

**Cross-Language Structural Priming:**

Long-Term Effects of Exposure to English Structures on Dutch Comprehension of  
Ambiguous Structures by Dutch-English Bilinguals

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### **Abstract**

The present study investigated the influence of second language (L2) syntactic priming on bilinguals' first language (L1) sentence comprehension of ambiguous relative clause (RC) structures. Additionally, the sustainability of L2 to L1 priming was studied, as well as the interaction between the priming effect and L2 proficiency. A group of native speakers of Dutch with English as their L2 (N = 45) participated in a picture selection task in which they were presented with ambiguous Dutch RC structures. Unambiguous English RC primes with object RC interpretation were used to elicit a corresponding interpretation for the ambiguous Dutch RC structures. Changes in interpretation preferences were investigated through analysing the differences between responses given in the priming phase and responses given in the pre-test and post-test phase, during which no primes were presented. The results suggested that the L2 primes influenced L1 sentence comprehension, as there was a significant increase in object RC interpretations during and after the priming phase. No interaction was found between the priming effect and the participants' L2 proficiency. The priming effect may be indicative of cross-language interactions and, potentially, even shared syntactic representations used in language comprehension. The sustained nature of the effect needs to be studied more elaborately before drawing definitive conclusions, but may be an indication of how L2 priming could potentially elicit implicit learning in the L1.

**Keywords:** Syntactic priming, cross-language interactions, priming in language comprehension, long-term priming, implicit learning, language proficiency effects, bilingualism, English, Dutch

## 1. Introduction

A myriad of people in the world speak more than one language. As a result, language phenomena such as code-switching and transfer may occur. Both these language phenomena are concerned with influences that the languages of multilinguals have on each other. Code-switching occurs when bilinguals make use of language elements of more than one language within one utterance, such as in the Spanish-English utterance “el dinero ese que n van a dar with the taxes” (Fricke & Kootstra, 2016, p. 187). This phenomenon is often observed in bilingual neighbourhoods, as was found by Zentella (1997) who closely examined language usage in a neighbourhood in New York City. Many people in this neighbourhood are of Puerto Rican descent, and therefore speak both Spanish and English. Zentella (1997) studied and recorded the language use of several children in the neighbourhood and found that, although English was predominantly used, on average, children made a switch to Spanish sentences and phrases every three minutes. Code-switching is an overt form of cross-language interaction, which can be directly observed (Kootstra, 2015).

Transfer, on the other hand, is usually a covert form of cross-language interaction, which occurs when multilingual speakers transfer and apply the linguistic features of one language in another language (Treffers-Daller, 2009). Such linguistic features could, for example, be the phonetic items of a language or the linguistic cues used for interpreting sentences. Linguistic cues, as explained by Li and MacWhinney (2013), compete with each other in order for thematic roles to be assigned in an utterance (i.e., how it is established, for example, which phrase takes on the agent role and which takes on the patient role). Languages generally differ in what information (e.g., word order or animacy) is the strongest cue, and it has been found that L2 speakers may use the cues from their L1 to assign the thematic roles in their L2 (Liu et al., 1992). This transfer of linguistic cues, as well as the phenomenon of code-

switching, clearly illustrate that when people speak multiple languages, there are ongoing interactions between these languages.

Another language phenomenon that appears to be related to how the languages of bilingual or multilingual speakers interact, is cross-language priming. Cross-language, or cross-linguistic, priming refers to the phenomenon where exposure to input from one language influences language processing and/or production in another language. Cross-language priming can be lexical, which was found, for example, by Jin (1990) whose results indicated that translation equivalents in Korean led to faster response times for Korean-English bilinguals (i.e., with Korean as their L1 and English as their L2)<sup>1</sup> in a lexical decision task with English target words, and vice versa. But cross-language priming can also be syntactic, meaning that the processing and/or production of a particular syntactic structure in one language is facilitated by having been exposed to a similar or related syntactic structure in another language. This was found, for instance, by Loebell and Bock (2003) and Hartsuiker et al. (2004). Those particular studies focussed on the effects of cross-language structural priming in experimental settings, but similar effects have been found in spontaneous language use.

Structural priming effects in authentic language use have been found, for example, by Fricke and Kootstra (2016). They analysed an English-Spanish corpus and found structural priming effects for spontaneous code-switching, both short-term and long-term. There seemed to be a tendency to code-switch after hearing an utterance that included a code-switch, and it was also found that self-priming was more influential than being primed by an interlocutor. Similar cross-language priming effects were found by Travis et al. (2017) in authentic language use of pronominal subject expression in Spanish-English bilinguals. As studies, such as the ones by Fricke and Kootstra (2016) and Travis et al. (2017), have demonstrated, cross-language

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<sup>1</sup> For the remainder of this thesis, when bilinguals are said to be X-Y bilinguals, X refers to the L1 or dominant language and Y to the L2 or less dominant language.

structural priming effects may also occur in real-life, and not only in experimental settings. Kootstra and Muysken (2017) have suggest that such real-life findings make priming effects found in experimental settings more ecologically valid. Cross-language priming is viewed as “a beautiful experimental measure of cross-linguistic interaction that, at the same time, shapes linguistic choices in real-life discourse” (Kootstra & Muysken, 2017, p. 217). Thus, cross-language interactions can be found in experimental settings as well as in natural discourse. In both contexts, it suggests that the languages of multilingual or bilingual language speakers interact with each other.

The present study is concerned with the topic of long-term cross-language priming effects in language comprehension and the influence that the L2 potentially has on the L1. However, before exploring this topic, an overview of previous research on language priming is presented (see section 2). This overview demonstrates that much research has been done on structural priming in language production (see e.g., Hartsuiker et al., 2004; Kantola & van Gompel, 2011; Loebell & Bock, 2003). In the area of language comprehension, syntactic priming studies are less common, although similar effects have been found (see e.g., Branigan et al., 2005; Nitschke et al., 2010; Kidd, Tennant et al., 2015). Whereas some studies considered priming effects within one language (see e.g., Branigan et al., 2005; Heyselaar & Segaert, 2021; Nitschke et al., 2010), others studied prime effects cross-linguistically (see van Gompel & Arai, 2018, for an overview on cross-linguistic structural priming). Cross-language priming effects have been interpreted as a potential indication of shared syntactic representations, because the activation of a syntactic structure in one language also seems to facilitate the use of the structure in the other language (Hartsuiker et al., 2004). Furthermore, sustained priming effects have been interpreted as an indication of implicit learning, because language exposure seems to elicit adaptations in syntactic representations (see e.g., Chang et al., 2006; Luka & Choi, 2012; Jackson & Hopp, 2020; Kootstra & Doedens, 2016). Finally, some studies have suggested that

the L2 proficiency of bilinguals may interact with the strength of priming effects, generally suggesting that higher L2 proficiency leads to stronger (cross-language) priming effects (see e.g., Bernolet et al., 2013; Kim & McDonough, 2008).

Most studies reviewed in section 2. that have investigated cross-language priming effects, focussed on the effect that L1 primes had on the L2. The only studies that have examined the priming effect in the opposite direction, L2 to L1 priming, considered priming in production, and those findings have been far from consistent (cf. Kantola & van Gompel, 2011; Kootstra & Doedens, 2016; Loebell & Bock, 2003). Moreover, studies that focussed on long-term priming effects, have not taken into consideration what the effect of L2 primes may be on L1 comprehension or production. The present study aimed to address these research gaps by means of investigating to what extent cross-language priming from the L2 to the L1 influences the interpretation, thus comprehension, of ambiguous structures. Additionally, this thesis aimed to find out whether this L2 to L1 priming effect could be long-term. Finally, it was examined how L2 proficiency might interact with the priming effect.

In order to answer these research questions, a cross-language structural priming experiment was conducted in which Dutch-English bilinguals participated in a picture selection task using unambiguous L2 primes to influence the interpretation of ambiguous L1 target structures. The interpretation of ambiguous Dutch structures were analysed before, during, and after primes were presented, in order to investigate the L2 to L1 priming effect and its sustainability. By means of measuring the participants' L2 proficiency and using the scores as a way of dividing the participants into a high and low proficient group, the interaction between the priming effect and L2 proficiency was examined. The results of the present study suggest that L2 to L1 priming may indeed take place in language comprehension, as the L2 primes led to a significant increase in the primed interpretation of ambiguous Dutch structures. The priming effects remained observable even after primes were no longer presented to the

participants, suggesting that the priming effect had long-term consequences. Finally, no significant differences were found between high and low proficient Dutch-English bilinguals, suggesting that, for this participant group, L2 proficiency did not interact with the strength of the priming effect.

Overall, this study suggests that L2 priming leads to cross-language interactions in language comprehension, similar to what had previously only been found for language production. It provides support for the idea that cross-language interactions in language comprehension and production share strong resemblances, and that language comprehension processes also make use of shared syntactic representations. The sustained nature of the L2 > L1 priming effect may potentially be an indication of L2 exposure leading to implicit learning in the L1, but more research on the nature of the sustainability of the effect is required.



## 2. Background

This section aimed to provide an extensive overview of how structural priming has been used as a methodological tool to investigate syntactic representations and cross-language interactions. The section is divided into various subsections, focussing on priming in language production (section 2.1), priming in language comprehension (section 2.2), sustained, or long-term, priming effects (section 2.3) and interactions between priming effects and second language (L2) proficiency (section 2.4).

### 2.1 Priming in Production

Many, if not most, studies on (cross-language) structural priming effects have focussed on language production (see e.g., Hartsuiker & Pickering, 2008; Pickering & Ferreira, 2008, for reviews on structural priming, and van Gompel & Arai, 2018, for a review on cross-language structural priming). A common structural priming technique for priming in language production has been the use of picture description tasks (see e.g., Hartsuiker et al., 2004; Loebell & Bock, 2003). Such tasks have often been used to elicit a particular syntactic choice, for example, the use of passive versus active structures, or sentences describing dative events using either double object (DO) structures or prepositional object (PO) structures (i.e., structures such as *I give you a book*, or *I give a book to you*, respectively). In cross-language experiments, bilingual participants are usually presented with a prime in one language, after which they describe a picture or ongoing action in their other language. This has allowed researchers to investigate the effect of the primes from one language, on the language production in another language, indicating a potential interaction between the syntactic representations used in language production.

One of the earliest studies using this kind of structural priming technique in a cross-linguistic setting was conducted by Loebell and Bock (2003). The participants in their study were German-English bilinguals who were presented with English or German primes, after

which they described target pictures in the other language. Both passive and active structures, as well as DO and PO structures, were used. Although a priming effect was found for the PO and DO datives, this was not the case for passive constructions (and it was suggested that lack of word order overlap played a role in this, as German and English passive structures differ in word order). They also found a tendency for a stronger priming effect from German to English ( $L1 > L2$ )<sup>2</sup> than from English to German ( $L2 > L1$ ). Loebell and Bock (2003) demonstrated that input from one language may interact with the production of similar structures in the other language, and that language dominance and the extent to which particular structures overlap may also have an effect on this.

Another influential study that built on the findings by Loebell and Bock (2003) was conducted by Hartsuiker et al. (2004), who conducted a similar experiment with Spanish-English bilinguals listening to Spanish passive and active primes after which they produced English targets. Unlike German and English, where there is a difference in word order for passive sentences, Spanish and English passive do resemble each other in word order. The results indicated that there was a priming effect for passive sentences; English passive sentences were produced significantly more often following Spanish passive primes than following Spanish active primes. Thus, the production of passives in the L2 of these bilinguals was influenced by input from their L1. Hartsuiker et al. (2004) interpreted these findings as evidence supporting the idea of shared-syntax.

The main idea of this shared-syntax model is that whenever the syntactic structures between the languages of multilingual language speakers are structurally similar, these syntactic representations may be shared (Hartsuiker et al., 2004). This single syntactic

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<sup>2</sup> For the remainder of this thesis, when  $LX > LY$  is used, this refers to the priming direction in which LX primes are used in combination with LY targets.

representation can then be used for both languages, and when it is used in one language, the same representation is also activated for the other language. Consequently, as van Gompel and Arai (2018) have explained, shared syntactic representations lead to cross-language priming. When bilinguals are exposed to, for example, a DO structure in one language, and they have to describe a dative event in their other language, the syntactic DO structure is still activated, which may then lead to a tendency to choose this activated structure over the non-activated PO structure. One prediction of the shared-syntax account has been that, as soon as bilinguals have learnt the corresponding syntactic structures in both languages, these representations become shared and priming effects within a language should be as strong as cross-language priming, or priming between languages (van Gompel & Arai, 2018). Because the same syntactic representations in both languages are used, activation in either language should also activate the other language.

Kantola and van Gompel (2011) tested the prediction that between and within language priming are equally strong in a structural priming experiment with Swedish-English bilinguals. The first part of their study used English as target language and English or Swedish DO and PO structures as primes. Thus, they studied within language priming for the L2 and between language priming in the direction of L1 > L2. In the second part of the study, the targets were Swedish and the primes either English or Swedish. Thus, they studied within language priming for the L1 and between language priming in the direction of L2 > L1. They found equally strong priming effects for both these types of priming. Furthermore, they found no effect of prime language and no significant interaction between prime and target language. Thus, not only can the L1 prime the L2, but the effects also seem to go in the opposite direction, with the less dominant language priming the dominant language. Kantola and van Gompel (2011) suggested that the syntactic structures of the languages of bilinguals are indeed integrated, supporting the shared-syntax model.

However, there have also been studies that did not support the idea that priming between languages is equally strong as within languages. For example, Bernolet et al. (2007) found no cross-language priming effects for Dutch-English bilinguals who were primed with relative clause (RC) structures, even though there were within language priming effects both in English and in Dutch. This lack of between language priming effects was explained by a difference in word order, since the position of the verb in Dutch and English RC structures is different. However, even when there is exact overlap in word order between two languages, within and between priming effects do not always seem to be equally strong. This was found by Bernolet et al. (2013) whose results indicated stronger within language priming effects than between language effects for Dutch-English bilinguals who were primed with genitive structures. They also found an interaction between L2 proficiency and priming effect: the cross-language priming effects were only as strong as the within language priming effects for high proficient L2 speakers (Bernolet et al., 2013). This seems to suggest that there are also other factors involved in language priming, such as word order overlap and L2 proficiency. The latter of these two, the role of L2 proficiency in syntactic priming, is discussed in section 2.4 below.

Findings from studies on structural priming in language production indicated that syntactic priming effects can, indeed, be found between languages. It has, therefore, been suggested that bilinguals share their syntactical representations, since representations in one language seem to activate the same structures in the other language. Indeed, cross-language priming effects in production have been both in the direction where the L1 primed the L2 as well as where the L2 primed the L1 (see e.g., Kantola & van Gompel, 2011). However, others have suggested that  $L1 > L2$  priming effects are stronger than  $L2 > L1$  priming effects (see e.g., Loebell & Bock, 2003) or that the strength of cross-language priming effects interact with language proficiency (see e.g., Bernolet et al., 2013). The findings discussed so far were all obtained in studies concerned with cross-language structural priming in language production.

The following subsection discusses studies that investigated priming in language comprehension.

## 2.2 Priming in Comprehension

Overall, much of the research on structural priming has focussed on language production, rather than priming in language comprehension. Although there seem to be differences between language production and comprehension, for example in the order in which processing takes place (see e.g., Tooley & Traxler, 2010), it has been found that syntactic processes involved in language comprehension are also influenced by cross-language interactions, similar to language production. This is, for example, what happens with language transfer of linguistic cues, as was mentioned earlier in section 1. (see e.g., Liu et al., 1992). It is, therefore, not entirely surprising that cross-language structural priming effects have also been reported for language comprehension (Nitschke et al., 2010). The current subsection starts by briefly exploring cross-language interactions found in language comprehension that have been related to the competition model (Li & MacWhinney, 2013). After this, results of studies on structural priming in language comprehension are discussed.

As was mentioned in the introduction, L2 speakers might transfer linguistic cues used in sentence comprehension from their L1 as a result of cross-linguistic interactions. According to the competition model, linguistic cues compete with each other; the strongest cue determines how sentences are interpreted (Li & MacWhinney, 2013). For instance, in the English sentence “the elephant kicks the rock” both the cues of animacy and word order point towards *the elephant* being the agent of the sentence (Li & MacWhinney, 2013, p. 1). The word order cue indicates that the noun preceding the verb is the agent of the construction, and the animacy cue indicates that the animate noun is the agent. But cues can also contradict each other, as can be seen in “the rock kicks the elephant” (Li & MacWhinney, 2013, p. 1). The animacy now points to *the elephant* as the agent of the construction, but word order favours *the rock* as agent. In

such cases where cues contradict, the strongest cue wins. Languages may differ in which linguistic cues are the strongest cues: whereas in English sentence processing the cue of word order is the strongest one, in Mandarin Chinese sentence processing the animacy cue wins. Liu et al. (1992) investigated which cues Chinese-English and English-Chinese bilinguals employ when interpreting English and Chinese Mandarin structures. The participants were presented with items such as “the carrot is kicking the horse” and were asked to indicate which of the two objects in this sentence (i.e., either *the carrot* or *the horse*) was doing the action (i.e., *kicking*) (Liu et al., 1992, p. 460). It was found that late Chinese-English bilinguals favoured the use of animacy cues (i.e., strongest in their L1) to assign the thematic roles of phrases in English and that English-Chinese bilinguals used word order cues (i.e., strongest in their L1) to process Chinese sentences. Thus, these findings supported the competition model, as well as the idea that in bilingual sentence comprehension, there are cross-language interactions and influences. Since such interpretation cues used in language comprehension are influenced by cross-linguistic interactions, it is not surprising that cross-language priming effects have also been found for language comprehension.

Although research on structural priming in language comprehension is more limited than research on language production, especially cross-linguistic contexts, effects have been found in various directionalities. Studies on structural priming in language comprehension generally focus on the meaning of syntactic structures, rather than on syntactic form choices that are similar in meaning, which is common in studies on priming in production. An exception to this, is the study by Weber and Indefrey (2009), who found structural priming effects for passive sentences in brain activity and reading times of German-English bilinguals. Both German and English structures primed English target structures, which resulted in decreased brain activity and faster reading times (i.e., priming from L2 > L2 and L1 > L2). Therefore, they concluded that syntactic priming effects could also be found in language comprehension,

supporting the idea of shared syntactic representations (Weber & Indefrey, 2009). Other studies on priming in language comprehension, however, focussed on meaning comprehension and often use ambiguity resolution to find priming effects (see e.g., Nitschke et al., 2010; Kidd, Tennant et al., 2015). With this research method, language users are presented with ambiguous syntactic structures (i.e., with multiple possible interpretations) and primed with (a) particular(s) interpretation. After this, participants are asked to indicate how they interpret such ambiguous structures, for example, by being asked to indicate which object is the agent in the sentence (similar to studies supporting the competition model, e.g., Liu et al., 1992).

Branigan et al. (2005) used a similar method for priming in language comprehension of monolingual English speakers. They used items that were ambiguous in the sense that it was unclear what phrase the prepositional phrase (PP) referred to. For example, in the phrase “the waitress prodding the clown with the umbrella” the PP *with the umbrella* could be related to either *the waitress prodding* or to *the clown* (Branigan et al., 2005, p. 468). The results demonstrated that the interpretations of such ambiguous sentences could be primed, though this was only the case when the verb used in the prime-target pairs was repeated. Nevertheless, this study indicated that indeed priming in comprehension may occur, albeit in a monolingual within language priming context (Branigan et al., 2005).

Nitschke et al. (2010), on the other hand, also considered L2 speakers in their study on priming in comprehension. L1 speakers of Italian, English-Italian bilinguals, L1 speakers of German and English-German bilinguals interpreted sentences with RCs that were structurally ambiguous in German and Italian, see (1) and (2). The first noun phrase (NP) in these RCs could either be the subject or object of these constructions. In English, the L1 of the bilingual participants, the equivalent of such structures are always disambiguated by word order: for the ambiguous German structure (1), the second NP of the English equivalent is interpreted as the subject, whereas for the ambiguous Italian structure (2), the first NP of the English equivalent

is interpreted as the subject. Although both in Italian and German such structures are ambiguous, there is generally a strong preference to interpret the first NP as the subject, also referred to as subject reading (SR).

(1) German: Hier ist die Frau, die das Mädchen küsst

Here is the woman<sub>[Subj/Obj]</sub> that the girl<sub>[Obj/Subj]</sub> kisses

(2) Italian: Ecco la donna che bacia la ragazza

Here is the woman<sub>[Subj/Obj]</sub> that kisses the girl<sub>[Obj/Subj]</sub>

(Nitschke et al., 2010, p. 98)

The experiment consisted of a picture selection task that required participants to choose which of two pictures depicted the sentence presented to them. First, during a baseline phase, the natural preference of the participants for ambiguous RC structures was measured (i.e., without there being any form of priming). Subsequently, the priming phase began, during which only one of the two picture options portrayed the verb used in the target sentence. In this correct picture option, the first NP was the object of the relative clause, also referred to as object reading (OR). The target items were the same type of structurally ambiguous items as were used during the baseline phase, where participants chose between the OR and the SR. After the priming phase, there was a post-test phase, similar to first phase of the experiment, to investigate whether preferences in interpreting ambiguous structures had shifted due to priming the object RC interpretation.

The results indicated that both L1 and L2 German speakers, and the L2 Italian speakers chose the OR significantly more often during and after the priming phase than during the initial baseline phase. Despite a clear preference for SRs found in the baseline phase, the less preferred interpretation was successfully primed. Therefore, Nitschke et al. (2010) concluded that particular interpretations in language comprehension can indeed be primed. Additionally, they suggested that this priming effect had long-term consequences as the effect sustained after



primes were no longer presented. Thus, in addition to L1 speakers, L2 speakers may also be primed during language comprehension. These findings are, however, only indicative of an effect of within language priming and not of ongoing interactions between the languages of bilinguals during language comprehension.

A study that used cross-language syntactic priming in comprehension was done by Kidd, Tennant et al. (2015). They conducted an experiment similar to that of Nitschke et al. (2010), only with English-German bilinguals and a cross-language priming paradigm. Unambiguous English primes with both OR and SR interpretations were used in combination with ambiguous German RC target items. There was a baseline phase containing only the ambiguous German items, followed by a priming phase that also included English OR and SR primes. The results indicated that English OR primes elicited a significant increase in the proportion of OR choices for ambiguous German structures, whereas the SR primes did not lead to such an increase. For OR structures, English and German sentences overlap in word order, but for SR structures this is not the case. Nevertheless, Kidd, Tennant et al. (2015) concluded that cross-language structural priming effects can also be found in language comprehension, as the OR interpretation had been successfully primed. Additionally, they suggested that their findings add to the understanding of the shared-syntax model, as the model might, in addition to production, also account for processes involved in language comprehension. Furthermore, Kidd, Tennant et al. (2015) proposed that syntactic representations may differ depending on what information is necessary in each language to successfully process structures, somewhat similar to the processes discussed in the competition model (cf. Li & MacWhinney, 2013). In the case of English ORs and SRs, information on word order is sufficient for interpreting the structures. However, when the word order of RCs leads to ambiguities, as is the case in German, thematic role information may also be part of the syntactic representations (at least for native speakers). English-German bilinguals seem to be

able to access and make use of their L1 syntactic representations, activated due to primes, when processing the German object RCs (Kidd, Tennant et al., 2015).

It has become apparent that the languages of multilingual speakers interact in language comprehension processes. Similar to L1 > L2 transfer of linguistic cues used in sentence comprehension, cross-language priming effects may also be interpreted as an indication of cross-language interactions. Despite the limited amount of research in this area, especially with regard to cross-language priming in comprehension, there has been evidence for structural priming effects in language comprehension for bilingual speakers, both in the direction of L1 > L2 (Kidd, Tennant et al., 2015) as well as L2 > L2 (Nitschke et al., 2010). As was already briefly touched upon, the findings by Nitschke et al. (2010) indicated that priming effects in language comprehension can be long-lasting, remaining observable even after primes are no longer presented. The duration of priming effects is something that has been studied quite extensively, and which will be discussed in the following subsection (section 2.3).

### **2.3 Sustained Priming Effects**

Structural priming effects appear to have a quality allowing them to be sustained effects, rather than simply short-lived effects that can only be found within prime-target pairs. Priming effects have been found to last throughout entire experiments (see e.g., Jackson & Hopp, 2020; Nitschke et al., 2010) or even for longer periods than that (see e.g., Heyselaar & Segaert, 2021; Luka & Choi, 2012). Exposure to primes may have long-term consequences, and it has been suggested that such long-term consequences are related to implicit learning (see e.g., Chang et al., 2006). In this subsection, several studies are discussed that found (different types of) long-term priming effects. Furthermore it is discussed how long-term and cumulative priming effects might be related to implicit learning and even language change.

Especially studies on structural priming in monolingual contexts have demonstrated that exposure to primes can have durable consequences, extending even further than a single

experimental session. This was found, for example, by Luka and Choi (2012), who conducted several experiments in which native speakers of English were primed during a reading task, after which they rated the grammaticality of sentences ranging from fully grammatical to moderately grammatical. Some of these items were identical to the ones read during the reading task, other items had similar syntactic structures but different content words, and finally there were some new sentences. In one of the experiments, participants came back two days after the first task to do another grammaticality rating task. In another experiment, they came back seven days after the first task. For both groups, the priming effects were still observable in the responses to the second task: items that were identical or structurally similar to the primes encountered during the reading phase were evaluated significantly more positively than novel items, even two or seven days after being exposed to these primes. Thus, recent language exposure can have long-lasting effects and may even lead to re-evaluations of the perceived grammaticality of syntactic representations (Luka & Choi, 2012).

Similar long-term priming effects in monolingual context were found by Heyselaar and Segaert (2021). They demonstrated that the use of passive sentence structures of older and younger adult monolingual English speakers increased after being primed with passive constructions. For older adults, this priming effect was still observable one week after the priming phase, and for young adults, it was even robust four weeks after the priming phase. Although both these studies have indicated that, within monolingual contexts, syntactic priming can have durable effects extending over a period of at least multiple days (Heyselaar & Segaert, 2021; Luka & Choi, 2012), a different type of long-term priming has been found in bilingual contexts.

Studies on long-term priming effects in bilingual contexts, and especially in cross-language structural priming contexts, have generally not been as conclusive as studies on long-term priming effects in monolingual speakers. Although, Nitschke et al. (2010) found that

within language priming effects for L2 speakers of German and Italian spilled over from the priming phase to a subsequent phase, as was discussed earlier in section 2.2, Jackson and Hopp (2020) found sustained priming effects for L1 speakers only. Jackson and Hopp (2020) conducted a study in which L1 speakers of German, L1 speakers of English and German-English bilinguals were primed with adverb-first word order structures. Before primes were presented to the participants, they first did a picture description task measuring the baseline usage of fronted-adverb word order structures. In the priming phase, the German L1 speakers were primed with German structures (i.e., L1 > L1 priming) and the English L1 speakers and the German-English bilinguals were primed with English structures (i.e., L1 > L1 priming and L2 > L2 priming, respectively). A third phase was added in order to investigate long-term priming effect, which was done by means of comparing the production of adverb-fronted word order structures from the baseline phase to the production during the post-test phase. Although short-term priming effects (i.e., priming effects in the priming phase) were found for all participant groups, long-term priming effects were only observed in the L1 speakers of German and English.

On the contrary, Kootstra and Doedens (2016) did find long-term, or cumulative, priming effects for Dutch-English bilinguals. Their experiment consisted of two phases and during the first phase of the experiment, half of the participants were presented with English PO and DO primes while describing dative events in Dutch, and the other half was presented with Dutch primes describing dative events in English. During the second part of the experiment, the participants switched tasks (i.e., the participants who were presented with English primes in part one, were presented with Dutch primes in the second part, and vice versa). Short-term priming effects were investigated by looking at the influence of primes on syntactic choices during each of the two parts of the experiment, whereas long-term priming effects were investigated by means of looking at the effect of the order of the experimental

blocks and whether the priming effect of the first block remained present. Short-term priming effects were found both after English (i.e.,  $L2 > L1$ ) and Dutch ( $L1 > L2$ ) primes. Long-term priming effects were also found: the production of Dutch targets during the first phase, influenced the production of English targets during the second phase, but not the other way around. Thus, in addition to short-term priming effects, there were also cumulative  $L1 > L2$  priming effects, suggested to stem from language users adapting “their language processing preferences on the basis of their ongoing experience” (Kootstra & Doedens, 2016, p. 712). These results, therefore, suggest that long-term priming may also occur for L2 speakers and in a cross-language contexts.

It should be noted, however, that these studies on long-term priming effects in bilingual contexts have investigated a different type of sustained priming. Whereas the studies on monolinguals by Luka and Choi (2012) and Heyselaar and Segaert (2021) considered long-term priming over multiple experimental sessions, these studies with bilingual participants by Nitschke et al. (2010), Jackson and Hopp (2020) and Kootstra and Doedens (2016) considered long-term priming within a single experimental session. Nevertheless, both these types of long-term or sustained priming effects have been related to the idea of implicit learning.

Chang et al. (2006) have hypothesised that, rather than simply activating syntactic representations, structural priming might lead to constant (re-)evaluations of structural representations. These ongoing adaptations of syntactic representations reflect implicit learning processes. This link between priming and implicit learning is also explained by the p-chain framework by Dell and Chang (2014). This framework suggests that language processes, such as, production, comprehension, priming, implicit learning and predictions, are all interrelated. An important idea of this framework is related to previous language experience, which language speakers constantly use to make predictions about how their language or languages works. When language users are subsequently exposed to a particular structure (and this works

particularly well for unexpected structures), then this leads to increased expectations for that particular structure, simultaneously affecting language production because production and prediction are also related. Thus, new language experiences and syntactic priming may have profound consequences for people's syntactic representations. It has also been suggested that these consequences may even result in language change.

If syntactic primes can have sustained and cumulative effects on language use, then it could be the case that frequency distributions of linguistic structures are influenced by this. Kootstra and Doedens (2016) specified that cross-language structural priming effects could then have the potential “to lead to contact-induced language change” (p. 727). This is supported by Kootstra and Şahin (2018), who indeed suggested that cross-language syntactic priming in real-life language use may be one of the mechanisms involved in contact-induced language change. Their study found differences between how Papiamentu-Dutch bilinguals living in Aruba and the Netherlands use PO and DO structures in Papiamentu. In Dutch, both PO and DO structures are used for describing dative events, whereas in Papiamentu there is a strong preference for using DO structures over PO structures. However, when describing dative events in Papiamentu, bilinguals based in the Netherlands used PO structures significantly more often than bilinguals living in Aruba. It has been suggested that these differences in PO structure usage between the two groups of Papiamentu-Dutch bilinguals are caused by increased exposure to Dutch for the bilinguals living in the Netherlands. Since Dutch plays a more dominant role in the daily lives of these participants, they encounter PO structures on a more frequent basis. This exposure potentially led to contact-induced language change in the syntactic representations of Papiamentu-Dutch bilinguals living in the Netherlands, demonstrating how real-life discourse can lead to cross-language structural priming effects (Kootstra. & Şahin, 2018).

Structural priming effects, therefore, seem to have long-term consequences, leading to

adjustments in syntactic representations and sometimes even language change. Syntactic priming effects have been found to spill over from one experimental phase to the next (see e.g., Kootstra & Doedens, 2016; Nitschke et al., 2010), to subsequent experimental sessions with longer periods of time intervening (see e.g., Luka & Choi, 2012), and in real-life language processing outside experimental settings (Kootstra & Şahin, 2018). Furthermore, the sustained characteristics of the effect may be explained in terms of implicit learning and adjustments made in the syntactic representations of language users (Chang et al., 2006). Finally, this subsection has demonstrated, albeit somewhat different types of effects, that long-term priming effects can be found in different contexts: both in L1 speakers and L2 speakers, both for within and between language priming, and both in language production and comprehension.

## **2.4 Role of Proficiency**

Thus far, it has become clear that structural priming effects can be found in language production and comprehension, that the effects may take place cross-linguistically, and that priming effects can be long-lasting and might even be related to implicit learning. As was discussed in section 2.1, the shared-syntax model predicts that, if syntactic representations of languages are similar, bilinguals may share these representations (Hartsuiker et al., 2004). In their review of this shared-syntax model, Hartsuiker and Pickering (2008) indicated that language proficiency should not affect cross-linguistic influences, as long as speakers have learnt this particular L2 structures. Therefore, it is predicted that cross-language priming effects should not be different for high or low proficient bilinguals. With regard to semantic priming, Zhao et al. (2011) found that higher proficiency, in addition to more language experience, led to stronger priming effects. Participants who scored lower on proficiency only demonstrated priming effects in the direction  $L1 > L2$ , whereas the effects for high proficient L2 speakers were stronger and found for both  $L1 > L2$  priming and  $L2 > L1$  priming. For cross-language structural priming, such interactions have also been found, as was briefly mentioned in

subsection 2.1 (see, e.g., Bernolet et al., 2013). This subsection focusses on studies that have investigated the role of L2 proficiency and how this factor might interact with cross-language structural priming effects.

Kim and McDonough (2008) conducted a study in which a group of Korean-English bilinguals was divided into three smaller groups varying in L2 proficiency. During the experiment, the participants described pictures in English, while English passive structures were used as primes. The low proficiency group rarely used passive structures in their descriptions when there was no lexical overlap between the verbs used for the prime and target pictures, whereas the middle and high proficient groups produced passive structure much more consistently, irrespective of lexical overlap within prime-target pairs. Thus, whereas low proficient L2 speakers required lexical overlap for structural priming to take place, more proficient L2 speakers demonstrated priming effects in all conditions (Kim & McDonough, 2008).

Kootstra et al., (2012) investigated a type of syntactic priming that is slightly different from the types of syntactic priming that have been discussed so far. This study investigated the role of language proficiency for priming in code-switching. Two experiments were conducted in which Dutch-English bilinguals described pictures after being presented with primes. The participants of the first experiment were beginning L2 learners, whereas the participants in the second experiment were more advanced and experienced L2 learners. During both experiments, the critical items contained code-switches. In some cases, there was also lexical repetition between words in the prime and target items. Additionally, some of the critical items contained cognates, which are words that overlap in form between two languages (e.g., the Dutch and English word *water*). The study investigated whether participants would produce a code-switch in the target item at the same position of the code-switch of the prime item. For low proficient L2 speakers, they found a priming effect which interacted with lexical repetition,



meaning that there was a stronger priming effect when the object of the prime and target overlapped semantically. The effect of cognates, however, was only marginally significant for the low proficient L2 speakers, leading to a slight increase in code-switches at the same position as the prime. For the high-proficient L2 speakers, they also found a significant effect of lexical repetition, as well as a stronger effect for cognates. Thus, although there was a priming effect for code-switching in both high and low proficient L2 speakers, the effects of semantic overlap and the use of cognates were larger for high proficient, as opposed to low proficient, bilinguals (Kootstra et al., 2012).

A final study on the interaction between priming and L2 proficiency described in this section, is the beforementioned study by Bernolet et al. (2013). They investigated whether syntactic representations become shared right away or whether syntactic integration depends on L2 proficiency. Both within language (L2 > L2) and between language (L1 > L2) priming effects were considered using English genitive *s*-structures and *of*-structures (e.g., “*the nun’s egg*” and “*the egg of the nun*”, respectively) and Dutch equivalents of these structure (Bernolet et al., 2013, p. 290). They hypothesised that if bilinguals start out with separate grammatical representations for each language, between language priming effects should be stronger for high proficient bilinguals than for low proficient bilinguals. However, if syntactic representations are shared right away, between language priming effects should be found irrespective of bilinguals’ L2 proficiency levels. The results indicated a stronger between language priming effects for high proficient L2 speakers than for low proficient L2 speakers. There was barely any sign of cross-language priming on the production of genitives of low proficient participants. For within language priming, the findings were similar to those of Kim and McDonough (2008), in the sense that low proficient L2 speakers particularly seemed to benefit from lexical repetition in prime-target pairs, whereas the priming effect was significantly stronger for high proficient bilinguals when there was no lexical repetition.

Bernolet et al. (2013) interpreted the results as an indication of less proficient participants using separate representations for genitive structures in Dutch and English, since the Dutch primes had no substantial influence on the production of English genitives. For more proficient bilinguals, they suggested that they use single shared representations for both Dutch and English genitives, as there were direct influences of Dutch primes on English targets.

These studies have indicated that L2 proficiency indeed seems to play a role in how priming effects are manifested. Such interactions have been found in different types of language priming. Studies generally suggested a link between higher L2 proficiency and stronger priming effects (see e.g., Bernolet et al., 2013; Kim & McDonough, 2008). Furthermore, as was indicated by Bernolet et al. (2013), between and within language priming effects only seem to be equally strong for high proficient L2 speakers. Whereas, according to Pickering and Hartsuiker (2008), the shared-syntax model predicts that, as soon as L2 speakers acquire syntactic representations, the representations are immediately shared, the process of representations becoming shared may actually be a bit more gradual. Bernolet et al. (2013) have proposed that there might be a shift from separate representations to shared representations, which develops as L2 proficiency increases. Nevertheless, previous research has indicated that L2 proficiency and priming effects may interact, and suggest a link between higher L2 proficiency and stronger priming effects, especially in the case of cross-language priming.

### 3. Present study

The previous section reviewed a selection of the abundance of research that has been done on language priming. It has become clear that structural priming may take place across languages, thereby indicating cross-language interactions between the languages of multilingual speakers. For instance, studies on structural priming in language production have demonstrated that priming syntactic structures in one language may lead to an increase in the production of a similar syntactic structure in another language (see e.g., Hartsuiker et al., 2004; Loebell & Bock, 2003; Kantola & van Gompel, 2011). Such findings have been interpreted as an indication of shared syntactic representations, suggesting that bilinguals use only one syntactic representation for processing particular syntactic structures in both languages, given that these structures are similar in both languages and that language learners have acquired them (Hartsuiker et al., 2004). Shared representations, therefore, seem to lead to cross-language influences in language production. Although Loebell and Bock (2003) found that the priming effect of the L1 on the L2 was stronger than vice versa, Kantola and van Gompel (2011) found that cross-language influences from the L1 on the L2 were of a similar magnitude as the influence from the L2 on the L1. Even though the results of these studies seem to be somewhat inconsistent, it does seem to be possible, at least in language production, for the L2 to influence processes involved in L1 production. However, this has not yet been studied for priming in language comprehension.

In studies on the area of syntactic priming in language comprehension, priming effects have been found for monolinguals (see e.g., Branigan et al., 2005) and bilinguals (see e.g., Nitschke et al., 2010). These studies have indicated that, in addition to the production of particular syntactic structures, it is also possible to prime the interpretation of syntactic structures during the process of language comprehension. Cross-language interactions have also been found for priming in language comprehension, but only in the direction where the L1

was priming the L2 (see e.g., Kidd, Tennant et al., 2015). Since  $L2 > L1$  priming effects have been found in language production, it might also be possible to find such priming effects in language comprehension. However, this priming directionality has not yet been studied and it remains to be seen whether L2 to L1 priming may also occur in language comprehension. If so, this would suggest that there are further resemblances between priming in language production and comprehension, supporting the idea that the shared-syntax model may also account for priming effects language comprehension, as was suggested by Kidd, Tennant et al. (2015).

Similar to how the  $L2 > L1$  priming directionality in language comprehension has not yet been studied, long-term priming effects in this direction also have not received much attention in previous research. Long-term priming effects have been studied in monolingual contexts, demonstrating priming effects lasting several days or even weeks (Heyselaar & Segaert, 2021; Luka & Choi, 2012). Long-term priming effects have also been found in bilingual contexts, only limited to sustained effects within a single experimental session. Such effects have been found for within language priming (Nitschke et al., 2010) and between language priming in the direction of  $L1 > L2$  (see e.g., Jackson & Hopp, 2020; Kootstra & Doedens, 2016). Long-term syntactic priming effects have been related to implicit learning processes. Language learners seem to adjust their representations based on new experiences in that language (Chang et al., 2006). Incremental adjustments and adaptations to such representations and language systems potentially lead language change, and this process may even occur cross-linguistically as was proposed by Kootstra and Şahin (2018), who suggested that exposure to Dutch, the dominant language, influenced real-life production, outside experimental settings, of particular syntactic structures in the less dominant language. Whether less-dominant languages may also elicit long-term priming effects has not yet been studied.

However, Pavlenko (2000) provided an overview of studies on L2 influences,

indicating that the L2 has the potential to influence the L1 in various different linguistic areas, such as phonology, lexicon and morphosyntax. Also related to the earlier mentioned competition model, it was found that the language cues used for sentence interpretation by Japanese speakers changed as a consequence of learning English (Cook, 1999, as cited in Pavlenko, 2000). Since the L2 has been shown to influence L1 language comprehension in language transfer context, it may also be interesting to investigate whether the L2 may influence the L1 in syntactic priming in language comprehension, considering the overlap in what is usually done in studies on priming in comprehension and what linguistic cue are used for, namely the processing of the interpretation of structures.

Finally, some of the studies on cross-language priming discussed in the previous section have suggested that L2 proficiency might play a role in syntactic priming. It has been demonstrated that there were differences between how priming effects were manifested for high and low proficient L2 speakers (see e.g., Bernolet et al., 2013; Kim & McDonough, 2008; Kootstra et al., 2012). Priming effects generally seem to be stronger for those bilinguals with a high L2 proficiency than for bilinguals with a low L2 proficiency. However, whether such an interaction may also occur in L2 > L1 priming has not yet been studied.

Previous research on cross-language structural priming has been informative on the nature of the priming effect and the different contexts in which the effects have been found. However, it has become clear that many questions remain unanswered. Especially the influence of the less dominant language, generally the L2, on the dominant language, generally the L1, has not been studied much. The L2 > L1 priming directionality has been considered by several studies on language production (see e.g., Kantola & van Gompel, 2011; Kootstra & Doedens, 2016; Loebell & Bock, 2003), but not in language comprehension. Similarly, studies investigating long-term priming effects have not yet addressed the L2 > L1 priming directionality. Finally, the interaction between L2 > L1 priming effects and L2 proficiency has

also not been investigated. The present study addresses these research gaps by means of investigating how L2 priming may influence L1 comprehension and whether or not long-term priming effects and interactions with L2 proficiency may be found for cross-language priming in this directionality.

Before delving into the method used to investigate the research questions, it is important to briefly explain the type of syntactic structures used for the present study, namely unambiguous English and ambiguous Dutch RC structures. Similar to the studies by Nitschke et al. (2010) and Kidd, Tennant et al. (2015), it was investigated whether the interpretation of ambiguous RC structures could be primed. Only in the present study, ambiguous Dutch structures were used, as opposed to Italian and German structures. Dutch structurally ambiguous RC sentences, such as (3), were used, which share word order overlap with unambiguous English RC structures, such as (4).

(3) Waar is de kat<sub>[subject/object]</sub> die de hond kust<sub>[subject/object]</sub>?

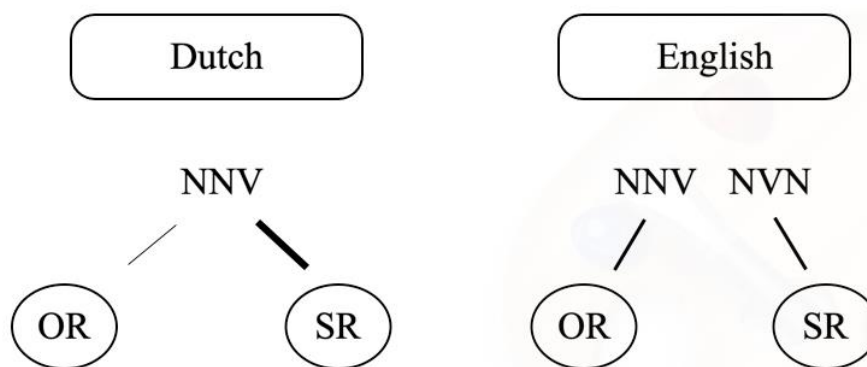
Where is the cat<sub>[subject/object]</sub> that the dog kisses<sub>[subject/object]</sub>?

(4) Where is the elephant <sub>[object]</sub> that the dog <sub>[subject]</sub> hugs?

(5) Where is the elephant <sub>[subject]</sub> that kisses the dog<sub>[object]</sub>?

**Figure 1**

*Illustration of RC Word Order Interpretation Differences Between Dutch and English*



These unambiguous English and ambiguous Dutch NNV (i.e., noun-noun-verb) word orders in RC structures generally lead to different interpretations (see Figure 1). In English NNV RC structures, the first noun is always interpreted as the object of the sentence. Thus, word order constraints make sure that this particular word order leads to an object RC interpretation, or an object reading (OR). The first noun of an RC structure can only be interpreted as the subject of the sentence when the word order is NVN, for example, as in (5). Thus, a NVN word order leads to subject RC interpretations, or subject reading (SR). In Dutch, however, the first noun in RC structures can be interpreted as both the object and the subject of the sentence, though there is generally a preference for the SR. In Figure 1, this preference for the SR in Dutch is illustrated by a thicker line between NNV and the SR, as this connection is stronger.

The present study used unambiguous English NNV RC structures to test whether the less-preferred object RC interpretation in Dutch was prone to syntactic priming. The primes were, therefore, in the L2 of the Dutch-English bilinguals, whereas the targets were ambiguous Dutch RC structures, thus in the L1 of the participants. By means of first establishing the natural interpretation preference, it was possible to subsequently investigate whether it was possible to influence (i.e., prime) the syntactic choice made during the ambiguity resolution in Dutch. Furthermore it could be tested whether this priming effect was long-lasting, by adding a post-test phase, similar to Jackson and Hopp (2020) and Nitschke et al. (2010), to investigate whether the priming effect would still be observable after primes were no longer presented to the participants.

It was predicted that there would also be a priming effect in syntactic comprehension with the direction of  $L2 > L1$ , since that was also found in language production in studies by Kantola and van Gompel (2011) and Loebell and Bock (2003). Thus, the weaker, less dominant language, was predicted to have an influence on the more dominant and entrenched language. Additionally, it was predicted that this  $L2 > L1$  priming effect would be long-term, sustaining

through the third phase of the experiment. This prediction was based on Pavlenko's (2000) proposal that L1 representations are more flexible than is generally thought. Since L2 linguistic cues for interpreting sentences were transferred onto L1 comprehension processes for Japanese speakers, as was discussed earlier (Cook, 1999, as cited in Pavlenko, 2000), it seemed plausible that within cross-language interactions, L2 primes may also have a sustained influence on the L1 representations. With regards to proficiency, it was predicted that more proficient L2 speakers would demonstrate a stronger priming effect, as earlier findings by Bernolet et al. (2013) and Kim and McDonough (2008) suggested that in cross-language priming, the priming effects are usually more robust for more proficient L2 speakers.



## 4. Method

This thesis aimed to find out whether there is a cross-linguistic syntactic priming effect in language comprehension where the second language (L2) influences first language (L1) comprehension of native Dutch speakers of English, or Dutch-English bilinguals. It also aimed to investigate whether or not this priming effect would be long-lasting, thereby being able to persist after primes are no longer presented. Finally, this study wanted to find out how L2 proficiency interacts with the strength of the priming effect. In order to answer these research questions, an experiment was conducted consisting of a picture selection task using relative clause (RC) structures. Unambiguous English prime structures were used in an attempt to elicit certain interpretations for ambiguous Dutch target structures. The choice that participants made between two pictures accompanying an ambiguous question, was linked to a certain interpretation. These choices were subsequently analysed in order to determine whether or not the English interpretations had primed Dutch comprehension of ambiguous structures.

### 4.1 Participants

A total number of 45 (29 women) native speakers of Dutch participated in this study. Although the instructions were clear about requiring English to be the second language of all participants, there were several people who indicated that English was not their second language. Therefore, the data were analysed twice: once including all participants and once excluding a selection of five participants, who either had another L2 than English or who seemed to be aware of the aim of the study. The participants were between the age of 18 to 68 ( $M = 30.56$ ,  $SD = 14.31$ ). Based on the results of a L2 proficiency task, the L2 proficiency of the participants in this study was estimated to range between B1 and C2 level.

The LexTALE test was used to make this estimation of the participants' L2 proficiency (Lemhöfer & Broersma, 2012). This test is a relatively short visual lexical decision task designed as an objective way of measuring lexical knowledge of learners of English. Scores on

this task have been shown to correlate with more extensive English proficiency tests. For the current experiment, the LexTALE was chosen as a means for measuring proficiency, rather than asking the participants to rate their own proficiency, due to its objectivity and because Lemhöfer and Broersma (2012) had found that, especially when a participant sample is “heterogeneous in terms of L2 proficiency and possibly L1 background”, the LexTALE task is generally more reliable than self-ratings (p. 338). The LexTALE task included a total of sixty items, forty of which were existing English words, and the remaining twenty items were pseudowords. The existing words in the task were rather low in frequency, meaning that for many participants the existing words are potentially subjective nonwords. Furthermore, the task’s words were from various syntactic classes, and the nonwords resembled actual words. No changes were made from the original LexTALE task in the use and order of the items that were presented. The scores from the participants of this study on the LexTALE task ranged from 55% to 100%, with an average of 79.61% ( $SD = 13.07\%$ ). Lemhöfer and Broersma (2012) predicted LexTALE scores from 80% to 100% to be related to a CEF level of C1 or C2, meaning that people with these scores are advanced learners. Scores ranging from 60% to 80% were presumed to be linked to upper intermediate B2 level learners. Finally, scores below 59% were predicted for learners of the CEF B1 level and lower. Following the same logic, 24 participants scored within range of C1-C2 level, and 21 participants at range of B1-B2 level.

## 4.2 Materials

For the purpose of this study, an online language experiment was constructed using ROLEG, an application from the Radboud University in Nijmegen that allows researchers to create and run linguistic experiments. This online language experiment contained both the picture selection task and the LexTALE task, but since the latter task and its results have already been discussed in the section on *participants* mentioned above, only the materials used for the picture selection task are discussed below.

The picture selection task of the current experiment took an approach similar to that of Nitschke et al. (2010) and Kidd, Tennant et al. (2015). Participants were presented with 76 trials, each trial consisting of a question sentences and two pictures. The pictures used for this task were based on Kidd, Chan et al. (2015), and retrieved from a picture database provided by Gerrit Jan Kootstra. The picture selection task was divided into three phases, and each phase contained RC structures as experimental items as well as filler items. The first and third phase of the experiment (i.e., the pre-test and post-test, respectively) were similar, and consisted of the same amount of critical items, namely six ambiguous Dutch RC question sentences, such as (6).

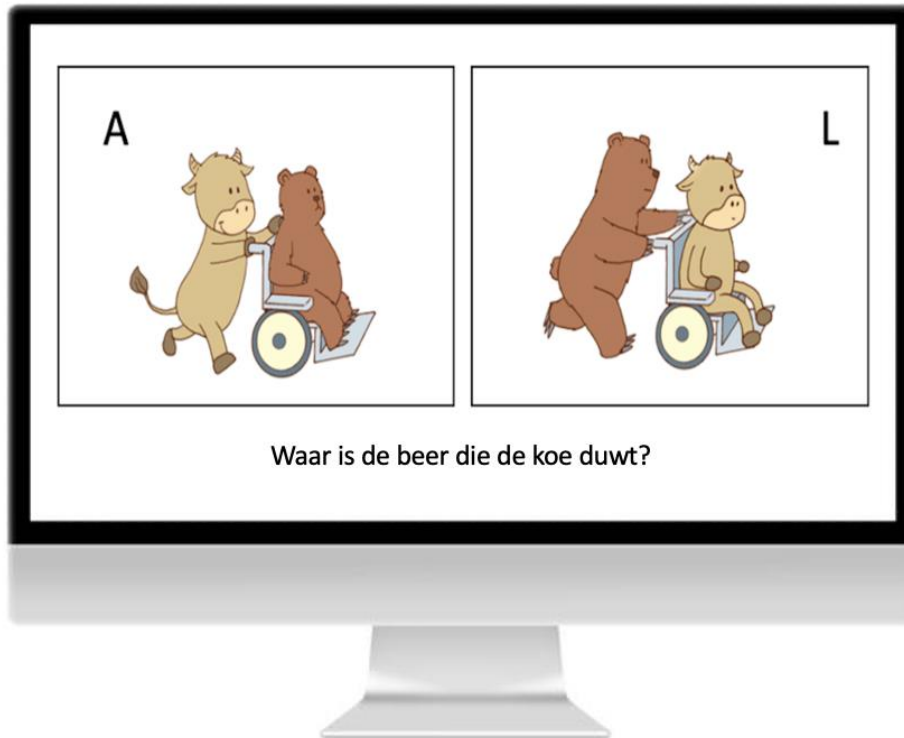
(6) Waar is de beer<sub>[subject/object]</sub> die de koe duwt<sub>[subject/object]</sub>?

Where is the bear<sub>[subject/object]</sub> that the cow pushes<sub>[subject/object]</sub>?

For every trial in which participants were presented with ambiguous Dutch RC structures, the two picture options each depicted one of the two possible sentence interpretations, as can be seen in Figure 2. In this particular example, the picture on the left depicts or the object RC interpretation. In this picture, the second character in the RC (i.e., the cow) is the subject and actor of the sentence, whereas the first character in the RC (i.e., the bear) is the object and patient of the sentence. The picture on the right depicts the subject RC interpretation. For the subject RC interpretation, the first character of sentence (i.e., the bear) is the subject and actor, and the second character (i.e., the cow) is the object and patient. In the second phase of the experiment (i.e., the priming phase), similar type of target items were used, namely eight ambiguous Dutch RC question sentences. Only during this phase, these Dutch target items were

**Figure 2**

*Dutch Target Item with Object RC Interpretation (Left) and Subject RC Interpretation (Right)*



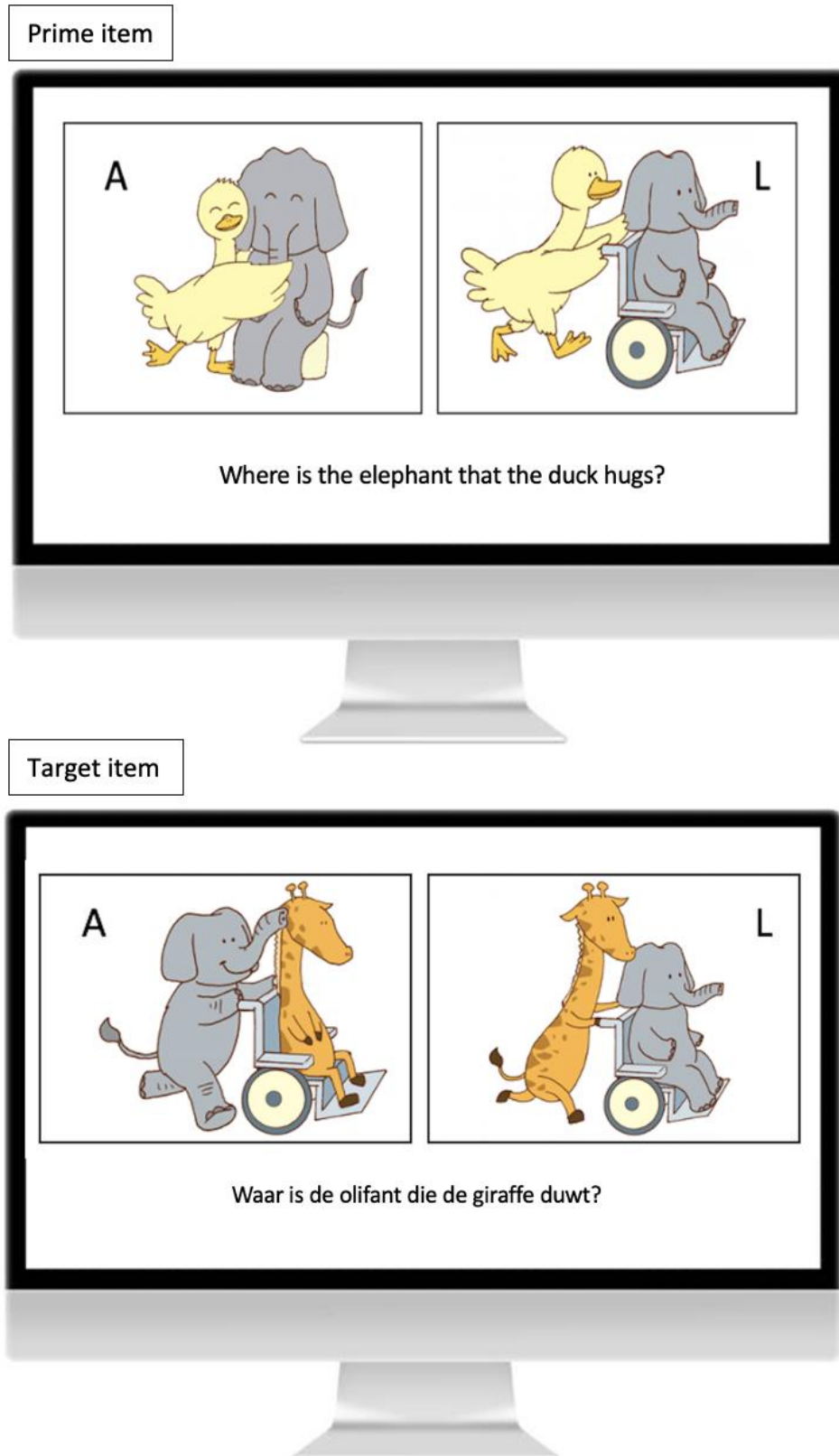
immediately preceded by primes: unambiguous English RC question sentences, such as (7). Thus, there were eight prime-target pairs, such as the example in Figure 3.

(7) Where is the elephant <sub>[object]</sub> that the duck <sub>[subject]</sub> hugs?

It was the case for all of the English prime items, as can also be seen in Figure 3 with the picture on the left, that the only picture matching the question sentence depicted the object RC interpretation. In this picture on the left, the second character in the RC structure (i.e., the duck) is the subject and actor of the sentence, whereas the first character in the RC structure (i.e., the elephant) is the object and patient. In the other picture, on the right side in Figure 3, the same animal characters were used, but performing a different action (albeit also with the second noun of the RC structure as the acting character). In total, for the three phases of the experiment combined, there were twenty critical ambiguous Dutch RC items. A selection of seven different animal characters and four transitive verbs were used for constructing the

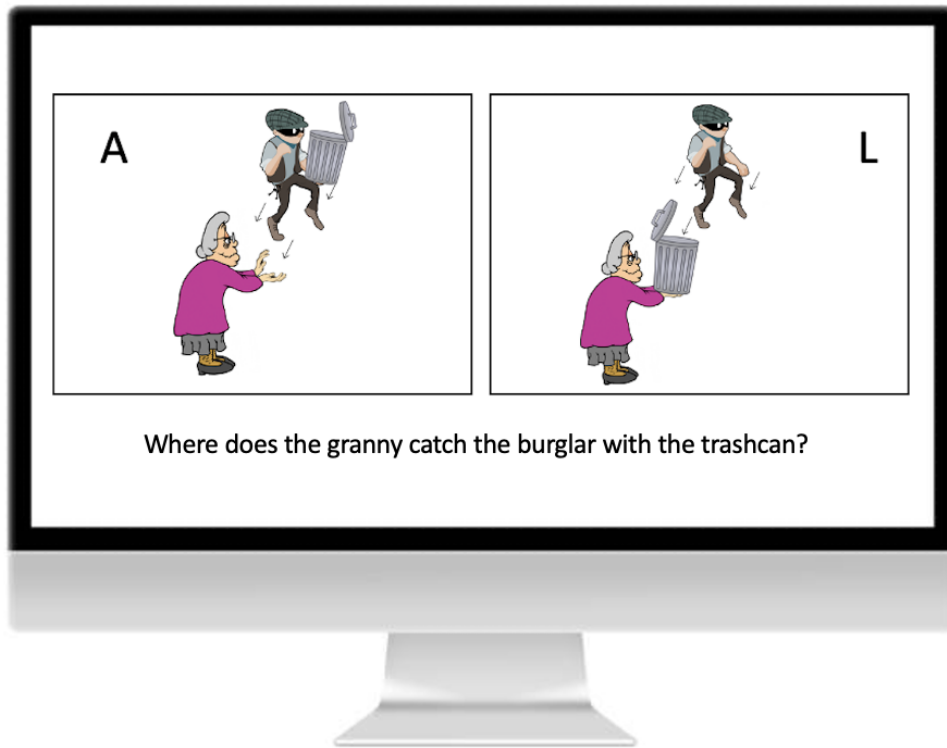
**Figure 3**

*Prime-Target Pair with Ambiguous English Prime and Unambiguous Dutch Target*

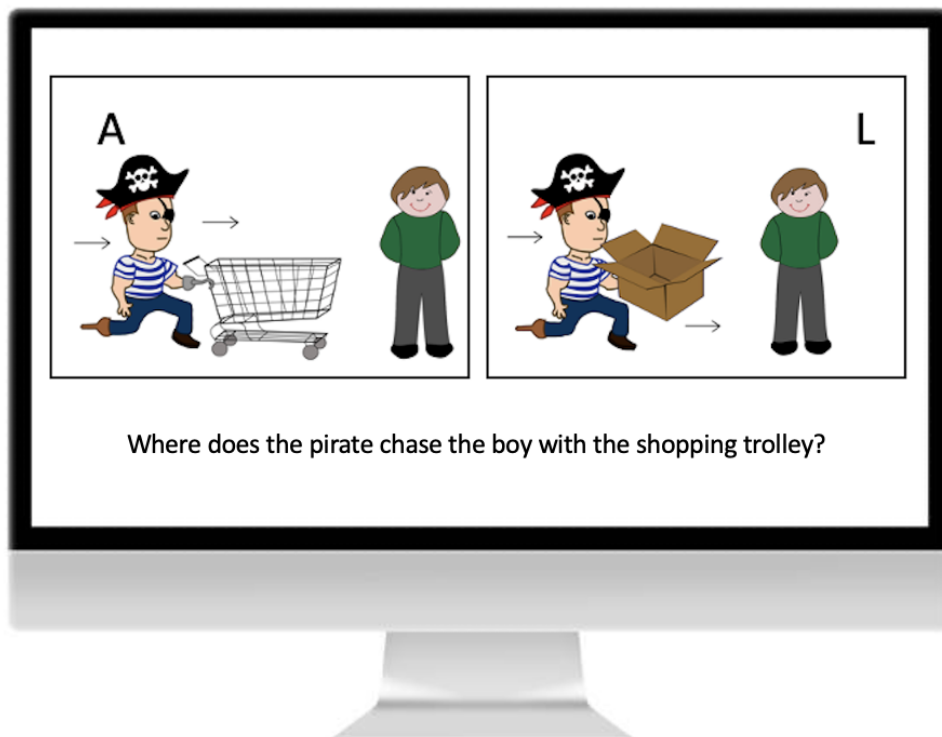


**Figure 4**

*Example of Ambiguous Prepositional Phrase Filler*

**Figure 5**

*Example of Prepositional Phrase Filler with One Matching Picture (Left)*



experimental items. It was made sure that within each prime-target pair four different animal characters (i.e., two characters for the prime item and two for the target item) and two different transitive verbs were used. This way, the potential priming effects were more likely to be syntactic rather than lexico-semantic. This refers to the idea that priming effects were not caused by semantic overlap and choosing, for example, the picture with the same animal as was presented in the preceding trial.

In addition to the experimental items, the picture selection task also contained 48 filler items. Half of the filler items were question sentences with prepositional phrases, such as (8), similar to the structures used in Branigan et al. (2005). Some of those fillers were ambiguous in the sense that it was unclear whether there was high or low prepositional phrase attachment. This ambiguity is illustrated in Figure 4, where it can be seen that both the burglar may be the one holding the trashcan (left picture) or the granny (right picture). In other trials with filler items with prepositional phrases, such as the one presented in Figure 5, the sentence itself was ambiguous, but only one of the picture choices portrayed a correct interpretation. In case of the example of Figure 5, only the left picture can be correct as this is the only picture displaying both the pirate and the boy, as well as the shopping trolley. Along with the items with prepositional phrases, the remaining half of the filler items were simple intransitive structures, such as (9). For these intransitive structures, there was always only one correct picture option, as is demonstrated in Figure 6. In this figure, only the picture on the right is correct as it contains the smiling snake. The filler items were used to distract participants from the purpose of the experiment and keep their attention away from the ongoing priming manipulation. Some fillers were ambiguous in order to draw attention to this ambiguity as opposed to the ambiguity of the critical items. Additionally, for the items without ambiguity, as well as the English primes during the second phase of the experiment, there was only one picture of the pair that matched the question sentence. Therefore, these items also fulfilled the purpose of checking whether

participants were paying attention to the trials of the task.

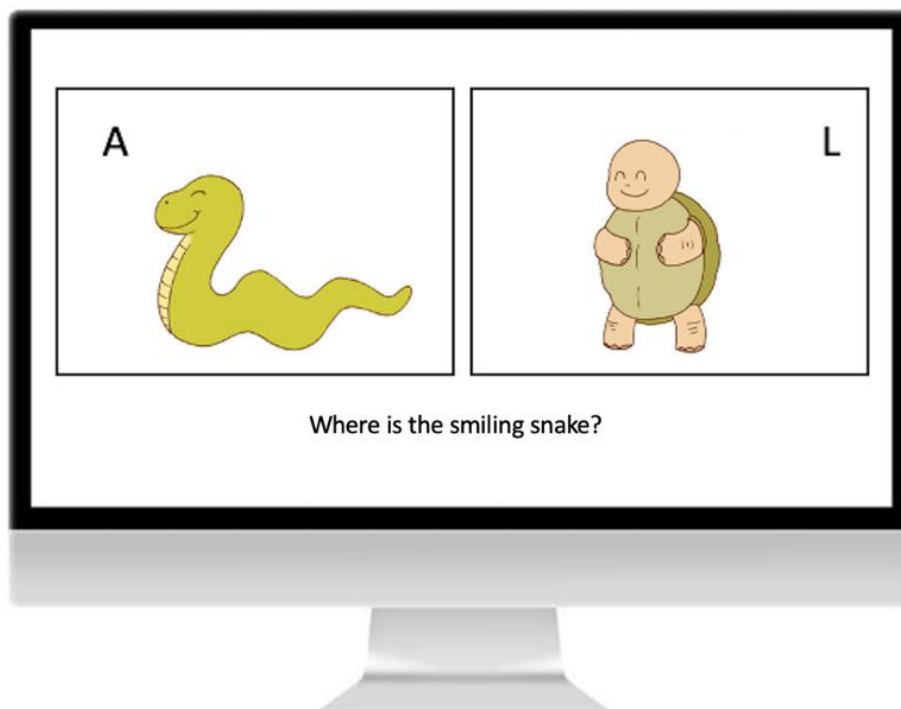
(8) Where does the granny catch the burglar with the trashcan?

(9) Where is the smiling snake?

As was mentioned before, the picture selection task consisted of three phases. The first phase, the pre-test or baseline phase, was used to measure participants' baseline preference for the critical trials, namely the ambiguous Dutch RC question structures. Thus, it was measured how often participants naturally interpret ambiguous Dutch RC structures as subject RC interpretations or object RC interpretations. During this phase, no unambiguous English primes were presented, but only ambiguous Dutch target sentences. This way, it could be determined what the natural preference for interpreting such ambiguous RC structures was for the participants, without there having been any manipulations due to priming. The pre-test phase consisted of six critical target structures, six intransitive filler sentences and six preposition phrase filler sentences. The second phase of the picture selection task was the priming phase.

### Figure 6

*Example of Intransitive Structure Filler with One Matching Picture (Left)*





As was mentioned earlier, the ambiguous Dutch RC structures were immediately preceded by unambiguous English RC structures. These English items functioned as primes, in an attempt to influence the choices made for Dutch ambiguous targets. This priming phase was used to investigate whether or not English primes with object RC interpretations would lead to an increase in object RC interpretations for Dutch ambiguous targets. Thus, the priming phase tested whether the English (L2) primes had a cross-language priming effect on the Dutch (L1) responses. A total of eight prime-target pairs was used (i.e., eight English primes and eight Dutch targets), in addition to twelve prepositional phrase filler items and twelve intransitive filler items. The third phase of the picture selection task was similar to the pre-test phase, and was used to measure whether the interpretation preferences for ambiguous Dutch RC structures had shifted or changed with respect to the initial preference before any priming had potentially taken place. Thus, again only ambiguous Dutch RC structures were used, without unambiguous English primes. This way, the potential long-term priming effect could be studied, because it would indicate whether the priming effect would sustain after primes were no longer presented. It is also important to note that the LexTALE task was positioned in between the second and third phase of the picture selection task. This allowed for some extra time between the priming and post-test phase, in order to see if the potential short-lived priming effects would also remain present if the participants had, in the meantime, concentrated on a completely different task. The post-test phase of the picture selection task, similar to the pre-test phase, consisted of six critical Dutch target structures, and twelve fillers, of which six were intransitive structures and six prepositional phrase structures.

The items of the picture selection task were balanced and consciously arranged in terms of language, position and order. Since all critical items, the twenty ambiguous Dutch RC structures, were Dutch items, there were only eighteen Dutch filler items (i.e., a total of 38 Dutch items), whereas there were thirty English filler items. These thirty fillers, combined with

the eight English primes, led to a total of 38 English items. Thus, half of the total items in the picture selection task were Dutch and half were English. The position of the picture correctly portraying the question sentence for the filler and the prime items was also balanced. Thus, for half of the items, the correct picture was placed on the left side and for the other half it was positioned on the right side. This was also the case for the object and subject RC interpretation of the ambiguous trials. For these critical trials, in half of cases, the object RC interpretation was depicted on the picture on the left side and half of the time on the picture on the right side. Finally, the order of the items was pseudo-randomised, with targets and prime-target pairs never immediately preceding and following each other, but with filler items in between. There were also four different versions of the experiment, in which the items were all similar, but the order of the items within each of the three phases differed. The items that were used for the pre-test phase of two of the four experiment versions were used for the post-test phase of the other two experiment versions, and vice versa. This mixing of the order and experimental blocks was done to avoid any effects being influenced by the order in which the trials were presented. An overview of all the question sentences used in the picture selection task can be found in Appendix I.

### **4.3 Procedure**

All the Dutch-English bilinguals that wanted to participate in the present study were sent an information letter containing the instructions for the experiment and specifying what was expected of them (see appendix II). In this letter, the participants could also find the contact information they could use if they had questions before, during or after the experiment. It was also explained for what purpose the data would be used, and that participants could withdraw from the study at any time. This letter was sent alongside a hyperlink directing the participants to the ROLEG website with the experiment. The instruction letter and most of the further instructions of the experiment were in Dutch, since that was the first language of the

participants. Only the instructions of the LexTALE task were in English, since that part of the experiment was fully in English. Participants were asked to complete the experiment using a computer device. The main reason for this was because ROLEG does not run experiments on other types of devices, but it was also important for the experiment that participants were able to see the pictures clearly and that they could respond using the keys on a computer keyboard.

Before the actual experiment started, the participants were asked to give informed consent. If they gave consent, this would mean that they agreed with what would happen with their responses: that this data would be used for this study, that it would be stored anonymously, and that it may be shared with other researchers. Additionally, through their consent, participants indicated that they were aware that participating in this study was voluntary. After giving consent, participants were asked several questions about their gender, age, first and second language. Subsequently, participants were redirected to the actual experiment and given further instructions on how the actual experiment worked.

The actual experiment was divided into four parts, namely the three phases of the picture selection task and the LexTALE task. The order of these four parts was as followed: first the baseline phase of the picture selection task, then the priming phase of the picture selection task, followed by the LexTALE task, and finally the post-test phase. The instructions explained that there would be four different parts and included information on the type of trials that the participants were going to be presented with, and how they should respond to those trials. It was explained that in three parts of the experiment (i.e., the first, second and fourth), they would be presented with questions and pictures. For each trial, they would see two pictures and a question, either in English or Dutch. It was their task to choose which picture fit best with the question. If the picture on the left matched with this question, they were asked to press the 'A' key on their computer's keyboard. If the picture on the right matched best with the question, they were asked to press the 'L' key. These keys were chosen, because the 'A' is a key on the

far left on a keyboard and the 'L' is a key on the far right. As can be seen in Figures 2-6, for each trial it was repeated on the computer screen which key participants had to press when selecting the picture they wanted to choose. If they pressed any other key on their keyboards, nothing would happen until they eventually pressed either 'A' or 'L'. Participants were additionally informed that it could happen that both pictures accompanying a question were possible options. In such cases, they were advised to follow their intuition. At the beginning of each of the three phases of the picture selection task, the instructions were briefly repeated.

The instructions for the LexTALE task were somewhat different from the picture selection task. First of all, the instructions were in English, because the task itself was fully English. These instructions were taken directly from Lemhöfer and Broersma's (2012) task, with only a minor change in how the responses were given. Participants were presented with lexical items that were either words or non-words. They decided for each item whether they thought it was an existing word or not. Instead of clicking on a 'yes' or 'no' button, as is done in the original LexTALE task, the participants were asked to press the 'Y' on their computer's keyboard when they thought the item was an existing English word, and 'N' when they thought the item was not an existing English word. The ROLEG application required keyboard responses, and although participants suddenly had to make a change in which keys they used, it seemed more appropriate to use the 'Y' and 'N' keys, rather than, for example, the 'A' or 'L', in order to avoid certain associations. It would not have been desirable for participants to associate, for instance, the 'L' key with 'yes' and the 'A' key with 'no', as this might have influenced their choices in the final part of the experiment, the post-test phase.

Immediately after finishing the final part of the experiment, the post-test phase, the participants were redirected to the ROLEG website. They were thanked for participating in the study, and asked to answer a final question. This question was concerned with whether or not the participants had noticed anything particular during the experiment, and if they had any

suspensions as to what the experiment was about. If their answer was yes, they were asked to elaborate on this. This final question was added for the purpose of finding out whether participants were aware of the prime sentences used to influence their interpretations. After answering this question, the experiment was over.

#### **4.4 Design and Analysis**

The experiment of the present study used a within-subject design, in which all participants took part in the same experiment with the same priming condition. The dependent variable was the response to the critical items of the experiment, namely the interpretation of the ambiguous Dutch RC structures. For each trial, there were two options: participants could choose for the subject RC interpretation or the object RC interpretation. Thus, for instance, in (10), which is the same item as the one earlier presented in Figure 2, participants could choose between the cow as actor in the structure (i.e., the one doing the pushing) or the bear. If they opted for the first noun of the structure as actor, (i.e., the bear in this particular example), then this would mean they interpreted the structure as a subject RC. If they selected the picture where the second noun of the structure was performing the action (i.e., the cow in this example), then this would mean they interpreted the structure as an object RC. Thus, the dependent variable of this study was the interpretation (either object or subject RC) of the ambiguous Dutch structures. The independent variable of the experiment was the experimental phase, as this is where the manipulation took place. The picture selection task consisted of three phases: the priming phase where primes were presented to the participants, and the pre-test and post-test phase where primes were not presented. Through using these three separate phases, the influence of English primes on Dutch responses could be measured: first the interpretation of ambiguous structures (object RC or subject RC interpretation) before primes were presented, then the interpretation while primes were presented, and subsequently afterwards when primes were no longer presented.

(10) Waar is de beer die de koe duwt?

Where is the bear that the cow pushes?

Before analysing the data of the experiment, the interpretations of the ambiguous Dutch structures were quantified per participant and per experimental phase. For each participant, the proportion of object RC interpretations per experimental phase was calculated by means of coding object RC responses as ‘1’ and subject RC responses as ‘0’. The mean score to all critical items would then automatically lead to the proportion of object RC interpretations<sup>3</sup>. For instance, if a participant had selected the object RC interpretation zero times in the baseline phase, twice in the experimental phase, and once in the post-test phase, this led to proportional scores 0, 0.25, and 0.167, respectively. The proportion of object RC interpretations for each phase could subsequently be used for the statistical analyses.

Another step that was taken before the data could be analysed was related to the results of the LexTALE scores. The responses to this lexical decision task provided each participant with an L2 proficiency score based on the following calculation:  $((\text{number of words correct}/40*100) + (\text{number of nonwords correct}/20*100))/2$  (Lemhöfer & Broersma, 2012). The participants were divided into two relative proficiency groups using Lemhöfer and Broersma’s (2012) system in which LexTALE scores of 80% up to and including 100% are an indication of advanced language speakers, and scores below 80% indicate intermediate language speakers. Thus, participants who scored 80% or higher were placed in a high proficient group and the participants who scored 79% or lower were placed in a low proficient group. This way, L2 proficiency could be used as between-subjects factor in the analyses,

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<sup>3</sup> Given that participants could only choose between object RC interpretations or subject RC interpretations, this proportion of object RC interpretations is the complement of the proportion of subject RC interpretations.

allowing for a direct comparison between the two groups.

Finally, before the data was analysed, the accuracy scores were calculated. Although the responses to the critical trials were not correct or incorrect, since both object RC interpretation and subject RC interpretation are valid options in Dutch, the responses to prime items and (most of the) filler items were either correct or incorrect. Only the filler items with prepositional phrase attachment ambiguity and two pictures portraying both possible interpretations (see Figure 4) were left out, since both responses were correct for these trials. For trials in which only one of the two pictures corresponded with the question sentence, it was checked whether participants had answered correctly. The percentage of correctly answered responses was taken into account for checking whether participants had paid attention to the task.

The statistical analyses of the data were conducted using JASP software. A repeated measures ANOVA was chosen for two separate analyses. The first analysis included experimental phase as independent variable in order to investigate if there would be significant differences between the three experimental phases. Pre-planned Helmert treatment were used in order to analyse how the three means differed from each other. The Helmert contrast allowed for a two-way comparison. The test first compared the baseline phase to the priming and post-test phase combined. Subsequently, it compared the priming phase to the post-test phase. Through this first comparison, it could be studied whether the primes had had any influence on the interpretations. Through the second comparison, it could be studied whether the priming effect was long term. Post hoc analyses (using Holm correction to control  $p$ ) were also conducted in order to confirm the findings. The second analysis was similar to the first, only adding L2 proficiency as independent variable, in addition to experimental phase. Through adding this variable as between-subject factor, the potential interaction between L2 proficiency and the priming effect could be studied.

It was predicted that there would be significant differences between these phases, thereby rejecting the null hypothesis that the means for the three phases would be similar. More specifically, it was predicted that the mean proportion of object RC interpretations would be higher in the second and third phase, than it would be in the first phase of the experiment. If there would be a significant difference between the means of the pre-test phase and the two subsequent phases, then this would be an indication of a priming effect. The difference between the means would be a consequence of the primes presented during the second phase. Furthermore, if there were no significant difference between the priming phase and the post-test phase, then this priming effect would potentially be a long-term effect. The absence of a significant difference between the priming and post-test phase would suggest that this priming effect was sustained. Finally, it was predicted that there would be significant differences between the two proficiency groups within the participant sample. If the priming effect, indicated by the increase in the proportion of object RC interpretations, was larger for high proficient participants than for low proficient participants, then this would indicate an interaction between L2 proficiency and the priming effect.



## 5. Results

This section reports on the outcomes that have been obtained from the experiment and from the statistical analyses that were conducted. The accuracy scores, as well as the results for the interpretation of the critical ambiguous RC structures are discussed. For the results of the LexTALE task, see section 4.1 on the participants of this study.

### 5.1 Accuracy

Participants scored generally high on the unambiguous filler items and English prime items. All participants scored at least 92% correct, meaning a maximum of three incorrect answers out of 38 trials. On average, the accuracy on the filler and prime items was 99.18% ( $SD = 1.67\%$ ). Therefore, it seemed to be the case that participants were paying attention to the task. The accuracy scores also indicated that the participants had understood the instructions of the task and that they were able to understand the content of the sentence structures.

### 5.2 Interpretation of Ambiguous Dutch RC structures

All 45 participants had been presented with 20 ambiguous Dutch RC question sentences, leading to a total of 900 experimental trials. For each trial, the participants had made a choice between two pictures, where one of the pictures depicted the subject RC interpretation (i.e., where the first noun in the sentence structure was the actor of the verb), and the other picture depicted the object RC interpretation (i.e., where the second noun in the sentence structure was the actor). A total of 72 out of 900 (8%) critical trials were interpreted as object RC sentences. In the baseline phase, where the natural preference for interpreting ambiguous RC structures was established, the object RC interpretation was chosen seven times out of 270 trials (2.59%). During the priming phase, when English structures were used to prime an object RC interpretation, this interpretation was chosen 37 times out of 360 trials (10.28%). Finally,

**Table 1**

*Mean Proportion and SDs of Object RC Interpretations per Experimental Phase*

<b>Phase</b>	<b><i>M</i></b>	<b><i>SD</i></b>
Baseline	0.026	0.071
Priming	0.104	0.184
Post-test	0.104	0.236

in the third phase following the priming phase, 28 out of 270 ambiguous items were interpreted as object RCs (10.37%). The mean proportion of object RC interpretation for each of the three experimental phases can be found in Table 1.

A repeated measures ANOVA was conducted using the proportions of object RC interpretation responses of the three experimental phases. Mauchly's test of sphericity indicated that the assumption of sphericity was violated. Therefore, the Greenhouse-Geisser correction was used. The results indicated that there was a significant difference between the means of the three different phases  $F(1.73, 74.24) = 4.148, p = .025$ . The pre-planned Helmert contrast was used to compare proportion of object RC responses of the baseline phase with the proportion of object RC responses of both the priming and post-test phase. The Helmert contrast indeed indicated a significant difference ( $p < .01$ ). Participants had chosen the object RC interpretation significantly less often during the pre-test phase ( $M = 0.026, SD = 0.071$ ) than during the priming phase ( $M = 0.104, SD = 0.184$ ) and the post-test phase ( $M = 0.104, SD = 0.236$ ). Thus, both during and after the priming phase, the object RC interpretation responses increased significantly. A second comparison made by the Helmert contrast compared the proportion of object RC responses of the priming phase to those of the post-test phase. This contrast indicated no significant difference between the priming and post-test phase ( $p > .05$ ).

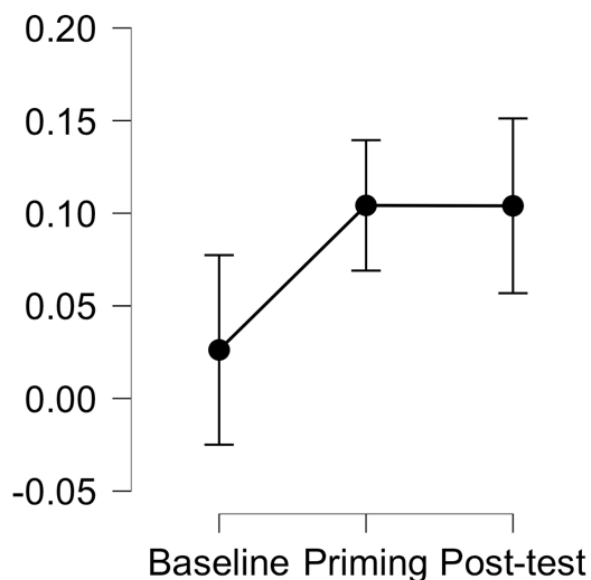
In order to check the findings by the Helmert contrast, post hoc analyses (using Holm correction to adjust  $p$ ) were conducted, which confirmed the findings from the Helmert contrast. There was a significant difference between the baseline phase and priming phase ( $p < .05$ ) as well as between the baseline and the post-test phase ( $p < .05$ ). But there was no significant difference between the priming phase and the post-test phase ( $p > .05$ ).

Thus, both the pre-planned treatment contrasts and post hoc tests indicated a significant increase in object RC interpretations after primes had been presented to the participants. For an overview and visualisation of how object RC interpretations were distributed throughout the three experimental phases, see Figure 7. This figure illustrates the increase of object RC interpretations during and after the priming phase.

As the research question was also concerned with the role of L2 proficiency,

**Figure 7**

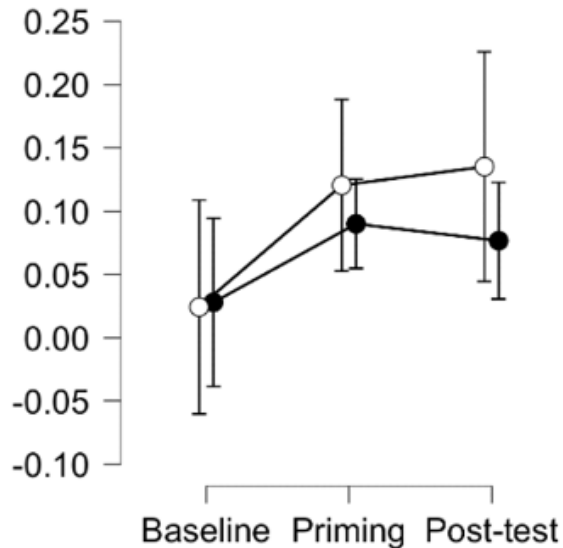
*Mean Proportions of Object RC Interpretations for All Participants*



*Note.* The dots represent the mean proportion of object RC interpretations per experimental phase. The lines above and below each mean display the error bars depicting the 95% confidence intervals.

**Figure 8**

*Mean Proportions of Object RC Interpretations for High and Low Proficient Group*



*Note.* The dots represent the mean proportion of object RC interpretations for the high proficient group (black) and the low proficient group (white) per experimental phase. The lines above and below are the error bars depicting the 95% confidence intervals.

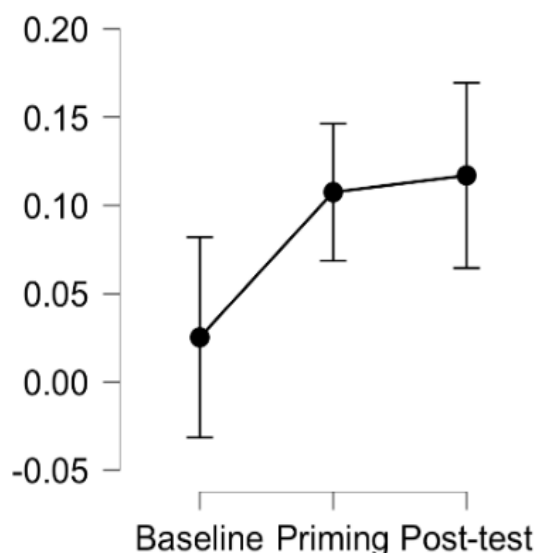
and whether or not this interacted with the priming effect, proficiency was added as between-subject factor to the repeated measures ANOVA. However, there was no significant interaction between *phase* and *proficiency*  $F(1.727, 74.24) = 0.48, p > .05$ . When taking a look at how the proportion of object RC interpretations were distributed among the two groups throughout the three experimental phases, it can be seen that there was an increase in object RC interpretations for both groups after the baseline phase (see Figure 8). Although in this figure it may appear as if for the low proficient group (white dots) the priming effects were somewhat higher and more robust than for the high proficient group (black dots), there was no significant difference between the two groups. Thus, the high and low proficient participants did not differ in how they interpreted the ambiguous trials. In order to verify this effect of proficiency, the continuous proficiency scores were used for an extra analysis. Instead of using L2 proficiency

as between-subjects factor, the continuous L2 proficiency scores were added as covariate to the repeated measures ANOVA. Adding the continuous scores revealed no interaction between the interpretations of critical items during the three experimental phases and L2 proficiency, but did cloud all other priming effects that had been found.

Overall, the results of the complete participant sample seemed to indicate a significant increase in object RC interpretations during and after the priming phase. However, the analysis of the full participant sample was potentially biased by the fact that two participants seemed to be aware of the purpose of the study. Those participants indicated that they had suspected that the pictures were used to influence their interpretations of ambiguous sentences. Additionally, there were also several participants who had indicated that English was not their L2 (even though the instructions clearly specified that this experiment was for participants whose native

**Figure 9**

*Mean Proportions of Object RC Interpretations for Smaller Selection of Participants*



*Note.* The dots represent the mean proportion of object RC interpretations per experimental phase. The lines above and below are the error bars depicting the 95% confidence intervals.

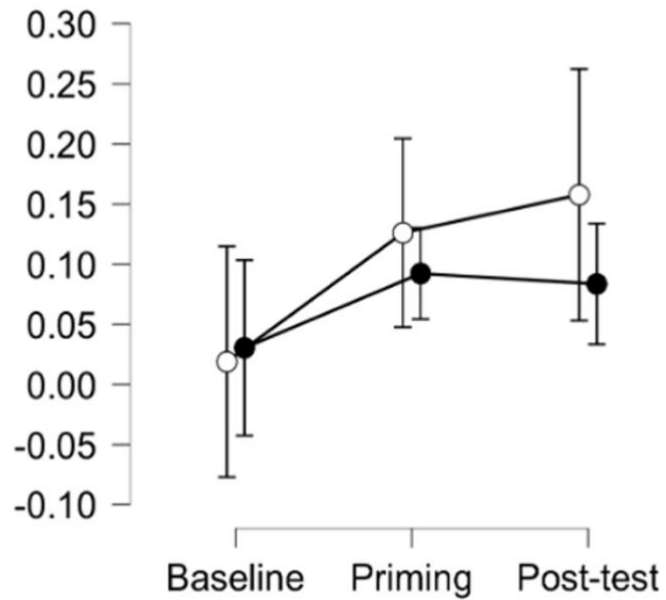
language was Dutch and their L2 English). For this reason, the aforementioned analyses were repeated with the data of the remaining forty participants that were unaware of the aim of the study and who had indicated English to be their L2.

The repeated measures ANOVA (with Greenhouse-Geisser correction) was conducted for a second time revealing similar patterns. There was a significant difference between the means of the three experimental phases  $F(1.73, 65.61) = 4.43, p = .02$ . The Helmert treatment contrasts indicated a significant difference between the baseline phase and the two subsequent phases, the priming and post-test phase ( $p < .01$ ). The object RC interpretation was chosen significantly more often during the priming phase ( $M = 0.107, SD = 0.194$ ) and the post-test phase ( $M = 0.117, SD = 0.248$ ), than during the baseline phase ( $M = 0.025, SD = 0.071$ ). Similar to the previous analysis, there was no significant difference between the priming phase and the post phase ( $p > .05$ ). These findings were also supported by the Holm correct post hoc analyses, which revealed a significant difference between the baseline and the priming phase ( $p < .05$ ) and between the baseline and the post-test phase ( $p < .05$ ). The distribution of object RC interpretations for the three experimental phases for the smaller selection of participants also looked similar to the descriptive plot of the full participant sample, as can be seen in Figure 9 (cf. Figure 7).

For the smaller selection of participants, the role of L2 proficiency was also analysed. It must be noted that, since the same division strategy was used for dividing the participants into high and low proficiency groups (i.e., LexTALE score of 80% or higher for high proficient group), eighteen participants were now classified as low proficient and 22 as high proficient, making the group sizes somewhat unbalanced. Nevertheless, the analyses were similar to that of the full participant sample, with no significant interaction between *phase* and *proficiency*  $F(1.73, 65.61) = 0.74, p > .05$ . See Figure 10 for a visualization of the distribution of object RC interpretations for the high and low proficient bilinguals of the selection of participants.

**Figure 10**

*Mean Proportions of Object RC Interpretations for High and Low Proficient Group of Smaller Selection*



*Note.* The dots represent the mean proportion of object RC interpretations for the high proficient group (black) and the low proficient group (white) per experimental phase. The lines above and below are the error bars depicting the 95% confidence intervals.

## 6. Discussion

This thesis aimed to study cross-language interactions taking place in language comprehension in the direction where bilinguals' second language (L2) influences their first language (L1) processing. A cross-language structural priming experiment was conducted investigating whether or not there would be an L2 > L1 syntactic priming effect in language comprehension, whether this priming effect would sustain throughout the experiment and whether or not the priming effect interacted with L2 proficiency. During the experiment, Dutch-English bilinguals participated in a picture selection task containing unambiguous English (L2) relative clause (RC) structures as primes and ambiguous Dutch (L1) RC structures as targets. This task was divided into three phases: a pre-test phase measuring the baseline preference for interpreting the Dutch ambiguous structures, a priming phase during which English unambiguous primes were used to influence the ambiguity resolution of Dutch ambiguous structures, and, finally, a post-test phase to investigate whether the effect elicited by the English primes had a long-term effect on interpreting Dutch ambiguous structures. This section discusses the results of the experiment in terms of how these findings relate to this study's research questions, how they relate to previous research, and what the implications of the findings are. Subsequently, the limitations of the present study are discussed as well as recommendations and ideas for future research.

### 6.1 L2 > L1 Priming Effect in Comprehension

The first and main research question of the present study was concerned with cross-language syntactic priming in language comprehension and whether such priming effects could be found in the direction in which bilinguals' L2 influenced language processing in the L1. The overall results indeed demonstrate that cross-language interactions take place, because exposure to particular L2 structure interpretations influenced L1 processing of similar structures. Both the analysis of the full participant sample and the selection of unaware



participants that specified English as their L2 demonstrated an effect of *phase*. A significant increase was found in how often Dutch object RC interpretations were chosen during the second and third phase of the experiment (i.e., priming and post-test phase, respectively) compared to the first phase (i.e., the baseline phase). This effect of *phase* indicates that cross-language syntactic priming has taken place: exposure to object RC interpretations in the L2 of participants (English) during the priming phase elicited a significant increase in choosing object RC interpretations in the L1 (Dutch) during and after this priming phase. Therefore, an L2 > L1 priming effect was found, demonstrating the influence of English primes on Dutch target comprehension.

This L2 > L1 directionality of the cross-language syntactic priming effect in language comprehension found in this study adds to earlier findings on cross-language syntactic priming in language comprehension (see e.g., Kidd, Tennant et al., 2015; Nitschke et al., 2010). Kidd, Tennant et al. (2015) found cross-language priming effects using similar object RC structures, with unambiguous English primes and ambiguous German targets. However, in their study, the L1 primed the L2, and not the other way around. Although priming effects in the opposite direction (i.e., L2 > L1) were found for semantic priming (Zhao et al., 2011) as well as syntactic priming in language production (Kantola & van Gompel, 2011; Loebell & Bock, 2003), this had not yet been found for syntactic priming in language comprehension. Thus, the results of the present study suggest that cross-language syntactic priming in the L2 > L1 direction may also take place in language comprehension, indicating an overlap between studies on language comprehension and language production. The L2 > L1 priming effect suggests that the less entrenched language (i.e., the L2) may also prime the dominant language of bilinguals (i.e., the L1) in language comprehension. This is in line with Pavlenko's (1999) proposal of L1 flexibility after reviewing studies on L2 influences on the L1. It was suggested that the L1 is more flexible and easily influenced by the cross-linguistic interactions and transfer from the

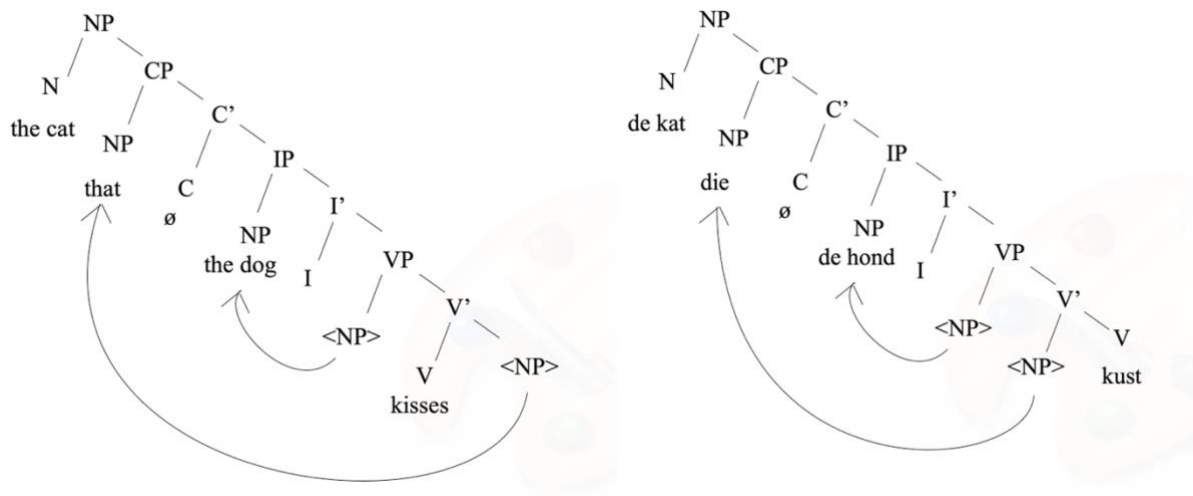
L2 than is generally assumed.

Furthermore, the findings provide support for the idea that cross-language interactions take place between the languages of bilingual speakers in language comprehension, similar to what, for example, the shared-syntax model has predicted for language production (Hartsuiker et al., 2004). Potentially, when Dutch-English bilinguals are comprehending and processing unambiguous English object RC structures, one single syntactic representation is activated (i.e., the one used when processing English RC Noun-Noun-Verb word order leading to an object RC interpretation). This activation then facilitates the choice for Dutch object RC interpretations when interpreting ambiguous Dutch RC structures, since the same syntactic representations can be used in Dutch. These shared representations may explain the significant increase for this object RC interpretation choice. Whereas many studies supporting the shared-syntax model have focussed on syntactic priming in production, the findings of the present study indicate that similar effects can be found for language comprehension (see van Gompel & Arai, 2018, for an overview of studies on language production supporting the shared-syntax model). In line with theories on the close link between language production, comprehension and acquisition, such as the p-chain theory by Dell and Chang (2014), this priming effect found in language comprehension may provide further support for this interwoven relationship between language production and comprehension.

The present study's priming effect could, in addition to the shared-syntax model, be explained in terms of the hierarchical tree model proposed by Jacob et al. (2017). This model is somewhat similar to the shared-syntax model, but has suggested that language users compute a mental representation of the syntactic hierarchical tree structure of a sentence, when being exposed to language input. This hierarchical tree representation is then what is being activated and reused in subsequent language processing. If the structures of the trees of two languages are consistent, they may be taken over in the other language, leading to cross-language

**Figure 11**

*Syntactic Hierarchical Tree Structure of English Object RC (Left) and Dutch Object RC (Right)*

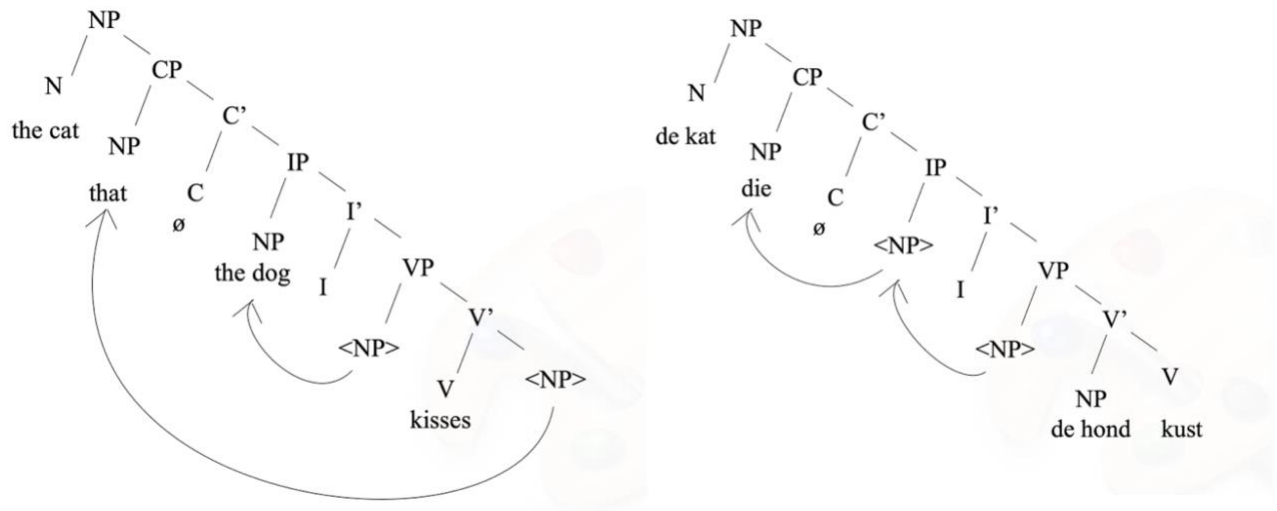


*Note.* The arrows indicate the movement of constituents and the brackets (<XP>) indicate the previous or original position where the constituent moved away from within the syntactic tree.

interactions. When considering the syntactic hierarchical tree structures of the type of Dutch and English object RC structures used in the experiment of the present study, it can be seen that these syntactic trees (see Figure 11) resemble each other much more closely than the syntactic tree structures of the Dutch subject RC interpretation and the English object RC interpretation (see Figure 12). Although there is a slight difference between the syntactic tree structures of the Dutch and English object RCs with regard to the position of the head of the verb phrase, the structures in Figure 11 are much more similar with regard to the traces and the positions of the noun phrases (NPs) than the structures in Figure 12. Besides, verb-head position differences between Dutch and English also did not prevent syntactic priming of high and low attached RCs in Desmet and Declercq (2006). This might be due to the difference being at the same hierarchical level within the syntactic tree structure. Nevertheless, the idea of reusing syntactic hierarchical tree structures by Jacob et al. (2017) could explain the increase in object RC interpretations in Dutch after being exposed to this particular structure in English

**Figure 12**

*Syntactic Hierarchical Tree Structure of English Object RC (Left) and Dutch Subject RC (Right)*



*Note.* The arrows indicate the movement of constituents and the brackets (<XP>) indicate the previous or original position where the constituent moved away from within the syntactic tree.

with a similar syntactic tree.

Overall, the significant increase in choosing object RC interpretations for ambiguous Dutch RC structures while and after being primed with unambiguous English object RC structures indicates that there can be cross-language syntactic priming effects in language comprehension in the direction where the L2 influences the L1, answering the main research question of the present study. The present study was the first to find such effects in language comprehension. Finding such similarities in priming effects in language comprehension and production could indicate a strong connection between the two language processes. Finally, the present study suggests that theories on priming effects in language production, such as the shared-syntax model (Hartsuiker et al., 2004) and the hierarchical tree model (Jacob et al., 2017), may also be applicable for explaining the phenomena of priming in language comprehension.

## 6.2 Long-Term Priming and Implicit Learning in the L1

Whereas the main research question of this thesis was concerned with the topic of priming in comprehension and the directionality of the effect, the second research question focussed on the continuity and persistence of this priming effect. The third phase of the experiment was added for the purpose of investigating this sustainability. The post-test phase allowed for checking whether the priming effect was still observable after the priming phase, when primes were no longer presented to the participants. This long-term effect was analysed by comparing the mean proportions of object RC interpretations of the third phase to that of the first and second phase of the experiment (i.e., the baseline and priming phase, respectively). This subsection elaborates on how the results of the present study are in line with earlier findings on long-term priming and how this might relate to the topic of implicit learning.

The results of the present study demonstrated that the cross-language syntactic priming effect remained observable after primes were no longer presented, indeed suggesting a long-term priming effect. In both the analysis of the full participant sample and the smaller selection, significant differences were found between how often object RC interpretations were chosen during the baseline phase (i.e., before priming) and during the two subsequent phases (i.e., during and after priming). Additionally, there was no significant difference between the means of the priming phase and post-test phase. This indicates that the increase in object RC interpretations remained stable even after the priming phase had ended, despite an interruption of the main task between these two phases (i.e., the LexTALE task was positioned in between the priming phase and the post-test phase). Thus, even though participants were no longer presented with primes and had been engaged in a completely different task for several minutes, the priming effect was still observable and as strong as it had been during the priming phase itself. This suggests that the influence of L2 primes on L1 interpretation is more than just a short-lived effect, but that it can be sustained for a longer period of time, at least within one

experimental session.

Although longer-term priming effects have previously been found in various contexts, especially monolingual and within language priming contexts (see e.g., Heyselaar & Segaert, 2021; Luka & Choi, 2012; Nitschke et al., 2010), the findings from the present study are the first to suggest that cross-language structural priming from L2 to L1 may also lead to longer-term priming effects. Kootstra and Doedens (2016) found a longer-term priming effect in cross-language settings, namely spill-over effects between experimental blocks, but only in the direction of L1 to L2 priming. Only when the L1 was the target language during the first experimental block, this L1 production primed the L2 production during the second experimental block, suggesting that the dominant language has a more powerful influence on the non-dominant language than the other way around. This was also what Loebell and Bock (2003) had concluded after findings stronger  $L1 > L2$  than  $L2 > L1$  priming effects. The present study's long-term priming effects, however, indicate that the less dominant language may also have a strong influence. Though no direct comparison between  $L1 > L2$  and  $L2 > L1$  priming was made, and therefore no claims can be made about  $L2 > L1$  being equally strong, the current results do suggest that the effect of the less dominant language on the dominant language is strong and robust enough to persist throughout an entire experiment, which had not been found by Kootstra and Doedens (2016).

As was earlier discussed in section 2.3, long-lasting priming effects have been interpreted as an indication of implicit learning (see e.g., Chang et al., 2006; Dell & Chang, 2014). The idea is that exposure to language, which may come from priming, leads to constant updating and adjusting the language system. Instead of only activating syntactic structures, priming effects are then believed to also have long-term ramifications. Even though L1 speakers are likely to have acquired their native language by the time they reach adulthood, their L1 system appears to be flexible enough for implicit learning to take place. Luka and Choi

(2012) demonstrated this by finding changes in the perceived grammaticality of particular L1 structures after similar structures had been primed, with the priming effects still being observable after a week. Other studies have also found long-term effects of syntactic priming on the L1 system of language speakers (see e.g., Heyselaar & Segaert, 2021; Jackson & Hopp, 2020). Thus, implicit learning takes place in the L1, at least when being presented with L1 primes. However, the findings of the present study suggest that implicit learning may also be elicited by exposure from another language, namely the L2. The current results have indicated that L2 to L1 priming also leads to long-term priming effects, which may suggest that a priming effect stemming from L2 primes could potentially also have the strength to lead to re-evaluations or adjustments in the L1 system. Although caution must be taken with fact that priming effects in the present study have not been investigated outside a single experimental session. It remains to be seen whether L2 priming is powerful enough to influence syntactic representations for a longer period of time.

Nevertheless, it can be said that indeed L2 to L1 priming effects can have long-term consequences, the effects still being observable after primes are no longer presented, answering the second part of the research question. The priming effect had not declined between the priming and post-test, despite an intervening task which was unrelated to the syntactic priming task. Present study's findings are the first to find this long-term priming effect in the direction of  $L2 > L1$ . More on the potential meaning of this effect is discussed in section 6.4.

### **6.3 Role of L2 proficiency**

The first and second part of the research question were mainly concerned with the presence and nature of the  $L2 > L1$  priming effect, whereas the third and final part of the research question focussed on an external factor that potentially interacts with cross-language priming: L2 proficiency. Several studies found interactions between L2 proficiency and the strength of cross-language priming effects, where generally higher L2 proficiency correlated

with stronger cross-language priming effects (see e.g., Bernolet et al., 2013; Kim & McDonough, 2008). This subsection discusses how the results of the present study relate to these earlier findings and how the lack of interaction between L2 proficiency and priming effect in the present study may be explained.

The present study's results do not suggest an interaction between L2 proficiency and the L2 to L1 priming effect in language comprehension. Participants' scores on the LexTALE task were used to divide the participant sample into two groups: high proficient and low proficient L2 speakers. The long-term priming effect from L2 to L1 was observable irrespective of L2 proficiency, and there were no significant differences between the two groups. Whereas other studies found no, or a much smaller, cross-language priming for low proficient L2 speakers (see e.g., Bernolet et al., 2013; Kim & McDonough, 2008), this study indicates that the priming effect was equally strong for both proficiency groups in this particular participant sample. The inconsistencies between the findings from the present study and those of earlier studies may be explained by the fact that L2 proficiency is not an absolute or exact factor.

There are several reasons as to why it may not be appropriate to make generalizations about L2 proficiency and how this affects cross-language interactions. Firstly, the type of syntactic structures that are used in priming studies might be acquired differently. As Hartsuiker and Pickering (2008) suggested, priming should not be affected by proficiency as long as L2 speakers have acquired the syntactic representations at question. Furthermore, Bernolet et al. (2013) suggested that, during the acquisition process, there might be a shift from separate representations to shared representations. Possibly, the syntactic representations of RC structures had already been fully acquired by the participants of both proficiency groups in the present study, whereas for other studies, the acquisition process for those syntactic structures were still in progress for the low proficient participants. Secondly, studies may take on various approaches to investigate the role of L2 proficiency. The present study and that of Kim and



McDonough (2008) measured L2 proficiency and divided participants according to their scores, whereas Bernolet et al. (2013) used self-assessment and took into account how many years of L2 experience the participants had. Thus, different studies are far from consistent in how they measure and study L2 proficiency. Alternatively, studies may differ in how proficiency is perceived: what is seen as low proficient in one study, may be interpreted as high proficient in another. Finally, it is important to note that most studies investigating the role of L2 proficiency considered syntactic priming in language production. Although there appear to be many similarities between priming in language production and comprehension, and it has been proposed that these processes are closely interrelated (see e.g., Dell & Chang, 2014; Pickering & Garrod, 2013), it could be that language proficiency interacts differently with these two types of priming. It has been suggested that in language acquisition, comprehension generally seems to precede production (Fraser et al., 1963). Because of this potential asymmetry in language acquisition, it might be possible that interactions with proficiency manifest differently in priming in comprehension as compared to priming in production.

Regardless of these apparent challenges in studying the role of L2 proficiency, it is the case that the present study found no interaction between this factor and cross-language language priming effects. Going against the hypotheses, at least for this participant sample, high L2 proficiency did not lead to stronger priming effects. It remains to be seen whether L2 > L1 syntactic priming in comprehension is really unaffected by this factor.

#### **6.4 Limitations and Recommendations**

Although the data obtained using the picture selection task answered the research questions, there have been several limitations in this present study that could be improved upon in future research. Furthermore, the findings of this study have also raised new questions that future research might look into. Therefore, this subsection focusses on the limitations of the present study and offers ideas and improvements for future research.

One of the limitations of the present study is related to the size of the participant sample and the experiment itself. First of all, the participant sample was rather small, and a larger sample size would have been likely to make the results and findings more reliable. The experiment itself was also somewhat small-scale, which was necessary as the experiment was conducted online (in order to accommodate for difficulties surrounding the ongoing COVID-19 pandemic). By keeping the experiment relatively short, it was more likely that participants would finish it in its entirety. Future research could improve on this by extending their experiment to include more critical data points, and by finding more participants, motivating these participants to complete this more extensive experiment by offering financial compensation, which was not available for the current project.

A second limitation of the present study was not related to the size of the participant sample, but to the type of bilinguals that the participant sample was comprised of. This study opted for an experiment including Dutch-English bilinguals for two reasons. Firstly, many people in the Netherlands speak English, and therefore there was a higher likelihood of finding sufficient Dutch-English bilinguals. Secondly, Dutch and English are closely related languages, and generally overlap substantially in how grammatical structures are used. This allowed the use of similar type of grammatical structures as were used in other studies on syntactic priming in comprehension (Kidd, Tennant et al., 2015; Nitschke et al., 2010). However, the disadvantage of studying a Dutch-English bilingual participant group is related to the issue of L2 proficiency. English is widely spoken in the Netherlands, and plays an important part in Dutch society. English as a school subject is mandatory and the language is also widely represented in Dutch media. As a consequence, most Dutch people have myriad experience with English and a relatively high language proficiency (Edwards, 2016). When taking a closer look at the LexTALE scores measuring the L2 proficiency of the participants in this study, it becomes clear that the participants in the present study were also quite proficient

speakers of English. Only one participant scored below 59% on the LexTALE task, which means that all other participants could be classified, at least, as upper intermediate learners (B2 level), and approximately half could be classified as advanced learners (C1 to C2 level). Thus, although the present study made a comparison between low and high proficient participant groups, the low proficient bilinguals were actually also rather high proficient L2 speakers. This lack of substantial variation in L2 proficiency may have clouded any potential interactions between the priming effect and L2 proficiency. It is, therefore, recommended that future research investigating the role of L2 proficiency (and thereby comparing higher and lower proficient L2 speakers) will consider studying such effects in participant groups where it is easier to find variation in L2 proficiency, for example in Dutch-French bilingual participant groups.

Further limitations of the present study and recommendations for future research are concerned with the topic of prime directionality and the sustainability of priming effects. The present study was the first to investigate L2 to L1 priming in language comprehension and, therefore, also the first to examine whether this effect was long-term. Though long-term L2 to L1 priming effects were indeed found, it remains unclear how the strength and sustainability of this effect relate to the strength and sustainability of L1 to L2 priming. It might be useful for future research on cross-language long-term priming in language comprehension to directly compare L1 to L2 and L2 to L1 priming effects. This way, it can be examined whether the influence of the dominant language is indeed much stronger on the less dominant language, than the other way around, as was suggested for structural priming in language production (see e.g., Kootstra & Doedens, 2016; Loebell & Bock, 2003).

Finally, as was mentioned in section 2.3 and 6.2, various types of periods of long-term priming have been found, some effects lasting as long as a single experimental session (see e.g., Nitschke et al., 2010; Jackson & Hopp, 2020; Kootstra & Doedens, 2016), while others

extend beyond that, continuing to be observed after a week (Luka & Choi, 2012) or even a month (Heyselaar & Segaert, 2021). Nevertheless, long-term priming effects have been interpreted as an indication of implicit learning processes (see e.g., Chang et al., 2006; Dell & Chang, 2014). As was also discussed in section 6.2, the priming effects of the present study have indicated that L2 primes may also lead to long-term priming effect in L1 comprehension. However, before drawing any conclusions on how L2 priming may, potentially, lead to implicit learning in the L1, it might be relevant to take a critical stance on the nature of the long-term priming effect found in the present study. The priming effect was observable in the post-test phase during which primes were no longer presented to the participants. Assuming that the participants immediately started the next part of the experiment after finishing the preceding part, there was a period of approximately five to ten minutes between the end of the priming phase and beginning of the post-test phase, during which participants were not engaged with interpreting ambiguous RC structures. Thus, the long-term priming effects in this study were quantitatively different from long-term priming effects that were observable days or weeks after primes were presented.

Because a longitudinal approach into studying long-term priming effects was beyond the scope of this thesis project, and since the present study was the first to even investigate whether L2 to L1 priming had the potential to induce long-term effects, it was chosen for this particular study to investigate long-term priming effects within a single experimental setting. For future research, however, it may be an interesting idea to construct a similar experimental paradigm adding an extra post-test phase several days, or even weeks, subsequent to the priming phase. Since it might be a bit premature to draw conclusions on re-evaluations in L1 representations after the exposure to eight L2 prime items, hopefully future research this will shed more light on whether or not L2 priming may lead to actual implicit learning and adjustments of syntactic representations.

## 7. Conclusion

The present study had set out to investigate whether exposure to particular second language (L2) syntactic structures could lead to cross-language priming effects influencing first language (L1) comprehension. Furthermore, this study aimed to find out whether this L2 > L1 priming effect could have sustained effects. Finally, it attempted to investigate whether the priming effect interacted with L2 proficiency.

The results of the cross-language structural priming experiment, using ambiguity resolution as a means of investigating priming in language comprehension, confirmed the hypothesis that L2 > L1 priming effects could be found. The unambiguous English (L2) object relative clause (RC) structures elicited a significant increase in object RC interpretations for ambiguous Dutch (L1) targets, thereby priming the interpretation of this syntactic structure. The three experimental phases clearly demonstrated at what point the English primes had been presented to the participants. The difference between the baseline phase, before primes were presented, and the priming and post-test phase, during and after primes were presented, was astounding. The sustainability of the effect of the L2 primes on L1 sentence interpretation was also promising. Even though primes were no longer presented to the participants, the significant increase in object RC interpretation had not decreased the slightest bit between the priming and post-test phase. The hypothesis that L2 > L1 priming effects would be long-term was, therefore, also borne out. Only the third hypothesis, that L2 proficiency would interact with the L2 > L1 priming effect, was not confirmed.

Although it was predicted that stronger L2 > L1 priming effects would be observed for the high proficient participant group, as opposed to low proficient group, the two groups did not differ in how they interpreted the ambiguous Dutch trials. The priming effect, therefore, appeared to be equally strong for both participant groups. A significant L2 to L1 priming effect

was observed for both high and low proficient bilinguals after they had been primed with object RC interpretations.

This study's findings add to previous research on cross-language syntactic priming in comprehension and long-term cross-language priming effects. Thus far, the only cross-language syntactic priming effects in language comprehension had been the  $L1 > L2$  priming effects found by Kidd, Tennant et al. (2015). Although  $L2 > L1$  priming effects had been found in language production, for example, by Kantola and van Gompel (2011) and Loebell and Bock (2003), the results of the study are the first to suggest that  $L2 > L1$  priming may also occur in language comprehension. Similarly, the findings add to previous research on long-term priming effects in cross-language contexts. Whereas cross-language long-term priming effects for were found for  $L1 > L2$  priming by Nitschke et al. (2010), this study has indicated that the effect of  $L2 > L1$  priming may also remain present after primes are no longer presented.

Consequently, the present study has indicated that  $L1$  language comprehension can be influenced by  $L2$  exposure. Cross-language interactions from the  $L2$  to the  $L1$  may also take place in syntactic priming in comprehension. More research is necessary on the exact relationship between  $L2 > L1$  priming and  $L2$  proficiency. Similarly, more research is required on the sustainability of the  $L2 > L1$  priming effect outside single experimental sessions. However, the results of the present study do suggest that  $L2 > L1$  priming in language comprehension can lead to robust effects: even the  $L2$ , the less dominant underdog within bilinguals' linguistic systems, may have the strength to make a change.

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## Appendix I

### *Overview of the items used in the picture selection task*

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**Targets:** ambiguous Dutch RC question sentences

Waar is de beer die de hond voert?  
 Waar is de hond die de eend kust?  
 Waar is de kat die de giraffe voert?  
 Waar is de kat die de koe knuffelt?  
 Waar is de giraffe die de kat duwt?  
 Waar is de koe die de olifant knuffelt?

Waar is de eend die de olifant knuffelt?  
 Waar is de beer die de eend kust?  
 Waar is de giraffe die de hond kust?  
 Waar is de koe die de eend knuffelt?  
 Waar is de kat die de beer voert?  
 Waar is de eend die de kat voert?  
 Waar is de hond die de koe duwt?  
 Waar is de beer die de koe duwt?

Waar is de olifant die de hond kust?  
 Waar is de olifant die de giraffe kust?  
 Waar is de koe die de giraffe duwt?  
 Waar is de hond die de kat voert?  
 Waar is de beer die de eend knuffelt?  
 Waar is de giraffe die de olifant duwt?

**Primes:** unambiguous English RC question sentences

Where is the cow that the dog kisses?  
 Where is the elephant that the cow pushes?  
 Where is the bear that the cat kisses?  
 Where is the dog that the bear feeds?  
 Where is the duck that the giraffe pushes?  
 Where is the giraffe that the bear hugs?  
 Where is the cat that the elephant feeds?  
 Where is the elephant that the duck hugs?

**Fillers:** structures with prepositional phrases

Where does the man touch the burglar with a stick?  
 Where does the witch chase the farmer with a flag?  
 Where does the granny catch the burglar with a trashcan?  
 Where does the knight catch the fireman with a wheelbarrow?  
 Where does the pirate tickle the nurse with an umbrella?  
 Where does the woman touch the girl with a banana?  
 Waar raakt de oma de boer met de wortel aan?  
 Where does the witch tickle the boy with a broom?  
 Waar achtervolgt de ridder het meisje met de tandenborstel?  
 Where does the pirate catch the fireman with a chair?  
 Waar kietelt de vrouw de boer met de kam?  
 Where does the knight touch the boy with a spoon?  
 Waar kietelt de man het meisje met de vork?  
 Where does the woman catch the girl with a bucket?  
 Waar achtervolgt de piraat de jongen met de winkelwagen?  
 Where does the granny tickle the girl with a banana?  
 Waar vangt de heks de verpleegster met de hoed?  
 Where does the man chase the farmer with a bag?  
 Where does the pirate touch the farmer with a stick?  
 Where does the woman chase the nurse with a toothbrush?  
 Where does the man catch the nurse with a chair?  
 Where does the knight tickle the burglar with a spoon?  
 Where does the granny chase the boy with a book?  
 Where does the witch touch the girl with an umbrella?

**Fillers:** intransitive question sentences

Waar is de schildpad die blij is?  
 Where is the small snake?  
 Waar is de vogel die aan het slapen is?  
 Where is the crying frog?  
 Where is the small spider?  
 Waar is de vis die aan het slapen is?  
 Where is the snake that is happy?  
 Where is the fish that is crying?  
 Where is the big spider?  
 Waar is de vlinder die aan het slapen is?  
 Waar is de schildpad die aan het lopen is?  
 Waar is de kleine spin?  
 Waar is de dunne bij?

Where is the bird that is sleeping?

Where is the big bee?

Waar is de vogel die aan het lopen is?

Where is the frog that is jumping?

Waar is de slang die aan het huilen is?

Waar is de blijde vogel?

Waar is de vlinder die aan het vliegen is?

Where is bird that is walking?

Where is the frog that is happy?

Where is the happy fish?

Waar is de kikker die aan het huilen is?

## Appendix II

### *Information letter for the participants*

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Welkom bij dit taalonderzoek.

U wordt gevraagd deel te nemen aan een wetenschappelijk onderzoek. Om mee te doen is uw toestemming nodig. Voordat u beslist of u wilt meedoen aan dit onderzoek, krijgt u uitleg over wat het onderzoek inhoudt.

Het onderzoek gaat over het verwerken van taal en wordt uitgevoerd door Femke Blankestijn (Student MA Language and Communication Coaching aan de Radboud Universiteit) onder begeleiding van dr. Gerrit Jan Kootstra.

Het experiment duurt ongeveer 15-20 minuten, en moet gemaakt worden op een **computer of laptop** in een rustige omgeving.

Tijdens het experiment ziet u zinnen, plaatjes en woorden. Het is de bedoeling dat u telkens een keuze maakt. Denk niet te lang na over deze keuzes, maar ga voor uw eerste ingeving. Bij het zien van een zin met twee plaatjes, kiest u welk plaatje het beste bij de zin past. Soms lijken de plaatjes erg op elkaar, dus let goed op. Soms kan het ook zijn dat beide plaatjes mogelijk zijn. Ga dan dus voor uw eerste ingeving. Kiest u het plaatje links, dan klikt u op de 'A' op uw toetsenbord. Kiest u het plaatje rechts, dan klikt u op de 'L' op uw toetsenbord. Bij deze taak wordt telkens herhaald op welke toets u moet drukken. Bij een ander onderdeel van het experiment krijgt u woorden te zien waarbij u kiest of het woord een bestaand woord is of niet. Als u denkt dat het woord bestaat, dan klikt u op de 'Y', van *yes*, op uw toetsenbord. Als u denkt dat het woord niet bestaat, dan klikt u op de 'N', van *no*, op uw toetsenbord. Let op, bij dit onderdeel wordt niet herhaald op welke toets u moet drukken. Dus vergeet niet: Y of N. Tijdens het experiment krijgt u aan het begin van elk onderdeel de instructies nog een keer te zien.

Het experiment wordt deels in het Engels gedaan en deels in het Nederlands. Het is daarom van belang dat uw moedertaal Nederlands is, maar dat u ook Engels spreekt. De twee talen wisselen elkaar continu af, dus let goed op.

Uw deelname aan dit onderzoek is vrijwillig. U mag dus op elk moment tijdens het onderzoek stoppen en uw toestemming intrekken. U hoeft hier geen reden voor te geven. Stoppen met de deelname heeft geen nadelige gevolgen voor u. U kunt tot twee weken na deelname ook uw onderzoeksgegevens en persoonsgegevens laten verwijderen. Dit kunt u doen door een mail te sturen naar [f.blankestijn@student.ru.nl](mailto:f.blankestijn@student.ru.nl).

De onderzoeksgegevens die tijdens dit onderzoek verzameld worden, zullen door wetenschappers gebruikt worden voor datasets, artikelen en presentaties. De anoniem gemaakte onderzoeksgegevens zijn tenminste 10 jaar beschikbaar voor andere wetenschappers. Als we gegevens met andere onderzoekers delen, kunnen deze dus niet

tot u herleid worden. De onderzoeksgegevens worden veilig bewaard volgens de richtlijnen van de Radboud Universiteit.

Voor verdere vragen en informatie over dit onderzoek, nu of in de toekomst, kunt u contact opnemen met Femke Blankestijn ([f.blankestijn@student.ru.nl](mailto:f.blankestijn@student.ru.nl)) of dr. Gerrit Jan Kootstra ([g.kootstra@let.ru.nl](mailto:g.kootstra@let.ru.nl)).