 participants for this experiment and all of them are Norwegian native speakers. English is their second language. Their proficiency in English was measured through a self-assessment test using the ILR (Interagency Language Roundtable). All the participants were the adult undergraduate students of University of Bergen from different faculties. All of them volunteered for this experiment. No personal data was saved and it was completely anonymous.

2.1.2 Confound This experiment didn't take account into the participants' gender, age or any sort of personal information. It was anonymous. All participants gave voluntary informed consent to participate, and were given the freedom to leave the lab at any point. Before the participant began the experiment they were provided a proficiency self-assessment on a printed form using the ILR scale. All the participants were asked to mark their English proficiency level. The form also included one question if they have any English parent so that participants having English parents can be excluded from the experiment, see Appendix 2 and 3.

2.1.3 Stimuli materials In this experiment, 40 cognates and 40 non-cognates were taken from the stimulus list of (Seim 2018). All of them are medium frequency. The cognates and non-cognates are real English words for this experiment. All 40 cognates were orthographically and semantically related in English and Norwegian. All the real words were open class words: nouns, verbs and adjectives. All words were checked for frequencies on the US frequency database SUBTLEX-a corpus of about 50 million words based on subtitles from movies and TV series (Seim 2018). The lengths of the words are 3-8 letters. The 40 cognates are matched with 40 medium frequency non-cognates, which are either retrieved from the online COCA (Corpus of Contemporary American English) (Davies 2008) or from appendixes in other research articles (Coltheart et al. 1979, De Groot & Nas 1991). The medium frequency non-cognates are used as a direct comparison group to the cognates, since the words in both groups are of similar frequencies (Seim 2018).

Then there were 40 true non-words, which were mostly taken from the supplementary list of Poort and Rodd (2017). All the words follow the rules of English words but they are made Norwegian-like words with the help of a Norwegian native speaker. They are also 3 to 8 letters in length and phototactically acceptable strings of letters and followed the pronunciation and spelling rules of Norwegian. Then 40 real medium frequency Norwegian words were also added to the stimulus list, for this experiment they will be considered as non-words. These Norwegian real words were selected from NORWEGIAN WORDS, A lexical database of a selection of Norwegian words, developed by the Research Group in Clinical Linguistics and Language Acquisition at the Department of Linguistic and Scandinavian Studies, University of Oslo (Lind et al. 2015). They are also open class words and of 3-8 letters in length.

In addition, there were some training materials added before the actual experiment in order to familiarize the participant with the whole experiment. The training session did not include any Norwegian words. To check the full set of stimulus list, see Appendix 1.

2.2 Procedure of the experiment design The whole experiment was designed in SuperLab software version 6.0 using a Mac-Mini. The experiment was conducted in a closed soundproof room, which is a laboratory for the linguistics department. A training block is added before the actual experiment where ten test words are used to familiarize the participants with the experiment procedure. As mentioned above no Norwegian words were added in training words and feedback was provided only for the training block. In the main experiment, participants saw Norwegian English cognates, English Non-cognates, Norwegian words and true non-words. They had to select a 'yes' response to English words only. The participants used the RB 530 model response pad, pressing the green button for 'words' and the red button for 'non-words'. A fixation cross was presented for 750 ms as an inter-stimulus interval. The stimuli words were presented for 2500 ms or until the participant responded. The time from when the word (stimuli) was presented on the screen to when they press the 'yes' - or 'no' - button was measured, providing the reaction time. Word order within each block was randomized for each participant. First the task was briefly explained to the participants orally and subsequently written instructions were presented on the computer screen. The instructions were given in English. Participants were not informed about the goal of the experiment, and no reference was made to its relation to bilingualism. R (version 4.1.2) and R Studio (version 2021.09.1) were

used to analyze the data for statistical test analysis. For this purpose two mixed-effect linear regression models were built, using the lme4 package and lmerTest to obtain p-values.¹

3 Results

From the data analysis, the results are quite clear and straightforward. Cognates were reacted to much faster compared to non-cognates. Mean RT for cognates is 1669.894 ms whereas, mean RT for non-cognates is 3291.926 ms. Figure 1 below shows the bar plot comparing RT for cognates vs. non-cognates.

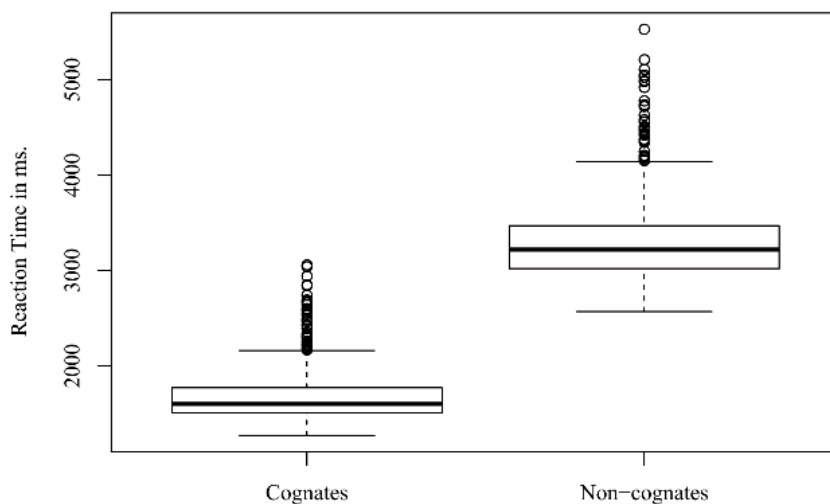


Figure 1: Reaction time for cognates vs. non-cognates.

Moreover, the figure below for reaction time of each participant is also showing that there is not much variation between them. That indicates that almost every participant responded quickly for the cognates compared to non-cognates. Figure 2 shows RT per participant (each bar is one person).

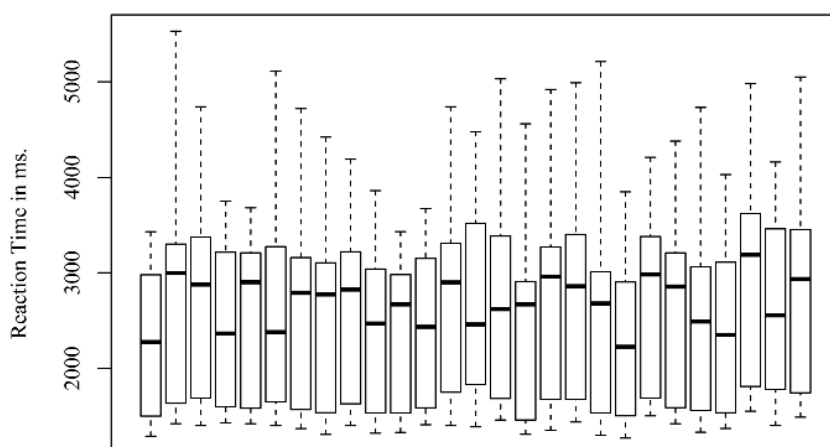


Figure 2: Reaction time for real words for participants.

¹ We thank Vadim Kimmelman for the help with the statistical analysis of the data.

Now let us take a look at the analysis for non-words and that are true non-words and real Norwegian words for this experiment. For the non-words, results are also very clear. Norwegian words took longer to process. The mean RT for non-words is 1891.309 ms and the mean RT for Norwegian words is 3687.520 ms. Figure 3 below shows the bar plot comparing RT for non-words vs. Norwegian words.

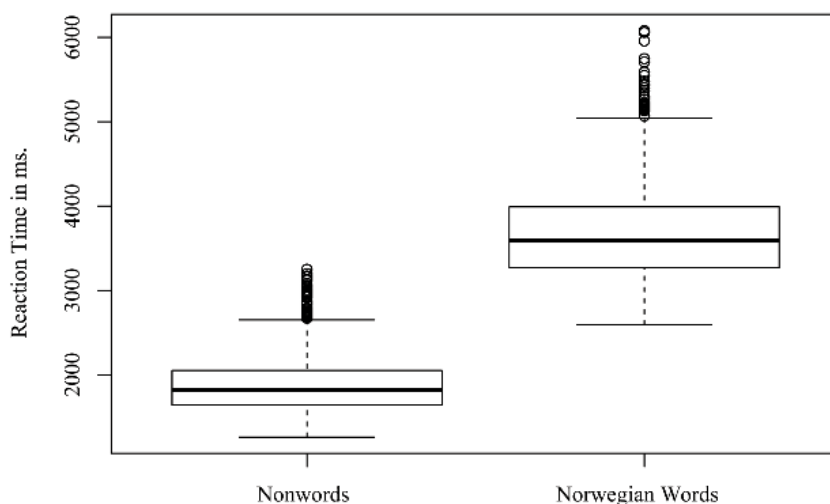


Figure 3: Reaction time for non-words vs. Norwegian words.

Similarly, if we look at RT per participant for non-words only, there is not much variation in this case as well. The figure below for reaction time of each participant for non-words is also showing the same result like the graph for words showed. Figure 4 below shows the graph for RT per participant (each bar is one person).

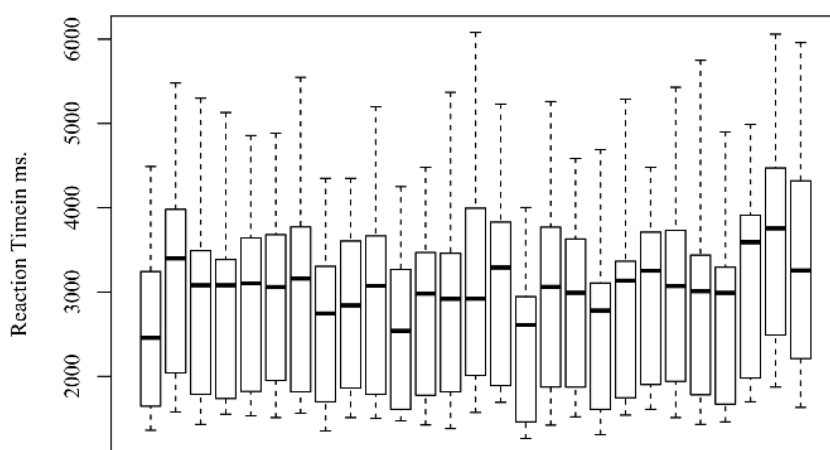


Figure 4: Reaction time for non-words of participants.

The first model was for processing of words, with RT as the dependent variable, the class of word (cognate vs. non-cognate) as the independent variable, and with random intercepts by Participant and Item. The model showed that cognates were processed 1621 ms faster than non-cognates (95% CI: 1574-1669, p-value <0.0001). We thus can conclude that cognates are processed significantly faster than non-cognates.

The second model was for processing of non-words, with RT as the dependent variable, the class of word (non-word vs. Norwegian word) as the independent variable, and with and with random intercepts by Participant and Item. The model showed that non-words were processed 1783 ms faster than Norwegian words (95% CI:

1712-1853, p -value <0.0001). We thus can conclude that non-words are processed significantly faster than Norwegian words.

4 Findings and Discussion

The experiment shows two effects: (1) cognate words are processed faster than non-cognates and (2) true non-words are processed faster than Norwegian words (which are non-words in the context of this experiment). Both findings provide support for the theory of non-selective lexical access. If the mental lexicons for English and Norwegian were separate, we would expect to have no cognate facilitation effect (because the cognates would be represented separately) and no inhibition effects for Norwegian words (as the experimental conditions only call for activation of the English mental lexicon) (Vanlangendonck et al. 2019). In contrast, non-selective lexical access predicts the cognate facilitation effects due to cognates activating similar lexical items in both languages, and the inhibition effects for Norwegian words due to the necessity to suppress the automatic identification of such words as real words by the active Norwegian mental lexicon (Dijkstra et al. 1998) and so supporting the general non-selective access theory.

5 Conclusion

The current study was conducted on 27 adult Norwegian bilinguals, whose second language is English and who do not have English parents. This experiment was done to check the mental lexical access of the participants. More specifically, whether their lexical access is selective or non-selective. This whole experiment was designed using a very popular method, lexical decision task, to observe the bilingual lexical access (Coltheart et al. 1979). This study shows that there is a significant reaction difference between the processing of cognates and non-cognates. This effect is known as cognate facilitation effect (Vanlangendonck et al. 2019). That means in this experiment, when the participants deal with any of their first or second language they showed that their mental lexicon is overlapping and so they processed cognates faster than non-cognates. It represents that there is an interference of their first language because they cannot access their lexicons separately. This goes against a prominent selective theory of lexical access (Gerard & Scarborough 1989). In order to examine this cognate facilitation effect more strongly, Norwegian words were added in the list of true non-words because adding words from the participant's first language as non-words will help to identify the mental lexical access easily (Poort & Rodd 2017). It was expected that as Norwegians they will be confused to identify Norwegian words as non-words, even though they were instructed to perform the task in English and identify the words that are only words in English. As expected, from Figure 3 it can be said that the participants indeed took longer time to respond the Norwegian words compared to the true non-words. Therefore, it also additionally proves that their mental lexicons are connected. It is evident that it is not possible to switch off one of the lexicon completely while doing a task on another language. Note that this contradicts with the result from Seim's (2018) study who did not find a cognate facilitation effect in Norwegian-English bilinguals. In conclusion, the current experiment has presented evidence supporting that bilinguals access their mental lexicons non-selectively and that cognates are processed faster than non-cognates and that Norwegian words (non- words for this study) are processed slower than true non-words (that don't exist in either languages) in case of Norwegian English bilinguals.

6 Appendixes

6.1 Appendix 1: List of stimulus for the main experiment

| Serial No. | Cognates | Non Cognates | Non-Words | Norwegian Words |
|------------|----------|--------------|-----------|-----------------|
| 1. | bible | arrive | balel | hytte |
| 2. | sport | hug | vek | vilje |
| 3. | fruit | rabbit | emte | rasende |
| 4. | media | castle | tunty | feie |
| 5. | belt | image | bip | bjeffe |
| 6. | uniform | bike | humner | jage |
| 7. | plant | wood | blyr | lykkes |

| | | | | |
|-----|----------|----------|----------|----------|
| 8. | slave | pink | prosse | spor |
| 9. | storm | shape | bub | svin |
| 10. | tongue | brave | herve | bevis |
| 11. | snow | stomach | kass | gni |
| 12. | energy | language | skjasp | gjeng |
| 13. | magazine | mountain | griep | tvinge |
| 14. | finger | pray | krale | nydelig |
| 15. | pair | page | tike | flau |
| 16. | project | airport | kare | snill |
| 17. | planet | view | deam | merkelig |
| 18. | guest | butt | diskjos | kjedelig |
| 19. | oil | color | majur | herlig |
| 20. | milk | battle | lenne | hjul |
| 21. | form | danger | mape | ansette |
| 22. | cake | nurse | etsisjon | brenne |
| 23. | nature | bird | fank | frykt |
| 24. | knife | pool | fap | beregne |
| 25. | rain | chair | pley | himmel |
| 26. | cream | bottle | flug | valp |
| 27. | rose | teacher | wittow | reklame |
| 28. | camera | beach | plir | tegne |
| 29. | wind | pants | hendir | kino |
| 30. | glass | gay | grag | gidde |
| 31. | bathroom | chicken | piteme | uheldig |
| 32. | race | laugh | nistak | sjel |
| 33. | hat | south | trake | opplegg |
| 34. | tree | smoke | kylle | knuse |
| 35. | arm | cry | kole | myk |
| 36. | cat | space | skjuse | utsikt |
| 37. | machine | hide | lymme | treg |
| 38. | ground | evil | apem | koselig |
| 39. | summer | brain | tribber | trygghet |
| 40. | bank | key | teke | bukse |

6.2 Appendix 2: Proficiency test form for participants

1. Do you have any English parent?

Yes No

2. Based on the ILR scale of 0-5 mentioned below, 0 being the lowest and 5 being the highest,

Rate your level of English proficiency.

□ 0 □ 1 □ 2 □ 3 □ 4 □ 5

English Proficiency: ILR scale

ILR Level 0 – No proficiency

- oral production limited to occasional, isolated words
- understanding limited to occasional isolated words or memorized utterances in areas of immediate needs.

ILR Level 1 – Elementary proficiency

- able to understand basic questions and speech, which allows for guides, such as slower speech or repetition, to aid understanding
- has a vocabulary only large enough to communicate the most basic of needs

ILR Level 2 – Limited working proficiency

- able to satisfy routine social demands and limited work requirements
- can handle limited work requirements, needing help in handling any complications or difficulties

ILR Level 3 – Professional working proficiency

- able to speak the language with sufficient structural accuracy and vocabulary to participate effectively in most conversations
- has comprehension which is quite complete for a normal rate of speech

ILR Level 4 – Full professional proficiency

- able to use the language fluently and accurately on all levels and as normally pertinent to professional needs
- can understand and participate in any conversations within the range of own personal and professional experience with a high degree of fluency and precision of vocabulary

ILR Level 5 – Native or bilingual proficiency

- has a speaking proficiency equivalent to that of an educated native speaker
- has complete fluency in the language, such that speech on all levels is fully accepted by educated native speakers in all of its features, including breadth of vocabulary and idiom, colloquialisms, and pertinent cultural references

6.3 Appendix 3: Participants' responses

| Participant no. | Proficiency level | English Parent | Date of participation |
|-----------------|-------------------|----------------|-----------------------|
| 1 | 4 | No | 1.11.2021 |
| 2 | 4 | No | 1.11.2021 |
| 3 | 4 | No | 2.11.2021 |
| 4 | 4 | No | 2.11.2021 |
| 5 | 4 | No | 2.11.2021 |
| 6 | 4 | No | 2.11.2021 |
| 7 | 4 | No | 2.11.2021 |

| | | | |
|----|---|----|-----------|
| 8 | 5 | No | 2.11.2021 |
| 9 | 5 | No | 2.11.2021 |
| 10 | 4 | No | 2.11.2021 |
| 11 | 4 | No | 2.11.2021 |
| 12 | 3 | No | 2.11.2021 |
| 13 | 4 | No | 2.11.2021 |
| 14 | 4 | No | 2.11.2021 |
| 15 | 5 | No | 2.11.2021 |
| 16 | 4 | No | 2.11.2021 |
| 17 | 5 | No | 2.11.2021 |
| 18 | 4 | No | 2.11.2021 |
| 19 | 4 | No | 2.11.2021 |
| 20 | 3 | No | 3.11.2021 |
| 21 | 3 | No | 3.11.2021 |
| 22 | 4 | No | 3.11.2021 |
| 23 | 4 | No | 3.11.2021 |
| 24 | 4 | No | 3.11.2021 |
| 25 | 3 | No | 3.11.2021 |
| 26 | 4 | No | 3.11.2021 |
| 27 | 4 | No | 3.11.2021 |

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