UNIVERSITY OF BERGEN

Faculty of Humanities

Department of Linguistic, Literary, and Aesthetic Studies

Ling 350

Master’s Thesis

November, 2023

Does the Stimulus List Composition Influence the Cognate Facilitation Effect in Bilingual Lexical Access?

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Acknowledgments

I would like to express my deepest gratitude to the Almighty for guiding me throughout this journey. I am also grateful to my parents, whose love, sacrifices, tireless efforts, encouragement, and belief in my abilities have been a constant source of motivation. I extend my sincere gratitude to my thesis supervisor, Vadim Kimmelman for his support throughout the process of completing this thesis. I would also like to extend my heartfelt appreciation to all the teachers who have played a crucial role in shaping our academic journey, imparting knowledge, and enlightening us with their passion for learning. I am thankful to my fellow classmates and friends, who gave me ideas, feedback, and support from time to time.

Abstract

The research explores the impact of stimulus list composition on cognate processing in Norwegian-English bilinguals through three lexical decision experiments in English with different stimulus list arrangements. The first experiment used a pure stimulus list containing cognates (words that are orthographically and semantically similar between the two languages), non-cognates, and true non-words, revealing a significant and strong cognate facilitation effect, that is, cognates were processed much faster than non-cognates. The second experiment introduced Norwegian words (from participants' L1, which should be classified as non-words in the context of the experiment) alongside the stimuli from the first experiment, unexpectedly also demonstrating evidence for the strong cognate facilitation effect. In the third experiment, interlingual homographs (words that are orthographically similar but semantically different in the two languages) were included in the stimulus list, and once again, a substantial and significant cognate facilitation effect was observed. Overall, all three experiments consistently indicated a clear cognate facilitation effect, supporting the theory of non-selective language access. The study's results were examined in light of the Bilingual Interactive Activation Plus (BIA+) model predictions concerning stimulus list composition effects and processing. According to the BIA+ model predictions, the degree of orthographic cross-linguistic similarity also affects the size of the cognate facilitation effect meaning stimulus list composition can be one of the factors that triggers increased response competition and thus negate the cognate facilitation effect. However, the results of this study contradict the BIA+ model predictions, revealing a notable cognate facilitation effect across all three experiments.

Keywords: Cognate facilitation effect, cognates, stimulus list composition, BIA+, bilingual lexical access, lexical decision task, interlingual homographs, bilingualism

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1.0 Introduction

Researchers over the years wondered about how the mental lexicon of bilinguals works. The investigation of mental lexicons was of central importance in the field of psycholinguistics and cognitive sciences. The language processing system of bilingual speakers diverges significantly from that of monolinguals. A key factor contributing to this difference is the occurrence of interference from the other language while reading words in either language. This nonselective perspective on language processing, articulated by Dijkstra and Van Heuven, (2002) and subsequent researchers, contrasts with earlier studies that endorsed a language-selective viewpoint of the bilingual mental lexicon (Gerard & Scarborough, 1989; Scarborough et al., 1984). However, recent studies view mostly the fact that languages in bilinguals mutually interfere and that leads to a competition of activation until the relevant one is selected. The term *word recognition* refers to an association of a given letter string (a word) with the lexical information it carries. This *word recognition* also plays a role in determining whether it will operate in a language-selective or nonselective manner. This encompassing information includes the orthographic, semantic, and phonological aspects of each word stored in the mental lexicon. This whole word recognition process is closely tied to lexical access, which is the mental process of retrieving all this information upon the word's entry into the mental lexicon (Dijkstra, 2005). This is an automatic and seamless process that happens whenever there is a requirement to link input be it visual or auditory, to a concept stored in the lexicon.

Cognates and interlingual homographs are crucial for the investigation of the shared linguistic overlap features as they are present in both languages. Cognates are a type of words that share form and meaning across languages (Poort & Rodd, 2017), and interlingual homographs refer to words that share their orthographic but not their semantic representations across two or more languages (Dijkstra et al., 1998). Hence, these two types of words are best suitable for an observation of the bilingual mental lexicon and how they access these words.

Numerous studies, comprehending both production and lexical recognition or decision experimental contexts, have consistently demonstrated that bilinguals demonstrate faster processing of cognates compared to non-cognates (control words). This phenomenon is known as the cognate facilitation effect (Costa et al., 2005; Sánchez-Casas & García-Albea, 2005). According to Rosselli et al. (2014), in lexical retrieval, cognates have a processing advantage over non-cognates because of overlap in form and meaning and how they are represented in the mental lexicon. Several studies have proved that retrieval of cognates takes less time compared to the retrival of non-cognates for example (Dijkstra et al. 2010; De moor, 1998; and Van Heste,1999).

Poort and Rodd (2017, p.52), in their study with Dutch and English bilinguals, decided to check the cognate facilitation effect when using a mixed list, where half of the regular non-words were removed by Dutch words and this "significantly reduced the cognate facilitation effect".

In another study with Dutch-English bilinguals, by Vanlangendonck et al., (2019) removing half of the true non-words with Dutch words turns the cognate facilitation effect into inhibition.

Conversely, interlingual homographs, due to their shared orthography but distinct semantic representations, have been observed to induce inhibition effects when compared to non-cognates and cognates. In addition, the mixed language setting has proven to be particularly effective in revealing inhibition effects for interlingual homographs (Anagnostopoulou, 2022).

In this study, experiment 1 is designed with a pure list meaning no words from the non-target language in order to observe the cognate facilitation effect. Contrastively, experiment 2 and 3 is designed with words from the non-target language and homographs with the latter one to observe the inhibition effect. Several additional studies have proven that the composition of the stimulus list, referred to as stimulus list composition, influences the performance of bilinguals in lexical decision tasks. Notably, the inclusion of L1 words in the stimulus list, which bilinguals must reject as non-words, generates response competition and increases the inhibitory effects, particularly for interlingual homographs (Dijkstra et al., 1998).

1.1 Aim of Study

The purpose of the current study is to contribute to the research on bilingual word recognition by investigating the bilingual group (Norwegian-English), because of cross-linguistic similarity (having cognates and interlingual homographs), fulfills the requirements to provide interesting results with respect to the reaction time of cognates and interlingual homographs. Hence, this study aims to examine the assumptions of the BIA+ model concerning cognates, specifically investigating the impact of stimulus list composition on their processing. As previously mentioned, the cognates and homographs have different representations and this can be observed thoroughly through a pure list and a mixed list experimental setting, as the two settings require different processing of the same words. Hence, the purpose of this study is to investigate the stimulus list composition effect on cognates and how it influences the facilitation effect by adding interlingual homographs to the list. As interlingual homographs were only presented in Experiment 3, it is hard to draw conclusions for the processing of homographs. According to the

BIA+ model predictions, the homographs can be expected to process slowly in the presence of non-target language words (Norwegian words). The research questions and hypothesis for this study will be discussed in the next chapter.

1.2 Research Questions and Hypothesis

1. Do Norwegian-English bilinguals process cognates more quickly than non-cognates in a pure list?

There are two sub-parts for the second hypothesis.

2. a) How will the inclusion of Norwegian words affect the cognate facilitation effect?

2. b) How will the inclusion of both Norwegian words and interlingual homographs affect the cognate facilitation effect?

These prime research questions derived the hypotheses mentioned below, which will be later discussed according to the BIA+ model predictions in Chapter 5.

1. Cognates will be processed faster than non-cognates in a pure list as they do not have any non-target words to cancel out this effect.

According to the previous literature mentioned above, we can hypothesize in the following way:

2. a) A mixed-language list will cancel out the facilitation effect. That means that the bilinguals will take a longer time to process cognates in the presence of words from a non-target language (Norwegian words).

2. b) In this case, cognates will again processed slowly as there will be Norwegian words. That means that the stimulus list composition would affect the cognate facilitation effect. The inhibition might be stronger compared to the results of Experiment 2.

2.0 Theoretical Background

2.1 What is Cognate?

Cross-language cognates refer to words that “share similar or identical semantics (meaning), orthography (spelling), and/or phonology (pronunciation) across two or more languages” (Sherkina-Lieber, 2004, p. 108). The reasons behind having a similar meaning or form is due to originating from the same word historically. For example, Norwegian and English both languages have similar vocabularies because they both came from the Germanic branch of the Indo-European family (Seim, 2018). Besides, cognates can be a common phenomenon between two languages as they loan words from each other or they both borrow words from a third language (Sherkina-Lieber, 2004). It is not uncommon for English and Norwegian to be closely related languages as during Norse settlements Scandinavian language “had a major influence on English” around 770-970 AD (Seim, 2018, p. 5). In English names of nature also places were mostly influenced by the Scandinavian languages, such as “sand”, “bank”, and “hut”, including place names ending in “by” in English, namely, Westby, a town in Southwest Wisconsin (Strang, 2015 p. 338-339). Notably, terms like “taxi”, “scanner”, “cafe”, and “hamburger” have found their way into numerous languages, a phenomenon accelerated by the massive influence of globalization, social media, television, business connections, and related factors (Seim, 2018, p.5).

2.2 Cognate Processing

How cognates are represented in the mental lexicon of bilinguals can be answered if we observe how cognates are processed in the brain, which is a major question in cognate processing studies. One of the important factors of language processing is lexical access. It is a process through which language users try to retrieve information about lexical items namely semantic, orthographic, phonological, and syntactic aspects of words by entering into the mental lexicon (Dijkstra, 2005, p. 180). Humans assess mental lexicons when they want to recognize and produce words. It is a subconscious process. This means that assessing the mental lexicon is an automatic process and we are completely unaware of it. The theories regarding bilingual lexical access will be discussed in Section 2.3

Words can be recognized either presented visually or orally. Bilinguals' minds can present several options that can be recognized, when the first part of a word is presented, several words that fit the first letter string either written or phoneme (oral) can activate the mind. For example, if the letter string 'c-a' could be activated words starting with this letter string such as 'cat', 'car', 'cap', and many other words matching this letter string can come to mind. It continues happening until the brain surpasses the recognition threshold and then the final target word is recognized (Dijkstra, 2005, p. 180). However, the whole process of the time from when a word is presented to when it is activated is very short. Thus, the language users cannot even notice that other words were activated in the mind upon the initial presentation of the first few letter strings. When other words are activated in the mental lexicon upon resenting the target word, this process is called spreading activation. The target word that is being presented (or letter strings) will spread activation to related words, even after recognizing the target word. These words can be orthographically, phonologically, or semantically related words. For example, seeing the word 'car', which will activate the words 'wheel', 'drive',' road' etc. semantically. The activation can also spread to the words 'cat', 'cap', 'can' etc., which will be activated at the orthographic level, due to their similar spelling.

All these are examples of activation within one language. It can also happen with bilinguals and second-language learners. The theory of spreading activation also works similarly when bilinguals and second language learners are performing a lexical decision task, and they recognize a word in both of their languages. For example, when Norwegians who have learned English as a second language are performing a lexical decision task and see an English cognate on the screen, such as, ‘bank’, to recognize the word they do not necessarily have to directly access the English word in their lexicon. They can primarily activate the Norwegian word in their mental lexicon and then they can activate the English translation of the cognate. In short, it is safe to assume that the similarity of two translations of words declares that the activation in one language will activate the equivalent in the other language (Peeters et al., 2013, p. 316). This theory is also relevant in understanding how words are accessed across languages.

Contrastively, this activation can also happen for interlingual homographs (false friends), leading to the wrong interpretation of the meaning of the word. It also applies to the case of partial cognates, which can have a similar impact on lexical retrieval. Partial cognates are words that contain two meanings in one language, but only one of these meanings overlaps with the corresponding word in the other language. For example, ‘rose’ can be a flower or it can also mean the past tense of the verb ‘rise’ in English, which can cause confusion in recognition as this will be dependent on the context. That is why, in real-life language using contextual aspects will lead to successful recognition. Although there are factors that can have a negative impact on lexical retrieval, the bottom line when it comes to cognate identification is that cross-language cognates can spread activation and assist lexical retrieval. Peeters et al. (2013, p. 316) claim that if cognates facilitate recognition in another language, one can also assume that a greater form overlap (more similar cognates) will result in faster recognition. In other words, orthographical identical cognates have a greater chance of faster recognition compared to cognates that are only near-identical.

2.3 Bilingual Lexical Access

The purpose of this chapter is to critically present and review the existing literature on lexical access in bilingual word recognition. In the field of bilingual lexical access research, one key question is how bilinguals access words in their two languages, which is quite different from monolinguals as the bilinguals have to constantly manage two languages while understanding and producing words in the appropriate language. There are two popular yet opposing views to address this issue, one is the language selective access theory and the other is the language non-selective access theory. Both these theories are discussed below.

2.3.1 Selective Access

Language selective access theory suggests that cognates have two representations of cognates in the mental lexicon instead of one shared representation in the two languages. Selective access indicates that only the language in use is being activated for retrieval as one language is not facilitated by an identical or very similar representation in the other language (Dijkstra, 2005). The selective access theory also suggests that the recognition of cognates will not be faster than the non-cognates when they have similar frequencies and word lengths. The reaction times for cognates and comparison words would then resemble each other (Seim, 2018). The studies that found evidence for language selective access theory are few compared to the language nonselective access theory. Among those that found evidence in language selective access theory are, Caramazza & Brones (1979), Costa et al. (1999), Gerard & Scarborough (1989), and Scarborough et al. (1984). Two of them are discussed briefly below.

In an early study by Scarborough et al. (1984) aimed to investigate language-specific and language-nonspecific aspects of lexical access in Spanish-English bilinguals through two lexical decision tasks. In the first experiment, participants were divided into groups, with one group exposed to Spanish words and non-words during the first part. During the second part with English words and non-words. The other group experienced the reverse order. The results of the first experiment revealed no transfer of word recognition experience between languages during this experiment. The second experiment involved three groups of participants, English monolinguals, Spanish-English bilinguals (where Spanish was used as the target language), and Spanish-English bilinguals (where English was used as the target language). In that mixed list condition, bilingual participants behaved similarly to monolinguals, demonstrating quick rejection of real Spanish words as well as non-target words. The result suggests that, under certain conditions, bilinguals could exhibit language-specific lexical access behavior, resembling monolingual patterns. Therefore, the researchers concluded that language access is selective.

In the study conducted by Gerard and Scarborough in 1989, the researchers aimed to explore how Spanish and English bilinguals access and process cognates in a lexical decision task. The stimulus list consisted of cognates, non-cognates, and homographs. The cognates and non-cognates used in the study were carefully chosen to be comparable in terms of frequencies and word lengths. The result of the study showed that there were no significant differences in response times between the cognates and non-cognates during the lexical decision task. This result led the researchers to support the theory that lexical access in bilinguals is language-selective. In other words, when bilinguals were presented with words in both languages, their recognition and processing of these words did not show a significant advantage or disadvantage based on whether the words were cognates or non-cognates. Gerard and Scarborough, (1989) concluded that bilinguals can selectively access the language they need without interference from the non-relevant language (p. 308).

Costa, (2005) on the other hand support both view of language selective and non-selective access. Costa (2005) supports language access being non-selective, "when it comes to activation flow from the semantic system to the two languages of the bilingual up to the phonological level". On the other hand, during the selection process, Costa, (2005) leaned for both views as according to the researcher "empirical evidence exists for both views and so decided high proficiency can be a matter behind language specificity" (as cited by Anagnostopoulou, 2022, p. 5).

2.3.2 Non-Selective Access

The non-selective access theory suggests that the lexicon for each language is continuously activated and it not something that a person can turn off according to the language context (Dijkstra, 2005, p. 179). The cognate facilitation effect being observed in visual lexical decision experiments, where researchers had concluded that language access is non-selective evidenced by many studies e.g. (Cristoffanini, Kirsner, & Milech, 1986; De Groot & Nas, 1991; Dijkstra, Grainger, & Van Heuven, 1999; Dijkstra, Miwa, Brummelhuis, Sappelli, & Baayen, 2010; Dijkstra, Van Jaarsveld, & Ten Brinke, 1998; Font, 2001; Lemhöfer et al., 2008; Lemhöfer & Dijkstra, 2004; Peeters, Dijkstra, & Grainger, 2013; Sánchez-Casas, García-Albea, & Davis, 1992; Van Hell & Dijkstra, 2002) (as cited by Poort and Rodd, 2017). Three of the studies are discussed briefly below.

The study by Peeters et al., (2013), where they conducted a lexical decision task with French-English bilinguals. English was the target language in their experiment meaning participants had to choose words that were only English. Words in both groups were matched for frequencies (in both languages) and word lengths (number of letters). The results revealed as expected significant differences in reaction times for the cognates and non-cognates. The reaction time difference is represented by milliseconds (ms). The average reaction times for cognates were 694 ms, and 726 ms for non-cognates (Peeters et al., 2013, p. 320). That means, the mental lexicons of the participants are connected and so they showed significant reaction time difference between cognates and non-cognates. The researchers concluded that the result of their study showed evidence for bilingual lexical access being nonselective.

Poort and Rodd, (2017) conducted two English lexical decision experiments, where participants had to choose words in English. The participants were Dutch-English bilinguals. Here I will only discuss task one, which is their *standard version*. In their standard version of the task where they used a pure list, meaning a list with cognates, non-cognates, and non-words only, showed a significant cognate facilitation effect. The cognates of that study were processed 31 milliseconds (ms) faster than the non-cognates. This also strongly provides evidence that bilinguals have one integrated lexicon and that lexical access is language non-selective (p. 52).

A lexical decision task by Lemhöfer & Dijkstra (2004) was performed on Dutch-English participants. The stimulus list consisted of cognates, non-cognates (English control words), and non-words. The frequency of cognates and non-cognates were matched as well as their word length. In the English lexical decision task experiment, the L2 learners showed a cognate facilitation effect. This means that the participants recognized English-Dutch cognates faster than the English words that were not cognates corresponding to the Dutch words that have similar frequencies and word lengths in the number of letters. The researchers' recorded average reaction time for cognates was 546 ms compared to the non-cognates, which was 601 ms (p. 540). The researchers concluded that there was a large cognate facilitation effect among the L2 learners (English is their L2 and Dutch is their L1). The participants demonstrated a very clear cognate facilitation effect when recognizing lexical items.

2.4 The Bilingual Interactive Activation (BIA) and Bilingual Interactive Activation Plus (BIA+) Models

The Bilingual Interactive Activation (BIA) by Dijkstra & Van Heuven (1998), and Dijkstra et al., (1999) and the Bilingual Interactive Activation Plus (BIA+) by Dijkstra & Van Heuven (2002) are both frameworks designed to simulate and explain the cognitive processes involved in bilingual language recognition. The BIA+ model is an extension and updated version of the original BIA model, incorporating additional features to enhance its accuracy in accounting for various phenomena observed in bilingual language processing (Dijkstra & Van Heuven, 2002). Contrasting features between BIA and BIA+ are given below as presented in (Dijkstra & Van Heuven, 2002).

In the original BIA model, connections between languages were unidirectional meaning activation flowed only from the language being processed to the other language. On the other hand, the BIA+ model introduced bidirectional connections between languages. This means that activation can flow both from the language currently being processed to the other language and vice versa. Bidirectional connections allow for a more interactive and dynamic representation of bilingual processing (Dijkstra & Van Heuven, 2002, p. 209).

The original BIA model did not include inhibitory connections between lexical entries of different languages. Inhibitory connections are essential for modeling certain effects, such as inhibition observed in interlingual homographs. Whereas, The BIA+ model introduced inhibitory connections to account for phenomena like inhibition effects in the presence of interlingual homographs. This addition allows the model to better capture the complexities of bilingual word recognition. “This BIA+ model is strongly affected by Green’s (1998) Inhibitory Control (IC) model specifies the control that bilinguals have over the processing in their lexico-semantic system in different task conditions" (Dijkstra & Van Heuven, 2002, p. 181).

Unlike the original BIA model, the BIA+ model explicitly considers the effects of stimulus list composition on bilingual word recognition. It addresses how the presence of words from both languages in a mixed list influences the competition and processing dynamics (Dijkstra & Van Heuven, 2002, p. 191).

While both the BIA and BIA+ are compatible with the Revised Hierarchical Model, The BIA+ model integrates elements of the Revised Hierarchical Model (RHM), introducing two levels of representation, the lexical level and the conceptual level. This integration enhances the model's ability to simulate bilingual lexical processing (Dijkstra & Van Heuven, 2002, p. 222-223).

The BIA+ model explains the details of orthographic representations. According to the predictions upon presenting a letter string a parallel activation of orthographic candidates (both L1 and L2) is triggered. The activation of L2 codes is slightly weaker than the L1 codes as they are less strongly represented in the lexicon. Therefore, the activation depends on the similarity to the input letter string, and the bigger the similarity the stronger the activation. The model may not be suitable for languages with distinct alphabetical writing systems, as no orthographically similar codes can be activated. Conversely, in languages with the same orthography but differing diacritic markers, such as English and Norwegian, a bottom-up effect may occur. Specific diacritic markers could restrict words to one language, preventing the activation of corresponding nodes in the other language. The degree of orthographic cross-linguistic similarity also plays a role in the Cognate Facilitation Effect and the interlingual homograph effect, as suggested by various studies namely, Anagnostopoulou, (2022), Dijkstra & Van Heuven, (2002), and Vanlangendonck et al., (2019) To summarize, while the BIA model laid the foundation for understanding bilingual word recognition, the BIA+ model builds upon it by introducing bidirectional connections, inhibitory mechanisms, and a more sophisticated representation of stimulus list composition and cognate processing. The enhancements in the BIA+ model contribute to a more accurate and comprehensive simulation of bilingual language recognition processes.

Given that the BIA+ model takes into account the impact of stimulus list composition, proposing that the inclusion of words from both languages in a mixed list could result in heightened competition and interference effects, this study will likewise assess and compare the cognate facilitation effect, aligning with the principles of the BIA+ model.

2.5 Adding Words from the Non-Target Language

In several studies, researchers have experimented with the stimulus list by adding words from the non-target language in a language-specific lexical decision task. The non-target language can be either the participants' first or second language. For example, in a study by Vanlangendonck et al., (2019) with Dutch-English participants pseudo words were supplemented with Dutch words, in an English lexical decision task. Since the task was in English that means participants had to choose words that were only in the English language, those Dutch words even though real words required a 'no' response from the participants. This change in the stimulus list from a pure language list to a mixed language list has been shown to turn the cognate facilitation effect into an inhibition effect.

As discussed in the previous sections, bilinguals tend to process cognates faster than the control words in a lexical decision task. This cognate facilitation effect has been observed in many experimental circumstances in visual word recognition (e.g., Cristoffanini, Kirsner & Milech, 1986; De Groot & Nas, 1991; Dijkstra, Grainger & van Heuven, 1999; Peeters, Dijkstra &

Grainger, 2013; Voga & Grainger, 2007) (as cited by Vanlangendonck et al., 2019, p. 836). This very cognate facilitation effect changes when in the stimulus list there are homographs and words from the non-target language. Whether there will be a null or inhibition effect, will be dependent on the stimulus list (Dijkstra, 2005). Moreover, in an experiment with homographs, if there are no words other than the target language, there tends to be a null effect (that is, homographs are not processed differently from non-homographs). On the other hand, where there is a mixed list, containing words from both L1 and L2, and the words from L1 require a 'no' response then the homographs were processed much slower than the control words.

For instance, a study by Dijkstra, Van Jaarsveld, and Ten Brinke (1998) conducted two experiments with Dutch-English bilinguals. In Experiment 1, they were presented with interlingual homographs in an English lexical decision task with only English words in the stimulus list. The result showed that the participants' RTs were not different from those matched English control words. However, in experiment 2, after half of the pseudo words in the list were replaced by Dutch words, requiring a 'no' response, showed slower RTs were obtained for interlingual homographs than for English control words.

Computational models of bilingual word recognition such as the BIA+ model (Dijkstra & van Heuven, 2002) and the Multilink model (Dijkstra & Rekké, 2010; Dijkstra et al., 2019) have proposed two mechanisms in order to explain the observed differences in result patterns across item types consider cognates vs interlingual homographs and stimulus lists that are pure vs mixed. The mechanisms relate to cross-linguistic overlap and to response competition in pure and mixed stimulus lists. In the case of the mixed list (i.e., contains words of two languages), words from the non-target language may frequently appear and must be explicitly considered and coupled to the 'no' response (Dijkstra, 2005; Van Heuven, Schriefers, Dijkstra & Hagoort, 2008). For example, in an English lexical decision task with mixed English and Dutch words, participants may encounter Dutch words so frequently that they need to exclude the possibility that the input is a Dutch word on every trial (Vanlangendonck et al., 2019, p. 837). Therefore, a change in the stimulus list (from pure to mixed list) can increase response competition associated with the interference effect. When homographs are added to the list both the L1 and L2 will be activated because there are going to be 'no' and 'yes' responses respectively. Hence, it will cause response competition. Due to the increased response competition, this will slow down the 'yes' decision from the L2 reading of the homograph relative to a matched control word.

A similar study was conducted by Poort & Rodd, (2017) about the cognate facilitation effect in bilingual lexical decision being influenced by stimulus list composition. In experiment 1 (*standard version*), where there was a pure list containing cognates, English control words, and regular non-words, participants' reaction time was 31 ms faster for the cognates than for the English control words. This means it showed a significant cognate facilitation effect. The *standard version* was discussed in the previous section 2.3.2. However, in the mixed version, where the list contained interlingual homographs, pseudowords, and Dutch-only words showed a non-significant disadvantage for the cognates (8ms). In contrast in experiment 2, just by adding Dutch words to the English lexical decision task, cognates were recognized 50 ms more slowly than English controls. The researchers also concluded that the response competition that arises between 'yes' and 'no' responses to non-target language words, cancels out the facilitation effect of cognates as a result of their shared form and meaning in both languages. Poort & Rodd, (2017) mentioned that the inclusion of interlingual homographs, pseudo homophones, and Dutch words as extra stimuli in experiment 2 had affected the size and/or direction of the cognate effect (p.53). In the next section, I would like to discuss the Inhibitory Control (IC) model because the mixed language stimulus list creates an inhibitory effect and that has been explained in detail in the IC model.

2.6 Inhibitory Control (IC) model

Researchers argue about how bilinguals select a representation between the competing alternatives in their two languages. This has been referred to as the 'hard problem' of bilingual lexical access in speech production (Finkbeiner, Gollan, and Caramazza, 2006). It is also associated with the comprehension domain of a bilingual and how they can successfully fetch the correct meaning of interlingual homographs in the appropriate language context if all of its meanings are activated regardless of the language in use. In order to address this issue the inhibitory model was proposed. It provides an appealing answer to this problem which is the inhibitory mechanism that actively suppresses the non-target representations.

This inhibitory hypothesis has been articulated in the Inhibitory Control model (IC model, Green, 1998). The IC model is a broad framework that explains how bilinguals select between active representations in both languages at several levels of processing (e.g., lexical semantic) in different linguistic domains namely language comprehension and language production.

According to the IC model, different levels of control are implied in bilingual language processing. There are two types of controls. One type of control is achieved by ' 'task schemas". This allows bilinguals to select a task rather than another from the many possible reading words, translating words, etc. This type of control is achieved by suppressing the competing task, which will be in favor of the intended task. The second type of control is located at the "lexico-semantic level". Green proposes that each lexico-semantic representation has an associated language tag (e.g., L1 or L2) that exerts control by activating and inhibiting lexico-semantic representations according to the intended language (Macizo et al., 2010, p. 233).

However, most of the empirical evidence supporting inhibitory processes in bilingual processing comes from the language production domain (Costa & Santesteban, 2004; Meuter & Allport, 1999) even though the IC model is intended to explain the control of the bilingual languages in comprehension and production. In a situation where the bilinguals are asked to name digits or pictures in their L1 or L2 in an unpredictable manner based on the language switching paradigm, the typical pattern of switching cost of L1 is larger than the switching to L2. Green, (1998) describes that this is because L1 is more activated and it needs to be more strongly suppressed when bilinguals speak in L2. Hence, it is harder to switch to the dominant L1 as it was strongly inhibited when speaking L2 and so, more time is required to reactivate it.

2.7 Relevant Studies

There are two studies that need to be discussed briefly as they have similarities with the current study.

2.7.1 The first study is by Seim, (2018)

Seim, (2018) conducted a study to investigate the organization of mental lexicons between two groups, i) the Norwegian English bilinguals (Having Norwegian and English parents), and ii) the English as second language learners (learn English later in their lifetime and do not have English parents). The stimulus list consisted of cognates, non-cognates, and true non-words. Among them, the non-cognates were divided into three different frequencies (high, medium, and low). "The medium frequency non-cognates were used as a direct comparison group to the cognates" (Seim, 2018, p. 19). A lexical decision task was conducted to measure the reaction time difference between cognates and non-cognates for both groups (Bilinguals and L2 learners). The test was done to observe, "whether lexical access was language selective or language nonselective, and whether there was a difference between the two groups in this respect" (Seim, 2018, p. 33). The results of her studies showed no significant reaction time difference between cognates and non-cognates. She concluded that the results of her study evidence for lexical access being selective. She also suggested that cognates have two representations in the brain and so the mental lexicons are not connected. The results were the same for both bilinguals and L2 learners meaning there is no reaction time difference between cognates and non-cognates in either group. This also suggested that there is no potential difference in lexical access between bilinguals and L2 learners.

2.7.1.1 Comparison with the Current Study

This present study also represents similar language groups which are Norwegian-English bilinguals. However, this study chose to work with participants who do not have an English parent (to match with Seim, (2018), the L2 learners group). The current study also experimented with the stimulus materials used in Seim's, (2018) study. It used only medium-frequency cognates and non-cognates. However, this current study conducted three different experiments with different stimulus lists (in all experiments the cognates and non-cognates remained the same). For further details on the stimulus list, please see chapter 3.3. The current study has also used, Norwegian words (as non-words) and interlingual homographs although Seim, (2018) did not use any of these stimulus materials. Interestingly, both the study of Seim, (2018) and the current study have contrasting results. The results of the current study will be discussed in Chapter 5.

2.7.2 The second study is by Anagnostopoulou, (2022)

The study by Anagnostopoulou, (2022) is a replication of Vanlangendonck et al., (2020). However, the difference between these two studies is the language group. Anagnostopoulou, (2022) experimented with Danish- Swedish bilinguals (divided into two groups early and late bilinguals), whereas Vanlangendonck et al., (2020) with Danish-English bilinguals (no division). The stimulus list of the study of Anagnostopoulou, (2022) contained cognates, control words (non-cognates) from the participants' second language, which is Swedish, interlingual homographs, and pseudo words (true non-words). Two lexical decision tasks were conducted by Anagnostopoulou, (2022). Both the tasks were language-specific, meaning participants had to choose words that only existed in the Swedish language. The first task where only, cognates, control words, interlingual homographs, and non-words were used. In the second task, all the materials were used as it is except for the non-words where half of them were replaced by Danish words (required a 'no' response from the participants). According to the study by Vanlangendonck et al., (2020), it was expected that a change from a pure to a mixed list will increase the response competition effect and turn cognate facilitation into inhibition. However, the result of Anagnostopoulou, (2022) showed a null cognate facilitation effect for both of her subject groups, early and late bilinguals.

2.7.2.1 Comparison with the Current Study

The current study represents a different participant group than Anagnostopoulou, (2022). The current study also did not divide early and late bilinguals between Norwegian-English bilinguals. However, this study carefully chose words from the participants' first language in order to avoid any language-specific diacritics unlike Anagnostopoulou, (2022). The current study conducted three lexical decision tasks, which were also language-specific (English). However, unlike the study of Anagnostopoulou, (2022), the current study had one task with a pure stimulus list, the second task with only words from the first language (Norwegian words), and the third task contained both Norwegian words and interlingual homographs. In this case too both the study of

Anagnostopoulou, (2022) and the current study have contrasting results. The results of the current study will be discussed in Chapter 5.

2.8 Expectations of the Current Study

The studies presented above predict that bilinguals will demonstrate a cognate facilitation effect. That means they will react faster to cognates than the controls in a given target language. However, this facilitation will also be dependent on the condition of the stimulus list. If it is a pure language list, which does not contain any words from the non-target language, then the cognate facilitation effect will be large and significant. Contrastively, if in the list there are words from the non-target language, the facilitation effect will disappear due to the response completion. Moreover, adding homographs to the list can also bring some challenges. They can create inhibition depending on the task requirement and language intermixing. These views have been suggested by a large number of studies. Although there are still some debates about cognate representation, cognates having one shared representation is the most popular view. Despite the differences in cognate facilitation and inhibition effect, it is widely accepted that bilinguals will be non-selective when assessing their mental lexicon. Based on these results, the current study will try to find evidence suggesting non-selective access.

This study includes three experiments with different types of stimulus lists. In the first experiment, there will be a pure language list and, according to the literature review, there will be a significant cognate facilitation effect. In the second and third experiments, there will be a mixed language list, meaning there will be words from non-target language (Norwegian words) and (in the third experiment), both Norwegian words and interlingual homographs. If we consider the previous studies, we can expect that cognate facilitation will disappear in both experiments 2 and 3, and there is a chance that this study will provide evidence of a null effect or inhibition effect. The result of this study will be analyzed in chapter 4.

3.0 Methodology

3.1 Experiment Design

This research is conducted based on the lexical decision task method. The lexical decision task is a type of experiment where participants will use a keyboard or a response pad to distinguish between words and non-words from a series of letter strings (words) presented on the computer screen and they have to choose as fast as possible because there will be a time limit on the presentation of each letter string. It is mostly a ‘yes’ or ‘no’ answer. According to (Keuleers & Brysbaert, 2012), lexical decision tasks are the most popular in the field of experimental psycholinguistics. It is the most frequently used experiment in psycholinguistics as it has been proven to be the most effective in identifying lexical organization among bilinguals and monolinguals (Balota & Chumbley, 1984). This is also a very simple and systematic experiment that yields an accurate result. It is also considered to be a financially affordable experiment as it only requires a simple data/web program and a computer to operate (Keuleers & Brysbaert, 2012). This type of experiment only required a quiet environment, other than that it does not require any special room to be performed in. As the participants were university students, this experiment was conducted in their university at a psycholinguistics lab to ensure a quiet and suitable environment. This also made it easier for the researcher to save time on finding participants who were almost the same age group.

In this research, three different lexical decision experiments were conducted. The target language of all three experiments was English. Participants had to choose if the presented letter strings were a real word in English. The "yes" response must be only given to the words from the target language (English). Among the letter strings, all three experiments have; medium-frequency cognates (words that share meaning and form across two languages), medium-frequency non-cognates (words only exist in the English language), complete non-words (these words will be created based on English phonetics but are non-sense words), real Norwegian words, and interlingual homographs (words that have same spelling but have different meaning in two languages). More details on the stimulus materials will be presented in Section 3.3. For each of the experiments, the variables are slightly different. For example, in one experiment it is the type of words; cognates vs non-cognates, and for non-words it is true non-words vs Norwegian words. Another variable is the participants' proficiency level. Reaction time here is the dependent variable. For the first two experiments, under words, there are two categories: one is cognate and the other is non-cognate. In the first experiment, under non-words, there are only true non-words to check the actual cognate facilitation effect. Then in the second experiment, non-words consist of true Norwegian words and nonsense words. In the third experiment, the words include homographs as well as cognates and non-cognates. Under non-words, it is the same as the second experiment containing, Norwegian words and complete nonsense words. For all three experiments, response time and accuracy are recorded.

3.2 Subjects

Initially, there were 63 participants for the three experiments in total. However, after they finished the task, data from 3 of them data were excluded due to a low percentage of correct answers. As it is mentioned earlier accuracy was measured so the researcher set a bar of 80%. Those who will get below 80% will not be included in the data collection. Besides, in the self-assessment test of their proficiency in the English language, most of them identified themselves as 4 on a 5-point scale. Then the data of 1 additional participant was also excluded as that participant has an English parent. This research is based on Norwegian native speakers who have learned English later as their second language. Hence in total, there were remaining 59 participants for all three experiments and all of them were Norwegian native speakers and English was their second language. To specify, in experiment 1, there were 20 participants in total. In experiment 2 there were 19 participants, and in experiment 3, there were 20 participants. Their proficiency in English was measured through a self-assessment test using the ILR (Interagency Language Roundtable) (ILR: Herzog, n.d.). All the participants were adult undergraduate students of the University of Bergen from different faculties. All of them volunteered for this experiment. No personal data such as gender or age was saved and the experiment was completely anonymous.

3.3 Stimulus Materials

This study consists of three consecutive experiments and each experiment had different stimulus list compositions. Since the main task of the study is to identify words or non-words, there are two main categories and they are words and non-words. The cognates, non-cognates, and interlingual homographs are real English words for this experiment. Norwegian words although real words in the Norwegian language are considered as non-words as the experiment is to identify words from the English language. There are also English look-alikes (following the rules of English pronunciation and spelling) but nonsense words are included in all three experiments as true non-words.

For the first experiment, in the stimulus list, there were 80 words (40 cognates and 40 non-cognates) and 80 complete nonsense words. In the second experiment, the stimulus list includes 80 words (40 cognates and 40 non-cognates) and 80 non-words (40 Norwegian words and 40 complete nonsense words). In the third and last experiment, there are 112 words, which include 40 cognates, 40 non-cognates, and 32 interlingual homographs. There are also 112 non-words used in the third experiment stimulus list and among them, there are 40 Norwegian words and 72 complete non-words. The study aims to observe the results based on different stimulus list composition and its impact on reaction time.

In addition, there were some training materials added before the actual experiment to familiarize the participants with the whole experiment. The training session did not include any Norwegian words or interlingual homographs because this data will not be calculated in the actual tests. In order to check the full set of stimulus lists (see Appendix 1 and 2).

3.3.1 Cognates and Non-Cognates

Cognates refer to those words that share their meaning and form across languages (Poort & Rodd, 2017). For example, *sport* in English has the same meaning in Norwegian. The non-cognate on the other hand refers to the words that only exist in one language. All 40 cognates and 40 non-cognates were retrieved from the stimulus list in Seim, (2018). They were open-class words meaning they include nouns, verbs, and adjectives (Seim, 2018). The cognates of Seim, 2018 study were collected from the vocabulary list of Peabody Picture Vocabulary Test (PPV fourth edition, form A and B). It is a test popular for assessing children's and adults' vocabulary knowledge (Hoffman et al., 2012, p. 754). 20 medium frequencies ranging from 30-75 were collected from the PPV list. These are the cognates that are designed to be understood by different age groups. The remaining 20 cognates were collected from the appendixes of two De Groot & Nas (1991) and Sherkina-Lieber (2004). These two research articles were on bilingual cognate processing. The word length of the cognates is 3-8 letters. Although these cognates were not phonetically identical between English and Norwegian, they had both orthographic and semantic similarities. This is because Norwegian and English are very different in terms of phonology. However, some cognates had varying degrees of phonological similarity for instance glass, bank, uniform, and so on (see Appendix 1).

The direct comparison group of these 40 medium-frequency cognates is 40 medium-frequency non-cognates. These are also extracted from Seim, (2018). The non-cognates of Seim, (2018) study were collected from Corpus of Contemporary American English COCA (https://corpus.byu.edu/coca/). It also gathers several others from the appendixes of the research articles of Coltheart et al. (1979), and De Groot & Nas, (1991). These non-cognates were also 3-8 letters in length. They had the same range of word frequency as the cognates because it has been used as the control for the difference between the medium frequency non-cognates and the cognates.

The frequency of both the cognates and non-cognates was checked from the US frequency database SUBTLEX (http://subtlexus.lexique.org). This database collected words from the subtitles of movies and TV series. The size of this corpus is almost 50 million words (Brysbaert and New, 2009).

3.3.2 Interlingual Homographs

An interlingual homograph is a word that is present in more than one written language. However, unlike cognates, it has a different meaning or pronunciation in each language (De Groot et al., 2000). In this study, 32 interlingual homographs were added to the stimulus list to inspect the effect of different list composition effect on cognate processing among bilinguals. These homographs were extracted from a Norwegian wordbook (https://ordbokene.no/?ordbok=begge) and from Corpus of Contemporary American English COCA (https://corpus.byu.edu/coca/). The frequency of homographs was checked from the US frequency database SUBTLEX (http://subtlexus.lexique.org) (see Appendix 1). All the homographs were of various frequencies because it was hard to find homographs of the same frequency as cognates and non-cognates. However, the word length was kept the same between 3-8 letters.

3.3.4 Non-words

The non-words were created through *Nonsense Word Generator* (https://www.soybomb.com/tricks/words/). All the non-words were three to eight letters in length to match with other real words (see Appendix 1). These non-words were created to be phonetically acceptable strings of letters. Most of these words are pronounceable gibberish. According to Keuleers, many researchers based on a consensus have decided to make them similar to real words meaning the inclusion of phonetically acceptable strings of letters of the target language in a lexical decision task (2010, p. 627). This is because complete nonsense words without any similarity between real words would be too easy and obvious for the participants to sort out and this would not pose an actual dilemma among participants of whether or not it is a word (Vitevitch & Luce, 1998). In this study, in total eighty non-words were created through the above-mentioned database.

3.3.5 Norwegian words

Another aspect of this study is to include words from the participants' first language which is Norwegian. These words were actually words in the Norwegian language. The reason behind putting them in the stimulus list is to observe the mixed list composition effect such as Vanlangendonck et al., (2019), and evaluate reaction time among participants, whether it takes longer to identify Norwegian words or the complete non-sense words (De Groot et al., 2000). These Norwegian 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) (see Appendix 1). They are also open-class words of 3-8 letters in length.

The word frequency of these words was not taken into account as they will be used as non-words in this study. Besides, these words were chosen carefully to avoid any language-specific diacritics, which can make these words very easy to identify. For example, none of the Norwegian words used in this study contained Norwegian special alphabets like “æ, ø, and å” (Anagnostopoulou, 2022). In total 40 Norwegian words were used in this study.

3.4 Experiment Procedure

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 at the University of Bergen. Before starting the experiment a questionnaire was given to the participants to identify their English proficiency level. The researcher used the ILR scale to analyze their proficiency. It is a self-assessment test and it is mostly popular in the US. It is a scale of 1 to 5, 1 being the lowest and 5 being the highest. Participants had to identify the proficiency levels that they thought suited them the best (ILR: Herzog, n.d.). There was another question about their parents if any of the participants have an English parent. The data of participants with English parents should be excluded as this study is focused on Norwegians who have learned English as their second language or later in their lives. For an overview of the questionnaire please see (Appendix 3) and for the participants’ responses please see (Appendix 4). The participants were given the questionnaire on paper. After that, they were taken to the soundproof room with the computer where they had to participate in the experiment using the designed program. Before starting the experiment, the participants were verbally told about how to participate in the experiment. A training block is added before the actual experiment where 10 test words were used to familiarize the participants with the experiment procedure. In the training block, there were only cognates, non-cognates, and complete nonsense words were used so that the participants didn't get aware before the actual experiment (see Appendix 2).

The study includes three separate experiments which were conducted independently. No participant participated in more than one experiment. In the first experiment, the participants had to choose an English word from cognates, non-cognates, and complete non-sense words. In the second experiment, there were elements from the first experiment which are cognates, non-cognates, and complete non-sense words, and another type was introduced which are the Norwegian words. In the third experiment, there were every item from the second experiment with another added item which is the interlingual homographs. All the participants 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 5000 ms or until the participant responded. The time from when the word (stimuli) was presented on the screen to when they pressed the 'yes' - or 'no'- button was measured, providing the reaction time. Word order within each block was randomized for each participant. The task was first 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.

3.5 Rationale for Conducting 3 Experiments

As mentioned in the previous chapters, the entire study was divided into three experiments. Experiment 1 aimed to observe the cognate facilitation effect in a pure list. This approach has been suggested in previous studies, such as by Brenders et al. (2011) and Poort and Rodd (2017).

Experiments 2 and 3 were conducted using mixed lists to observe the stimulus list composition effect on cognate facilitation. In Experiment 2, the stimulus list included cognates, non-cognates, true non-words, and Norwegian words (non-words). The addition of Norwegian words as non-words made Experiment 2 a mixed language list experiment, where inhibitory effects could be expected. This experimental design was chosen based on a previous study conducted by us (Sapti & Nazir, 2022), where no inhibitory effects of cognates were found; rather, a significant facilitation was observed. To reexamine these results, Experiment 2 was conducted with the inclusion of only Norwegian words and not homographs.

In Experiment 3, the stimulus list contained cognates, non-cognates, interlingual homographs, true non-words, and Norwegian words (as non-words). Previous studies, such as those by Vanlangendonck et al., (2019), Brenders et al. (2011), and Poort and Rodd (2017), performed lexical decision tasks to observe the stimulus list effect by adding both interlingual homographs and non-target language words. Therefore, Experiment 3 of this study followed the same stimulus list types by including both homographs and Norwegian words. Additionally, it was anticipated that the inhibitory effect for cognates would increase compared to what was expected in Experiment 2. Consequently, a total of three experiments were carried out to observe the effects of pure list and mixed list on cognate processing.

3.6 Statistical Analysis

3.6.1 Data Selection and Preparation

Statistical analysis was performed in R computer programming (RStudio Team, 2020). R (version 4.1.2) and R Studio (version 2021.09.1) were used to analyze the data for statistical test analysis. This analysis was performed with the help of Professor Vadim Kimmelman. Reaction time differences were calculated using linear mixed-effects models implemented with the lme4 and lmerTest packages (Bates et al., 2015; Kuznetsova et al., 2017). First, the data was modeled with non-transformed RT (reaction time). It was also checked log-transformed RT because log-transforming data avoids positively skewed ratios and presents distributions as normal (Wolfe, 1998, p. 35). However, the results did not change with or without log transformation.

The reaction time during the trial session was not recorded. It was done to familiarize the participants with the experiments. Moreover, participants with 80% of correct answers, were considered appropriate to measure the reaction time. This has been done to avoid indulging incorrect data for this study. If participants' response is below 80% then this could either be a result of pressing the wrong response key by mistake, or consciously pressing the wrong key. According to their proficiency level in English, the correct response should not go below 80%. This could also be because they did not know that a real word was real, or they thought a non-word was a real word. Since the current research observes different reaction times to different word types based on conscious and correct responses, inclusion of incorrect data could disrupt the findings, leading to an unreliable results. Hence, the analysis would not be adequate (Balota & Chumbley, 1984, p. 353). Therefore, the data of 3 participants from this current study have been excluded due to the high percentage of inaccurate responses given during the experiment. Despite the fact that they have identified themselves at level 4 of the ILR (Interagency Language Roundtable) self-proficiency test, which means they have intermediate proficiency in English. There is still a chance that participants might not be responding very seriously during the whole experiment. Moreover, 1 participant had an English parent and that data was also excluded, as we needed participants who learned English later in their lifetime and cannot be native tongue.

Even though all correct responses were included in the analysis, it is not possible to know whether all these responses were given on a conscious basis. Furthermore, outliers were also excluded from the data like incorrect responses. In general terms, outliers mean an abnormal range of dataset that is different from other values of the sample.

In the present study, all data points beyond +-2 standard deviations were excluded (RTs that were outside of the range of two standard deviations from the mean within each participant). In this process, approximately 3% of data were removed.

3.6.2 Data Analysis

On the dataset, various statistical analyses were performed, which included fitting linear mixed models to the data and calculating summary statistics. As mentioned before, R code is used for conducting data analysis on multiple datasets from 3 different experiments. The code involves data preprocessing, visualization, and the fitting of linear mixed models to the data. The primary goal of these analyses is to understand the effects of different experimental conditions such as type of stimuli, and English proficiency on reaction times. The code includes data visualization and model fitting to evaluate these effects and their statistical significance. All the data from all 3 experiments were imported from text files.

In experiment 1, all the data were summarized based on correct answers and then reaction time was calculated for cognates, non-cognates, and non-words. Box plots and density plots are created to visualize RT distributions.

Linear mixed models (LMMs) are fitted to the data to examine the effects of different factors, for example, type and proficiency on RT.

In experiment 2, similar preprocessing and analysis steps are performed. Here the data is divided into four different types, namely cognates, non-cognates, non-words, and Norwegian words. In experiment 3 data undergoes similar preprocessing and analysis. The data is divided into five types namely cognates, non-cognates, homographs, non-words, and, Norwegian words.

Throughout the code, linear mixed models (LMMs) are used to analyze the data. LMMs are a type of statistical model that can handle repeated measures and account for random effects. These models are used to assess the relationships between different factors as mentioned before, type, proficiency, and reaction times (RT) while taking into account individual variation between the individual participants.

Overall, this data analysis and modeling were done to explore and understand the experimental data from three different experiments. It provides insights into the relationships between various factors and reaction times. Here reaction time is the dependent variable. It will change depending on the type of words and non-words. An attempt to fit linear mixed models using the "*lmer*" function to understand the relationships between the "Reaction" variable and various factors, including "type" and "Proficiency" was done. "*ggplot2*" (Wickham, 2016) has been used to create boxplots to visualize the data distribution for different types of categories. The output of these data includes model summaries, significance tests, and confidence intervals for model parameters, which are essential for drawing conclusions from the collected data. The results will be further discussed in chapter 4.

3.7 Ethical consideration

One of the most important aspects of obtaining informed consent is to assure that participants are qualified enough to make a strong decision on their participation in the experiment (Abbuhl et al., 2013). The experiment was completely anonymous and, the participants gave voluntary informed consent to participate, and were given the freedom to leave the lab at any point.

3.8 Prediction

3.8.1 Words vs Non-words

A lexical decision study by Schubert & Einmas in 1977 compared native English speakers' reaction times concerning words vs. non-words. The results showed that words were recognized faster than non-words. The average reaction times of words were 584 ms and 739 ms for non-words, with a 155 ms difference. Another study by Caramazza and Brones, (1979) showed similar results for English-Spanish bilinguals. In their study, words (cognates and non-cognates) took 652 ms to identify while for non-words it took 811 ms. Hence, there is a 159 ms difference. Forster & Chambers, (1973) showed an overall faster reaction to words (high and low frequencies) than to non-words. For words, it was 706 ms and for non-words it was 763 ms, giving them a 57 ms difference. Previous studies have demonstrated that words will be recognized faster than non-words. Hence, we can assume that the participants of this study will do the same. However, even though homographs are categorized as words in this study, there is a chance that participants might find it difficult to process even compared to non-words. In a study of lexical decision tasks by Brenders et al., (2011) the participants took longer to react in cognates and homographs compared to the control words. The results showed that in the presence of the interlingual homographs, the participants reacted differently than usual as they found the homographs hard to process. Therefore, there is a chance that in this study it will happen the same.

3.8.2 Cognates vs Non-cognates

The reaction time between cognates and non-cognates will indicate the participants' representation of language selectiveness or non-selectiveness. Language selective theory suggests that participants have two representations of cognates (each for one language). This theory also means that the participants will be able to shut off their non-target language lexicon whenever it is necessary (Caramazza & Brones, 1979). On the other hand, language non-selective theory suggests that participants have one shared representation of cognates. This will also mean that this will overlap in accessing each word from the mental lexicon. Shorter reaction time to cognates will support language non-selectiveness and if there is no difference in reaction time then it will support the language selective theory. More about these two theories was presented in section 2. For the current studies, there could be several outcomes based on the participants' reaction time. Some of them are as follows:

1. If the Norwegian English bilinguals take the same to react to both cognates and non-cognates meaning if there is no difference in the reaction time, then this will provide evidence for language selectiveness in the mental lexicon.

2. If the participants react faster to cognates this will mean that this study provides evidence for language non-selectiveness.

3. If the participants react faster to non-cognates then it will imply that there will be a null cognate facilitation effect.

From these predictions mentioned above the most plausible assumption is that compared to the other possibilities it is most likely to demonstrate a cognate facilitation effect. Many studies such as Beauvillain & Grainger, (1987); Poort & Rodd, (2017); and Van Heste, (1999) have found evidence of bilinguals having a shared representation, explaining the cognate facilitation effect. In lexical decision tasks, researchers have found evidence of cognate facilitation effect such as Brenders & Dijkstra, (2011); Dijkstra et al., (1999); and Lemhöfer & Dijkstra, (2004) have found that participants react faster to cognates compared to non-cognates. Hence, it is safe to assume that this current study will get the same results.

3.8.3 Mixed list effect

In lexical decision tasks, researchers found that having a mixed version of the stimulus list can turn the cognate facilitation effect into a null or inhibition effect. Poort & Rodd, (2017) conclude that the cognate facilitation effect is a real effect that originates in the lexicon, but that cognates can be subject to competition effect outside the lexicon (p. 52). In their mixed version of the lexical decision task experiment adding interlingual homographs and words from non-target language words (in their case, Dutch words) showed a significant difference in the cognate facilitation effect. They revealed that cognates were recognized 50 ms more slowly than the English controls. It was suggested that when participants had to respond ‘no’ even to non-target language words they were utterly confused when a ‘yes’ or ‘no’ response was associated with cognates having existed in both the languages. Hence, it cancels the facilitation effect. Another study by (Vanlangendonck et al., 2019) showed similar results when adding interlingual homographs to the stimulus list it significantly changes the cognate facilitation effect and turns it into an inhibition effect. Changing from a pure to a mixed language list can turn the cognate facilitation effect into inhibition. Another study by Brenders et al., (2011) of lexical decision tasks performed on Dutch children learning English showed the same result when adding interlingual homographs to the stimulus list. In the pure list, the participants showed a cognate facilitation effect however it is the opposite case in the mixed list. The researchers concluded that it will be the same case regardless of the age and proficiency level of the participants that they will respond differently to the cognates in the presence or absence of false friends (interlingual homographs) in the stimulus list. Therefore, we can hypothesize that for the present study in

Experiments 2 and 3, we might be able to see that cognate will not have facilitation effects among participants and it might turn into inhibition.

4.0 Results

4.1 Introduction

Considering the results of the reaction times to cognates and non-cognates, which was the main comparison of this study, there were significant time differences between cognates and non-cognates in all three experiments. The list composition did not matter when it came to the cognate facilitation effect. This cognate facilitation effect is very large and significant in all three experiments despite having a mixed language stimulus list in the second and third experiments. It is very unusual considering all the previous literature, where it was mentioned that mixed language stimulus list turns cognate facilitation effect into inhibitory effect. This will be discussed in each experiment in the next sections.

4.2 Experiment 1

In experiment 1, the stimulus list consisted of cognates, non-cognates, and true non-words. This experiment was done to check for the cognate facilitation effect and as expected the results showed significant time differences among cognates and non-cognates. This evidently proves the cognate facilitation effect among Norwegian-English bilinguals. The following graph shows the mean reaction time between cognates, non-cognates, and non-words with standard deviation.

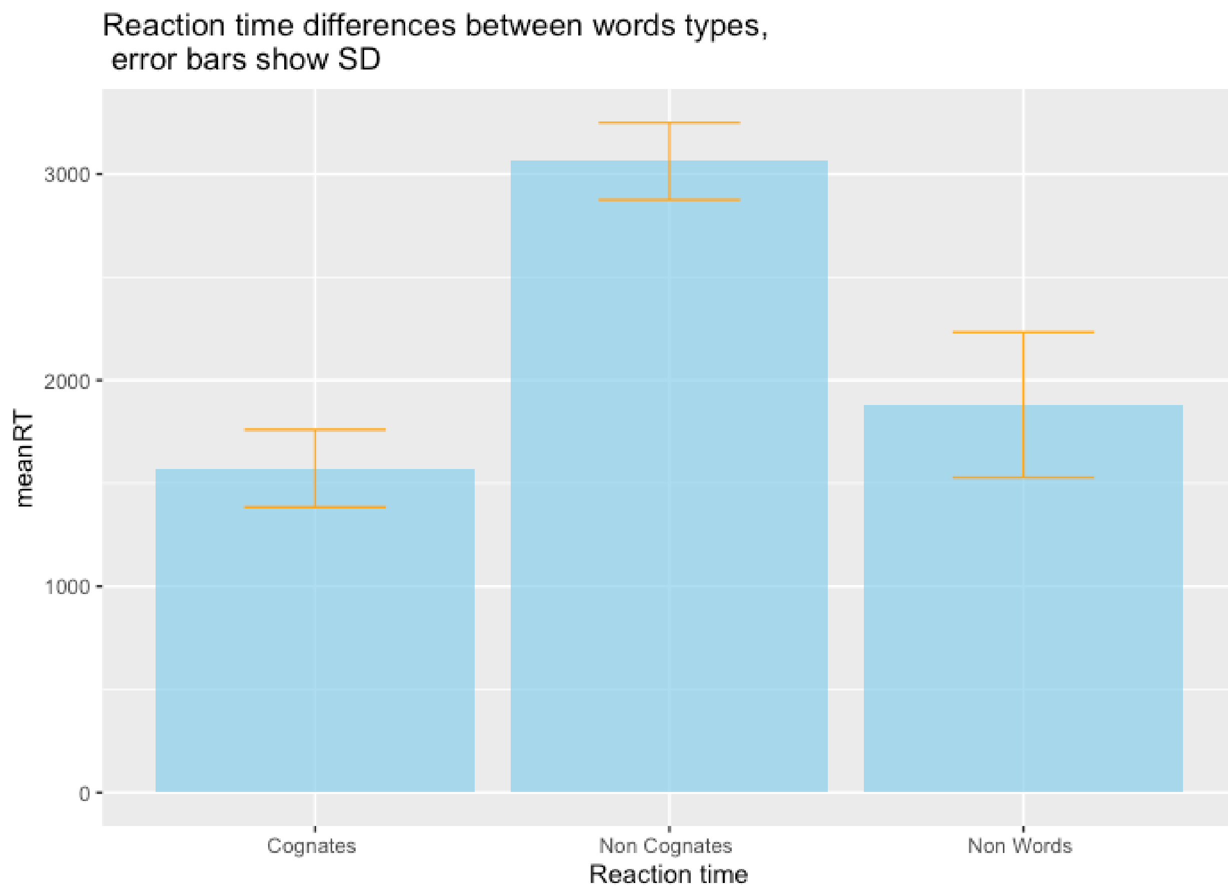

Figure 1: Bar plot showing RT differences between word types with standard deviation of experiment 1.

The mean reaction time (RT) for cognates is 1572 milliseconds (ms) and the standard deviation is 188 ms. Similarly, for non-cognates mean RT and standard deviation are 3062 ms and 188 ms respectively, and for true non-words, they are 1880 ms and 352 ms respectively. Hence, we can say that there is a huge reaction time difference between accessing cognates and non-cognates. Cognates are processed 1490 ms faster than non-cognates. The result of experiment 1 provides evidence in favor of the cognate facilitation effect among Norwegian English bilinguals.

Below is a detailed representation of a boxplot of the data from experiment 1.

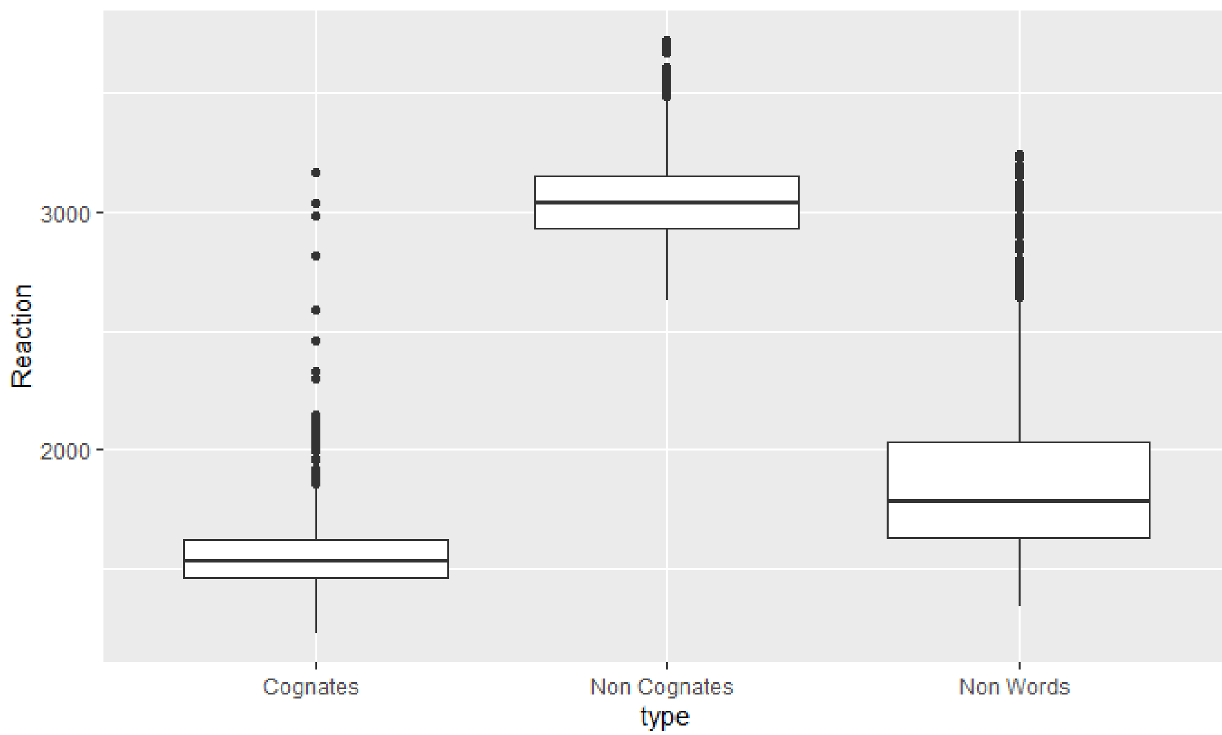

Figure 2: Boxplot representing RT of cognates, non-cognates, and non-words.

One of the research questions was to look for the cognate facilitation effect. The boxplot in Figure 2 describes 3 different categories from the stimulus list, cognates, non-cognates, and non-words. Boxplots are crucial for providing a summary of the distribution of the data, showing key statistics such as the median, quartiles, and potential outliers. In Figure 2, the "X" axis represents the type or the categories from the stimulus list and the "Y" axis represents the reaction time in milliseconds (ms). Each box in the plot represents a group e.g., cognates, non-cognates, non-words. The box represents the interquartile range (IQR) of the reaction times for that group, which contains the middle 50% of the data. The lower boundary of the box is the first quartile (Q1), and the upper boundary is the third quartile (Q3). The line inside the box represents the median reaction time for that group. Whiskers: Lines (whiskers) extend from the top and bottom of the boxes. They represent the range of typical values within a certain range of the IQR. Any data points beyond these whiskers are considered outliers and are often plotted individually as points (Wickham et al., 2023).

The analysis indicates that there is a large difference in reaction times between these word types. The fastest reaction times are associated with cognates, followed by non-words, and the slowest for non-cognates. These differences are presented by the coefficients and significance levels in the model output (discussed below), as well as by the boxplot in Figure 2 that illustrates the distributions of reaction times.

Let's also visualize the reaction time difference between cognates and non-cognates through a density plot below.

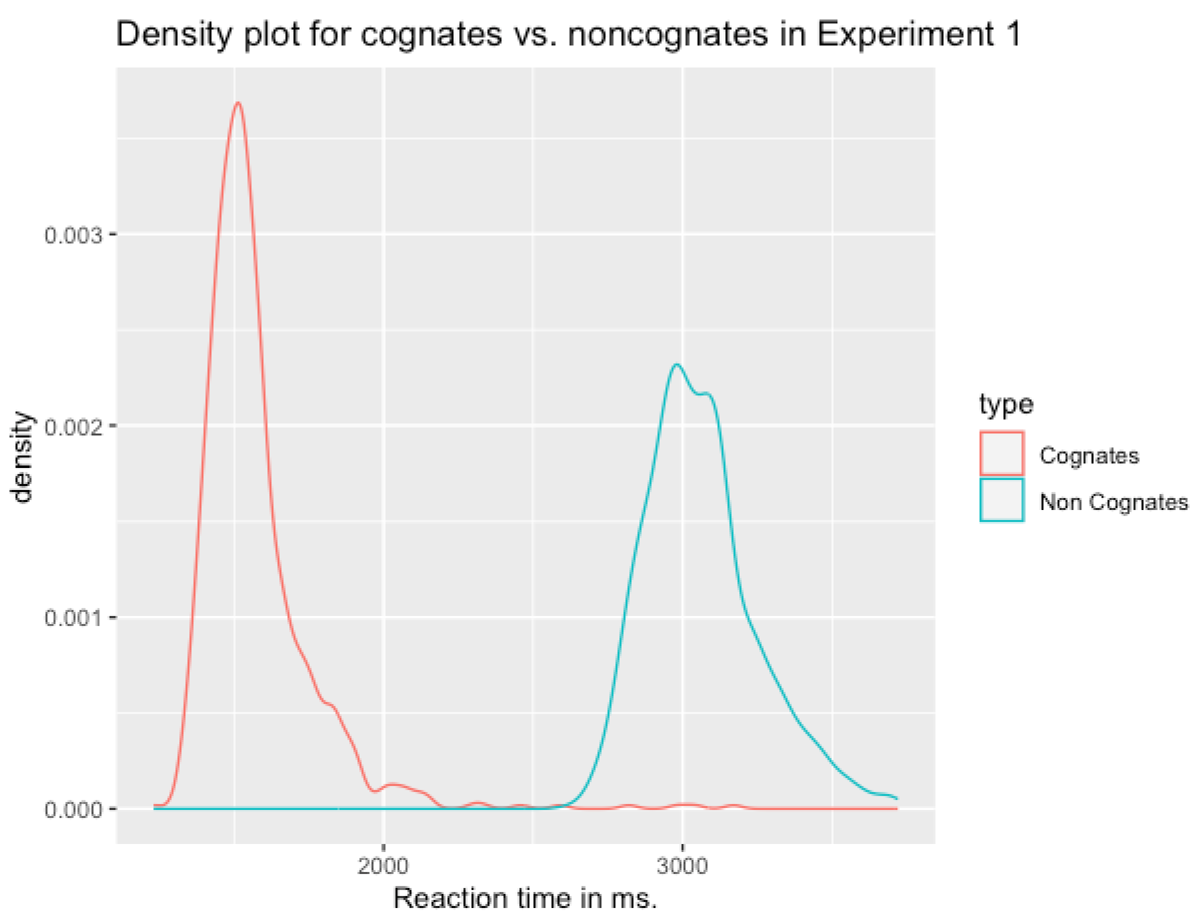

Figure 3: Density plot showing reaction time between cognates and non-cognates in Experiment 1.

Density plots are generally used to visualize the continuous distribution of data. This plot is used to display the probability density of the data across the range of values. In Figure 3, the density plot shows the distribution of the reaction times of cognates and non-cognates in Experiment 1. The cognates have a higher density than the non-cognates, and the non-cognates have a lower density than the cognates. This means that the cognates are more likely to have a reaction time within a certain range, while the non-cognates are more likely to have a reaction time outside of that range. Furthermore, the density plot shows that the cognates have a wider distribution of reaction times than the non-cognates. This means that there is a greater range of reaction times for cognates than for non-cognates. Moreover, in the graph, the peak density for cognates is approximately 1500 ms, while the peak density for non-cognates is approximately 3000 ms. The distribution of reaction times for cognates is more spread out than the distribution of reaction times for non-cognates. There is a small overlap between the two distributions, meaning that some cognates have a longer reaction time than some non-cognates. These observations suggest that cognates are generally processed more quickly than non-cognates, but there is some variation in reaction times for both types of words. To summarize, the density plot suggests that cognates are processed more quickly and efficiently than non-cognates. If we consider the previous literature, cognates are words that are shared between two languages, and speakers of those languages are already familiar with the meaning of the words. On the other hand, non-cognates are words that are not shared between two languages, and speakers of those languages need to learn the meaning of the words from scratch. Hence, the bilinguals tend to process cognates faster than the non-cognates.

4.2.1 Result of Modeling

To model the differences between the word classes, we created a linear mixed effect model with RT as the dependent variable, type (coded as orthogonal contrasts between cognates and non-cognates, and between words and non-words) and proficiency as independent variables, and random intercepts for participants.

Based on this analysis it is safe to say that cognates are processed faster than non-cognates. In addition, the 95% confidence interval for the difference between cognates and non-cognates is 1515 to 1598 ms. The p-value is lower than (< 0.001), indicating that the difference is highly statistically significant. This means that there is strong evidence that this fixed effect significantly impacts the response variable. Therefore, there are significantly lower reaction times for cognates than non-cognates, suggesting that cognates are recognized more quickly or processed more efficiently. In addition, non-words also have relatively fast reaction times. Non-words, while not actual words are processed faster than non-cognates, which might be due to their linguistic distinctness from English and Norwegian. Besides, participants' proficiency was also taken into account but the p-value for that is 0.617 suggesting that the "Proficiency" fixed effect is not statistically significant. In other words, there is no strong evidence to conclude that "Proficiency" has a significant effect on the response variable.

4.3 Experiment 2

In experiment 2, the stimulus list consisted of cognates, non-cognates, completely non-words, and Norwegian words. The Norwegian word for this experiment will be non-words as the participants have to select words that are only real words in English. This experiment was done to check for the cognate facilitation effect and whether it turns into an inhibitory effect as this is a mixed language list. However, surprisingly it did not show any inhibition or even null effect.

Instead, it showed significant time differences among cognates and non-cognates. This experiment also proves the cognate facilitation effect among Norwegian-English bilinguals. Despite having a mixed language stimulus list, it proved that a mixed language list did not create any impact on the cognate facilitation effect among Norwegian English bilinguals. The following graph shows the mean reaction time between cognates, non-cognates, Norwegian words, and non-words with standard deviation.

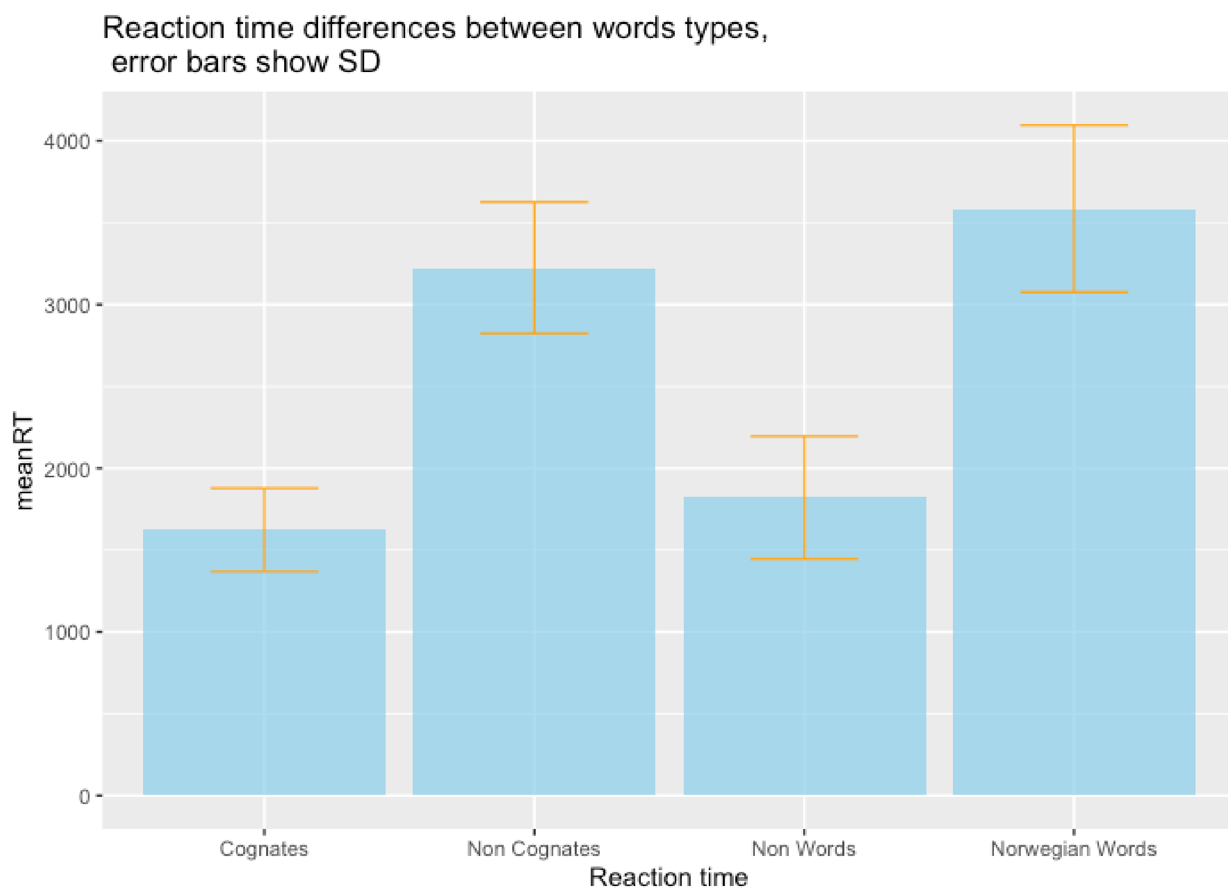

Figure 4: Bar plot showing RT differences between word types with the standard deviation of experiment 2.

In Figure 4, the mean RT for cognates is 1625 ms and the standard deviation is 226 ms. For non-cognates, they are 3207 ms and 338 ms. For non-words and Norwegian words, they are 1828 ms and 305 ms, and 3537 ms and 417 ms respectively. Cognates are processed 1582 ms faster than non-cognates. Hence, there is a big reaction time difference between accessing cognates and non-cognates. The result of experiment 2 provides evidence in favor of the cognate facilitation effect among Norwegian English bilinguals even though there was a mixed language stimulus list.

A detailed representation of a boxplot of the data from experiment 2 is presented below.

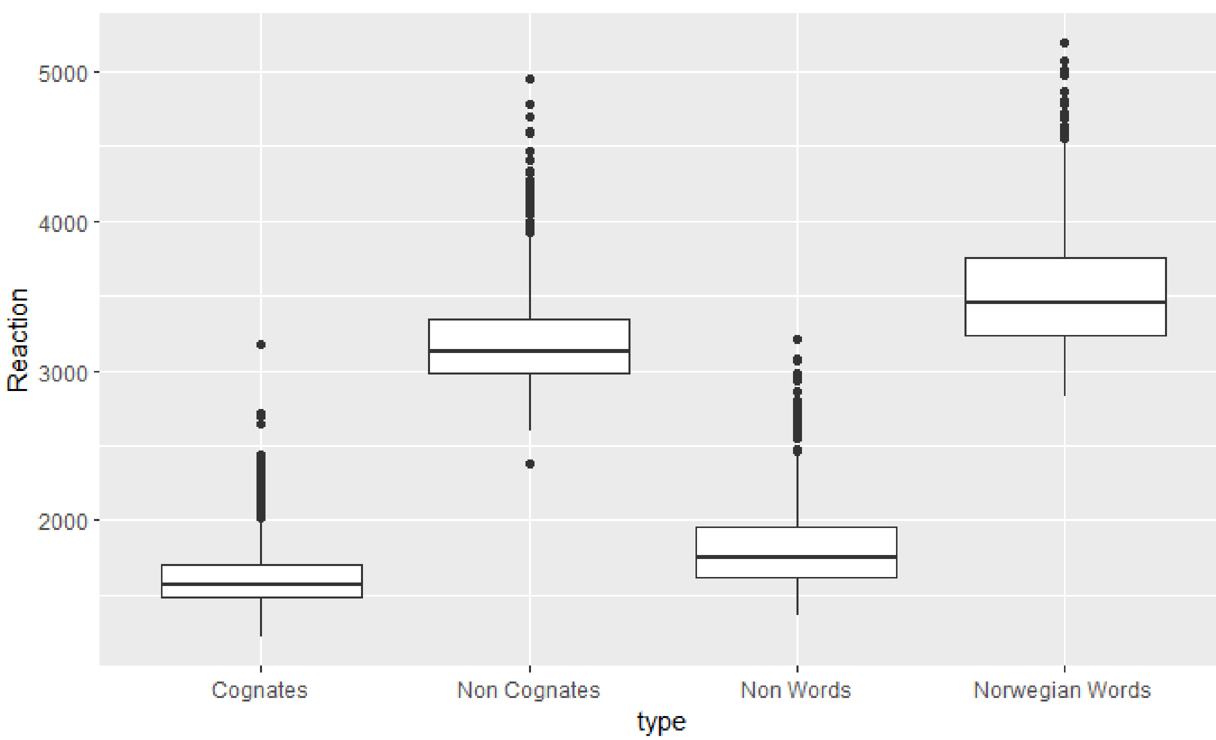

Figure 5: Boxplot representing RT of cognates, non-cognates, non-words, and Norwegian words.

The boxplot in Figure 5 represents the distribution of the reaction times of cognates, non-cognates, non-words, and Norwegian words. The x-axis represents the word types, and the y-axis represents the reaction time. This boxplot helps in visualizing the distribution and characteristics of reaction time for these different types. As we can see from the boxplot in experiment 2, the reaction time to cognate is the quickest just like in experiment 1. Hence, this experiment also supports the cognate facilitation effect. The boxplot shows that cognates have the fastest reaction times than all the categories namely, Norwegian words, non-cognates, and non-words. The boxplot also shows that cognates have the narrowest distribution of reaction times. In addition, the median reaction time for cognates is lower than the median reaction time for all the other four categories. The IQR for cognates is also smaller than the IQR for non-cognates, non-words, and Norwegian words. This means that there is a narrower range of reaction times for cognates than for the other types of words.

Let's also visualize the cognate facilitation effect in experiment 2 through a density plot.

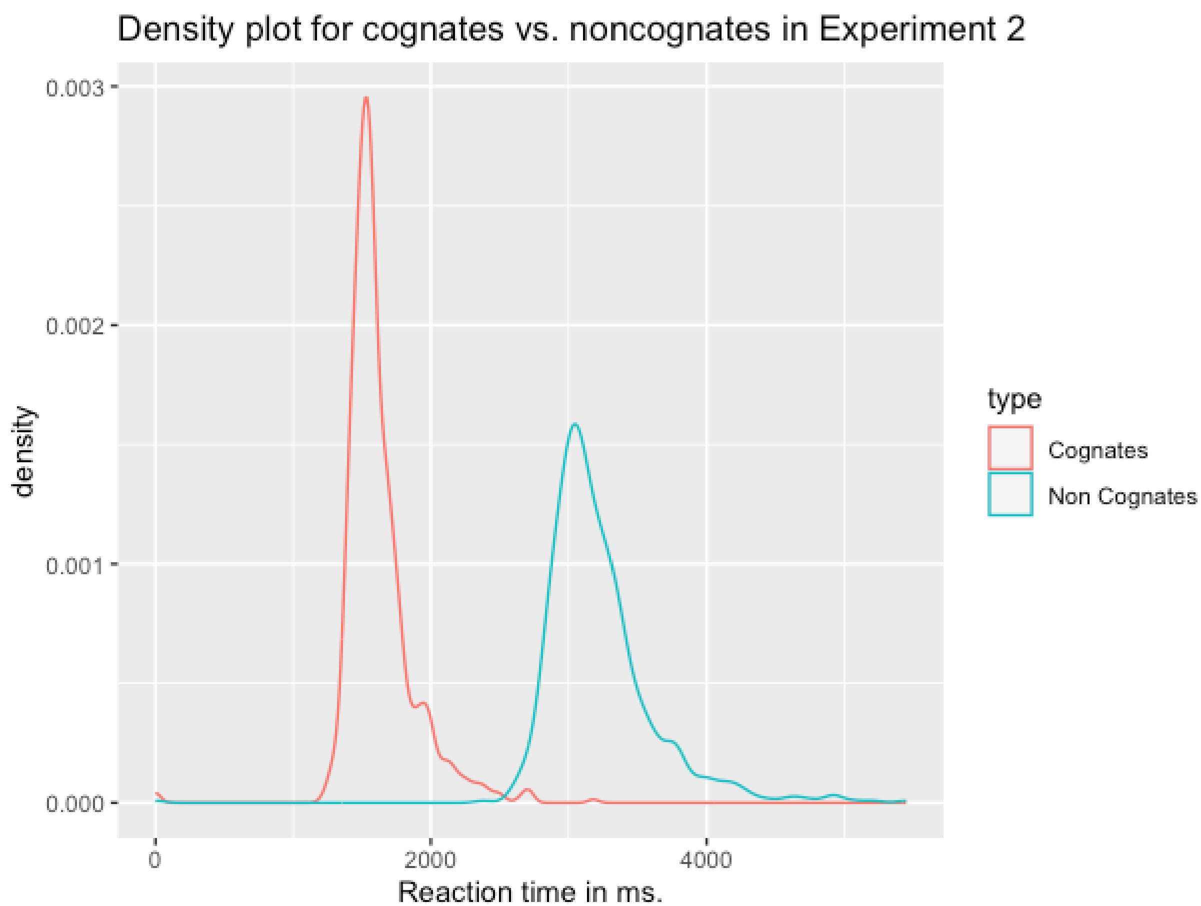

Figure 6: Density plot showing reaction time between cognates and non-cognates in Experiment 2.

The density plot shows the distribution of the reaction times of cognates and non-cognates in Experiment 2. The cognates have a higher density than the non-cognates, and the non-cognates have a lower density than the cognates. This can mean that the cognates are more likely to have a reaction time within a certain range, while the non-cognates are more likely to have a reaction time outside of that range. This plot also shows that the cognates have a narrower distribution of reaction times than the non-cognates. This means that there is a smaller range of reaction times for cognates than for non-cognates. In simple words, most of the cognates took less time to react.

In a nutshell, the density plot suggests that cognates are processed more quickly and efficiently than non-cognates in Experiment 2. Despite the fact that the stimulus list of experiment 2 contained words from participants' L1, which needed to be treated as a non-word. That is an exception if we compare it to previous literature that has been done with the speakers of other languages. Here we can also see that the peak density for cognates is approximately 1750 ms, while the peak density for non-cognates is approximately 3000 ms. Moreover, the distribution of reaction times for cognates is more concentrated around the peak density than the distribution of reaction times for non-cognates. There is a small overlap between the two distributions, meaning that some cognates have a longer reaction time than some non-cognates. Nonetheless, these observations suggest that cognates are generally processed more quickly than non-cognates in Experiment 2, but there is some variation in reaction times for both types of words.

4.3.1 Result of Modeling

As previously mentioned in experiment 1, the modeling of experiment 2 has been done in a similar process. To model the cognate facilitation effect, we created a linear mixed effect model with RT as the dependent variable, type (cognates vs. non-cognates) and proficiency as independent variables, and random intercepts for participants.

Based on the analysis, surprisingly the cognate facilitation effect still remained even after using a mixed language stimulus list. The 95% confidence interval for the difference between cognates and non-cognates is 1548 to 1618 ms. The p-value for the intercept is <0,0001, which indicates a highly significant result. This means that there is strong evidence that these fixed effects significantly impact the response variable. Therefore, once again there are significantly lower reaction times for cognates than non-cognates, suggesting that cognates are recognized more quickly or processed more efficiently. However, the p-value for "Proficiency" is 0.233, which is greater than the commonly accepted significance level of 0.05. This higher p-value suggests that "Proficiency" doesn't have a statistically significant effect on reaction time. In other words, the proficiency of the participants does not appear to be a significant factor in explaining the variation in reaction time of different categories mentioned here.

Overall, the analysis suggests that cognates are processed more quickly and efficiently than non-cognates, non-words, and Norwegian words. Even though according to previous literature adding words from participants' L1 can raise response competition and thus creates an inhibitory effect for the cognates. In this case, the scenario is different and proves otherwise. It is also noticeable that participants took longer to process Norwegian words compared to the complete nonsense words because it is easier for them to identify the non-words and hard to identify Norwegian words as non-words as they are actual words from their first language. We also modeled this effect using a linear mixed effect model with RT as the dependent variable, type (true non-words vs. Norwegian words) and proficiency as independent variables, and random intercepts for participants. The confidence interval for the difference between true non-words and Norwegian words is 1657 to 1741 ms. The p-value for the intercept is <0,0001, which indicates a highly significant result. However, for proficiency, the p-value is 0.427, which is not a significant value. To put it briefly, the effect of the type is highly significant, while the effect of proficiency is not.

4.4 Experiment 3

Experiment 3 is the last and a lengthy one compared to the previous two experiments. In this experiment, the stimulus list is also different from the first two experiments. In experiment 3, the stimulus list consisted of cognates, non-cognates, complete non-words, Norwegian words, and homographs. This experiment was also done to check for the cognate facilitation effect in a mixed language stimulus list as there will be words from the non-target language (Norwegian words) as well as homographs. I was wondering whether in this experiment the facilitation effect might turn into an inhibitory effect as this is a mixed language list and a complicated one. However, in this case, the result still shows the cognate facilitation effect. This time it again showed significant time differences among cognates and non-cognates. Despite adding homographs and words from the non-target language in the stimulus list, it did not create any impact on the cognate facilitation effect among Norwegian English bilinguals. The cognate facilitation effect prevails in all three experiments even when the stimulus list is different. The following graph shows the mean reaction time between cognates, non-cognates, Norwegian words, non-words, and homographs with standard deviation.

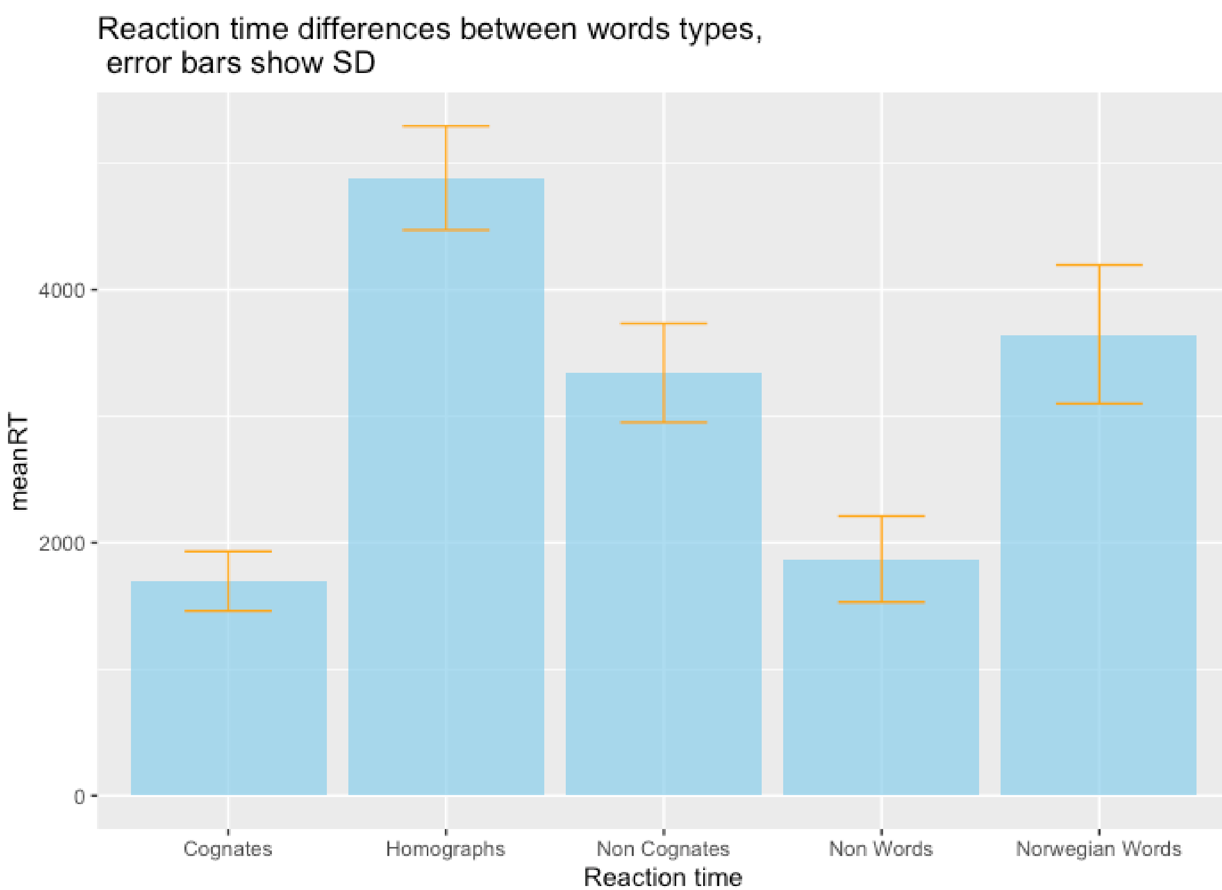

Figure 7: Bar plot showing RT differences between word types with the standard deviation of experiment 3.

The mean RT for cognate is 1696 ms and the standard deviation is 235 ms. For homographs, they are 4885 ms and 411 ms; for non-cognates, they are 3343 ms and 391 ms; for non-words, they are 1871 ms and 340 ms; for Norwegian words, they are 3649 ms and 549 ms respectively. So, the cognates are processed 1647 ms faster than the non-cognates. The interesting fact about this is that homographs are the hardest to process. It takes the longest time to react by the participants even compared to non-cognates and Norwegian words.

A box plot of more detailed data from experiment 3 has been presented below.

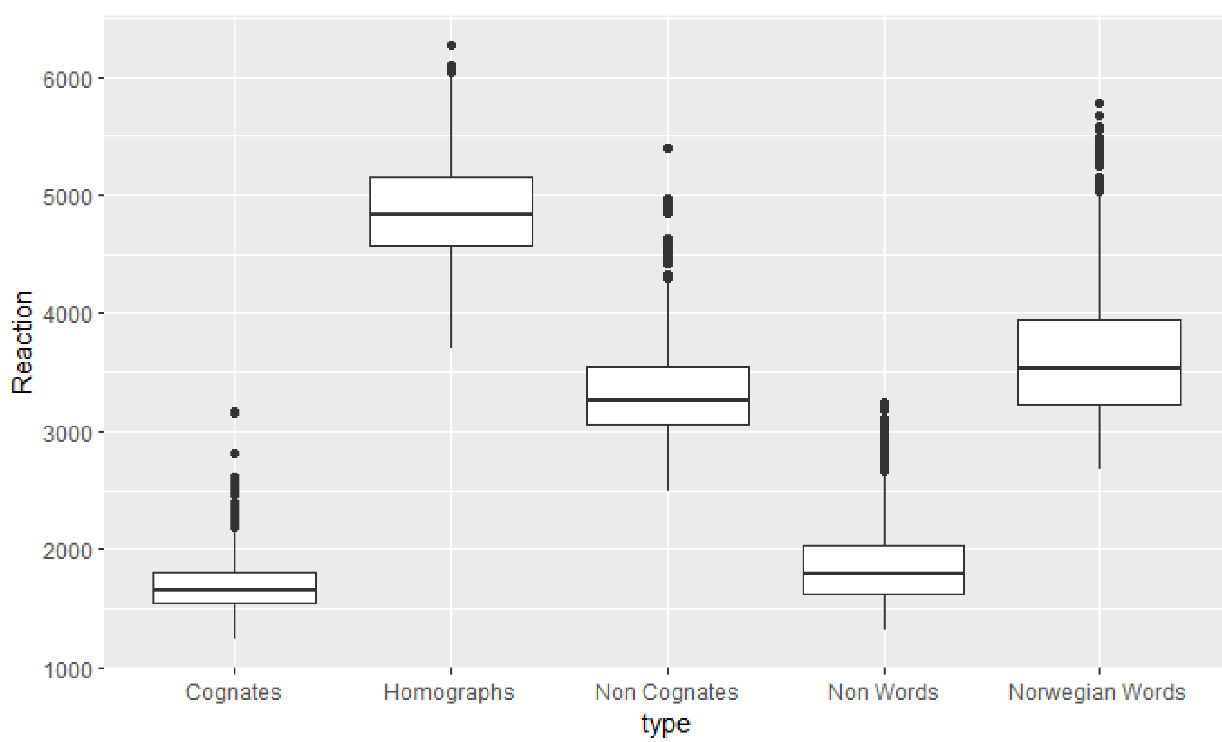

Figure 8: Boxplot representing RT of cognates, homographs, non-cognates, non-words, and Norwegian words.

The boxplot of Figure 8 just like the previous boxplots also represents the distribution of the reaction times of several categories of experiment 3. The X axis is representing the types, cognates, homographs, non-cognates, non-words, and Norwegian words. The Y axis represents the reaction time. The boxplot shows that cognates have a faster median reaction time than non-cognates and that the distribution of reaction times is narrower for cognates compared to non-cognates. This means that the cognates are processed faster than the non-cognates in experiment 3. The median reaction time for cognates is lower than the median reaction time for non-cognates. This means just like in the previous experiment half of the cognates in the dataset had a reaction time lower than the median reaction time, and half of the cognates in the dataset had a reaction time higher than the median reaction time. This means that there is a narrower range of reaction times for cognates than for the other types of words. The IQR for cognates in Experiment 3 is approximately 500 ms, while the IQR for Norwegian words is approximately 600 ms, the IQR for non-cognates is approximately 750 ms, and the IQR for homographs is approximately 900 ms. In other words, the IQR for cognates is lower than the IQR for non-cognates. This means that there is a narrower range of reaction times for cognates than for non-cognates.

A density plot is given below for a detailed look at the reaction time difference between cognates and non-cognates.

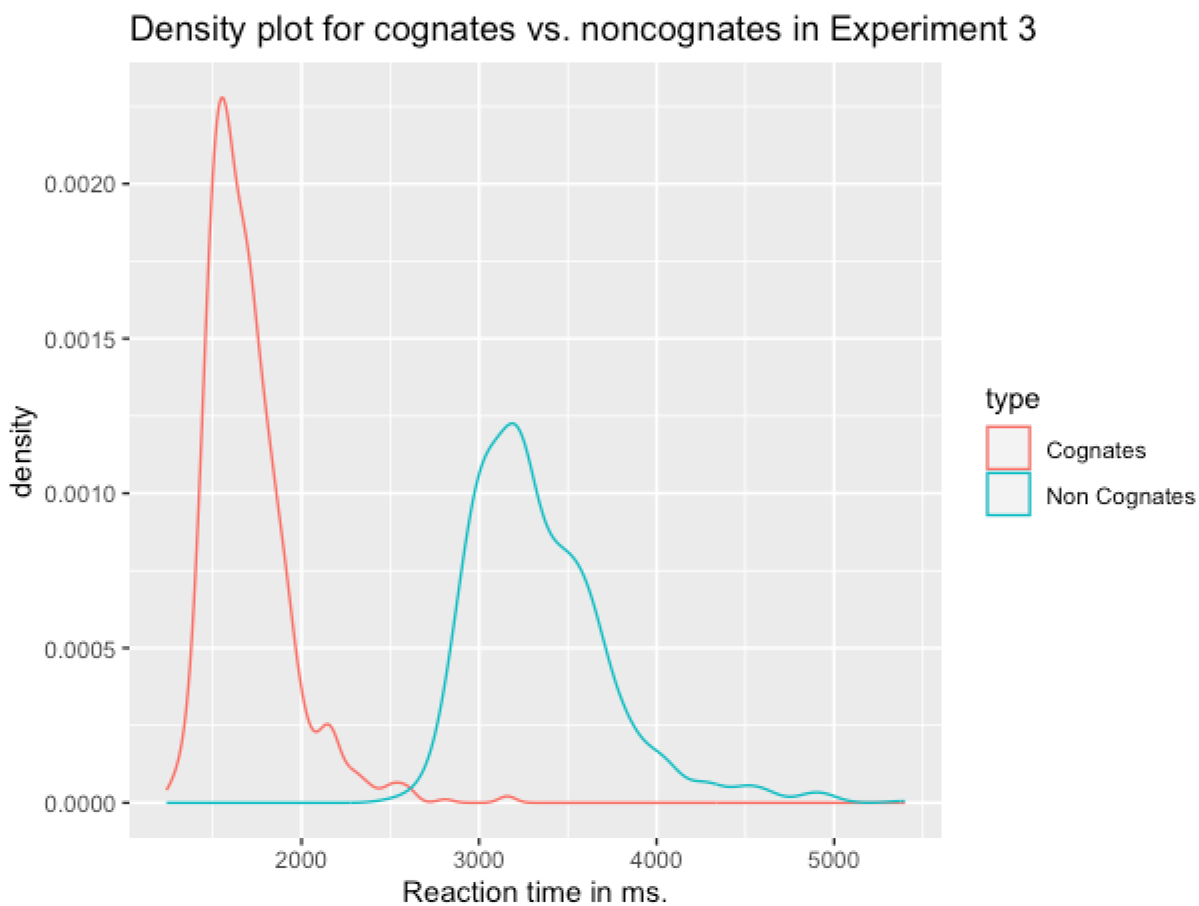

Figure 9: Density plot showing reaction time between cognates and non-cognates in experiment 3.

The density plot shows the distribution of the reaction times of cognates and non-cognates in Experiment 3. The x-axis of the density plot shows the reaction time in milliseconds. The y-axis of the density plot shows the density of cognates or non-cognates at a given reaction time. The density plot shows that the cognates have a higher peak density than the non-cognates, and the non-cognates have a lower peak density than the cognates. This means that more cognates have a reaction time close to the median reaction time than non-cognates. It also shows that the cognates have a narrower distribution of reaction times than the non-cognates, meaning there is less variability in the reaction times for cognates compared to non-cognates. However, there is a small overlap between the two distributions, meaning that some cognates have a longer reaction time than some non-cognates. The peak density of a distribution is the highest point on the curve. It represents the most common reaction time for that type of word. The peak density for cognates is approximately 1100 ms, while the peak density for non-cognates is approximately 3200 ms. The spread of the distribution for cognates is narrower than the spread of the distribution for non-cognates. This means that the reaction times for cognates are more concentrated around 1100 ms than the reaction times for non-cognates are concentrated around 3200 ms.

4.4.1 Result of Modeling

To model the cognate facilitation effect, we created a linear mixed effect model with RT as the dependent variable, type (cognates vs. non-cognates, and cognates + non-cognates vs. homographs, coded orthogonally) and proficiency as independent variables, and random intercepts for participants.

The result of this analysis also evidently proves the cognate facilitation effect. In experiment 3 the mixed language stimulus list did not have any impact as well. The 95% confidence interval for the difference between cognates and non-cognates is 1611 to 1678 ms. The difference between homographs and cognates+non-cognates is also highly significant, CI: 2341-2406. The p-value for cognates vs. non-cognates is <0,0001, which is highly significant. In addition, the p-value for cognates + non-cognates vs. homographs is <0,0001, also highly significant. On the other hand for proficiency, the p-value is 0.885, which is greater than the common significance threshold. Hence, proved that proficiency does not bear a significance among the dependent variable types.

We also modeled this effect for experiment 3 as well, using a linear mixed effect model with RT as the dependent variable, type (true non-words vs. Norwegian words) and proficiency as independent variables, and random intercepts for participants. The confidence interval for the difference between true non-words and Norwegian words is 1727 to 1815 ms. The p-value for true non-words vs. Norwegian words is <0,0001, which is significant. Whereas, for proficiency, it is 0.885, which is not significant.

To sum up, the results of experiment 3 also show a huge cognate facilitation effect among Norwegian English bilinguals. The stimulus list used for experiment 3 contained words from the non-target language as well as homographs. However, it did not bring any changes to the cognate facilitation effect. We can see that cognates were processed faster. However, homographs took the longest time to recognize. As previously mentioned in the literature review, the competition of 'yes' and 'no' responses to the actual words in English arose when participants had to choose whether homographs as real words in English or not because the homographs both existed in Norwegian and English language. We also expected that a similar effect would be on the cognates and this would cancel out the facilitation effect. However, the cognate facilitation effect remains large in all three experiments despite having mixed language list composition.

To sum up, the overall trend is clear for all three experiments, which is cognates are processed more quickly than non-cognates even after using different types of stimulus lists. According to these three experiments, the stimulus list composition did not have any impact on the cognate facilitation effect among the Norwegian-English bilinguals. The result will be discussed in detail in the next chapter.

5.0 Discussion

5.1 The Current Study

The current investigation involved three experiments aimed at examining the cognate facilitation effect and its transformation by using a mixed language stimulus list with Norwegian-English bilinguals. The three research questions for this study were 1) Do bilinguals process cognates more quickly than non-cognates? 2. a) How will the inclusion of Norwegian words affect the cognate facilitation effect? 2. b) How will the inclusion of both Norwegian words and interlingual homographs affect the cognate facilitation effect? We set out to determine whether the cognate facilitation effect in the bilingual lexical decision is affected by the list composition. In Experiment 1, the stimulus list contained only cognates, non-cognates (English controls), and regular non-words. Experiment 2 has the same stimulus materials but it added an extra item and that is words from the participants' first language. Adding the Norwegian words made it a mixed-language stimulus list. In the third experiment, homographs were added with all the existing stimulus material from the previous two experiments to check if the inhibition increases. The results of the study reveal a noteworthy pattern in the processing of cognates in the presence of different word types, shedding light on the cognitive mechanisms involved in word recognition. The analysis of the results of this study will be discussed in Chapter 5.3.

5.2 Expectation

According to the previous literature, it was expected that in a pure list (in Experiment 1), the Norwegian English bilinguals would react faster to the cognates than the non-cognates (Brenders & Dijkstra, 2011; Dijkstra et al., 1999; Lemhöfer & Dijkstra, 2004). According to Seim, (2018) study results, cognates and non-cognates were being reacted the same way and not faster or slower. She did not find any cognate facilitation effect in her study even after using a pure stimulus list. Despite using the medium frequency cognates and non-cognates from Seim, (2018) study, it is still expected to observe a cognate facilitation effect in the current study as most of the studies done previously found this effect in a pure list. Contrastively, in the second and third experiments where the stimulus list compositions were different, it was expected that the participants would react slower to the cognates than the non-cognates (Brenders et al., 2011; Poort & Rodd, 2017; Vanlangendonck et al., 2019). As presented in Chapter 3, when participants had to respond 'no' to non-target language words they became confused. Because those words are actual words in their first language. This creates a 'yes' or 'no' response competition. As cognates are present in both languages, the response competition for cognates gets stronger and it takes longer time to react. Thus, it cancels the facilitation effect of cognates (Dijkstra & van Heuven, 2002; Vanlangendonck et al., 2019). The study by Vanlangendonck et al., (2019) showed similar results when adding interlingual homographs to the stimulus list. It significantly changes the cognate facilitation effect and turns it into an inhibition effect. Changing from a pure to a mixed language list can turn the cognate facilitation effect into inhibition. In the pure list, it showed a cognate facilitation effect however it is the opposite case in the mixed list. Therefore, it was expected to have a cognate facilitation effect in Experiment 1 and a cognate inhibition effect in Experiments 2 and 3.

5.3 Analysis of Results

The primary focus of our investigation was to understand the time it takes for participants to recognize and react to different types of words, including "cognates," "non-cognates," "homographs", "Norwegian words", and "non-words." The data analysis demonstrated a clear and statistically significant difference in reaction times across these word categories.

To address the first research question, the result of Experiment 1 was confirmed. The result showed compelling evidence for the cognate facilitation effect. The results match with Brenders et al., (2011), Poort & Rodd, (2017), and Vanlangendonck et al., (2019). However, the result contradicts the Seim, (2018) study as in her study she did not find any cognates facilitation effect even after using a pure list.

Let's analyze the key questions for this paper, which are presented in Research Questions 2. a) and 2. b). In relation to research question 2. a) Adding Norwegian words as non-words did not negate or inhibit the cognate facilitation effect. The cognates were significantly processed faster than non-cognates. Dijkstra and Van Heuven, (2002) described that in the presence of words from the non-target language (Norwegian words for this study) cognates will lose their facilitation effect. The result of Experiment 2 does not match with the BIA+ model predictions. Comparison with the BIA+ model will be discussed later. On the contrary, an equivalent study was conducted by Sapti & Nazir, (2022) with Norwegian-English bilinguals, and a huge cognate facilitation effect was found in that study similar to the result of Experiment 2 of the current study.

In order to, make Experiment 3 more accurate, the stimulus list contained interlingual homographs as well as Norwegian words (non-words for this study). It was also expected that adding homographs might cause a greater inhibitory effect. The results of Brenders et al., (2011), Poort & Rodd, (2017), and Vanlangendonck et al., (2019) showed a huge inhibitory effect while processing cognates, unlike the result of Experiment 3 of the current study that showed a strong cognate facilitation effect. This result is also different compared to the result of Anagnostopoulou, (2022). Anagnostopoulou, (2022) did not find any cognate facilitation effect or any inhibitory effect. She found a null cognate facilitation effect.

To sum up, the cognate facilitation effect persists in all 3 experiments. Despite having a mixed language stimulus list, the results consistently indicate that cognates were processed faster than non-cognates and other word types in Experiments 2 and 3. In all three experiments, the median reaction time for cognates was notably shorter than that for non-cognates, non-words, and other word types. This suggests that individuals tend to recognize and respond to cognates more swiftly than to other word categories from the stimulus list. Additionally, in the statistical analysis, the linear mixed-effects model emphasized the robustness of these findings. The model indicated a highly significant difference in reaction times between cognates and non-cognates, as the p-value was lower than 0.001 in all three experiments, affirming that cognates are indeed processed faster. A comparison of the results with the BIA+ model will be discussed in Section 5.4.

Though this is not part of the main analysis, in Chapter 3, we predicted that words would be processed faster than non-words according to some previous research namely Schubert & Einmas in 1977, and Caramazza and Brones in 1979. However, in this study the result is different. In all three experiments, non-words were quite fast, even faster than the non-cognates (words for this study). The non-words were created by following the conventional rules of English spelling. However, the patterns of non-words might be easier for the participants to identify and so they reacted very fast.

5.4 Analysis in terms of the BIA+ model

As The BIA+ model explores the issue of linking stimuli to responses in lexical decision-making, this model places a central focus on how cognates and interlingual homographs are represented and processed in the bilingual brain. The composition of stimulus lists is a factor that can lead to increased competition in responses. In a lexical decision task specific to a particular language, for this study, it is specific to the English language, where the stimulus list is a mix of both L1 and L2 words, and the L1 words (for this study Norwegian words) require a 'no' response, it becomes evident that the linking of stimulus to response acts as a "magnifying glass", as described by Dijkstra and van Heuven, (2002, p. 193). This can result in strong inhibition. The two types of stimulus list composition and their effect on cognate processing are discussed below as mentioned in the BIA+ model.

5.4.1 Cognate Facilitation in a Pure List

According to the BIA+ model (Dijkstra & van Heuven, 2002), cognate facilitation will be observed when there are no words from the non-target language. According to BIA+, the model presumes that identical cognates have shared semantic representations in the bilingual mental lexicon, and this cross-linguistic overlap is the element that increases the performance in language-specific tasks, where a pure list has been used. However, at the same time, this will hinder performance in the mixed language list task. In the current study, Experiment 1 was designed to observe this particular condition. As the stimulus list was formed by using cognates, non-cognates, and true non-words, and the target language was English (language-specific), it was expected that cognates would be processed faster. As expected, the results turn out to be a large reaction time difference between cognates and non-cognates, suggesting a cognate facilitation effect among Norwegian-English bilinguals. Hence, the first part of the hypothesis of this study was borne out.

5.4.2 Cognate Facilitation in a Mixed List

The BIA+ model (Dijkstra & van Heuven, 2002) for bilingual lexical processing suggests increased response competition under mixed conditions. In a mixed condition, items from the non-target language, which is absent in the pure condition required a "no" response. This is due to the fact that, in the mixed task, the first language (L1) interpretation of the cognate is associated with a “no” response, leading to a conflict in the lexical decision process. The shared orthographic representation and the cross-linguistic semantic overlap of the cognates render the negative response in the mixed language list task making it harder than the other tasks. This will intensify response competition and interference effects. The BIA+ predicts that these effects will be observed in cognates and interlingual homographs. However, this pattern wasn't observed in the results of this study. Homographs were only used in experiment 3, where it showed that they took the longest time to process. On the other hand, in experiment 3, cognates were faster to be recognized and did not have an impact on the mixed list. Moreover, experiment 2, where there are no homographs but only Norwegian words (mixed language list), also experienced a cognate facilitation effect. Hence, the second part of the hypothesis (both 2. (a) and (b)) of this study was not borne out.

5.5 Explaining the Results

Since the second part of the research hypotheses were not borne out, it is crucial to explore the reasons behind the unexpected results, which are strongly supported by the previous literature in general, i.e., the cognate facilitation effect cancels out in the presence of a mixed language stimulus list.

Every language has a different orthographic pattern. Prior studies have predominantly involved Dutch-English participants, and it is essential to recognize that for Norwegian-English bilinguals, the cognitive processing of shared linguistic overlap features may differ. In a study by Anagnostopoulou, (2022) with Danish-Swedish bilinguals, the results were quite different from the existing pieces of literature as well. In her study, she did not find any evidence of the cognate facilitation effect in a pure list nor a cognate inhibition effect in a mixed list. Moreover, Seim,

(2018) conducted a study, which was about lexical organization in bilinguals and L2 learners of Norwegian and English. In her study, in a pure list, she did not find any evidence of cognate facilitation effect. Hence, the different results of the current study could be a product of different language intermixing along with different lexical tasks based on different languages.

There is no certainty as to why the results of this current study differ from the previous studies. Regarding homographs that took the longest time to process in Experiment 3 could be analyzed in this way: Dijkstra et al. (1998) described in their study, “interlingual homographs may be recognized faster than, slower than, or as fast as monolingual control words depending on the task requirements and language intermixing” (p. 51). Therefore, in the present study, the reason behind homographs having the longest time could be the reason for having English-specific lexical decision tasks in experiment 3 and the intermixing of Norwegian and English languages.

We previously conducted a similar study with Norwegian-English bilinguals in 2021 (Sapti & Nazir, 2022). The design of the experiment in that study is equivalent to Experiment 2 in the current study. The participants were also volunteers from the university and there were 27 adult undergraduate students. There was only one experiment and the stimulus list contained cognates, non-cognates, true non-words, and Norwegian words. Thus, it was a mixed language list. The participants had to choose words that were only words in English. In that experiment, the cognates were processed 1621 ms faster than non-cognates (95% CI: 1574-1669, p-value <0.0001) (Sapti & Nazir, 2022). Even in that study, the cognates were processed significantly faster than non-cognates in a mixed language stimulus list. Similarly, the model of that study showed that non-words were processed 1783 ms faster than Norwegian words (95% CI: 1712-1853, p-value <0.0001) (Sapti & Nazir, 2022). The second experiment of this current study is also a replication of this study and here as well the result is the same. The cognates were processed 1582 ms faster than non-cognates including the non-words that were processed 1699 ms faster than the Norwegian words. Therefore, in both studies with Norwegian-English bilinguals in a mixed list, the cognates were processed faster than the non-cognates, and true non-words were processed faster than the Norwegian words. Thus, even though we do not have a good explanation for the results of experiments 2 and 3, the direct replication in Experiment 2 of our earlier study increases our confidence in the results.

5.6 Limitation

Some of the results can be due to limitations of the study. This study only added medium-frequency cognates and non-cognates. Like other studies such as Seim, (2018) this study did not add different frequencies to the stimulus materials. Word frequency plays a vital role in processing a lexicon in the brain and responds accordingly. Words that are used frequently in a conversation have high frequency. Forster & Chambers, (1973), and James, (1975) have demonstrated the facts about high-frequency words being processed faster than low-frequency words. Besides, word frequency can be also significant in assessing the cognates and homographs as the word is from both participants' first and second language might not be necessary that the same word will contain similar frequency in both languages (Diependaele et al., 2013). Another interesting study by (Sherkina-Lieber, 2004) presented that bilinguals perceive cognates as having a higher frequency. In that study a test of frequency rating on English words, Russian English bilinguals rated the cognate frequency significantly higher than the English monolinguals, whereas there was no such difference when it comes to rating the non-cognates. Therefore, we can assume that word frequency is an important aspect when we are looking into cognates or any word assessed by the mental lexicon. Consequently, the distinct results of this study might be due to the absence of frequency identification for cognates in

Norwegian, the lack of contrasting frequencies for non-cognates, and not having to match frequencies for the interlingual homographs. In addition, due to the shortage of time, it was hard to arrange a proficiency test for the participants to check their English proficiency. The self-assessed test might not be able to determine the actual proficiency of the participants. That might be the reason why the model of this study could not prove significant when compared to participants' proficiency. Besides, for each experiment, 20 participants were selected, which is not a very large sample. Participants were also not compensated. This could demotivate them a bit to go through the whole experimental procedure. However, the found effects in all three experiments are so large that we are quite confident that the limitations did not directly affect the results, at least for the main effects.

6.0 Conclusion

The goal of this study was to test the assumptions of the BIA+ model on cognates with regard to the effect of stimulus list composition and how they are being processed. For this reason, a number of Norwegian-English bilinguals were recruited to perform lexical decision tasks that were specific to the English language in both pure and mixed-list situations. Experiment 1 was referred to as the pure task with only cognates, non-cognates, and true non-words. Experiments 2 and 3 were mixed list tasks containing words from the non-target language (Norwegian words) and homographs. According to the BIA+ model (Dijkstra & Van Heuven, 2002) and consecutively previous studies, it was assumed that the cognates would be processed faster in Experiment 1 while in both Experiments 2 and 3, this facilitation effect would be gone.

To sum up, in all three experiments cognates were the fastest to be recognized, with the comparison between true non-words and Norwegian words, non-words were quicker to be reacted, the non-words were even quickest than other word types except for the cognates, and lastly, homographs were the hardest to recognized among all other word types. Self-assessed language proficiency was found to be non-significant in all three experiments.

Thus, in this study, we can see a large cognate facilitation effect in all three experiments. Here the list composition effect on cognates did not prove to be impactful. Although the results of cognates could not matched with the former studies, homographs in Experiment 3 were processed very slowly, following the list composition effect described in the BIA+ model (Dijkstra & Van Heuven, 2002). Hence, the first hypothesis was confirmed but not the last two hypotheses. This study also revealed that the Norwegian-English bilinguals like the previous study (Sapti & Nazir, 2022) process cognates faster regardless of the stimulus list composition.

This study also supports the theory of language non-selective access. (De Groot, 2011; van Assche, Duyck, & Hartsuiker, 2012).

For a follow-up study, instead of a self-assessed proficiency assessment, an actual regulated test can be organized for the participants to determine the accurate proficiency level. Word frequency can be included as a factor by including words of different frequencies and compared with other statistical models to observe their effect on the reaction time of cognate processing.

Besides, future research could investigate different experimental designs by following the BIA+ model studies such as Van Hell & Dijkstra, (2002), Vanlangendonck et al., (2019), and Van Heuven & Dijkstra, (2010). This study then can be compared to the multiple other studies with the same language pairing groups as to why the cognates facilitation effect remained in a mixed language list task.

Finally, considering the well-established presence of the cognate facilitation effect in the existing literature, there is a chance to explore the practical implications of this event in educational environments. This might help in investigating more effective methods for teaching foreign languages in classrooms, as they have potential cross-linguistic similarities between the languages acquired by learners.

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Appendix 1- Stimulus Materials

Serial no.	Word	SUBTLwf	Lg10WF	Length	Classification
1.	bible	18,33	2,9713	5	Med Cognate
2.	sport	19,9	3,0069	5	Med Cognate
3.	fruit	21,73	3,0449	5	Med Cognate
4.	media	22,29	3,0561	5	Med Cognate
5.	belt	24,35	3,0945	4	Med Cognate
6.	uniform	24,82	3,1028	7	Med Cognate
7.	plant	27,61	3,1489	5	Med Cognate
8.	slave	28,43	2,9736	5	Med Cognate
9.	storm	30,86	3,1973	5	Med Cognate
10.	tongue	31,16	3,2014	6	Med Cognate
11.	snow	31,35	3,2041	4	Med Cognate
12.	energy	32,9	3,2251	6	Med Cognate
13.	magazine	33,2	3,2289	8	Med Cognate
14.	finger	36,67	3,2721	6	Med Cognate
15.	pair	37,25	3,279	4	Med Cognate
16.	project	37,39	3,2806	7	Med Cognate
17.	planet	38,73	3,2958	5	Med Cognate
18.	guest	39,94	3,3092	5	Med Cognate
19.	oil	41,08	3,3214	3	Med Cognate
20.	milk	42,53	3,3365	4	Med Cognate
21.	form	42,75	3,3387	4	Med Cognate
22.	cake	45,06	3,3615	4	Med Cognate
23.	nature	45,16	3,3625	6	Med Cognate
24.	knife	46,8	3,378	5	Med Cognate
25.	rain	48,9	3,3971	4	Med Cognate
26.	cream	48,91	3,3953	5	Med Cognate
27.	rose	53,02	3,4322	4	Med Cognate
28.	camera	57	3,4636	6	Med Cognate
29.	wind	59,37	3,4813	4	Med Cognate
30.	glass	60,71	3,4909	5	Med Cognate
31.	bathroom	61,67	3,4978	8	Med Cognate
32.	race	61,9	3,4994	4	Med Cognate
33.	hat	64,18	3,5151	3	Med Cognate
34.	tree	65	3,5206	4	Med Cognate
35.	arm	65,41	3,5234	3	Med Cognate
36.	cat	66,33	3,5294	3	Med Cognate
37.	machine	70,25	3,5544	7	Med Cognate
38.	ground	72,47	3,5678	6	Med Cognate
39.	summer	78,67	3,6035	6	Med Cognate
40.	bank	84,98	3,637	4	Med Cognate

Seim, (2018)

Serial no.	Word	SUBTLwf	Lg10WF	Length	Classification
1.	arrive	18,69	2,9795	6	Med Non-Cognate
2.	hug	19,33	2,9943	3	Med Non-Cognate
3.	rabbit	20,94	3.029	6	Med Non-Cognate
4.	castle	21,55	3,0414	6	Med Non-Cognate
5.	image	22,63	3,0626	5	Med Non-Cognate
6.	bike	25,88	3,1209	4	Med Non-Cognate
7.	wood	27	3,1392	4	Med Non-Cognate
8.	pink	28,47	3,1623	4	Med Non-Cognate
9.	shape	30,24	3,1884	5	Med Non-Cognate
10.	brave	31,71	3,209	5	Med Non-Cognate
11.	stomach	33,82	3.237	7	Med Non-Cognate
12.	language	35,1	3,2531	8	Med Non-Cognate
13.	mountain	35,39	3,2567	8	Med Non-Cognate
14.	pray	36,22	3,2667	4	Med Non-Cognate
15.	page	37,49	3,2817	4	Med Non-Cognate
16.	airport	38,04	3,288	7	Med Non-Cognate
17.	view	38,53	3,2936	4	Med Non-Cognate
18.	butt	38,57	3,294	4	Med Non-Cognate
19.	color	39,43	3,3036	5	Med Non-Cognate
20.	battle	42,25	3,3336	6	Med Non-Cognate
21.	danger	43,67	3.3479	6	Med Non-Cognate

22.	nurse	44,98	3,3608	5	Med Non-Cognate
23.	bird	45,45	3,3653	4	Med Non-Cognate
24.	pool	46,98	3,3797	4	Med Non-Cognate
25.	chair	49,24	3,4	5	Med Non-Cognate
26.	bottle	50,75	3,431	6	Med Non-Cognate
27.	teacher	55,73	3,4538	7	Med Non-Cognate
28.	beach	56,63	3,4607	5	Med Non-Cognate
29.	pants	58,75	3,4767	5	Med Non-Cognate
30.	gay	59,08	3,4791	3	Med Non-Cognate
31.	chicken	61,73	3,4982	7	Med Non-Cognate
32.	laugh	62,86	3,5061	5	Med Non-Cognate
33.	south	64,47	3,5171	5	Med Non-Cognate
34.	smoke	65,43	3,5235	5	Med Non-Cognate
35.	cry	65,65	3,5249	3	Med Non-Cognate
36.	space	66,06	3,5276	5	Med Non-Cognate
37.	hide	69,69	3,5508	4	Med Non-Cognate
38.	evil	73,16	3,5719	4	Med Non-Cognate
39.	brain	77,02	3,5943	5	Med Non-Cognate
40.	key	86,86	3,6465	3	Med Non-Cognate

Seim, (2018)

Serial no.	Word	SUBTLwf	Lg10WF	Length	Classification
1.	handle	108.41	3.7427	5	Homograph
2.	gang	30.14	3.187	4	Homograph
3.	barn	13.59	2.8414	4	Homograph
4.	gift	64.51	3.5173	4	Homograph
5.	fire	215.49	4.041	4	Homograph
6.	gutter	5.24	2.4281	6	Homograph
7.	store	81.92	3.6211	5	Homograph
8.	mutter	0.43	1.3617	6	Homograph
9.	her	2835.82	5.1603	3	Homograph
10.	fat	79.43	3.6077	3	Homograph
11.	latter	1.25	1.8129	6	Homograph
12.	rope	22.71	3.0641	4	Homograph
13.	travel	33.37	3.2312	6	Homograph
14.	smell	83.14	3.6275	5	Homograph
15.	vent	4.41	2.3541	4	Homograph
16.	fart	6.43	2.5172	4	Homograph
17.	god	903.16	4.6633	3	Homograph
18.	fast	137.45	3.8458	4	Homograph
19.	sin	15.94	2.9106	3	Homograph
20.	fare	6.16	2.4983	4	Homograph
21.	roman	10.47	2.7284	5	Homograph
22.	grave	26.27	3.1274	5	Homograph
23.	anger	19.43	2.9965	5	Homograph
24.	stem	2.24	2.0607	4	Homograph
25.	tier	1.06	1.7404	4	Homograph
26.	pose	6.08	2.5416	4	Homograph
27.	late	269.73	4.1385	4	Homograph
28.	tale	12	2.7875	4	Homograph
29.	last	723.1	4.5668	4	Homograph
30.	skip	21.1	3.0322	4	Homograph
31.	tall	32.33	3.2175	4	Homograph
32.	blind	45.82	3.3688	5	Homograph

Serial no.	Non-Words	Length
1.	tumb	4
2.	drunch	6
3.	emty	4
4.	bryle	5
5.	creame	6
6.	humner	6
7.	feum	4
8.	prosse	6
9.	spoule	6
10.	splier	6
11.	thwerv	6
12.	piln	4
13.	griep	5
14.	gluit	5
15.	holf	4
16.	knomb	5
17.	cretch	6
18.	hotche	6
19.	beld	4
20.	gourse	6
21.	sneam	5
22.	gribbe	6
23.	yeiled	6
24.	tir	3
25.	pley	4
26.	flug	4
27.	wittow	6
28.	fliefe	6
29.	loke	4
30.	jalt	4
31.	blild	5
32.	mistak	6
33.	chowth	6
34.	stume	5
35.	rast	4
36.	ghooze	6
37.	loame	5
38.	kear	4
39.	shobbe	6
40.	brize	5
41.	girlin	6
42.	findent	7
43.	immome	6
44.	ausitor	7

45.	snator	6
46.	precte	6
47.	sukine	6
48.	luctes	6
49.	brittea	7
50.	respar	6
51.	confout	7
52.	pread	5
53.	affeign	7
54.	kicke	5
55.	rupted	6
56.	puress	6
57.	egated	6
58.	sillet	6
59.	droor	5
60.	aniz	4
61.	dybul	5
62.	halite	6
63.	vole	4
64.	comp	4
65.	plaim	5
66.	dou	3
67.	agin	4
68.	comp	4
69.	mismus	3
70.	clasial	7
71.	oviste	6
72.	fuln	4

Serial no.	Norwegian Words (non-words)	Length
1.	hytte	5
2.	vilje	5
3.	rasende	7
4.	feie	4
5.	bruke	5
6.	jage	4
7.	lykkes	6
8.	spor	4
9.	svin	4
10.	bevis	5
11.	gni	3
12.	mage	4
13.	tvinge	6
14.	ben	3
15.	flau	4
16.	snill	5
17.	merkelig	8
18.	kjedelig	8
19.	herlig	6
20.	vann	4
21.	ansette	7
22.	brenne	6
23.	frykt	5
24.	beregne	7
25.	himmel	6
26.	valp	4
27.	reklame	7
28.	tegne	5
29.	kino	4
30.	gidde	5
31.	uheldig	7
32.	seks	4
33.	opplegg	7
34.	knuse	5
35.	myk	3
36.	utsikt	6
37.	treg	4
38.	koselig	7
39.	trygghet	8
40.	bukse	5

Appendix 2: List of training words (these data were not included in the analysis)

Cognates	Non Cognates	Non Words
Problem	Drain	Reget
Festival	Sky	Pitol
Atom		Hust
		Mumple
		Shurry

Cognates: https://blogs.transparent.com/norwegian/norwegian-words-that-are-the-same-as-english-words/

Non Cognates: Through translator/ dictionary

Non Words: Poort supplementary article

Poort, E. D., & Rodd, J. M. (2017). The cognate facilitation effect in bilingual lexical decision is influenced by stimulus list composition. *Acta Psychologica*, *180*, 52–63. https://doi.org/10.1016/j.actpsy.2017.08.008

Appendix 3: Proficiency test form for participants

1. Do you have any English parent?

☐ Yes ☐ No

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

2. Based on the ILR scale of 0-5 mentioned above, 0 being the lowest and 5 being the highest, Rate your level of English proficiency.

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Appendix 4: Participants' responses

Participant numbers	English Proficiency Level	English Parent	Date
1	4	no	13.03.2023
2	4	no	13.03.2023
3	4	no	13.03.2023
4	4	no	13.03.2023
5	4	no	13.03.2023
6	4	no	13.03.2023
7	4	no	15.03.2023
8	3	no	15.03.2023
9	3	no	15.03.2023
10	4	no	15.03.2023
11	4	no	15.03.2023
12	4	no	15.03.2023
13	4	no	15.03.2023
14	3	no	15.03.2023
15	5	no	15.03.2023
16	4	no	15.03.2023
17	5	no	15.03.2023
18	3	no	15.03.2023
19	4	no	15.03.2023
20	4	no	15.03.2023
21	4	no	20.03.2023
22	3	no	20.03.2023
23	3	no	20.03.2023
24	3	no	20.03.2023
25	4	no	20.03.2023
26	3	no	20.03.2023
27	3	no	20.03.2023
28	4	no	20.03.2023
29	4	no	20.03.2023
30	3	no	20.03.2023
31	3	no	20.03.2023
32	4	no	20.03.2023
33	3	no	20.03.2023
34	3	no	20.03.2023
35	4	no	20.03.2023
36	3	no	22.03.2023
37	4	yes	22.03.2023
38	4	no	22.03.2023
39	5	no	22.03.2023

40	4	no	22.03.2023
41	4	no	22.03.2023
42	4	no	22.03.2023
43	3	no	22.03.2023
44	4	no	22.03.2023
45	4	no	22.03.2023
46	4	no	27.03.2023
47	4	no	27.03.2023
48	4	no	27.03.2023
49	4	no	27.03.2023
50	4	no	27.03.2023
51	5	no	27.03.2023
52	4	no	27.03.2023
53	5	no	27.03.2023
54	4	no	29.03.2023
55	4	no	29.03.2023
56	3	no	29.03.2023
57	4	no	29.03.2023
58	4	no	29.03.2023
59	4	no	29.03.2023
60	4	no	29.03.2023