Anna Evjen Seim

Lexical organization in bilinguals and L2 learners

A study of lexical access and cognate representation

Master's thesis in English

Trondheim, May 2018

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Abstract

The current study investigates how bilinguals and second language learners' mental lexicons are organized. Studying how learners access their mental lexicon provides information on how cognates (words with similar or identical form) are represented in the mental lexicon, and further whether the mental lexicons are overlapped or unconnected. Through a lexical decision experiment, reaction times to cognates and noncognates of corresponding frequencies were compared. We tested whether accessing a word in one lexicon activated its counterpart in the other (*nonselective access*), or only activated the representation in the used language (*selective access*). Nonselective access suggests that cognates have one shared representation across languages, and selective access proposes that cognates have two separate representations (one for each language). The results showed no differences in reaction times, suggesting evidence for lexical access being selective, that cognates have two representations in the mind, and that the mental lexicons are unconnected. There were no differences in reaction times between the bilingual and L2 learner group, indicating that proficient L2 learners and bilinguals access their mental lexicons comparably, suggesting similar lexical organization.

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1.0 Introduction

1.1 Lexical Organization

A major topic within the field of psycholinguistics is how the mental lexicon is organized and accessed. When it comes to bilinguals with two native languages (two L1s) and second language (L2) learners, they both presumably have two mental lexicons (one for each language), and the relation between the two lexicons is of interest. Whether the two lexicons are separate or overlapping can be explored by looking into how the bilinguals and L2 learners access their lexicon(s). This can be studied by how they access *cognates*, which are words that are similar or identical in form and meaning between two languages (Sherkina-Lieber, 2004).

1.1.1 Research Question

The current study investigates how the mental lexicons of bilinguals and L2 learners are organized by how they access cognate words. Investigating their lexical access will provide information about how cognates are represented; whether they have two distinct or one shared representation across the two lexicons. Potential differences between the two participant groups will also be explored. The bilinguals in the current study have English and Norwegian as their native languages, and the L2 learners are Norwegian native speakers who are acquiring English as a second language.

1.2 Background and Motivation

English and Norwegian share a large number of lexical items that are similar or identical in form and meaning, referred to above as cognates. A common question regarding cognates is how they are lexically represented by bilinguals, whether they have a single representation shared between two languages or distinct representations in each language. There is research presenting evidence for both shared and separate cognate representations (e.g. Kirsner et al., 1993; Dijkstra & Van Heuven, 2002), which will be presented in Chapter 2. Looking into how bilinguals and L2 learners access cognates in their mental lexicons will provide information about how their mental lexicons are organized. If only the mental lexicon in the used language is activated, that suggest that lexical access is selective. Selective access will further suggest that they have two separate representations of cognates, meaning that the lexicons are also separate. If both Norwegian and English lexicons are activated, that implies that lexical access is nonselective. Nonselective access suggests one shared representation for cognates, and that both lexicons are overlapping each other. We investigated access through a lexical decision experiment, where reaction times to cognates and noncognates of corresponding frequencies were compared (Keuleers & Brysbaert, 2012). Unconnected lexicons (two cognate representations) are supported by no reaction time differences between cognates and noncognates, and overlapping lexicons (shared cognate representations) are supported by faster reaction times to cognates.

Although there are a number of studies investigating how bilinguals access their lexicons (e.g. Dijkstra et al., 1999; Peeters et al., 2013), there are not as many on lexical access for second language learners (e.g. Lemhöfer & Dijkstra, 2004). Additionally, the selection of studies comparing these participant groups is limited. More importantly, no published studies have compared lexical access in Norwegian-English bilinguals and Norwegians learning English as a second language (to my knowledge). Since Norwegians are highly exposed to English through input from school and media (Utdanningsdirektoratet, 2013; Simensen, 2009), it is assumed that their English proficiencies are relatively high, at least compared to L2 learners in countries with limited English exposure. Even though Norwegians who are learning English as a second language might be highly proficient in English, which bilinguals also are, it is possible that the lexical organization is different in the two groups. Because English-Norwegian cognates are similar/identical across Norwegian and English, it is possible that they only have one shared representation in the mental lexicon for both groups (De Groot & Nas, 1991).

1.3 Thesis Outline

Chapter 2 presents theoretical background on cognates and previous research regarding how cognates are represented and processed in the brain. Chapter 3 provides methodological discussion on how we investigated cognate processing and lexical access using a lexical decision experiment. The experiment measured the bilinguals and L2 learners' reaction times when responding to whether strings of letters were real words or not. The main comparison was between reaction times to medium frequency cognates and medium frequency noncognates. Reaction times to high- and low frequency noncognates were also measured, used as controls for the participants reacting expectedly based on results from previous research.

Nonwords were included for the same reason, in addition to giving the participant a reason to make a decision on the words being real words or not. The results and discussion chapters follow. In the results chapter, reaction times to the cognates, noncognates, and nonwords are presented, along with a statistical analysis. The discussion chapter considers how the results inform our understanding of lexical access of bilinguals and L2 learners, cognate representation and differences between the two groups. A discussion of the reliability of the study is also included, with issues that could possibly interfere with the results.

2.0 Theoretical Background

2.1 Cognates

Cross-language cognates are words that share similar or identical semantics (meaning), orthography (spelling) and/or phonology (pronunciation) across two or more languages (Sherkina-Lieber, 2004, p. 108). There are several reasons for words being similar in form and meaning. Most often it is that they originate from the same word historically. English and Norwegian both stem from the Germanic branch of the Indo-European language family, which means that the two languages share many characteristics, vocabulary being one of them. Two other reasons for word similarities are that they could have been borrowed from each other's languages, or that they both have borrowed from a third language (p. 108). Lexical borrowings, or loanwords, are words that have been transferred from one language to another and entered that language's lexicon (Haspelmath, 2009, p. 35). The Scandinavian languages had a major influence on English during the Norse settlements during 770-970 AD. Nature-names and place-names were of particular influence, such as (sand) 'bank', 'hut' and most place names ending in 'by', e.g. Westby, a town in Southwest Wisconsin (Strang, 2015 p. 338-339). In the mid 1900s, loanwords were also considered to be a result from continuous language intermixing in bilinguals. This view was presented in a study by Einar Haugen in 1950. Haugen proposed that language intermixing is the process when two mental lexicons interfere with each other, meaning that when a speaker uses one language, lexical items from another language might be used (p. 210). Although language intermixing is still considered a reason for borrowings to develop, current borrowing has become a term in a broader sense; it does no longer only occur for bilinguals. Lexical borrowing is often a result from words being implemented into a language as an effect of globalization, e.g. the influence of the English language through business relations, TV and social media (Witalisz, 2011, p. 5). Words such as 'taxi', 'scanner' and 'hamburger' are only a few examples of words that have been adopted into many languages; Norwegian, Spanish, German and Hungarian being a few of them. Both English and Norwegian have also experienced influence from third languages, especially from Latin. Some loanwords that have been adopted to English and Norwegian from Latin are 'plant/plante', 'month/måned' and 'choir/kor' (Strang, 2015, p. 338).

Based on a number of studies and theoretical papers on cognates, linguists seem to agree that a criterion for categorizing words as cognates is that the they overlap (in different degrees) both in meaning, orthographic form and/or phonological form (Dijkstra et al., 1999; Lemhöfer & Dijkstra, 2004; Brenders & Dijkstra, 2011). A similar group of words are those that only share orthographic form but are not related semantically. Such words are called *false friends* (Brenders & Dijkstra, 2011). An example of false friends in English and Norwegian is ‘anger’. Both languages have a word spelled ‘anger’ but these two are not semantically related, meaning that they are false friends. In Norwegian ‘anger’ means ‘regret’. False friends are also often referred to as *interlingual homographs,* which are words that have similar phonological form, but are not semantically related. An example of such words are ‘core’ in English and ‘kår’ in Norwegian. The English word for ‘kår’ is condition, i.e. not the same meaning as ‘core’.(Lemhöfer & Dijkstra, 2004, p. 533).

Another important term is *partial cognates*. These are words that have several meanings, where one of them is cognates with its translation equivalent. An example is ‘rose’, which is a cognate with the Norwegian word for a type of flower. However, ‘rose’ in English is also the simple past tense of the verb ‘to rise’. It also has a another meaning in Norwegian, ‘to praise’, meaning that the word ‘rose’ is partial cognates both ways. Partial cognates can then be considered homonyms, because they are semantically ambiguous words where one of the words’ meanings share form with its translation equivalent, while the other meaning does not (Sunderman & Schwartz, 2008, p. 528).

2.2 Cognate Representation

An important term within language representation is *mental lexicon.* The mental lexicon is the aspect of our mind where we store our lexical items (words), and information about these items, mainly semantic, orthographic, phonological and syntactic information (Dijkstra, 2005, p.180). A major question is how cognates are represented in the mental lexicon. A central debate in research on cognates is whether (child) bilinguals and second language learners have two representations of cognates in their mind (one for each language), or one shared representation for both languages. There are two leading theories within bilingual representation, the *common memory theory* and the *multiple-memory theory* (Sánchez-Casas & García-Albea, 2005, p. 226). The common memory theory proposes that bilinguals have one vocabulary system integrating both languages, while the multiple memory theory suggests that the two mental lexicons are separated, i.e. two representations of all lexical entries. A model has been presented based on possible problems in the previously mentioned theories; the mixed hierarchical model. This model is based on two levels of representation, the lexical level and the conceptual level, and how these levels are interconnected in bilinguals and L2 learners' minds. The model suggests that because of the similar morphology between cognates, they are jointly related in the lexicon, proposing a shared representation (p. 226). This model could then account for bilinguals having both separate representations and shared representations - noncognates being represented separately and cognates having one shared representation. A study by Davis et al. (2010) supports this model, by demonstrating priming for cognates (faster recognition) but not for noncognates in a lexical decision task. This suggests that cognates have one shared representation in the mental lexicon, while noncognates are represented twice (Sánchez-Casas & García-Albea, 2005, p.238). A shared representation of a cognate means that the word is more frequently encountered (one representation used in two languages), and will potentially facilitate faster retrieval than for words with two representations (Davis et al, 2010, p.152-153). Theories discussing in more detail how cognates are represented will be presented further.

Dijkstra et al. (2010) conducted a study that also supports evidence for the mixed hierarchical model. In a lexical decision task, reaction time results demonstrated that identical cognates showed a large facilitation effect when compared to non identical cognates. Although the latter group were nonidentical, they were still very similar. Regardless, the results showed that lexical recognition is highly impacted by cognate status. The reaction times increased with larger degrees of form disparity of the cognates, and were longest for words that were noncognates (Dijkstra et al., 2010, p. 290). Based on these results, cognate status (identical vs. nonidentical) could possibly determine whether identical cognates and near-identical cognates are represented differently or not in the brain (Dijkstra et al., 2010, p. 290-291). Following the mixed hierarchical model, this finding could suggest that only identical cognates have shared representations, and that non-identical cognates and noncognates have two representations. Dijkstra et al.'s (2010) study further suggests that the cognate facilitation effect becomes larger with an increase in orthographic similarity between the two representations of the cognate in two languages (p. 292). The cognate facilitation effect is an effect that occurs for cognates in lexical retrieval, where they have a processing advantage over noncognates because of overlap in form and meaning and how they are represented in the mental lexicon(Rosselli et al., 2014, p. 650). In other words, retrieval of cognates should be faster than retrieval of noncognates, which have been supported by a number of studies, e.g. Dijkstra et al. (2010), De moor (1998) and Van Heste (1999) (see section 2.4.2).

Peeters et al. (2013) also discuss cognate representation, and refer to Dijkstra et al.'s (2010) work when they conclude that non-identical cognates must have two representations in the mind, but argue that it is unclear whether identical cognates are represented once or twice (p. 316). Following up on Sánchez-Casas & García-Albea (2005), Peeters et al. (2013) discuss in detail how cognates are represented in isolation. There are several theoretical views on cognate representation, one being that words that share morphemes across languages have one representation in the brain, the *shared-morpheme view*, which was presented by Kirsner et al. in 1993 (cited by Peeters et al., 2013, p. 316). According to this view, identical cognates have a shared representation for the morpheme of two translations of a cognate. This means that 'rose' is only represented once for an English-Norwegian bilingual. Another theoretical view, the *form overlap view*, presented by Voga & Grainger (2007) and Midgley et al. (2011), suggests that identical cognates have one shared orthographic representation, two phonological representations, and one shared semantic representation (Peeters et al., 2013, p. 316). Cumulative frequency (the frequencies of a cognate in two or more languages added together) will facilitate cognate recognition in both the shared-morpheme view and the form overlap view (Peeters et al., 2013, p. 316-317). The last view presented is the *two-morpheme view*, presented by Dijkstra & Van Heuven (2002), Dijkstra et al. (1998), (1999), and Van Hell & Dijkstra (2002). In contrast to the shared-morpheme view and the form-overlap view, the two-morpheme view claims that the morphemes of identical cognates are represented twice, in addition to two phonological representations. The proposed reason for cognates having two morpheme representations is that even though identical cognates have identical form, they can have different gender, plural markers, and frequencies across two languages (Peeters et al., 2013, p. 317).

The shared-morpheme view, the form overlap view, and the two-morpheme view were tested by Peeters et al. (2013) by doing a lexical decision task, aiming to see which theory fit the results. They looked into how cumulative frequency of the cognates had an impact on cognate retrieval, which in turn could explain how cognates are represented in the brain. A discussion of the overall reaction times to cognates vs. noncognates will be presented in section 2.4.2. The measurements of reaction times (RT) and event related potentials (ERP) in a lexical decision task on French-English bilinguals (French L1, English L2) suggested that the cognates were represented in the brain by the two-morpheme view. This finding was supported by the significance of the cumulative frequencies of only the English representations of cognates in the English lexical decision task, rather than the French representations. The significance of only the frequencies of the English representations supports the theory that cognates have two morpheme representations in the brain, and not one shared representation (p. 326). This is suggested because if bilinguals have two representations of cognates, only the frequency of the cognate in the target language should be activated, which the results showed evidence for. The shared-morpheme view and the form-overlap view were therefore rejected. The shared-morpheme view did not fit into the results of the measurements of RTs and ERPs because the participants reacted faster to high frequency English low frequency French (HELF) cognates than to low frequency English high frequency French (LEHF) cognates (p. 325). If bilingual cognate representation followed the shared-morpheme view, where cumulative frequency across both languages should facilitate recognition because of shared morphemic representation, the participants should have reacted faster to LEHF cognates than to HELF cognates. This is because the participants were native speakers of French, and would naturally encounter French high frequency cognates more frequently than French low frequency cognates. However, the French-English bilinguals relied more strongly on high frequency of English (their L2), meaning that the results rejected the shared-morpheme view. The form-overlap view was rejected for the same reason, since this view also account bilingual cognate facilitation to be based on cumulative frequencies across the two languages (p. 326). Peeters et al.'s (2013) finding, that cognates have two morpheme representations in the mental lexicon, is supported by a number of studies (Baayen & Milin (2010) and Midgley et al. (2011).

2.3 Cognate Processing

A major question concerning cognates is how they are processed in the brain, which in turn will say something about how they are represented. A key factor in language processing is *lexical access*, which is a process where language users enter their mental lexicon to retrieve information about lexical items; particularly semantic, orthographic, phonological and syntactic aspects of words (Dijkstra, 2005, p. 180). The mental lexicon is constantly being accessed, both when humans *recognize* and *produce* words. Accessing the mental lexicon is a subconscious process, meaning that it is an automatic process that we are completely unaware of. The process of recognizing words is all based on presentation of words either visually or aurally. When presented with the first part of a word, several words that fit with that first letter string (written) or phoneme (oral) are activated in the mind. This means that the mind presents many options that could be recognized. Being presented with 'f-a-' could for example activate 'fat', 'fan', 'far' and other words starting with the same letter string. It is not until the brain surpasses the recognition threshold that the final target word is recognized (p. 180). The time from when a word is presented to when it is activated is so short that language users do not even notice that other words were activated upon the initial presentation of the first letter string.

The process of other words being activated in the mental lexicon because they are related to the target word is called *spreading activation*. Presented words (or letter strings) will spread activation to related words, even after recognition of the target word. These can be orthographically, phonologically or semantically related words. For example, seeing or hearing the word 'car', will activate 'wheel', 'drive',' road' etc. semantically. Similarly, 'cat', 'cap', 'can' etc. will be activated at the orthographic level, due to their similar spelling. These examples are activation within one language. When bilinguals and second language learners recognize words in a lexical decision task, the theory of spreading activation becomes relevant in understanding how words are accessed across languages. When Norwegians who are learning English as a second language see an English cognate on the screen in a lexical decision task - for example 'bank', they do not necessarily have to have the English word as part of their mental lexicon to be able to recognize that word. Having the Norwegian word in their mental lexicon can prime activation of the English translation of the cognate. This means that the similarity of two translations of words proposes that the activation in one language will activate the equivalent in the other language (Peeters et al., 2013, p. 316). However, this facilitation can also occur for false friends, leading to the wrong interpretation of the meaning of the word. Partial cognates can have a similar impact on lexical retrieval. If a word has two meanings in English, like 'rose' mentioned above, it can cause confusion in recognition. However, usually contextual aspects will lead to successful recognition in real-life language use. Even though there are factors that can have a negative impact on lexical retrieval, the main message when it comes to cognate priming is that cross-language cognates can spread activation and assist lexical retrieval. Peeters et al. (2013) 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 (2013, p.316). In other words, orthographical identical cognates should cause faster recognition than cognates that are only near-identical.

2.4 Lexical Access in Bilinguals

A major concern that deals with the accessing of the mental lexicon is whether bilinguals are selective or nonselective when accessing their mental lexicon. Dijkstra (2005) claims that bilinguals generally believe that their language processing is selective, meaning that when they read, write or speak in one of their languages, only one the lexicon of the used language is activated (p.179). Evidence for lexical access being language selective was observed already in 1979, in a study by Caramazza & Brones, where no differences in reaction times between cognates and noncognates were observed. Evidence for selective lexical access suggests that the mental lexicon is organized with two representations of cognates (one for each language). The theory of nonselective access, which among others has been presented by Beauvillain & Grainger (1987) claim that both lexicons of bilinguals are activated at all times during language processing (Van Assche et al., 2012, p. 1). The fact that both lexicons are activated at all times suggests that cognates have one shared representation of cognates. Several researchers have found evidence supporting the theory of nonselective access. Among these are De moor (1998), Van Heste (1999), and Brysbaert et al. (1999) (Cited by Dijkstra, 2005).

When looking into lexical access, it is important to account for different aspects that can affect the process. For example, when investigating language selectiveness, the language of instruction can be a 'gamechanger' (Dijkstra, 2005, p.180). If an English/Dutch bilingual is tested whether retrieval of the English lexicon is selective or nonselective, the language of instruction needs to be in English. If the instructional information is in Dutch, that could possibly cause interference, and the Dutch mental lexicon will be activated. The results for selectiveness may then be incorrect, proposing that such experiments/tests need to be conducted in the target language.

2.4.1 Selective Access

As previously mentioned, the idea of selective access is that cognates have two representations of cognates in the mental lexicon, and not one shared representation in the two languages. Henceforth, selective access indicates that retrieval in one language is not facilitated by an identical (or very similar) representation in the other language, because only the language in use is being activated for retrieval (Dijkstra, 2005). If lexical access is selective, the recognition of cognates will not be faster than for noncognates of similar frequencies and word lengths.

The reaction times for cognates and comparison words would then be resembling each other. Scarborough et al. (1984) did a study investigating language selectiveness on Spanish-English bilinguals. In one of their experiments, the participants were tested if repetitive presentation of a word in Spanish would assist recognition of the word when it was translated into English. The results showed no faster recognition than to other words that had not been primed (p. 89). What is noteworthy here, is that this study did not involve cognates. It was simply a study that investigated priming of a word in one language to the translation equivalent in the other language. Hence, the study was only looking at semantic priming. However, one may wonder if these results also could account for cognate retrieval, whether there are any studies supporting this finding that deal with bilingual cognate priming, and how strong evidence there is for language selectiveness in bilingual lexical access. Looking into this, a number of research on bilingual language selectiveness seem to find evidence supporting the theory of nonselectiveness, which will be presented in section 2.4.2, and not the theory of selectiveness. Among the studies that did find evidence supporting the theory selective access in bilinguals are Caramazza & Brones (1979), Costa et al. (1999) and Gerard & Scarborough (1989). The latter research group conducted a lexical decision study, investigating how Spanish-English bilinguals access cognates, noncognates, and noncognate homographs (false friends). The cognates and noncognates were matched for frequencies (in both languages) and word lengths in number of letters. The results showed no difference in latencies between the cognates and the noncognates, supporting the theory of lexical access being language selective (Gerard & Scarborough, 1989, p. 308).

2.4.2 Nonselective Access

According to evidence from a number of researcher's work, the lexicon for each language is not something a speaker can just turn off; they are continuously activated (Dijkstra, 2005, p. 179). This can be seen in lexical decision tasks in several studies (e.g. Dijkstra et al., 1999), where there have been a significant difference in reaction times between cognates and comparison words (noncognates), with a generally faster reaction to cognates. This RT difference is believed to be a result of priming from the cumulative frequency of one shared cognate representation across languages (Peeters et al., 2013). Although there are studies supporting bilingual language selectiveness, there is a large group of studies supporting the theory of language nonselectiveness (De moor, 1998; Van Heste, 1999; Beauvillain & Grainger, 1987 and others); that bilingual lexical access is nonselective. The study conducted by Peeters et al. (2013) showed evidence for bilinguals' lexical access being nonselective. They conducted a study where 19 French-English bilinguals completed a lexical decision task, exploring differences in reaction times to cognates and noncognates. English was the target language in the experiment. Words in both groups were matched for frequencies (in both languages) and word lengths (number of letters). The results revealed significant differences in reaction times for the cognates and noncognates. The average reaction times for cognates were 694 ms, and 726 ms for noncognates (Peeters et al., 2013, p. 320). These findings suggest that the processing of language for bilinguals is nonselective, because a shared representation across two languages in the mental lexicon facilitates retrieval of cognates in the target language. Michael & Gollan (2005) also agree with this view, saying that bilinguals can never become 'functional monolinguals', because they will never be able to completely shut off the nontarget language in any language processing or production situation (p. 392). There are several studies supporting the theory that lexical access is nonselective, among these are De Groot et al. (2000) and Dijkstra et al. (2010).

Due to the different perspectives presented, there seem to be a general consensus that bilinguals access their mental lexicons nonselectively, and henceforth that cognates have one shared representation across languages in the mental lexico. Findings supporting selective lexical retrieval has been tested under similar conditions in more recent studies, and have not recreated similar results (Dijkstra, 2005, p.181). It is difficult to conclude on what made the initial results non-replicable, but it could possibly relate to the selection of stimulus materials, contextual aspects and/or the the selection of participant. Regardless, most research on this topic presents results supporting that bilinguals retrieve and produce language nonselectively.

2.5 Lexical Access in L2 Learners

What about L2 learners? How do cognates affect their lexical retrieval? A study by Lemhöfer & Dijkstra (2004) was performed on Dutch participants in the ages of 20-31. These participants had learned English as a foreign language for 12 years on an average (p. 540). The study showed that the L2 learners presented a cognate facilitation effect in an English lexical decision task. This effect initiated faster recognition to English-Dutch cognates than to English words that were not cognates with corresponding Dutch words (with similar frequencies and word lengths in number of letters). The average reaction time for cognates was 546 ms, and 601 ms for comparison words (noncognates) (p. 540). There was also a difference in reaction times between the different types of cognates. Cognates that were semantically and orthographically related with the Dutch word had shorter RT (564 ms) than for the cognates that were semantically, orthographic and phonological related (583 ms) (p. 540). Although there was a difference between these cognate conditions, this difference was considered to be insignificant. The most noteworthy finding here is that there was a significant difference between all cognates and their compared noncognates, demonstrating that the L2 learners were experiencing a clear cognate facilitation effect when recognizing lexical items, and presumably accessed lexical items nonselectively. Furthermore, the results suggests that cognates have one shared representation in the mental lexicon, and that the mental lexicons of the two languages are overlapped.

Brenders & Dijkstra (2011) conducted a similar study on how L1 speakers of Dutch with English as their L2 process cognates. The ages of the participants ranged from 10 to 15. Their proficiency levels were mixed; the youngest were at beginner levels, and the oldest were at intermediate levels (p. 387). They conducted three lexical decision experiments, two of them in English, where they observed a clear cognate facilitation effect for cognate conditions. These two experiments indicated that the Dutch children who were learning English as a second language already from an early age experienced a cognate effect when accessing lexical items (p. 393). Additionall, the results suggest that L2 learners access their lexicons nonselectively.

As presented, the studies by Brenders & Dijkstra (2011) and Lemhöfer & Dijkstra (2004) both suggest that lexical retrieval for L2 learners is nonselective. Since L2 learners are acquiring a language as a second language, and are not native-like in that language, it seems plausible to assume that they are mainly nonselective when using their second language, and not so much when using their first language. Individuals with knowledge of more than one language have one set of concepts, but two sets of lexical entries - one per language. Because of learning paths, frequency of use etc., connections between L1 and concepts are stronger than between L2 and concepts. Furthermore, connections from L2 to L1 are stronger than connections from L1 to L2. Based on this, it is likely that L2 learners are selective in their L1, because the lexicon of their L2 does not interfere with their lexicon in their L1 (Kroll et al., 2013). This also accounts for cognates; being native in one language and not in a second language suggests more frequent encounters with a cognate in L1, and less frequent in L2 (Peeters et al., 2013, p.318). However, because of the existence of two mental lexicons, interference might still occur in L1 processing, just maybe not as much as for when they process their L2. The degree of proficiency and frequency of usage in their L2 might also affect whether retrieval in their L1 is selective or nonselective, and to which degree.

2.6 The Current Study

The studies presented propose that (1): bilinguals are mainly nonselective when accessing their mental lexicon, meaning that both lexicons are activated at all times, and that cognates have one shared representation. This has been suggested in a large number of studies where bilingual participants have recognized cognates faster than noncognates in a given target language, demonstrating a cognate facilitation effect. (2): L2 learners are also nonselective (especially when accessing L2), because they experience a cognate facilitation effect, even when their mental lexicon in the foreign/second language is of non-native character.

Based on theoretical background on the topic, looking into whether bilinguals and L2 learners show evidence of similar or different lexical access is of interest. How are their lexicons organized? Faster retrieval of cognates compared to noncognates will be evidence suggesting nonselective access. This will suggest that cognates are represented as one shared item, suggesting that the mental lexicons are overlapping. If there is no difference in retrieval of cognates and noncognates, that is evidence suggesting that lexical access is selective. This will indicate that cognates are represented twice (one for each language), meaning that the two mental lexicons are unconnected. Because the majority of studies have presented evidence for nonselective access (cf. Peeters et al., 2013; Lemhöfer & Dijkstra, 2004), it may be expected that participants in the current study will do the same in their lexical decision task.

3.0 Methods

3.1 Participants

The participants were divided into two groups: 12 Norwegian-English child bilinguals and 18 Norwegians who were learning English as a second language (referred to as L2 learners). The ages of the bilingual participants were 13-16, with an average of 14. For the L2 learners, the age of the participants ranged from 14-15, with an average of 14. 05. There were 8 female and 4 male participants in the bilingual group, and 11 female and 7 male participants in the L2 learner group. The criterion for the bilinguals was that they had to have one Norwegian and one English-speaking parent. Additionally, it was important that they were using both languages on a daily basis, and that their proficiency was approximately equal in both languages. The L2 learners consisted of Norwegian children who had learned English as a second language since age 6. Hence, most of these participants were fairly proficient in English. The main difference between these groups was that the bilinguals can be said to have had native competence in two languages, while the L2 learners only were native in Norwegian.

3.2 Experiment

The experiment consisted of a lexical decision task. Lexical decision tasks are experiments where participants are presented with a letter string (words) on a computer screen, and they are expected to decide as quickly as possible whether that word is a real word or not by pressing buttons on a keyboard corresponding to their answer (yes/no). Lexical decision tasks are one of the most used research method within the area of psycholinguistics (Keuleers & Brysbaert, 2012, p. 231). The reason why this type of experiment was chosen for the current study was that it is an effective tool for investigating lexical organization for monolinguals and bilinguals (Balota & Chumbley, 1984, p. 351). Another reason was its simplicity and efficiency. Considering the financial frame of this experiment, it was a very cheap experiment to perform, because it only required a simple data program/web program that could be used on any computer (Keuleers & Brysbaert, 2012, p. 231). Other than the importance of quietness, the experiment did not require participants to perform the experiment in a special room or environment, it could simply be done anywhere. Since the study consisted of participants that were in school, it was most efficient to conduct the experiment at their own school, mainly to save time for all individuals (the researcher, participants, and school staff) involved in the study.

Participant responses were measured to five different groups: low frequency noncognates, high frequency noncognates, medium frequency noncognates, medium frequency cognates, and nonwords. The participants decided whether presented words were real words or not, and 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. Only correct trials and trials with reaction times between 200 ms and 4000 ms were run for analysis (see results chapter). A group of nonwords were also included, because a lexical decision task could not be run if the participants' job was to decide whether something was a word if the answer to all the items were yes. The nonwords were also used as a control, making sure the participants were not just pressing ‘yes’ without paying attention to whether the words were real words or not. Details on how the procedure was performed will be discussed in section 3.4.

3.3 Stimulus Materials

The stimulus materials involved three groups of English words; 40 cognates, 120 noncognates and 160 nonwords. All the real words (cognates and noncognates) were open-class words; nouns, verbs and adjectives. All words were checked for frequencies on the US frequency database SUBTLEX (http://subtlexus.lexique.org). This database consists of a corpus of about 50 million words based on subtitles from movies and TV series (Brysbaert and New, 2009).

A number of the cognates were retrieved from a vocabulary list used for the Peabody Picture Vocabulary Test (PPV fourth edition, form A and B) which is a test commonly used to assess vocabulary knowledge among children and adults (Hoffman et al., 2012, p. 754). The words in this normed list are words that are expected to be familiar for the average speaker across age groups. 20 medium frequency (30-75 occurences per million) cognates were retrieved from the PPV list. The remaining 20 cognates were retrieved from appendixes in De Groot & Nas (1991) and Sherkina-Lieber (2004), two research articles on bilingual cognate processing. The cognates had lengths of 3-8 letters, with an average of approximately 5 letters. All cognates were both orthographically and semantically related. Since Norwegian and English are fairly different in the matter of phonology, we did not focus on guaranteeing that cognates were phonetically identical. Although none of the cognates in this experiment have identical phonology, most of the words have similar phonology to varying degrees, in addition to semantics and orthography. All 40 words are orthographically similar, but only 12 are identical, e.g. ‘glass’, ‘bank’ and ‘uniform’ (See Appendix 2).

The 40 cognates were matched with 40 medium frequency noncognates, which were either retrieved from the online *Corpus of Contemporary American English* (COCA) (https://corpus.byu.edu/coca/), or from appendixes in other research articles (Coltheart et al. 1979; De Groot & Nas, 1991). The medium frequency noncognates were used as a direct comparison group to the cognates, since the words in both groups were of similar frequencies. Additionally, two groups of high- and low- frequency noncognates were generated, 40 words in each group. These words were also retrieved from COCA or from items used in previous experiments (Coltheart et al. 1979; Sherkina-Lieber, 2004). It was important that these words also matched the cognates in terms of average lengths (approximately 5 letters), providing basis for accurate comparisons. The high- and low- frequency words were used to assess different reaction times between these words and the medium frequent words, as a control for the difference between the medium frequency words and the cognates. The 40 low frequency words had frequencies of <15 occurences per million. Many of the high frequency words were words that are often encountered in normal English. All these words were checked for frequencies in the SUBTLEX frequency database, being >100 occurences per million.

Table 1: Stimulus material lengths and frequencies.

	Average Length	Range of Word Length	Average Frequency	Frequency Range
MedFreqCognates	4,975 letters	5	45,48 per mil.	66,65
MedFreqWords	5,025 letters	5	45,64 per mil.	68,17
LowFreqWords	5 letters	5	7,78 per mil.	12,49
HighFreqWords	4,925 letters	5	348,16 per mil.	1186,86

The last group of words was a group of 120 nonwords. The nonwords were created through *ARC Nonword Database*(http://www.cogsci.mq.edu.au/research/resources/nwdb/nwdb.html). Nonwords ranged from 3 to 8 letters in length, with an average of 5,06 letters. All nonwords were phonotactically acceptable strings of letters, meaning that they followed the pronunciation and spelling rules of English (Keuleers and Brysbaert, 2010, p. 627). According to Keuleers and Brysbaert, there is a consensus among researchers that the use of nonwords in lexical decision tasks should only include strings of letters that are phonotactically acceptable in the language used in the research (2010, p. 627). This is because there is evidence showing that including phonotactically unacceptable nonwords makes identifying real words in lexical decision tasks too obvious and 'easy'. If phonotactically unacceptable nonwords were used, participants would not actually have to process the individual words, because they would obscure the actual question of interest ('is this a real word or not?' (Vitevitch & Luce, 1998). As a result, word features such as word frequency and age of acquisition would lose their impact on lexical decision (Keuleers and Brysbaert, 2010, p. 627).

3.4 Procedure

The lexical decision task was implemented on the online experimental platform Ibex Farm (http://spellout.net/ibexfarm). Participants were tested individually in a closed room at school. They were given a questionnaire before starting the test, where background information was collected, such as age, gender, language of parents, language used in childhood, which language(s) participants used daily and whether participants had any diagnoses that could have an impact on language processing (See Appendix 3). Participants completed the experiment using a 13" MacBook Air laptop. The instructions of the online-based experiment were given in English. Test words were split into two blocks of 120 words each. Two lists were created where the order of blocks was counterbalanced. Half of the participants were tested on the first list, while the other half was tested on the second list. Word order within blocks was randomized for each participant.

The participants used the keyboard when responding to the stimuli, pressing the 'f'- key for 'yes' and the 'j'-key for 'no', and the time from when the stimulus was presented to when they pressed the button was measured by the online experiment program.The inter-stimulus interval (time between each word presentation) was set to 1000 ms. There was a break included between blocks, where the participants could take as long time as they wanted before continuing.

There were some noise issues during the experiment for the bilinguals. The only room available that day was next to a hallway, where other students could occasionally be heard. After the participants had performed the experiment, they were asked whether they were bothered by noise. All of them said no. Although some interference from the noise cannot be ruled out, it is likely that it did not influence the results in any significant way. A discussion of this concern will be presented in Chapter 5, Section 5.7.3.

3.5 Ethical Aspects

Since the project consisted of a participant-based experiment, the project was registered to NSD (Norwegian Center for Research Data). To safeguard the participants' anonymity in this project, all personal identifiable information, how and where they were recruited from, stays confidential.

3.6 Predictions

3.6.1 Words vs. Nonwords

Looking into previous studies on reaction times to words and nonwords can suggest how participants in the current study will react to the same conditions. A lexical decision study by Schubert & Einmas (1977) compared native English speakers' reaction times to words vs. nonwords. The results showed that words were recognized faster than nonwords, with average reaction times of 584 ms for words and 739 ms for nonwords (155 ms difference) (p. 31). A study by Caramazza and Brones in 1979 showed similar results for English-Spanish bilinguals, with 652 ms for words (cognates and noncognates), and 811 ms for nonwords (159 difference) (p.213). Another study, by Forster & Chambers (1973), showed an overall faster reaction to words (high and low frequencies) than to nonwords, with 706 ms for words and 763 ms for nonwords (57 ms difference). Based on these previous findings, it is likely that the participants in the current study will also react faster to words than to nonwords.

3.6.2 Frequency Effects

Shorter reaction times to lexical items are assumed to be connected to words that are easily accessed in the mental lexicon, because they presumably are high frequency words, and are encountered more frequently. Longer reaction times suggests that the brain has to 'dig deeper' to recognize words, because the words are of particularly low frequencies. Because higher frequency words are naturally encountered more frequently than low frequency words, it is expected that the participants in the current study will have faster reaction times to the high frequency words. A study by Schilling & Rayner (1998) presented a clear effect of frequency. In a lexical decision task conducted by 48 English native speakers, the average reaction time to high frequency words were 522 ms, and 671 ms to low frequency words. Forster & Chambers (1973) presented similar results in their lexical decision task conducted by English native speakers, with faster average responses to high frequency words (608 ms) than to low frequency words (804 ms) (p. 629). James (1975) also demonstrated similar results, showing a clear effect of frequency. For this reason, it is likely that in the current study, participants will react faster to high frequency noncognates than to medium- and low frequency noncognates, and slower to low frequency noncognates than to high- and medium frequencies.

If the results in the current study presents these effects, that is an indication of the experiment working as intended. Furthermore, it suggets that the participants have English lexicons structured similarly to that of native speakers.

3.6.3 Cognates vs. Noncognates

The reaction time to cognates and. noncognates for bilinguals will provide information about their language selectiveness, and henceforth their lexical organization. Nonselective lexical access suggests that they have one shared representation of cognates. Such phenomena will be supported by shorter reaction times to cognates than noncognates. If there is no difference in reaction times between cognates and noncognates in the lexical decision task, that could account for language selectiveness, meaning that participants have two representations of cognates in their mental lexicon (one for each language). This also suggests that they are able to 'shut off' their non-target language and only retrieve/process words from the target language. For the current study, there are several possible outcomes of the reaction times to cognates vs. noncognates that can demonstrate how the mental lexicons of child bilinguals and late L2 learners are organized. The possibilities are:

1. The bilingual group and the L2 learner group will react faster (shorter RT in milliseconds) to cognates than to noncognates. If this is the case, lexical access is nonselective and facilitated from shared representations of cognates for both groups.
2. The bilingual group will react faster to cognates than to noncognates, and the L2

learner group will react faster to noncognates than to cognates. If this is the case, lexical access will be nonselective and facilitated for the bilingual group, and nonselective with interference between two mental lexicons for the L2 learner group.

3. The bilingual group will react faster to cognates than to noncognates, and the L2 learner group will react similarly to cognates and noncognates (ie. no difference). If this is the case, lexical access will be nonselective and facilitated for the bilingual group, and selective because of two representations of cognates for the L2 learner group.
4. The bilingual group will react faster to noncognates than to cognates, and the L2 learner group will react faster to cognates than to noncognates. If this is the case, lexical access will be nonselective and interfered for the bilingual group, and nonselective and facilitated for the L2 learner group.
5. The bilingual group and the L2 learner group will react faster to noncognates than to cognates. If this is the case, lexical access will be nonselective and interfered for both groups.
6. The bilingual group will react faster to noncognates than to cognates, and the L2 learner group will react similarly to cognates and noncognates (ie. no difference). If this is the case, lexical access will be nonselective and interfered for the bilingual group, and selective for the L2 learner group.
7. The bilingual group will react similarly to cognates and noncognates (ie. no difference), and the L2 learner group will react faster to cognates than to noncognates. If this is the case, lexical access will be selective for the bilingual group, and nonselective and facilitated for the L2 learner group.
8. The bilingual group will react similarly to cognates and noncognates (ie. no difference), and the L2 learner group will react faster to noncognates than to cognates. If this is the case, lexical access will be selective for the bilingual group, and nonselective and interfered for the L2 learner group.
9. The bilingual group and the L2 learner group will react similarly to cognates and noncognates (ie. no difference). If this is the case, lexical access will be selective for the both groups.

Based on the research referred to in Chapter 2, it seems plausible to assume that a few of these possibilities are more likely to occur than others in the current study. One possibility is prediction 1, where both groups react faster to cognates than to noncognates, meaning that language retrieval is nonselective and is facilitated by having a shared representation of the cognate across both languages. This prediction is based on evidence found by De moor (1998), Van Heste (1999), Beauvillain & Grainger (1987), who all found evidence of bilinguals having a cognate facilitation effect, and in studies by Lemhöfer & Dijkstra (2004) and Brenders & Dijkstra (2011), where also L2 learners experienced a cognate facilitation effect in lexical decision tasks.

Another possible prediction is that bilinguals will experience no significant difference in reaction time to cognates and noncognates, and L2 learners will react faster to cognates than to noncognates (prediction 7). This would mean that bilinguals are selective in language retrieval, meaning that they would be able to 'shut off' the nontarget language at any time. L2 learners would retrieve language nonselectively (cf. Lemhöfer & Dijkstra, 2004; Brenders & Dijkstra 2011). If bilinguals retrieve language selectively, such results would be supported by Costa et al. (1999) and Gerard & Scarborough (1989), where the latter researchers presented results showing that bilinguals elicited no latencies between cognates and noncognates in a lexical decision task.

What seems most probable, based on previously presented theories, is that both L2 learners and bilinguals will experience a cognate facilitation effect, which mean that they retrieve language nonselectively, and that cognates have one shared representation in the mental lexicon. Although there is research presenting evidence for both nonselective and selective lexical access for bilinguals, there seem to be larger number of research showing evidence that bilinguals retrieve language nonselectively. Due to the bilinguals' assumed higher proficiencies in English than the L2 learners, it is expected that they will react faster overall to all the English words (both cognates and noncognates) in the lexical decision task. However, L2 learners might still experience stronger priming, potentially presented by larger reaction time distinctions between cognates and noncognates than for the bilingual group. Although the most likely predictions based on previous research are presented, any of the presented possibilities can be true for the current study. After all, there is research providing evidence for both a response difference (nonselective access, shared representation of cognates) and no difference (selective access, two representation of cognates) between cognates and noncognates. Hence, both outcomes are expected, and both outcomes would demonstrate normal behaviour.

4.0 Results

4.1 Statistical Analysis

Statistical analysis was conducted in the R statistical computing environment (R Core Development Team, 2013). Reaction time differences were analyzed using linear mixed effects models implemented with the lme4 and lmerTest packages (Bates et al., 2015; Kuznetsova et al., 2017). All reaction times were log-transformed before analysis. Log- transforming data avoids positively skewed ratios, and presents distributions as normal (Wolfe, 1998, p. 35). Only reaction times for trials where participants gave a correct response were run for analysis. The reason for this is that the reaction times for incorrect trials would not be relevant for this study. If participants responded incorrectly, it could either be a result of pressing the wrong response key by mistake, or consciously pressing the wrong key, either because they did not know that a real word was real, or they thought a nonword was a real word. Because the current study looks at different reaction times to different word conditions based on conscious and correct responses, incorporating incorrect data would interfere with the results, resulting in incorrect data. Hence, the analysis would not be adequate (Balota & Chumbley, 1984, p. 353). However, even though all correct responses were used in the analysis, it is impossible to know whether all these responses were given on a conscious basis.

In addition to incorrect responses, outliers were also excluded from the data. Outliers were categorized as trials with reaction times less than 200 ms and more than 4000 ms from the offset of the stimulus material until either the 'yes' or 'no' button is pressed (Staub, 2010). The lower cutoff was determined on the basis that it is impossible to make a lexical decision in less than 200 ms. Items with such short responses could not even have been consciously recognized before responding. For reaction times above 4000 ms, it is possible that participants could have been distracted or lost focus, resulting in a late response. Naturally, these trials were excluded, because the participants did not show their true response, which would have resulted in inaccurate data (Baayen & Milin, 2010, p. 15). Error trials and outliers made up 2,4% of the data.

4.1.1 Models

Two separate linear models were run for analysis. In the first model, a comparison of the average reaction times for all words to nonwords was performed. The word group consisted of the average reaction times to *medium frequency cognates, low-, medium-, and high frequency noncognates*. Potential differences between the bilingual and L2 groups were also investigated. The model incorporated word-status (nonwords vs. words), group (bilingual vs. L2), and their interaction as fixed effects and random intercepts for subject and item. In the second analysis step, differences between the average reaction times for low frequency, medium frequency, high frequency, and cognate words for all participants were examined and compared. Whether there were significant differences between the groups was also run for analysis. The analysis was conducted using a linear mixed effect model with condition, group and their interaction as fixed effects. The models also included random intercepts for subject and word. Pairwise comparisons between the conditions were performed using the difflsmeans() function from lmerTest.

4.1.2 Statistical Significance

All average reaction time differences were tested for significance. The null hypothesis that was tested was that there were no significant differences between the different conditions. When testing the hypothesis, t-, p-, and Beta values were interpreted. Low t-values (< 1) suggest that there is no significant difference between the data that is being compared, ie. there is no evidence against the null hypothesis. High t-values (larger than or equal to 2) in combination with a p-value lower than .05, provide evidence against the null hypothesis, presenting the difference as significant. The p-value gives information about the significance of the results by giving an estimate of how likely they occured on a coincidental basis or not. The Beta value determines the estimated size of the given effect, providing information about the difference between the conditions that are being compared (Gelman & Hill, 2007). In the rest of this chapter, t- and p-values will be referred to as *t* and *p*.

4.2 Results

When looking at the average reaction times to cognates and noncognates, which was the main comparison in this study, there were no significant differences between the two conditions either across groups or within groups. However, differences in average reaction times to words and nonwords, as well as differences between the different frequency conditions were observed. These comparisons were used as controls, and were useful when examining the relevance of the similar reaction times to cognates and noncognates. Interpretation and discussion of the reaction times to cognates vs. noncognates through the results from the control conditions and previous research will be presented in the following chapter.

4.2.1 Words vs. Nonwords

Table 2: Average reaction times to words and nonwords for both participant groups, in addition to the combined averages.

	Words	Nonwords
Bilinguals	742 ms	974 ms
L2 Learners	770 ms	991 ms
Average	759 ms	984 ms

The average response time across both groups to nonwords was longer than the average response time to real words (t = 9.31; *beta* = 0.24; p < .001). As presented in table 2, the average reaction time to words was 759 ms and 984 ms for nonwords (difference of 225 ms). Figure 1 presents the density of the log-transformed reaction times to words and nonwords, demonstrating that the difference was of significant character (little overlap). A large number of observations were seen for shorter reaction times for the word group, and most of the responses to nonwords had longer reaction times.

The faster reaction times to words appear to be consistent with previous research on reaction times to words and nonwords (cf. Schuberth & Eimas, 1977; Caramazza & Brones, 1979; Forster & Chambers, 1973). This means that the participants responded as expected based on how English language users responded in those studies. The relevance of this finding will be discussed chapter 5. There were no significant differences between the two participant groups (t < 1), meaning they responded with similar reaction times to words and nonwords (see figure 2). For words, the average reaction time was 742 ms for bilinguals, and 770 ms for L2 learners. For the nonwords, bilinguals had an average reaction time of 974 ms and L2 learners 991 ms. Although there were some slight differences, the word-status by group interaction was not considered significant (t = -1.59). This means that there is no strong evidence concluding that the differences in reaction times did not occur by chance.

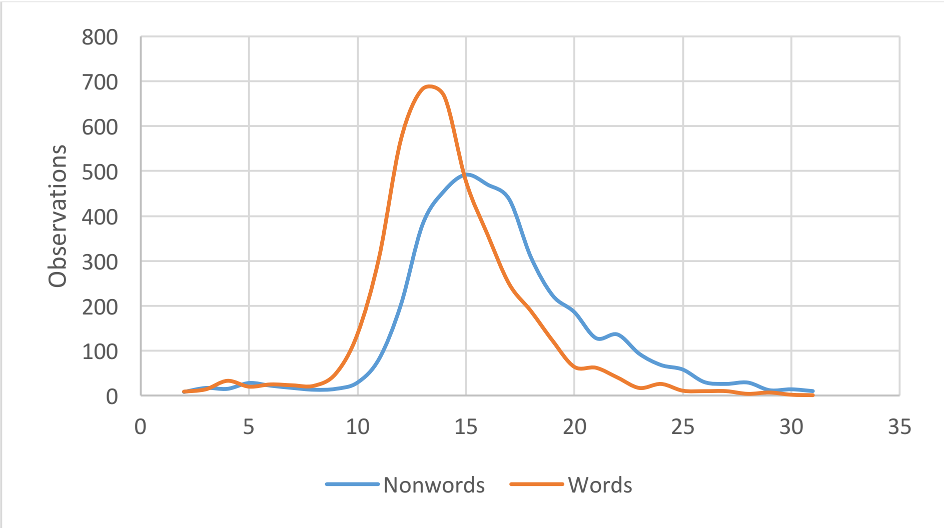

Figure 1: Density plot providing the distribution of all participants' log-transformed reaction times to words and nonwords.

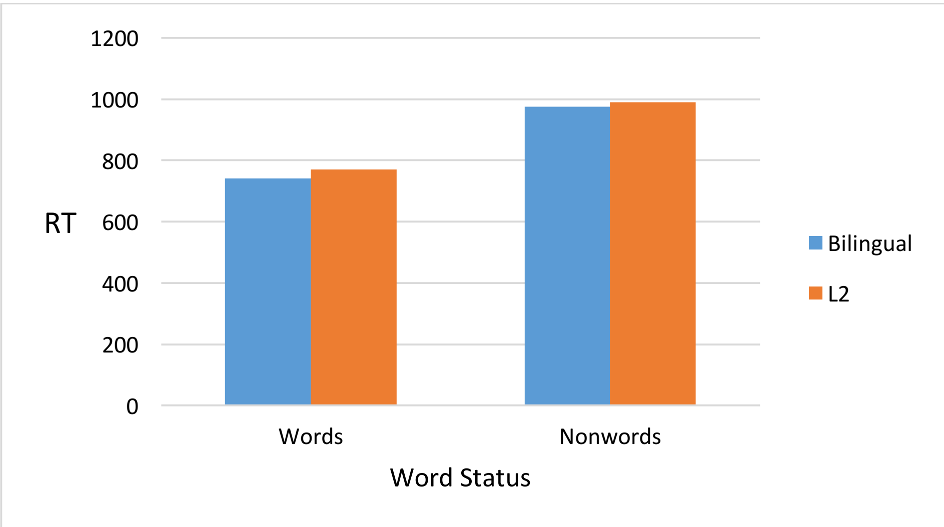

Figure 2: Group comparison of average reaction times to words and nonwords.

4.2.2 Effects of Frequency

Table 3: Average reaction times to all word conditions for both participant groups, in addition to combined averages.

	Medium Frequency Cognates	High Frequency Noncognates	Medium Frequency Noncognates	Low Frequency Noncognates
Bilinguals	749 ms	698 ms	729 ms	795 ms
L2 Learners	758 ms	723 ms	763 ms	844 ms
Average	755 ms	713 ms	749 ms	824 ms

There was a main effect of condition of the words ($t = 6.86$; beta = .06; $p < .001$), which means there were significant differences between average reaction times for word groups of different frequencies (low-, medium- and high frequency noncognates, medium frequency cognates). Similarly to reaction times to words and nonwords, reaction times to frequency conditions did not differ significantly between the bilingual and late-learner group ($t < 1$). This means that, on average, the bilinguals and the L2 learners had similar average reaction times to the different conditions of words. There was also no significant condition by group interaction ($t < 1$). As presented in table 3, there were some small differences in average reaction times between the groups for some conditions, for example for medium frequency noncognates, with an average reaction time of 729 ms for the bilinguals and 762 ms for the L2 learners. The t- and p-values presented no significant difference between these data. This suggests that the differences in reaction times for those conditions may have been coincidental. This is illustrated in figure 3, where reaction times to all word conditions for both groups are presented.

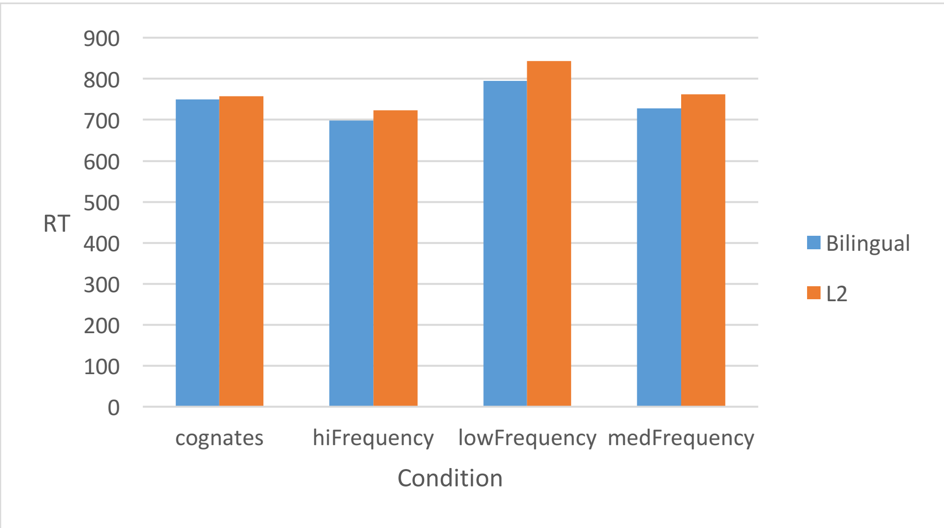

Figure 3: Group comparison of average reaction times to all word conditions.

4.2.3 Pairwise Comparisons

We followed up the main analysis with pairwise comparisons between the conditions, comparing the average reaction times to all participants (see table 3). Overall, high frequency noncognates, with an average reaction time 713 ms were recognized more quickly than medium frequency cognates (755 ms) (t = -2.98, p < .01), medium frequency (749 ms) (t = -2.49, p < .05), and low frequency noncognates (824 ms) (t = -6.93, p < .001). Participants responded more quickly to medium frequency noncognates than to low frequency words (t = -4.47, p < .001). They also recognized cognates faster than they recognized low frequency words (t = -3.97, p < .001). These results, which show a definite effect of frequency, are consistent with a number of previous studies (e.g. Forster & Chambers, 1973 and Schilling & Rayner, 1998). Participants responded just as quickly, on average, to cognate words and medium frequency words that were not cognates (t < 1). Although there was a 20 ms difference between the two conditions, it was not significant. The density plot in figure 4 demonstrated that observations of reaction times to medium frequency cognates and medium frequency noncognates are overlapping. It also shows that low frequency noncognates had less responses with shorter reaction times than the other conditions, and more responses with relatively longer reaction times. As seen in the figure, high frequency noncognates had most of its responses to relatively shorter reaction times. The relevance of reaction time differences will be discussed in Chapter 5.

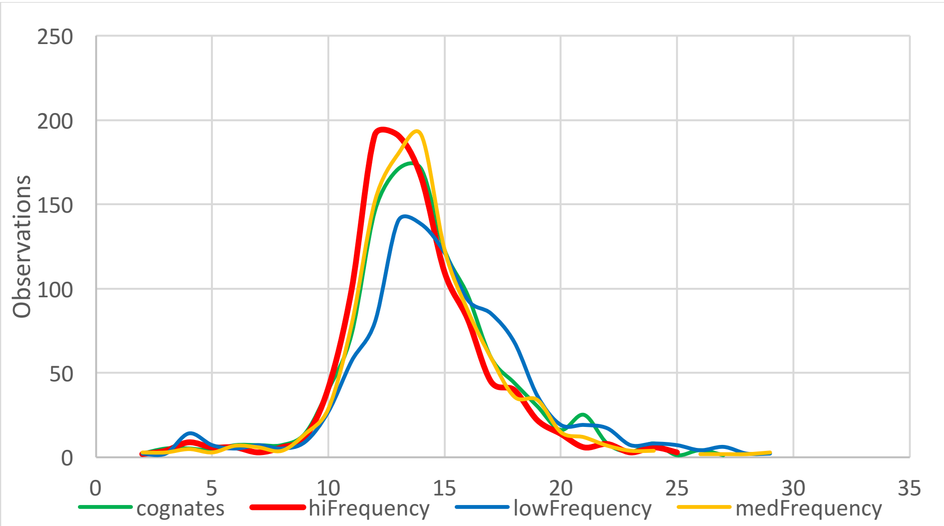

Figure 4: The density distribution of log-transformed reaction times to all word conditions across all participants.

4.2.4 Planned Comparisons

Further, we conducted planned comparisons by group, investigating whether there were any significant differences between the different conditions that were concealed when comparing the conditions by the average reaction time from all participants (both bilinguals and L2 learners).

4.2.4.1 Bilingual Group

The bilingual group had their fastest reaction times to high frequency noncognates and slowest reaction times to low frequency noncognates, just like the both groups combined. High frequency noncognates, with an average reaction time of 680 ms were recognized considerably faster than medium frequency cognates (749 ms) (t = -2.57, p < .01), somewhat faster than medium frequency noncognates (729 ms) (t = -1.82, p < .10), and significantly faster than low frequency words (795 ms) (t = -4.94, p < .01). They also responded more quickly to medium frequency noncognates (729 ms) than to low frequency noncognates (795 ms) (t = -3.15, p < .01). A similar difference was seen between cognates and low frequency noncognates (t= -2.37; p < .05). Although a difference of 20 ms between the medium frequency cognates and noncognates was observed, this difference was not significant. This means that the difference in responses was possibly coincidental, and a processing difference cannot be proposed (t < 1).

4.2.4.2 L2 Learners

For the L2 group, the interactions between the word conditions were of similar character. The high frequency noncognates, with an average reaction time of 723 ms, were recognized significantly faster than medium frequency cognates, with an average reaction time of 758 ms (t = -2.28, p < .05). High frequency noncognates were also recognized faster than medium frequency noncognates, with an average reaction time of 763 ms (t= -2.28, p <.05), and low-frequency noncognates, with an average reaction time of 844 ms (t = -6.45, p < .001). L2 learners responded more quickly to medium frequency noncognates than to low frequency words (t = -4.23, p < .001). Similarly, they also responded more quickly to cognates than to low frequency words (t=-4.20, p < .001). Just like the bilingual group, the L2 learners had similar reaction times to cognates and medium-frequency noncognates. The initial difference in reaction times between the two conditions was only 5 ms and not significant (t < 1).

5.0 Discussion

5.1 The Aim of the Study

The main focus when conducting this study was how the mental lexicons of bilinguals and L2 learners are organized. This was studied by investigating how they accessed their mental lexicons; whether lexical access was language selective or language nonselective, and whether there was a difference between the two groups in this respect. The way we looked into this was by studying how the two groups processed cognates, investigating differences in reaction times between cognates and noncognates of corresponding frequencies. Referring back to the Chapter 2, it was evident that a number of previous studies on cognate processing (e.g. Dijkstra, 2010; Peeters et al., 2013; Poort & Rodd, 2017; Brenders & Dijkstra, 2011) had observed a cognate facilitation effect for both groups, proposing that cognate retrieval is assisted by cognates having a shared representation in the mind and that its representation is more frequently encountered. These findings are evidence supporting that L2 learner and bilingual lexical accessing is language nonselective, meaning that both lexicons are activated at all times during language processing. Another presented outcome in cognate processing studies is evidence supporting lexical retrieval being language selective, as presented by Costa et al. (1999) and Gerard & Scarborough (1989). Although we were prepared for different outcomes (see Chapter 3, Section 3.6), the most probable prediction, based on the studies presented in Chapter 2, was that all participants in this study would experience a cognate facilitation effect, but possibly to different degrees based on group categorization (bilingual or L2 learner). A confirmed cognate facilitation effect would support lexical access being nonselective, and that cognates have a shared representation in the mind, and that the lexicons are overlapped. No differences in reaction times, ie. no cognate faciliation effect, would favor the idea of lexical access being language selective, suggesting that cognates have two separate representations, and that the mental lexicons are unconnected.

5.2 Expectations

Considering bilinguals' (assumed) higher proficiency levels in English, it was predicted that they would probably react faster to all conditions (medium frequency cognates, low-, medium- and high frequency noncognates) overall compared to the L2 learners. It was also expected that both groups would demonstrate differences in reaction times between cognates and noncognates, with a faster response to cognates, indicating that they would access language nonselectively. This was expected because of more frequent encounters with cognates, since they were used in two languages. More frequent encounters as a result of one shared representation would prime faster retrieval, as presented in chapter 2 (Sánchez-Casas & García-Albea, 2005; Davis et al., 2010). Because the L2 learners did not use English as frequently as the bilingual participants (based on their answers in the questionnaire), their overall responses to all word conditions were expected to be slower. It was also predicted that the difference between reaction times for cognates and noncognates, respectively, would be larger for the L2 learners than for the bilingual group. This was predicted because the L2 learners' lower proficiencies in English would account for a slower response to English noncognates compared to the bilinguals' responses, while the effect would be less pronounced for cognates where the presence of a Norwegian cognate would lessen this effect. However, both reaction time differences were predicted to be substantial, just possibly more distinctive for the L2 learners. Regardless of these expectations, it was still very possible that evidence of scenarios outlined in the other predictions could be found (see Chapter 3, Section 3.6.3).

5.3 Results

As presented in Chapter 4, neither the bilinguals nor the L2 learners presented a cognate facilitation effect. For the L2 learners, the average reaction to medium frequency cognates and medium frequency noncognates differed by only 5 ms, and for the bilinguals, the difference was 20 ms. The analysis presented these differences as nonsignificant, meaning that any reaction time difference may have been coincidental. These results were quite surprising, considering the large number of studies supporting the idea of lexical access being nonselective (cf. Dijkstra et al., 1999; Peeters et al., 2013). These studies were also conducted in a similar manner to the current study, using a lexical decision experiment. If we were to interpret these results without scepticism, these results would definitely be evidence for lexical access being language selective. This suggests that retrieval in one language is not facilitated by an identical (or very similar) representation in the other language, because only the language in use is being activated for retrieval. Although this can most certainly be accurate, a discussion of the reliability and validity of the results is of interest. There may be limitations to the study which may have caused the unexpected results, and these will be returned to after a discussion of the implications of the findings.

5.4 Selective Access

As presented, neither the bilinguals nor the L2 learners demonstrated significant reaction time differences to medium frequency cognates compared to medium frequency noncognates. This finding suggests that we have evidence from the current study supporting that bilinguals and L2 learners access language selectively. However, we cannot imply that they access their lexicons selectively during all language processing. These findings only support that the participants access lexical items language selectively when they read words on a screen during a lexical decision experiment. We do not know if this is true for oral processing. We also do not know to which extent the present results would generalize beyond the specific test setting where they were obtained.

As presented in Chapter 2, there are a few studies supporting the theory that language retrieval is selective for bilinguals (cf. Caramazza & Brones, 1979; Costa et al., 1999; Gerard & Scarborough, 1989). Although these studies mainly showed evidence for bilinguals with two L1s (and not L2 learners) being language selective, the L2 learners in the current study behaved similar to the bilinguals, suggesting that their language selectiveness can also be interpreted similarly. The indication we have in the current study that bilinguals and L2 learners access their mental lexicons selectively, is that reaction times in the lexical decision task were not significantly different for cognates compared to noncognates. Because only one mental lexicon is activated during language processing through selective access, only one representation of both cognate words and noncognate words is activated. This was seen in a study by Gerard & Scarborough in 1989, where bilinguals presented no latency differences between cognates and noncognates in a lexical decision task, indicating that cognates and noncognates were accessed similarly (see Chapter 2, Section 2.4.1).

5.5 Cognate Representation

The results in the current study also suggests evidence for how the mental lexicon is organized in terms of how cognates are represented in the mind. That the participants showed evidence of retrieving cognates and noncognates language selectively, proposes that cognates are represented following the multiple-memory theory (cf. Sánchez-Casas & García-Albea, 2005). This is likely because lexical access could not be language selective if there was only one representation of cognates in the mind, as the common-memory theory suggests. When lexical access is language selective, only the lexicon of the language being used is activated. This means that each cognate must have two representations - one for each lexicon. Similarly, the results fits the description of a two-morpheme view (presented and confirmed by Dijkstra & Van Heuven, 2002, Dijkstra et al., 1998, 1999 and Van Hell & Dijkstra, 2002). Just like the multiple-memory theory, the two-morpheme view argues that the morphemes of cognates are represented twice, one for each lexicon.

5.6 No Group Difference

A major finding in the current study is that there were no significant differences between the groups to any of the stimulus materials; they both responded with similar reaction times to the different word conditions and to the nonwords. Although one of the possible outcomes in the prediction section was that the groups would react similarly to cognates and noncognates, it was not expected that they would elicit similar reaction times across groups. It was predicted that bilinguals would react faster overall compared to the L2 learners, based on their assumed higher proficiency levels. Surprisingly, both groups reacted with similar reaction times to all word/nonword conditions. Essentially, all participants could have been considered as one group, since their performances did not differ in any aspects in the lexical decision experiment. The similar behavior of the two groups could indicate that the L2 learners are in fact also bilinguals, although this is not something we can conclude. After all, they have two mental lexicons - just as the bilinguals do.

The reason that we expected the proficiency levels of the L2 learners to be relatively high was based on the starting age in school and volume of input of English in Norway. In Norwegian schools, students start learning English already at age 6. They have 138 hours of English per year during years 1-4, 228 hours for years 5-7, and 222 hours during years 8-10 (Utdanningsdirektoratet, 2013, p .4). In addition to aquiring English at school, Norwegian children get a large amount of their English input through media, by watching and listening to English TV and music, and through activity on social media. Because of the heavy input of English on Norwegians from an early age, it was therefore assumed that their proficiencies were quite high. However, the idea of high proficiencies cannot be generalized among all L2 learners. If an age-matched L2 group in a different country with different (less central) status of English would have performed the same lexical decision task that was conducted in this study, it is possible that they would perform quite differently.

Because of the timeframe and size of this project, an evaluation of the participants' proficiencies in English was not possible. The only aspects that were considered were the languages of their parents, whether the participants had used their English growing up, and whether they used English on a daily basis. This information was requested through a questionnaire (see Appendix 3). All bilingual participants answered that they used English daily (outside of school), and some of the L2 learners did the same. However, the dimensions of English usage and proficiency were impossible to evaluate. The fact that they were assumed to have different proficiency levels was only based on the participants' own answers in the questionnaire, in addition to volume of input of English in Norway, through school and media. To get a better understanding of their proficiency levels, a proficiency test could have been conducted, such as the TOEFL (Test of English as a Foreign Language) Junior test or a Cloze test (Fotos, 1991). But as mentioned, the size and timeframe of this study made aspects like these difficult to include. However, knowing the proficiency levels of the participants would have been very helpful when interpreting the data. If a proficiency test was run, and the test scores presented similar proficiencies across the two groups, that could have provided an explanation for the similar reaction times in the lexical decision times. Unfortunately, we cannot formally conclude anything regarding their proficiency levels.

Since the participants did not complete a proficiency test, there is no way to adequately measure their proficiency levels. However, one can wonder if the results in this study is some sort of evidence of their similar proficiency levels. It is possible that the participants were similarly proficient in English. If that is the case, there are two options regarding the 'classification' of the participants. One way is that the bilinguals are very unbalanced, i.e. their proficiencies in Norwegian are higher than their proficiencies in English (Scontras et al., 2015). The other alternative is that the L2 learners can be considered bilinguals, and that their English proficiencies are at similar levels as the bilingual participant group. It is however important to note that because reaction times do not in themselves indicate proficiency, we can only conclude that they had similar reaction times to cognates and noncognates in the lexical decision experiment. Even though we cannot conclude anything regarding proficiency, the lack of differences could possible be explained by the status of English in Norway, as mentioned above. Additionally, we have evidence that suggests that they at least access their lexicons similarly (see section 5.4).

5.7 Limitations and Suggestions for Further Research

5.7.1 Number of Participants

One reason that could account for the lack of difference in reaction times between cognates and noncognates is limitations in terms of number of participants. There were only 12 bilinguals and 18 L2 learners that participated in the experiment.

Looking into some of the studies presented earlier, the number of participants were 24 for Dijkstra et al.'s (2010) study, who investigated cognate processing for bilinguals (see Chapter 2, section 2.2). Beauvillain & Grainger (1987) and Poort & Rodd (2017) conducted similar lexical decision experiments on 40 and 41 bilinguals (see Chapter 2, section 2.4.2). Considering the current study only included 12 bilinguals, the studies presented in Chapter 2 had a higher number of participants when studying how bilinguals process cognates. The study of Peeters et al. (2013) was of similar size to the current study in terms of participant group, with 19 bilinguals. Even so, their study, with only seven more participants, still presented very different results from the current study. The bilinguals in Peeters et al.'s (2013) study reacted faster to cognates than to noncognates, which supports the theory of lexical access being language nonselective. Regarding the larger number of participants in Dijkstra et al. (2010) and Beauvillain & Grainger' (1987) studies, we do not know whether the different results in those studies are due to the higher number of participants or not. However, the fact that Peeters et al. (2013) found similar results as the others with a lower number of participants is reason to believe that the results in the current study cannot be explained simply by the low number of participants

For studies investigating L2 learners' cognate processing, Lemhöfer & Dijkstra (2004) included 20 L2 learners, a similar number to the number of L2 learners in the current study. Interestingly, the participants in Lemhöfer & Dijkstra's study showed a cognate facilitation effect, seen in their faster responses to cognate words than to comparison words, with a difference of 55 ms on average. The study by Brenders and Dijkstra (2011), which also presented evidence for L2 learners being language nonselective by their faster reaction times to cognates compared to noncognates, tested 28 L2 learners in their study. Although their participant group was slightly larger than for the present study, it is not necessarily the cause for the differences in results. Regardless, Lemhöfer & Dijkstra's (2004) study, with a very similar participant group size, showed very different results compared to the current study, indicating that the number of participants did not seem to be the explanation for the different results. That is not to say that a larger participant group would not have been valuable.

Because of the timeframe and budget of the present project, it was not realistic recruiting a larger participant group. It would however have improved the study remarkably, as the results, whether differences between reaction times were observed or not, would have been more reliable (Putka & Sackett, 2010). With more participants, stronger evidence would have developed regarding language selectiveness of bilinguals and L2 learners. However, even though it would be ideal to include a larger number of participants, the results in the current study could still provide evidence on how the mental lexicon is accessed by bilinguals and L2 learners, suggesting that lexical retrieval is language selective (See Section 5.4).

5.7.2 Age

Another possible explanation for the differences in the results on how bilinguals and L2 learners process cognates could be the age groups of the participants, that younger learners would perform differently than older learners. The majority of studies that have been referred to have used older participant groups. The average age of the participants in the current study is 14.03, ranging from 13-16 years. Comparing to Lemhöfer & Dijkstra (2004), the L2 participants in their study had an average age of 24.4 years, ranging from 20-31. Peeters et al. (2013) used participants ranging from 20–27 years of age, with an average of 22.3. The participants in both of these studies presented a cognate facilitation effect in their lexical decision studies, by faster responses to cognates than to noncognates. One of the previously mentioned studies that studied a young participant group is Brenders & Dijkstra (2011), who tested L2 learners ranging from 10-15 years old, which is similar to the age of the participants in the current study (p. 387). The difference between Brenders & Dijkstra's study and the current study is that the participants in their study showed evidence for lexical retrieval being language nonselective, by the participants faster reaction times to cognate than to noncognates. Based on this, we cannot imply that lexical access is influenced by age, and that nonselective access occurs only in older learners; it has already been observed in children of 10 years old. This suggests that the difference in results from other studies was not caused by age.

5.7.3 Materials and Test Administration

The choice of and/or method of retrieving stimulus materials could also be a possible explanation for the unexpected results. It is possible that results would have been different if, for example, the material consisted of identical cognates only. After all, only 12 of the 40 cognates were identical, e.g. ‘rose’ and ‘sport’. The remaining 28 cognates were either near identical, only with one letter differing, or less identical, with two or more letters differing. Examples of near identical cognates are ‘milk’ (norwegian: ‘melk’) and ‘cake’ (norwegian: ‘kake’), and examples of less identical cognates are ‘bathroom’ (norwegian: ‘baderom’) and ‘rain’ (norwegian: ‘regn’) (See Appendix 2). One can wonder if the use of near identical and less identical cognates could have had an impact on the data, implying longer reaction times to similar cognates than for the identical cognates. Dijkstra et al. (2010) showed that identical cognates elicited shorter reaction time than near- and less-identical cognates, concluding that greater form overlaps should lead to faster recognition (see section 2.2). We wanted to test this, and did a comparison of only the identical cognates to the noncognates. Still, the results showed no significant difference in reaction times ($t < 1$). Based on this, we can suggest that for this study, there was no effect of degree of cognate similarity. Hence, there is no reason to believe that including only identical cognates would have had an impact on the results.

Another factor that could have had an impact on the experiment is the noise issues the bilingual group was experiencing. As mentioned in Chapter 3, there were some noise in the hallway outside the room where the experiment was conducted. This was unavoidable, as students walked in and out of their classrooms for reasons impossible to control. Although the participants said they were not distracted from the noise when asked, they may have been subconsciously distracted. This is however impossible to evaluate, and thus, it cannot be completely ruled out that noise may have been an issue. However, if noise have had an impact on the results, it should have equally influenced noncognates, which it seems not to have done. This will be returned to in section 5.7.4.

5.7.4 Noncognates and Nonwords

An aspect that could ensure that the results from the cognate and noncognate conditions are accurate is the control conditions. Incorporating high and low frequency noncognates was meant to demonstrate whether the participant behaved as expected or not. Previous research has presented participants reacting faster to high frequency words and slower to low frequency words than to medium frequency words (cf. Schilling & Rayner, 1998; Forster & Chambers, 1973) (see Chapter 3, Section 3.6.2). Since the result in the current study produced similar results, this suggests that the participants were behaving as expected. The group of nonwords was included because nonwords forced participants to consider, for each item they encountered, whether it was a word or not. For this reason, the lexal decison experiment could not have been run if nonwords had not been included. Additionally, the nonwords were used as a control for the participants paying attention to the experiment and responding consciously. If a participant had pressed 'yes' to all nonwords, it would be evident that this participant was not paying attention in his/her responses, and their data would be unreliable. Additionally, observing a difference in reaction times between words and nonwords tells us that the participants behaved as expected, since previous research has shown that English language users have reacted faster to words than to nonwords (cf. Schuberth & Eimas, 1977; Caramazza & Brones, 1979) (see Chapter 3, Section 3.6.1). As presented in the results, all participants, both bilinguals and L2 learners, reacted faster to words than to nonwords.

If we had not seen any effects of frequency, or any effect of word status, that could have indicated issues in the test set-up which might have influenced the reliability and validity of the experiment. Since these control conditions were responded to as expected, that suggests that the participants' responses to cognates vs. noncognates could likely be accurate. Furthermore, since both groups in the present study behaved similiarly to the participants in the studies mentioned above, that could indicate that the lexicons of bilinguals with two L1s and L2 learners are structured similarly to those of monolingual native speakers in the relevant respects. Based on these findings, it is likely that the bilingual participants were not distracted due to noise during the experiment, as previously implied (see section 5.7.3). Moreover, the results suggest that the material was successfully retrieved for the high- medium-, and low frequency noncognates, because the participants reacted to the different conditions as expected.

The results from the control conditions provides useful information on how to interpret the validity of the data from the cognates vs. noncognates. Given that the expected patterns are found for nonwords and noncognates in the current study, it is likely that the results for the cognates are valid. However, there might be some issues regarding the cognate materials that could have an impact on their reaction times to those words. Even though we concluded that the materials for control and comparison conditions yielded the expected and thus presumably valid results, it is not obvious that the choice of cognates was equally successful for obtaining reliable results. However, the cognates were checked for frequencies in the same database as the noncognates (SUBTLEX), and corresponding frequencies were used for the medium frequency cognates and medium frequency noncognates. The fact that they were retrieved in a similar matter, proposes that the results obtained from these words should be equally reliable. The only factor that was previously suggested to be a possible problem, was that they were not all identical cognates. Nevertheless, when tested, the difference in average reaction times between the identical cognates and the noncognates of similar frequencies was still of no significance (see section 5.7.3).

Although it is still possible that a larger participant group, less noise issues, different stimulus materiales etc. could have presented different results, the above discussion suggests that at least the participant numbers and choice of materials were probably not the reason why the present results differ from those of previous studies. Additionally, results from control conditions showed that the participants behaved as expected, and henceforth probably presented legitimate results in the cognate-noncognate conditions. On this basis, it is very likely that the results in the current study accurately show that there is no cognate facilitation effect in the groups studied. This, in turn could be taken as evidence for selective access, and that the mental lexicon is organized with two representations, one for each language. It is however important to remember that the current study only investigated lexical organization of Norwegian-English bilinguals and higly proficient Norwegians who were learning English as a second language. The results from the current study may not be generalized across all bilinguals and L2 learners, as proficiency levels and language status' would probably differ between different language users.

5.7.5 Further Research

A comparison of lexical organization of biliguals and L2 learners is definitely something that could be looked more into. It could for example be useful to look into proficiencies of bilinguals and L2 learners by conducting a English proficiency test prior to investigating lexical organization (see section 5.6). The proficiency tests would provide useful information on how similarly proficient the two groups are, which would further be interesting in regard to lexical organization. Another interesting aspect of lexical organization that could be investigated further could be whether bilinguals and/or L2 learners access lexical items differently in oral language processing. We only have evidence for lexical access being selective when reading words on a screen. For this reason, we cannot imply that lexical access is selective also during oral language processing. An interesting question to investigate could be if bilinguals, in a context where both English and Norwegian are used interchangeably, access lexical items selectively or nonselectively. This could possibly be studied through an event related potential (ERP) study, measuring the brain response to a presented oral stimuli (Sur & Sinha, 2009). Although it is possible that they would access their lexicons in the same way as when they read letter strings on a screen, it is also possible that they would do it differently, ie. nonselectively.

6.0 Conclusion

The current study has provided evidence suggesting that bilinguals and proficient second language learners access their mental lexicons selectively and that cognates are represented twice in the mental lexicon, which also suggests that the mental lexicons of bilinguals and L2 learners are unconnected. Furthermore, the results indicate that there are no remarkable differences in lexical access between norwegian-english bilinguals and norwegians learning English as a second language.

The results from a lexical decision task showed no differences in reaction times between cognates and noncognates. Additionally, the results from control conditions showed that the participants behaved as expected and that the experiment was conducted as intended. Furthermore, the control reaction times suggests that the results from the cognate vs. noncognate conditions could be interpreted as legitimate. This means that we have evidence suggesting that bilingual and L2 learner lexical access is language selective; that only the lexicon of the language being processed is activated. Selective lexical access is proposed because participants did not react faster to the cognate words, meaning that recognition of English cognates was not facilitated by an identical (or very similar) representation of the Norwegian cognate. Activation of only the representation from the used language also suggests that the mental lexicons in the two languages are unconnected.

As suggested above, the evidence for participants accessing their lexicons selectively also indicates how cognates are represented in the brain. Because there were no differences in reaction times to cognates and noncognates, that proposes, as mentioned, that cognates are represented twice in the mental lexicon - one for each language. This finding supports the multiple-memory theory and the two-morpheme view (cf. Sánchez-Casas & García-Albea, 2005; Dijkstra & Van Heuven, 2002, and others). Lastly, we observed that the L2 learners behaved similarly to the bilinguals, which *could* suggest that they can be considered bilinguals, and/or that the bilingual participants were highly unbalanced (cf. Scontras et al. 2015, see section 5.6). This finding could also propose that Norwegian adolescents who are learning English as a second language are either very proficient in English, or that the bilinguals are not native in English. It is however important to note that reaction times from lexical decision tasks cannot conclude anything regarding proficiency levels. More importantly, the results suggests that bilinguals and L2 learners access their lexicons in a similar manner.

Although larger participant groups would have improved the study's reliability, findings from other studies involving small groups have previously been presented (cf. Peeters et al., 2013 and Lemhöfer & Dijkstra, 2004), suggesting that the current study could also be of relevance. As presented, the majority of studies have proposed that bilingual (and L2 learner) lexical access is nonselective. However, there are still a few studies who have found evidence for lexical access being selective, and the current study now belongs to that group. An interesting question is what causes these studies to present different findings, even when conducting experiments in similar manners. Although we have implied that aspects such as age of the participants did not have an impact in the experiment in the current study, a more thorough study of such factors could be done. Investigating possible factors that could have an impact on studies of lexical access would be very beneficial for further research.

Nevertheless, the current study has presented a number of evidence supporting that bilinguals and proficient L2 learners access their mental lexicons selectively and that cognates are represented twice in the mental lexicon. Furthermore, two cognate representations in the mind also suggests that the two mental lexicons are unconnected as opposed to overlapped. The similarities between the two participant groups also suggest that Norwegian-English bilinguals and Norwegians learning English as a second language access lexical items similarly.

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APPENDIXES

APPENDIX 1 – Relevance of the work for the teaching profession

The study has examined how the mental lexicons of bilinguals and L2 are organized. This was done by studying how they accessed their mental lexicons, which in turn said something about how cognates are represented and how the two mental lexicons of Norwegian and English are related.

In my future as a teacher, I will most likely work with both bilinguals and students who are learning a second language. Information about how they access lexical items could most certainly be useful in the teaching profession. Understanding that, at least for highly proficient L2 learners, their lexical access (and maybe proficiency levels) are not that different from bilinguals, could be very useful in language teaching. Moreover, the use of cognates could be a valuable teaching tool. It could for example assist students in vocabulary learning, by learning new lexical items based on similar words. As mentioned in Section 2.3, cognates could assist English language learning, in the way that the English representation of a word will be primed by the Norwegian representation. In the English subject curriculum, one of the competence aims is that students should be able to "identify significant linguistic similarities and differences between English and one's native language and use this knowledge in one's own language learning" (Utdanningsdirektoratet, 2013). For this competence aim, cognates could be a useful tool in identifying differences and similarities in the vocabularies of both languages, and further use that knowledge to acquire new lexical items.

The current study has provided evidence suggesting that bilinguals and L2 learners access their mental lexicons selectively when reading words on a screen, and that cognates have two representations in the mind. As implied in Chapter 5, Section 5.7.5, it would be interesting looking into how learners access lexical items during oral processing. This is for example something that could be investigated by me as a teacher, and possibly use the findings to improve my language teaching. This would however require a lot of time and resources (such as equipment for measuring ERP).

APPENDIX 2 – Materials

WORD	SUBTLwf	Lg10WF	LENGTH	CLASSIFICATION
bible	18,33	2,9713	5	MED Cognate
sport	19,9	3,0069	5	MED Cognate
fruit	21,73	3,0449	5	MED Cognate
media	22,29	3,0561	5	MED Cognate
belt	24,35	3,0945	4	MED Cognate
uniform	24,82	3,1028	7	MED Cognate
plant	27,61	3,1489	5	MED Cognate
slave	28,43	2,9736	5	MED Cognate
storm	30,86	3,1973	5	MED Cognate
tongue	31,16	3,2014	6	MED Cognate
snow	31,35	3,2041	4	MED Cognate
energy	32,9	3,2251	6	MED Cognate
magazine	33,2	3,2289	8	MED Cognate
finger	36,67	3,2721	6	MED Cognate
pair	37,25	3,279	4	MED Cognate
project	37,39	3,2806	7	MED Cognate
planet	38,73	3,2958	5	MED Cognate
guest	39,94	3,3092	5	MED Cognate
oil	41,08	3,3214	3	MED Cognate
milk	42,53	3,3365	4	MED Cognate
form	42,75	3,3387	4	MED Cognate
cake	45,06	3,3615	4	MED Cognate
nature	45,16	3,3625	6	MED Cognate
knife	46,8	3,378	5	MED Cognate
rain	48,9	3,3971	4	MED Cognate
cream	48,91	3,3953	5	MED Cognate
rose	53,02	3,4322	4	MED Cognate
camera	57	3,4636	6	MED Cognate
wind	59,37	3,4813	4	MED Cognate
glass	60,71	3,4909	5	MED Cognate
bathroom	61,67	3,4978	8	MED Cognate
race	61,9	3,4994	4	MED Cognate
hat	64,18	3,5151	3	MED Cognate
tree	65	3,5206	4	MED Cognate
arm	65,41	3,5234	3	MED Cognate
cat	66,33	3,5294	3	MED Cognate
machine	70,25	3,5544	7	MED Cognate
ground	72,47	3,5678	6	MED Cognate
summer	78,67	3,6035	6	MED Cognate

bank	84,98	3,637	4	MED Cognate

WORD	SUBTLwf	Lg10WF	LENGTH	CLASSIFICATION
arrive	18,69	2,9795	6	MED Noncognate
hug	19,33	2,9943	3	MED Noncognate
rabbit	20,94	3.029	6	MED Noncognate
castle	21,55	3,0414	6	MED Noncognate
image	22,63	3,0626	5	MED Noncognate
bike	25,88	3,1209	4	MED Noncognate
wood	27	3,1392	4	MED Noncognate
pink	28,47	3,1623	4	MED Noncognate
shape	30,24	3,1884	5	MED Noncognate
brave	31,71	3,209	5	MED Noncognate
stomach	33,82	3.237	7	MED Noncognate
language	35,1	3,2531	8	MED Noncognate
mountain	35,39	3,2567	8	MED Noncognate
pray	36,22	3,2667	4	MED Noncognate
page	37,49	3,2817	4	MED Noncognate
airport	38,04	3,288	7	MED Noncognate
view	38,53	3,2936	4	MED Noncognate
butt	38,57	3,294	4	MED Noncognate
color	39,43	3,3036	5	MED Noncognate
battle	42,25	3,3336	6	MED Noncognate
danger	43,67	3.3479	6	MED Noncognate
nurse	44,98	3,3608	5	MED Noncognate
bird	45,45	3,3653	4	MED Noncognate
pool	46,98	3,3797	4	MED Noncognate
chair	49,24	3,4	5	MED Noncognate
bottle	50,75	3,431	6	MED Noncognate
teacher	55,73	3,4538	7	MED Noncognate
beach	56,63	3,4607	5	MED Noncognate
pants	58,75	3,4767	5	MED Noncognate
gay	59,08	3,4791	3	MED Noncognate
chicken	61,73	3,4982	7	MED Noncognate
laugh	62,86	3,5061	5	MED Noncognate
south	64,47	3,5171	5	MED Noncognate
smoke	65,43	3,5235	5	MED Noncognate
cry	65,65	3,5249	3	MED Noncognate
space	66,06	3,5276	5	MED Noncognate
hide	69,69	3,5508	4	MED Noncognate
evil	73,16	3,5719	4	MED Noncognate
brain	77,02	3,5943	5	MED Noncognate

key	86,86	3,6465	3	MED Noncognate

WORD	**SUBTLwf**	**Lg10WF**	**LENGTH**	**CLASSIFICATION**
edit	1,51	1,8921	4	LOW Noncognate
mushroom	2,14	2,0414	8	LOW Noncognate
cod	2,24	2,0607	3	LOW Noncognate
broker	3,63	2,2695	6	LOW Noncognate
biscuit	3,75	2,2833	7	LOW Noncognate
carrot	3,82	2.2923	6	LOW Noncognate
grape	4	2,3118	5	LOW Noncognate
leaf	5,2	2,4249	4	LOW Noncognate
spine	5,75	2,4683	5	LOW Noncognate
boil	5,94	2,4829	4	LOW Noncognate
shade	5,96	2,4843	5	LOW Noncognate
starve	6,16	2,4983	6	LOW Noncognate
peach	6,35	2,5119	5	LOW Noncognate
feather	6,63	2,5302	7	LOW Noncognate
label	6,88	2,5465	5	LOW Noncognate
shelf	6,96	2,5514	5	LOW Noncognate
jaw	7,14	2,5623	3	LOW Noncognate
bully	7,22	2,587	5	LOW Noncognate
umbrella	7,49	2,2504	8	LOW Noncognate
bold	7,55	2,5866	4	LOW Noncognate
sausage	7,78	2,5999	7	LOW Noncognate
arrow	7,84	2.6031	5	LOW Noncognate
rash	8,04	2,6138	4	LOW Noncognate
fur	8,27	2,6263	3	LOW Noncognate
scar	8,47	2,6365	4	LOW Noncognate
cough	8,78	2,6522	5	LOW Noncognate
fork	8,82	2,6542	4	LOW Noncognate
fluid	8,94	2,6599	5	LOW Noncognate
fog	9,45	2,6839	3	LOW Noncognate
praise	9,45	2,6839	6	LOW Noncognate
bucket	10,02	2,7093	6	LOW Noncognate
abuse	10,25	2,7193	5	LOW Noncognate
rage	11,31	2,7619	4	LOW Noncognate
pillow	11,39	2,7649	6	LOW Noncognate
dish	11,45	2,7672	4	LOW Noncognate
puppy	11,45	2,7672	5	LOW Noncognate
clay	12	2,7875	4	LOW Noncognate
sheep	13,43	2,8363	5	LOW Noncognate
flow	13,75	2,8463	4	LOW Noncognate

rubber	14	2,8543	6	LOW Noncognate

WORD	**SUBTLwf**	**Lg10WF**	**LENGTH**	**CLASSIFICATION**
early	108,04	3,7412	5	HIGH Noncognate
explain	111,18	3,7537	7	HIGH Noncognate
movie	122,96	3,7974	5	HIGH Noncognate
picture	138,45	3,8489	7	HIGH Noncognate
sound	143,39	3,8642	5	HIGH Noncognate
power	149,02	3,8809	5	HIGH Noncognate
drive	153,14	3,8927	5	HIGH Noncognate
child	157,65	3,9053	5	HIGH Noncognate
country	161,84	3,9167	7	HIGH Noncognate
news	164,69	3,9243	4	HIGH Noncognate
city	169,1	3,9358	4	HIGH Noncognate
children	175,1	3,9509	8	HIGH Noncognate
bed	187,12	3,9797	3	HIGH Noncognate
speak	187,18	3,9799	5	HIGH Noncognate
dog	192,84	3,9928	3	HIGH Noncognate
body	195,53	3,9988	4	HIGH Noncognate
dinner	202,67	4,0144	6	HIGH Noncognate
walk	215,86	4,0428	4	HIGH Noncognate
break	221,08	4,0522	5	HIGH Noncognate
couple	223,41	4,0567	6	HIGH Noncognate
read	241,22	4,09	4	HIGH Noncognate
everyone	241,65	4,0908	8	HIGH Noncognate
hurt	246,35	4,0992	4	HIGH Noncognate
town	247,92	4,1019	4	HIGH Noncognate
deal	261,37	4,1249	4	HIGH Noncognate
easy	265,71	4,132	4	HIGH Noncognate
run	350,55	4,2523	3	HIGH Noncognate
play	354,53	4,2572	4	HIGH Noncognate
pretty	392,22	4,3011	6	HIGH Noncognate
friend	419,29	4,3301	6	HIGH Noncognate
woman	434,63	4,3457	5	HIGH Noncognate
wrong	523,1	4,4262	5	HIGH Noncognate
old	608,94	4,4922	3	HIGH Noncognate
believe	625,14	4,5036	7	HIGH Noncognate
money	640,76	4,5143	5	HIGH Noncognate
name	641,86	4,515	4	HIGH Noncognate
work	798,02	4,6096	4	HIGH Noncognate
talk	855	4,6395	4	HIGH Noncognate
people	1102,98	4,7501	6	HIGH Noncognate

need	1294,9	4,8198	4	HIGH Noncognate

APPENDIX 3 – Questionnaire

Spørreskjema

Det er frivillig å delta i studien, og du kan når som helst trekke deg uten å oppgi grunn. Dersom du trekker deg, vil alle opplysninger om deg bli anonymisert.

1. Kjønn
   Jente □
   Gutt □

2. Alder: ....

3. Hva er dine foreldres morsmål?
   Mor: ....
   Far: ....

4. Hvilke/hvilket språk har du brukt i din oppvekst?
   Norsk □
   Engelsk □
   Andre: ....

5. **Hvis** du har krysset av for både norsk og engelsk i spørsmål 4, føler du at du mestrer begge språkene like godt (eller nesten like godt)?
   Ja □
   Nei, jeg mestrer engelsk bedre □
   Nei, jeg mestrer norsk bedre □
   Vet ikke □

6. **Hvis** du har krysset av for både norsk og engelsk i spørsmål 4, bruker du begge språkene daglig?
   Ja □
   Nei □
   Vet ikke □

7. Hvis du oppga å ha brukt andre språk i spørsmål 4, hvordan vil du vurdere din kompetanse i dette/disse språkene?
   Grunnleggende □
   Middels □

Avansert □

8. Hvis du oppga å ha brukt andre språk i spørsmål 4, hvor gammel var du da du først begynte å lære dette/disse språkene?
   Alder: ....

9. Har du noen diagnoser? (for eksempel autisme, dysleksi eller andre lese- og skrivevansker)
   Ja, jeg har ....
   Nei □
   Vet ikke □