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The effect of cognate status and proficiency on Voice Onset Time in first and second language

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Abstract

The aims of the present study were to find out whether there was an effect of cognate status on the first and second language Voice Onset Time production and whether there was a correlation between English language proficiency and this effect for Dutch-English bilinguals. The VOT values were gathered using a word naming task and proficiency scores were gathered using an online English LexTALE proficiency test (Lemhöfer & Broersma, 2011). The word naming task consisted of individual words, which were either cognates, non-cognates and filler items, which were read aloud by the participant. The experiment took place in a recording studio, where the pronunciation was recorded, and the recordings of the cognate and non-cognate words were analysed for their VOT values. The present study found that in the first language, Dutch, there is no significant effect of cognate status on the VOT production. In the second language, English, cognates showed a small numerical, but nonetheless also non-significant, decrease in VOT as compared to non-cognates. Finally, in neither Dutch nor in English there was a correlation between English language proficiency and the effects of cognate status. These results suggest a language-specific activation during production at a phonological level in both the first and the second level throughout all levels of proficiency. This information could be useful for the understanding of speech production processing and for language learning and teaching.

Keywords: cognates, phonetics, L1, L2, VOT, proficiency, word reading, bilingual mental lexicon, English, Dutch

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1. Background

1.1 Introduction

Imagine speaking to someone in a language that is not your own. You have a conversation about the weather, about hobbies or about how life is going. Throughout this conversation, you might come across several words that also exist in your own language in a very similar form, for instance, for Dutch speakers of English, the English word *telephone*, which is equivalent to the Dutch word *telefoon*. These words are very special to bilinguals, as they show the commonalities between the different languages known to the bilingual. The words described above are called 'cognates'. Cognates are words that have translations with significant orthographic or phonetic overlap. These cognates might have special properties and could give us insight into how language in the brain is processed. Are you really only talking in one language or is the other language also active or playing a role in the production? Is the recognition or production of these words different than of other words?

Language processing consists of several components, with the two most prominent being recognition and production. Cognates could perhaps, because they are shared between languages, make it easier to recognise words. They could perhaps even make it easier to produce words. These possibilities could open up a whole world of possibilities when it comes to language processing. There are also many questions that can be posed because of these possibilities. How and when are languages activated? Is it the context of the words that causes the brain to select a language to activate, is it the word itself or are some or all languages always activated? To what extent are languages activated during production and to what extent is production language-specific or language-nonspecific?

The production of speech generally consists of three levels. Levelt (1989) argues, in his Blueprint for the Speaker, that speech production requires conceptualising, formulating and articulating. Costa (2005) used this general speech model for his discussion of bilingual speech models. The first of the three levels is the "Conceptualizer" or conceptual level, where you select the ideas you would like to convey to your conversational partner. The purpose of the speech must first be established. The second level is the "Formulator" or lexical level, where you select the word that fits the meaning of the concept selected in the first level. The third and final level of speech production is the "Articulator" or phonological level, where phonemes are selected to best fit the words selected in the second level. When these phonemes have been selected, they are activated and the word is pronounced. On these different levels, either one or more languages could be selected. The concepts on the conceptual level could be shared between the different languages, but they could also be present in only a single language. If the concepts are universal, the lexical level could see an activation of the words that correspond to the activated concept in both languages or in only one language. If the activation on the lexical level is language-nonspecific, the phonological level could see an activation of the phonemes corresponding to the activated words in both languages or only the phonemes corresponding to the activated word in one language (Costa, 2005; Levelt, 1989). Perhaps, if both languages are activated at a phonological level during the production of cognates, there might be an influence of the second language during the production of phonemes in first language speech or an influence of the first language during the production of phonemes in second language speech.

Regarding the production of phonemes in different languages, something that differentiates similar phonemes in many languages is the length of Voice Onset Time (Lisker &

Abramson, 1964). The Voice Onset Time, or VOT in short, is "the lapse of time that occurs between the release of a stop/plosive [...] and the beginning or onset of a vowel sound" (LinguisticsNetwork, 2015). Examples of a relatively long VOT duration can be found all over the English voiceless plosives, like /p/, /t/ and /k/. English voiceless plosives usually have aspiration, a little "h"-like sound in between the plosive and the vowel after it, like in the words *pill*, *telephone* and *cat*, which are pronounced [pʰɪl], [ˈtʰelɪfəʊn] and [kʰæt], respectively. Dutch voiceless plosives, however, usually do not have aspiration, and therefore have a relatively short VOT duration. This means the words *pil*, *telefoon* and *kat* would be pronounced as [pɪl], [teːləˈfoːn] and [kɑt], respectively (Gussenhoven & Broeders, 1997). If both languages are activated during the production of cognates, perhaps Voice Onset Time might be influenced by the language that is not being spoken.

Another thing that might influence the production of speech is the language proficiency. When the proficiency in a language improves, the speech production in that language becomes closer to that of native speakers. When you are Dutch and only a beginner at English, you might not yet hear or produce many differences between similar phonemes in Dutch and English. As you progress in your learning of English, however, you start to notice the subtle differences between the languages, like the difference in VOT, more and more, and this shows during the production of the English speech (Flege, 1995). This development in second languages raises another question in relation to cognates. Does the possible effect of cognates increase, decrease or stay the same as proficiency increases?

The previous research introduces us to all the aforementioned topics. This includes effects of cognates in recognition and production, language-specific or language-nonspecific

activation, Voice Onset Time, different models of bilingual activation in recognition and

production and the relationship between proficiency and cognates.

1.2 Previous research

1.2.1 Cognate effects in recognition

Cognates are very special in the research on bilinguals, as they are a commonality

between two or more languages spoken by them. They can give us information on how words are

stored in the bilingual mental lexicon. The first effects were found in visual word recognition.

Gerard and Scarborough (1989) found a facilitation effect of cognates in a lexical decision task.

The three different word types they used were cognates, e.g. English and Spanish *actual*,

non-cognates with the same meaning, e.g. English *dog* and Spanish *perro*, and homographic

non-cognates or "false friends", which are words with considerable orthographic overlap but a

different meaning, e.g. English *red* and Spanish *red* "net". Recognition of cognates as words, as

opposed to nonwords, was faster than that of non-cognates with the same meaning for their

English-Spanish bilingual participants. This was furthermore contrasted with the effect of false

friends, which inhibited the recognition and caused a longer reaction time in comparison to

non-cognates (Gerard & Scarborough, 1989). Van Hell and Dijkstra (2002) later used a lexical

decision task as well, but this time with Dutch speakers of English and French. Their findings

were that Dutch-English and Dutch-French cognates also facilitated the lexical decision and led

to shorter response times in the first language, Dutch (Van Hell & Dijkstra, 2002). The cognate

facilitation effect was also observed in more recent research, for instance in the Dutch-English

bilingual participants of Bultena, Dijkstra and Van Hell (2014) by means of eye tracking and

self-paced reading tasks in a sentence context of the second language, English. This resulted in faster reading times for cognates as compared to non-cognates (Bultena et al., 2014). These results suggest a simultaneous activation of both languages. Much research supports this idea of language-nonspecific activation, even when performing in a monolingual mode or when the second language is not in the immediate context of the task, and some studies even argue for language-nonspecific activation without the use of cognates (Gass, 2013; Jared & Kroll, 2001; Kroll & Stewart, 1994; Marian & Spivey, 2003; Sunderman & Kroll, 2006).

Two models for the bilingual language comprehension process that fit these effects found in recognition are the Bilingual Interactive Activation (BIA) model and the Bilingual Interactive Activation Plus (BIA+) model. Van Heuven, Dijkstra and Grainger (1998) proposed the BIA model after a set of lexical decision experiments, which resulted in evidence for parallel activation of cognates in a bilingual Dutch-English lexicon because of "neighbourhood density effects" in both the first and second language. Neighbourhood density effects entail that the activation of a word causes words with orthographic or phonetic overlap to be activated as well, e.g. English *plant* and *plan*, or, across languages, English and Dutch *plant* (Van Heuven et al., 1998). The model was later updated to the BIA+ model, which was supported by Van Heuven and Dijkstra (2010) with the use of fMRI and ERP evidence. The main difference between the BIA model and the BIA+ model is that the BIA model showed an interaction between the two systems of word identification and task/decision, which allowed for the possibility of the task or decision to influence the word identification, while the BIA+ model only allows for the word identification system to influence the task/decision system (Van Heuven & Dijkstra, 2010). The models show quite clearly how the bilingual lexicon works and covers the recognition and

comprehension of bilinguals' speech, but it does not cover the production of speech. Is language-nonspecific activation present only in recognition or is it also present in language production?

1.2.2 Cognate effects in speech production

The cognate facilitation effect was also found in the production of speech. Costa, Caramazza and Sebastian-Galles (2000) asked their participants, Catalan-Spanish bilinguals, to name pictures of which the names in both languages were either cognates, with phonological overlap, or non-cognates. Their results revealed that the cognate facilitation effect also applies to the production of language, as the cognate pictures were named faster that the non-cognate pictures, which did not happen for monolingual speakers (Costa et al., 2000). More evidence for a cognate facilitation effect in production came from Costa, Santesteban and Caño (2005), who conducted a longitudinal study, consisting of a picture naming task every week. This study also resulted in faster naming times for cognates than non-cognates, and therefore an interconnected bilingual lexicon. This facilitation effect grew even larger as the study progressed, therefore also showing faster learning for cognates compared to non-cognates (Costa et al., 2005). In contrast, a study by Broersma, Carter and Acheson (2016) found that cognates could both facilitate and inhibit production in bilingual speech. Welsh-English bilinguals performing a picture naming task showed faster picture naming for cognates than non-cognates, a cognate facilitation effect, when their dominant language was either Welsh or both English and Welsh, but slower naming for cognates than non-cognates, a cognate inhibition effect, when their dominant language was

English (Broersma et al., 2016). However, all of these results are still more evidence for language-nonspecific activation.

Costa (2005) offered a useful overview of how lexical access takes place in bilingual production, reviewing models with both language-specific and language-nonspecific views. Similarly to the Blueprint of the Speaker by Levelt (1989), Costa argued that there are three main levels in speech production: the conceptual level, the lexical level and the phonological level. These levels are a chronological representation of the process between the selection of concepts and the articulation of phonemes. First, a concept is selected that corresponds to what the speaker wants to express. A word is then selected to fit that concept and its meaning. Finally, the phonemes required to pronounce the word are selected and the word is produced. Current lexical selection models for bilinguals usually argue for a language-nonspecific selection "up to the phonological level" (p. 322). The lexical nodes and phonological nodes are activated for both languages. Costa speculated, however, due to contrasting evidence, that the mechanism of lexical selection might be different for bilinguals with high proficiency compared to those with low proficiency. Higher proficiency L2 speakers could select language-specific concepts, while lower proficiency L2 speakers might inhibit the non-target language at different possible levels (lexical or phonological), which would argue for a language-nonspecific selection, due to a universally shared concept or both languages being activated on a lexical or even on a phonological level (Costa, 2005). If it is true that the phonological nodes are activated in both languages, there could be an effect of the non-target language on the phonetic qualities of the target language production.

1.2.3 Cognate effects in phonology

Phonological effects of cognates in production have also been found. Brown and Harper (2009) argued that cross-linguistic ties are stronger for cognates than non-cognates, as reduction of word-final /s/ in Spanish-English bilinguals' first language, Spanish, was lower in words with a translation that also had a word-final /s/, e.g. Spanish *rosas* and English *roses* (Brown & Harper, 2009). Another phonological cognate effect was found by Mora and Nadeu (2009), who examined Catalan-Spanish bilinguals. Catalan has a phonemic inventory with both /ɛ/ and /e/, while Spanish only has /e/. Mora and Nadeu found that, during a read-aloud task, the articulation of /ɛ/ in Catalan was higher, and therefore closer to Spanish /e/, in cognates than in non-cognates, showing an effect of the second language (Mora & Nadeu, 2009).

Kartushina, Frauenfelder and Golestani (2016) reviewed a number of papers on the topic of "backward transfer", an effect of the L2 on L1 production, on the level of phonetics. They concluded that the L1 is well-known to impact L2 production, but that L2 influence on L1 production is not as well-determined. The review also covered the topic of cognates by reviewing several papers about the effects of cognates on the extent and quality of the L2 influence on the L1, arguing that there is generally a stronger influence of the second language noticeable during the production of cognates than during the production of non-cognates in that cognates are produced more similarly to the L2 (Kartushina et al., 2016). Mora and Nadeu (2012), for instance, found that L2 Catalan /ɛ/ in cognates was articulated higher, and therefore closer to L1 Spanish /e/, than in non-cognates during a read-aloud task. They found that proficiency, which was determined by the objectively measured scores and reaction times during an exercise in discriminating /e/ and /ɛ/, also had an effect on the articulation. The higher the

Catalan proficiency, the more the effect of the L1 /e/ on the L2 /ɛ/ was inhibited (Mora & Nadeu, 2012). The aforementioned effects were found in the general domain of phonology, while this study is concerned with a specific aspect of phonology: Voice Onset Time.

1.2.4 Voice Onset Time: Dutch-English differences

Lisker and Abramson (1964) found that a difference exists in Voice Onset Time between Dutch and English plosives. The mean VOT for Dutch voiceless plosives specifically were 10 ms for /p/, with a range between 0 and 30 ms, 15 ms for /t/, with a range between 5 and 35 ms, and 25 ms for /k/, with a range between 10 and 35 ms. The mean VOT for (American) English voiceless plosives were 58 ms for /p/, with a range between 20 and 120 ms, 70 ms for /t/, with a range between 30 and 105 ms, and 80 ms for /k/, with a range between 50 and 135 ms (Lisker & Abramson, 1964). Plosives in English are aspirated and those in Dutch are unaspirated, causing the generally higher VOT for plosives in English (Gussenhoven & Broeders, 1997).

Another useful discovery by Flege and Eefting (1987) was that the difference in VOT of voiceless plosives, also found by Lisker and Abramson (1964), was discernible by Dutch speakers of English across several L2 proficiency levels. The participants were asked to identify whether different pronunciations of /t/, in isolation, with varying VOT were English or Dutch. The mean VOT of the identified English /t/ was higher than the identified Dutch /t/ for nearly all participants, with the effect becoming greater by a small but significant amount as proficiency increased. This suggests that there are separate phoneme categories for Dutch /t/ and English /t/ in the bilinguals' minds (Flege & Eefting, 1987). Flege (1995) argued in his Speech Learning Model that bilinguals only create a separate phonetic category for an L2 if they can notice a

difference between the L2 sound and an existing L1 sound, and that there will otherwise be a single, shared phonetic category for both the L1 and the L2 sound. If a bilingual has not created a new phonetic category, the two sounds will eventually "resemble one another in production" (Flege, 1995, p. 239). However, it is not entirely clear how similar the sounds need to be to create a new phonetic category (Gass, 2013).

1.2.5 Cognate effects in Voice Onset Time

Spanish, just like Dutch, has lower VOT values for plosives than English. Jacobs, Fricke and Kroll (2016) used this information and asked English-Spanish bilinguals, both classroom learners and immersed learners, to pronounce cognates and non-cognates in their second language, Spanish. They found that cognates were named faster than non-cognates for all learners and, moreover, that the VOT of cognates was generally longer, and therefore more English-like, than non-cognates for the classroom learners. These effects were, however, not found for the immersed learners. Additionally, they did not find an effect of L2 proficiency on the naming speed, but only looked at two different proficiency groups, intermediate and highly proficient, instead of a scale. They also focused more on the effect of inhibition of the non-target language than proficiency, comparing classroom learners to immersed learners. However, proficiency and non-target language inhibition might be correlated (Jacobs et al., 2016).

Amengual (2012) similarly looked at the effect of the second language on first language VOT production. His participants were a control group (non-English-speaking Catalan-Spanish bilinguals) and four experimental groups, namely Spanish heritage speakers (early English-Spanish bilinguals), English heritage speakers (simultaneous Spanish-English

bilinguals), L1 English and L2 Spanish advanced learners, and L1 Spanish and L2 English advanced learners. These participants, in a monolingual Spanish context, had to pronounce Spanish words starting with /t/, of which the VOT was measured. Amengual found an effect of cognates, as participants pronounced /t/ in cognates with a higher VOT, closer to the English values, than /t/ in non-cognates. This influence of the second language phonetics on the first language phonetics seems to imply that the phonemes in both languages are activated. Amengual also looked at the effect of proficiency on these effects, but found no significant effect. However, the different groups of bilinguals in the study, early learners and late learners, might have shown different levels of proficiency, but they might also not have been completely accurate to their practical language skills. Apart from the contrast between early and late learners, the values used for their proficiency levels were subjectively self-evaluated and the effect of proficiency was not sufficiently elaborated upon, as there was no focus on the differences between those who did not grow up with the language, but do have different proficiency scores (Amengual, 2012).

Goldrick, Runnqvist and Costa (2014) found that during a language-switching task for Spanish-English bilinguals, there was an influence of the first language, Spanish, on the VOT values of the phonemes /t/ and /d/ in the participants' second language, English. The VOT values for both phonemes were shorter, and therefore closer to Spanish, during the production of cognates than during the production of non-cognates. However, this influence did not go both ways. In contrast to what Amengual (2012) found, Goldrick et al. did not find any effects of the second language on the VOT of /t/ and /d/ in the first language (Goldrick et al., 2014).

1.2.6 Second language proficiency and cognate effects

As mentioned above, bilinguals only make different phonetic categories when sounds are perceived as different and sounds that share a phonetic category between languages will eventually be produced similarly (Flege, 1995). Separate phonetic categories for Dutch and English /t/ are generally present in Dutch-English bilinguals, however, and the perception of the differences is greater as L2 proficiency increases (Flege & Eefting, 1987). Costa (2005) speculated that proficiency influences the language specificity of the lexical access in production and Mora and Nadeu (2012) found that higher proficiency had an inhibiting effect on the effects of cognates on vowel height and closeness in Spanish-Catalan bilinguals' L2 Catalan pronunciation. Kartushina et al. (2016) also argued that the presence, extent and nature of L2 influence on L1 production could also be influenced by proficiency. Amengual (2012) and Jacobs et al. (2016) touched on the issue of L2 proficiency, cognates and VOT with separate groups of learners and found no significant difference between these groups, but did not look at the true correlation between objective proficiency scores and the VOT cognate effect.

Proficiency has, however, been subject to more thorough research in the area of cognate effects in recognition, such as in the domain of visual word recognition. Libben and Titone (2009), for instance, conducted eye tracking experiments with French-English participants. They looked at cognates in an L2 English sentence context and used eye tracking measurements to objectively assess proficiency. Their results suggested a cognate facilitation effect, faster reading times for cognates, with higher L2 proficiency causing a smaller cognate facilitation effect (Libben & Titone, 2009). Similarly, Bultena et al. (2014) found this same pattern of a smaller cognate facilitation effect for higher L2 proficiency, which was here assessed objectively by

means of reading speed in the second language. These results were gathered in both eye tracking and self-paced reading tasks for cognates in an English sentence context, performed by Dutch-English bilinguals (Bultena et al., 2014). However, these studies only found proficiency effects in recognition and only focus on the effects in second language processing. Research on proficiency effects in production, specifically VOT production, has been lacking. Also dissatisfactory were the results, like those in Amengual (2012), regarding the effects of L2 proficiency on cognate effects in the first language.

1.3 Current research

Previous research has already found several effects of cognates in recognition (Gerard & Scarborough, 1989; Van Hell & Dijkstra, 2002), production at a lexical level (Broersma et al., 2016; Costa et al., 2000; Costa et al., 2005) and production at the phonological level (Brown & Harper, 2009; Jared & Kroll, 2001; Kartushina et al., 2016; Mora & Nadeu, 2009, 2012), which argues for a language-nonspecific activation (Costa, 2005; Gass, 2013; Jared & Kroll, 2001; Kroll & Stewart, 1994; Marian & Spivey, 2003; Sunderman & Kroll, 2006; Van Heuven et al., 1998; Van Heuven & Dijkstra, 2010), but it is not clear whether this language-nonspecific activation in production always reaches as far as the phonetic level (Costa, 2005).

Even more specifically, effects of cognates on Voice Onset Time were also found in the second language (Goldrick et al., 2014; Jacobs et al., 2016), but there were mixed results for effects of cognates on VOT in the first language, as Amengual (2012) found that VOT of the first language production does get closer to that of the second language, but Goldrick et al. (2014) found that the first language VOT production is not influenced by the second language, making

the effects unclear. What is also unclear is whether Dutch-English bilinguals show the same effects as the Spanish-English bilinguals in Amengual (2012) and Goldrick et al. (2014) and the English-Spanish bilinguals in Jacobs et al. (2016).

The effects of proficiency on cognate effects have been found in second language recognition (Bultena et al., 2014; Libben & Titone, 2009) and phonetic production (Mora & Nadeu, 2012), but regarding VOT, the effect of proficiency on cognate effects has been only touched upon by Amengual (2012) and Jacobs et al. (2016), but they are insufficiently focused on the issue of the real correlation between proficiency and the cognate effects.

This study aims to fill the aforementioned gaps and therefore asks the question: What is the effect of cognate status and English language proficiency on VOT in Dutch and English language production for Dutch native speakers? In the present study, the independent variable of proficiency is measured using an objective proficiency test, the independent variable of cognate status is tied to the target stimuli and the dependent variable of Voice Onset Time is measured using recordings of a word naming task.

The theory suggests that in English, the second language, an effect of cognate status will be found, as was also the case for Jacobs et al.'s (2016) English-Spanish bilinguals. The cognate VOT is expected to be lower than the non-cognate VOT, and therefore more like the first language, Dutch. In Dutch, the first language, there will likely be no significant effects of cognate status, which can be seen in the more recent results from Goldrick et al.'s (2014) Spanish-English bilinguals. The cognate VOT will likely be very similar to the non-cognate VOT, without any influence of the second language. The effect of English language proficiency on the cognate effect on VOT in the second language is likely to show an inhibition of the effects

as proficiency increases, similar to the proficiency effects found before in recognition (Bultena et al., 2014; Libben & Titone, 2009) and Spanish-Catalan vowel height (Mora & Nadeu, 2012), as the perceived difference between the L1 and L2 phonetic categories increases with proficiency (Flege & Eefting, 1987). The effect of L2 proficiency on the VOT cognate effects in the first language will likely not be significant, as Amengual (2012) found no effect of proficiency, although his methods were unsatisfactory, and the second language has generally been found to have a much smaller effect on the first language than vice versa (Goldrick et al., 2014; Kartushina et al., 2016).

2. Methodology

2.1 Participants

The participants for this study were 19 students at Radboud University between the ages of 18 and 34 ($M = 22.26$, $SD = 4.10$). They were recruited by approaching them personally, by placing a message on a Facebook page and by messaging lecturers. 10 participants were bilingual native speakers of Dutch with English as a second language, of which 5 were male and 5 were female, with varying proficiency and ages between 19 and 33 ($M = 22.8$, $SD = 3.68$). No additional data was acquired on the regional dialects or other spoken languages of the bilingual participants. The other 9 participants were monolingual native speakers of English from England, Scotland and Ireland, of which 2 were male and 7 were female, with ages between 18 and 34 ($M = 21.67$, $SD = 4.45$). Each participant received a letter-number combination as to remain anonymous. The letters are connected to the participant's native language, which the participants were asked for prior to the numbering, and is either a D for Dutch or an E for English. The

number simply went up by one with every participant within a language group (e.g. D-01, E-01, D-02 etc.).

2.2 Materials

The main task of the experiment required participants to read words "aloud and as clearly as possible" from a computer screen inside a recording studio. The equipment needed for this task were a recording studio, a microphone, a computer with the computer programme Adobe Audition (Version CS6; Adobe Systems, 2012).

Displaying the stimuli was done using two PowerPoint presentations. The first presentation contained only the English words and was intended for the monolingual participants. The second presentation, intended for the bilingual participants, contained both Dutch and English words. The PowerPoint presentations also contained instruction pages for the word reading tasks, one for each language. See Appendix A for the text of these instruction pages.

There were thirty target words in each language, of which fifteen were cognates and fifteen were non-cognates which are not homophonic with any English word with a different meaning (i.e., no "false friends"), henceforth simply called "non-cognates". The groups of fifteen each contained five words starting with /k/, five starting with /p/ and five starting with /t/. See Appendix B for a table of these target words. The order of the words was randomised before the PowerPoints were created and this order was then used, in the PowerPoints, for every participant. For both languages, cognates and non-cognates were matched in frequency, using SUBTLEX-UK (Van Heuven, Mandera, Keuleers, & Brysbaert, 2014) for English words and

SUBTLEX-NL (Keuleers, Brysbaert, & New, 2010) for Dutch words. For English, the mean log frequency for cognates was 4.40 and that of non-cognates was 4.39 and for Dutch, these were respectively 2.86 and 2.89. Apart from the target words, there were fifteen filler words in each language, which did not start with the voiceless plosives /p, t, k/, to distract participants from the true purpose of the study, to prevent the skewing of the results and to increase the number of task stimuli. These filler words could be both cognates and non-cognates. See Appendix C for a list of the order in which all of the words, including filler words, were shown.

2.3 Procedure

Participants were first asked to enter the studio, in which they were asked to read an information document and read and sign an informed consent form, which were either in Dutch or in English according to their nationality. See Appendix D for the information document and Appendix E for the informed consent form in English. Participants were allowed to ask questions, but were not told the exact purpose of the study as not to skew results. They were informed that, if they so desired, they could be informed after the experiment.

When they had finished signing the form, they were asked to take place on the chair inside the studio, in front of a computer screen with a mouse and a microphone. The bilingual participants were then asked to perform an online English LexTALE task (Lemhöfer & Broersma, 2011), which is a lexical decision task that accurately represents the participant's proficiency (Lemhöfer & Broersma, 2012). This task resulted in percentages serving as the participants' English language proficiency score. The monolingual participants, due to their known native proficiency, were only asked to perform the second task.

Prior to the second task, the microphone inside the studio was tested. The second task consisted of reading words aloud that were shown on the screen in the recording studio. The PowerPoint was then started, which consisted of Dutch and English words for the bilingual speakers and only English words for the monolingual English speakers.

The bilingual Dutch-English participants first received instructions in Dutch and the monolingual English participants received instructions in English (both on the screen and verbally from the researcher), which asked the participants to pronounce the words they would be presented with aloud and as clearly as possible and to press the left mouse button when and only when they had finished naming the word completely. Finally, they were asked to press the left mouse button when the recording had been started and when they were ready to begin naming the words.

The words for bilinguals were presented in two blocks, first in a Dutch block and then in an English block, while the words for monolinguals were presented in only one, English, block. The words were not presented in a mixed fashion, as it is often not clear whether the cognates belong to the first or second language. Each of the words was presented in isolation, on its own slide, in the Arial font, size 48. The font colour was black and the background was white, to ensure legibility.

The bilingual participants were first asked to read a block of 45 Dutch words. These were shown one by one on the screen, in a randomised order. The participant was asked to read the displayed word and press the button to continue to the following word, but only when they had completely pronounced the word, as to prevent the sound of the button press interfering with the recordings of the words. Participants did not have to read out a carrier phrase. They were used in

Amengual (2012), but Jacobs et al. (2016) found significant results without them. The pronunciation of the words was recorded using the microphone and Adobe Audition (Version CS6; Adobe Systems, 2012). When all Dutch words were finished, the English block followed.

The English block was present in both PowerPoints and was therefore read by both groups of participants. The bilinguals participants then also received instructions in English prior to the block, again both on the screen and from the researcher, and had a final opportunity to ask questions.

The procedure went as before in the Dutch block. The 45 English words were shown one by one after the press of a button and the pronunciation was recorded. When the final word was pronounced, the PowerPoint presentations and recordings were stopped. All recordings were anonymously saved as WAV files. The participants were then informed that the experiment was over and they received their reward for participating, which was a bar of chocolate. If participants were interested, they could ask the researcher what the purpose of the study was.

2.4 Design and analysis

The first set of data that was acquired consisted of the Dutch-English bilingual participants' scores (in percentages) from the LexTALE test. These scores served as the bilinguals' level of English language proficiency.

The WAV files recorded in the recording studio were cut into pieces of one word using Praat (Boersma & Weenink, 2019). Only the segments containing the target stimuli were kept and loaded back into Praat, which was used for a phonetic analysis of the recordings, which consisted of the VOT values (in milliseconds) for each of the word-initial plosives. The VOT

values for each of the bilingual participants were then gathered in a spreadsheet, categorised into

four groups of rows according to language (Dutch or English) and cognate status (cognate or

non-cognate), with one column for every participant. The VOT values for each of the

monolingual participants were gathered in another spreadsheet, categorised into two groups of

rows according to only cognate status. These spreadsheets contained an additional column of

mean VOTs for each of the target stimuli. These means, the mean item VOTs, were used for the

cognate-VOT analyses, as they were more manageable than the unprocessed data due to the large

number of VOT measurements (in total, there were 600 measurements for the bilinguals and 270

measurements for the monolinguals). The spreadsheets also contained additional rows of mean

VOTs for each combination of language and cognate status for each of the participants. The

$\varDelta VOT_D$, which is the difference between mean VOT of cognates and the mean VOT of

non-cognates in Dutch ($VOT_{cognates} - VOT_{non-cognates}$), and the $\varDelta VOT_E$, which is the difference

between the mean VOT of cognates and the mean VOT of non-cognates in English

($VOT_{non-cognates} - VOT_{cognates}$), were calculated for each of the bilingual participants for the

proficiency analyses.

To check whether bilinguals showed any effects of cognate status or language on their

VOT in general, a two-way independent analysis of variance (ANOVA) was performed with

independent variables "cognate status" and "language" and dependent variable "mean item

VOT". Additionally, the bilingual data from both languages were separated, and analysed using

an independent samples t-test, to examine the effect of cognate status in both languages

separately. Similarly, the monolingual English data, the control group, was also analysed using

an independent samples t-test to see if there is an effect of cognates for monolinguals. All of the

independent samples t-tests were performed with the independent variable "cognate status" and the dependent variable "mean item VOT".

The next and final two analyses that were carried out were correlation analyses. The first was performed with the variables "proficiency" and "ΔVOT_D", which will show whether proficiency influences the effects of cognate status on VOT in the first language, and the second was performed with the variables "proficiency" and "ΔVOT_E", which will show whether proficiency influences the effects of cognate status on VOT in the second language. All of the analyses were carried out with JASP (JASP Team, 2018).

3. Results

The English language proficiency test for the bilingual participants, the LexTALE task, resulted in the participants varying nicely in terms of proficiency, with scores ranging between 58.75 and 97.5 percent ($M = 79.4$, $SD = 13.7$).

The two-way ANOVA for the bilingual data in both English and Dutch showed that the main effect of cognate status on mean VOT (in milliseconds) was not significant ($F(1, 56) = 1.02$, $p = 0.32$), but that there was a main effect of language on mean VOT ($F(1, 56) = 131$, $p < .001$), with English ($M = 45.7$, $SD = 10.1$) having a significantly longer mean VOT than Dutch ($M = 21.0$, $SD = 6.42$), and that there was no significant interaction effect between cognate status and language ($F(1, 56) = 2.45$, $p = .12$).

The mean VOT in English produced by the control group, the English monolinguals, was also calculated ($M = 72.1$, $SD = 10.5$) for comparison with the mean VOT in English produced by the Dutch-English bilingual participants. The mean VOT values for L1 Dutch, L2 English and

monolingual English can be found in Figure 1. The mean L2 English VOT values were significantly lower than the monolingual English VOT values ($t(58) = -9.91$, $p < .00001$).
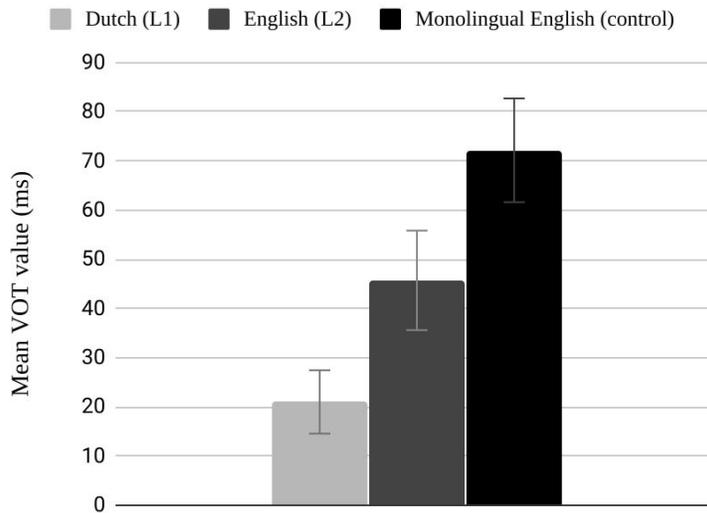

Figure 1: *The effect of language on Dutch-English bilinguals' VOT production, with error bars representing standard deviations*
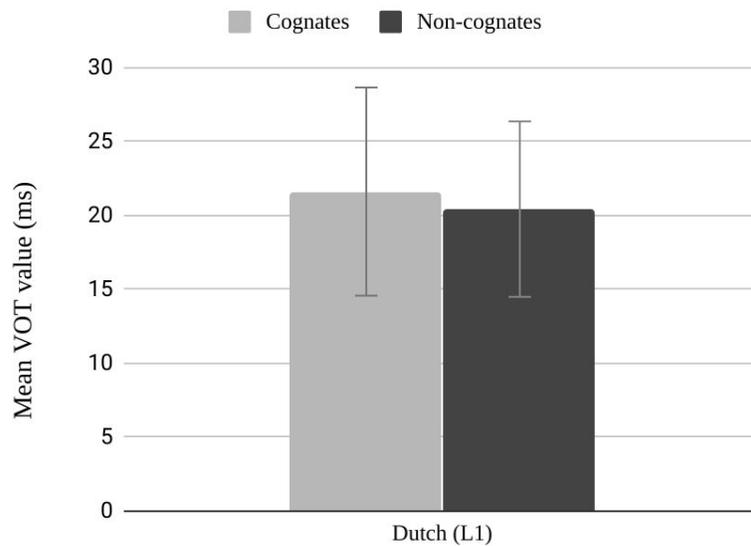

Figure 2: *The effect of cognate status on Dutch-English bilinguals' Dutch VOT production, with error bars representing standard deviations*

The isolated data for the bilinguals' first language, Dutch, was analysed using an independent samples t-test, which resulted in no significant effect of cognate status on mean VOT ($t(28) = .50$, $p = .61$), with hardly any numerical difference, 1.20 ms, between the groups of cognates ($M = 21.6$, $SD = 7.04$) and non-cognates ($M = 20.4$, $SD = 5.93$). The values in cognates and non-cognates in L1 Dutch VOT production can be seen in Figure 2.

Figure 3: *The effect of cognate status on Dutch-English bilinguals' English VOT production, with error bars representing standard deviations*

The isolated data for the bilinguals' second language, English, was similarly analysed using an independent samples t-test, which also resulted in no significant effect of cognate status on mean VOT ($t(28) = -1.54$, $p = .13$), but with a slight numerical difference of 5.57 ms between the groups of cognates ($M = 42.9$, $SD = 9.55$) and non-cognates ($M = 48.5$, $SD = 10.2$) The values in cognates and non-cognates in L2 English VOT production can be seen in Figure 3.
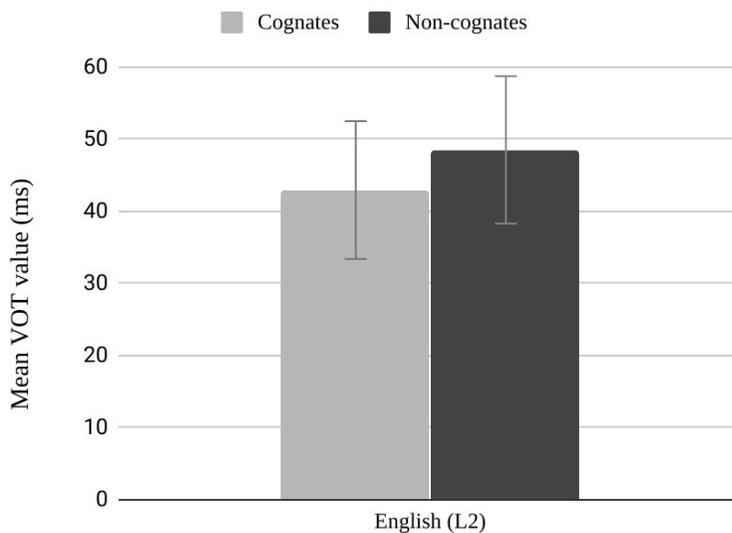
Figure 4: *The effect of cognate status on English monolinguals' VOT production, with error bars representing standard deviations*

The third and final independent samples t-test was performed for the monolingual English participants' data, which showed that there was no significant effect of cognate status on mean VOT ($t(28) = .002$, $p = 1.00$), with no numerical difference between the groups of cognates ($M = 72.2$, $SD = 7.12$) and non-cognates ($M = 72.1$, $SD = 13.4$). The values for cognates and non-cognates in 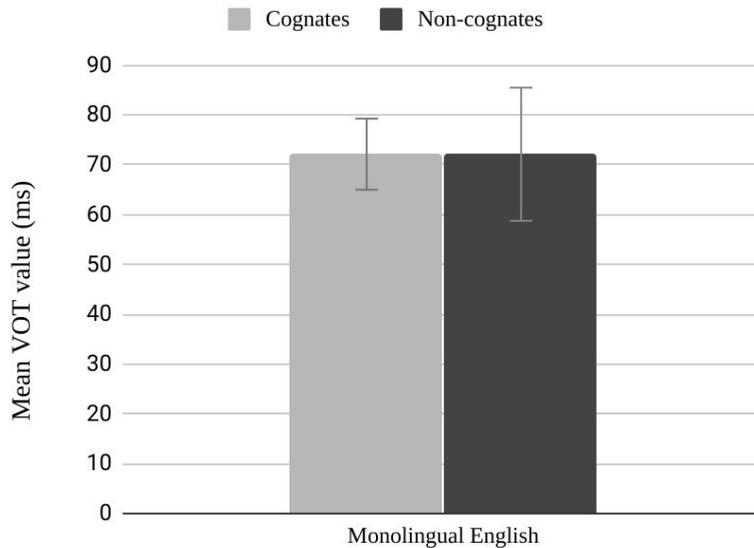monolingual English VOT production can be seen in Figure 4. Additionally, all of the VOT values for cognates and non-cognates in L1 Dutch, L2 English and monolinguals were gathered to facilitate comparison in Figure 5.
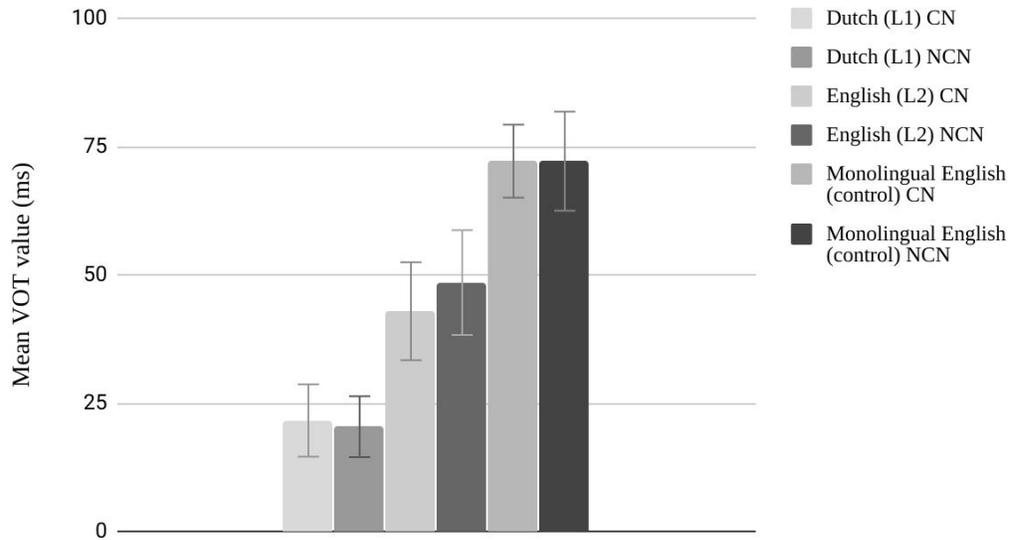
Figure 5: *Collected mean VOT values for cognate and non-cognate production by Dutch-English bilinguals and English monolinguals, with error bars representing standard deviations*
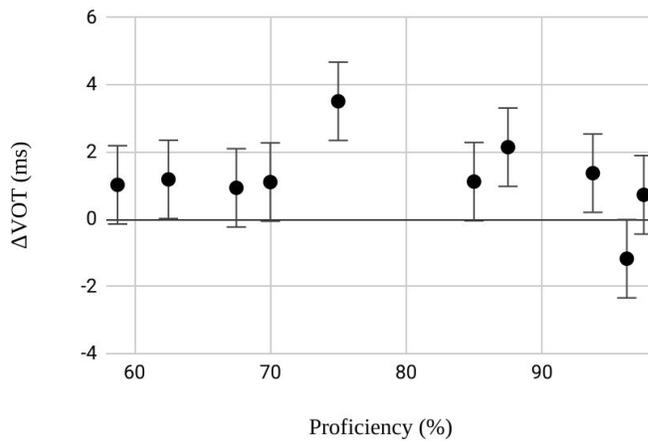
Figure 6: *The effect of English language proficiency on the difference between cognates and non-cognates in Dutch-English bilinguals' Dutch VOT production, with error bars representing standard deviation*

The penultimate analysis, a correlation analysis, showed that there was no correlation between English language proficiency and bilingual participants' difference between cognates

and non-cognates in Dutch VOT production (Pearson's $r(10) = -.27$, $p = .45$). A scatter plot of the proficiency values and the ΔVOT_D can be found in Figure 6.
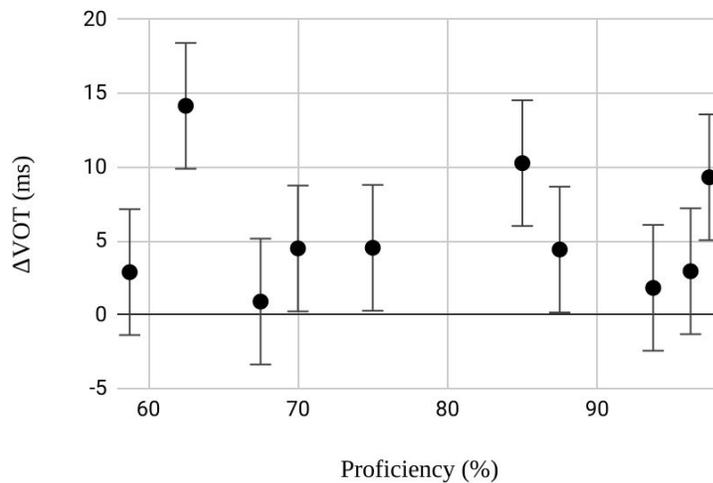
Figure 7: *The effect of English language proficiency on the difference between cognates and non-cognates in Dutch-English bilinguals' English VOT production, with error bars representing standard deviation*

The final analysis was another correlation analysis and showed that there was also no correlation between English language proficiency and bilingual participants' difference between cognates and non-cognates in English VOT production (Pearson's $r(10) = -.059$, $p = .87$). A scatter plot of the proficiency values and the ΔVOT_E can be found in Figure 7.

4. Discussion

The current study examined several possible effects found in the phonetics of Dutch-English bilinguals during the production of cognates. These effects consisted of the effects of cognate status on the first and second language Voice Onset Time production and the

correlation between these effects and the participants' English language proficiency. The following section discusses the results found in the present study's experiment and their interpretations and relevance. The discussion covers the results for the monolingual English participants, to see whether monolinguals show any effects which would cause the effects in bilinguals not to be due to their bilingualism, and the results for the bilingual participants for both the effects on first and second language VOT and the effects of proficiency. The section also discusses their theoretical explanations and their theoretical implications, including those for the models of bilingual speech production covered in Costa (2005).

4.1 Monolingual English

The present study found no significant effects of cognate status on the Voice Onset Time of the monolingual native speakers of English. This lack of effects was expected in light of previous research. There have generally not been found any effects of cognate status for monolinguals in previous research, throughout all the aspects of language (see, e.g., Amengual, 2012; Costa et al., 2000; Gerard & Scarborough, 1989; Jared & Kroll, 2001). This can be explained by the fact that the monolinguals do not have a second language to influence their first language. The cognates are only words in their own language, but not in another language that they speak, so their existence in the other language should not influence them.

4.2 Bilinguals: Overall effects

The results of the two-way independent analysis of variance (ANOVA), which was performed using the VOT data from the Dutch-English bilingual participants, can also be

explained by the theory. There was a significant main effect of language, no main effect of cognate status and no interaction effect between cognate status and language on the VOT values.

The first result that was found through the ANOVA, a significant main effect of language on the mean VOT values of the items, entailed that the L2 English VOT values were significantly higher than the L1 Dutch VOT values. The theory shows that there is a theoretical difference between VOT values in Dutch, which are generally lower, and VOT values in English, which are generally higher (Lisker and Abramson, 1964). It also shows that the difference between the isolated /t/ for Dutch and the isolated /t/ for English is discernible by Dutch-English bilinguals with varying proficiency (Flege & Eefting, 1987). The same might be true about the other two voiceless plosives, /k/ and /p/, as well. If the bilinguals perceive the Dutch and English phonemes as different, it makes sense that they also pronounce them differently. However, it is still very clear, when the bilingual English VOT values are compared to the monolingual English VOT values, that there are effects of the first language, Dutch, visible in the VOT values. The bilingual English VOT values are much lower, and therefore much closer to the Dutch VOT values, than the monolingual English VOT values. It is quite well-established that transfer from the first language to the second language can generally be found throughout all languages and proficiency levels (Gass, 2013; Kartushina et al., 2016).

The other results of the ANOVA, neither a main effect of cognate status nor an interaction effect between cognate status and language on the mean VOT values, can be explained through the more thorough analyses. The subsequent analyses found that there were no significant effects of cognate status for either language, so there will neither be a main effect of cognate status, nor an interaction effect between language and cognate status.

4.3 Bilinguals: Dutch

When the bilinguals' first language VOT data were isolated from their second language VOT data, the analysis regarding the bilinguals' VOT production in their first language, Dutch, did not result in a significant effect of cognate status on the mean VOT values.

These results are in line with the hypothesis and the results of Goldrick et al. (2014), as they did not find an effect of cognate status on first language VOT production for Spanish-English bilinguals during a language switching task, and there has generally been found little influence of the second language on the first language, especially as compared to the previously found influence of the first language on the second language (Kartushina et al., 2016). The results do, however, go against those of Amengual (2012), as he did find that there was an effect of cognates on first language VOT production for Spanish-English bilinguals, in a word naming task similar to the present study. Although the task in Amengual (2012) is closer to the task in the present study than the task in Goldrick et al. (2014), the results regarding first language VOT production in the latter coincide more with those of the present study, which are evidence against language-nonspecific activation on a phonetic level in the first language.

4.4 Bilinguals: English

The bilinguals' second language VOT data was also isolated from the first language VOT data. The analysis regarding the bilinguals' VOT production in their second language, English, had similar results to those of the first language. The effect of cognate status on the mean VOT values in the second language was not significant. However, there was a slight numerical

difference, with the VOT values of cognates being slightly lower, and therefore closer to the first language VOT values, than the VOT values of non-cognates.

This numerical difference of 5.57 ms could be a remnant of possible language-nonspecific activation on the phonetic level, like was the case in Goldrick et al. (2014), who found a significant effect of cognate status on second language VOT production for Spanish-English bilinguals during a language switching task, and Jacobs et al. (2016), who found a significant effect of cognate status on second language VOT production for English-Spanish bilinguals during a word naming task. Amengual (2012) found significant results for Spanish-English bilinguals in their first language with even smaller differences between cognates and non-cognates, ranging between 1.13 ms and 4.02 ms for different groups. However, the numerical difference in the present study was not significant, likely due to a much smaller sample size. The results of the present study are therefore not in line with the hypothesis and evidence for a language-specific activation on the phonetic level.

4.5 Implications for bilingual speech models

The evidence reviewed by Costa (2005) was quite divided between several different language-specific and language-nonspecific models of speech production. However, the results in the present study, which showed no significant effects of cognate status in both the first and the second language, support a model of speech production with language-specific activation on the phonological level. Two possible speech production models reviewed by Costa could fit the found results. The first possible model features a fully language-specific speech production, in which only the target language is activated. The production in this model starts at the activation

of a language-specific concept, which is not shared between languages, and then continues to activate language-specific words at a lexical level and language-specific phonemes at a phonological level, while the other language is never activated. The second possible model features a partly language-nonspecific and partly language-specific speech production. The production in this model starts at the selection and activation of a language-nonspecific concept, a concept with a meaning that is shared between languages, and then continues to activate words at a lexical level language-nonspecifically, meaning that there is activation of the words in both languages that fit the meaning of the activated concept. The language-nonspecific activation at the lexical level is supported by the results of Broersma et al. (2016), Costa et al. (2000) and Costa et al. (2005), who have found effects of cognate status at the lexical level of speech production in picture naming tasks, in which the naming speed is facilitated or inhibited during the production of cognates as compared to non-cognates. The results found in the present study suggest that, in the partly language-nonspecific production model, there is a language-specific activation at the phonological level. The activation inhibits the activation of the phonemes at the phonological level, causing only the phonemes for the activated word in the target language to be activated (Costa, 2005).

4.6 Proficiency: Dutch

The correlation between the English language proficiency scores and each bilingual participant's difference between the mean VOT value of cognates and the mean VOT values of non-cognate in the first language, Dutch, was not significant.

This result is in line with the hypothesis. There is generally little influence of the second language on the first language compared to the first language influences on the second language, especially on the phonetic level (Kartushina et al., 2016). This would make any effects of second language proficiency either very small or even non-existent. The results are also in line with the results found by Amengual (2012), whose analysis of two groups of Spanish-English bilinguals with different proficiency levels, i.e. early learners of English and late learners of English, showed the same results as the gradual scale of proficiency and the more thorough analysis of the correlation between proficiency for Dutch-English bilinguals in the present study, in that proficiency has no significant influence on the effects of cognates on the VOT production in the first language.

4.7 Proficiency: English

Similarly to the results found for the first language, there was no significant correlation found between the bilinguals' English language proficiency scores and the difference between their mean VOT scores for cognates and their mean VOT scores for non-cognates in the second language.

This is not in line with the hypothesis and therefore unlike the effects of proficiency in phonetics found in Mora and Nadeu (2012), who found that Spanish-Catalan bilinguals with a higher Catalan proficiency had smaller, inhibited effects of cognate status, and therefore less effects of the Spanish /e/, on the vowel height of Catalan /ɛ/. The results of the present study also suggest that there is an asymmetry between the lack of effects found in VOT production and the presence of effects found in recognition by Bultena et al. (2014) and Libben and Titone (2009),

who found that the effects of cognates in eye-tracking and self-paced reading tasks in the second language, faster reading times for cognates compared to non-cognates, were inhibited more and more as second language proficiency increased.

On the other hand, transfer from the first language to the second language production is known to happen often (Kartushina et al., 2016), so perhaps the influence does not come from second language proficiency, but, as Jacobs et al. (2016) proposes, from the inhibition of the first language. If a second language learner learns, through the use of classroom learning, to inhibit the first language more, then the effects of the first language on the second language, and therefore the effects of cognate status, might be inhibited more as well (Jacobs et al., 2016). However, if there is no significant effect of cognate status on second language VOT values in the first place, then first language inhibition might not make a significant difference either way.

4.8 Possible methodological issues: Participants

The lack of any significant effects of cognate status on VOT values for bilinguals in both the first language and second language found in the present study might be due to methodological issues. These issues could be in the selection process of the participants, as no data was obtained regarding any other languages spoken by the participants, which might influence the VOT values. Common languages learnt by Dutch students are, for instance, German, French and Spanish. This is the case especially at university level. The aforementioned languages also have a different range of VOT values for their voiceless plosives, which were found and summed up by Lisker and Abramson (1964). Similarly, no data was obtained on any

dialects or accents of Dutch that might be spoken by the bilingual participants, which might possibly have an influence on the VOT values as well.

4.9 Possible methodological issues: Materials

Another possibility of a methodological issue that might have prevented significant effects of cognate status could lie in the materials, specifically the target stimuli, as there are theoretical differences between VOT values between the three voiceless plosives /p/, /t/ and /k/. According to Lisker and Abramson (1964), the mean VOT values for Dutch are 10 ms for /p/, 15 ms for /t/ and 25 ms for /k/, and the mean VOT values for English are 58 ms for /p/, 70 ms for /t/ and 80 ms for /k/. Other studies, like Amengual (2012) and Goldrick et al. (2014) used, of the voiceless plosives, only the /t/ in their target stimuli.

Additional analyses were performed to see the differences between the gathered VOT data in the present study. Means were calculated in L1 Dutch production of /p/ ($M = 13.9$, $SD = 3.50$), /t/ ($M = 23.9$, $SD = 4.36$) and /k/ ($M = 25.2$, $SD = 4.12$), in L2 English production of /p/ ($M = 37.9$, $SD = 7.68$), /t/ ($M = 51.5$, $SD = 9.15$) and /k/ ($M = 47.8$, $SD = 8.79$) and in monolingual English production of /p/ ($M = 66.2$, $SD = 10.7$), /t/ ($M = 74.2$, $SD = 11.1$) and /k/ ($M = 76.0$, $SD = 7.77$). An independent sample t-test was then performed for each combination of two voiceless plosives for every data group. For the L1 Dutch data, there was a significant difference between /k/ and /p/ ($t(18) = 6.59$, $p < .001$), no significant difference between /k/ and /t/ ($t(18) = .66$, $p = .26$) and a significant difference between /p/ and /t/ ($t(18) = -5.67$, $p < .001$). For the L2 English data, there was a fairly significant ($p < .01$) difference between /k/ and /p/ ($t(18) = 2.69$, $p = .008$), no significant difference between /k/ and /t/ ($t(18) = -.93$, $p = .18$) and a fairly significant

($p < .01$) difference between /p/ and /t/ ($t(18) = -3.61$, $p = .001$). Finally, for the monolingual English data, there was a slightly significant ($p < .05$) difference between /k/ and /p/ ($t(18) = 2.33$, $p = .016$), no significant difference between /k/ and /t/ ($t(18) = .42$, $p = .34$) and no significant difference between /p/ and /t/ ($t(18) = -1.63$, $p = .060$).

These analyses show that there are many significant differences in the bilingual data, mainly between /p/ and the other two voiceless plosives, so that might explain why the results are not significant. The differences between the plosives bring a lot of variance, which might cause the standard deviation to be too high and the results for each separate language to be non-significant. However, there is too little data for each separate plosive to have a proper representative sample. Any analyses performed with this little data would not have satisfactory results if any conclusions are to be drawn.

On the other hand, it can also be seen that the differences between plosives are generally less or not at all significant for the monolinguals. Perhaps the significant difference between the plosives in the bilinguals' L2 English data could be the result of influences from the first language, as is the case with the main effect of language that was found.

4.10 Possible methodological issues: Procedure

Finally, another possible methodological issue that might have caused the lack of any significant effects of cognate status on the bilinguals' VOT values is procedural. The target stimuli were presented as isolated words without a sentence context and without a carrier phrase. This procedure was successful in finding significant results before for Jacobs et al. (2016), who found that there was an effect of cognate status on VOT values in the second language for

English-Spanish bilinguals in a word naming task with isolated words, but carrier phrases were used in the task of Amengual (2012) and language switching and a sentence context were used in the task of Goldrick et al. (2014). Perhaps significant effects might have been found if carrier phrases or a sentence context had been used in the present study, as a sentence context might elicit more naturalistic speech and a similar reading speed for all words, while individual words do not appear often in everyday speech and allow for more variance in the reading speed, which could cause more variance in the VOT values.

The experiment also consisted of only one session, which contained both the Dutch and the English block. Perhaps this might have caused the bilinguals not to be in a fully monolingual mode, which might have caused the Dutch language context from the Dutch block to have influenced the production of the words in the English block more.

What might also have been problematic in terms of the procedure of the present study could be the proficiency test. The proficiency test used in the present study was an online English LexTALE test (Lemhöfer & Broersma, 2011), which was a task in visual word recognition. The proficiency scores from the test were shown to be an accurate representation of the general language proficiency of the bilingual speaker by Lemhöfer and Broersma (2012), but they might not be an accurate representation of a specific part of language proficiency, namely the bilingual's pronunciation in comparison to a native speaker's. Flege and Eefting (1987) found that bilinguals have a stronger perception of the difference between the Dutch and English plosives, so according to Flege (1995), the pronunciation should resemble the native speakers' production more as proficiency increases. An extra correlation analysis was therefore performed to check whether there was a correlation between the bilingual participants' LexTALE

proficiency scores and the difference for each of the participants between the mean Dutch and English VOT values. This resulted in no significant correlation between the proficiency scores and the differences between mean Dutch and English VOT values (Pearson's $r = .41$, $p = .24$). This could mean that there is no increasing difference between the first and second language VOT production as proficiency increases, but this is not very likely due to the results of much research (Flege, 1995; Flege & Eefting, 1987). The more likely option is that the LexTALE test is not accurate in assessing proficiency scores in terms of phonetics or, more specifically, VOT.

5. Conclusion

The present study set out to examine the questions whether cognate status has an effect on the Voice Onset Time production of Dutch-English bilinguals in their first and second language and whether English language proficiency has an influence on this effect.

The study attempted to answer the first question, whether there is an effect of cognate status on VOT, using a word naming task. This resulted in no significant effects of cognate status on the VOT production found in the first language. These results are at odds with Amengual (2012), and in line with the hypothesis and Goldrick et al. (2014). On the other hand, the results of the present study were nearly completely at odds with the previous research regarding the effects of cognate status on VOT production in the second language, as previous research generally found a significant effect of cognate status on the VOT (Goldrick et al., 2014; Jacobs et al., 2016). The present study did find a slightly lower mean VOT value for cognates in English, which was closer to Dutch VOT values, but these results were not significant and therefore not in line with the hypothesis. The lack of significant effects of cognate status on the mean VOT

production in both the first and second language argue against a language-nonspecific activation during speech production, at least at the phonological level.

The second question asked by the present research, whether second language proficiency has an influence on any cognate effects on VOT, was also examined using the same word naming task and the bilinguals' scores on an online English LexTALE proficiency test (Lemhöfer & Broersma, 2011). The hypothesis regarding the influence of English language proficiency on the effects of cognate status on VOT in the first language was that there is no significant correlation between the participants' proficiency scores and the difference in VOT between cognates and non-cognates. The results of the present study, which used a gradual scale of objective English language proficiency, turned out to be in line with this hypothesis. The correlation between English language proficiency and the effects of cognate status on VOT in the second language in the present study was hypothesised to be significant, with an inhibition of cognate effects as proficiency increases (Bultena et al., 2014; Libben & Titone, 2009; Mora & Nadeu, 2012). However, the results of the present study were inconsistent with this series of results, as there was no significant correlation between proficiency and the effects of cognate status on VOT. Perhaps there is only an influence of inhibitory control of the non-target language instead of an influence of proficiency (Jacobs et al., 2016).

All in all, the present study aimed to fill the gaps left by the previous research regarding whether there were effects of cognate status on VOT in the first and second language for Dutch-English bilinguals and whether there was a correlation between the effects of cognate status on VOT and English language proficiency. The results of the present study show that there is no effect of cognate status on VOT in either language and that there is no correlation between

these, practically non-existent, effects and second language proficiency. These results all support

a language-specific activation at the phonological level. This helps us understand how speech

production is processed in the brain, and perhaps it teaches us more about language processing in

general, which can help in the learning and teaching of languages.

6. Recommendations

Future research on the current study's topic could examine these same effects of cognate

status on the VOT values of Dutch-English bilinguals and their correlation to proficiency, but it

could correct the possible issues in the methodology of the present study. For instance, future

research could pre-screen the bilingual participants on all of their known languages and either

exclude the participants who might be influenced by possible other languages, e.g. because of a

high proficiency level, or find out whether there is an effect of these third languages, at which

level and to what extent. Furthermore, the target stimuli could be created so that they all start

with the same voiceless plosive, either /p/, /t/ or /k/, or they could have separate analyses

performed for them, given that there is enough data for every plosive, to check whether there are

differences between the cognate effects different plosives, which could be connected to the size

of the difference between Dutch and English. Further research could also adapt the procedure to

Amengual (2012), who used carrier phrases to pronounce the words instead of only pronouncing

isolated words. The words could also be presented and pronounced in a sentence context. The

two blocks in the bilinguals' experiment, the Dutch block and the English block, could also be

split up into two experimental sessions, to keep the bilinguals' pronunciation in a fully

monolingual mode. A final recommendation for further research could be to use a different test

to establish objective English language proficiency in terms of pronunciation. Theoretically, this could be done by measuring the difference between the mean Dutch VOT values and the mean English VOT values, as this difference should increase as proficiency increases (Flege, 1995; Flege & Eefting, 1987). A larger sample size could also paint a better picture of any possible effects.

7. Acknowledgments

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Appendix A: Instruction page

The English instruction page included in the PowerPoint presentation read,

"Welcome! In the following experiment, 45 English words will appear on screen one by one. Please read these words aloud and as clearly as possible into the microphone. Only when you have pronounced the word completely, please press the button to continue to the next word. If you have any questions, please pose them now. Please press the button when you are ready to begin."

The Dutch instruction page was a translation of this, but with "45 Dutch words" instead of "45 English words".

Appendix B: Target stimuli

Dutch				
Cognates		**Non-cognates**		
Item	**Log word freq.**	**Item**	**Log word freq.**	
/k/				
Kasteel 'castle'	3,0821	Kerst 'christmas'	3,1931	
Kat 'cat'	3,364	Kapper 'barber'	2,7118	
Kilometer 'kilometre'	3,3369	Kies 'molar'	3,1895	
Kok 'cook'	2,7924	Kop 'head'	4,0011	
Kust 'coast'	3,1446	Kunst 'art'	3,2103	
/p/				
Park 'park'	3,1307	Paard 'horse'	3,5632	
Parallel 'parallel'	1,8261	Paraplu 'umbrella'	2,179	
Pen 'pen'	2,9768	Poen 'money'	2,7101	
Pil 'pill'	2,6149	Pier 'earth-worm'	2,5092	
Puzzel 'puzzle'	2,3636	Pooier 'pimp'	2,5899	
/t/				
Telefoon 'telephone'	3,8365	Tellen 'to count'	3,0781	
Toerist 'tourist'	2,3541	Toets 'examination'	2,3541	
Toorts 'torch'	1,7782	Toveren 'to do magic'	2,238	
Totaal 'total'	3,3282	Tas 'bag'	3,4071	
Tunnel 'tunnel'	3,0302	Tillen 'to carry'	2,3541	

English			
Cognates		**Non-cognates**	
Item	**Log word freq.**	**Item**	**Log word freq.**
/k/			
Cat	4,82956194027099	Catch	5,04413795377223
Castle	4,68322323232768	Care	5,3403318542447
Coast	4,86470437274936	Cough	3,67528410089869
Cook	5,032755478795	Current	4,81452935413894
Kilometre	3,63575388120225	Keep	5,72291402912542
/p/			
Parallel	3,81598052174096	Parent	4,20761908717346
Park	5,08130625392006	Portable	3,98034131273578
Pen	4,37470910211436	Pants	4,28791248359046
Pill	3,80767000252727	Peacock	3,66561736994109
Puzzle	3,92720531662527	Poison	3,66515163854857
/t/			
Telephone	4,32073932720945	Tense	4,08044746913287
Torch	4,2133274569065	Talk	5,51693471938235
Total	4,97332202197935	Toad	3,69224739834877
Tourist	4,1596287151805	Tool	4,07194757647726
Tunnel	4,23430946000145	Timber	4,04540171029122

Appendix C: Word order

#	Dutch		English	
	Item	**Word type**	**Item**	**Word type**
1	pil	cognate	catch	non-cognate
2	maan	filler	cat	cognate
3	pier	non-cognate	peacock	non-cognate
4	telefoon	cognate	keep	non-cognate
5	dieren	filler	display	filler
6	fruit	filler	tool	non-cognate
7	tas	non-cognate	meat	filler
8	paard	non-cognate	current	non-cognate
9	tillen	non-cognate	torch	cognate
10	toerist	cognate	hour	filler
11	omlaag	filler	buy	filler
12	toets	non-cognate	timber	non-cognate
13	kunst	non-cognate	draft	filler
14	kerst	non-cognate	telephone	cognate
15	dun	filler	care	non-cognate
16	voet	filler	poison	non-cognate
17	pooier	non-cognate	bulb	filler
18	slinger	filler	puzzle	cognate
19	adelaar	filler	slave	filler
20	kasteel	cognate	parent	non-cognate
21	totaal	cognate	hip	filler

22	tellen	non-cognate	parallel	cognate
23	kop	non-cognate	session	filler
24	bloem	filler	total	cognate
25	puzzel	cognate	castle	cognate
26	zon	filler	portable	non-cognate
27	kok	cognate	pill	cognate
28	tunnel	cognate	nuclear	filler
29	kust	cognate	pants	non-cognate
30	parallel	cognate	coast	cognate
31	poen	non-cognate	kilometre	cognate
32	eland	filler	sale	filler
33	kies	non-cognate	talk	non-cognate
34	kat	non-cognate	dress	filler
35	park	cognate	park	cognate
36	pen	cognate	failure	filler
37	toorts	cognate	fresh	filler
38	kapper	non-cognate	tourist	cognate
39	gras	filler	toad	non-cognate
40	huid	filler	cook	cognate
41	toveren	non-cognate	stomach	filler
42	paraplu	non-cognate	tunnel	cognate
43	snor	filler	tense	non-cognate
44	kilometer	cognate	pen	cognate
45	vlieg	filler	cough	non-cognate

Appendix D: Information document

INFORMATION DOCUMENT

Title of the research study: *Reading words*
Researcher responsible: Mike van der Burg

Aim and procedure of the research study
In this research study, you will read aloud English words to contrast their phonetics with the Dutch phonetics. If you wish, we can explain what is being researched in more detail afterwards.

Risks and discomfort
There are no health or safety risks.

Confidentiality of the research data
The data collected during this study will be used solely for writing a Bachelor's thesis. Of course, these data will be made fully anonymous and safely stored following the guidelines of Radboud University.

Audio recordings will be made during this study. You will be handed a form on which you can give permission for the making and the use of these recordings.

Voluntariness
You participate voluntarily in this research. Therefore, you can withdraw your participation at any time during the research. All data we have collected from you will be deleted permanently.

Compensation
To thank you for participating, you will receive something tasty.

More information
Should you want more information on this research study, now or in future, please contact Mike van der Burg (telephone: +31 6 34777078; e-mail: mike.ssjb.vd.burg@gmail.com).

Appendix E: Informed consent form

<div align="center">

CONSENT FORM

</div>

Title of the research study: Reading words

Researcher responsible: Mike van der Burg

Statement of participant
The aim of the research study has been outlined to me. I was given the opportunity to ask questions regarding the research study. I participate voluntarily in the research study. I understand that I can stop at any point during the research study, should I wish to do so. I understand how the data of the research study will be stored and how they will be used. I consent to participating in the research study. I give permission to have audio recordings made of me for the research study and have them analysed phonetically.

Permission for audio recordings

I give permission to:

Yes   No
☐   ☐   use these audio recordings for this Bachelor's thesis.

other remarks: ……………………………………………………………………………….

Name: ……………………………………………………………….........
Date of birth:………………………………………....

Signature: .... Date:…………………………………....................

Statement of executive researcher

I declare that I have informed the above-mentioned person correctly about the research study and that I abide by the ethical guidelines for research.

Name: ………………………………………………………….

Signature: .... Date:…………………………….......................