UNIVERSITEIT GENT

FACULTEIT PSYCHOLOGIE EN
PEDAGOGISCHE WETENSCHAPPEN

Lexical-syntactic representations in bilingual sentence production

Sarah Bernolet

Promotor: Prof. Dr. Robert J. Hartsuiker

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Proefschrift ingediend tot het behalen van de academische graad
van Doctor in de Psychologische Wetenschappen

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ACKNOWLEDGEMENTS

Het is eindelijk zover. Ik heb mijn doctoraat ingediend. Bij de vakgroep Experimentele Psychologie nog wel, als niet-psycholoog. Dat maakt van mij binnenkort misschien wel de enige Doctor in de Psychologische wetenschappen waar mensen nog mee durven praten, omdat ze gerust kunnen zijn dat ik hun grootste angsten en diepste wensen niet zal aflezen van de blos op hun wangen (ik kan me vergissen; misschien wil er gewoon niemand praten met Doctors in de Psychologie :-).

Ik ben ontzettend blij dat ik de kans heb gekregen om als linguïste een doctoraat voor te bereiden in de Experimentele Taalpsychologie. Dat heb ik uiteraard in de eerste plaats te danken aan mijn promotor, Rob Hartsuiker, en mijn copromotor, Martin Pickering. Rob and Martin, you were the best supervisors I could ever imagine. Not everyone gets the chance to do research with two absolute experts on their side! Thank you for letting me benefit from your immense knowledge on syntactic processing and syntactic priming. Your enthusiasm, confidence and support gave me the privilege to be in a constantly motivating working and learning environment. Thank you for your patience, and for not freaking out on me when I sent you the umpteenth attachmentless e-mail!

Ik zou echter nooit in Gent beland zijn, mocht ik destijds niet voor een licenciaatsthesis in de psycholinguïstiek gekozen hebben. En die keuze had ik misschien niet eens kunnen maken als Steven Frisson geen goed woordje voor mij gedaan had bij Dominiek Sandra. Via mijn thesis belandde ik op het Centrum Voor Psycholinguïstiek, waar ik twee jaar erg graag gewerkt heb onder begeleiding van Dominiek Sandra en Heike Martensen. Heike, jou zou ik nog eens extra willen bedanken. Niet alleen omdat je een geweldige burogenoot en tae-bo kompaan was en omdat je mij ontzettend veel geleerd hebt, maar vooral omdat jij een wetenschapster in mij zag nog voor ik die

zelf gezien had. Merci ook nog eens aan alle ex-collega's van de ufsia, die hevig voor mij gesupporterd hebben toen ik in Gent ging solliciteren.

Buiten Rob, Martin en Dominiek zou ik ook graag de overige leden van mijn begeleidingscommissie bedanken, die mij met raad en daad hebben bijgestaan de afgelopen drieënenhalf jaar. Heel erg bedankt, Mieke Van Herreweghe en Wouter Duyck. Wouter, toen ik de eerste versie van dit dankwoord schreef, wist ik nog niet dat je mij zelfs op het laatste nippertje nog zou redden van een totale nervous breakdown!

Als u al eens door dit doctoraat gebladerd heeft, dan heeft u wellicht gezien dat ik mijn proefpersonen op een schandalige manier om de tuin geleid heb. Ik heb dat niet alleen gedaan. Ik kreeg daarbij hulp van de volgende professionele 'fakers': Sofie Schoonbaert, Benjamin Sturtewagen, Lennart Bernolet, Cecilia Aernoudts, Marijke Welvaert, Wietske Van Gils, Birgit Van Keymeulen, Nils Baetens, Ann Van der Jeugd, Evelyne Lagrou, Charlotte Desmet en Aaron Vanarwegen. Omdat ze aan niet minder dan drie experimenten meewerkte, krijgt Wietske een speciale vermelding (en vergeef ik het haar dat ze mijn pokerface testte door steeds weer dezelfde onnozele vragen te stellen). Een speciale dankuwel ook aan Marloes Bressers, die de experimenten van hoofdstuk 4 voor haar rekening heeft genomen.

Ik heb tijdens mijn doctoraat een buro gedeeld met 2 verschillende collega's die, elk op hun eigen manier, ideale burogenoten waren, nl. Michael Stevens en Ilse Tydgat. Michael leerde mij het schrijven van een doctoraat te relativeren. Merci daarvoor, Michael. Een hyperambitieuze burogenoot had mij waarschijnlijk de gordijnen in gejaagd (en er hangt enkel zo'n plastieken scherm voor ons raam!). Ilse, bedankt om mij aan te moedigen tijdens mijn spurtje naar de eindstreep. Ik beloof dat ik minder stresskonijn zal zijn de komende maanden.

Filip, Chantal en Els wil dan weer net danken omdat ze mee stresskonijn geweest zijn de laatste weken. Vooral aan Els heb ik veel gehad, omdat wij

bijna letterlijk in hetzelfde schuitje zaten. Merci, Els, dat ik mocht komen uitrazen op je buro (en sorry, Ine, dat jij daar altijd van moest meegenieten) en voor je hulp in de laatste dagen.

Er lopen hier verder op de vakgroep teveel collega's rond om ze allemaal persoonlijk te kunnen bedanken in dit dankwoord (ik trakteer ze wel een glas op mijn receptie (als ze nog recepties kunnen zien op dat moment)), maar toch een speciale merci voor Lies, Christophe, Antoine en Pascal. Doctoraatsstudenten die ook al aan onze vakgroep gestudeerd hebben, beseffen misschien niet hoe hard wij met ons gat in de boter gevallen zijn met zo'n ondersteunend team, dus: Merci! Ook een bedankje aan mijn collega's van de taalgroep, waarmee het aangenaam vertoeven is op congressen en workshops. En Imotythey, omdat jij so vain bent dat je toch al denkt dat deze song of praise about you is, hoef ik je niet extra te vermelden (maar ik vind het wel tof dat ge mij een stom kieken vindt!).

Ik heb het geluk dat veel van mijn vrienden ook op één of andere manier met doctoraatsstress te maken (gehad) hebben. Bijgevolg kon ik met veel van hen een boompje opzetten over de horror van wetenschappelijk onderzoek en de verschrikkingen die een doctoraat kenmerken. De rest van mijn vrienden was maar matig geïnteresseerd in mijn onderzoek (maar velen stuurden lieve supportersmails en smssen!) en dat was maar goed ook: op die manier kon ik de wetenschap toch uit een groot deel van mijn leven bannen. Bedankt toneelvrienden, jullie zorgden voor een creatieve uitlaatklep. En bedankt Erwin en Karel: in tijden van creatieve ontbering waren onze muzikale tussendoortjes meer dan welkom. En vooral een dikke merci aan my sista Eline, die alle voorgaande dingen tegelijk is voor mij : mede-seut, mede-zangeres en soulmate (en die zeker een geweldig doctoraat gaat schrijven!).

Omdat ze heel veel voor mij betekenen, wil ik uiteraard ook mijn ouders, mijn broers en hun beider madammen bedanken. Mama en papa, bedankt voor jullie oeverloze vertrouwen in mij, you really taught your children well

(en bedankt voor de quote, papa!). Lennart en Cecilia, bedankt om jullie morele waarden op te offeren voor mijn onderzoek (zie par. 5). Bram en Jill, als good neighbours (en als good friends) waren jullie echt ne kado.

Voor ik afsluit, wil ik ook twee mensen bedanken die onbewust een bijdrage hebben geleverd aan deze thesis: Billy Ocean, omdat hij mijn lijflied schreef en Bert Haelvoet, voor de grap die ik zo dadelijk ga plagiëren, want, last but not james, wil ik uiteraard ook Kevin bedanken, mijn partner-in-crime (en in al de rest ook). Weinig koppels zijn zo zot om twee doctoraten af te leveren. Het feit dat wij twee doctoraatsthesissen overleefd hebben en nog altijd graag samenwonen (EN samen werken EN 3 uur per dag samen pendelen) betekent misschien wel dat wij elkaar heel graag zien.

CHAPTER 1
INTRODUCTION

"I may be small, but I can stand my man"
Rudy Kousbroek, Dutch-English bilingual

Producing sentences is a complex process: first, a speaker has to retrieve the correct words from the mental lexicon. Then, the speaker must place these words in a sentence structure that conforms to the grammatical rules of the language she or he is speaking, avoiding grammatical errors or syntactic ambiguities as 'Your chair hangs on your coat.' or 'Do you mean what I understand?'. For people speaking more than one language, this coordination between the selection of words and the construction of syntactic structures becomes even more complex, for the speaker then has to make sure that words and grammatical structures of the correct language are selected (Hartsuiker & Pickering, in press). Closely related languages (members of the same language family, e.g. Germanic languages, Romance languages, ...) often show strong structural similarities: prepositional object datives (The girl gives a bone to the dog) and double-object datives (The girl gives the dog a bone), for example, are structurally identical in English, Dutch, German, Swedish and Frisian. If a Dutch-English bilingual accidentally selected the grammatical structure for English double-object datives to form a Dutch sentence, this would therefore not even lead to a syntactic error. Transfer errors like 'We see us tomorrow!' (Wir sehen uns morgen!) or 'Where do we talk off?' (Waar spreken we af?) indicate, however, that even among closely related languages syntactic and morpho-syntactic rules cannot always be transferred from one language to another. Despite the apparent difficulties that may occur during bilingual language processing more than half of the world's population manages to use more than one language on an everyday basis (Grosjean, 1982). In many cases, these languages are not

even closely related: people living in South Africa, for example, may know related African languages such as siSwati, isiNdebele, isiXhosa and isiZulu. At the same time, most South Africans are able to speak and understand Germanic languages such as Afrikaans and English (Du Plessis, 2000)[1]. Most people suffering from a hearing impairment are also multilingual, because they know an oral language (in its written and – sometimes – also in its spoken modality) and one or more sign languages. Since monolingualism appears to be the exception, rather than the rule, it is essential to study the bilingual mind. In this thesis, we will investigate how bilinguals learn, use and store their different languages in memory. More specifically, we will focus on the representation of lexical-syntactic information in bilingual memory.

Most research on bilingualism has centered on bilingual visual word processing, focusing on the conceptual and lexical representations of words: Do bilinguals have two separate lexicons or are the words of both languages stored in one integrated lexicon? In recent years, experiments investigating bilingual word comprehension (lexical decision experiments) and production (naming and translation experiments) have yielded evidence for the latter option. It has been shown that the time-course of word processing in the target language is influenced by the activation of words in the non-target language (Dijkstra, Van Heuven & Grainger, 1998; Lemhöfer & Dijkstra, 2004; Van Hell & Dijkstra, 2002). Likewise, effects of semantic facilitation for translation equivalents suggest that conceptual representations can be shared between two languages (Grainger & Frenck-Mestre, 1998). Furthermore, the fact that greater facilitation is observed for cognates (*hotel-hotel*) than for translation equivalents (*bucket-emmer*) indicates that words that are identical in both languages of a bilingual have shared or at least overlapping lexical representations (Lemhöfer, Dijkstra & Michel, 2004;

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[1] All of the mentioned languages are official languages in South Africa, which counts 11 official languages since 1996 (isiZulu, isiXhosa, Afrikaans, Sepedi, English, Setswana, Sesotho, Xitsonga, siSwati, Tshivenda, isiNdebele).

Sánchez-Casas, Davis & Garcia-Albea, 1992). Though it is still debated how bilinguals control the access to the different languages they speak (Costa 2005; Costa, Santesteban & Ivanova, 2006), there is a great consensus among researchers in assuming that in the course of lexical access the lexical representations of the two languages of a bilingual become activated simultaneously (Costa and Caramazza, 1999). Thus, it is widely accepted that bilinguals have an integrated lexicon containing shared lexical and conceptual representations for words that are similar both languages.

Analogously, syntactic structures that are similar across languages could be shared in bilingual memory. This hypothesis originates from the observation that there appears to be a basic unity that underlies the immense diversity in the world's languages (Whaley, 1997), making that grammars do not vary randomly. According to Chomsky (1981), this unity is due to human biology: all humans are genetically endowed with a 'language faculty' containing a 'Universal Grammar' from which all grammars are constructed. From a functional perspective, this unity results from commonalities in the way language is put to use: Because different languages serve the same communicative tasks, languages evolve such that they exhibit the same structural similarities (Whaley, 1997). In any case, for any pair of languages, some structures will be grammatically similar across languages, while other structures will be different. Hence, it is interesting to investigate how such similarities affect the representation of syntactic structure in bilinguals: Is the syntax of each language stored separately (*separate syntax account*) or is the syntax shared across languages (*shared syntax account*)? Both accounts have their benefits: Syntactic sharing allows bilinguals to economize on storage capacity, because similar structures are represented only once. Furthermore, a shared syntax might facilitate code switching during a conversation (i.e. switching from one language to another in a sentence or between different sentences in dialogue), as the same syntactic store has to be accessed for sentence production in both languages of a bilingual. On the other hand, separate syntactic stores might allow for more efficient processing: As separate stores would only contain syntactic

structures for one of both languages, fewer constructions need to be taken in consideration when the bilingual is using one language at a time. This argument might be critical for languages that are not closely related: If only a few grammatical structures are similar across languages, the benefits of syntactic sharing might be equaled out because too many constructions need to be considered during syntactic processing in both languages. In that case, it might be better if the syntax of both languages is kept separate, even if this means that similar structures are represented twice (once in each language-specific store). Additionally, keeping the syntax of both languages separated minimizes the risk of making transfer errors (cf. supra).

Recently, a few studies have focused on syntactic processing in bilinguals (Desmet & Declercq, 2006; Hartsuiker et al., 2004; Loebell & Bock, 2003; Salamoura & Williams, 2006; 2007; Schoonbaert et al., 2007). As all of these studies have used syntactic priming, we will first explain how syntactic priming can be used to investigate the different representations that are involved in syntactic processing, before we turn to the different studies investigating cross-linguistic syntactic priming.

SYNTACTIC PRIMING AS A TOOL TO INVESTIGATE SYNTACTIC PROCESSING

One of the most frequently used methods to investigate sentence production processes is syntactic priming. Priming occurs when prior exposure to a stimulus facilitates subsequent processing of the same or a related stimulus: the word *butter*, for example, is read faster when it is preceded by the same word or by the semantically related word *bread* than when it is preceded by an unrelated word like *doctor* (Meyer & Schvaneveldt, 1971). Syntactic priming, then, is the phenomenon by which processing one utterance facilitates processing of another utterance on the basis of repeated syntactic structure. By examining which expressions prime which other expressions,

inferences can be drawn about the nature of syntactic representation and the processes involved in syntactic processing (Branigan, 2006).

Levelt and Kelter (1982) provided one of the earliest experimental observations of syntactic priming: They phoned shopkeepers in Nijmegen to ask them either *"What time does your shop close?"* or *"At what time does your shop close?"* and found that, in most cases, the shopkeepers' answers reflected the syntactic structure of the question (*"Five o'clock."* or *"At five o'clock."*). In Levelt and Kelter's experiment, however, the syntactic repetition could be tied to the close relationship between question-answer pairs. Furthermore, the participants in the experiment might have been aware of the prime-target relationship. To exclude these alternative explanations, Bock (1986) ran an experiment in which participants had to decide whether they had previously encountered certain sentences and pictures. The participants were instructed to repeat the sentences they heard and to describe the pictures that were presented, without being aware that some of the sentences were in fact primes for the following pictures. Bock discovered that participants were more likely to describe a picture of lightning striking a church using the passive sentence *"The church is being struck by lightning"* if they had just repeated a very different passive sentence such as *"The referee was punched by one of the fans"* than if they had just repeated an active sentence. Likewise, she found that prepositional object datives like *"The man is reading a story to the boy"* were more frequently used after prime sentences containing a prepositional object dative *"A rock star sold some cocaine to the undercover agent"* than after sentences containing a double-object dative *"A rock star sold the undercover agent some cocaine"*. Further syntactic priming experiments have shown that what is primed, is the abstract syntactic structure of sentences: syntactic priming occurs in the absence of open-class (Cleland & Pickering, 2003; Pickering & Branigan, 1998) and closed-class lexical repetition (Bock, 1989); it occurs when the thematic roles between prime and target differ, but not when prime and target are only superficially similar, but structurally different (Bock &

Loebell, 1990). Hence, it can be assumed that syntactic priming taps into abstract syntactic processing.

Since Bock's seminal study (1986) numerous syntactic priming experiments have been conducted to investigate the representations and the mechanisms involved in syntactic processing. Syntactic priming has been found for different syntactic constructions: transitives (Hartsuiker & Kolk, 1998a), datives (Hartsuiker & Kolk, 1998b; Hartsuiker, Bernolet, Schoonbaert, Speybroek & Vanderelst, 2008; Pickering & Branigan, 1998; Pickering, Branigan & McLean, 2002), noun phrases (Cleland & Pickering, 2003), and relative clauses (Ferreira, 2003). Although most studies have used English, the effects have also been found in Dutch (Hartsuiker & Kolk, 1998a, 1998b; Hartsuiker, Kolk & Huiskamp, 1999; Hartsuiker & Westenberg, 2000) and in German (Melinger & Dobel, 2005; Scheepers, 2003). Alternative methods include sentence completion (Pickering & branigan, 1998) and sentence recall (Potter & Lombardi, 1998).

Syntactic priming occurs not only during sentence production, but also during comprehension: the repetition of sentences facilitates the comprehension of sentences (Arai, Van Gompel & Scheepers, 2007; Branigan, Pickering & McLean, 2005; Noppeney & Price, 2004). Branigan et al. (2000) found syntactic priming between comprehension and production in dialogue, when participants merely heard the prime. Such priming appears to be particularly strong, in spoken (Branigan et al., 2000; Cleland & Pickering, 2003) and in written production (Hartsuiker et al., 2008). A possible explanation for these stronger effects in dialogue is that syntactic alignment during conversation facilitates mutual understanding (Pickering & Garrod, 2004). An interesting thing to notice is that people even tend to align with dialogue partners that are not visually present: Strong priming effects have also been obtained in dialogue when computer-mediated chatting was used to elicit responses (Hartsuiker et al., 2008).

In the syntactic priming literature two different explanations can be found for the phenomenon of syntactic priming. The implicit learning account (Chang, Dell, Bock & Griffin, 2000; Chang, Dell & Bock, 2006) argues that syntactic priming is a side effect of the implicit learning of syntax. According to the implicit learning model, the procedures for the production of syntax are continuously adjusted during the comprehension of sentences. Consequently, the corresponding syntactic procedures are more readily executed the next time a similar message has to be formulated. An important feature of this model is that it assumes that the processing of a sentence induces permanent changes to the production system. Hence, this account predicts that syntactic priming effects are long lasting. Furthermore, implicit learning models place syntactic priming outside the mental lexicon: They assume that abstract syntactic priming is not influenced by lexical overlap between sentences. With this assumption the implicit learning account is at right angles with the lexicalist model put forward by Pickering & Branigan (1998). Pickering and Branigan view syntactic priming as an effect of residual activation of syntactic representations, which are connected to the lexical representations of nouns and verbs. They assume that links between lemma nodes and the nodes specifying syntactic information (*combinatorial nodes*) are strengthened whenever these representations are simultaneously active. Consequently, the lexicalist model predicts that syntactic priming is stronger when the same verb or head noun is repeated in prime and target sentences. This 'lexical boost' of syntactic priming has been obtained in several studies (Branigan et al., 2000; Cleland & Pickering, 2003; Corley & Scheepers, 2002; Hartsuiker et al., 2008; Pickering & Branigan, 1998). The finding that syntactic priming can also be obtained by presenting single-verb primes (e.g., dative verbs that can exclusively be used with a prepositional object dative) yields additional evidence for the claim that syntactic information is linked to lexical items (Melinger & Dobel, 2005). On the other hand, studies showing that syntactic priming effects can be long-lasting (Bock & Griffin, 2000; Branigan, Pickering, Stewart & McLean, 2000; Hartsuiker et al., 2008) speak against a lexical-syntactic

model of sentence production: As in most activation models, the activation in the combinatorial nodes in Pickering & Branigan's model is assumed to decay quickly. Hence, this model cannot explain why priming persists when sentences with unrelated structures intervene between prime and target utterances.

<div align="center">

CROSS-LINGUISTIC SYNTACTIC PRIMING

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Hartsuiker et al. (2004) used syntactic priming as a tool to investigate syntactic processing in bilinguals. They had Spanish–English bilinguals describe cards to each other in a dialogue game (cf. Branigan et al., 2000). Participants first heard a prime description in their native language (henceforth L1), Spanish, and then had to describe the subsequent picture using their second language (henceforth L2), English. The experiment showed cross-linguistic syntactic priming for passive sentences: Spanish–English bilinguals tended to produce English passive sentences more often following a Spanish passive than following a Spanish active or an intransitive sentence. Because the grammatical structure of passives could be primed between Spanish and English, Hartsuiker et al. (2004) concluded that Spanish-English bilinguals have a shared syntactic representation for Spanish and English passive sentences and that the same grammatical rules are used to form passives in both languages.

In order to accommodate this finding, Hartsuiker et al. (2004) proposed a lexical-syntactic model of bilingual sentence production, which is a direct extension of the lexicalist model of Pickering and Branigan (1998). As already mentioned, Pickering and Branigan (1998) assume that combinatorial information such as the types of arguments a verb takes are represented at the lemma stratum, which is a level of lexical representation that encodes syntactic information (Levelt, Roelofs, & Meyer, 1999). In Pickering and Branigan's model, the lemmas of nouns and verbs are linked to combinatorial nodes (encoding combinatorial information), as well as

other nodes (category nodes and featural nodes). The combinatorial nodes are assumed to be shared across all lemmas they can combine with: The combinatorial node for the prepositional object dative (*The girl gives a bone the dog*), for example, is thus connected to the lemmas of all ditransitive verbs (i.e., verbs that can take two arguments: *give, lend, sell, offer, ...*). Furthermore, all lemmas are connected to at least one categorical node specifying its grammatical category (noun, verb, adjective) and to nodes containing featural information (gender, case and number in the case of nouns; number, person, tense and aspect in the case of verbs).

Hartsuiker et al. (2004) adapted this model such that it could explain bilingual sentence processing (see Figure 1). In Hartsuiker et al's model, the lemmas of nouns and verbs in both languages of a bilingual – in this case Spanish and English – are connected to the same category nodes and to the same combinatorial nodes: the English verbs *hit* and *chase* and their Spanish translation equivalents *golpear* and *perseguir* are all connected to the categorical node "Verb" and to the combinatorial nodes "Active" and "Passive". Furthermore, translation equivalents are assumed to share a conceptual representation: *hit* and *golpear* both link to the same semantic node, whereas *chase* and *perseguir* both link to another semantic node (Kroll & Stewart, 1994; cf. Costa, Miozzo, & Caramazza, 1999). All lemmas are tagged for their language (Spanish or English), by being linked to a ''Spanish'' or ''English'' language node (Dijkstra & Van Heuven, 2002; Van Heuven, Dijkstra & Grainger, 1998). As the combinatorial nodes in this model are not language-specific, the activation of a grammatical structure in itself does not determine the language of an utterance. Instead, the language of the utterance is dependent on the choice of lexical items that are inserted into this structure: If the combinatorial node for passive sentences is activated in combination with the English verb *chase*, the eventual utterance will be an English passive (e.g., *The truck is chased by the taxi*), while the combination of the same combinatorial node and the lemma of the Spanish verb *perseguir* results in a Spanish sentence (e.g., *El camión es perseguido por el taxi*).
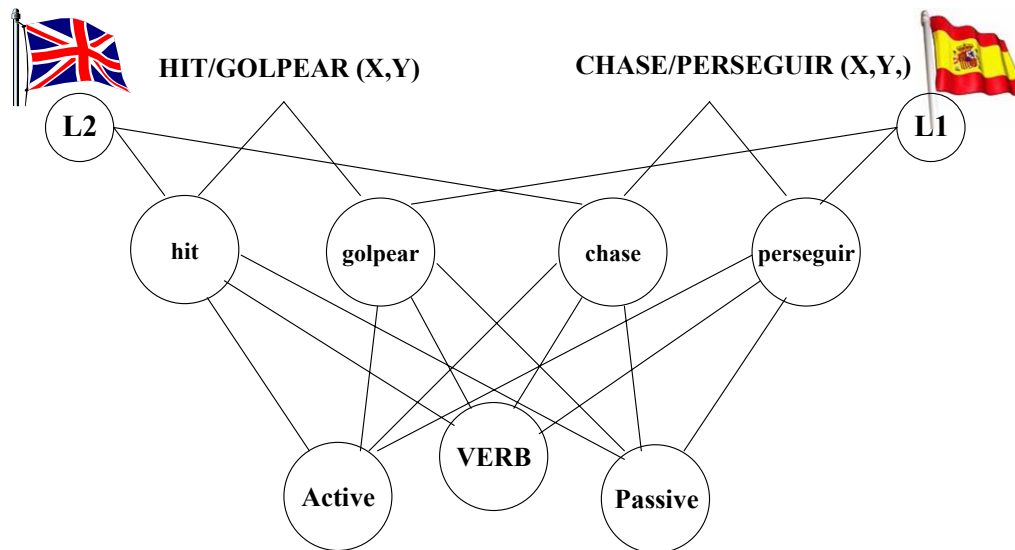
Figure 1: Hartsuiker et al.'s (2004) lexical-syntactic model of bilingual sentence production

Hartsuiker et al. (2004) assume that grammatical rules are shared between different languages, whenever these rules are sufficiently similar. Thus, they predict cross-linguistic syntactic priming for all structures that are sufficiently similar across languages. This hypothesis has been confirmed in several studies investigating syntactic priming between languages. Loebell and Bock (2003) investigated priming between German (L1) and English (L2) in both directions using a picture description task (Bock, 1986). Whereas significant priming was found between German and English datives (prepositional object datives and double object datives), no comparable priming effect was found for transitives (actives and passives). In the same study, between-language priming was only obtained for German datives, and not for German transitives, so the absence of cross-linguistic priming for transitives was not necessarily due to an absence of shared representations

for German and English actives and passives. Alternatively, differences in the word order of English (verb-medial word order) and German passives (verb-final word order) might make these structures dissimilar enough to receive separate syntactic representations.

Cross-linguistic priming has further been found for datives in Spanish-English bilinguals (Meijer & Fox Tree, 2003), Dutch-English bilinguals (Schoonbaert et al., 2007) and Greek-English bilinguals (Salamoura & Williams, 2007). In addition, Desmet & Declercq (2006) showed cross-linguistic syntactic priming is not tied to the repetition of function words across languages: they found that relative clause attachment (e.g., *The farmer fed the calves of the cow that..*, where the modifier starting with *that* can either be attached to ''calves'' or ''cow'') can be primed from Dutch to English. As in this study both prime structures contained the same words (only the gender of the relative pronoun differed, in order to disambiguate between high and low attachment), the obtained priming effect can only be structural in nature. Finally, Shin and Christianson (2007) obtained priming for datives between Korean and English, languages that are typologically very different and genetically unrelated. Though the linguistic distance between both languages of a bilingual might have an influence on the number of syntactic structures that can be shared (more closely related languages have more structures that are grammatically similar than less closely related languages), it does not seem to determine whether or not the syntax of two languages is represented separately in the bilingual mind.

The bilingual model of Hartsuiker et al. (2004) does not only assume that similar structures can be primed across languages; it also predicts that syntactic priming for shared structures is as strong between languages as it is within languages. Evidence for this claim was provided in a syntactic priming study by Schoonbaert et al. (2007). Using a single set of items to test priming for datives in Dutch-English bilinguals in all four directions of priming (L1 to L1, L2 to L1, L2 to L2 and L1 to L2) they obtained equivalent syntactic priming within and between languages. Analogous to

what has been found in within-language syntactic priming, Schoonbaert et al. also found that cross-linguistic syntactic priming can be 'boosted' by repeating related verbs between prime and target: Stronger priming was obtained when the verbs in prime and target were translation equivalents (*geven-give*) than when the verbs were unrelated (*verkopen-give*). This translation equivalence boost was significantly smaller than the lexical boost that was obtained within languages, as translation equivalents generally do not share the same lemma. Furthermore, it only occurred when participants had to describe pictures in their L2 (English), but not when they were using their L1 (Dutch). This led to the assumption that the lexical modulation of priming is target-based and that the connections between concepts and L2 lemmas are relatively weak (Kroll & Stewart, 1994). Because of these weaker connections between L2 lemmas and their concepts, L2 lemmas are not strongly co-activated during L1 sentence processing. Consequently, in priming from L2 to L1, the L1 target lemma (*geven*) does not strongly re-activate the L2 prime lemma (*give*), so that the priming effect is of a comparable magnitude as it is in the unrelated condition (with a prime like *show*). Conversely, in priming from L1 to L2, the L2 target lemma (*give*) strongly re-activates the L1 prime lemma (*geven*), with some activation spreading via the link between the lemma geven and the combinatorial node that has just been used with this lemma, yielding a translation equivalence boost.

The findings of Schoonbaert et al. (2007) called for an adaptation of Hartsuiker et al.'s (2004) model of bilingual sentence production: Firstly, their model does not specify whether between-language priming is prime-based or target-based. Furthermore, as the model does not assume that the link between shared concepts and L2 lemmas is weaker than the link between the same concepts and L1 lemmas, it incorrectly predicts an equally strong translation-equivalence boost when priming from L1 to L2 and vice versa. Therefore, in the adapted model of Schoonbaert et al. (2007) the links between the Dutch (L1) lexical representations and their concepts are stronger than the English (L2) lexical representations and their concepts

(Figure 2; DO stands for double object dative, PO stands for prepositional object dative. Stronger connections between different nodes [resulting in more spreading activation] are indicated by full lines; weaker connections between different nodes [resulting in less activation spreading] are indicated by dotted lines).
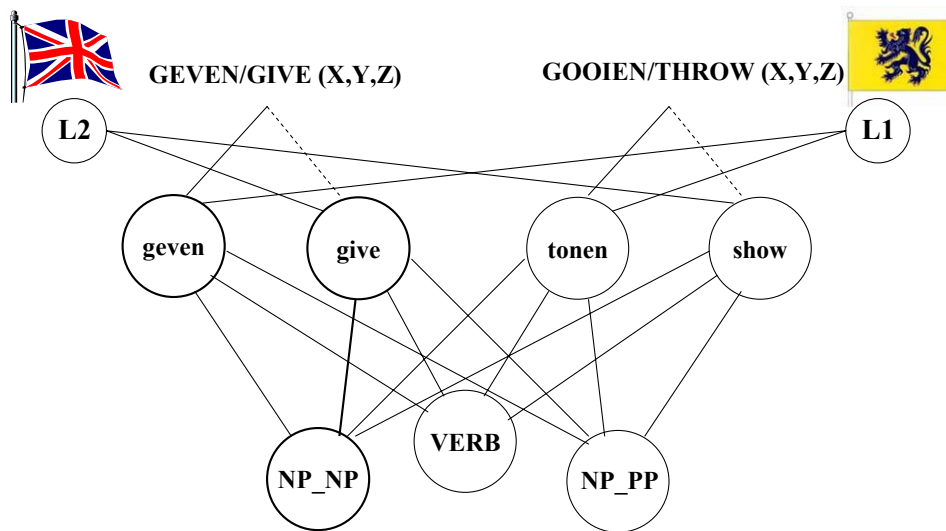
Figure 2: Schoonbaert et al.'s (2007) adaptation of the model of Hartsuiker et al. (2004).

LEXICAL-SYNTACTIC REPRESENTATIONS IN BILINGUAL SENTENCE PROCESSING

As may be suspected from the title of this thesis, we will conduct further research in order to investigate the representations and the mechanisms involved in bilingual sentence processing. Though Hartsuiker et al's (2004) and Schoonbaert et al's. (2007) lexical-syntactic models of bilingual sentence processing are supported by a wide range of studies (see Hartsuiker

& Pickering, in press) they are, in some respects, underspecified. Firstly, a lexical-syntactic account of bilingual syntax might provide a good model for the storage and use of structures that are identical across languages (i.e., actives and passives in Spanish and English; datives in Dutch and English), but not for structures that are not completely identical in both languages of a bilingual. Secondly, it is not clear how shared syntactic representations are established: Are new structures of the second language immediately shared with similar structures of the first language or are new L2 structures represented separately before they are merged with the representations of their L1 counterparts? And finally, does the syntactic preference of verbs and nouns influence syntactic priming? In this thesis, we try to answer these questions in order to move towards a more complete model of bilingual language processing.

THE INFLUENCE OF WORD-ORDER DIFFERENCES ON CROSS-LINGUISTIC SYNTACTIC PRIMING

The syntactic structures that were used in the studies by Hartsuiker et al. (2004) and Schoonbaert et al. (2007) are structurally identical in the languages under study. Spanish and English transitives and Dutch and English datives are conceptually and functionally identical, they have the same hierarchical structure and they have an identical word order. Though both studies showed that syntactic structures can be primed across languages, they can thus not be specific about the level of representation at which syntactic priming occurs. Several monolingual studies on syntactic priming have indicated that word order can be a determinant of the occurrence of syntactic priming (Hartsuiker et al., 1999; Hartsuiker & Westenberg, 2000; Pickering et al., 2002), suggesting that syntactic priming occurs at a level at which the constituents of a to-be-uttered sentence are placed in the right order. If cross-linguistic syntactic priming occurs at a level of production at which word order is specified, no between-language priming is predicted between syntactic structures that have a different word

order across languages. If, however, between-language priming is obtained for structures with different word orders, cross-linguistic priming can be assumed to originate from a shared structure at a higher level of representation. This higher level can then either be the constituent structure level, the functional level or the conceptual level.

The influence of word order differences on cross-linguistic syntactic priming was assessed in two studies. In a first study (Chapter 2), we investigated cross-linguistic syntactic priming for noun phrases in Dutch-English and Dutch-German bilinguals. Cleland and Pickering (2003) have found that the structure of noun phrases in which the adjective is placed before the noun (*the red shark*, henceforth AN-structure) and noun phrases in which the noun is followed by a relative clause containing the noun (*the shark that is red*, henceforth RC-structure) can be primed in English. In English, all relative clauses have a verb-medial word order, but in Dutch and German, relative clauses have a verb-final word order (*de haai die rood is/der Hai der rot ist*). Therefore, the RC-structure has a different word order in English compared to Dutch and German, while the AN-structure has an identical word order in all three languages.

In a series of 5 experiments, we investigated within- and between-language priming of Dutch, English and German AN- and RC-structures in order to find out whether or not between-language syntactic priming occurs at the positional level of sentence processing. An absence of cross-linguistic syntactic priming between Dutch and English RC-structures would indicate that priming occurs at the positional level, because in that case an identical word order is needed for syntactic priming to occur. Furthermore, the absence of priming between Dutch and English RC-structures would argue against the existence of constituent structure representations that are not yet specified for word order: If during the production of an RC-structure a constituent structure would be formed that specifies the hierarchical relations between its constituents, but not their ordering, between-language priming

would have to occur between Dutch and English RCs (different word order) as well as between Dutch and German RCs (identical word order).

In Chapter 3, we studied cross-linguistic syntactic priming for transitive sentences in Dutch-English bilinguals, in a further attempt to distinguish the different levels at which between-language priming can occur. Hartsuiker and Kolk (1998b) found that in Dutch, the word order of passive sentences can be primed: verb-final passives prime verb-final passives (*De bokser wordt door de non achtervolgd*), verb-medial passives prime verb-medial passives (*De bokser wordt achtervolgd door de non*), but both passives do not prime each other. The absence of within-language priming between these passives suggests that both structures do not share a representation at any level of production. Both forms are, however, functionally identical (i.e., their constituents have the same grammatical functions), so they might share a representation at the functional level.

In a series of 3 experiments, we investigated whether the level of functional assignment can be primed during the production of Dutch and English transitive sentences. We exploit the fact that Dutch has two word orders for the passive (verb-final and verb-medial word order) whereas English only has one (verb-medial word order). In a between-language priming experiment with Dutch primes and English targets, we can thus investigate whether passive priming still occurs when the word order of the passive prime can not be preserved in the target sentence. Passive priming in the absence of word order priming would indicate that functional representations are accessed during the comprehension and the production of Dutch and English transitives.

With the studies presented in chapters 2 and 3 we hope to contribute to the ongoing discussion about the levels of representation that are involved in syntactic processing in general, for any representation that produces priming between languages can be assumed to be involved in syntactic processing in both languages under study.

THE INFLUENCE OF SECOND LANGUAGE PROFICIENCY ON CROSS-LINGUISTIC SYNTACTIC PRIMING

Another aspect of Hartsuiker et al.'s (2004) model that has not yet been investigated is whether and how second language proficiency influences the representations in bilingual memory. In a recent paper, Hartsuiker and Pickering (in press) argue that from the moment that syntactic nodes are shared between languages, their shared syntax model does not predict an influence of L2 proficiency on syntactic processing. The level of second language proficiency might, however, influence whether or not representations are shared. It is not inconceivable that new syntactic structures of the second language initially receive separate, language-specific representations before they are merged with the existing L1 representations for these structures. Such an account of syntactic acquisition in L2 would predict that less proficient late bilinguals might not show between-language priming to the same extent as more proficient bilinguals. In order to test this hypothesis, we compared within- and between language priming for English genitives (e.g., *the rose of the boy is blue* vs. *the boy's rose is blue*) in less proficient and more proficient Dutch-English bilinguals (Chapter 4). If more proficient bilinguals show stronger between-language priming than less proficient bilinguals, it is clear that a certain level of L2 proficiency is required before syntactic structures can be shared across languages.

THE INFLUENCE OF VERB BIAS ON SYNTACTIC PRIMING

Lexicalist models of sentence production (Hartsuiker et al. 2004; Pickering & Branigan, 1998; Schoonbaert et al., 2007) predict that syntactic priming can be modulated by lexical repetition: Active links between the lemmas of nouns and verbs and the combinatorial nodes they can combine with can increase the preference for a certain syntactic structure. This lexical enhancement of syntactic priming is mostly short-lived: Hartsuiker et al. (in press) only obtained a lexical boost of dative priming if the target

immediately followed the prime sentence. However, as verbs do not always occur equally frequently with their different syntactic alternatives, the production system should somehow 'remember' that a certain verb was combined with a certain syntactic structure. In order to investigate whether the system learns the probability of a syntactic construction given a certain verb, we compared the strength of dative priming for DO-biased (e.g. *aanbieden* (to offer)), PO-biased (e.g. *verkopen* (to sell)) and neutral prime verbs (e.g. *tonen* (to show)) in Dutch (Chapter 5). In a first experiment, the same verbs were used in prime and target structures. In a second experiment, we investigated whether an effect of prime verb bias could still be obtained if an unrelated verb had to be used in the target sentence.

This study aims to broaden the discussion about the underlying mechanisms behind syntactic priming: an influence of verb bias on syntactic priming is not predicted by the lexicalist account of syntactic priming (Pickering & Branigan, 1998) or by current models of implicit learning (Chang, Dell, Bock & Griffin, 2000; Chang, Dell & Bock, 2006). We argue that both accounts are not necessarily mutually exclusive and plead for an integration of lexical and implicit learning models of syntactic production.

CHAPTER 2
SHARED SYNTACTIC REPRESENTATIONS IN BILINGUALS: EVIDENCE FOR THE ROLE OF WORD-ORDER REPETITION

Studies on syntactic priming strongly suggest that bilinguals can store a single integrated representation of constructions that are similar in both languages (e.g., Spanish and English passives; Hartsuiker et al., 2004). However, they may store two separate representations of constructions that involve different word orders (e.g., German and English passives; Loebell & Bock, 2003). In five experiments, we investigated within- and between-language priming of Dutch, English, and German relative clauses. We found priming within Dutch (Experiment 1) and within English as a second language (Experiments 2 and 4). Importantly, priming occurred from Dutch to German (Experiment 5), which both have verb-final relative clauses; but it did not occur between Dutch and English (Experiments 3-4), which differ in relative-clause word order. The results suggest that word-order repetition is needed for the construction of integrated syntactic representations.

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[1] This paper was co-authored by Robert Hartsuiker and Martin Pickering

INTRODUCTION

The study of sentence production presents us with an interesting paradox of the language system: Although speakers have the linguistic competence to produce and comprehend an unlimited number of different sentences, they tend to repeat the same syntactic structures over and over again. Research on syntactic priming has shown that speakers tend to re-use the syntactic structures that they have recently encountered. For example, when two syntactic alternatives with roughly the same meaning are available to describe a given picture or to complete a sentence (e.g., *The dog chases the cat – The cat is being chased by the dog*), people are inclined to use the structure they have just read or heard as a prime (e.g., Bock, 1986; 1989; Bock & Loebell, 1990; Branigan, Pickering, & Cleland, 2000; Corley & Scheepers, 2002; Hartsuiker, Kolk & Huiskamp, 1999; Hartsuiker & Westenberg, 2000; Pickering & Branigan, 1998). This tendency to repeat syntactic structure even occurs between languages in bilinguals (Hartsuiker, Pickering, & Veltkamp, 2004; Loebell & Bock, 2003), suggesting that similar syntactic structures have a shared representation between different languages. However, these studies did not ask *how similar* syntactic structures need to be in order to have a shared representation. For example, an important domain of cross-linguistic syntactic variation is word order (Greenberg, 1963). It is possible that bilingual syntactic representations abstract from the details of word order, so that otherwise similar structures that merely differ in word order across languages have a shared representation. But it is also possible that word order is an integral part of syntactic representations, so that structures that differ in word order across languages are represented separately for each language. We use cross-linguistic syntactic priming to distinguish between these alternatives.

Studies on bilingual language processing have focused on the extent to which bilinguals have separate representations for their languages and the

extent to which they use a single, integrated representation. However, the great majority of work has been concerned with the representation of words: Do bilinguals have two separate lexicons or are the words of both languages stored in one integrated lexicon? In recent years there has been much evidence for the latter option. Thus, the time-course of word processing in the target language is influenced by the activation of words in the non-target language (Dijkstra, Van Heuven & Grainger, 1998; Lemhöfer & Dijkstra, 2004; Van Hell & Dijkstra, 2002). Likewise, effects of semantic facilitation for translation equivalents suggest that conceptual representations can be shared between two languages (Grainger & Frenck-Mestre, 1998). Larger facilitation effects for cognates (*film – film)* as compared to translation equivalents (*aap – monkey*) seem to indicate that word forms that are identical in two languages have a shared concept (Van Hell & De Groot, 1998), and a shared or at least overlapping lexical representation (Lemhöfer, Dijkstra, & Michel, 2004; Sanchez-Casàs, Davis, García-Albea, 1992). Analogously, bilinguals could have shared representations for syntactic structures that are similar in two languages.

Syntactic representations can be investigated in syntactic priming experiments, in which participants typically describe pictures of everyday objects or events (e.g., Bock, 1986). The critical pictures can be described using two (or more) syntactic structures that have very similar meanings (e.g., *lightning strikes the church* vs. *the church is struck by lightning*). Before the picture is presented, participants hear or read a prime sentence using a particular syntactic form. Syntactic priming occurs when participants more often describe a picture using a particular structure after they have just encountered that structure than after they have just encountered the alternative structure. Alternative methods include sentence completion (Pickering & Branigan, 1998) and sentence recall (Potter & Lombardi, 1998). Syntactic priming occurs for different syntactic constructions, such as transitives (Bock, 1986; Hartsuiker & Kolk, 1998a), datives (Bock, 1986; Pickering & Branigan, 1998; Hartsuiker & Kolk, 1998b; Pickering, Branigan & McLean, 2002), noun phrases (Cleland & Pickering, 2003), and relative

clauses (Ferreira, 2003). Most studies have used English, but the effects have also been found in Dutch (Hartsuiker & Kolk, 1998a, b; Hartsuiker et al., 1999; Hartsuiker & Westenberg, 2000) and in German (Scheepers, 2003).

Syntactic priming occurs not only during sentence production, but also during comprehension: The repetition of syntactic structure facilitates the comprehension of sentences (Arai, Van Gompel, & Scheepers, 2007; Branigan, Pickering, & McLean, 2005; Noppeney & Price, 2004). Branigan, Pickering, and Cleland (2000) found syntactic priming between comprehension and production in dialogue. Such priming appeared to be particularly strong (though there has been no direct comparison with monologue).   A possible explanation is that syntactic alignment during conversation facilitates mutual understanding (Pickering & Garrod, 2004). Furthermore, Pickering and Branigan (1998) found that syntactic priming is enhanced by lexical repetition: Priming effects for dative sentences were stronger when the head verb was repeated across prime and target sentences than when a different verb was used. However, syntactic priming also occurred in the absence of lexical repetition between prime and target structures, as in many other studies (e.g., Bock, 1986). This indicates that the effects are not just due to lexical repetition: Priming seems to operate at a fairly abstract level of representation.

Monolingual studies on syntactic priming have suggested that word order can be a determinant of the occurrence of syntactic priming (Hartsuiker et al., 1999; Hartsuiker & Westenberg, 2000; Pickering et al., 2002). Hartsuiker et al. found that word order by itself can be primed. In the experiment, the syntactic alternatives that were used as primes were identical with respect to functional and hierarchical relations between constituents, and only the word order differed (1a-1b).

(1a) Op de tafel ligt een bal

[On the table lies a ball]

(1b) Een bal ligt op de tafel

[A ball lies on the table]

Their experiment showed that word order did persist: After a prime sentence with a given word order, speakers were more likely to re-use that specific word order than to use the alternative order. Although these data suggest that word order can be primed, an alternative explanation attributes these effects to conceptual priming (the topic-comment structure differs between 1a and 1b). However, Hartsuiker and Westenberg found persistence of the order of auxiliary and participle in Dutch (2a and 2b).

(2a) Ik kon er niet door omdat de weg was geblokkeerd

[I couldn't pass through because the road was blocked]

(2b) Ik kon er niet door omdat de weg geblokkeerd was

[I couldn't pass through because the road blocked was]

As auxiliaries are function words without any intrinsic meaning, they cannot cause conceptual priming. On the basis of these results, Hartsuiker et al. (1999) and Hartsuiker and Westenberg (2000) concluded that constituent structure is underspecified for word order. Following Kempen and Hoenkamp (1987) and De Smedt (1990), they assume that after a constituent structure is constructed, a subsequent linearization process imposes word order on that structure. This two-stage model of syntax production allows for incremental processing: As soon as a unit is constructed at the constituent structure level, it can be transferred to the linearization process. Constituents that are constructed early (because they are highly accessible) are placed as early as possible in the sentence. This minimizes the need to buffer constituents and hence facilitates sentence formulation (cf. Ferreira, 1996).

The two-stage model was challenged, however, by Pickering et al. (2002). They tested priming with English "shifted" datives, in which the prepositional phrase preceded the noun phrase (3a).

(3a) The captain gave to the old sailor the spare lifejacket

(3b) The captain gave the spare lifejacket to the old sailor

Although shifted datives and prepositional datives (3b) arguably constitute different forms of the same construction, there was no priming from shifted datives to prepositional datives, suggesting that these structures do not share a representation of their common constituent structure that is not yet specified for word order. Pickering et al. therefore concluded that constituent structure is formulated in one stage: Pre-syntactic representations are mapped onto representations that are fully specified syntactically. According to this view, word order is part of constituent structure.

SYNTACTIC PRIMING ACROSS LANGUAGES

A few recent studies have examined syntactic priming across languages. Because syntactic constructions are often quite similar in different languages, it is important to investigate how such similarity affects the representation of syntactic structure in bilinguals. Is the syntax of each language stored separately (*separate-syntax account*) or is syntactic information shared between the languages (*shared-syntax account*)? According to the *shared-syntax* account, people who know English, Dutch, and French have only one representation for the structure of the English question '*Is he ill*?' and the Dutch translation of that question '*Is hij ziek*?' as these questions are structurally similar in the two languages. In contrast, a French translation of that question, '*Est-ce qu'il est malade*?', probably does not share a representation with either the Dutch or the English sentence, as this sentence is formed by applying different syntactic rules (e.g., to introduce the interrogative particle *est-ce que* and to capture the order of

subject and auxiliary). So the shared-syntax account claims that representations are shared whenever possible.   But according to the *separate-syntax* account, all three sentence structures are represented separately, irrespective of the formal similarity between the English and the Dutch sentences.

As stated above, the existence of shared representations for syntactic structures of different languages can be studied using syntactic priming. For example, if the same syntactic representation is activated in order to produce English and Dutch passive sentences (*The boy is being hit by a baseball* and *De jongen wordt getroffen door een honkbal)*, then it should be possible to prime the use of Dutch passive sentences by presenting English passives and vice versa. The occurrence of syntactic priming across languages would therefore provide evidence for the shared-syntax account.

Loebell and Bock (2003) presented some evidence for this account. They found cross-linguistic syntactic priming between German (first language, henceforth L1) and English (a later acquired language, henceforth L2), in a picture description task (L1 → L2 and L2 → L1). They used datives [prepositional (PO) and double-object (DO) datives) and transitives (actives and passives)]. The participants first repeated a prime sentence in either their first or their second language and then described a picture in the other language. They found that German datives (4a, 5a) were primed by English datives (4b, 5b) and vice versa. For transitives (6a, 6b, 7a, 7b), however, no cross-linguistic priming was found.

4a)   Der kleine Junge schrieb seinem Brieffreund einen Brief.

[The little boy wrote his pen pal a letter]

(DO - German)

4b)   A boy is giving a girl a present.

(DO - English)

5a)   Der kleine Junge schrieb einen Brief an seinen Brieffreund

[The little boy wrote a letter to his pen pal]

(PO - German)

5b) A boy is giving a present to a girl.

(PO-English)

6a) Der chemische Abfall vergiftete den Fluss.

[The chemical waste poisoned the river]

(Active - German)

6b) The fire hydrant is squirting a firefighter

(Active - English)

7a) Der Fluss wurde von dem chemischen Abfall vergiftet.

[Lit. The river was by the chemical waste poisoned]

(Passive-German: verb-final)

7b) The firefighter is being squirted by a fire hydrant

(Passive-English: by-phrase final)

Loebell and Bock argued that the absence of cross-linguistic priming for passives could be explained in terms of the word-order differences between English and German passives. In English, the *by*-phrase is placed at the end of the sentence, whereas in German, the past participle comes at the end of the sentence, and is preceded by the *by*-phrase (cf. 7a and 7b). However, they repeated the experiment with German primes and targets. In this within-language experiment, there was no significant priming effect with transitives either. Thus, the absence of cross-linguistic priming may have resulted from an absence of syntactic priming with German transitives in general.

Hartsuiker et al. (2004) did find significant cross-linguistic priming for transitive sentences. They had Spanish-English bilinguals describe cards to each other in a dialogue game (cf. Branigan et al., 2000). Participants first heard a prime description in their L1 (Spanish) and then had to describe the subsequent picture using their L2 (English). The experiment showed cross-

linguistic priming for passive sentences: Spanish-English bilinguals tended to produce English passive sentences more often following a Spanish passive than following a Spanish active or an intransitive sentence. In Spanish and English however, passive sentences have an identical word order (see 8). Hence, cross-linguistic priming of transitives can occur when the word order of the sentences is the same.

8a)   The truck is chased by the taxi.

8b)   El camión es perseguido por el taxi.

Cross-linguistic priming (L1 → L2 and L2 → L1) also occurs for dative sentences in Spanish-English bilinguals (Meijer & Fox Tree, 2003) and in Dutch-English bilinguals (Schoonbaert, Hartsuiker, & Pickering, 2007). Meijer and Fox Tree used a sentence recall task (Lombardi & Potter, 1998), and found that English dative sentences with a double-object structure are more often falsely remembered as datives with a prepositional object after Spanish datives containing a prepositional object than after Spanish primes that contain no prepositional object. However, their task was very demanding: Many participants could not remember more than half of the target sentences correctly. This resulted in a great loss of data, as these participants were excluded from the analyses. Moreover, the items in this study were not rotated across conditions, so there is a possibility that these priming effects were due to item idiosyncrasies.

Using spoken dialogue, Schoonbaert et al. (2007) found priming in L1 (Dutch), in L2 (English), and between L1 and L2 (in both directions) for dative sentences. Within-language priming was enhanced when the verb was repeated between prime and target (as in Pickering & Branigan, 1998, Branigan et al., 2000, Corley & Scheepers, 2002, and Cleland & Pickering, 2006) in L1 and L2. Cross-linguistic priming was enhanced when prime and target verbs were translation equivalents, but only when priming from L1 to L2.

The cross-linguistic syntactic priming effects discussed above could in theory be due to lexical priming of translation-equivalent function words between languages (e.g., from *por* to *by* in Hartsuiker et al., 2004). This explanation is unlikely because there is no evidence for any effect of function word repetition on within-language syntactic priming (Bock, 1989; Fox Tree & Meijer, 1999). Moreover, Desmet and Declercq (2006) showed that relative clause attachments (e.g., *Someone shot the servant of the actress who was on the balcony*, where the servant or the actress can be on the balcony) can be primed from Dutch to English in Dutch-English bilinguals. As the same words are used for both attachments, these results show that abstract structure can be primed.

In addition, cross-linguistic priming effects can be lexically triggered. Salamoura and Williams (2006) found L1 to L2 priming in a sentence completion task when participants simply read an isolated verb as the prime: More English prepositional object datives were produced after Dutch verbs that could only take a prepositional dative [e.g., *uitreiken* (present)] than after verbs that could only take a double-object dative [e.g., *besparen* (save)] and vice versa.

All six studies on syntactic priming across languages provide evidence for shared syntactic representations between languages. Cross-linguistic syntactic priming (L1 → L2 and L2 → L1) has been found for different syntactic structures (transitive sentences, dative sentences, relative clause attachment) and between different pairs of languages (German-English, Spanish-English, and Dutch-English). The only case in which priming did not occur and hence there is no evidence for shared representations is passive sentences in German-English bilinguals (Loebell & Bock, 2003).

THE EFFECT OF WORD ORDER ON CROSS-LINGUISTIC PRIMING OF SYNTACTIC STRUCTURE

As the results of several within-language priming studies suggest that word order influences syntactic priming, the most obvious explanation for the absence of cross-linguistic priming between German and English passives (Loebell & Bock, 2003) is differences in word order. In our study, we focused on the adjectival modification of nouns. In English, a noun can be modified by an adjective in two ways: Either the adjective is placed before the noun (9a, henceforth *AN-structure*), or the noun is followed by a relative clause containing the adjective (9b, henceforth *RC-structure*):

9a)   the red shark

9b)   the shark that is red

Cleland and Pickering (2003) showed priming of syntactic structure of noun phrases (i.e., AN- vs. RC-structures) in English. More RC-structures were produced following an RC-structure than following an AN-structure. Furthermore, just as with dative sentences, the priming effect for noun phrases was 'boosted' by lexical repetition: Though priming was obtained when prime and target descriptions contained different head nouns, the effect was larger when they contained the same head noun.

In this study, we first investigate such priming effects in Dutch as L1 (Experiment 1) and in English as L2 (Experiment 2). Our main question is, however, whether there is cross-linguistic priming for these types of noun phrases. Both the AN-structures and the RC-structures are comparable in Dutch and in English. But whereas the AN-structures have identical word order (see 10a-b), the RC-structures have a different word order in Dutch and English (see 11a-b). In German, both the AN-structures and the RC-structures have a word order that is identical to that of the Dutch AN- and RC-structures (see 10c & 11c).

10a)	the red shark	*AN-structure, English*
10b)	de rode haai	*AN-structure, Dutch*
10c)	der rote Hai	*AN-structure, German*
11a)	the shark that is red	*RC-structure, English*
11b)	de haai die rood is	*RC-structure, Dutch*
11c)	der Hai der rot ist	*RC-structure, German*

In Dutch and in German, the adjective (*rood* or *rot*) is placed between the relative pronoun and the verb of the relative clause (see 11b & 11c), whereas in English, the adjective (*red*) is placed at the end of the relative clause (see 11a). The order of the adjective and the verb of the relative clause could influence the occurrence of cross-linguistic priming. If word order equivalence is necessary for syntax to be shared between languages, then we should not find priming of RC-structures between Dutch and English. However, we should find priming of RC-structures between Dutch and German. If word order equivalence is not necessary for syntax to be shared between languages, we should obtain priming of RC-structures between Dutch and English. In addition, we might find priming of AN-structures between Dutch and English and between Dutch and German.

If word order equivalence is indeed necessary for cross-linguistic priming, this would provide evidence against two-stage models of bilingual sentence production. If syntactic structures are constructed in two stages, there might be a common representation for RC-structures, irrespective of word order. Hence, cross-linguistic priming of these structures could be expected to occur not only between Dutch and German, but between Dutch and English as well (to a lesser extent, as between Dutch and English only the common representation could be primed, whereas between Dutch and German both the common representation and the word-order specific representation could cause priming). According to the single-stage account, structures that have different word orders cannot be shared. Accordingly, an absence of cross-linguistic priming between Dutch and English RC-

structures is predicted. We assume that the AN-structure is so greatly favored that we expect most – if not all - priming to be driven by the RC-structures (see the introduction of Experiment 3a & b for a more detailed discussion). Because the RC structures would be driving the effects, the predictions depend on whether the RC is similar or different across languages.

We investigated cross-linguistic priming of noun phrases in four experiments. In Experiment 3a, we studied priming from Dutch (L1) to English (L2) and in Experiment 3b we studied priming from English (L2) to Dutch (L1). In Experiment 4, we compared priming within English (L2) and priming from Dutch (L1) to English (L2) in a within-participants design. In Experiment 5, we studied priming from Dutch (L1) to German (L2). But first we examined priming for noun phrases in two within-language experiments, conducted in Dutch (L1) and English (L2). All experiments used a computerized version of the 'dialogue game' (similar to Schoonbaert et al, 2007). The prime sentences were produced by a confederate, who pretended to be a participant in the experiment. The confederate and the participant took turns to describe pictures that were presented on a computer screen (with the confederate and the participant each looking at his or her own computer screen, so that the participant could not see that the confederate saw prime sentences instead of pictures).

EXPERIMENT 1: DUTCH (L1) TO DUTCH (L1) PRIMING

This experiment tested whether noun phrase structure can be primed in Dutch. The design of this experiment is based on Experiment 1 of Cleland and Pickering (2003), but differs in that we used pictures of everyday objects rather than geometrical figures and that we presented the stimuli on a computer screen rather than on cards.

METHOD

Participants. Thirty-two first-year psychology students at Ghent University (22 females and 10 males) participated in exchange for course credit. All participants were native speakers of Dutch and had normal or corrected-to-normal vision. A female PhD student (with Dutch as L1) acted as confederate.

Materials. Three sets of 48 pictures were constructed for the participants, one response set and two description sets. Each picture displayed a 4 x 4 grid of objects, so that each row contained four versions of a particular object (e.g., a baby) each of a different color (red, yellow, green, or blue); within each column the color of the objects was the same (Figure 1). The four objects were always a target object, a semantically and phonologically unrelated control object, and two filler objects. Next to each of the 16 objects a letter from 'a' to 'p' was printed. Each of the 24 possible orders of objects (target object, control object, and two filler objects) and each of the 24 possible orders of the colors of the columns occurred equally often. The pictures in both the response set and the description sets were identical, apart from the fact that in the description sets either the prime object or the control object was framed in a black rectangle. In addition to the 48 critical pictures, there were four filler pictures in the three sets, each depicting four objects that appeared as filler objects in the critical pictures.
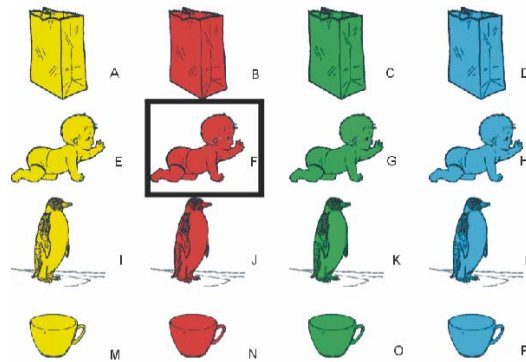
Figure 1: Example of a target picture. The target object is framed in a black rectangle

The confederate's description and response sets did not contain pictures, but phrases. The confederate's description set contained descriptions for the objects in each of the pictures in the participant's response set. These prime descriptions could have an AN-structure (12a) or an RC-structure (12b).

(12a) de rode baby

[the red baby]

(12b) de baby die rood is

[Lit. the baby that red is. (i.e., the baby that is red)]

An item was defined as the pairing of a confederate's prime sentence with the description of a target picture. In the same-object conditions, the noun that was used to describe the upcoming target object (the target noun) was the same noun as the one that was used in the prime description (the prime noun); in this case, *baby*. In the different-object conditions, the unrelated control object (*penguin*) was selected as target picture. In this case, the prime and target nouns were semantically and phonologically unrelated. The prime nouns and their unrelated controls had the same number of

syllables and were matched for prosody. In Experiments 1-4, half of the prime nouns were Dutch-English cognates with an identical orthographic form (e.g., *baby - baby*), and half were translation equivalents with an unrelated orthography in Dutch and English (e.g., *ananas – pineapple*). In Experiment 5, 26 out of the 48 target items were Dutch-German cognates. However, no experiment revealed any effects of the cognate status of the items that were used. Therefore this factor was removed from the analyses of all experiments. All prime and target nouns had common (non-neuter) gender, so that for all nouns the same determiner (*de [the]*) and the same relative pronoun (*die [that]*) could be used. The colors of prime and target objects were always different (see Appendix 2A for a list of items).

Four counterbalanced pseudo-random lists were constructed so that each target object was preceded by the same object in two lists (same-object conditions) and by a different object in the two other lists (different-object conditions). Both in the same-object and the different-object conditions the target picture was preceded by an AN-description in two lists and by an RC-description in the two other lists. Within each list, there were 12 AN and 12 RC prime sentences in the same-object condition and 12 AN and 12 RC prime sentences in the different-object condition. For each of the four lists, the trials were presented in the same pseudo-random order. At the beginning of each list, four filler trials were presented, one in each prime condition. The primes for these filler trials were counterbalanced across the four lists. Each participant was presented with one of these four lists.

Procedure. Though participants were tested individually, they were under the misapprehension that they were tested in pairs because the confederate pretended to be the second participant in the experiment. Both the participant and the confederate were seated in front of a PC, and they were told that they would be playing a dialogue game: They would have to describe pictures to each other and verify each other's descriptions (see Figure 2). Confederate and participant were seated opposite each other, with the PCs between them. Neither of them could see what appeared on the opposite screen. First, they

were familiarized with the material in a study session, where each of the 192 objects (48 prime objects, 48 control objects, and 96 filler objects) was presented together with its name. The participant and the confederate were instructed to look at the pictures and to memorize the corresponding names. After that, the participant's first response picture was shown in order to explain how the objects were arranged on the screen and how the participants were supposed to respond. The use of either AN- or RC-structures was avoided in the instructions. Instead, both dialogue partners were told that they would have to mention the name of the object that was depicted and its color, because every object could have four different colors. They were informed that their speech would be recorded on minidisk. The program for the participants always showed a response picture as first picture. In this way, we ensured that the confederate would always be able to take the first turn.

The participant and the confederate performed phrase/picture matching while their dialogue partner was speaking. The participants responded to the confederate's prime descriptions by typing the letter printed next to the object that was described to them. For each description of the participants, a combination of a color and a noun was presented to the confederate. The confederate had to tap the 'y'-key if this combination matched the participant's description. If either the color or the object was different, the confederate had to type the first letter of the word (the adjective or the noun) that did not match the participant's description. If both the color and the object were different, she had to tap the 'n'-key. We made the confederate's filler task rather complicated in order to avoid routine in the confederate's responses, because consistently fast responses by the confederate might arouse suspicion.
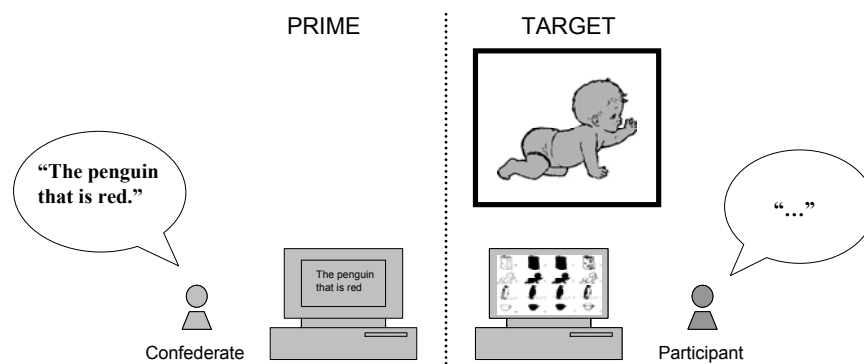
Figure 2: Computerized version of the dialogue game (the target object is framed in a black rectangle). During the experiment, the participants were seated opposite to each other, so they could not see what appeared on the computer screen of their dialogue partner.

The sequence of events during the experiment was as follows: 1) a picture appeared on the screen of the participant's PC (Figure 1, but without the black rectangle). This picture was necessary for the verification task; 2) the confederate read the prime description from the screen of her PC; 3) the participant responded to the prime description by typing the letter that appeared next to the object that matched the description. When any of the keys on the keyboard was pressed, the response picture automatically changed into a description picture. At the same time, a beep notified the confederate that the participant had responded; 4) at the sound of the beep, the confederate had to press '3', in order to change the prime sentence into a noun phrase. This noun phrase was necessary for the confederate's verification task; 5) the participant produced a description for the target object in the description picture that was framed by a rectangle (see Figure 1); 6) the confederate responded to the participant's description by pressing one of the keys on the keyboard. By doing this, the noun phrase was automatically replaced by the prime sentence for the next trial. At the same time, a beep notified the participant that the confederate had responded; 7) at the sound of the beep, the participant had to press '3', in order to make the response picture for the next trial appear on the screen. The experiment lasted about 15 minutes.

Scoring. The responses were recorded on minidisk, and were manually coded as AN or RC responses. A description was coded as AN when the adjective preceded the noun, and no words intervened between the adjective and the noun (e.g., 12b). A description was coded as RC when the adjective formed part of a relative clause following the noun, and the relative clause was introduced by die (that; e.g., 12a). Constructions with the same word order as the RC structure that did not contain a relative pronoun [e.g., de baby in het rood (literally, the baby in the red), de baby rood (literally, the baby red] were coded as Other. If the target noun was replaced by a synonym or a hyponym [e.g., vogel (bird) instead of eend (duck)], the response was still counted as an AN or an RC response in the different object condition. In the same object condition, only responses containing an exact repetition of the head noun were counted.

RESULTS

Four of the 1536 target responses were Other responses (0.3%). The remaining 1532 responses were classified either as AN (1367, 88.0%) or RC-responses (165, 10.7%). For all four priming conditions, we then calculated the proportion of RC-responses out of all RC and AN responses for each participant and item (the response frequencies are reported in Table 1). These proportions were subsequently arcsine-transformed (as were the RC-proportions of all other experiments reported in this paper).

ANOVAs were run on these transformed proportions with Prime Type (AN vs. RC prime) as a within-participant and within-item factor and Object Repetition (same vs. different object) as a within-participant and between-item factor. More RC-responses were produced after RC-primes (19.9%) than after AN-primes (1.6%). This 18.3% effect of Prime Type was significant [$F1$ (1, 31) = 22.96, MSE = 6.07, p <.001; $F2$ (1, 94) = 143.36, MSE = 7.31, p <.001]. There was a main effect of Object Repetition [$F1$ (1, 31) = 5.69, MSE = .21, p <.05; $F2$ (1, 94) = 6.05, MSE = .31, p<.05]. More

importantly, there was an interaction between Prime Type and Object Repetition [$F1$ (1, 31) = 6.31, MSE = .21, p <.05; $F2$ (1, 94) = 6.05, MSE = .31, p <.05]: The priming effect was larger in conditions where the object was repeated in prime and target pictures (21.8%) than in conditions where the object differed (14.8%). Separate analyses for each level of Object Repetition showed a significant effect of Prime Type for the same-object conditions [$F1$ (1, 31) = 22.92, MSE = 4.27, p <.001; $F2$ (1, 47) = 90.05, MSE = 5.31, p <.001] and for the different-object conditions [$F1$ (1, 31) = 18.06, MSE = 2.01, p <.001; $F2$ (1, 47) = 53.67, MSE = 2.31, p <.001].

Table 1: Response Frequencies of Experiment 1 (L1 → L1), Experiment 2 (L2 → L2), Experiment 3a (L2 → L1), and Experiment 3b (L1 → L2).

| Experiment | Prime Type | Object Type | | | | | |
| | | Repeated Object | | | Different Object | | |
		AN	RC	Other	AN	RC	Other
1: L1 to L1	**AN**	378	6	0	378	6	0
	RC	290	90	4	321	63	0
2: L2 to L2	**AN**	381	1	2	339	4	41
	RC	327	54	3	292	52	40
3a: L2 to L1	**AN**	186	0	6	186	0	6
	RC	188	2	2	185	1	6
3b: L1 to L2	**AN**	167	0	25	160	0	32
	RC	166	4	22	145	7	40

Note. L1 = native language; L2 = second language; AN = structure in which the adjective is placed before the noun; RC = structure in which the noun is followed by a relative clause containing the adjective.

DISCUSSION

This experiment showed a clear effect of syntactic priming and a lexical boost. Participants tended to use the syntactic structure they had recently encountered, and therefore they produced more RC-responses after RC-primes than after AN-primes. Moreover, this effect was stronger when the

head noun of the prime description (the object) was repeated in the target description than when it was not. Thus, we replicated the results of Cleland and Pickering (2003; Experiment 1). The syntactic priming effects were of similar magnitude in both studies (19% in Cleland & Pickering vs. 18% here), but the lexical boost was larger in Cleland and Pickering (15% vs. 8% here). Overall, rather few RC-responses were produced in our experiment. It is possible that the RC constructions are more strongly disfavored in Dutch than English. Alternatively, the low proportion of RC constructions in our experiment may reflect differences in procedure from Cleland and Pickering.

EXPERIMENT 2: ENGLISH (L2) TO ENGLISH (L2) PRIMING

Experiment 1 showed that noun phrase structure can be primed in Dutch. Before we can test for cross-linguistic priming of noun structure in Dutch-English bilinguals, we should investigate priming of noun phrases in English as a second language. Schoonbaert et al. (2007) found effects in L2 in Dutch-English bilinguals using dative structures, thereby replicating Branigan et al. (2000) for L2 English. To test whether we would obtain comparable results using noun phrases instead of dative structures, we replicated Experiment 1 using English translations of the stimuli and participants who were native Dutch speakers but bilingual in English.

METHOD

Participants. Thirty-two further students at Ghent University (25 females and 7 males) participated, in exchange for course credit or payment. All of them were native speakers of Dutch and had normal or corrected-to-normal vision. They all reported to have had at least 5 years of experience with English as a second language (mean number of years of experience = 10.6 years). A female undergraduate student (with L1 Dutch and L2 English) acted as a confederate.

Materials. The materials were identical to those in Experiment 1, except that the prime descriptions appeared in English, instead of in Dutch. The noun phrases that were used for the confederate's filler task were also in English.

Procedure and design. The procedure and the design were almost identical to those of Experiment 1. The only differences were related to the fact that in this experiment, the prime language and the target language were English, instead of Dutch. Hence, in the study session that preceded the experiment, every object was presented with its English name instead of its Dutch name. The objects were named in English by the experimenter, in order to reinforce participants' choice of words. The participants and the confederate were told that if they did not know or could not remember the English name of one of the objects during the experiment, they could use an English synonym or, if necessary, a hyponym (e.g., animal instead of lobster). If they could not think of another English word that adequately described the object in question, they could use the Dutch name of the object. Target descriptions containing Dutch nouns were counted as Other responses. In the different-object conditions, responses containing synonyms or hyponyms were counted as correct responses; in the same-object conditions, they were counted as Others. After this and all subsequent experiments, the participants were asked to rate their L1 (Dutch) and L2 (English) proficiency (L2 German proficiency in Experiment 5) with respect to several skills (reading, writing, speaking, general proficiency) on a 7-point scale ranging from very bad to very good (see Table 2 for the means of the self-ratings of L1 and L2 proficiency for Experiments 2-5). A one-way ANOVA on the self-ratings for L2 proficiency of Experiments 2-5 showed that the mean L2 proficiency did not differ significantly for any of the abovementioned language skills across experiments (all Fs < 2).

Table 2: Self-Assessed Ratings (7-Point Likert Scale Ranging From Very Bad to Very Good) of L1 and L2 Proficiency (Experiments 2, 3a, 3b, **4, and 5**)

Language	Skill	Exp. 2	Exp. 3a	Exp. 3b	Exp. 4	Exp. 5
L1 (Dutch)	Writing	5.47 (1.02)	5.81 (1.11)	5.75 (1.13)	6.22 (0.71)	5.71 (0.98)
	Speaking	5.72 (0.81)	5.75 (0.93)	5.88 (0.86)	6.16 (0.72)	5.79 (1.13)
	Reading	5.88 (1.04)	6.44 (0.73)	5.88 (0.72)	6.50 (0.57)	5.89 (0.96)
	General	5.75 (0.62)	5.51 (0.75)	5.56 (0.84)	6.25 (0.57)	5.86 (0.89)
L2 (English)	Writing	4.50 (0.84)	4.69 (1.20)	4.31 (1.08)	4.78 (1.07)	
	Speaking	4.81 (1.03)	4.69 (1.20)	4.50 (1.03)	5.06 (0.88)	
	Reading	5.38 (1.01)	5.50 (0.82)	5.31 (1.01)	5.78 (0.83)	
	General	4.84 (0.81)	4.94 (0.99)	4.81 (0.84)	5.16 (0.72)	
L2 (German)	Writing					4.54 (0.79)
	Speaking					4.43 (0.92)
	Reading					5.39 (0.86)
	General					4.64 (0.68)

Note: Standard deviations are indicated in parentheses. L1 = native language; L2 = second language

RESULTS

Eighty-six of the 1536 target responses were Other responses (5.6%). The remaining responses were classified either as AN (1339, 87.2%) or RC (111, 7.2%) responses (see Table 1 for the response frequencies in all conditions). ANOVAs were run on the proportions of RC responses with Prime Type (AN vs. RC prime) as a within-participant and within-item factor and Object Repetition (same vs. different object) as a within-participant and between-item factor. The mean proportion of RC-responses was larger after RC-primes (14.9%) than after AN-primes (0.7%), yielding a 14.2% effect of Prime Type [$F1$ (1, 31) = 17.42, MSE = 3.54, p <.001; $F2$ (1, 94) = 44.22, MSE = 3.80, p <.001]. There was no main effect of Object Repetition [$F1$ <1; $F2$ (1, 94) = 1.59, MSE = .15, p >.1] and no Prime Type x Object Repetition interaction [both Fs < 1]. The effect of Prime Type was of a similar magnitude in the same-object (13.9%) and the different-object conditions (14.5%). Separate analyses for each level of Object Repetition indicated that the effect of Prime Type was significant for both the same-

object conditions [$F1$ (1, 31) = 19.71, MSE = 1.87, p <.001; $F2$ (1, 47) = 25.40, MSE = 1.89, p <.001] and the different-object conditions [$F1$ (1, 31) = 10.65, MSE = 1.67, p <.005; $F2$ (1, 47) = 19.59, MSE = 1.90, p <.001].

DISCUSSION

These results show a very clear effect of syntactic priming in L2 English: More RC-descriptions were produced after RC-primes than after AN-primes. Similar effects occurred when the head noun was repeated in prime and target descriptions and when it was not. The absence of a lexical boost means that our results differ from Cleland and Pickering's (2003) results for L1 English. Note that the RC-proportions in the current experiment were lower than in Experiment 1 in all conditions. They were also lower than the RC-proportions in Cleland and Pickering (Experiment 1) in all conditions. The tendency to produce English RC-constructions appears to be weak for L2 participants. The low percentages of RC-productions in this experiment could explain the lack of a lexical boost. Another possibility is that a lexical boost in L2 is less evident for repeated nouns than for repeated verbs. We will return to this issue in the General Discussion. The fact, however, that we found significant priming of noun phrase structures in Dutch-English bilinguals in their L1 as well as in their L2, even in the absence of full lexical repetition, gives us reason to believe that we can study cross-linguistic priming of these structures in Dutch-English bilinguals.

EXPERIMENT 3: ENGLISH (L2) TO DUTCH (L1) AND DUTCH (L1) TO ENGLISH (L2) PRIMING

Experiment 3 investigated cross-linguistic priming of noun-phrase structure in Dutch-English bilinguals. More specifically, we wanted to know whether differences in word order can indeed influence cross-linguistic priming. Recall that Dutch and English RC structures have different word orders, with the adjective coming after the verb in English (*the baby that is red*) but

before the verb in Dutch (*de baby die rood is*). Therefore, a syntactic priming effect in this experiment would suggest that these languages share a syntactic representation for these structures that abstracts away from word order.

The results of Experiments 1 and 2 show that the percentage of AN structures was virtually at ceiling in primed conditions (98.4% in Experiment 1, 99.3% in Experiment 2). The percentage of AN responses was still very high in the RC-conditions (80.1% in Experiment 1, 85.1% in Experiment 2), so it seems that the AN structure is greatly preferred to the RC structure. As the preference for AN structures could hardly be increased, the priming effects in Experiments 1 and 2 were caused by priming of the RC, the structure that is less frequent. This observation is consistent with a number of studies that have shown that structures that were in general less preferred or less common were primed more than structures that were more preferred (Ferreira, 2003; Hartsuiker & Kolk, 1998b; see Ferreira & Bock, 2006 for review). If structures need to have the identical word order before their representations can be shared across languages, no effect of syntactic priming should occur between Dutch and English noun phrases with a relative clause (RC-structures). And if there is no cross-linguistic priming of the less frequent structure, we might not find any priming between Dutch and English noun phrases. In this experiment, we investigated priming from L2 to L1 (Experiment 3a) and from L2 to L1 (Experiment 3b).

METHOD

Participants. Thirty-two first-year Psychology students at Ghent University (1 male, 31 females) participated in exchange for course credit (16 participants in Experiment 3a, 16 participants in Experiment 3b). All participants were native speakers of Dutch and had normal or corrected-to-normal vision. They all reported to have had at least 5 years of experience

with English as a second or language (mean = 10 years). A male undergraduate student (with L1 Dutch and L2 English) acted as confederate.

Materials. The materials were identical to those in Experiments 1 and 2. In Experiment 3a, we used the English prime descriptions of Experiment 2 and the Dutch target pictures of Experiment 1; in Experiment 3b, we used the Dutch prime descriptions of Experiment 1 and the English target pictures of Experiment 2.

Procedure and design. The procedure was identical to that of Experiment 2, with the exception that the dialogue partners used different languages for their descriptions: In Experiment 3a the confederate produced English prime descriptions, while the participant produced Dutch target descriptions; in Experiment 3b, the primes were produced in Dutch and the targets had to be described in English. For this experiment, the pictures in the study session contained both the Dutch and the English names of each object. After the study session the experimenter assigned a target language to the participant and the confederate, making it look as if these languages were randomly assigned.

RESULTS

Experiment 3a: English (L2) →Dutch (L1). Strikingly, the participants produced only three RC-responses in the whole experiment. Twenty of the 768 target responses were scored as Other responses (2.6%). The remaining responses were classified either as AN (745 out of 768; 97.1%) or RC (3 out of 768; 0.4%) responses. The response frequencies are reported in Table 1. ANOVAs were run on these proportions with Prime Type (AN vs. RC prime) as a within-participant and within-item factor and Object Repetition (same-object vs. different-object) as within-participant and between-item factor.

The mean proportions of RC-responses were very low in all conditions, and the 0.8% effect of Prime Type was not reliable [F1 (1, 15) = 2.48, MSE = .003, p >.10; F2 < 1]. No other effects were significant and none of the reported main effects interacted with the factor Prime Type.

Experiment 3b: Dutch (L1) →English (L2). The number of RC-responses in Experiment 3b (11) was only slightly higher than in Experiment 3a. One hundred nineteen of the 768 target responses were scored as Other (15.5%). The remaining responses were classified either as AN (638 out of 768; 83.1%) or RC (11 out of 768; 1.4%) responses. The response frequencies are reported in Table 1. Because of the large number of Other responses, six items were discarded from the analyses. ANOVAs were run on the proportions of RC-responses with Prime Type (AN vs. RC prime) as a within-participant and within-item factor and Object Repetition (same-object vs. different-object) as a within-participant and between-item factor.

Again, the proportion of RC-responses was very low in all conditions. The 3.6% difference between RC primes and AN primes was not reliable [F1 (1, 15) = 1.56, MSE = .10, p >.10; F2 (1, 88) = 3.10, MSE = .07, p <.10]. The only marginally significant result was a main effect of Object Repetition [F1 (1, 15) = 3.61, MSE = .03, p <.01; F2 (1, 88) = 3.62, MSE = .22, p <.10]: More RC-responses were produced in the different-object conditions than in the same-object conditions. This main effect of Object Repetition did not interact with Prime Type [F1 (1, 15) = 1.71, MSE = .01, p >.10; F2 < 1]. No other effects were significant.

DISCUSSION

In Experiments 3a (L2 → L1) and 3b (L1 → L2) only 14 out of 1536 responses were RCs and no effect of Prime Type was obtained. Across both experiments, 26 out of 32 participants (81.2%) did not produce a single RC-description. These results strongly suggest that the syntactic priming effect that was observed in Experiments 1 and 2 does not survive in a cross-

linguistic task. However, it would be premature to conclude that noun phrase structure can only be primed within L1 Dutch and within L2 English, but not across these two languages, because so far we have only presented an indirect comparison (i.e., using different participants). The purpose of Experiment 4 was to provide a direct comparison.

EXPERIMENT 4: ENGLISH (L2) TO ENGLISH (L2) AND DUTCH (L1) TO ENGLISH (L2) PRIMING

In this experiment we compared within- versus between-language priming of noun phrase structure in a within-participants design. The target language was English. Participants received a within-language block of English prime descriptions and a between-language block of Dutch prime descriptions, in one or other order. In this way, we were able to compare within- and between-language priming directly. We chose to investigate priming from L1 to L2 because such priming may be more likely than L2 to L1 priming. Loebell and Bock (2003) found a trend toward more syntactic priming for datives from L1 (German) to L2 (English) than vice versa. And although Schoonbaert et al. (2007) found equivalent L1-to-L2 and L2-to-L1 priming for datives in the different verb conditions, the translation equivalence boost only occurred from L1 to L2. Furthermore, the numerical tendency to priming in Experiment 3b (4%) was stronger than the numerical tendency in Experiment 3a (1%).

Additionally, Experiment 4 followed the Cleland and Pickering (2003) study more closely than Experiments 1-3: It contained an equal number of critical trials and filler trials, the factor of Object Repetition was varied within-items, and the color of prime and target objects was kept constant in the critical trials. By keeping the colors of the prime and the target objects constant, we attempted to increase the priming effects: Cleland and Pickering found a strong tendency toward stronger syntactic priming when the adjective was repeated between prime and target than when it was not.

Furthermore, we counterbalanced the order of the within- and between-language blocks: For half of the participants, the within-language block was presented first; for the other half, the between-language block was presented first. Such counterbalancing aimed to control for any "spill-over" effects from one block to the next. This is important because syntactic priming effects can be long-lasting. For example, Bock and Griffin (2000) found that priming effects for English transitive and dative structures persisted over as many as 10 sentences. Additionally, Hartsuiker and Kolk (1998b) found more (transitive and dative) target responses in the experimental conditions than in a pre-experimental baseline condition, irrespective of prime type. They suggested that this difference in response frequency resulted from cumulative long-term priming of the target structures over the course of the experiment, making these structures more accessible than before the experiment.   Finally, Kaschak, Loney, and Borreggine (2006) found that repeated exposure to a construction at the beginning of an experimental session affected subsequent priming by an immediately preceding prime. In the same way, long-term priming could influence the response patterns in our experiments.

In Experiment 4, we presented both a within-language block and a between-language block. If the activation of different target structures is built up during an experiment, then the response patterns in the second block should be influenced by the responses in the first block. If the between-language block is presented first, we expect virtually all responses to have the AN-structure (given the results of Experiments 3a and 3b). Long-term, cumulative priming of the AN-structure could then 'spill over' to the subsequent within-language block, reducing the frequency with which RC-structures are produced, and thereby possibly reducing the priming effect caused by the RC-structures. In contrast, if the within-language block is presented first, we expect some responses to have the RC-structure (given the results of Experiment 2). Priming of the RC-structure could then 'spill over' to the subsequent between-language block. This could lead to a higher frequency of RC-structures than when the between-language block is

presented first. This gives the greatest chance of finding a cross-linguistic priming effect, if Dutch and English RCs do share a linguistic representation.

METHOD

Participants. Thirty-two students at Ghent University (23 females and 9 males) participated in exchange for a small monetary reward. All participants were native speakers of Dutch and had normal or corrected-to-normal vision. They all reported to have had at least 6 years of experience with English as a second language (mean = 13.4 years). A female undergraduate student (with Dutch L1 and English L2) acted as confederate.

Materials. The materials were the same as in Experiments 1-3, except that only the response pictures from the repeated-noun condition were used. These target pictures were used in the repeated-noun conditions as well as in the different-noun conditions. The prime descriptions were altered such that each target object was preceded by a prime sentence describing a semantically unrelated control object in half of the lists. In the other half, the target object was preceded by a prime sentence describing the same object. We also changed the colors in the prime sentences, so that prime and target objects had the same color. In order to have an equal number of critical trials and filler trials (i.e., 48), 44 filler picture pairs were added. In the filler trials, the prime object was never the same object as the target object. Furthermore, prime and target objects always had different colors in the filler trials. In this way, we had full repetition (object and color) between prime and target object for the critical trials in the same-object condition, partial repetition (only color) for the primes and targets in the different-object condition, and no repetition for the primes and targets in the filler trials.

For this experiment, we had 16 pseudo-random lists, instead of four. The lists now consisted of two blocks: a within-language block (English primes, English target descriptions) and a between-language block (Dutch primes, English target descriptions). Each block contained 48 trials, 24

critical trials, and 24 filler trials. Both blocks contained six critical trials in each of the four priming conditions. The order of the two blocks was counterbalanced across the 16 lists. Furthermore, the items in each block were swapped in half of the lists, so as to create a different trial order for half of the lists. Each block started with four filler trials.

Procedure and design. The procedure was identical to that of Experiments 1-3, except that the prime language was varied within the experiment. The experiment was split into two blocks: a within-language block and a between-language block. The order was counterbalanced across participants. After the first block was completed, the confederate and the participant were notified that they had reached the second part of the experiment. A short instruction followed, in which the experimenter explained that the language used by the confederate would switch either to English or to Dutch. After the break, the confederate again took the first turn in the dialogue. The experiment lasted about 30 minutes.

To summarize, the design of this experiment was different from the previous experiments in the following ways: 1) the factor Object Repetition was varied within items; 2) the prime language was varied within participants; 3) the extra factors Block Order and Trial Order were both manipulated between-participants and within-items. In other respects, the design stayed the same as the previous experiments.

RESULTS

Across all conditions, 45 of the 1536 target responses were Other responses (2.9%). The remaining responses were classified either as AN (1472 out of 1536; 95.8%) or RC (19 out of 1536; 1.2%) responses. The response frequencies of Experiment 4 are reported in Table 3. The RC-proportions were calculated for all conditions and subjected to ANOVAs with Prime Type (AN vs. RC prime), Object Repetition (same-object vs. different-object), and Prime Language (Dutch vs. English) as within-participant and

within-item factors, and Block Order (between-language vs. within-language block first) as a between-participants and within-items factor.

Table 3: Response Frequencies of Experiment 4 (L1 → L2 and L2 → L2)

First Block	Prime Language	Type	Object Type					
			Repeated Object			Different Object		
			AN	RC	Other	AN	RC	Other
L2→L2	**L1→L2**	**AN**	95	0	1	93	0	3
		RC	92	0	4	93	0	3
	L2→L2	**AN**	93	0	3	94	0	2
		RC	80	13	3	88	3	5
L1→L2	**L1→L2**	**AN**	89	0	7	92	0	4
		RC	91	0	5	93	1	2
	L2→L2	**AN**	96	0	0	95	0	1
		RC	93	2	1	95	0	1

All RC-responses (1.2%) were produced when the prime language was English. Overall, we obtained a significant main effect of Prime Type [$F1$ (1, 30) = 6.86, MSE = .15, p<.05; $F2$ (1, 44) = 6.00, MSE = .12, p<.05], with participants producing more RC target responses following RC primes than following AN primes. However, this effect is due to the RC-responses in the within-language conditions only. Separate analyses for each prime language revealed that the effect of Prime Type was significant when the prime language was English (i.e., within-language) [$F1$ (1, 30) = 5.90, MSE = .26, p<.05; $F2$ (1, 47) = 12.37, MSE =.29, p<.005] but not when the prime language was Dutch (i.e., between-languages) [$F1$ (1, 30) = 1.22, MSE = .002, p>.10; $F2$ < 1].

Additionally, a further division between the levels of Block Order and Prime language shows that within-language priming only occurred when the within-language block was presented first [$F1$ (1, 15) = 4.90, MSE =.42,

$p<.05$; $F2$ (1, 47) = 13.49, MSE =.41, $p<.005$)]. In this group, we found an 8.6% effect of Prime Type. When the within-language block was preceded by the between-language block, no within-language priming was found [$F1$ (1, 15) = 2.52, MSE = .01, $p>.10$; $F2$ (1, 47) = 1.83, MSE = .013, $p>.10$]: Only 1.0% more RC responses were produced after RC primes than after AN primes. This results in an interaction between Prime Type and Block Order for the within language block (marginally significant by-participants) [$F1$ (1, 30) = 3.79, MSE = .17, $p<.10$; $F2$ (1, 47) = 9.64, MSE = .14, $p<.005$]: More within-language priming may have occurred when the within-language block was presented first than when it was presented after the between-language block.

When the within-language block was presented first, the effect of Prime Type was much larger in the same-object condition (14.0%) than in the different-object condition (3.3%). Despite this lexical boost of 10.7%, the interaction between Prime Structure and Object Repetition was not significant [$F1$ (1, 15) = 2.55, MSE = .17, $p>.10$; $F2$ (1, 47) = 2.67, MSE = .07, $p>.10$]. No other effects were significant.

DISCUSSION

The results of this experiment confirm that for Dutch-English bilinguals, syntactic priming of noun phrase structure does not transfer between Dutch and English. There was a main effect of Prime Type, but it was due to effects in only one pair of conditions: There was an effect of syntactic priming only with within-language primes, and only when the within-language block was presented first. Under these conditions, the effects that were found were similar to those in Experiment 2 for English primes: We found syntactic priming in both experiments, and no reliable lexical boost of this effect.

The most important finding in this experiment is, of course, that no syntactic priming was obtained in the between-language block. Moreover,

the absence of RC-descriptions in the between-language block appeared to influence descriptions in the within-language block. The proportion of RC-responses in the within-language block dropped from 4.3% when this block was presented first to 0.5% when the between-language block was presented first. This difference of 3.8% could be an effect of long-term priming. If the between-language block was presented first, participants had encountered up to 72 AN-structures (24 prime sentences and up to 48 target sentences) and only 24 RC-structures, all of which were not in the target language and hence had a different word order, when they started with the within-language block. This predominance of AN-structures in the between-language block may have boosted the accessibility of the AN-structure. Accordingly, the imbalance between the accessibility of both structures may have become insurmountable by the time the participants had to start with the within-language block. When the within-language block was presented first, the difference between the accessibility of both structures was smaller, and therefore the RC-primes were able to influence the target responses.

EXPERIMENT 5: DUTCH (L1) TO GERMAN (L2) PRIMING

The absence of cross-linguistic syntactic priming between Dutch and English noun phrases seems to be a very robust finding. We tested cross-linguistic priming in three different experiments (Experiments 3a, 3b, and 4) and did not obtain significant cross-linguistic priming in any of them. This suggests that the use of RC structures cannot be primed between Dutch and English. The results of Experiment 4 showed that the absence of cross-linguistic priming for noun phrases can even influence the priming effects in a within-language priming experiment.

These results suggest that the absence of cross-linguistic priming is because relative clauses have different word orders in Dutch and English. However, it is conceivable that the lack of priming has some other explanation. Thus, cross-linguistic priming of noun-phrase structure might

not occur (even though both within-language priming of noun-phrase structure and other forms of cross-linguistic priming do occur). Hence it was important to test for cross-linguistic priming of noun phrases when word order was repeated. We therefore conducted a cross-linguistic syntactic priming experiment with Dutch-German bilinguals. Both the AN-structures and the RC-structures have the same word order in Dutch and German (see 10b-c and 11b-c). If the absence of cross-linguistic priming in Experiments 3-4 is the result of word order differences in Dutch and English RC-structures, we should obtain cross-linguistic priming between Dutch and German noun phrases. Since several studies of lexical priming have found stronger effects from L1 to L2 than from L2 to L1 (De Groot & Nas, 1991; Gollan et al., 1997; Grainger & Frenck-Mestre, 1998; Sanchez-Casas et al., 1992), we opted to prime from Dutch (L1) to German (L2).

METHOD

Participants. Twenty-eight second year students studying German at Ghent University, the University of Antwerp, or the school for interpreters in Ghent or Antwerp (19 females and 9 males) participated, in exchange for payment. All of them were native speakers of Dutch and had normal or corrected-to-normal vision. They all reported to have had at least 3 years of experience with German (mean = 9.1 years). A female undergraduate student (with L1 Dutch and L2 German) acted as a confederate.

Materials. The materials were identical to those in Experiments 1-4. The prime descriptions and the noun phrases that were used for the confederate's filler task were printed in Dutch (see Appendix 2B).

Procedure and design. The procedure and the design were almost identical to that of Experiments 1-3. In this experiment, the prime language was Dutch and the target language was German. Hence, in the study session that preceded the experiment, every object was presented with its Dutch and its German name. If German synonyms or hyponyms were used to describe

pictures in the same-object condition, the corresponding responses were counted as Other responses; when used in the different-object condition, such responses were counted as correct responses.

RESULTS

One hundred fifty of the 1344 target responses were Other responses (11.2%). The remaining responses were classified either as AN (1105, 82.2%) or RC (89, 6.6%) responses (see Table 4 for the response frequencies in all conditions). ANOVAs were run on the proportions of RC responses with Prime Type (AN vs. RC prime) as a within-participant and within-item factor and Object Repetition (same-object vs. different-object) as a within-participant and between-item factor. The mean proportion of RC-responses was larger after RC-primes (11.2%) than after AN-primes (3.6%), yielding a 7.6% effect of Prime Type [F_1 (1, 27) = 4.69, MSE = .78, p <.05; F_2 (1, 47) = 36.73, MSE = .29, p <.001][2]. There was no main effect of Object Repetition [both Fs < 1] and no Prime Type x Object Repetition interaction [both Fs < 1]. The effect of Prime Type was of a similar magnitude in the

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[2] The effect of cross-linguistic priming was numerically smaller for students studying German at the school for interpreters (3.4%) than for students studying Dutch and German literature and linguistics at the university (9.2%). However, the interaction between Prime Type and Type of Education (interpreter vs. linguist) was not significant by participants [F_1 <1; F_2 (1, 36) = 15.66, MSE = .36, p <.001]. Furthermore, the analyses showed no difference in the percentages of Other responses that were produced by the linguistics students (11.2%) and the interpreters (12.1%) [F_1<1; F_2 (1, 43) = 2.46, MSE = .72, p >.1]. As the majority of the Other responses were naming errors, this suggests that there is no difference between the level of proficiency of the two groups. The small difference in the amount of cross-linguistic priming may be due to different emphases in the training program for linguists and interpreters. As interpreters are trained to translate under time pressure and between different languages, they might avoid the use of parallel sentence structures in different languages, in order to lower the error risk.

same-object (7.9%) and the different-object conditions (7.3%). Separate analyses for each level of Object Repetition indicated that the effect of Prime Type was only marginally significant in the same-object conditions [$F1$ (1, 27) = 3.09, MSE = .44, p <.10; $F2$ (1, 47) = 12.78, MSE = .64, p <.001] but significant in the different-object conditions [$F1$ (1, 27) = 4.54, MSE = .35, p <.05; $F2$ (1, 47) = 12.24, MSE = .42, p <.001].

Table 4: Response Frequencies of Experiment 5 (L1 → L2)

| | Object Type | | | | | |
| | Repeated Object | | | Different Object | | |
Prime Type	AN	RC	Other	AN	RC	Other
AN	279	10	47	296	12	28
RC	251	31	54	279	36	21

Note. L1 = native language; L2 = second language; AN = structure in which the adjective is placed before the noun; RC = structure in which the noun is followed by a relative clause containing the adjective.

DISCUSSION

The results of this experiment show cross-linguistic syntactic priming from Dutch (L1) to German (L2): More German RC-descriptions were produced after Dutch RC-descriptions than after Dutch AN-descriptions. This syntactic priming effect did not only occur when the head nouns were translation equivalents in prime and target descriptions, but also when a different head noun was used. Thus, cross-linguistic priming of noun phrases does occur.

The effect was of a similar magnitude in the same-object and the different-object conditions and no translation-equivalent boost was observed. In contrast, Schoonbaert et al. (2007) did find a translation equivalence boost for datives when priming from L1 to L2. In our experiment, the large number of Other responses in the same-object conditions may be partly

responsible for the absence of a translation-equivalence boost. However, a more obvious explanation for the absence of a translation-equivalence boost in the present experiment is that the priming effects are rather small (maximum 8%), and are thus not easily influenced.

The most important result is, however, that significant cross-linguistic priming can be obtained for noun phrases if these noun phrases have an identical word order in the languages under study [here: Dutch (L1) and German (L2)]. This contrasts strikingly with the absence of cross-linguistic priming between Dutch and English when word order differs (Experiments 3-4).

GENERAL DISCUSSION

In this study, we wanted to determine the conditions in which Dutch, English, and German noun phrases share a syntactic representation in the memory of Dutch-English and Dutch-German bilinguals. More specifically, we investigated the level of abstractness of these representations: Are they specified for language and for word order or is there a common, non-language-specific representation that is unspecified for word order? To this aim, we conducted five experiments that investigated syntactic priming of noun phrases in Dutch (L1: Experiment 1), in English (L2: Experiments 2 and 4), between English and Dutch (L2 → L1: Experiment 3a; L1 → L2: Experiments 3b and 4) and between Dutch and German (L1 → L2: Experiment 5). Experiments 1, 2, and 4 showed that the structure of noun phrases can be primed in a within-language context: In both L1 and L2, significantly more RC structures were produced following RC primes than after AN primes. Hence, abstract syntactic representations of both noun phrase structures were accessed during the comprehension and the production of both Dutch and English noun phrases. However, cross-linguistic priming occurred only when prime and target phrases had an identical word order: Significant priming was found between Dutch and

German (Experiment 5), but not between Dutch and English (Experiments 3a, 3b, and 4). These results suggest that Dutch RC structures do not prime the use of English RC structures (and vice versa) because these structures do not share the same word order.

It is important to stress that previous studies (Hartsuiker et al., 2004; Loebell & Bock, 2003; Meijer & Fox Tree, 2003; Schoonbaert et al., 2007), including studies that tested Dutch-English bilinguals (Schoonbaert et al., 2007), also   provided strong evidence for cross-linguistic priming, specifically for structures that do have the same word order in both languages. The one experiment that did not find any cross-linguistic priming (Loebell & Bock's study with German and English transitives) used sentences that differed in word order between the languages. Consequently, the most likely explanation of the lack of cross-linguistic priming between Dutch and English noun phrases is that Dutch and English relative clauses differ in word order.

At first sight, this finding seems to contradict the results that were found by Desmet and Declercq (2006): They obtained cross-linguistic priming for relative clause attachments from Dutch to English, despite the word order differences in Dutch and English relative clauses. Participants produced more high-attachment relative clauses in English after Dutch primes that forced disambiguation towards high attachment (e.g. *De politie ondervroeg de veroorzaakster van het ongeval **die**…*, in which the relative pronoun refers to the feminine noun 'veroorzaakster') than after primes in which a low attachment was enforced (e.g. *De politie ondervroeg de veroorzaakster van het ongeval **dat**…*, in which the relative pronoun refers to the neuter noun 'ongeval'). However, their task and the syntactic choices were different from ours: In their study, a relative clause had to be produced to complete the target sentences (target sentence beginnings like *'The farmer fed the calves of the cow that…'* could only be completed by a relative clause), whereas in our study, a choice could be made between RC-structures and AN-structures for the description of a picture. In the former case,

participants have to choose *where* to attach the relative clause, in the latter case participants have to choose *whether* or not to produce a relative clause. Because the participants in the study by Desmet and Declercq (2006) were not free to choose whether to use an AN- or an RC-structure to complete the target sentences, the results of their study cannot inform us on the influence of word order differences in Dutch and English relative clauses on cross-linguistic syntactic priming of relative clauses.

Note that in all our cross-linguistic priming experiments, the AN structures had the same word order, irrespective of whether the RC structures had the same order or not. One might therefore expect cross-linguistic priming of the AN structures in Experiments 3-4. However, the AN structure is always so strongly preferred that there is little "room" for priming of the structure. As the AN structures are much more frequently used than the RC structures, the accessibility of AN structures is so high that an increase in the accessibility of AN structures can no longer be reflected in the responses in the AN conditions: In Experiment 4, the proportion of AN responses was at ceiling (100%) in all AN conditions. In the same experiment, however, the AN responses influenced the production of RC responses: The predominance of AN structures in the first block caused a steep drop in the proportion of RC responses in the second block. This effect of cumulative long-term priming suggests that the accessibility of the AN structures was further increased during the experiment and that AN structures are primed between languages.

It is interesting to see that the occurrence of cross-linguistic priming for noun phrases is conditional on the match in word order after the decision about whether to start with the noun or the adjective. In other words, the internal structure of the relative clause influences the syntactic choice that has to be made earlier on in the formulation of the sentence. This finding is compatible to what Griffin and Weinstein-Tull (2003) found for the priming of infinitive complements. The finite complements of object-raising verbs (e.g., *John believed that Mary was nice*) were less often paraphrased as

infinitive complements (e.g., *John believed Mary to be nice*) after primes with identical constituent orders as object-raising infinitives but an additional conceptual role (e.g., *John persuaded Mary to be nice*, where *Mary* is not only the direct object of the main verb, but also the argument of *nice*) than after object-raising infinitives. The decision to place either *that* or *Mary* after the verb is conditional on the number of conceptual roles that are assigned to *Mary*. This suggests that the internal structure of constituents can influence structural priming.

One further aspect of our data merits discussion. Our experiments varied whether the head noun was identical between prime and target or not. Previous within-language studies have shown that repetition of the head verb in dative sentences (e.g., Branigan et al., 2000; Cleland & Pickering, 2006; Corley & Scheepers, 2002; Pickering & Branigan, 1998) or head noun in noun phrases (Cleland & Pickering, 2003) resulted in a considerably larger priming effect (the "lexical boost"). Indeed, Schoonbaert et al. (2007) showed that with datives, verb repetition increased within-language priming effects both within L1 and L2. In contrast, the current study found a reliable boost within L1 (Experiment 1) but inconsistent results within L2 (no difference in Experiment 2; a non-significant trend of 10% in the within-language condition of Experiment 4). In cross-linguistic priming conditions, Schoonbaert et al. (2007) also found a translation equivalence boost when priming from L1 to L2 but not when priming from L2 to L1. The translation-equivalence boost never occurred in the current study (Experiments 3-5). In fact, the translation-equivalence boost could only occur between Dutch and German, as we obtained no significant priming between Dutch and English.

The fragility of the lexical boost in within-language priming in L2 and the absence of a translation-equivalence boost in cross-linguistic priming from L1 to L2 may reflect the relatively small priming effects in our experiments in comparison to earlier studies of the lexical boost (Branigan et al., 2000: 55% in the same-verb condition; 26% in the different-verb condition; Cleland & Pickering, 2003 (Experiment 1): 27% in the same-noun

condition; 12% in the different-noun condition; Cleland & Pickering, 2006: 34% in the same verb condition; 13% in the different verb condition; Pickering & Branigan, 1998: 20% in the same-verb condition; 5% in the different-verb condition). Furthermore, the lexical boost that is caused by the repetition of verbs [Branigan et al., 2000: 29% lexical boost; Schoonbaert et al, 2007 (Experiment 3): 29% lexical boost] seems to be larger than the boost that is obtained by repeating the head noun in prime and target constructions (Cleland & Pickering, 2003: 15% lexical boost; Experiment 1 in this study: 8% lexical boost). This difference in the magnitude of the lexical boost could explain why the lexical boost for verbs survives when the target language is not L1, whereas the lexical boost for nouns does not.

We now turn to the theoretical implications of our claim that word order needs to be similar before a construction is shared between the different languages of a bilingual speaker. In the introduction we discussed two models of syntax production that aimed to explain word order effects in syntactic priming within languages: a one-stage account (Pickering et al. 2002) and a two-stage account (Hartsuiker et al, 1999; Hartsuiker & Westenberg, 2000). The absence of RC-priming between Dutch and English in this study is consistent with the one-stage-account of the formulation of constituent structure advocated by Pickering et al. (2002). On this account, a fully specified constituent structure is constructed directly from the functional level (specified in terms of grammatical roles such as subject and object; see Bock & Levelt, 1994). As there is no separate level that specifies the word order of the constituent structures, the syntactic representations necessarily incorporate information about word order. Word order forms part of constituent structure; hence structures with differing word orders are represented separately, even though these structures might have identical hierarchical relations between constituents. In accord with this account, Pickering et al. found no syntactic priming between shifted datives (*The captain gave to the old sailor the spare lifejacket*) and prepositional datives with the same hierarchical relations (*The captain gave the spare lifejacket to the old sailor*). Specifically, they argued against a two-stage account, in

which people initially construct a hierarchical representation that is not specified for word order, and then convert it to a fully specified representation following a process of linearization. Such an account would incorrectly predict priming between shifted datives and prepositional datives, because they share a level of representation in which hierarchical (or dominance) relations are specified.

Recently, Haskell and MacDonald (2005) provided additional evidence against two-stage-models of sentence production. They found proximity effects in the production of subject-verb agreement following disjunctive noun phrases (e.g., *the shirt or the socks*). Participants most often inflected the verb to agree with the nearer noun, whether this noun was singular or plural, and whether the verb followed or preceded the disjunction. They interpreted this influence of linear proximity on agreement as evidence for a one-stage account (in which agreement is computed over a linearly specified representation of constituent structure).

Our results can be explained by the one-stage account (Pickering et al., 2002). Across our experiments, the prime expressions had three different word orders: determiner, adjective, noun (for AN-structures); determiner, noun, relative pronoun, adjective, verb (for Dutch and German RC-structures); and determiner, noun, relative pronoun, verb, adjective (for English RC-structures). The two-stage account predicts that people construct a level of representation specified for hierarchical structure but not linear order, and so we should have found priming between the Dutch and English RC-structures, as these structures share dominance relations: The only difference between the structures is the position of the verb and the modifier in the relative clause. According to the one-stage account, however, Dutch-English bilinguals have (at least) three different word-order specific representations for noun phrases: a representation for the AN-structure and two separate representations for the RC structures. Because a different representation is accessed during the processing and the production of Dutch and English RC-structures, no cross-linguistic priming is observed. Note that

our results could also be explained by recent implicit learning models (e.g., Chang, Dell, Bock & Griffin, 2000; Dell, Chang & Griffin, 1999), as they also suggest that syntax is formulated in one stage.

In Figure 3 we present a model for the comprehension and the production of complex noun phrases in Dutch-English-German trilinguals, based on Hartsuiker et al. (2004) and derived from Pickering and Branigan (1998) and Cleland and Pickering (2003). This model features a shared representation for Dutch, German, and English AN-structures that is connected to the lemmas of Dutch, German, and English nouns. It includes two representations for RC-structures: The node [RC (verb-final)] is connected to the lemmas of Dutch and German words; the node [RC (modifier-final)] is connected to the lemmas of English words. The lemmas, in their turn, are tagged for their language by being linked to a 'Dutch', 'English' or 'German' language node. The lemmas of translation equivalent words in Dutch, English, and German are linked to a shared semantic node and all noun lemmas are linked to the same categorical node 'noun'. A model for Dutch-English bilinguals would be similar, except that it would contain no German lemmas and no German language node; a model for Dutch-German bilinguals would contain no English lemmas, no English language node, and no RC modifier-final node.

The combinatorial nodes in our model are not language-specific: The [RC (verb-final)] is shared for Dutch and German nouns. Likewise, the [RC (modifier-final)] node could be linked to both English and French nouns (as French relative clauses have the same word order as English relative clauses). Consequently, our model predicts cross-linguistic syntactic priming between relative clauses that have the same word order in two given languages (e.g., between Dutch and German, between English and French). In general, it predicts cross-linguistic priming for any related syntactic structures that have the same word order in the languages under study.
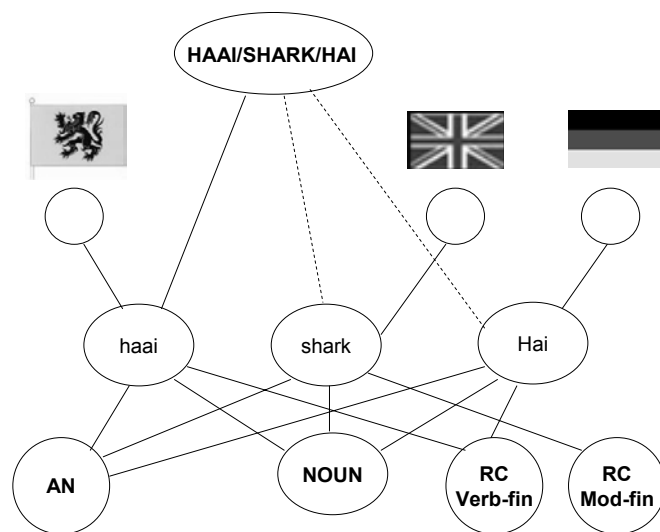
Figure 3. Model for the representation of noun-phrase structure in Dutch–English–German trilinguals (adapted from Schoonbaert et al., 2007). In this integrated network (featuring a shared lexicon and shared lexical representations), the lemma representations of Dutch (*haai*), English (*shark*), and German (*Hai*) nouns are linked to one conceptual node at the conceptual level, to one category node (Noun), and to one language node (represented by a Flemish, a British, and a German flag). Stronger connections between different nodes (resulting in more spreading activation) are indicated by full lines; weaker connections between nodes are indicated by dotted lines. All lemma representations are connected with the combinatorial node for the structure in which the adjective is placed before the noun (the AN-structure). Dutch and German lemmas are linked to the RC-verbfinal node (RC Verb-fin); English lemmas are linked to the RC-modifier-final node (RC Mod-fin). RC _ structure in which the noun is followed by a relative clause containing the adjective.

In conclusion, our study showed syntactic priming of noun phrase structures (AN- and RC-structures) within the first and the second language of Dutch-English bilinguals. In spite of significant within-language priming, no cross-linguistic priming was obtained between Dutch and English RC-structures. However, significant cross-linguistic priming was found between Dutch and German RC-structures. Given the data of Experiment 5 and given the strong evidence for cross-linguistic priming when word order is repeated (Hartsuiker et al., 2004; Loebell & Bock, 2003; Meijer & Fox Tree, 2003; Schoonbaert et al., 2007), the absence of syntactic priming between Dutch

and English noun phrases can be ascribed to the different word order of Dutch and English relative clauses. As these syntactic structures have different word orders, they do not share a syntactic representation. In contrast, because Dutch and German relative clauses have the same word order, they do share a syntactic representation.

CHAPTER 3
IS THERE A FUNCTIONAL LEVEL IN LANGUAGE PRODUCTION? EVIDENCE FROM CROSS-LINGUISTIC SYNTACTIC PRIMING

Manuscript submitted for publication[1]

This study investigates whether functional representations are computed during sentence production. Three experiments investigated within-language syntactic priming for Dutch transitives (actives, verb-medial passives, and verb-final passives) and cross-linguistic priming between Dutch and English transitives. Whereas Dutch allows two passives that differ in word order but involve the same grammatical functions, English allows only one word order for the passive (verb-medial order). Experiment 1 showed priming of each sentence type within Dutch, but no priming between verb-medial and verb-final passive. In contrast, Experiments 2 and 3 showed that both types of Dutch passive primed English passives (relative to both active and baseline primes). This indicates that priming occurs between passives with different word orders, at least when no alternative form is available. The results support the existence of functional-level representations in sentence production.

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[1] This paper was co-authored by Robert Hartsuiker and Martin Pickering.

INTRODUCTION

Speakers can often convey a message in many ways. Different words or phrases can be used to refer to the same entities (*Elvis/the king/Priscilla Presley's former husband* all refer to the same person) and different syntactic structures can be used to express the same conceptual representation (*the cat chases the mouse* and *the mouse is chased by the cat* both describe the same action). In some languages, certain syntactic structures can even be expressed by more than one word order. Dutch, for example, has two possible orders for passives:

> 1a)   De kerk wordt getroffen door de bliksem.
>
>   [The church is hit by lightning]
>
> 1b)   De kerk wordt door de bliksem getroffen.
>
>   [The church is by the lightning hit]

How do speakers select a word order? Most researchers assume that they compute different levels of representation when producing utterances. More specifically, Bock and Levelt (1994) distinguish two separate levels in sentence production: a functional level and a positional level. At the functional level, the speaker retrieves lemmas corresponding to the concepts in the message and assigns syntactic functions such as subject, direct object, or indirect object to these lemmas. At the positional level the speaker constructs the constituent structure, based on the representation computed at the functional level. An important task of positional processing is to put the to-be-uttered words in their final order. The resulting representation is then used as input for later stages in the production process that are concerned with sound and articulation. In some cases, the functional level determines the constituent structure, but in other cases more than one word order is possible, as in (1a-b). This paper asks whether people compute a functional representation and, if so, how they do it.

EVIDENCE FOR THE FUNCTIONAL LEVEL

The evidence for a functional level in sentence processing and production is fairly indirect. Indeed, not all linguists agree on its existence. Whereas some theories assume functional representations (e.g., Lexical-Functional Grammar; Kaplan & Bresnan, 1982) as basic, the Chomskyean tradition tends to regard functions as merely derivative (e.g., subject is a noun phrase that is immediately dominated by a sentence node; Chomsky, 1965).

Traditional psycholinguistic evidence comes from fairly rare speech errors (Garrett, 1980, 1984). In the Dutch example, *ze mocht niet van hem* (she was not permitted by him) instead of *hij mocht niet van haar* (he was not permitted by her) the masculine and feminine pronouns exchanged position (example from the Utrecht speech error corpus; Schelvis, 1985). Critically, they bear the correct case for the position they are in, suggesting that these were function assignment errors. Additionally, in exchange errors involving nouns with different number specifications (e.g., *most cities are true of that* instead of *that is true of most cities*, Stemberger, 1992), the verb tends to have the correct number for the produced subject rather than the intended subject. Again, this is suggestive that the error involved a misassignment of grammatical functions, with subsequent processes proceeding correctly. However, an alternative interpretation views these errors as missassignments of thematic roles at the conceptual level so that in the first example above the role of agent of *permit* is assigned to the masculine instead of the feminine gender (Vigliocco & Hartsuiker, 2002). Note furthermore that such exchanges occur extremely infrequently: Stemberger's analysis of exchanges of phrases with different number was for instance based on only eight errors (with seven displaying agreement with the produced number). Because such rare speech errors may not be representative of normal language production processes, it is important to look for additional evidence for the functional level.

Experimental evidence from structural priming can be interpreted as supporting a functional level, although in this literature there is no consensus on the existence and the nature of functional representations. Bock (1986) used picture description to investigate the stages in sentence production. She discovered that participants were more likely to describe a picture of lightning striking a church using the passive sentence *The church is being struck by lightning* if they had just read a very different passive sentence such as *The referee was punched by one of the fans* than if they had just read an active sentence. This effect of syntactic persistence or syntactic priming was interpreted as evidence that the abstract syntactic structure of sentences is represented in memory. In a later study, Bock and Loebell (1990) specified the nature of the syntactic representations responsible for syntactic priming. They found that passive target sentences (e.g., *The golf player was hit by lightning*) were more frequent after locative sentences containing the preposition *by* (e.g., *The foreigner was loitering by the blinking traffic light*) than after active sentences (e.g., *The foreigner misunderstood the blinking traffic light*). Locatives and passives share the same constituent structure, but are functionally different: The *by*-phrase in the passive sentence is an oblique argument of the verb *to hit*, whereas the *by*-phrase in the locative sentence is not an argument of the verb *to loiter* (it is an adjunct). As this priming effect between locatives and passives could not be explained in terms of the priming of functional level processing, Bock and Loebell (1990) concluded that structural priming originates from constituent assembly processes at the positional level.

However, Hartsuiker, Kolk, and Huiskamp (1999) suggested that structural priming with actives and passives is localized at the functional level. According to Hartsuiker et al., Bock and Levelt's (1994) theory implies that constituent structure is largely determined by functional relations in English, because word order is relatively fixed. Consider for example the description of the event of an ambulance hitting a man. If during functional processing, the subject role is assigned to *ambulance* and the object role to *man*, the resulting sentence must be active (*the ambulance*

hits the man); whereas if the subject role is assigned to *man* and the oblique role to *ambulance*, it must be passive (*the man is hit by the ambulance*). Hence, Hartsuiker et al. argued that the effects obtained by Bock (1986) and Bock and Loebell (1990) result from priming at the functional level. Note that on Hartsuiker et al.'s account, there is also priming at the positional level. Consistent with this, they found priming of locatives (*A book lies on the shelf/On the shelf lies a book*), which are identical in functional relations but differ in their positional level representations (specifically, in word order). In short, some authors assume that structural priming of actives and passives takes place at the positional level (e.g., Bock & Loebell, 1990) but others assume it takes place at the functional level (e.g., Hartsuiker et al., 1999).

Another study that can be taken to provide evidence for functional structure is Bock, Loebell, and Morey (1992). They manipulated the animacy of the subject and object arguments of the transitive prime sentences that were used: Half had animate subjects and inanimate objects (*Five people carried the boat/Five people were carried by the boat*) and half had inanimate subjects and animate objects (*The boat carried five people/The boat was carried by five people*). They found additive effects of syntactic persistence (more actives after actives than after passives and vice versa) and of the animacy of the subject and the object (primes with inanimate subjects elicit more targets with inanimate subjects than primes with animate subjects do). Put differently, the percentage of active responses with an inanimate subject (*The alarm clock awakened the boy*) increased after active primes with an animate subject (*Five people carried the boat*) as well as after passive primes with an inanimate subject (*The boat was carried by five people*). The finding that both the syntactic form of the prime and the animacy of its arguments affected the production of the target sentences suggested that syntactic choices are affected by processes at two separate levels: The tendency to repeat the assignment of animacy to subject and object results from functional processing, and the tendency to repeat syntactic structure results from positional processing.

However, Bock et al. (1992) acknowledged that the data can also be explained in terms of a semantically conditioned positioning of phrases (see also Hartsuiker et al., 1999). Specifically, their task may have tapped into the binding of conceptual features to word order positions (animate to first mention etc.), not to grammatical functions (animate to subject etc.). This explanation is supported by data on a free word-order language (Branigan, Pickering, & Tanaka, in press). Just as the basic priming effect with actives and passives, the animacy effects of Bock et al. have several interpretations, one of which attributes them to functional level processing.

On the other hand, data obtained by Pickering, Branigan, and McLean (2002) seem to speak against a functional level. They had participants read prime fragments that induced the production of a double-object dative without a prepositional phrase (DO: *The racing driver showed the helpful mechanic…*), a prepositional object dative (PO: *The racing driver showed the torn overall…*), or a shifted dative, in which the prepositional phrase immediately followed the verb (Shifted: *The racing driver showed to the helpful mechanic…*). Although shifted datives and prepositional datives are identical except for their word order, there was no priming from shifted datives to prepositional datives. These data might be taken as evidence against a functional level, under the assumption that the shifted and prepositional dative have a shared functional representation (which can be primed) that differs from that of the double-object dative. Indeed, on some linguistic analyses the PO and shifted dative have a direct object and an oblique object, whereas the DO dative has a direct object and an indirect object (e.g., Bresnan & Kaplan, 1982). However, it is also possible that all three datives have the same functional representation (e.g., all forms involve accusative and dative case-marked arguments in languages such as German). If such an analysis is right, priming of datives must take place at a level concerned with constituent structure.

Finally, Hartsuiker and Kolk (1998) investigated structural priming for Dutch transitive sentences in a picture description task. Dutch allows

both verb-final (2b) and verb-medial passives (2c), as well as actives (2a) for the description of a transitive event:

2a)   De politieagent achtervolgt de zwemmer.

[The policeman chases the swimmer.]

2b)   De zwemmer wordt door de politieagent achtervolgd.

[The swimmer is by the policeman chased.]

2c)   De zwemmer wordt achtervolgd door de politieagent.

[The swimmer is chased by the policeman.]

As both passive alternatives involve the same grammatical roles (subject and oblique), it may be possible to prime between them. They should contrast with the active, which involves the direct object role rather than an oblique role.[2] However, Hartsuiker and Kolk (1998) found that the proportion of actives was unaffected by priming. In contrast, there were more verb-medial passives in the verb-medial condition than in the other conditions, and there were more verb-final passives in the verb-final condition than in the other conditions. There was no priming between the two passive conditions.

The lack of priming between the two types of passives may be interpreted as evidence against functional-level priming. It is possible however that the experimental task used by Hartsuiker and Kolk (1998) was not sensitive enough to measure effects of functional priming. They used the same paradigm as Bock (1986), in which participants repeat prime sentences and describe target pictures under the guise of a memory task. Experiments with this paradigm tend to show numerically rather small priming effects (5-10%, see Chang, Dell, & Bock, 2006 for meta-analysis), and Hartsuiker and Kolk had a relatively small number of items per condition (eight) and

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[2] Notice that both passives involve the same order of roles as well, though current theories do not assume that functional representations involve ordering.

discarded a relatively large number of responses that were not transitives (45%), thus reducing experimental power. More recent studies have shown numerically much larger priming effects in a task in which two interlocutors describe each other pictures (Branigan et al., 2000). In addition, Hartsuiker and Kolk varied the verb between prime and target; but priming is much stronger when the verb is repeated (e.g., Branigan et al., 2000; Schoonbaert, Hartsuiker, & Pickering, 2007; Hartsuiker, Bernolet, Schoonbaert, Speybroeck, & Vanderelst, in press).

Additionally, even if there is reliable functional-level priming, this does not necessarily lead to the prediction of priming between passives with different word orders. This is because any such priming effect can be obscured by a second priming effect at the level of constituent structure. In other words, a verb-final passive prime might make passive responding more likely (because of functional priming), but the large majority of these passives would have the verb-final order (because of positional priming). This account predicts priming effects for actives, verb-final passives, and verb-medial passives in Dutch, but not between the two types of passive, a prediction tested in Experiment 1.

To investigate whether there really is a functional level in production, the current study contrasts within-language priming for Dutch passives with cross-linguistic syntactic priming between Dutch and English. It exploits the fact that Dutch has two word orders for the passive (verb-final and verb-medial word order) whereas English only has one (verb-medial word order). Cross-linguistic syntactic priming occurs between various pairs of languages (Dutch-German: Bernolet, Hartsuiker & Pickering, 2007; Dutch-English: Desmet & Declercq, 2006; Spanish-English: Hartsuiker, Pickering & Veltkamp, 2004; Greek-English: Salamoura & Williams, in press; see Hartsuiker & Pickering, in press, for a review). The size and the robustness of priming effects are comparable within and between languages (Schoonbaert et al., 2007), suggesting that syntactic structures have largely or entirely shared representations in bilingual memory. We thus use

bilingualism to investigate a property of the language production system in general.

The logic is as follows: Dutch verb-final passives and verb-medial passives have a different word order, but they might have a shared functional representation. This means that priming effects for Dutch passives could be functional or positional (or both). To tease apart effects of word order priming and of functional priming, we have to restrict the number of passives that can be used to formulate a passive sentence. If, for example, only verb-medial passives could be used to describe a transitive target picture, we could compare the percentage of passives after verb-medial and verb-final passives in order to verify whether passive priming occurs even if the word order does not match. By using English as a target language, we can restrict the number of response possibilities. If functional representations are involved in the production of Dutch and English passives, we expect to find an increase in the number of English (verb-medial) passives after Dutch verb-medial passives (same word order), but also after Dutch verb-final passives (different word order), because of the existence of a shared functional representation for both passives.

In Experiment 1, we examine structural priming between Dutch transitives using the confederate-scripting technique (Branigan et al., 2000). By studying syntactic priming in dialogue and by repeating the transitive verbs in prime and target constructions, we aim to maximize our chances of finding priming (cf. Pickering & Branigan, 1998). This way, we want to verify whether under more favorable circumstances it is possible to obtain transitive priming in Dutch, for the lack of priming for actives in the study by Hartsuiker and Kolk (1998) remains puzzling: Priming for actives is not only predicted from a functional perspective, but also because actives and passives differ in word order. Additionally, Experiment 1 is a first test of whether there is priming between passives with different word orders. In Experiments 2 and 3, we investigate functional priming for Dutch transitives by studying cross-linguistic priming between Dutch and English transitives.

In all experiments, we used a computerized version of the confederate-scripting technique (Bernolet et al., 2007; Schoonbaert et al., 2007). The prime sentences were produced by a confederate, who pretended to be a participant in the experiment. The confederate and the participant took turns to describe pictures that were presented on a computer screen, and we investigated whether the form of the confederate's utterance primed the form of the participant's subsequent utterance.

EXPERIMENT 1: PRIMING BETWEEN DUTCH (L1) TRANSITIVES

METHOD

Participants. Twenty-seven students at Ghent University (18 females and 9 males) were paid to take part. All participants were native speakers of Dutch and had normal or corrected to normal vision. A female undergraduate student acted as confederate.

Materials. Two sets of 108 pictures were constructed for the participants, one verification set and one description set. On each of these pictures, an action was displayed, accompanied by a Dutch verb in the infinitive, describing the action. Thirty-six of the pictures in the naïve participant's description set were experimental target pictures, depicting a transitive action involving an agent and a patient. On 12 of these pictures the action involved an animate agent and an animate patient (e.g., a nun chasing a boxer), 12 pictures showed an inanimate agent and an animate patient (e.g., an arrow hitting a bird), and 12 pictures showed actions with an inanimate agent and an inanimate patient (e.g., a ball knocking over cans). In order to increase the production of passives, the patient of the action was always depicted on the left side of the picture (Bock & Griffin, 2000 showed that there is a tight coupling between visual scanning patterns and order or mention in event descriptions; Bock, 1986 and Hartsuiker et al., 1999 found effects of visual collocation on syntactic structure that were compatible with

a left-to-right scanning pattern). The remaining 72 pictures in the description set were filler items, displaying actions that had to be described by using unergative (e.g., to run) or unaccusative (e.g., to die) intransitive verbs. The pictures in the naïve participant's verification set were used as filler items in the cover task of matching pictures with the confederate's descriptions.

Half of the pictures in the participant's verification set matched the descriptions in the confederate's description set, which contained 108 Dutch prime sentences. Thirty-six of these sentences were critical transitive prime sentences. There were 12 sentences with an animate agent and an animate patient, 12 with an inanimate agent and an animate patient, and 12 with an inanimate agent and an inanimate patient, such that the experimental target pictures were always preceded by a transitive prime sentence with the same animacy for the agent and the patient. This repetition of animacy is a consequence of our decision to repeat the verb in prime and target descriptions: Some of our target verbs were less common with animate patients, while others could not be combined with inanimate agents, and so on (e.g., destroy is hardly ever used with an animate patient). Note that in 67% of the trials, any animacy-to-function repetition effect of the type Bock et al. (1992) reported would not influence syntactic choice. The remaining 72 sentences were fillers that were similar to those in the participant's description set. In addition to the prime sentences, 108 pictures were selected for the confederate's verification set. These pictures were used as filler items in the cover task of matching pictures with the participant's descriptions.

Three counterbalanced pseudo-random lists were constructed so that each target picture occurred once in each prime condition (active prime (2a), verb-final passive prime (2b), and verb-medial passive prime (2c)) across the three different lists. The verb was always repeated in prime and target sentences. The agent and the patient in the prime-target-pairs were never related in form or meaning.

An experimental trial consisted of a Dutch transitive prime sentence, produced by the confederate, followed by a transitive target picture (see Figure 1), to be described by the naïve participant. The experimental trials were preceded by at least one filler trial. Separate sublists for the confederate and the naïve participant were derived from the three master lists.

Figure 1: Target picture: a pirate chasing ("achtervolgen") a boxer

Procedure and design. Though participants were tested individually, they were under the misapprehension that they were tested in pairs, because the confederate pretended to be the second participant in the experiment. Both the participant and the confederate sat in front of a PC, and they were told that they would be playing a game in which they would have to describe pictures to each other and verify each other's descriptions (see Figure 2). They sat opposite each other, with the PCs between them. Neither of them could see what appeared on the opposite screen. First, they were familiarized with the material in a study session, where all objects and all characters that appeared on the pictures in the experiment were presented together with their names. The participant and the confederate were instructed to look at the pictures and to memorize the corresponding names. After that, the participant's first verification picture was shown in order to explain how the objects were arranged on the screen and how the participants were supposed to respond. The participant and the confederate were informed that their

speech would be recorded on minidisk. The program was set up so that the confederate always took the first turn. The lists for the confederate and the naïve participant were designed to be run simultaneously on two different PCs.

The sequence of events during the experiment was as follows: 1) a picture appeared on the screen of the participant's PC (Figure 1). This picture was necessary for the verification task; 2) the confederate read the (critical) prime description from the screen of her PC; 3) the participant responded to the prime description by pressing '1' if this description matched the picture on his/her screen or '2' if the description and the picture did not match. When either key was pressed, the verification picture changed into a description picture. At the same time, a beep notified the confederate that the participant had responded; 4) at the sound of the beep, the confederate pressed '3', to change the prime sentence into a verification picture; 5) the participant produced a description for the action depicted on the (critical) description picture; 6) the confederate responded to the participant's description by pressing '1' (match) or '2' (mismatch). By doing this, the picture was automatically replaced by the prime sentence for the next trial. At the same time, a beep notified the participant that the confederate had responded; 7) at the sound of the beep, the participant had to press '3', in order to make the verification picture for the next trial appear on the screen. There was a match between the description and the verification pictures on 50% of the trials. Sessions lasted about 25 minutes.
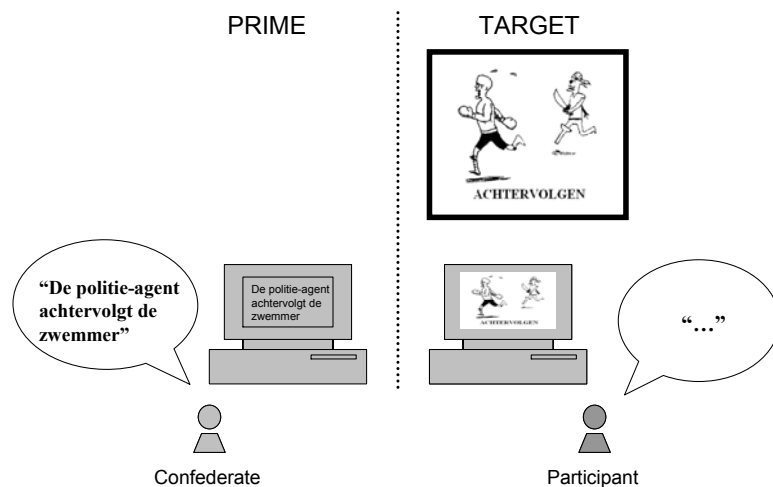
Figure 2: Computerized version of dialogue game

Scoring. The responses were manually coded as active sentences, verb-final passives, verb-medial passives or 'Other' responses. A response was coded as an active sentence when the agent of the transitive action was mentioned first, followed by the verb and the patient. When the patient was mentioned first, either the main verb of the sentence or the *by*-phrase expressing the agent could take the sentence-final position. Passive sentences that ended with the main verb were coded as verb-final passives; passive sentences that ended with the *by*-phrase were coded as verb-medial passives. Short passives, in which the agent was not overtly realized (e.g., *The doctor was killed*), were coded as 'Other' responses, as were all other responses.

RESULTS

Twenty-four of the 972 target responses were 'Other' responses (2.5%). The remaining 948 target responses were classified either as actives (561, 57.7%), verb-medial passives (247, 25.4%), or verb-final passives (140, 14.4%). The proportions of active, verb-medial passive, and verb-final

passive responses (Figure 3) were calculated for each participant and item and subsequently arcsine-transformed (as were the proportions of target responses of the other experiments reported in this paper).

Figure 3: Percentages of Actives (ACT), Verb-medial passives (VMP), and Verb-final Passives (VFP) in each condition
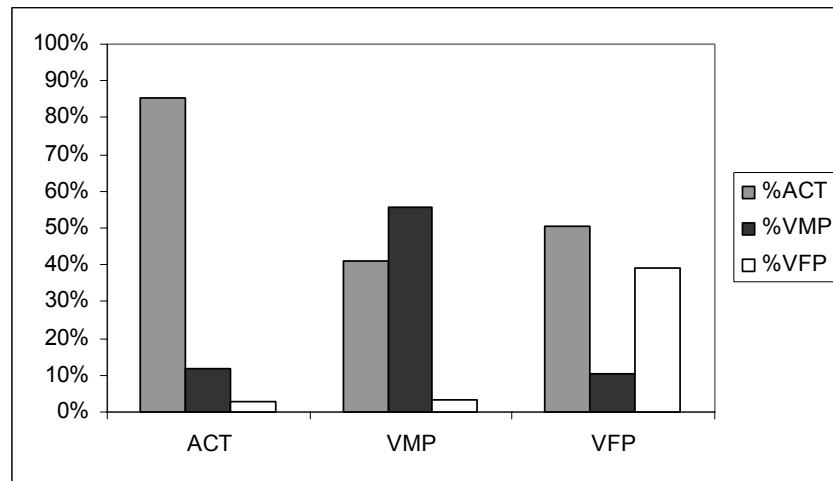
Note: ACT = Active condition, VMP = Verb-medial passive condition, VFP = Verb-final passive condition

ANOVAs were run on these proportions with Prime Type (active/verb-medial passive/verb-final passive) as a within-participants and within-items factor. The analyses revealed a significant effect of Prime Type on the production of active sentences [F_1 (1, 25) = 35.05, *MSE* = 7.46, *p*<.001; F_2 (1, 34) = 77.54, *MSE* = 9.43, *p*<.001], the production of verb-medial passives [F_1 (1, 25) = 55.08, *MSE* = 9.17, *p*<.001; F_2 (1, 34) = 113.28, *MSE* = 11.40, *p*<.001] and the production of verb-final passives [F_1 (1, 25) = 30.11, *MSE* = 5.95, *p*<.001; F_2 (1, 34) = 142.40, *MSE* = 7.73, *p*<.001]. More active sentences were produced in primed (85.6%) than in unprimed conditions (45.9%). This 40.3% effect of syntactic priming was

significant in paired t-tests (two-tailed) [t_1 (1, 26) = 6.54, *MSE* = .14, *p*<.001; t_2 (1, 35) = 13.40, *MSE* = .06, *p*<.001]. The percentage of verb-medial passives was also higher in primed conditions (55.8%) than in unprimed conditions (11.0%), yielding a 44.8% effect of syntactic priming [t_1 (1, 26) = 8.23, *MSE* = .12, *p*<.001; t_2 (1, 35) = 13.25, *MSE* = .07, *p*<.001]. Likewise, the number of verb-final passives was higher in primed (39.0%) than in unprimed conditions (3.0%). This 36.0% effect of syntactic priming was significant [t_1 (1, 26) = 5.73, *MSE* = .14, *p*<.001; t_2 (1, 35) = 12.70, *MSE* = .06, *p*<.001]. Moreover, the percentage of verb-medial passives was comparable in the active (11.6%) and the verb-final passive condition (10.3%) [*ts* < 1]. Also, the percentage of verb-final passives did not differ in the active (2.8%) and the verb-medial passive condition (3.1%) [*ts* < 1].

Additional analyses on the subset of items with the same animacy for agent and patient (only animate-animate and inanimate-inanimate items) showed the same pattern as the main analysis: more actives were produced in primed (87.7%) than in unprimed conditions (50.2% actives after verb-medial passives, 57.4% after verb-final passives) [t_1 (1, 26) = 7.00, *MSE* = .11, *p*<.001; t_2 (1, 23) = 10.17, *MSE* = .07, *p*<.001]. Significant priming was also obtained for verb-medial passives (47.9% verb-medial passives in the verb-medial condition, 9.9% in the active and 9.1% in the verb-final condition) [t_1 (1, 26) = 6.11, *MSE* = .11, *p*<.001; t_2 (1, 23) = 10.17, *MSE* = .08, *p*<.001] and for verb-final passives (33.5% in the verb-final condition, 2.4% in the active and 1.4% in the verb-medial condition) [t_1 (1, 26) = 4.82, *MSE* = .13, *p*<.001; t_2 (1, 23) = 10.49, *MSE* = .07, *p*<.001]. Though the priming effects were somewhat smaller than in the main analysis (33.9% compared to 40.3% for actives, 38.4% compared to 44.8% for verb-medial passives, 31.6% compared to 36.0% for verb-final passives), strong priming effects were obtained for all three sentence types in this subset of items.

DISCUSSION

This experiment showed a clear effect of syntactic priming with Dutch actives and passives. Participants tended to preserve the word order of the primes in the description of the target pictures. Therefore they produced more actives after active primes (in contrast to Hartsuiker & Kolk, 1998), more verb-medial passives after verb-medial passive primes and more verb-final passives after verb-final passive primes. No priming was found between Dutch passives with a different word order: Although verb-medial passives and verb-final passives share the same functional assignment (patient as subject, agent as oblique object), the percentage of passive targets after passive primes with the alternative word order was not different from the percentage of passives in the active condition. The data pattern was the same when only trials were considered in which the agents and patients in prime and target were both animate or both inanimate.

On one account of these data, there is no functional-level representation in language production, at least not one that can be primed. On such an account, the priming effects shown here are all the result of the repetition of a constituent structure which is specified for word order. But as noted in the introduction, it is also possible that there is priming at the functional level, which is however obscured by a further priming effect of constituent structure.

In a cross-linguistic priming experiment with Dutch as prime language and English as target language, it is no longer possible to preserve the word order in all conditions, as verb-final passives are ungrammatical in English. An increase in the number of English (verb-medial) passives after Dutch verb-final passives would thus provide evidence for the existence of functional representations for transitives.

EXPERIMENT 2: PRIMING BETWEEN DUTCH (L1) AND ENGLISH (L2) TRANSITIVES

As mentioned in the introduction, a number of studies have investigated the existence and the nature of shared syntactic structures across languages by conducting cross-linguistic syntactic priming experiments (Bernolet et al., 2007; Desmet & Declercq, 2006; Hartsuiker et al., 2004; Loebell & Bock, 2003; Salamoura & Williams, 2006; Schoonbaert et al., 2007). These studies suggest that syntactic structures can be primed across languages and thus have shared representations in the bilingual memory. Many of these studies, however, have used syntactic structures that have an identical word order in the languages under study (Desmet & Declercq, 2006; Hartsuiker et al., 2004; Schoonbaert et al., 2007). Hence, they cannot distinguish between models that assume that only word-order specific representations at the positional level can exert priming and models that assume that representations at the functional level can be primed too. However, studies investigating cross-linguistic syntactic priming between structures that show word order variations across languages (Bernolet et al., 2007; Heydel & Murray, 2000; Loebell & Bock, 2003; Salamoura & Williams, in press) might provide a way to discriminate between these two accounts.

Heydel and Murray (2000) briefly describe experiments in which German-English bilinguals judged whether a German prime sentence matched pairs of pictures. After they decided whether the prime matched one of both pictures in the pair (which was never the case for experimental items), they had to describe the pictures in English. English passives were produced more often after German passives or German topicalized sentences (i.e., object-verb-subject order) than after German actives. However, the search for similarities between the prime sentences and the target pictures may have caused strategic processing.

Loebell and Bock (2003) provided evidence against a functional level using the same structures as Heydel and Murray (2000). They studied

syntactic priming between German (L1) and English (L2) in a picture description task. German datives were primed by English datives and vice versa, but no cross-linguistic priming occurred for transitives, even though they share a functional level. The absence of cross-linguistic priming in this study might have been due to the difference in word order between German and English passives, but Loebell and Bock also found no priming of transitives within German.   As we have noted, picture-description experiments have yielded small effects (and sometimes null-effects) of active/passive priming (Bock, 1986; Bock & Griffin, 2000; Hartsuiker & Kolk, 1998).

However, two other studies that investigated between-language priming for structures with different word orders do indeed indicate that no priming occurs if the word order of the structures under study is different across languages (Bernolet et al., 2007; Loebell & Bock, 2003; Salamoura & Williams, in press). Salamoura and Williams studied cross-linguistic syntactic priming in a Greek-English sentence completion task using DO-datives (3a-b), PO-datives (4a-b), and Shifted-PO-datives (5a-b). The results were very similar to Pickering et al.'s (2002) findings for within-language priming in English: Although PO-datives and Shifted-PO-datives share the same constituent structure and hierarchical relations, the number of English PO target completions after Greek Shifted-PO-datives was not higher than in the intransitive baseline condition (6a-b).

3a)   Ο πρόεδρος έδωσε <u>του νικητή</u> το βραβείο

3b)   The president gave <u>the winner</u> the prize

4a)   Ο πρόεδρος έδωσε το βραβείο <u>στο νικητή</u>

4b)   The president gave the prize <u>to the winner</u>

5a)   Ο πρόεδρος έδωσε <u>στο νικητή</u> το βραβείο

5b)   The president gave <u>to the winner</u> the prize

6a)   Ο πρόεδρος χρεωκόπησε

6b)   The president went bankrupt

Bernolet et al. (2007) investigated the influence of word order differences on the sharing of syntactic structures across languages using a picture description task. In particular, they studied cross-linguistic syntactic priming of noun phrases in spoken dialogue for Dutch-English and Dutch-German bilinguals using adjective-noun order (7a-c) and noun-relative clause order (8a-c):

7a)	the red shark	*AN-structure, English*
7b)	de rode haai	*AN-structure, Dutch*
7c)	der rote Hai	*AN-structure, German*
8a)	the shark that is red	*RC-structure, English*
8b)	de haai die rood is	*RC-structure, Dutch*
8c)	der Hai der rot ist	*RC-structure, German*

The results indicated that the order of the adjective and the verb of the relative clause influenced the occurrence of cross-linguistic priming for noun phrases: Significant priming occurred within languages (Dutch and English; see also Cleland & Pickering, 2003), between Dutch and German (which have identical word order for RC-structures [8b-c]), but not between Dutch and English (which have different word orders for RC-structures [8a-b]). These results suggest that priming of RC structures requires word-order repetition and that different word orders are represented separately. As no priming occurred between structures that differ in word order but which were otherwise identical, Bernolet et al. interpreted these data as evidence against the existence of constituent structure representations that are not yet specified for word order.

Though Salamoura and Williams (in press) and Bernolet et al. (2007) provide clear evidence against the existence of shared constituent structure representations for structures with different word orders, their studies cannot rule out the existence of shared functional-level representations. In Bernolet et al., the noun phrases do not differ in functional structure; in Salamoura

and Williams, the datives may have the same functional structure, depending on linguistic analysis. Actives and passives are functionally different and thus can provide more conclusive evidence about the existence of functional representations. As Heydel and Murray (2000) and Loebell and Bock (2003) obtained inconclusive and conflicting results for cross-linguistic priming between passives with different word orders, we conduct a new cross-linguistic syntactic priming experiment in order to investigate whether functional priming occurs between passives with a different word order.

The fact that we obtained strong within-language priming effects for Dutch verb-medial and verb-final passives (44.8 and 36.0% priming, respectively) suggests that cross-linguistic priming may occur between Dutch and English transitives. If only representations at the positional level can be primed, we predict that Dutch actives will prime English actives and Dutch verb-medial passives will prime English passives, but that Dutch verb-final passives will not prime English passives. If representations at the functional level can also be primed, we expect that Dutch verb-final passives will prime English passives, although possibly to a lesser extent than verb-medial passives.

METHOD

Participants. Thirty-three further students from Ghent University (23 females and 10 males) were paid to take part. All participants were native speakers of Dutch with English as L2. They all reported having at least 4 years of experience with English as their second language (mean of 12 years of experience). A male and a female undergraduate student with Dutch as L1 and English as L2 acted as confederates (the male student for 17 participants, the female student for 16 participants).

Materials. The materials were identical to the materials of Experiment 1, except that the verbs on the description pictures of the participant and on the verification pictures of the confederate were printed in English. The verbs on

the verification pictures of the participants were printed in Dutch, as the participants had to respond to Dutch prime descriptions.

Procedure and design. The procedure and the design of this experiment were almost identical to those of Experiment 1. Now, however, the participants were instructed to describe the target pictures in English (their L2). Therefore, the pictures in the study session now showed the Dutch and the English name of the objects and the characters that could appear in the experiment. The participants were told that if they did not know or could not remember the English name of one of the objects or the characters during the experiment, they could use an English synonym or, if necessary, a hyponym (e.g., *man* instead of *judge*). If they could not think of another English word that adequately described the object or the person in question, they were allowed to use the Dutch name of the object.

After this experiment and Experiment 3, the participants rated their L1 (Dutch) and L2 (English) proficiency with respect to several skills (reading, writing, speaking, general proficiency) on 7-point scales ranging from *very bad* to *very good* (see Table 1 for the means of the self-ratings of L1 and L2 proficiency for Experiments 2 and 3). Ratings were consistently higher for participants' L1 than for their L2. The ratings for L2 were quite high and very similar in both experiments, indicating that both the participants of Experiment 2 and Experiment 3 were highly proficient in English. The participants also completed a test in which they had to write down the past participle for the transitive verbs that had to be used for the description of the experimental items; poor mastery of past participle formation could lead participants to avoid the use of passive sentences. The results showed that most participants were in fact quite familiar with the formation of the past participle, with the mean score being 84% (range: 64% - 100%).

Table 1: Self-Assessed Ratings (7-point Scale) of L1 and L2 Proficiency (Experiments 2 and 3).

Language	Skill	Experiment 2	Experiment 3
L1 (Dutch)	Writing	6.27 (0.76)	5.73 (1.06)
	Speaking	6.12 (0.89)	5.93 (1.04)
	Reading	6.42 (0.79)	6.13 (0.77)
	General	6.24 (0.75)	5.80 (0.90)
L2 (English)	Writing	4.94 (0.90)	4.72 (1.09)
	Speaking	5.09 (0.80)	5.00 (1.08)
	Reading	5.61 (0.90)	5.52 (0.82)
	General	5.24 (0.66)	5.09 (0.91)

Note. Standard deviations are indicated in parentheses. L1 = native language; L2 = second language

Scoring. The responses were recorded on minidisk, and were manually coded as active sentences or verb-medial passives. Short passives, in which the agent was not overtly realized (e.g., *The doctor was killed*), were coded as 'Other' responses, as were (ungrammatical) verb-final responses. If a past participle was morphologically incorrect (e.g., *striked* or *strucked* instead of *struck*, *lift* instead of *lifted*) the response still counted as an allowable response. But if a different verb was used than the verb that appeared on the target picture, the response was coded as 'Other'.

RESULTS

Sixty-nine of the 1188 target responses were coded as 'Other' (5.8%). None of these 'Other' responses was a verb-final-passive. The remaining 1119 target responses were coded either as actives (563, 47.4%) or as verb-medial passives (556, 46.8%). The proportions of actives and verb-medial passives out of all responses were calculated for each participant and item and subsequently arcsine-transformed (see Figure 4).

Figure 4: Percentage of Actives (ACT) and Verb-medial passives (VMP) in each condition
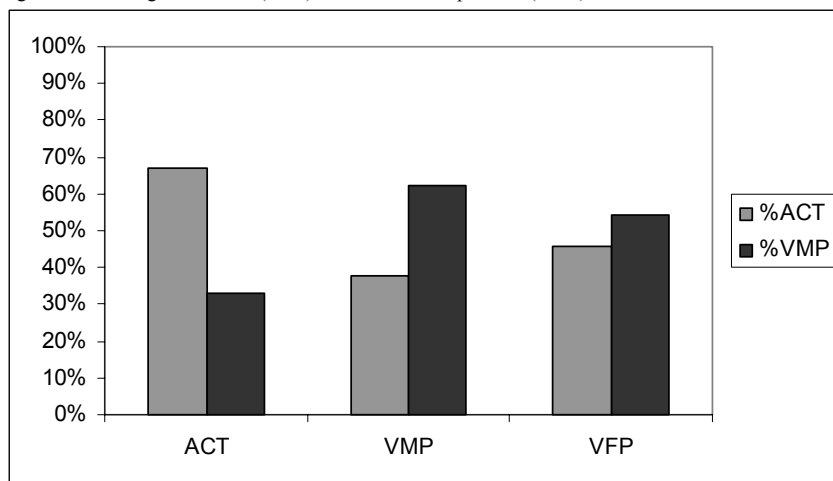
Note: ACT = Active condition, VMP = Verb-medial passive condition, VFP = Verb-final passive condition

ANOVAs were run on the proportions of verb-medial passives with Prime Type (active vs. verb-medial passive vs. verb-final passive) as a within-participants and within-items factor.[3] The analyses showed a significant effect of Prime Type on the production of passive sentences [F_1 (1, 31) = 46.46, *MSE* = 3.72, *p*<.001; F_2 (1, 34) = 24.15, *MSE* = 3.95, *p*<.001]. Paired t-tests (two-tailed) on the proportions of passives showed that the proportion of passives was higher after verb-medial passives (62.4%) than after active prime sentences (33.0%), yielding a 29.4% effect of passive priming [t_1 (1, 32) = 8.07, *MSE* = .08, *p*<.001; t_2 (1, 35) = 6.95,

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[3] The percentage of passive target descriptions was slightly lower when the primes were produced by confederate 1 (47.0%) than when the primes were produced by confederate 2 (54.0%). This effect was only significant by-items [F_1 < 1; F_2 (1, 69) = 4.88, *MSE* = 10.09, *p* <.05]. More importantly, the syntactic priming effects did not differ depending on the confederate that produced the primes [F_1 (1, 30) = 1.10, *MSE* = .09, *p* > .1; F_2 < 1]. Hence, the factor Confederate was omitted from the analyses.

$MSE = .09$, $p<.001$]. The proportion of passives was also significantly higher after verb-final passives (54.2%) than after active primes (33.0%), resulting in a 21.2% effect of passive priming for verb-final passives [t_1 (1, 32) = 6.38, $MSE = .07$, $p<.001$; t_2 (1, 35) = 4.74, $MSE = .10$, $p<.001$]. Moreover, the effect of Prime Type was larger for verb-medial passives (29.4%) than for verb-final passives (21.2%). This 8.2% difference in the magnitude of passive priming was significant by participants and marginally significant by items [t_1 (1, 32) = 3.78, $MSE = .05$, $p<.005$; t_2 (1, 35) = 1.87, $MSE = .10$, $p<.1$].

Additional analyses on the 24 items with the same animacy for agent and patient again showed a very similar pattern: significant passive priming (35.8%) for verb-medial passives [t_1 (1, 32) = 6.66, $MSE = .10$, $p<.001$; t_2 (1, 23) = 8.76, $MSE = .09$, $p<.001$] as well as for verb-final passives (24.6% priming) [t_1 (1, 32) = 5.70, $MSE = .09$, $p<.001$; t_2 (1, 23) = 4.94, $MSE = .13$, $p<.001$].

DISCUSSION

The results of this experiment suggest that representations at the functional level can indeed be primed: The percentage of English passives was smallest after Dutch actives, and was significantly greater after both Dutch verb-medial passives and Dutch verb-final passives. As Dutch verb-final passives and English verb-medial passives have different word orders, they cannot have a shared representation at the positional level. Priming between both structures thus originates from a higher level of production, which we propose is the functional level. Again, the data pattern was the same when only trials were considered in which the agents and patients in prime and target were both animate or both inanimate, suggesting that the between-language priming effects did not arise from a tendency to preserve the animacy of subject and object in the target descriptions.

The difference in passive priming for verb-medial passives versus verb-final passives suggests that the priming effects can originate from both priming at the functional and the positional level: More priming appeared to be obtained if the passive structure is identical across languages. This suggests that for the comprehension and the construction of Dutch and English verb-medial passives, the same representation is accessed at the positional level. We will come back to this in the discussion of Experiment 3 and in the General Discussion.

However, as our experiment did not include a neutral baseline, we cannot be sure that passive priming occurs in the verb-final passive condition. The percentage of passives that was produced after verb-final passives could in fact be at baseline level. Actually, the percentage of English passives that was produced in this experiment (46.8%) was quite high, so it could be that the baseline percentage of passives in English as a second language is higher than it is in Dutch.[4] We therefore repeated Experiment 2 while adding a neutral baseline. In the baseline, no verbs were used in the prime sentences (because any verb has voice). Instead of formulating a full sentence, the confederate simply named the two persons or objects that appeared on the screen (e.g., the nun and the hippo). This allows us to measure the percentage of passives produced in unprimed conditions. Thus, clear evidence for functional priming would occur if English passives were more frequent after verb-final passives than after baseline primes. Such an experiment would also test whether the difference between the effect of verb-medial and verb-final passives was reliable.

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[4] In a pretest in which 32 Dutch-English bilinguals described 76 transitive pictures (a selection of these pictures was used in the experiments) in Dutch in unprimed conditions, only 7.3% passives were produced (4.9% verb-medial passives, 2.4% verb-final passives). Eighty-three percent of the responses were active transitives, 9.7% were Other responses (3.3% of the Other responses were short passives, in which the Agent was not expressed).

EXPERIMENT 3: PRIMING BETWEEN DUTCH (L1) AND ENGLISH (L2) TRANSITIVES

METHOD

Participants. Forty-four further students from Ghent University (35 females and 9 males) were paid to take part. They all reported having at least 6 years of experience with English as their second language (mean of 11 years). A female undergraduate student with Dutch as L1 and English as L2 acted as confederate.

Materials. The materials were identical to the materials of Experiment 2, except that we added 12 Dutch baseline prime sentences consisting of two conjoined noun phrases (e.g., *de gorilla en de piraat*, meaning "the gorilla and the pirate"); see Appendix 3A. Consequently, we selected 12 additional transitive target pictures (4 animate-animate, 4 inanimate-animate and 4 inanimate-inanimate). We also added 24 target pictures to the description and the verification set of the naïve participant and the description set of the confederate. These pictures were similar to the ones that were used in Experiments 1 and 2, except that no verb was printed. These pictures were added in order to justify the use of conjoined noun phrases in the baseline condition: Both the confederate and the participant used conjoined noun phrases on 24 of the 132 trials.

In sum, there were 132 prime-target pairs in this experiment: 48 experimental prime-target pairs (12 in the baseline condition, 12 in the active condition, 12 in the verb-medial passive condition, and 12 in the verb-final passive condition), and 84 filler pairs. Four counterbalanced pseudo-random lists were constructed so that each target picture occurred once in each condition across the four different lists. In each list 4 baseline primes were combined with a target picture with an animate agent and an animate patient, 4 baseline primes were combined with a target picture with an inanimate

agent and an inanimate patient, and 4 baseline primes were combined with a target picture with an animate agent and an inanimate patient.

Procedure and design. The procedure was identical to that of Experiment 2, except that the participants and the confederate were told that target pictures without a verb had to be described by just naming the persons or the objects in the picture. After the experiment, the participants self-rated their proficiency (see Table 1) and completed the test of their knowledge of the participles; the mean score was 81% (range: 54% - 100%); see Table 1.

RESULTS

Figure 5: Percentages of Actives (ACT) and Verb-medial passives (VMP) in each condition
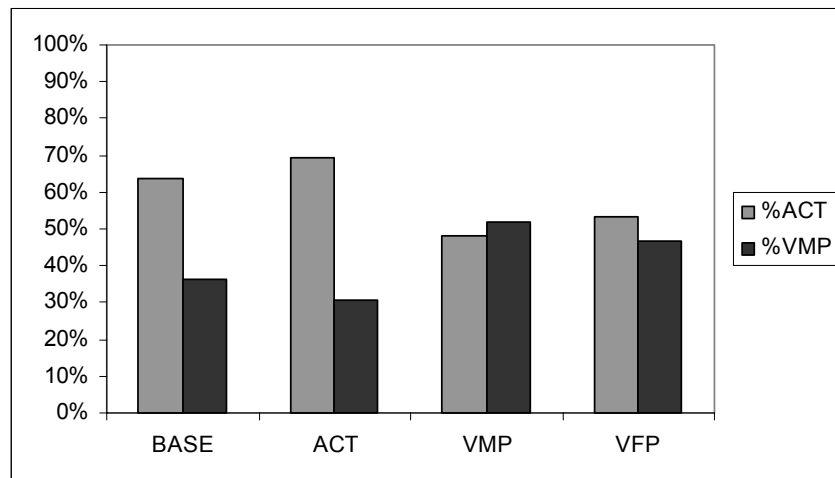
Note: BASE = Baseline, ACT = Active condition, VMP = Verb-medial passive condition, VFP = Verb-final passive condition

One hundred and eighty-nine of the 2112 target responses were coded as 'Other' (9.5%). None of these 'Other' responses was a verb-final-passive. The remaining 1923 target responses were classified either as actives (1125,

53.3%) or as verb-medial passives (798, 37.8%). The proportion of verb-medial passives out of all responses was calculated for each participant and item (see Figure 5) and subsequently arcsine-transformed.

ANOVAs were run on these proportions with Prime Type (baseline vs. active vs. verb-medial passive vs. verb-final passive) as a within-participants and within-items factor. The analyses showed an effect of Prime Type on the production of verb-medial passives [F_1 (1, 41) = 25.58, MSE = 1.98, $p<.001$; F_2 (1, 45) = 20.70, MSE = 2.31, $p<.001$]. Paired t-tests on the proportions of passive sentences showed that the proportion of passives in the verb-medial condition (52.0%) was significantly higher than after baseline primes (36.2%), yielding a 15.8% effect of syntactic priming [t_1 (1, 43) = 5.78, MSE = .06, $p<.001$; t_2 (1, 47) = 6.45, MSE = .07, $p<.001$]. Likewise, the proportion of passives after verb-final passive primes (46.8%) differed significantly from the baseline level, resulting in 10.6% passive priming [t_1 (1, 43) = 4.37, MSE = .05, $p<.001$; t_2 (1, 47) = 3.95, MSE = .06, $p<.001$]. The proportion of passives was lower in the active condition (30.8%) than in the baseline condition (36.2%). This 5.4% difference was significant in the analysis by participants, though not significant in the analysis by items [t_1 (1, 43) = 2.05, MSE = .06, $p<.05$; t_2 (1, 47) = 1.32, MSE = .08, $p>.1$]. The difference in the magnitude of cross-linguistic passive priming for verb-medial passives (15.8%) and verb-final passives (10.6%) was very close to significance [t_1 (1, 43) = 1.95, MSE = .06, p = .058; t_2 (1, 47) = 2.01, MSE = .06, p = .051].

Finally, the data pattern was again very similar if only the items with the same animacy for agent and patient were taken up in the analyses: the percentage passives in the verb-medial passive condition (45.9%) was significantly higher than in the baseline condition, resulting in 11.4% priming (34.5%) [t_1 (1, 43) = 4.66, MSE = .07, $p<.001$; t_2 (1, 31) = 4.92, MSE = .07, $p<.001$]. The percentage of passives in the verb-final condition (41.4%) also differed significant from the baseline [t_1 (1, 43) = 4.07, MSE = .06, $p<.001$; t_2 (1, 31) = 3.19, MSE = .07, $p<.005$]. The 11.5% priming effect

for actives was significant by participants and marginally significant by items [t_1 (1, 43) = 2.30, *MSE* = .07, *p*<.05; t_2 (1, 31) = 1.90, *MSE* = .09, *p*<.1].

DISCUSSION

The most important result of this experiment is that more English passives were produced after Dutch verb-final passives than after baseline descriptions. In addition, more English passives were produced after Dutch verb-medial passives than after baseline descriptions.

In the active condition, only marginally significant priming was found in comparison with the baseline. It is not very surprising that weaker priming occurred for actives (5.4%) than for passives (13.2%): Many studies have shown that more preferred structures exhibit greater structural priming than less preferred structures relative to a neutral baseline (e.g., Bock & Griffin, 2000; see Ferreira & Bock, 2006). This probably explains why priming for active transitives was weak or nonexistent in this and other studies (Hartsuiker & Kolk, 1998; Hartsuiker et al., 2004).

An interesting observation in this experiment and in Experiment 2 is that more passive priming was obtained for verb-medial than for verb-final passives. Although this difference in the amount of priming is small and only marginally significant (8.2% additional priming of word order in Experiment 2, 5.2% in Experiment 3), it suggests that congruency in word order promotes priming even when the language has only a single word order for the passive. The crucial finding of this cross-linguistic experiment is, however, that functional representations for transitives can be primed between languages.

GENERAL DISCUSSION

This study asked whether syntactic priming can take place at the level of function assignment. Therefore we compared within-language priming in Dutch in Experiment 1 and between-language priming from Dutch (L1) to English (L2) in Experiments 2-3, using transitive sentences. Experiment 1 showed a clear effect of word-order priming: Actives, verb-final passives, and verb-medial passives were more frequent in primed than in unprimed conditions. As in Hartsuiker and Kolk (1998), no priming occurred between Dutch verb-medial and verb-final passives, despite the fact that these structures share the same functional assignment and constituent structure. Conversely, priming between passives with differing word orders occurred across languages (Experiments 2-3): The percentage of passives in English increased after Dutch verb-medial passives, with a word order that is identical to that of English passives, but also after Dutch verb-final passives, in which the order of the *by*-phrase and the main verb of the sentence is different from English. Experiment 3 included a baseline condition and confirmed that Dutch verb-final passives primed English passives.

The between-language priming results thus suggest that verb-medial and verb-final passives share a representation at some level of sentence production. In the remainder of this discussion we will argue why we assume that this level is the level of functional assignment, as suggested by Hartsuiker et al. (1999) and Hartsuiker and Westenberg (2000), rather than any other processing level.

As an alternative to the functional level, one might argue that our cross-linguistic priming effect between passives with different word orders should be localized at either a higher production level (conceptualizing) or a lower level (the positional level). An explanation in terms of conceptualizing might be that our speakers repeated a semantically driven process of assigning concepts with certain features (i.e., animate or inanimate) to certain positions in the sentence (cf. Bock et al., 1992; Hartsuiker et al.,

1999). As we held the animacy of agents and patients constant between prime and target, one could argue that the observed priming effect between Dutch and English passives arose from the tendency to perseverate the assignment of an argument with a particular animacy to a particular grammatical function. Such effect can only influence participant's responses under the condition that agent and patient differ in animacy. However, in two thirds of our experimental targets the agent had the same animacy as the patient of the action (animate agent – animate patient or inanimate agent – inanimate patient). In all three experiments the results for this subset were very similar to the results that were obtained when all items were analyzed, indicating that the obtained effects are not driven by a tendency to assign an argument with a particular animacy to a particular grammatical function.

Another account that would place cross-linguistic priming for passives at the conceptual level holds that a representation of discourse functions is primed. More specifically, one might argue that active and passive sentences differ in which element receives focus in the discourse, but that the two passive word orders are similar at this level. However, Hartsuiker and Westenberg (2000) showed priming between structures that only differ in the order of a function word and a content word and that therefore do not differ in discourse functions. This shows that overlap in discourse functions is not necessary for priming. Additionally, Bernolet et al. (2007) only found between-language priming of noun phrases (*the red shark* vs. *the shark that is red*), when those structures had the same word order in the two languages (between Dutch and German) but not when they had a different word order (Dutch and English), even though the versions with relative clauses presumably have similar discourse functions. This suggests that similarity in discourse functions is also not sufficient for priming.

Those same data also rule out another possible account, in which priming occurs at two distinct processing stages at the positional level, one concerned with hierarchical relations between constituents and one concerned with word order. On such an account, the two passives share a

representation at the hierarchical stage, so that they can prime each other. But in contrast to that account, Bernolet et al. (2007) found no priming between Dutch and English RC-structures, which would likewise share a representation at that hierarchical stage.

Bernolet et al.'s (2007) data also speak against a purely incremental model of sentence production that does not contain a functional level. The implicit learning model proposed by Chang et al. (2006) contains no functional representations, yet it can explain the data pattern that was obtained in the current study. Because their connectionist model predicts words one at a time, based on the input, it can explain the word order effects that were obtained in Experiment 1 as well as the effects of functional priming that were obtained in Experiments 2 and 3. The choice between an active and a passive sentence has to be made when the first noun phrase is produced. Both after a verb-final and a verb-medial passive prime the patient of the transitive action receives higher activation than the agent. Consequently, the patient of a new transitive action is placed in sentence initial position, resulting in a passive response. The choice between a verb-medial and a verb-final passive has to be made later on, after the auxiliary. During the comprehension of a Dutch verb-final passive, the model predicts that a past participle will immediately follow the passive auxiliary, because verb-medial passives are more frequent than verb-final passives in Dutch. If the next word in the input is the preposition *by* instead of the predicted past participle, the connection weights in the model are altered so as to adjust its predictions for passive sentences. If subsequently a passive transitive has to be produced, production will be biased towards a verb-final passive sentence. However, Chang et al.'s model cannot explain the Bernolet et al.'s data (2007): As this account states that decisions that are made early in the sentence cannot be influenced by later decisions, it incorrectly predicts priming between Dutch and English noun phrases with different word orders.

If functional assignment can be primed, why did we not obtain priming between Dutch verb-final and verb-medial passives in Experiment 1? As mentioned in the introduction, the most likely explanation is that any functional-level priming effect was obscured by a second priming effect at the positional level. Thus, even though a passive prime with a particular order facilitated the production of both types of passive (at the functional level), a further priming effect (at the positional level) then facilitated the choice of a passive with the same order in particular. This account is supported by the data of Experiments 2-3, which showed that passive primes with the same order in Dutch and English exerted a somewhat stronger priming effect than passives with different orders. Presumably, positional-level priming occurred from the Dutch verb-medial primes but not the Dutch verb-final primes. After a Dutch verb-medial passive has been processed, feedback going from its positional level representation to the functional level representation adds to the activation resulting from functional priming, because the same positional representation can be used to form an English passive sentence. As the positional level representation for verb-final passives is never activated during the production of English transitives, no feedback occurs between the positional and the functional level, resulting in weaker passive priming for verb-final passives.

Alternatively, the difference in the strength of passive priming for verb-medial and verb-final passives can be explained in terms of a revision process: After a Dutch verb-final passive, functional priming biases production towards a passive, but during the planning of the English passive utterance, a mismatch in word order with the Dutch passive is discovered. Consequently, the decision to produce a passive sentence may be revised, resulting in fewer passives after verb-final passives than after verb-medial passives.

Finally, our study showed that priming effects that are obtained by using cross-linguistic priming do not necessarily emerge in within-language priming experiments: The functional priming effects that we obtained by

studying priming between Dutch and English transitives were completely overruled by word-order effects when we used Dutch as a target language. By using English as a target language, we were able to restrict the number of allowable responses and thereby cancel out word order priming effects for verb-final passives. This way, we could investigate priming between syntactic structures that are functionally identical, but have different word orders. Thus, cross-linguistic syntactic priming is not only a useful tool to study syntactic and lexical representations in the bilingual memory; it can also be used to investigate aspects of syntactic processing in general.

CHAPTER 4
THE REPRESENTATION OF L2 SYNTAX IS INFLUENCED BY SECOND-LANGUAGE PROFICIENCY: EVIDENCE FROM CROSS-LINGUISTIC SYNTACTIC PRIMING

Manuscript in preparation [1]

Studies investigating cross-linguistic syntactic priming in bilinguals (e.g., Hartsuiker, Pickering & Veltkamp, 2004) have shown that syntactic representations can be shared in bilingual memory. The current study investigates how these representations are established in late learners of a second language: are representations of syntactic structures in a second language (L2) immediately collapsed with similar structures of the first language (L1) when they are learned or are they initially represented separately? To this aim, we studied within- and between-language syntactic priming for English genitives (the ball of the boy vs. the boy's ball) in late Dutch-English bilinguals. Experiment 1 showed within-language priming of English genitives for both less proficient and more proficient bilinguals; Experiment 2 showed cross-linguistic priming between Dutch and English genitives for more proficient bilinguals but not for less proficient bilinguals. Hence, our results indicate that there is a shift from language-specific representations in less proficient late bilinguals to shared representations in more proficient late bilinguals.

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[1] This paper was co-authored by Robert Hartsuiker, Marloes Bressers and Martin Pickering

INTRODUCTION

Research on bilingualism focuses on the question of how the representations of the two languages are related in memory. Are they closely integrated, with information being shared as much as possible, or are they kept largely separate? Recently, a number of studies showing cross-linguistic syntactic influences in bilinguals (Bernolet, Hartsuiker & Pickering, 2007; Desmet & Declercq, 2006; Loebell & Bock, 2003; Salamoura & Williams, 2006; 2007; Schoonbaert, Hartsuiker, & Pickering, 2007) yielded evidence for a shared-syntax account in which syntactic representations can be shared in bilingual memory (Hartsuiker, Pickering & Veltkamp, 2004). But how are these shared representations established in late learners of a second language? In particular, are the representations of new L2 structures immediately collapsed with the representations of equivalents in the first language (L1) or do late bilinguals start with separate L1 and L2 representations before they subsequently move to shared syntactic structures? In order to answer these questions we investigate the influence of L2 proficiency on the representation and the use of L2 grammatical structures.

Most research on language integration in bilinguals has been concerned with conceptual and lexical representations (Dijkstra, Van Heuven, & Grainger, 1998; Kroll & Stewart, 1994; Van Hell & De Groot, 1998). Though the degree of lexical and conceptual sharing in bilinguals is likely to be influenced by the bilingual's proficiency in both of these languages, only a few studies found that the integration of languages in bilingual memory is influenced by second language proficiency or by factors that are highly correlated with a bilingual's level of proficiency in his/her second language (e.g. language dominance, language immersion, Age of Acquisition). Van Hell and Dijkstra (2002) found that L1 visual word recognition was facilitated by the existence of L2 cognates in a group of Dutch-English-French trilinguals. Facilitation effects of L3 cognates were

only obtained for trilinguals with a high level of proficiency in their L3. Similarly, translation priming from L2 to L1 appears to occur for participants living in an L2 dominant environment but not otherwise (Basnight-Brown & Altarriba, 2007; Grainger & Frenck-Mestre, 1998; Jiang, 1999; see Duyck & Warlop, 2007). Also in spoken-word recognition immersion and L2 dominance seem to determine to which extent the activation of L2 words influences L1 lexical processing. In an eye-tracking experiment, Spivey and Marian (1999) found effects of L2 phonological distractors on auditory word recognition in L1; but using the same task, Weber and Cutler (2004) observed no L2 word activation when participants listened to materials in their first language. Weber and Cutler attributed this to the fact that the participants in Spivey and Marian's study were resident in the second-language country (L2 dominant), whereas their own participants lived in their native country (L1 dominant).

Taken together, the results of lexical decision, translation priming, and eye-tracking experiments seem to indicate that the representations of L1 and L2 (and L3) words may differ according to the level of proficiency in the non-native language. More specifically, they suggest that L1 and L2 representations are more closely integrated when the L2 proficiency increases and that language processing in both languages is more similar for high proficient bilinguals than for low proficient bilinguals. The current study raises the question whether L2 proficiency also affects the integration of L1 and L2 syntactic structures in late bilinguals: Is there a shift from separate L1 and L2 syntactic representations in less proficient bilinguals to more abstract, shared representations in more proficient bilinguals? In short, this study investigates how late L2 learners initially represent L2 structures that can be shared in bilingual memory.

A few years ago, Hartsuiker et al. (2004) proposed a lexical-syntactic model for bilingual sentence production. Their bilingual model is based on Pickering and Branigan's (1998) model for the production of syntax, which is in its turn an extension of the models of lexical production proposed by

Roelofs (1992, 1993) and Levelt et al. (1999). Following these models, Hartsuiker et al.'s model assumes that lexical entries consist of conceptual, lemma, and word-form strata, with syntactic information being represented at the lemma stratum. In addition, the model assumes that the lexicon is shared between the different languages of a bilingual. The lemma stratum thus contains lemma nodes (corresponding to the base forms of words) from both languages, which are connected to language nodes (Fig. 1). These lemma nodes are also connected to *categorical* and *combinatorial nodes* capturing syntactic information. For example, the lemma for the verb *hit* is connected to a categorical node that indicates its grammatical category (i.e. verb) and a combinatorial node indicating that it can combine with a subject and an object noun phrase to form a sentence in the active voice. Importantly, these nodes are connected to all words with the relevant properties, irrespective of language. In other words, the combinatorial nodes containing syntactic information do not belong to a particular language, but are connected to the language-specific lemmas that can be used in the syntactic construction in question. Consequently, the activation of a grammatical structure in itself does not determine the language of an utterance. Instead, the language of the utterance is dependent on the choice of lexical items that are inserted into this structure: If the combinatorial node for passive sentences is activated in combination with the English verb *chase*, the eventual utterance will be an English passive (e.g., *The truck is chased by the taxi*), while the combination of the same combinatorial node and the lemma of the Spanish verb *perseguir* results in a Spanish sentence (e.g., *El camión es perseguido por el taxi*).
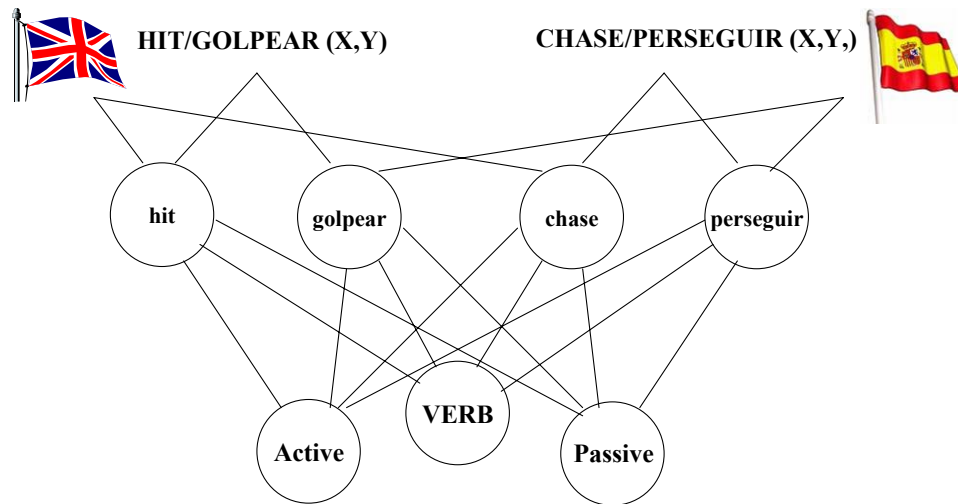
Fig. 1. Hartsuiker et al.'s (2004) lexical-syntactic model of bilingual sentence production.

The bilingual model of Hartsuiker et al. (2004) assumes that grammatical rules are shared between different languages, whenever these rules are sufficiently similar. Thus, it predicts cross-linguistic grammatical influences for these shared rules. Grammatical influences on the production of syntax have often been studied in syntactic priming studies. Syntactic priming is the phenomenon by which processing one utterance facilitates processing of another utterance on the basis of repeated syntactic structure (Branigan, 2007). By examining which utterances prime which other utterances, inferences can be drawn bout the syntactic representations that are accessed during sentence processing. In a seminal study, Bock (1986) used picture description to study the stages involved in sentence production: participants alternated between repeating sentences they had just heard and describing pictures of actions involving one or two persons and/or objects. She discovered that participants were more likely to describe a picture of lightning striking a church using the passive sentence *The church is being*

struck by lightning if they had just read a very different passive sentence such as *The referee was punched by one of the fans* than if they had just read an active sentence. This effect of syntactic persistence or syntactic priming indicates that the abstract syntactic structure of sentences can be primed. Later experiments have shown that syntactic priming occurs in the absence of open-class (Cleland & Pickering, 2003; Pickering & Branigan, 1998) and closed-class lexical repetition (Bock, 1989); it occurs when the thematic roles between prime and target differ, but not when prime and target are only superficially similar, but structurally different (Bock & Loebell, 1990). Syntactic priming does not only occur for transitives (Bock, 1986; Hartsuiker & Kolk, 1998a), but also for datives (Bock, 1986; Hartsuiker & Kolk, 1998b; Pickering & Branigan, 1998; Pickering, Branigan, & McLean, 2002), noun phrases (Cleland & Pickering, 2003), and relative clauses (Ferreira, 2003) and although most studies have used English, the effects have also been found in Dutch (Hartsuiker & Kolk, 1998a, 1998b; Hartsuiker et al., 1999; Hartsuiker & Westenberg, 2000) and in German (Scheepers, 2003).

Hartsuiker et al. (2004) used syntactic priming as a tool to investigate their predictions on syntactic processing in bilinguals. They had Spanish–English bilinguals describe cards to each other in a dialogue game (cf. Branigan et al., 2000). Participants first heard a prime description in their L1 (Spanish) and then had to describe the subsequent picture using their L2 (English). The experiment showed cross-linguistic syntactic priming for passive sentences: Spanish–English bilinguals tended to produce English passive sentences more often following a Spanish passive than following a Spanish active or an intransitive sentence. This suggests that Spanish-English bilinguals indeed have a shared syntactic representation for Spanish and English passive sentences and that the same grammatical rules are used to form passives in both languages.

Several studies showing cross-linguistic syntactic priming support the bilingual model of Hartsuiker et al. (2004): Between-language priming has

been found for different language pairs and for several syntactic constructions (Bernolet et al., 2007; Desmet & Declercq, 2006; Hartsuiker et al., 2004; Loebell & Bock, 2003; Salamoura & Williams, 2006; Schoonbaert et al., 2007), suggesting that bilinguals share syntactic structures whenever possible. Recently, Schoonbaert et al. (2007) showed that grammatical influences from shared structures can even be as strong between languages as they are within a language. They tested priming for datives in Dutch-English bilinguals in all four directions (L1 to L1, L2 to L1, L2 to L2, and L1 to L2) using a single set of items. In each experiment, the dative verbs either differed between prime and target or were identical or translation equivalents. In the latter case, stronger priming was obtained within languages than between languages, because the lexical boost of syntactic priming that was caused by repeating the same verb in prime and target was much larger than the boost that was obtained when translation equivalent verbs were repeated. When the verb differed, however, priming within and between languages was very similar. This does not only suggest that the same syntactic node was accessed during unilingual and bilingual syntactic processing, it also suggests that the use of this shared node was generalized to all dative verbs in the L1 and the L2. Two unpublished studies also obtained virtually identical within- and between-language priming in within-participants designs (Pickering, McLean, Branigan, Cheung, & Peacock, 2008; Kantola & Van Gompel, 2008).

To summarize, the lack of difference between syntactic priming within and between languages is suggestive that fully shared representations occur under some conditions. This study investigates how these shared representations are established: What happens when late learners of a second language learn L2 syntactic structures that are similar to structures in their L1? If a second language is learned later in life it can be assumed that the syntax of the L1 is already well-established. The production lexicon thus already contains combinatorial nodes for several syntactic structures that are used in the L1. According to Hartsuiker et al. (2004) these combinatorial nodes are language-neutral, but before a second language is learned they are

in fact only connected to lemmas of the native language. What happens then if during L2 acquisition an L2 syntactic structure is encountered that is similar to a structure that is used in the L1?

One the one hand, it is possible that, due to the great similarity between the L1 and the L2 structure, the existing combinatorial node for this structure is immediately accessed when the new L2 structure is first processed. On the other hand, it is not inconceivable that all syntactic structures in L2 receive separate representations when they are first encountered. This is because even though some L2 structures may seem very similar to structures that are already represented, it may be hard to tell whether these new structures can be used in the exact same way as their L1 equivalents if they have only been encountered in a limited number of combinations. For example, a Dutch-English bilingual might realize quite quickly that the English double-object dative *The girl gives the dog a bone* is very similar to its equivalent in Dutch *Het meisje geeft de hond een been*, but based on this one exemplar it cannot be decided whether the use of this dative, like in Dutch, can be generalized to other dative verbs in English. Hence, in order to reduce the risk of making errors, bilinguals might initially store L2 syntactic structures separately. If the second language learner eventually discovers that the new L2 structure and its equivalent L1 structure can be used in exactly the same way, the representation of both structures may be merged into a more abstract, language-neutral representation.

It may be worth mentioning that an analogue situation occurs during syntactic acquisition in L1. Research has shown that children as young as 28 months of age are influenced by abstract features of sentence structure in their interpretation of sentences containing a novel verb (Fisher, 2002). Nonetheless, at the same age children are found to be quite conservative in their use of novel verbs: Results from both naturalistic observations and controlled experiments indicate that before 3 years of age only a few English-speaking children manage to produce canonical transitive utterances (i.e. actives or passives) with nonce verbs they had not yet heard used in this

way (Tomasello, 2000). Tomasello therefore concluded that the acquisition of L1 syntax is characterized by a shift from concrete, item-based linguistic schemas to more abstract adult-like representations. This hypothesis is supported by a priming study (Savage et al., 2003) in which 3-, 4- and 6-year-old children were primed to produce active and passive sentences. The prime sentences either had a high or a low lexical overlap with the target sentence that had to be produced. While 6-year-old children showed both lexical (i.e. item-based) and structural (i.e. abstract) priming for both the active transitive and passive constructions, 3- and 4-year old children showed lexical priming only. These results confirm that combinations of verbs and syntactic structures have item-based representations in an initial stage of acquisition. Based on both the type and the token frequency with which certain linguistic structures are encountered, these item-based representations grow in strength and abstractness as the L1 proficiency increases (Savage et al., 2003). In other words: children generalize the use of a verb or a syntactic structure only when they are sure that this generalization is warranted.

In order to investigate whether late bilinguals initially have separate representations for structures that are similar across languages, we compared within- and between-language priming for English genitives (1a-b) in less proficient and more proficient Dutch-English bilinguals.

1a)   <u>The pirate's banjo</u> is red   *s-genitive*

1b)   <u>The banjo of the pirate</u> is red   *of-genitive*

We chose genitives as target structures because genitives are not completely identical in Dutch and English. It might be easier to observe effects of L2 proficiency on syntactic priming for structures that are not completely identical across languages, because it might take bilinguals longer to realize that these structures are structurally identical. Both in Dutch and in English, a genitive noun phrase can be formed by either placing the

owner of the object before the object that is owned (resulting in a *Saxon genitive* or an *s-genitive* (1a)) or after the object that is owned (resulting in an *of-genitive* (1b)). Both constructions have an identical word order in Dutch and English. Dutch and English *s*-genitives, however, differ in a number of respects. Both languages have an *s*-genitive that is formed by attaching a sibilant to the possessor[2]. This form can be used for proper names in both languages (*Anna's bike, Anna's fiets*), and for all common names in English (though it is preferred for animate, short possessors; Rosenbach, 2005). In Dutch it is limited to common nouns that can be used to address someone (e.g. *vaders fiets– father's bike*).

In spoken Dutch, however, there is a second form of the *s*-genitive in which the sibilant is replaced by a form of the possessive pronoun (clitic and/or full form)[3] that agrees with the possessor in number and gender (*z'n/zijn (his)* for singular masculine possessors, *d'r/haar (her)* for singular feminine possessors, *hun (their)* for plural possessors). This pronominal *s*-genitive can only be used in spoken, informal language. It presupposes some kind of informal knowledge of the owner, who further has to be animate (*De koningin d'r hoed (the queen's hat)* and *God z'n genade (God's mercy)* are considered infelicitous and *de fiets z'n frame" (the bike's frame)* is

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[2] In Dutch, the sibilant is always omitted in spoken and written forms when the noun already ends in a sibilant (*Cas' fiets [Cas's bike, Bush' beleid [Bush's policy]*). In English, this unmarked form is used for plurals (*a boys' school*), Greek proper names ending in a sibilant (*Socrates' philosophy*) and proper names ending in [z] (*Dickens' novel*). For names of the latter category, either the unmarked form or a form with a sibilant can be used (*St. James' Park/St. James's Park*). Both forms are pronounced with a single sibilant.

[3] In standard Dutch, clitic forms of the possessive pronoun are used (z'n/d'r). A full form of the possessive pronoun (zijn/haar) can be used as well. The preference for either a clitic or a full form of the possessive pronoun differs according to the different Dutch dialects: In Flemish, the regional variant of Dutch that is spoken in Belgium and that is the L1 of the participants in our study, full forms are preferred. Clitic forms (especially *d'r* the form for feminine possessors) are more often used in variants of Belgian Dutch.

considered impossible (Algemene Nederlandse Spraakkunst, 1997)). The use of this pronominal genitive is less restricted than the use of the Dutch sibilant s-genitive, as it can be used for all animate entities.

In this study, we investigate whether Dutch-English bilinguals at different levels of proficiency represent Dutch pronominal *s*-genitives (e.g., *Jan zijn fiets*) and English *s*-genitives (e.g., *John's bike*) differently. If Dutch and English s-genitives initially receive separate representations (Fig. 2a), between-language priming for these structures might only occur for more proficient bilinguals, because they might be the only ones who have exchanged their language-specific representations for a shared, language-neutral representation (Fig. 2b). If, however, already at the outset the same language-neutral node is accessed during the processing of Dutch and English s-genitives, between-language priming will occur for all Dutch-English bilinguals, irrespective of their level of L2 proficiency.

Figure 2a   Figure 2b

EMMER/BUCKET   **EMMER/BUCKET**
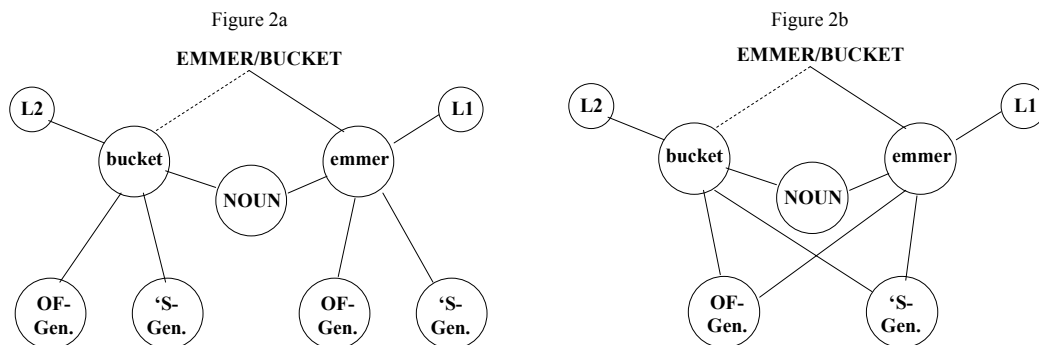
Figure 2a and 2b: Hypothetical models for the representation of Dutch and English genitives in Dutch-English late bilinguals in an early stage of acquisition. Figure 2a represents a model in which L2 structures initially receive separate representations; Figure 2b represents a model in which the representations of Dutch and English s-genitives are shared from te outset.

Furthermore, if L2 syntactic acquisition, like syntactic acquisition in L1, is characterized by a shift from item-based to more abstract representations, L2 proficiency may not only determine whether or not

syntactic structures are shared, but also the extent to which the use of a syntactic structure is generalized. Regardless of whether Dutch and English *s*-genitives have shared representations, less proficient bilinguals may not have generalized the use of the English *s*-genitive to the same extent as more proficient bilinguals. Consequently, less proficient bilinguals might only use the English *s*-genitive for English nouns that have already been encountered with this structure. Therefore we investigate syntactic priming for genitives both in unrelated conditions, in which prime and target constructions contain unrelated head nouns, and in related conditions, in which the same head noun or translation equivalents have to be used in both constructions. If syntactic priming for English *s*-genitives occurs when an unrelated noun has to be used in prime and target, we can conclude that the use of this structure is generalized to all nouns that can be used with this structure. In this case, the priming effects may be boosted by the repetition of identical or related nouns in the related conditions (cf. Schoonbaert et al. (2007). In the absence of an abstract representation for English *s*-genitives, however, priming might still occur in the related conditions because item-based representations of this structure are learned.

In the following, we report two studies that compared syntactic priming for English genitives (*of*-genitive vs. *s*-genitive) for less proficient and more proficient late bilinguals having L1 Dutch and L2 English. In Experiment 1, we tested whether the choice of an English *s*- genitive or *of*-genitive is affected by the prior comprehension of an English *s*- genitive or *of*-genitive. In Experiment 2, we tested whether the choice of an English *s*-genitive or *of*-genitive is affected by the prior comprehension of a Dutch pronominal *s*-genitive or an *of*-genitive. The participants of both experiments rated their L1 (Dutch) and L2 (English) proficiency with respect to four skills (writing, speaking, reading, and general proficiency) after the experiment (see also Bernolet et al. 2007; Elston-Güttler, Paulman & Kotz,

2005; Elston-Güttler & Friederici, 2007) and were divided in two groups on the basis of this self-rated L2 proficiency (see Methods)[4].

The names of the possessors in prime and target were always animate and short, to make the English *s*-genitive the preferred construction to express the possessive relation (Rosenbach, 2005). Furthermore, the possessors had to be named using common nouns (e.g. nun, pirate, …) in order to justify the use of the Dutch pronominal *s*-genitive in the between-language priming experiment (Experiment 2). Like in Schoonbaert et al. (2007), we had a related and an unrelated condition in both experiments: In the same object conditions, the head of the genitive construction (i.e. the possessed object) was repeated between prime and target; in the different object conditions the object was different. Consequently, in the within-language priming experiment (Experiment 1), the exact same head noun had to be repeated between prime and target in the related condition; in the between-language priming experiment (Experiment 2), the head nouns of prime and target were translation equivalents.

First, we compared within-language syntactic priming of English genitives (*of*-genitive vs. *s*-genitive) for less proficient and more proficient Dutch-English bilinguals in order to find out whether both groups of bilinguals have abstract memory representations for these constructions.

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[4] We did not determine our participants' proficiency level on the basis of an L2 vocabulary test. Though the performance on these tests clearly separates native speakers from non-native speakers of a language (Elston-Güttler & Friederici, 2007), differences in the performance of non-native speakers are much smaller (Elston-Güttler, Paulman & Kotz, 2005). As the bilinguals that were tested were all very fluent in English (i.e., at least 5 years of experience), a vocabulary test might not be sensitive enough to measure differences in L2 proficiency

EXPERIMENT 1: PRIMING BETWEEN ENGLISH (L2) GENITIVES

METHOD

Participants. Twenty-four students from Ghent University (18 females and 6 males) took part. All participants were native speakers of Dutch with English as L2. They all reported to have had at least 8 years of experience with English as their second language (mean of 13 years). A female undergraduate student with Dutch as L1 and English as L2 acted as confederate.

The participants of this and the following experiment rated their L1 (Dutch) and L2 (English) proficiency with respect to four skills (writing, speaking, reading, and general proficiency) on 7-point scales, with 1 meaning *very bad* and 7 meaning *very good*, after the experiment (see Table 1 for the means of the self-ratings of L1 and L2 proficiency for Experiments 1 & 2). On the basis of these self-ratings, we computed a single proficiency score, defined as the median of the 4 scores, for each participant. By means of a median split the participants were then divided in two groups: a group of less proficient bilinguals and a group of more proficient bilinguals (see Table 1 for the means of the self-ratings of L1 and L2 proficiency for less and more proficient bilinguals in Experiments 1 & 2).

Table 1: Self-assessed ratings (7-point Scale) of L1 and L2 Proficiency for less proficient and more proficient bilinguals (Exps 1-2).

Language	Skill	Experiment 1		Experiment 2	
		less proficient	more proficient	less proficient	more proficient
L1 (Dutch)	Writing	6.17 (0.39)	6.17 (0.58)	5.75 (0.87)	6.42 (0.67)
	Speaking	6.08 (0.79)	6.50 (0.52)	6.17 (0.94)	6.58 (0.51)
	Reading	6.17 (0.94)	6.75 (0.45)	6.08 (0.79)	6.75 (0.45)
	General	6.08 (0.51)	6.50 (0.52)	5.92 (0.51)	6.42 (0.51)
L2 (English)	Writing	4.08 (1.31)	5.67 (0.65)	4.83 (0.71)	5.67 (0.65)
	Speaking	4.33 (0.78)	5.92 (0.67)	4.92 (0.51)	6.00 (0.43)
	Reading	4.92 (0.79)	6.33 (0.49)	5.42 (0.79)	6.25 (0.45)
	General	4.50 (1.00)	5.91 (0.51)	5.08 (0.51)	6.00 (0.00)

Note. Standard deviations are indicated in parentheses. L1 = native language; L2 = second language.

Materials and design. Two sets of 96 pictures were constructed for the naïve participant: a verification set and a description set. All pictures in the experiment showed black-and-white line drawings of 2 figurines (out of a boy, a girl, a nurse, a wizard, a pirate, a nun, a priest, and a witch) in frontal view. The naïve participant's description set contained 48 critical description pictures and 48 filler pictures. On the critical description pictures the figurines in the picture were both depicted with the same object (small objects [e.g. a glass] were placed on the figure's hands; larger objects [e.g. a church] were placed close to the figures). One of both objects in the critical description pictures was always colored (in yellow, red, blue or green); the rest of the picture was in black and white (see Fig 1). On the filler pictures, no objects were shown. Instead, one of both figures in the description picture was completely colored (thus allowing descriptions such as *the nun is green*). Each of the four colors was used equally often for the different objects and the figures.

Figure 1: example of a critical target picture with its corresponding primes
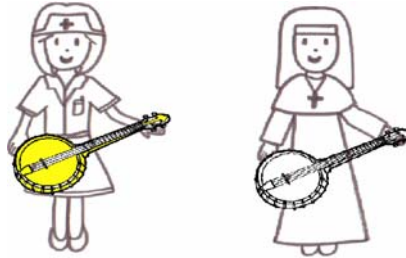
2a)	The pirate's banjo is yellow.	*s-genitive, same object*
2b)	The pirate's mirror is yellow.	*s-genitive, diff. object*
3a)	The banjo of the pirate is yellow.	*of-genitive, same object*
3b)	The mirror of the pirate is yellow.	*of-genitive, diff. object*

Half of the pictures in the participant's verification set matched the descriptions in the confederate's description set, which contained 96 English prime sentences (See Appendix 4A for a full list of items). Forty-eight of these sentences were critical genitive prime sentences. These prime sentences could either be *s*-genitives (2a-b) or *of*-genitives (3a-b). In the same-object conditions, the head noun of the genitive prime (i.e. the possessum), matched the object that was depicted in the corresponding target picture (2a & 3a); in the different-object conditions an unrelated control noun was used in the prime (2b & 3b). The unrelated controls had the same number of syllables and were matched for prosody with the nouns that had to be used to form the target descriptions. The objects in the prime- and target- descriptions always had the same color; the owner of the object was always different in prime- and target- descriptions. The remaining 48 sentences in the confederate's description set were filler sentences that could be used to describe the filler items in the naïve participant's description set.

Four counterbalanced pseudo-random lists were constructed so that each target object was preceded by the same object in two lists (same-object conditions) and by a different object in the two other lists (different-object conditions). Both in the same-object and the different-object conditions the target picture was preceded by an *s*-genitive in two lists and by an *of*-genitive in the two other lists. Within each list, there were 12 *s*-genitive and 12 *of*-genitive prime sentences in the same-object condition and 12 *s*-genitive and 12 *of*-genitive prime sentences in the different-object condition. For each of the four lists, the trials were presented in the same pseudo-random order. At the beginning of each list, four filler trials were presented; in the rest of the list critical trials were separated by 0 to 6 filler trials. Each participant was presented with one of these four lists.

Procedure. The participants were tested in groups of 2 in a dialogue experiment. Both dialogue partners took turns in describing pictures that appeared on the screen of their computers. They were instructed to listen and react to their dialogue partner's descriptions. One of both participants was in fact not a real participant, but a confederate. Instead of describing pictures, the confederate read prime sentences from the screen of her computer. In order to make sure that the real participant would not see this, both dialogue partners were also seated opposite each other. First, the confederate and the naïve participants were familiarized with the materials in a study session, in which all objects (96 objects) and all persons (8 different persons) that could appear in the target pictures were shown together with their Dutch and English name. After that, the participant's first verification picture was shown in order to explain how the objects were arranged on the screen and how the participants were supposed to respond. The use of either *s*-genitives or *of*-genitives was avoided in the instructions. Instead, both dialogue partners were told to name the color and the name of what was colored. The participant and the confederate were informed that their speech would be recorded on minidisk. The program was set up so that the confederate always took the first turn. The lists for the confederate and the naïve participant were designed to be run simultaneously on two different PCs.

The participant and the confederate both performed a picture verification task while their dialogue partner was speaking. The sequence of events during the experiment was as follows: 1) a verification picture appeared on the screen of the participant's PC (Figure 1); 2) the confederate read the (critical) prime description from the screen of her PC; 3) the participant responded to the prime description by pressing '1' (match) or '2' (mismatch). When either key was pressed, the verification picture changed into a description picture, while a beep notified the confederate that the participant had responded; 4) at the sound of the beep, the confederate pressed '3', to change the prime sentence into a verification picture; 5) the participant produced a description for the situation depicted on the (critical) description picture; 6) the confederate responded to the participant's description by pressing '1' (match) or '2' (mismatch), the verification picture was replaced by the prime sentence for the next trial and a beep notified the participant that the confederate had responded; urging the participant to press '3', in order to make the verification picture for the next trial appear on the screen. There was a match between the description- and the verification pictures on 50% of the trials. Sessions lasted about 35 minutes.

Scoring. The responses were manually coded as *s*-genitives, *of*-genitives, or Other responses. A response was coded as an s-genitive when the owner of the object (possessor) preceded the object that is owned (possessum). Only if the genitive was then formed by adding a sibilant to the name of the possessor (e.g. *the boy's rose is green*) the response counted as correct. If a full form of the possessive pronoun was used instead (e.g. *the boy his rose is green*), the response was coded as a full pronoun error (and counted as an Other). A response was coded as an *of*-genitive when the sentence began with the object that is owned (possessum), followed by the preposition *of* and the possessor (e.g. *the rose of the boy is green*). If a different preposition was used (e.g. *the rose from the boy is green*), the response counted as an Other response. If the target noun was replaced by an English synonym, the

response was counted as an Other response in the same-object conditions; in the different-object conditions synonyms were allowed.

RESULTS

One hundred twenty-four of the 1152 target responses were Other responses (10.8%). Nineteen Other responses were s-genitives with a full form of the possessive pronoun (15.3%). The remaining 1028 responses were classified either as *of*-genitives (648, 56.3%) or *s*-genitives (380, 32.9%). The proportion of s-genitives out of all *s*- and *of*-genitives was calculated for each participant (see Figure 2) and item and subsequently arcsine-transformed (as were the proportions of target responses of the other experiments reported in this paper).

Figure 2: Percentage of *s*-gentives out of all *s*- and *of*-genitives in each condition for less proficient and more proficient bilinguals (Experiment 1)
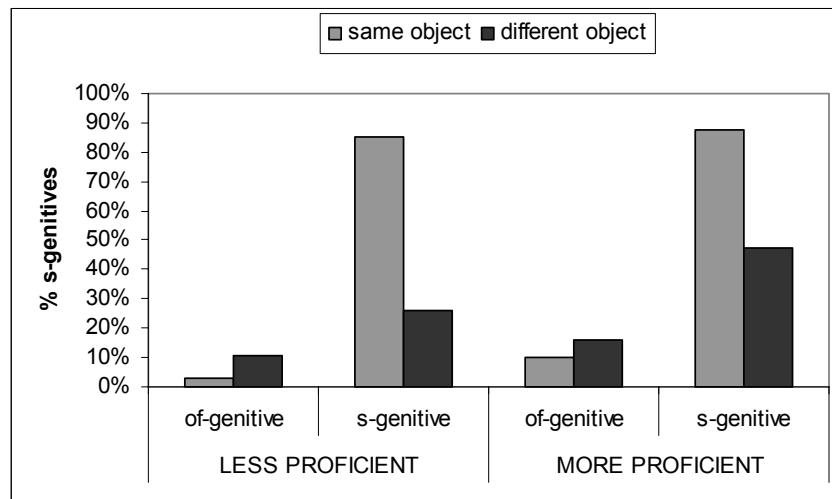
Priming data. Analyses of variance (ANOVAs) were run on these transformed proportions with Prime Type (*s*-genitive vs. *of*-genitive prime) and Object Repetition (same vs. different object) as within-participant and within-item factors and L2 Proficiency (less vs. more proficient) as a between-participant and within-item factor. Three of the 48 items were discarded from the analyses due to a lack of observations in one of both proficiency groups.

The three-way ANOVAs showed a main effect of Prime Type, F_1 (1, 22) = 217.76, MSE = 33.41, p <.001; F_2 (1, 44) = 455.56, MSE = 41.85, p <.001: more English s-genitives were produced in primed conditions (61.7%) than in unprimed conditions (9.7%). This main effect of Prime Type was not influenced by L2 proficiency (F_s <1), and separate analyses showed an effect of Prime Type both for less proficient, F_1 (1, 11) = 86.11, MSE = 14.198, p <.001; F_2 (1, 44) = 171.69, MSE = 19.33, p <.001; and for more proficient Dutch-English bilinguals, F_1 (1, 11) = 144.15, MSE = 17.86, p <.001; F_2 (1, 44) = 248.03, MSE = 22.58, p <.001. In both proficiency groups, significant priming was found in the same object conditions: The effect amounted to 77.5% in more proficient bilinguals F_1 (1, 11) = 344.78, MSE = 18.09, p <.001; F_2 (1, 44) = 342.11, MSE = 24.27, p <.001; and to 82.2% in less proficient bilinguals F_1 (1, 11) = 294.24, MSE = 20.31, p <.001; F_2 (1, 44) = 348.08, MSE = 26.55, p <.001. More importantly, in the different object conditions significant priming was obtained for more proficient bilinguals F_1 (1, 11) = 23.39, MSE = 2.97, p <.005; F_2 (1, 44) = 31.36, MSE = 3.22, p <.001 as well as for less proficient bilinguals F_1 (1, 11) = 6.09, MSE = 0.68, p <.05; F_2 (1, 44) = 9.75, MSE = 1.13, p <.005.

An interaction between Prime Type and Object Repetition indicated that larger priming effects were obtained when the head noun was repeated between prime and target than when a different head noun was used, F_1 (1, 22) = 248.13, MSE = 9.97, p <.001; F_2 (1, 44) = 161.38, MSE = 13.03, p <.001: the lexical boost amounted to 56.7%. Separate analyses showed that this effect occurred both for less proficient, F_1 (1, 11) = 451.92, MSE = 6.79,

p <.001; F_2 (1, 44) = 104.69, MSE = 8.36, p <.001 and more proficient bilinguals F_1 (1, 11) = 57.79, MSE = 3.203, p <.001; F_2 (1, 44) = 59.401, MSE = 4.91, p <.001. There was some sign that the lexical boost was larger for less proficient bilinguals (67.1%) than for more proficient ones (46.1%), but this interaction was only significant by participants F_1 (1, 22) = 9.45, MSE = 0.33, p <.01; F_2 (1, 44) = 2.80, MSE = 0.23, p >.1. Although the percentage of genitives after s-genitive primes in the different object conditions was numerically much smaller for less proficient bilinguals (26.0%) than for more proficient bilinguals (47.2%), this difference was only marginally significant by items t_1 (1, 22) = 1.70, MSE = 0.26, p >.1; t_2 (1, 44) = 1.97, MSE = 0.09, p <.1 (.055). Finally, the main effect of L2 proficiency was significant by items only, F_1 (1, 22) = 1.59, MSE = 0.86, p >.1; F_2 (1, 44) = 7.94, MSE = 0.82, p <.01.

Errors. As we already mentioned, 19 full pronoun errors were made in this experiment. Most of these errors (73.7%) occurred after s-genitive primes in the same object conditions (see Figure 3 for the distribution of errors).

Figure 3: Distribution of full pronoun errors in Experiment 1
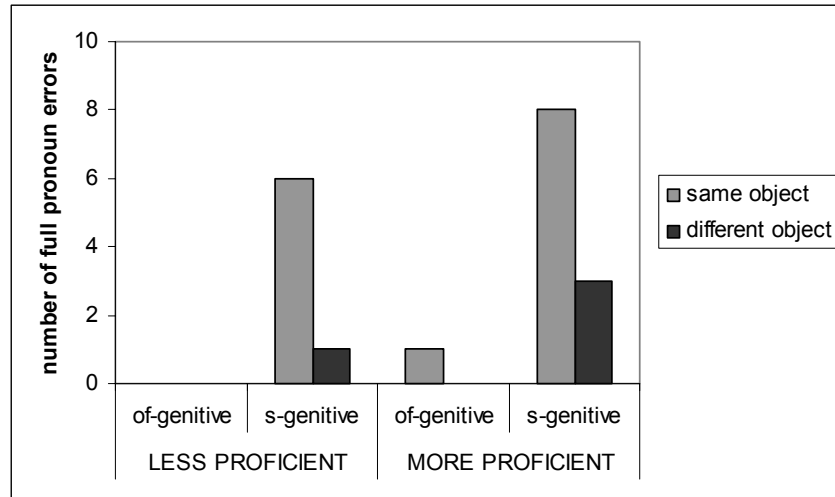
DISCUSSION

This experiment showed a clear effect of syntactic priming in L2 and a lexical boost, both for less proficient and for more proficient bilinguals. Participants tended to preserve the structure of the English L2 prime in order to describe the target pictures in their L2. Therefore they produced more *s*-genitives after *s*-genitive primes than after *of*-genitive primes. Moreover, this effect was stronger when the head noun of the prime description (the object that is possessed) was repeated in the target description than when it was not. Though this lexical boost of syntactic priming is in itself not a new finding (Cleland & Pickering, 2003; Hartsuiker et al. (in press), Pickering & Branigan, 1998 and Schoonbaert et al. 2007), this experiment presents the first observation of a lexical boost for repeated head nouns in L2. In the absence of noun repetition, significant priming was still obtained in both groups of bilinguals. This indicates that both less proficient and more proficient bilinguals have an abstract memory representation for English genitives.

A possible influence of L2 proficiency could be seen in the number of s-genitives that was produced and in the size of the lexical boost: more proficient participants produced more s-genitives than less proficient participants. To be more precise, both participant groups produced a comparable percentage of s-genitives after an s-genitive prime when the same noun had to be used in prime and target (85.2% (less proficient bilinguals) and 87.6% (more proficient bilinguals)). If, however, a different noun had to be used, the percentage of s-genitives was numerically much higher in the group of more proficient bilinguals (47.2%) than in the group of less proficient bilinguals (26.0%). This difference in the percentage of s-genitives in the different object condition could indicate that our less proficient bilinguals did not yet generalize the use of the English s-genitive to the same extent as the more proficient bilinguals. Both groups benefit from the example structures that are provided in the related condition (the name of the possessor is the only part that needs to be changed to form a

target construction), but only the more proficient bilinguals use the English s-genitive quite frequently in the unrelated condition, i.e. for nouns they did not recently encounter with this construction. Alternatively, the difference in the percentage of *s*-genitives could indicate that less proficient bilinguals have a stronger preference for the *of*-genitive than more proficient bilinguals. Consequently, less-proficient bilinguals might only select an *s*-genitive structure if the activation in its combinatorial node is boosted by the repetition of the noun between prime and target.

Although this experiment only used English, errors like *the nurse her banjo is green* occurred, in which the rules for the formation of the Dutch pronominal *s*-genitive are applied to an L2 construction. These full pronoun errors occurred most often after *s*-genitive primes in the repeated noun conditions (see Figure 3), indicating that the errors may be lexically mediated. Schoonbaert et al. (2007) showed that during sentence processing in L2 the activation of an L2 lemma automatically co-activates the lemma of its L1 translation equivalent. In our experiment, the activation in the L1 lemma might thus have activated the syntactic rules and the morpho-syntactic rules for Dutch pronominal *s*-genitives during the processing of the prime. As a consequence of the activation of the (morpho-) syntactic rules of the pronominal s-genitive in which a possessive pronoun is used, a possessive pronoun 'intrudes' into the English s-genitive that is used to describe the target picture. In the same object conditions, the lemma of the L1 translation equivalent is re-activated when the target sentence is produced, thereby re-activating the L1 morphosyntactic rules for the s-genitive. This is why the risk of making a full pronoun error is higher when the same noun has to be used in prime and target. We will return to this issue in the discussion of Experiment 2.

A final thing to notice is that the overall percentage *of*-genitives (56.3%) is higher than the percentage of *s*-genitives (32.9%), even though in English the *s*-genitive is the preferred genitive for short, animate possessors such as the ones that have to be used in this experiment (Rosenbach, 2005).

This may be a transfer effect, because in Dutch, the *s*-genitive with a sibilant is only used in combination with proper names (e.g. *Jans fiets [John's bike], Sofie's handtas [Sophie's bag]*). Because this form of the *s*-genitive is quite infrequently used in Dutch, Dutch-English bilinguals might not use it very frequently in their L2 too.

In Experiment 1, we showed that both less proficient bilinguals and more proficient bilinguals show significant syntactic priming for English genitives in related and unrelated conditions. In Experiment 2, we investigate whether between-language priming occurs between Dutch pronominal *s*-genitives and English *s*-genitives with a sibilant. If priming occurs, this means that the constructions have a shared representation, despite the difference in the genitive. By comparing between-language priming for less proficient bilinguals and more proficient bilinguals we investigate whether the representations of both *s*-genitives are always shared or whether they are initially represented separately before they are merged. If both representations are shared from the outset, between-language priming will occur for less proficient bilinguals as well as for more proficient bilinguals. If, however, Dutch-English bilinguals start out with separate representations for Dutch and English s-genitives, reduced between-language priming is predicted for less proficient bilinguals, because some less proficient bilinguals might already have a shared representation for both genitives, while others still access a different combinatorial node for Dutch and English s-genitives.

EXPERIMENT 2: PRIMING BETWEEN DUTCH (L1) AND ENGLISH (L2) GENITIVES

METHOD

Participants. Twenty-four further students from Ghent University (19 females and 5 males) took part. All participants were native speakers of

Dutch with English as L2. They all reported to have had at least 5 years of experience with English as their second language (mean of 11 years, see Table 1 for the participants' self-rated proficiency in L1 and L2). A female undergraduate student with Dutch as L1 and English as L2 acted as confederate.

Materials and design. The materials and the design were identical to the materials and the design of Experiment 1, except that the prime sentences in the confederate's description set were now printed in Dutch. Specifically, we used Dutch *of*-genitives (4a) and Dutch pronominal *s*-genitives (4b). Note that we used full forms of the possessive pronoun (*zijn/haar*) as these are more common than clitic forms of the possessive pronoun (*z'n/d'r*) in Belgian Dutch, the regional variant of Dutch that is the L1 of our participants.

4a)   De banjo/spiegel van de piraat is geel. *of-genitive*

[The banjo/mirror of the pirate is yellow]

4b)   De piraat zijn banjo/spiegel is geel.   *pronominal s-genitive*

[The pirate's banjo/mirror is yellow]

Procedure. The procedure was identical to that of Experiment 1, except that the dialogue partners used different languages for their descriptions: the confederate provided prime descriptions in Dutch (L1), whereas the naïve participant was asked to describe his/her pictures in English (L2). After the study session that preceded the experiment, the experimenter assigned a target language to the participant and the confederate, making it look as if these languages were randomly assigned.

RESULTS

One hundred sixty-six of the 1152 target responses were Other responses (14.4%). Forty-one Other responses were full pronoun errors (24.7%). The

remaining 986 responses were classified either as *of*-genitives (656, 56.9%) or *s*-genitives (330, 28.6%). The percentages of s-genitives in all conditions are reported in Figure 4.

Figure 4: Percentage of s-genitives out of all *s*- and *of*-genitives in each condition for less proficient and more proficient bilinguals (Experiment 2)
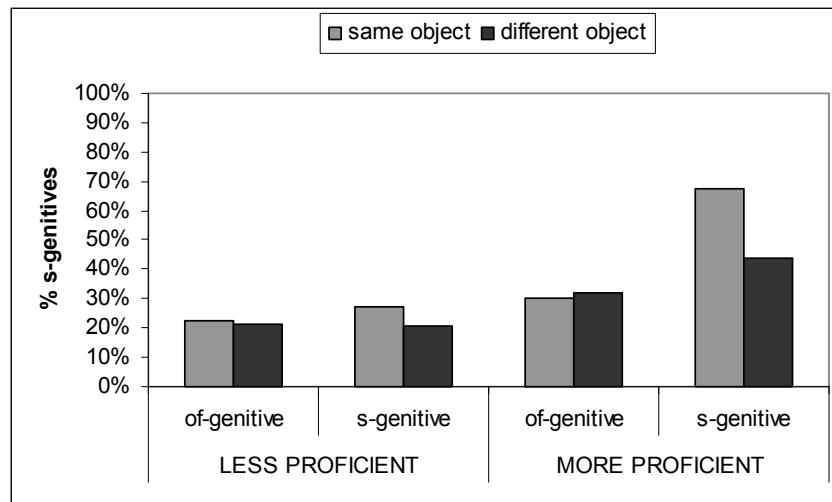
Priming data. Analyses of variance (ANOVAs) were run on these transformed proportions with Prime Type (*s*-genitive vs. *of*-genitive prime) and Object Repetition (same vs. different object) as within-participant and within-item factors and L2 Proficiency (less vs. more proficient) as a between-participant and within-item factor. Seven of the 48 items were discarded from the analyses due to a lack of observations for one or both proficiency groups.

As in Experiment 1, the analyses showed that more *s*-genitives were produced after *s*-genitive primes (39.9%) than after *of*-genitive primes (26.5%), yielding a 13.4% effect of Prime Type F_1 (1, 23) = 11.26, *MSE* = 2.28, *p* <.005; F_2 (1, 40) = 43.67, *MSE* = 3.78, *p* <.001. A significant interaction between the factors Prime Type and L2 Proficiency indicated that this between-language effect of Prime Type was significantly larger for more

proficient L2 users (25.9%) than for less proficient L2 users (1.5%) F_1 (1, 22) = 8.76, MSE = 1.47, $p <.005$; F_2 (1, 40) = 11.51, MSE = 0.91, $p <.005$. In fact, this interaction is due to a complete absence of priming for less proficient bilinguals F_1 (1, 11) = 2.07, MSE = 0.05, $p >.1$; F_2 (1, 40) = 3.74, MSE = 0.52, $p <.1$. In this group, the percentage of s-genitives was barely higher after s-genitives (23.9%) than after *of*-genitives (21.8%). For more proficient bilinguals, however, a 24.7% effect of Prime Type was obtained F_1 (1, 11) = 11.95, MSE = 3.74, $p <.01$; F_2 (1, 40) = 76.61, MSE = 4.29, $p <.001$.

The analyses further showed a significant interaction between Prime Type and Object repetition F_1 (1, 23) = 9.74, MSE = 0.74, $p <.01$; F_2 (1, 46) = 10.97, MSE = 1.48, $p <.005$: The priming effect was larger for prime-target pairs in which the object was repeated (21.1%) than for prime-target pairs in which the object differed (5.8%), yielding a translation-equivalence boost of 15.3%. This interaction was only significant for more proficient bilinguals F_1 (1, 11) = 8.51, MSE = 0.68, $p <.01$; F_2 (1, 40) = 4.55, MSE = 1.46, $p <.05$, as these were the only participants showing significant priming. Separate analyses for each level of object repetition indicated that, for more proficient bilinguals, a 37.4% effect of prime Type was obtained in the same object condition F_1 (1, 11) = 14.98, MSE = 4.27, $p <.005$; F_2 (1, 40) = 33.88, MSE = 5.37, $p <.001$. In the different object condition, a non-significant 11.99% trend towards between-language priming was obtained F_1 (1, 11) = 2.74, MSE = 0.45, $p >.1$; F_2 (1, 40) = 1.704, MSE = 0.37, $p >.1$. Finally, the three-way ANOVA again showed a main effect of L2 proficiency in the analysis by-items F_1 (1, 22) = 1.91, MSE = 5.40, $p >.1$; F_2 (1, 40) = 96.94, MSE = 6.52, $p <.001$: more proficient bilinguals used more s-genitives (44.6%) than less proficient bilinguals (23.1%).

Errors. In this experiment, forty-one full pronoun errors were produced. Again, most of these errors (73.2%) occurred after *s*-genitive primes in the same object conditions (see Figure 5 for the distribution of errors). In this

condition, more proficient bilinguals made twice as many errors as less proficient ones.

Figure 5: distribution of full pronoun errors in Experiment 2
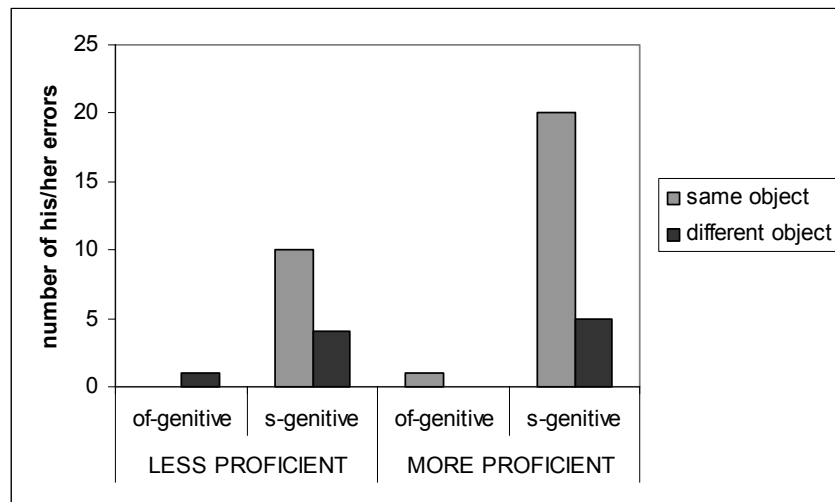
DISCUSSION

In this experiment, between-language priming was observed between Dutch and English genitives: More English *s*-genitives were produced after Dutch pronominal *s*-genitives than after Dutch *of*-genitives. Furthermore, a translation equivalence boost was obtained: the effect of between-language priming was stronger if the head nouns of prime and target constructions were translation equivalents. However, both effects were only obtained for more proficient bilinguals: in the group of less proficient bilinguals no structural priming was obtained between Dutch and English *s*-genitives. This absence of between-language priming in the group of less proficient bilinguals seems to indicate that the less proficient participants in our study had a separate, language-specific representation for English *s*-genitives: though English s-genitives were sometimes used, the Dutch primes had

virtually no effect on the response patterns. Even though in the group of more proficient bilinguals the effect of between-language priming was largely due to priming effects in the repeated object conditions, the numerical trend towards priming in the different object conditions indicates that, for some participants, the representations of Dutch and English *s*-genitives may already be collapsed into one shared syntactic representation for the *s*-genitive.

If more proficient bilinguals have a shared representation for Dutch and English *s*-genitives, why is there a clear difference between within-language priming for English genitives (54.4% priming) and between-language priming between Dutch and English genitives (24.7% priming)? The difference between within- and between-language priming in more proficient bilinguals is caused by two factors: Firstly, the percentage of *s*-genitives in unprimed conditions is 18.2% lower in the between-language priming experiment compared to the within-language priming experiment. This might be due to the fact that more proficient bilinguals realize that the *of*-genitive is less preferred in English for simple, short possessors like the ones used in our experiment. Hence, more proficient bilinguals might use *of*-genitives more often when they are primed with English *of*-genitives compared to when they are primed with Dutch genitives: The fact that the confederate uses English of-genitives might convince them that the use of this structure is appropriate. As the percentages of *s*- and *of*-genitives are complementary, a decrease in the percentage of *of*-genitives implicates an increase in the percentage of *s*-genitives in these conditions.

Furthermore, after *s*-genitives in the same-object conditions, more proficient bilinguals produced 19.9% fewer *s*-genitives in the between-language experiment than in the within-language priming experiment. The reason why more proficient bilinguals produced fewer *s*-genitives in the same object conditions of Experiment 2 is probably due to the risk of making pronoun errors for this form. In Experiment 1, we noted that transfer errors like *the nurse her banjo is green* (full pronoun errors) occurred in a strictly

unilingual experiment and that these errors might be lexically mediated. In this experiment, these errors were much more frequent (41 his/her errors) than in Experiment 1 (19 his/her errors). As the primes were presented in Dutch and no examples of English genitives were provided in Experiment 2, it could, however, be expected that the number of intrusions caused by the activation of Dutch morpho-syntactic rules would increase. What is more important: after Dutch *s*-genitives in the repeated object condition, i.e. the condition with the highest risk of full pronoun errors, more proficient bilinguals made twice as many errors as less proficient bilinguals (see Figure 5). It could thus be that more proficient bilinguals deliberately produced fewer *s*-genitives in the same object conditions in order to lower the risk of making these errors. The fact that more proficient bilinguals produced these errors only in the beginning of the experiment seems to indicate that they might have noticed the error risk and adapted their responses in order lower this risk. Together with the increased baseline-preference for *s*-genitives the increased risk of making full pronoun errors made that weaker priming was observed between languages than within languages in more proficient bilinguals. The fact that more full pronoun errors were observed for more proficient bilinguals than for less proficient bilinguals does, however, yield extra evidence for our claim that the representations of Dutch and English *s*-genitives are more closely integrated in more proficient bilinguals.

Taken together, the results of our experiments seem to indicate that L2 structures are not immediately shared when they are first encountered. In an initial stage of L2 acquisition, the L2 structure gets its own syntactic node and within-language syntactic priming can be obtained for all nouns that can be used with this structure. If, after a certain amount of experience with the structure in question, the new L2 structure appears to be sufficiently similar to its L1 counterpart, the separate nodes for the L1 and the L2 construction are consolidated into one shared combinatorial node. From that moment on, cross-linguistic syntactic priming can be observed between the structures of both languages.

Reanalysis of Schoonbaert et al.'s (2007) data. In order to verify whether the same effects of proficiency can be found for structures that are identical across languages, we re-analyzed Schoonbaert et al's (2007) data on within- and between language priming for datives in Dutch-English bilinguals. The participants in that study belonged to the same population as the participants in our study (undergraduate students with Dutch (Flemish) as L1 and English as L2). Furthermore, Schoonbaert et al.'s participants rated their L1 and L2 proficiency in the same way as the participants in our study (see procedure Experiment 1), so we could divide their participants into groups of less proficient and more proficient bilinguals in the same way as in the current study.

Our re-analysis of Schoonbaert et al.'s Experiment 2 (L1-L2) indicates that the representations of identical structures may also differ in function of the amount of experience with these structures: less proficient bilinguals showed no between-language priming if a different verb was used in prime and target, while more proficient bilinguals showed significant priming in the related (same verb) and in the unrelated (different verb) conditions. The fact that less proficient bilinguals showed no between-language priming in the unrelated conditions may indicate that these bilinguals only recently developed a shared representation and that this shared representation is not yet generalized to all L1 and L2 verbs it can combine with. Alternatively, it could mean that the resting activation level of this new, shared syntactic node needs an extra boost before this node is active enough to be selected. To summarize, the influence of L2 proficiency on Schoonbaert et al.'s data (2007) confirms that, even for identical structures, the acquisition of L2 syntax is characterized by a gradual evolution from separate, language-specific syntactic representations to shared representations for L1 and L2 syntactic constructions.

GENERAL DISCUSSION

This study investigated whether the acquisition of L2 syntactic structures is characterized by a shift from separate, language-specific representations for L2 structures to shared representations for structures that are very similar in L1 and L2. Several cross-linguistic syntactic priming experiments have shown that syntactic structures can be shared in bilinguals (Hartsuiker et al., 2004; Pickering et al. (submitted); Kantola & Van Gompel (submitted); Schoonbaert et al., 2007), but the development of these shared structures has not yet been investigated. Therefore, we tested whether the use and the representation of English s-genitives differs for less proficient and more proficient Dutch-English bilinguals. As English s-genitives (*John's car*) and Dutch s-genitives with a possessive pronoun (*Jan zijn auto*) differ in the realization of their possessive marker, it may be less obvious that these structures are, in fact, structurally identical. This made the English s-genitive an ideal test case to investigate whether similar structures are shared immediately or whether L2 syntactic structures are represented separately in an initial stage of L2 acquisition.

In a first within-language experiment, we showed that the choice for English *of-* and *s*-genitives can be primed in less proficient and more proficient Dutch-English bilinguals. Though L2 proficiency did not influence the basic effect of within-language priming, it did have an influence on the percentage of English s-genitives that was produced: the use of s-genitives increased together with the participants' L2 proficiency. The translation equivalence boost was also numerically larger for less proficient than for more proficient bilinguals. We concluded that both effects might be due to the fact that more proficient bilinguals have generalized the use of the English s-genitive to a greater extent than less proficient bilinguals. Alternatively, these effects might be due to a stronger preference for *of-* genitives in less proficient bilinguals, as this structure is more frequently used in Dutch. In Experiment 2, a between-language priming experiment, we investigated whether differences in the level of L2 proficiency do not only

influence the use of English *s*-genitives, but also their representation in bilingual memory. The results of this experiment confirmed our hypothesis that less proficient bilinguals might not yet have a shared representation for Dutch pronominal *s*-genitives and English s-genitives: less proficient bilinguals showed no priming between Dutch and English genitives. A re-analysis of the Schoonbaert et al. (2007) data on between-language priming for datives indicated that this proficiency effect does not only occur for dissimilar structures, but also for structures that are identical across languages: Less proficient bilinguals showed no between-language priming for datives when the dative verb was not repeated in prime and target.

Taken together, the data of the current study and that of Schoonbaert et al. (2007) seem to indicate that bilinguals move from separate syntactic representations for syntactic structures of the second language to shared, language-neutral representations for structures that are similar across languages. They also indicate that these shared representations are established quite gradually: Both in our experiments and the experiments of Schoonbaert et al. (2007) priming caused by the activation of shared representations occurred first in conditions where the heads of prime and target constructions are translation equivalents. In Schoonbaert et al.'s study, less proficient bilinguals only showed cross-linguistic priming for datives in related conditions. In our study, less proficient bilinguals showed no between-language priming at all. More proficient bilinguals showed strong priming in the related conditions, but only weak priming in the unrelated conditions. This could be due to the fact that, in the beginning, shared representations are still weak because the language-specific representations have not completely died out. Alternatively it could be due to the fact the links between the lemmas of nouns and verbs in both languages and this new, shared combinatorial node are not yet completely established.

In any case it can be stated that the shared syntax model for bilingual language use as it was developed by Hartsuiker et al. (2004) represents the final state of the bilingual memory. Initially, L2 structures receive separate

representations. On the basis of our data we cannot be more precise about the mechanism that is responsible for the merge of these representations, but it is very likely that the mechanism is driven by the frequency with which the L2 structure is encountered. This means that shared representations will be established more rapidly for structures that are very frequent in the L2 than for structures that are less frequent. The results of our study also indicate that the amount of exposure that is needed before the L1 and L2 representations overlap and between-language priming can be obtained may depend on the similarity of the structures across languages: high proficient Dutch-English bilinguals with a comparable level of L2 proficiency showed stronger between-language priming for datives (identical structures) than for genitives (same word order, but differences in morpho-syntactic realization).

Though we assume a general tendency toward syntactic sharing that is influenced by L2 proficiency, we cannot predict whether shared representations can also be obtained for structures that have a different word order across languages. It is not unconceivable that the absence of priming between Dutch and English RC-structures in the study by Bernolet et al. (2007) was due to the fact that English RC-structures as the ones that were used in this study are not very frequently encountered. If between-language priming for RC-structures was hindered by the low frequency of these structures in Dutch and English, it should be possible to obtain between-language priming for RC-structures for balanced Dutch-English bilinguals. The fact, however, that significant between-language priming was found between Dutch and German RC-structures (that are, presumably, equally infrequently encountered in the L2), indicates that the frequency of the L2 structure is not the only factor preventing priming between Dutch and English RCs. Further research is necessary to determine how structural differences and L2 proficiency jointly influence the learning, the representation and the use of grammatical structures in bilingual.

CHAPTER 5
VERB BIAS MODULATES SYNTACTIC PRIMING

Manuscript submitted for publication[1]

The inverse- preference effect (Ferreira & Bock, 2006) suggests that structural priming is caused by the implicit learning of syntactic procedures. Jaeger and Snider (2007) found that this inverse-preference effect is inversely correlated with Verb Bias in spontaneous speech. We aimed to provide experimental evidence for the claim that priming strength is modulated by Verb Bias by comparing the strength of double-object dative priming (DO) and prepositional object dative priming (PO) for DO-biased, PO-biased and Neutral verbs in two syntactic priming experiments (Experiments 2-3). First, we measured the alternation bias for 18 Dutch dative verbs in a picture description experiment (Experiment 1). In Experiment 2, we obtained a general inverse frequency effect for these datives as well as a verb-specific one: in general, more priming was caused by DO-primes (generally less preferred) than by PO-primes (generally more preferred). This inverse-frequency effect was modulated by the alternation bias of the dative verbs that were used. In Experiment 3, in which prime and target verbs always had a different alternation bias, comparable effects were obtained. These data yield evidence for a model of implicit learning of syntax that keeps track of the general distribution of syntactic structures as well as the conditional probability of a syntactic construction (PO or DO) given a certain verb.

INTRODUCTION

An intriguing paradox of language production is that speakers repeat themselves as well as each other, even though one of the important aspects of natural language is that it is infinitively productive (Chomsky, 1965). For example, when two syntactic alternatives with roughly the same meaning are available to describe a given picture or to complete a sentence (e.g., *The dog chases the cat—The cat is being chased by the dog*), people are inclined to use the structure they have just read or heard as a prime (e.g., Bock, 1986, 1989; Bock & Loebell, 1990; Branigan, Pickering, & Cleland, 2000; Corley & Scheepers, 2002; Hartsuiker, Kolk, & Huiskamp, 1999; Hartsuiker & Westenberg, 2000; Pickering & Branigan, 1998). This tendency to repeat syntactic structures is called *syntactic priming* or *syntactic persistence*. The current study investigates to which extent syntactic priming interacts with lexical factors. More specifically, we investigate whether the syntactic preference of a specific verb (verb bias) influences the strength of syntactic priming for that verb.

Several sentence processing studies have shown that the syntactic preference of verbs influences readers' resolution of temporarily ambiguous sentences (Trueswell & Kim, 1998). Because in a sentence like 1a the complementizer *that* is omitted, readers might think that *the prize* is the direct object of the verb *to accept*, while in fact it is the subject of the sentence complementing that verb. Therefore, readers typically show increases in reading times at the disambiguating region (*was not*) as compared to when the complementizer is present (Holmes, Stowe & Cupples, 1989; Ferreira & Henderson, 1999; Rayner & Frazier, 1987). In an eye-tracking study, Trueswell et al. (1993) found that this *garden-path* effect occurs for verbs that prefer a direct object complement (e.g., *to accept,* 1a) but not for verbs that prefer a sentence complement (e.g., *to realize,* 1b): Only when verbs like *to accept* were used, longer fixations and regressive

eye movements on the disambiguating region were registered. Furthermore, Trueswell & Kim (1998) found that garden-path effects for sentences like 1a can be significantly reduced if they are primed with verbs that prefer a sentence complement above a direct object (e.g., *to realize*). Hence, these studies suggest that readers make predictions based on the syntactic preferences of verbs and that these predictions can be primed.

1a)   The man accepted the prize was not going to him.

1b)   The man realized the prize was not going to him.

In a further attempt to investigate the influence of specific lexical items on the comprehension and production of sentences, we investigate whether the syntactic preference of dative verbs influences syntactic choices in a syntactic priming experiment. In the last two decades, syntactic priming has been often used to investigate the process of sentence production. In a typical syntactic priming experiment (e.g., Bock, 1986), participants are presented with a visual or auditory prime sentence with a particular form. After the prime has been processed, the participants have the choice of two or more syntactic alternatives to describe a picture or to complete a sentence (e.g., a prepositional object dative *The girl hands a paintbrush to the boy* (PO/NPPP) or a double-object dative *The girl hands the boy a paintbrush* (DO/NPNP)). Syntactic priming occurs if a certain syntactic alternative is more frequently used in primed than in unprimed conditions.

Syntactic priming effects have been found for several syntactic structures in different languages (English: Bock, 1986; Bock & Loebell, 1990; German: Melinger & Dobel, 2005; Scheepers, 2003; Dutch: Hartsuiker et al., 1999; Hartsuiker & Westenberg, 2000), the tendency to repeat syntactic structure even occurs between languages in bilinguals (Bernolet, Hartsuiker & Pickering, 2007; Hartsuiker, Pickering, & Veltkamp, 2004; Schoonbaert, Hartsuiker & Pickering, 2007; Salamoura & Williams, 2006; 2007). The effects occur during the production and the comprehension of spoken and written language (e.g., Hartsuiker, Bernolet, Schoonbaert,

Speybroeck & Vanderelst, in press), in dialogue settings (Branigan, Pickering & Cleland, 2000) as well as in experiments without a dialogue partner (Pickering & Branigan, 1998; Potter & Lombardi, 1998).

Several explanations have been given for syntactic priming. On one account, syntactic priming is assumed to be a side-effect of the implicit learning of syntactic procedures (Chang, Dell, Bock & Griffin, 2000; Chang, Dell & Bock, 2006). According to the implicit learning model, the procedures for the production of syntax are continuously adjusted during the comprehension of sentences. Consequently, the corresponding syntactic procedures are more readily executed the next time a similar message has to be formulated (Chang et al., 2000; 2006). In the implicit learning models implemented by Chang and colleagues, implicit learning comes about through changes to connection weights by a form of error-driven learning (i.e., backpropagation of error): the model predicts the next word in the input; if the predicted word does not match the next word the input, the connection weights that were responsible for the prediction are adjusted.

In recent years, a lot of syntactic priming experiments have yielded evidence for the implicit learning account. One line of evidence is found in studies showing that the effects of syntactic priming are long-lasting. Bock and Griffin (2000) investigated syntactic priming for datives and transitives by making people repeat auditory prime sentences and describe pictures depicting dative and transitive actions. In between the prime and its corresponding target picture either 0, 1, 2, 4 or 10 unrelated filler sentences were heard and repeated. The results of this study showed that the number of intervening sentences between the prime and the target sentence did not affect the magnitude of priming for datives and transitives, indicating that the effect of syntactic priming is persistent. This persistence of priming does not seem to be tied to a specific experimental task: Using a spoken sentence completion task, Branigan et al. (2000) found comparable priming when prime and target sentences were adjacent and when they were separated by one intervening sentence or a temporal lag. Furthermore, structural priming

appears to persist regardless of the modality in which language structures are experienced. Bock et al. (2007) found persistent priming from comprehension to production when participants merely heard the prime sentences and Hartsuiker et al. (in press) found the effects in spoken dialogue as well as in written dialogue. Long-lasting effects of syntactic priming can only be explained if it is assumed that the act of processing leaves behind a change within the system. Hence, the abovementioned effects argue for the implicit learning of syntactic structures.

A second effect that also indicates that syntactic priming may be caused by a form of implicit learning of syntactic structures is the so-called *inverse frequency effect* (Ferreira & Bock, 2006). In a number of experiments (Bock, 1986; Bock & Griffin, 2000; Scheepers, 2003), structures that are in general less preferred or less common (e.g., passives) have been found to exhibit greater structural priming relative to a neutral baseline than more frequent structures (e.g., actives). According to supporters of the implicit learning model, this is a side-effect of the implicit learning of syntactic structures: because learning is error-driven, more learning occurs during the processing of structures that are in general less preferred (e.g., passives) than during the processing of structures that are more frequently used. Consequently, stronger priming is observed for less preferred structures. Ferreira (2003) even found that the same structure can cause stronger priming in a context in which it is less preferred than in a context in which it is quite frequently used (see Ferreira & Bock, 2006). The fact that the syntactic preference for one construction over the other influences syntactic priming indicates that the general distribution of syntactic structures is learned and that the processing of sentences induces permanent changes to the production system.

The abovementioned effects indicate that syntactic priming occurs because syntactic procedures are learned. They do, however, not prove that this learning of syntactic structures is implicit, rather than explicit. Ferreira & Bock (2006) argue that strong evidence for this claim is provided in a

study by Ferreira, Bock, Wilson, and Cohen (2005), investigating structural priming in a group of patients with *anterograde amnesia*. Patients with this particular memory condition have a severely impaired ability to encode new knowledge into explicit memory. At the same time, anterograde amnesia leaves implicit learning nearly intact. Ferreira et al. (2005) tested speakers with anterograde amnesia and matched control speakers in a structural priming paradigm similar to the one used by Bock and Griffin (2000), investigating both structural priming from a set of prime sentences and explicit memory for the same sentences. The results of this study showed comparable priming for speakers with anterograde amnesia and control speakers. However, the same prime sentences that caused about equivalent syntactic priming in speakers with anterograde amnesia and control speakers led to significantly poorer recognition memory in speakers with anterograde amnesia than in control speakers. The finding that syntactic priming occurs for patients with impaired explicit memory suggests that syntactic priming reflects a kind of learning that is, to a great extent, implicit.

Although the implicit learning account provides a convincing explanation for the occurrence of syntactic priming, it cannot explain the full range of data that have been obtained in syntactic priming experiments. According to the implicit learning model, syntactic priming comes about by changes to abstract syntactic processes, which take place independently of the mental lexicon. Hence, this model predicts no lexical influences on syntactic priming. However, Pickering and Branigan (1998) found that syntactic priming for datives can be boosted by repeating the main verb of the dative construction between prime and target. In later studies, this lexical boost of priming has not only been obtained for repeated head verbs (Branigan et al., 2000; Corley & Scheepers, 2003), but also for repeated head nouns (Cleland & Pickering, 2003) and even for translation-equivalent verbs in cross-linguistic priming (Schoonbaert et al., 2007). Furthermore, it has been shown that exposure to an isolated word can induce syntactic priming (Melinger & Dobel, 2005). Taken together, these results indicate

that information about syntactic structures must somehow be linked to specific lexical items.

Recently, Jaeger & Snider (2007) proposed a model of implicit learning in which not only the general distribution of syntactic structures is learned, but also the probability of a syntactic structure given a specific verb. They found that the syntactic preference of verbs affects the case-by-case strength of syntactic persistence and the inverse frequency effect. In their study, they re-analyzed the ditransitives in the corpus of spontaneous speech compiled by Bresnan et al. (2007). Bresnan et al. annotated all 2360 instances of dative constructions used by speakers in the full Switchboard collection of recorded and transcribed telephone conversations for 14 explanatory variables which were considered likely to influence the choice of alternative dative structures. Their analyses showed effects of dative priming in spontaneous speech: Speakers were more likely to produce a prepositional dative if the most recent ditransitive structure (the prime) was a prepositional dative structure. Jaeger and Snider (2007) then computed the alternation bias for each of the verbs in Bresnan et al's corpus as the total number of prepositional dative occurrences (PO) on the total number of datives (DO+ PO) for that verb. They found that the strength of PO priming was inversely correlated with the alternation bias of the prime verb: prepositional object primes exerted stronger priming if they were used with verbs that are biased towards a double-object dative construction. Jaeger and Snider (2007) attributed this lexically mediated priming effect to *surprisal-sensitive-persistence*: as the probabilistic distribution of syntactic structures is learned, less expected prime structures prime more than more expected prime structures. Whereas formerly this effect of surprisal was only obtained for structures that are in general less preferred, Jaeger and Snider showed that surprisal affects the priming effects for each individual verb. This means that people implicitly learn the syntactic preferences of verbs.

As we already mentioned, the learning effect that was observed by Jaeger and Snider (2007) is not predicted by the implicit learning model of

Chang et al. (2000), as this model separates learning about particular syntactic constructions from learning about individual lexical items. The effect also appears to be inconsistent with recent findings of Kashak and Borregine (in press), showing that long-term structural priming is not affected by patterns of experience with individual verbs. Kashak and Borregine manipulated participants' patterns of experience with the verbs *to give* and *to lend* in a bias phase preceding their actual priming experiment: participants in the balanced bias phase saw both verbs equally often with a DO construction and a PO construction; participants in the skewed bias phase saw the verb *to give* only in DO constructions and the verb *to lend* only in PO constructions (or the reverse). They found that the training given in the bias phase did not influence the priming effects for DO and PO primes.

There are, however, several problems with this study. First, the alternation biases of the verbs that were used could already have influenced processing in the bias phase. For example, the verb *to give* is biased towards a DO-construction in English: A corpus study by Gries (2005) showed that of all dative sentences that use the verb *to give* almost 80% had a DO-structure. If it is true that speakers keep track of the syntactic preference of a verb, the production of datives with this verb might still be skewed towards the DO-construction after training in the balanced bias phase (or even when only PO-datives were produced in the bias phase). Second, in Kashak and Borregine's (in press) study no baseline condition was used. As this study does not provide information about the strength of DO-priming vs. PO-priming, it cannot draw conclusions regarding the case-by-case strength of the inverse frequency effect.

As converging evidence from experiments and corpora is obviously more compelling, given the relative advantages and disadvantages of each method, we aimed to provide experimental evidence for Jaeger and Snider's (2007) claim that priming strength is modulated by a verb's alternation bias. In the current study we compared the strength of DO- and PO-priming (vs.

baseline) for Dutch dative verbs with differing alternation biases. For this purpose, 18 dative verbs varying in their bias towards DO- and PO-constructions were selected from a corpus compiled by Colleman (2006). First, we measured the alternation bias for each of these verbs in a norming study using written picture description (Experiment 1). The fact is, in the Colleman corpus, a corpus of written language containing 9.4 million words from Dutch and Flemish newspapers, there is a great variety in the dative constructions: The datives occur in main clauses or in subclauses and abstract entities can be used for the roles of agent, theme or beneficiary. Furthermore, concrete nouns as well as pronouns or proper names can be used to refer to these entities. In our experiments, however, the use of the selected dative verbs will be much more restricted: they can only be used to describe the actions depicted on our target pictures. This is why it was necessary to measure the syntactic preference for each of the selected verbs in a picture description experiment. For each of the verbs, 3 different target pictures were constructed, depicting dative actions involving persons and objects with the roles of agent, theme and beneficiary. These pictures were presented to undergraduate students, with the request to write down a sentence describing the action on the picture. The alternation biases observed in this first experiment were then used to measure the influence of alternation bias on the size of DO- and PO-priming in two syntactic priming experiments using comparable target pictures as in Experiment 1 (Experiments 2 and 3).

In Experiment 2, all of the 18 selected verbs were used as target verbs. In this experiment, the alternation bias was kept constant by repeating the dative verb between prime and target, for if we would use verbs with differing alternation biases in prime and target, the syntactic preference of the target verb might obscure effects caused by the alternation bias of the prime. In Experiment 3, only 4 dative verbs were used as target verbs; the prime verbs always differed from the target verbs and were either DO-biased, Neutral or PO-biased. If the strength of priming is indeed inversely correlated with the alternation bias of the prime verb, the effect of DO-

priming should be larger for PO-biased prime verbs than for DO-biased prime verbs in both experiments, i.e. both when prime and target verb have an identical bias as when they differ in their syntactic preference. Likewise, in both experiments more PO-priming should be obtained for DO-biased prime verbs than for PO-biased prime verbs.

EXPERIMENT 1: NORMING STUDY

METHOD

Participants. Nine hundred and forty-three undergraduate students at Ghent University participated on a voluntary basis. All participants were native speakers of Dutch.

Materials. From Colleman's corpus, 18 different dative verbs with varying alternation biases were selected. For each of the 18 selected verbs, 3 different target pictures were constructed. The pictures all showed line drawings of dative actions involving persons and objects with the roles of agent, theme and beneficiary. On all pictures, the beneficiary was depicted on the left, the agent on the right, and the theme in between beneficiary and agent. This ordering was used in order to boost the number of DO-dative descriptions (participants have to start with looking at the agent on the right of the picture, but after that, they may go from left to right in order to describe the action on the picture), because in earlier experiments investigating dative priming in Dutch (Hartsuiker et al., 2007; Schoonbaert et al., 2007) participants showed a strong overall bias for PO-datives. For each of the 54 target pictures, a different combination of persons and objects was used. Beneath the actions on the pictures, a dative verb was printed (see Figure 1). Above the actions, a short instruction was printed ('write a short sentence that describes what you see on the picture, using the verb that is printed beneath the picture'). The target pictures were printed on slips of

paper; next to the pictures a few lines were printed, indicating the place where the sentence had to be written.

Figure 1: example of a target picture in Experiment 1

Schrijf een korte zin die weergeeft wat je op het prentje ziet. Gebruik hiervoor het werkwoord dat afgebeeld is onder de prent.

AANBIEDEN

Procedure. Participants were tested in a classroom setting. In order to avoid that participants would prime themselves when constructing sentences for the target pictures, participants received only one target picture. An instruction on the sheet asked participants to describe the picture in a single sentence using the verb that was provided. The sheets of paper were collected as soon as the participants had written down a sentence. For each target verb, at least 50 descriptions were collected.

Scoring. The responses were manually coded as prepositional object datives (PO) or double-object datives (DO). A description was scored as a PO if the theme of the action immediately followed the verb, and was followed by the preposition *aan* (to) and the beneficiary (e.g., De non geeft een boek aan de soldaat—The nun gives a book to the soldier). A description was scored as a DO if the beneficiary immediately followed the verb, and was followed by the theme (e.g., De non geeft de soldaat een boek—The nun gives the soldier a book). Shifted datives (e.g., De non geeft aan de soldaat een boek), i.e., datives in which the beneficiary follows the verb, but is preceded by the

preposition *aan* (to), are considered as Other responses, because in these sentences the beneficiary and the theme are ordered like in the DO-dative, while, at the same time, the preposition *aan* for the PO-dative is used. Constructions in which a different verb was used than the verb that was printed beneath the target picture were also coded as Others.

RESULTS

Of the 943 sentences that were collected, 127 were DO-datives (13.5%), 482 were PO-datives (51.1%), 37 were Shifted datives (3.9%) and 297 used non-dative constructions (31.5%). The total number of Others (i.e., Shifted datives and non-dative constructions) added up to 334 (35.4%). For each verb, the alternation bias was computed as the number of DO-responses on the total number of DO- and PO-responses. Despite our efforts to increase the online preference for DO-datives (see Materials), the percentage of DO-responses (13.5%) was much lower than the percentage of PO-responses (51.1%). Except for the verb 'betalen', the alternation bias that was obtained in this pretest was lower than the alternation bias that was computed on the basis of Colleman's corpus study for all verbs, resulting in a 28.2% difference in the percentage of DO-responses (see Appendix 5A for the alternation bias and the raw numbers of DO- and PO-datives for all verbs used in the pretest). A significant positive correlation was obtained between the two alternation biases (R = .641, N = 18, p <.005), indicating that both biases corresponded to a great extent. On the basis of their bias towards DO- and PO-datives in our norming study, the 18 dative verbs were divided in three groups (see Table 1): DO-biased verbs (e.g., *aanbieden* (to offer)), Neutral verbs (e.g., *tonen* (show)) and PO-biased verbs (e.g., *verkopen* (to sell)).

Table 1: alternation biases (% DO-datives) for DO-biased, Neutral and PO-biased verbs in Colleman's corpus and in Experiment 1

| | Corpus | |
Type of verb	Colleman	Experiment 1
DO-biased	0.76	0.46
Neutral	0.49	0.14
PO-biased	0.21	0.09

DISCUSSION

The results of our first experiment indicate that Colleman's alternation bias is highly correlated with the alternation bias that was obtained in our experiment, even though both biases were computed on the basis of completely different text materials (newspaper articles vs. written descriptions for simple pictures). The overall percentage of DO-datives that was obtained for the 18 verbs under study is much lower in our pretest (20.3%) than in Colleman's corpus study (48.5%). On the other hand, it is very comparable to the overall percentage of DO-datives that was found in other experiments investigating dative priming in Dutch (Hartsuiker et al., 2007; Schoonbaert et al., 2007). In two experiments, we will now investigate whether the alternation bias that was obtained in our norming study influences the strength of DO- and PO-priming for these verbs. More specifically, we want to investigate whether the strength of priming for a syntactic alternative is inversely correlated with the alternation bias of the prime verb. If this is the case, DO-biased prime verbs should elicit stronger PO-priming than PO-biased verbs. Likewise, stronger DO-priming should be observed for PO-biased verbs than for DO-biased verbs. As it is not yet clear to which extent the alternation bias of the dative target verb influences syntactic priming, we kept the alternation bias constant in this first experiment by repeating the verb between prime and target.

EXPERIMENT 2

METHOD

Participants. Thirty undergraduate students at Ghent University (28 females and 2 males) were paid to take part. All participants were native speakers of Dutch and had normal or corrected to normal vision. A female undergraduate student acted as confederate.

Materials. The set with critical stimuli for the participant contained 54 pictures showing line drawings of dative actions (the pictures that were used in the pretest). Beneath the actions on the pictures, one of the 18 critical verbs was printed (6 DO-biased verbs, 6 PO-biased verbs, 6 Neutral verbs; each verb was printed on 3 different pictures). For each of these pictures 3 prime sentences were constructed (one for each prime condition): a prime sentence using a DO-dative construction, a prime using a PO-dative construction and a baseline prime sentence (see Figure 2). In the DO- and PO-conditions, the prime verb was always identical to the verb that was depicted on the corresponding target picture; in the baseline condition a transitive verb was used in the prime sentence. Apart from the critical pictures, 108 non-critical pictures were selected as fillers. The fillers either showed pictures of intransitive (e.g., the cowboy is weeping) or transitive actions (e.g., the nun chases the swimmer). Prime sentences were constructed for the filler pictures as well. In 63 filler pairs the same verb was used in prime and target, in the remaining 45 filler pairs a different verb was used. Consequently, the same verb had to be used in prime and target constructions in half of the trials (critical + filler trials). Additionally, 162 pictures were selected for the verification set of participant and confederate. These pictures were used for the verification task that was used to mask the real purpose of the experiment: Both dialogue partners had to match the descriptions they heard with the picture that appeared on the screen of their computer (press '1' in case of a match, '2' in case of a mismatch).

The prime sentences were presented on the confederate's computer screen, in three counterbalanced lists. In each of these lists the primes were presented equally often in the three priming conditions (DO-prime, PO-prime, baseline) and across all participants every target picture was presented equally often in each of the three conditions. Each verb was used 3 times in each list, once in each priming condition. Within the groups of DO-biased, PO-biased and Neutral verbs the primes were also equally divided over the 3 priming conditions. The primes and targets were always presented in the same, pseudo-random order.

Figure 2: example of a target picture (Policeman offering book to painter) with corresponding primes (a-

c)
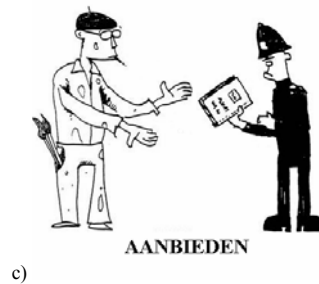
a)   De kok biedt de dokter een pistool aan   *DO-dative*

      [The cook offers the doctor a gun]

b)   De kok biedt een pistool aan aan de dokter   *PO-dative*

      [The cook offers a gun to the doctor]

c)   De kok scheldt de dokter uit   *Baseline*

      [The cook scolds the doctor]

Procedure. The participants were tested in groups of two in a dialogue experiment. Both dialogue partners took turns in describing pictures that appeared on the screen of their computers. They were instructed to listen and react to their dialogue partner's descriptions by pressing '1' if the description matched the picture that was simultaneously presented on their computer screen or '2' if the description and the picture did not match. One

of both participants was a confederate. Instead of describing pictures, the confederate read prime sentences from the screen of her computer. In order to ensure that the real participant would not see this, the screens of the participant's and the confederate's computer faced opposite directions. Before the actual experiment, both dialogue partners were familiarized with the material in a study session, where all objects and all characters that appeared on the pictures in the experiment were presented together with their names. The participant and the confederate were instructed to look at the pictures and to memorize the corresponding names. After that, the participant's first verification picture was shown, in order to explain how the objects were arranged on the screen and how the participants were supposed to respond (the use of either DO- or PO-datives was avoided in the instructions). The participant and the confederate were informed that their speech would be digitally recorded. The program was set up so that the confederate always took the first turn. The lists for the confederate and the real participant were designed to be run simultaneously on two different PCs. Sessions took about 30 minutes.

Scoring. The responses were recorded on minidisk, and were manually coded afterwards, in the same way as for Experiment 1.

RESULTS

One hundred and thirty of the 1620 target responses were classified as 'Others' (8.02%). The remaining 1490 responses were either DO-datives (432, 26.7%) or PO-datives (1058, 65.3%). The proportion of DO-datives out of all DO- and PO-datives was calculated for each participant (see Figure 3) and item and subsequently arcsine-transformed (as were the proportions of target responses of Experiment 2). An ANOVA was run on these transformed proportions with Prime Type (DO-prime, PO-prime, or baseline prime) as a within-participant and within-item factor and Verb Bias (DO-

biased verbs, PO-biased verbs or Neutral verbs) as a within-participant and between-item factor.

The analysis showed a significant main effect of Prime Type F_1 (2, 28) = 98.88, MSE = 26.08, p <.001; F_2 (2, 50) = 228.45, MSE = 19.11, p <.001: the percentage of DO-datives was highest after DO-primes (58.7%), lower after baseline primes (22.2%) and lowest after PO-primes (5.3%). Planned comparisons indicated that the percentage of DOs in the DO-condition was significantly higher than in the baseline condition F_1 (1, 29) = 79.92, MSE = 45.31, p <.001; F_2 (1, 51) = 149.33, MSE = 30.85, p <.001. The percentage of DOs in the PO-condition was significantly lower than in the baseline condition F_1 (1, 29) = 30.38, MSE = 10.81, p <.001; F_2 (1, 51) = 75.24, MSE = 9.43, p <.001. The analysis also showed a main effect of Verb Bias F_1 (2, 28) = 24.39, MSE = 2.07, p <.001; F_2 (2, 50) = 10.81, MSE = 0.54, p <.001: the percentage of DO-datives was higher for DO-biased target verbs (35.1%) than for Neutral target verbs (31.7%) and PO-biased target verbs (20.4%). Furthermore, a significant interaction between the factors Prime Type and Verb bias indicated that the priming effects in our experiment were influenced by the verb bias of the prime and target verbs F_1 (4, 26) = 4.25, MSE = 0.33, p <.005; F_2 (4, 102) = 3.19, MSE = 0.27, p <.05.

Figure 3: percentages of DO-responses for DO-biased verbs (DO-BIAS), Neutral verbs (NEUT) and PO-biased verbs (PO-BIAS) in all conditions of Experiment 2
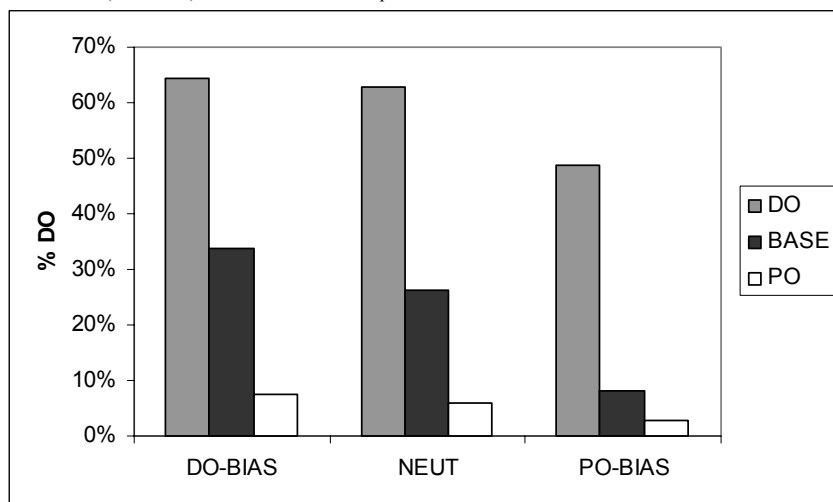
We then computed the amount of DO-priming (percentage of DOs in the DO-condition minus the percentage of DOs in the baseline condition) and the amount of PO-priming (percentage of DOs in the baseline condition minus the percentage of DOs in the PO-condition) for each participant and item. Paired t-tests on the amount of DO- and PO-priming indicated that the effect of DO-priming was significantly larger than the effect of PO-priming t_1 (1, 29) = 3.16, MSE = .11, $p<.005$; t_2 (1, 53) = 3.32, MSE = .10, $p<.005$. Analyses of Variance on the amount of DO-priming with Verb Bias (DO-biased, Neutral, or PO-biased) as a within-participant and between-item factor showed no main effect of Verb bias on the size of DO-priming (F_s. <2). The amount of PO-priming, on the other hand, showed a significant influence of Verb Bias F_1 (2, 28) = 14.05, MSE = 1.24, $p <.001$; F_2 (2, 53) = 8.25, MSE = 1.03, $p <.001$: the effect of PO-priming was larger for DO-biased verbs (26.4%) than for Neutral verbs (20.3%) and PO-biased verbs (5.4%). T-tests on the amount of PO-priming for the different bias groups (paired t-tests in the F_1, independent samples in the F_2) showed a significant difference in the strength of PO-priming for PO-biased and DO-biased verbs

t_1 (1, 29) = 5.71, *MSE* = 0.07, *p* <.001; t_2 (1, 34) = 3.72, *MSE* = 0.13, *p* <.005. The 19.9% difference between Neutral and PO-biased verbs was also significant F_1 (1, 29) = 4.01, *MSE* = 0.07, *p* <.001; F_2 (1, 34) = 3.08, *MSE* = 0.11, *p* <.005. The 6.1% difference in the amount of PO-priming for DO-biased and Neutral verbs was not significant (t_s < 2).

Finally, regression analyses were carried out with the amount of DO-priming and PO-priming as dependent variables and the alternation bias for each of the 18 verbs as independent variable (the biases were arcsine-transformed before they were entered in to the regression). The regression analysis showed that for the amount of PO-priming the pretest alternation bias was a significant predictor: the regression model yielded R = 0.77, *F* (1, 16) = 23.64, *p* <.001. For the size of DO-priming, on the other hand, the alternation bias was a marginally significant predictor. The regression analysis yielded R = 0.44, *F* (1, 16) = 3.74, *p* <.1. Whereas the effect of DO-priming was inversely correlated with the bias towards a DO-construction, the effect of PO-priming increased together with the DO-bias.

Table 2: Regression of the pretest alternation bias on the amount of DO- and PO-priming in Experiment

	Pretest Alternation Bias		
	Beta	*SE*	*t*
DO priming	-0,44	0,11	-1,93
PO priming	0,77	0,09	4.86*

*Note: SE = Standard Error, * = p<.05*

DISCUSSION

The results of this experiment showed clear effects of a general preference for PO-structures: overall, more PO-structures than DO-structures were produced, but priming effects were significantly larger in the DO-conditions than in the PO-conditions. Thus our data replicate the inverse-preference effect that was observed in several studies investigating syntactic priming (Bock, 1986; Bock & Griffin, 2000; Ferreira, 2003; Hartsuiker & Kolk, 1998; Hartsuiker et al., 2004; Scheepers, 2003). In addition to this general inverse-preference effect, a significant interaction was found between priming strength and verb bias. The amount of PO-priming significantly increased as the bias towards PO-constructions decreased: More PO-priming was found for DO-biased verbs than for neutral and PO-biased verbs. This influence of verb bias on the size of PO-priming was not only obtained when verb bias was defined as a factor (DO-biased vs. Neutral vs. PO-biased), but also when the alternation bias of each of the different dative verbs was used: When the bias towards a DO-dative increased, more PO-priming was observed. In sum, this is the first experiment to show verb-specific inverse-preference effects.

The amount of DO-priming showed a much weaker influence of alternation bias: an effect of verb bias on the size of DO-priming was only obtained when the alternation bias for each separate verb was considered. Though the effect of alternation bias was only marginally significant in the regression, it did go in the predicted direction: the amount of DO-priming

increased when the bias towards a DO-dative decreased. It is possible that, for DO-primes, the verb-specific effect of inverse frequency is concealed by the general inverse frequency effect. Almost for all verbs used in this experiment, stronger DO-priming than PO-priming was obtained, due to the lower frequency of DO-datives in general. It could be that a DO-structure in the prime increases the probability of re-using this structure already to such an extent that the effect caused by a specific verb bias cannot influence this probability much further. Furthermore, our norming study shwoed that our selection of dative verbs contained no verbs that are heavily biased towards a DO-dative construction, for which only a small effect of DO-priming would be observed. Hence, an influence of alternation bias on the amount of DO-priming might just be more difficult to obtain.

To summarize, the results of our experiment confirm Jaeger and Snider's (2007) finding that the inverse-preference effect caused by PO-primes is inversely correlated with verb bias in spoken dialogue. However, it is unclear whether the effect is caused by the bias of the prime verb or of the target verb, because in the current experiment the same verb was used in prime and target. It is obvious from our data that the alternation bias of a target verb influences the response patterns for that verb: the percentage of DO-dative responses increased when the target verb's preference for a DO-dative increased. This was not only the case in primed conditions: the baseline percentage of DO-datives was higher for DO-biased target verbs (33.6%) than for Neutral and PO-biased target verbs (26.4% and 8.2% datives, respectively). Hence, it is possible that the differences in the size of DO- and PO-priming were due to ceiling- and floor-effects. Because the percentage of PO-datives for PO-biased verbs is already very high in the baseline condition, the percentage of PO-datives cannot be increased much more by presenting a PO-prime. For DO-biased target verbs, however, the baseline percentage of PO-datives is relatively low, so, following a PO-prime, this percentage can increase more strongly. Furthermore, it is possible that the effects obtained in our experiment were systematically boosted: Not only was the verb always repeated between prime and target, the target verbs

in this experiment were also always primed with a verb with an identical alternation bias. Hence, we do not know for sure whether the alternation bias of a prime verb also influences the amount of PO- (and DO-) priming for unrelated verbs with a different alternation bias. Only if such priming is obtained, can we be certain that the inverse frequency effect arises because speakers implicitly learn the alternation bias of different dative verbs and consequently greater learning occurs when a verb is used with its least preferred syntactic alternative.

In order to investigate whether or not the effects we obtained were determined by the alternation bias of the prime verb, a further experiment was carried out in which the primes and target always used a different verb (DO-biased, Neutral and PO-biased prime verbs were combined with a set of 4 different target verbs). If in this experiment an inverse correlation is still obtained between the size of DO- and PO-priming and the alternation bias of the prime verb, we can conclude that the alternation bias of dative verbs is learned and represented in memory. More importantly, we can conclude that because this bias is learned, structures that are less preferred for a certain verb cause stronger priming than structures that are more preferred.

EXPERIMENT 3

METHOD

Participants. Thirty undergraduate students at Ghent University (25 females and 5 males) were paid to take part. All participants were native speakers of Dutch and had normal or corrected to normal vision. A female undergraduate student acted as confederate.

Materials. From the materials of Experiment 2, 4 DO-biased prime verbs, 4 Neutral prime verbs and 4 PO-biased prime verbs were selected. Of the six remaining dative verbs, only 4 were used as target verbs (*teruggeven* (give

back), *tonen* (show), *betalen* (pay) and *schenken* (donate)). Two of these target verbs were DO-biased (*teruggeven, betalen*) and two were Neutral verbs (*tonen, teruggeven*)[2]. Each of the 4 different target verbs was combined with each of the 12 different prime verbs. For each of the target verbs, 9 further target pictures were constructed in addition to the 3 target pictures that were used in Experiment 1, bringing the total number of target pictures to 48. Ninety-six filler targets and filler primes were selected from the set of fillers that were used in Experiment 2. In 24 filler pairs, a different verb was used in prime and target; the other 72 pairs used the same verb in prime and target. Consequently, in the whole experiment, the same verb had to be used in prime and target constructions in half of the trials. Additionally, 144 pictures were selected for the verification set of participant and confederate.

The prime sentences were again presented in three counterbalanced lists. In each of these lists the primes were presented equally often in the three priming conditions (DO-prime, PO-prime, baseline) and across all participants every target picture was presented equally often in each of the three conditions. Within the groups of DO-biased, Neutral and PO-biased prime verbs the primes were equally divided over the 3 priming conditions. The primes and targets were always presented in the same, pseudo-random order.

Procedure and scoring. The procedure was identical to that of Experiment 2. The responses were also scored in the same way.

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[2] The two remaining PO-biased target verbs *voorstellen* (present) and *verklappen* (give away) elicited large numbers of Others in Experiment 2. Furthermore, it would be too difficult to create 9 extra target pictures for these verbs.

RESULTS

Sixty-seven of the 1440 target responses were classified as 'Others' (4.7%). The remaining 1373 responses were either DO-datives (311, 21.6%) or PO-datives (1062, 73.8%). The proportion of DO-datives out of all DO- and PO-datives was calculated for each participant (see Figure 5) and item and subsequently arcsine-transformed. An ANOVA was run on these transformed proportions with Prime Type (DO-prime, PO-prime or baseline prime) as within-participant and within-item factor and Verb Bias (DO-biased verbs, Neutral or PO-biased verbs) as a within-participant and between-item factor.

Figure 4: percentages of DO-responses following DO-biased prime verbs (DO-BIAS), Neutral (NEUT) and PO-biased verbs (PO-BIAS) in all conditions of Experiment 3
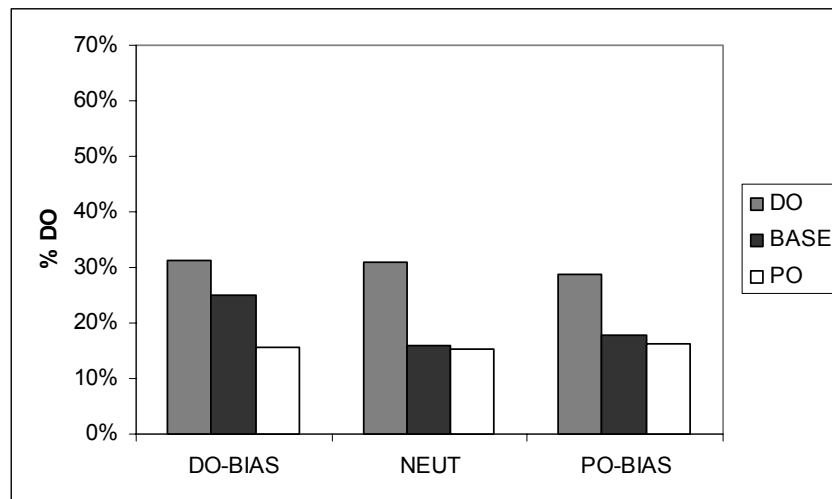
For this experiment, the analyses of variance only showed a main effect of Prime Type F_1 (2, 28) = 17.29, MSE = 1.97, p <.001; F_2 (2, 45) = 17.29, MSE = 1.53, p <.001: the percentage of DO-datives was again higher after DO-primes (31.3%) than after baseline primes (20.7%) or PO-primes (16.3%). Planned comparisons showed that significant DO-priming (vs. baseline) was obtained F_1 (1, 29) = 13.29, MSE = 4.19, p <.005; F_2 (1, 46) =

12.42, $MSE = 2.66$, $p <.005$. Furthermore, the percentage of DOs in the PO-condition was significantly lower than in the baseline condition F_1 (1, 29) = 4.31, $MSE = 0.41$, $p <.05$; F_2 (1, 46) = 4.43, $MSE = 0.63$, $p <.05$. There was no main effect of Verb Bias or a Prime Type X Verb Bias interaction ($F_s <$ 2.5).

The amount of DO-priming and the amount of PO-priming was again computed for each participant and item. In this experiment, paired t-tests only showed a marginally significant difference between the overall amount of DO-priming (10.8%) and PO-priming (3.9%) in the analysis by-participants t_1 (1, 29) = 1.91, $MSE = .08$, $p<.1$; t_2 (1, 47) = 1.13, $MSE = .11$, $p>.1$. Analyses of Variance on the amount of DO-priming with Verb Bias (DO-biased, Neutral or PO-biased) as a within-participant and between-item factor showed no effect of Verb bias on the size of DO-priming ($F_s <1$): the effect of DO-priming was not stronger for PO-biased verbs than for Neutral verbs or DO-biased verbs. The amount of PO-priming was also not influenced by Verb Bias ($F_s <2$).

As two target verbs were DO-biased and two were Neutral verbs, Target Bias was taken up in the analyses as an extra within-participant and between-item variable. The resulting ANOVA showed a main effect of Target Bias on the size of DO-priming F_1 (1, 28) = 5.59, $MSE = 0.86$, $p <.05$; F_2 (2, 42) = 6.73, $MSE = 1.31$, $p <.05$: the amount of DO-priming was significantly larger for Neutral target verbs (17.4%) than for DO-biased target verbs (3.1%), indicating that the alternation bias of the target verbs was inversely correlated with the strength of DO-priming observed for these verbs. Target Bias did not influence the amount of PO-priming ($F_s <2$) and showed no interaction with other factors.

Regression analyses with the amount of DO-priming and PO-priming as dependent variables and pretest alternation bias as independent variable showed that, for the amount of DO-priming, alternation bias was no significant predictor: The regression analysis yielded $R = 0.40$, F (1, 10) =

1.93, *p* >.1. Importantly, for the amount of PO-priming the pretest alternation bias again turned out to be a significant predictor (Table 3): The regression analysis yielded $R = 0.62$, $F (1, 10) = 6.27$, $p < .05$. Also in this experiment, the amount of PO-priming increased together with the bias towards a DO-dative. Although no significant effect of prime alternation bias on the amount of DO-priming was obtained, it is clear from the regression coefficient (see Table 3) that the effect moved again in the opposite direction.

Table 3: Regression of the pretest alternation bias on the amount of PO-priming in Experiment 3

	Pretest Alternation Bias		
	Beta	*SE*	*t*
DO priming	-0,40	0,08	-1,39
PO priming	0,62	0,08	2.50*

*Note: SE = Standard Error, * = p<.05*

DISCUSSION

The results of this experiment are comparable to the results of Experiment 2: Again, we observed a general inverse-frequency effect as well as a verb-specific one. In this experiment, however, the effects were much weaker than in Experiment 2: The general effect of inverse frequency was only marginally significant in the analysis by participants and the effect of alternation bias on the size of PO-priming was only obtained when the alternation bias of each individual verb was used a predictor in a regression analysis. The size of DO-priming was again not influenced by the alternation bias of the prime verb, but was, on the other hand, influenced by the alternation bias of the target verb: Stronger DO-priming occurred for Neutral target verbs than for DO-biased targets.

The results of this experiment suggest that the effects observed in Experiment 2 were partly caused by the alternation bias of the target verbs that were used: If a certain target verb elicits a high percentage of DO-datives in the baseline condition, this percentage cannot increase much further by the presentation of a DO-prime. Furthermore, the results of this experiment and Experiment 2 indicate that stronger effects of alternation bias can be observed when priming effects are boosted by repetition of the verb in prime and target. The most important result of this last experiment is, however, that the alternation bias of our dative prime verbs still influenced the size of PO-priming for unrelated target verbs. This inverse correlation between the alternation bias of the prime verb and the strength of PO-priming for an unrelated target verb with a different alternation bias yields evidence for a model of implicit learning that keeps track of the general distribution of syntactic structures as well as the conditional probability of a syntactic construction (PO or DO) given a certain verb.

GENERAL DISCUSSION

In this study, we investigated whether the strength of DO- and PO-priming in Dutch is dependent on the alternation bias of Dutch dative verbs. To this aim, we selected 18 verbs with different alternation biases from a database containing frequency data for 225 dative verbs in Dutch (Colleman, 2006). In a first experiment, additional frequency data on the use of DO- and PO-constructions was collected for these verbs and, afterwards, these verbs were used as prime and target verbs in two syntactic priming experiments. The alternation biases observed in Experiment 1 were used to measure the influence of alternation bias on the size of DO- and PO-priming. In Experiment 2, all of the 18 verbs were used as targets. In the DO- and PO-conditions, the prime and target sentences always used the same verb; in the baseline transitive verbs were used. The results of this experiment showed a general inverse frequency effect as well as a verb-specific one: In general, more priming was caused by DO-primes (generally less preferred in our

norming study) than by PO-primes (generally more preferred). Furthermore, this inverse-frequency effect appeared to be modulated by the alternation bias of the dative verbs that were used: The amount of PO-priming significantly increased when the bias towards a DO-dative increased. For the DO-primes only a marginal effect of alternation bias on the amount of priming was observed. In a third experiment we showed that these differences in the size of DO- and PO-priming were not merely reducible to ceiling and floor effects caused by differing baselines for DO-biased and PO-biased verbs or by repetition of the verb in prime and target: when unrelated verbs were used as targets, the size of PO-priming was still influenced by the alternation bias of the prime verbs. The results of this last experiment indicate that the effects that were obtained in Experiment 2 were at least partly due to the surprisal caused by the dative prime.

In sum, the results of our experiments confirm Jaeger and Snider's (2007) results from a corpus study, namely that priming effects caused by DO- and PO-datives are inversely correlated with the alternation bias of the dative verb that is used. This lexical influence on syntactic priming cannot be explained by the implicit learning model proposed by Chang et al. (2006): The finding that the strength of priming is modulated by the alternation bias of each separate dative verb indicates that information about syntactic processes must be linked to lexical items. Consequently, the current results can only be accommodated by a model of implicit learning that keeps track of the general distribution of syntactic structures as well as the conditional probability of a syntactic construction (PO or DO) given a certain verb (Jaeger & Snider, 2007).

In the production model of Pickering and Branigan (1998) information about syntactic structures is linked to specific lexical items. Following Levelt et al. (1999) Pickering & Branigan assume that lexical entries consist of conceptual, lemma, and word-form strata, with syntactic information being represented at the lemma stratum. In their model, the lemmas of nouns and verbs are connected to combinatorial nodes specifying

the lemmas' combinatorial properties. The lemmas of Dutch dative verbs, for example, are assumed to be connected with a node for the PO-dative construction and with a node for the DO-dative construction. In order to explain our data, this lexical model should 'count' the number of times a certain verb is used with a certain syntactic structure, e.g., by increasing the weight of the connection between the lemma of this verb and the syntactic node in question. A model with weighted links between lemma nodes and the combinatorial nodes they can combine with could explain why more DO-datives are produced for DO-biased target verbs than for PO-biased target verbs: the higher the weight of a link between a lemma and a combinatorial node, the higher the probability that this combinatorial node will be selected. However, such a model would not explain why an increase in the weight of a link between the lemma of a certain verb influences priming for a different verb. This effect can only be explained if the syntactic preferences of separate verbs can influence the overall preference for one syntactic construction over the other.

In the model of Jaeger and Snider (2007) each structure that is encountered (e.g. a DO-dative structure containing a specific dative verb) is considered as a piece of evidence that affects the overall probabilistic distribution of syntactic structures (e.g. the distribution of DO vs. PO structures). Jaeger and Snider's model learns how often a syntactic structure is combined with a certain verb. The number of times a verb is encountered with its different syntactic alternatives then determines the verb's alternation bias. The Dutch verb *verkopen* (sell), for example, is very frequently combined with a PO-dative, so the model predicts a PO-dative when the verb *verkopen* is encountered in the input. A PO-prime with the verb *verkopen* is therefore far less surprising than a PO-prime containing the verb *aanbieden*, for which a DO-dative is predicted. Consequently, stronger PO-priming is observed for PO-primes using DO-dominant verbs like *aanbieden* than for PO-primes using PO-dominant verbs like *verkopen*. Note that in this account, the general inverse frequency effect for datives is determined by the alternation bias of separate dative verbs: If in a language most verbs are PO-

dominant, DO-primes will exert stronger priming than PO-primes. If, however, the majority of dative verbs are DO-dominant, stronger dative priming will occur for PO-primes. The results of our norming study (Experiment 1) indicated that the majority of our selected verbs were PO-dominant in Dutch. The finding that DO-primes exerted stronger priming than PO-primes in both of our syntactic priming experiments is thus also consistent with the predictions of Jaeger & Snider's account.

To summarize, the results of our study plead for an integration of lexical and implicit learning models of syntactic production. The model that provides the best explanation for our data is the implicit learning model described by Jaeger and Snider (2007) in which priming is determined by surprisal-sensitive persistence. According to Jaeger and Snider, the finding that priming gets stronger the less expected the prime structure given a certain verb indicates that priming -like learning- is error-driven. Thus, the results of Jaeger and Snider's corpus study as well as the results of our experimental study argue for an implicit learning account of syntactic persistence. This model of implicit learning should not only learn the general distribution of syntactic structures, but also keep track of the probability of a syntactic structure for the different verbs this structure can combine with, for the kind of lexically specified learning observed in this study can only be accommodated if information about syntactic procedures is linked to specific lexical items in the mental lexicon.

CHAPTER 6
GENERAL DISCUSSION

The aim of the syntactic priming studies presented in this doctoral dissertation was to further investigate the representations and the mechanisms involved in bilingual sentence processing. In this final chapter the main empirical findings of this thesis are summarized and discussed within the framework of the lexical-syntactic model of bilingual sentence processing (Hartsuiker, Pickering & Veltkamp, 2004; Schoonbaert, Hartsuiker & Pickering, 2007) as well as other models (Chang et al., 2000 & 2006; Jaeger & Snider, 2007). The chapter is concluded with some directions for future research on bilingual syntactic processing and syntactic processing in general.

RESEARCH OVERVIEW AND THEORETICAL IMPLICATIONS

As mentioned in the Introduction, the research presented in this thesis deals with three major questions regarding bilingual syntactic processing and syntactic processing in general. In Chapters 2 and 3 we investigated the influence of word-order differences on the occurrence of cross-linguistic syntactic priming in order to gain information on the different levels of representation at which syntactic structures can be shared across languages. In Chapter 4, the influence of second language proficiency on between-language priming was assessed in order to investigate how shared syntactic representations are established in bilingual memory. Finally, in Chapter 5, a more general issue regarding syntactic processing was investigated, namely the question whether information about the syntactic preferences of verbs is represented in memory. We will consider these three issues separately, summarizing the main findings and discussing the theoretical implications.

THE INFLUENCE OF WORD-ORDER DIFFERENCES ON CROSS-LINGUISTIC SYNTACTIC PRIMING

One of the major questions in language production research concerns the mental representation of syntax: what is the nature of the syntactic representations or the syntactic processes that are active during the comprehension and the production of sentences? Several monolingual studies on syntactic priming have indicated that word order can be a determinant of the occurrence of syntactic priming (Hartsuiker et al., 1999; Hartsuiker & Westenberg, 2000; Pickering et al., 2002), suggesting that the syntactic representations responsible for syntactic priming are specified for linear order. If priming occurs at a level of representation that is word-order specific, one could expect that structures with a different word order across languages do not prime each other. This hypothesis was investigated in Chapters 2 and 3 of this dissertation.

Chapter 2 investigated between-language priming for noun phrases (*the red shark* (AN) - *the shark that is red* (RC)) in Dutch-English (Experiment 1: L1→ L1, Experiment 2: L2 → L2; Experiment 3: L1 → L2 & L2 → L1; Experiment 4: L2 → L2 & L1 → L2) and Dutch-German bilinguals (Experiment 5: L1 → L2). Experiments 1, 2, and 4 showed that the structure of noun phrases can be primed in a within-language context: In both L1 (Dutch) and L2 (English), significantly more RC-structures were produced following RC-primes than after AN-primes. Hence, abstract syntactic representations of both noun phrase structures were accessed during the comprehension and the production of both Dutch and English noun phrases. However, cross-linguistic priming occurred only when prime and target phrases had an identical word order: Significant priming was found between Dutch and German (Experiment 5) but not between Dutch and English (Experiments 3a, 3b, and 4). In fact, in all Dutch-English priming experiments, hardly any RC-structures were produced. These results thus suggest that Dutch RC-structures do not prime the use of English RC-structures (and vice versa) because these structures do not share the same word order.

The results obtained in this first study can be explained by the single-stage account of syntactic processing advocated by Pickering and colleagues (Pickering, Branigan & McLean, 2002). According to this account, the processor constructs syntactic representations from the functional-level input in a single stage. Pickering et al. obtained evidence for their single-stage account in a priming study in which the production of English datives was primed by presenting double object datives (*The girl gives the dog a bone*), prepositional object datives (*The girl gives a bone to the dog*) and shifted datives, in which the prepositional object preceded the noun phrase (*The girl gives to the dog a bone*). Although shifted datives and prepositional datives are variants of the same syntactic structure (only the word order is different), shifted datives did not prime the use of prepositional object datives in English. Therefore, Pickering et al. concluded that word order is part of constituent structure. Like shifted and prepositional datives, Dutch and

English RC-structures have the same hierarchical syntactic structure, but a different word order. The finding that no between-language priming occurs for these structures yields converging evidence for the claim that language production involves the mapping of a pre-syntactic representation to a representation that is fully specified syntactically.

In the discussion of our first chapter, we argued that our data might also be explained by implicit learning models (e.g., Chang, Dell, Bock, & Griffin, 2000; Dell, Chang & Griffin, 1999), as they also suggest that syntax is formulated in one stage. Although these models are indeed single-stage models, the predictions they make regarding our data differ from the predictions that can be derived from the single-stage account advocated by Pickering et al. (2002). Implicit learning models assume that syntactic processing is strictly incremental: during sentence comprehension, the next word in the input is predicted on the basis of the word that is currently processed; if this prediction does not match the actual input, the predictions of the system are adjusted. As such, implicit learning models can explain why shifted datives (e.g., *The girl gives to the dog a bone*) do not prime the use of prepositional object datives or double-object datives (Pickering et al., 2002): after a shifted dative prime, the system has learned that the dative verb has to be followed by the preposition *to*, and not by a determiner introducing a noun phrase. However, the absence of priming between Dutch and English RC-structures poses serious problems for models assuming that production is strictly incremental, for the point where the structural decision has to be made between an AN- or an RC-structure precedes the point at which Dutch and English RCs differ in word order. Hence, these models would incorrectly predict priming between Dutch and English RCs, despite the differences in word order. Interestingly, if Dutch and English would allow two word orders for the relative clause, the implicit learning model would predict that RC-structure priming would only occur between RCs with an identical word order: the head-initial structure of the prime would elicit an RC-response, but competition between the two word orders of the

relative clause (ADJ COPULA vs. COPULA ADJ) would result in only RCs with an identical word order as the prime being produced.

What are the implications of our findings for bilingual language processing? The results of this first study have shown that between-language priming occurs between structures that share the same constituent structure, though only if these structures additionally have an identical word order. As word order seems to be part of constituent structure, similar structures that have a different word order across languages (e.g., Dutch and English RC-structures) have to be represented separately at the constituent structure level. Between-language priming for structures with differing word orders can thus only be obtained if these structures share a pre-syntactic representation in bilingual memory. As structures with an identical word order across languages (e.g., Dutch and German RC-structures, Dutch, English and German AN-structures, Dutch and English datives, Spanish and English passives,…) have an identical constituent structure, their constituent structure representation can be shared. Consequently, cross-linguistic priming will occur for any related syntactic structures that have the same word order in the languages under study.

In Chapter 3, we investigated whether cross-linguistic syntactic priming can be obtained for structures with different word orders that are functionally identical. The active sentences *The cat chases the mouse* and *The mouse chases the cat* have different meanings, but they involve the same grammatical functions: the agent of the action (i.e. the chaser) has the function of subject, the patient of the action (i.e. the one that is being chased) is the direct object of the sentence. This makes both sentences functionally identical and on the other hand functionally different from their passive alternatives (*The mouse is chased by the cat, The cat is chased by the mouse*), which involve a subject and an oblique object. Hartsuiker and Kolk (1998) suggested that the assignment of grammatical functions can be primed. More specifically, they assume that structural priming with actives and passives is localized at the functional level. However, they failed to

obtain priming between Dutch verb-final (*De non wordt door de bokser achtervolgd - *The nun is by the boxer chased**) and verb-medial passives (*De non wordt achtervolgd door de bokser - The nun is chased by the boxer*): structures that are functionally identical (*nun* = subject, *door de bokser* = oblique), though they have different word orders. In order to further investigate whether functional representations can be primed, we compared within-language priming in Dutch (Experiment 1) and between-language priming from Dutch (L1) to English (L2) (Experiments 2-3), using transitive sentences.

In the first experiment, we replicated Hartsuiker and Kolk's (1998) results: significant within-language priming was obtained for Dutch verb-medial and verb-final passives, but both passives did not prime each other. Conversely, priming between passives with differing word orders occurred across languages (Experiments 2-3): The percentage of passives in English increased after Dutch verb-medial passives, with a word order that is identical to that of English passives, but also after Dutch verb-final passives, in which the order of the *by*-phrase and the main verb of the sentence is different from English. Furthermore, stronger passive priming occurred when the passives in prime and target had an identical word order. Experiment 3 included a baseline condition and confirmed that Dutch verb-final passives primed English passives.

The occurrence of syntactic priming between Dutch verb-medial passives and English verb-final passives suggests that both passives have a shared representation in bilingual memory. In the discussion of Chapter 3, we argued that both forms share a representation at the level of functional assignment, rather than any other processing level (see discussion Chapter 3). This shared functional representation produces priming between Dutch and English passives with a different word order. In the within-language priming experiment, however, the effect of functional priming is obscured by a second priming effect at the positional level. Thus, even though a passive prime with a particular order facilitated the production of both types

of passive (at the functional level), a further priming effect (at the positional level) then facilitated the choice of a passive with the same order in particular.

Two critical comments have to be made regarding the discussion of Chapter 3. Firstly, we argued that that functional processing occurs at a level that is separate from positional processing. Because we assume two different representational levels, we can only explain the occurrence of stronger priming between Dutch and English passives with an identical word order by making the additional assumption that the activation of the shared functional representation is influenced by priming at the positional level: feedback from the positional level has to enhance this level of activation in the case of a word order match or decrease it when a mismatch in word order is detected. If, however, functional and constituent structure information would be represented at the same level, such feedback mechanisms would not be needed in order to explain the data obtained in this study. Recently, Branigan, Pickering and Tanaka (2008) proposed a sentence production model in which both word order and grammatical function are differentiated at the lemma stratum. In this extended version of Pickering and Branigan's (1998) model, people access a verb lemma together with a voice node that is associated with grammatical function specifications and a combinatorial node that specifies constituent structure (including word order, Branigan et al., 2008). According to this model, the strength of priming between two structures depends on how similar both structures are in terms of both grammatical functions and constituent order. This model works for free word order languages, such as Japanese: in Japanese, both active and passive constructions can have a subject-first and an object-first word order. Functional assignment and the determination of constituent structure are thus two independent processes. In Dutch and in English, however, the constituent structure of active sentences (i.e., NP VERB NP) can not be used for passive constructions and vice versa. As it is not yet clear whether Branigan et al.'s model provides a mechanism that prevents the co-activation of functional nodes and constituent representations that can not be combined,

it is too early to decide whether this model could explain the data obtained in the current study.

Secondly, further research might be necessary in order to determine whether our between-language priming effects for transitives are functional or conceptual in nature. As actives and passives are not only functionally (subject first vs. object first), but also conceptually different (agent first vs. patient first), it is difficult to exclude explanations in terms of conceptual processing. The implicit learning model proposed by Chang and colleagues (2006), for example, could explain the data obtained in this third chapter, as it assumes that the order of thematic roles (agent, patient, …) can be primed and that words are predicted one at a time, based on the input. At the beginning of the utterance, competition between the agent and the patient of the action that needs to be described determines whether the sentence will be an active or a passive. The choice between a verb-medial and a verb-final passive has to be made later on, after the auxiliary. If, during prime comprehension, the system has learned that the auxiliary is followed by the past participle, production will be biased towards a verb-final passive. If, on the other hand, it has learned that the auxiliary is followed by the preposition *by*, a verb-final passive will be produced. As in English only adverbs can be placed between auxiliaries and the main verbs they modify, there is no competition after the auxiliary has been produced. This is why both Dutch verb-medial and verb-final passive primes lead to an increase in the use of English verb-medial passives. As we already mentioned, Chang et al.'s (2006) implicit learning model cannot explain the data that were obtained in our first chapter. Furthermore, if the choice between actives and passives would be determined on the basis of semantic factors, one could expect that animacy effects would add to the priming caused by a repetition of thematic roles (cf. Bock, Loebell & Morey, 1992). This was, however, not the case: we obtained comparable priming effects when the agent and the patient differed in animacy and when agent and patient did not differ in animacy. Our experiments were, however, not designed to tease apart effects of conceptual and functional priming. Therefore, our claim that functional

information is accessed during bilingual syntactic processing would be greatly strengthened if we were able to show functional priming in the absence of functional overlap.

To summarize, the results reported in chapters 2 and 3 indicate that in bilingual memory, both functional information and constituent structure information can be shared across languages. The functional information determines the grammatical function (subject, direct object, indirect object,…) of the concepts that will be used in the sentence; the constituent structure information determines which constituents (prepositional noun phrase, noun phrase, …) will be used to construct the sentence. In Chapter 2 we showed that constituent structure representations are specified for word order. Hence, similar structures that differ in word order do not have shared constituent structure representations and between-language priming can only be obtained if the structures in question share a functional representation. Finally, in these first two chapters we showed that cross-linguistic syntactic priming is not only a useful tool to study syntactic and lexical representations in bilingual memory; it can also be used to investigate aspects of syntactic processing in general: By comparing priming between different sets of languages, priming effects may emerge that are otherwise obscured.

THE INFLUENCE OF SECOND LANGUAGE PROFICIENCY ON CROSS-LINGUISTIC SYNTACTIC PRIMING

Chapter 4 investigated how shared syntactic representations are established in late bilinguals. Hartsuiker et al.'s (2004) bilingual model predicts that, from the moment that syntactic structures have a shared representation, second language proficiency will not influence the strength of between-language priming (Hartsuiker & Pickering, 2007). The model does, however, not specify when this 'moment' occurs: Are structures shared immediately when a new L2 structure is acquired, or is there a gradual evolution from

separate L1 and L2 representations to shared syntactic structures? To investigate this, we compared priming effects for English (L2) genitives (*the rose of the boy is blue* vs. *the boy's rose is blue)* in less- and more-proficient Dutch-English bilinguals. As English s-genitives (*John's car*) and Dutch s-genitives with a possessive pronoun (*Jan zijn auto*) differ in the realization of their possessive marker, English s-genitives may be quite difficult to learn. This makes the English s-genitive an ideal test case to investigate whether L2 syntactic structures are acquired via concrete, item-based linguistic schemas over language-specific syntactic representations to more abstract representations that are shared across languages.

In a first within-language experiment, we showed that the choice for English *of-* and *s*-genitives can be primed in less proficient and more proficient Dutch-English bilinguals. Though L2 proficiency did not influence the basic effect of within-language priming, it did have an influence on the percentage of English s-genitives that was produced: the use of s-genitives increased together with the participants' L2 proficiency. The translation equivalence boost, caused by the repetition of translation equivalent nouns (e.g., *emmer – bucket*) in prime and target, was also numerically larger for less proficient than for more proficient bilinguals. We concluded that both effects are due to the fact that more proficient bilinguals have generalized the use of the English s-genitive to a greater extent than less proficient bilinguals. In Experiment 2, a between-language priming experiment, we investigated whether differences in the level of L2 proficiency influence the representation of English s-genitives in bilingual memory. The results of this experiment confirmed our hypothesis that less proficient bilinguals might not yet have a shared representation for Dutch s-genitives with a possessive pronoun and English s-genitives with the clitic 's: less proficient bilinguals showed no priming between Dutch and English genitives. A re-analysis of the Schoonbaert et al. (2007) data on between-language priming for datives indicated that this proficiency effect does not only occur for dissimilar structures, but also for structures that are identical across languages: less proficient bilinguals showed no between-language

priming for datives when the dative verb was not repeated in prime and target.

In the discussion of Chapter 4, we argued that our data and the data obtained by Schoonbaert et al. (2007) argue for a usage-based account for the acquisition of L2 syntax. In an initial stage of L2 acquisition, new syntactic structures are repeated, and not constructed from memory. After a while, L2 learners discover the abstract rule that binds different occurrences of the same structure. From that moment on, a syntactic representation for the L2 structure is formed and within-language priming can be observed. If, after a certain amount of exposure to or experience with the new L2 structure, it appears that the structure in question is similar enough to its L1 equivalent, both representations merge into one. In other words: the shared syntax model for bilingual language use as it was developed by Hartsuiker et al. (2004) represents the final state of the learning trajectory. Initially, L2 structures receive separate representations.

The influence of L2 proficiency on the sharing of syntax suggests that the mechanism responsible for the merge of syntactic representations is driven by the number of times an L2 structure is encountered. This means that shared representations will be established more rapidly for structures that are very frequent in the L2 than for structures that are less frequent. The results of our study also indicate that the amount of exposure that is needed before the L1 and L2 representations overlap and between-language priming can be obtained depends on the similarity of the structures across languages: high proficient Dutch-English bilinguals with a comparable level of L2 proficiency showed stronger between-language priming for datives (identical structures) than for genitives (same word order, but differences in morpho-syntactic realization). If both between-language differences and an infrequent use hamper the establishment of shared syntactic structures, one might reason that the absence of priming between Dutch and English RC-structures in our first study (Chapter 2) was due to the fact that the English RC-structures that had to be produced are not very frequently encountered.

The German RC-structures used in the same study are, presumably, equally infrequently encountered. However, because our Dutch-German participants were all linguistics students studying their second language, they might have learned about this infrequent structure in class. Our Dutch-English participants (mostly students at the Psychology faculty) used their second language during their studies, but did not explicitly study it. Hence, it might be interesting to investigate whether between-language priming for RC-structures can be obtained for Dutch-English bilinguals studying English linguistics.

Finally, the measure of L2 proficiency used in this study, might not be as accurate as we want it to be. We asked our participants to rate their L2 proficiency with respect to four skills (writing, speaking, reading, and general proficiency) on 7-point scales, with 1 meaning *very bad* and 7 meaning *very good*. Our participants were then divided in groups on the basis of their median proficiency on these four skills. As these self-ratings may be co-determined by various non-linguistic measures (How do participants interpret the question? What is their reference level? How modest are they in general?), they might be rather subjective and not very accurate. Hence, it would be better to develop a converging assessment of L2 proficiency, based on indirect (self-rating of L2 proficiency, language history questionnaire) and more direct measures of L2 proficiency (lexical decision tasks, naming tasks and verbal fluency tasks in L2). Using a more fine-grained measure of L2 proficiency we could gain a better insight in the development of shared representations in bilingual memory.

However, despite the obvious limitations of self-ratings, self-rated L2 proficiency appeared to interact with syntactic priming effects in different experiments. A recent further study we conducted provides converging evidence for the influence of self-rated L2 proficiency on between-language priming. Using the same syntactic structures as the experiments reported in Chapter 4 (i.e., Dutch and English genitives), we investigated whether the size of the translation equivalence boost in between-language priming is

influenced by the cognate status of the repeated head noun. We found a three-way interaction between priming strength, cognate status and L2 proficiency, measured by means of self-ratings: Stronger between-language priming was obtained when the repeated head nouns were Dutch-English cognates (*appel – apple*) than when they were non-cognates (*emmer – bucket*). This effect was only significant for more proficient bilinguals; for less proficient bilinguals, no between-language priming was obtained. The finding that participants with a lower self-rated proficiency and participants with a higher self-rated proficiency seem to represent and process L2 syntactic structures in a different way, indicates that self-rated L2 proficiency and actual L2 proficiency correspond to a great extent.

THE INFLUENCE OF VERB BIAS ON SYNTACTIC PRIMING

In the last empirical chapter of this dissertation (Chapter 5) we focused on the mechanism behind syntactic priming. An effect that suggests that syntactic priming is caused by a form of implicit learning of syntactic structures is the *inverse- preference effect* (Ferreira & Bock, 2006): Structures that are in general less preferred or less common exhibit greater structural priming relative to a neutral baseline than more frequent structures. In a corpus analysis, Jaeger and Snider (2007) found that this inverse-preference effect is inversely correlated with Verb Bias in spontaneous speech. We aimed to provide experimental evidence for the claim that priming strength is modulated by Verb Bias by comparing the strength of double-object dative priming (DO) and prepositional object dative priming (PO) for DO-dominant, PO-dominant and Neutral verbs in two syntactic priming experiments (Experiments 2-3). First, we measured the alternation bias for 18 Dutch dative verbs in a picture description experiment (Experiment 1). In Experiment 2, we obtained a general inverse frequency effect for these datives as well as a verb-specific one: In general, more priming was caused by DO-primes (generally less preferred) than by PO-primes (generally more preferred). This inverse-frequency effect was

modulated by the alternation bias of the dative verbs that were used: More PO-priming was found for DO-dominant verbs (e.g., *aanbieden (offer)*) than for neutral (e.g., *tonen (show)*) and PO-dominant verbs (e.g., *verkopen (sell)*). In Experiment 3, in which prime and target verbs always had a different alternation bias, comparable effects were obtained, indicating that this lexically-based inverse frequency effect is, at least partly, caused by the alternation bias of the dative prime verb. In the same experiment, the strength of DO-priming interacted with the alternation bias of the dative target verb: the effect of DO-priming was stronger for Neutral verbs than for DO-dominant verbs.

The interaction between alternation bias and priming strength that was obtained in this study poses problems for lexical accounts as well as implicit learning accounts of syntactic priming, for this effect can only be explained by a production model that keeps track of the distribution of syntactic structures given a certain verb. In its current form, Pickering and Branigan's (1998) lexicalist activation model does not contain a mechanism that counts the number of times a certain syntactic structure is encountered or the number of times a combinatorial node is co-activated with a specific verb. In fact, because the model is activation-based, the activation of lemmas and combinatorial nodes is taken to decay quickly and automatically (see Dell, 1986; Levelt, Roelofs & Meyer, 1999; Roelofs, 1992). The model could, however learn the general preference for one syntactic structure over the other if the level of resting activation of the combinatorial nodes would be adjusted according to the frequency with which syntactic structures are encountered: If a PO-dative is more frequently encountered than a DO-dative, the combinatorial node for the PO-dative could have a higher level of resting activation than the combinatorial node for its syntactic alternative, the DO-dative. In this way, the model could explain why, in unprimed conditions, more POs than DOs are produced (combinatorial nodes with a higher level of resting activation are more easily selected) and why DO-primes exert stronger priming than PO-primes (an increase in the activation level has a stronger effect for nodes with a lower level of resting activation).

If, additionally, the weights between verb lemmas and combinatorial nodes would be strengthened during sentence processing as a result of Hebbian learning (cf. Hartsuiker et al., in press), the model could also predict a verb-specific effect of inverse frequency. However, in this modified model the general effect of inverse frequency and the verb-specific effect of inverse frequency would be caused by different processing mechanisms. Hence, this model would still not be able to explain why the syntactic preference of one dative verb influences syntactic priming for an unrelated verb.

The implicit learning model proposed by Chang and colleagues (2000, 2006) can explain why structures that are in general less preferred exhibit greater structural priming: a less preferred prime structure is not predicted by the production system and thus causes greater implicit learning than a prime structure that is more preferred. Consequently, the processing of an unexpected prime structure leads to a greater tendency to repeat this structure. However, the occurrence of a verb specific effect of inverse frequency in our study indicates that information about syntactic processes must be linked to lexical items. As the implicit learning account places syntactic priming outside the lexicon, it cannot explain the data pattern obtained in the current study.

Summarizing, the obtained data pattern can only be explained by a model of implicit learning in which the general distribution of syntactic structures is learned as well as the probability of a syntactic structure given a certain verb. On the basis of several corpus studies investigating the influence of suprisal and cumulativity on syntactic priming, Jaeger and Snider (2007) argued for such a model. In their view, it is the probabilistic distribution of structures that is being learned (or rather: maintained). A crucial aspect of their account is that each structure that is encountered (e.g. a DO-dative structure containing a specific dative verb) can be seen as a piece of evidence that affects the overall probabilistic distribution of syntactic structures (e.g., the distribution of DO vs. PO structures). Jaeger and Snider's model learns how often a syntactic structure is combined with a

certain verb. The number of times a verb is encountered with its different syntactic alternatives then determines the verb's alternation bias. The Dutch verb *verkopen* (sell), for example, is very frequently combined with a PO-dative, so the model predicts a PO-dative when the verb *verkopen* is encountered in the input. A PO-prime with the verb *verkopen* is therefore far less surprising than a PO-prime containing the verb *aanbieden*, for which a DO-dative is predicted. Consequently, stronger PO-priming is observed for PO-primes using DO-dominant verbs like *aanbieden* than for PO-primes using PO-dominant verbs like *verkopen*. Note that in this account, the general inverse frequency effect for datives is determined by the alternation bias of individual dative verbs: If in a language most verbs are PO-dominant, DO-primes will exert stronger priming than PO-primes. If, however, the majority of dative verbs are DO-dominant, stronger dative priming will occur for PO-primes. The results of our norming study (Experiment 1) indicated that the majority of our selected verbs were PO-dominant in Dutch. The finding that DO-primes exerted stronger priming than PO-primes in both of our syntactic priming experiments is thus also consistent with the predictions of Jaeger & Snider's account.

DIRECTIONS FOR FUTURE RESEARCH

Although the studies presented in this dissertation resulted in a further specification of Hartsuiker et al.'s (2004) model, it is clear that further research is necessary if we want to move towards a more complete model of bilingual sentence production. More information needs to be gathered on the exact nature of the representations involved in bilingual sentence processing and the influence of specific lexical items on the selection of these representations. Furthermore, we did not investigate how bilinguals deal with syntactic structures that cannot be shared between languages. In the following, I will briefly discuss a few topics that will be tackled in future research.

IS WORD ORDER DETERMINED IN A SEPARATE PROCESSING STAGE?

Why would we make every effort to find out whether word order is determined in a separate stage when we argued against this hypothesis in Chapter 2 of this dissertation? Because bilingual sentence production models could be greatly simplified if constituent structure representations would not be specified for word order. Branigan et al. (2006) found that a PO structure embedded within a subordinate clause (e.g., *The paper alleged that the blackmailer sent the photos to the politician*) primes a PO structure within a main clause (e.g., *The lonely sailor sent a postcard to his family*). In English, however, the word order of PO-datives and other syntactic constructions does not vary with the syntactic context: Even in questions, the word order of a syntactic construction can be preserved, due to the use of a do-support (e.g., *Did the lonely sailor send a postcard to his family?*). In Dutch, different word orders are used in main clauses (SVO), subordinate clauses (SOV) and questions (VSO). Consequently, if word order would be part of constituent structure, speakers of Dutch would need three different constituent structure representations for every possible syntactic structure. Of all these structures, only the ones with an SVO order would then be shared between Dutch and English. Therefore, a model describing sentence production in Dutch-English bilinguals could be greatly simplified if more general rules specifying linear order would work on abstract syntactic structures that are shared across languages. In a recent study, we found that Dutch datives in affirmative sentences (e.g., *De non geeft een hoed aan de clown*) could be primed by datives in questions (e.g., *Geeft de non een hoed aan de clown?*), despite the word order difference in both sentences. When prime and target were both affirmative, stronger priming was observed. These results seem to argue for models in which the final word order of a sentence is not necessarily determined by its abstract syntactic structure (cfr. Chang et al. 2000; 2006; Kempen & Hoenkamp, 1987). In future experiments, further predictions of such an account (e.g., priming between Dutch intransitives and passives with the same word order (*De jongen wil met de bal spelen [The boy wants to play with the ball] - De non wordt door*

de matroos achtervolgd [The nun is chased by the sailor]), priming between datives in English subordinate clauses and datives in Dutch main clauses) will be tested.

HOW DO SPECIFIC LEXICAL ITEMS INFLUENCE THE CHOICE FOR A CERTAIN SYNTACTIC STRUCTURE?

One of the aims of this thesis was to use between-language syntactic priming to gain more information on lexical representations in bilinguals. The emergence of a translation equivalence boost for dative verbs in the study by Schoonbaert et al. (2007) gives us reason to believe that syntactic priming can be used to investigate to which extent lexical and conceptual representations of nouns and verbs are shared in bilingual memory. The studies reported in Chapter 4 showed that between-language priming can be enhanced when the head nouns of prime and target constructions are translation equivalents. In a follow-up experiment, we found that this enhancement is stronger for repeated cognates (*appel – apple*) than for repeated non-cognates (*emmer – bucket*). This cognate-effect could be due to the fact that cognates have shared or overlapping representations (Sánchez-Casas et al., 1992) or because more activation flows back from the wordform-level to the lemma-level when cognates are repeated (Duyck et al., 2007). In the latter case, a boost of between-language priming should also be obtained for "false friends" or interlingual homographs (e.g., *pet [cap] - pet [animal]*) that have an identical form, but unrelated meanings in both languages. As these forms cannot share a lemma representation (Levelt et al., 1999) a boost of syntactic priming can only be due to feedback from word form representations. Such feedback is not predicted by Levelt et al.'s (1999) production model, on which the production models of Pickering & Branigan (1998) and Hartsuiker et al. (2004) are based. Hence, it would be interesting to find out what caused the obtained cognate effect.

In Chapter 5, we showed that lexical items can also influence the formulation of syntax when they are not immediately repeated: The syntactic preference of Dutch dative verbs did not only predict which syntactic alternative would be produced in unprimed conditions, it also determined to which extent a prime with the dispreferred structure could influence this choice. Apparently, lexical items can influence the production of syntax a) because the syntactic preference of verbs is learned and b) because the co-activation of a lexical item and a syntactic structure temporarily increases the association between them. It is, however, not clear to which extent syntactic preferences are learned: do we only learn the syntactic preferences of verbs or do we also keep track of the associations between nouns and adnominals (i.e. determiners and modifiers)? If we learn the associations for all items in our lexicon, the lexical boost of priming might be a side-effect of this learning of associations. If only the syntactic preferences of verbs are learned, a lexical boost for repeated nouns cannot be explained from this particular learning mechanism. To summarize, further investigation of the interplay between lexical factors and constituent structure in syntactic priming could provide important insights into the lexical basis of syntactic structure and the mechanisms behind syntactic priming.

WHAT HAPPENS WITH STRUCTURES THAT ARE NOT SHARED BETWEEN LANGUAGES?

The finding that syntactic structures of a second language are not immediately shared in bilingual memory (Chapter 4) also raises a more general question about syntactic representations in bilinguals, namely: What happens with structures that are not shared across languages? Imagine a native speaker of French learning Dutch who is confronted with two syntactic alternatives for expressing a passive sentence. As French only allows verb-medial word order for passive sentences (e.g., *Le matelos est poursuivi par le boxeur*), only one of both passives can be shared with its L1 counterpart. Do French-Dutch bilinguals have a memory representation for

Dutch verb-final passives, in addition to the shared representation for French and Dutch verb-medial passives? If this alternative passive is not represented, French-Dutch bilinguals will only produce verb-medial passives in a within-language priming experiment in Dutch, even though Dutch allows two word orders for the passive. This could mean that an L2 syntactic structure is only learned and represented in memory if there is no L2 syntactic alternative that can be shared with its equivalent L1 structure. If this is the case, the representation of L2 syntax in bilingual memory might show considerable variations according to the syntax of the bilingual's native language.

CONCLUSIONS

The research reported in this dissertation provides converging evidence for the claim that bilinguals share syntactic constructions whenever this is possible (Hartsuiker & Pickering, in press). By representing similar constructions only once, the amount of redundant information in bilingual memory can be greatly reduced. Furthermore, code-switching between two languages is much easier if bilinguals make use of shared syntactic constructions. My doctoral research indicated that syntactic sharing also has an important drawback: The use of shared syntactic structures increases the risk of making transfer errors. Our between-language priming experiments enabled us to specify the syntactic representations that are accessed during bilingual sentence production and the influence of specific lexical items on the selection of these representations. In this way, our results provided an important contribution to the ongoing debate between proponents of lexically driven models of language production (Pickering & Branigan, 1998) and models based on the implicit learning of abstract (non-lexical) rules (Chang, Dell, & Bock, 2006): both models differ in their assumptions on the representations that are accessed during sentence processing and the involvement of the lexicon in the formulation of syntactic structures. The results of our last study indicate that both accounts don't need to be

necessarily mutually exclusive. Further research will have to point out how lexical and implicit learning models of syntactic production can be integrated.

NEDERLANDSE SAMENVATTING

Het produceren van zinnen is een complex proces. Eerst moet een spreker de juiste woorden selecteren uit het lexicon en vervolgens moet de spreker met deze woorden een zin vormen die voldoet aan de grammaticale regels van de taal die hij of zij spreekt. Dat dat niet altijd probleemloos verloopt, blijkt uit zinnen als *'Je stoel hangt over je jas'* of '*Bedoel je wat ik begrijp?'* die moeilijk te interpreteren zijn, omdat ze grammaticale fouten bevatten. Wanneer mensen meer dan één taal spreken, wordt de coördinatie tussen het selecteren van woorden en het construeren van zinnen nog een stuk complexer, omdat de spreker er dan ook nog op moet letten dat woorden en grammaticale structuren van de juiste taal geselecteerd worden. In veel gevallen, gebruiken twee- of meertaligen echter zinsstructuren die heel gelijkaardig zijn in de talen die ze spreken. Dit roept de vraag op of tweetaligen slechts één geheugenrepresentatie hebben voor deze gelijkaardige structuren (die ze gebruiken in hun eerste en hun tweede taal (respectievelijk L1 en L2)), of dat er aparte representaties zijn voor elke taal.

Hartsuiker, Pickering & Veltkamp (2004) veronderstellen dat alle grammaticale structuren die gelijkaardig zijn in de L1 en de L2 van tweetaligen gedeelde geheugenrepresentaties hebben (zie Fig. 1). Hun lexicaal-syntactisch model voor tweetalige zinsproductie gaat ervan uit dat de lemmas (i.e. de basisvormen) van naamwoorden en werkwoorden uit beide talen van een tweetalige – in het oorspronkelijke model Spaans en Engels – opgeslagen zitten in één gemeenschappelijk productielexicon. Deze lemmas zijn verbonden met *categorieknopen* die informatie bevatten over de categorie waartoe een lemma behoort en met *combinatieknopen* die aangeven met welke zinsstructuren een bepaald lemma kan gecombineerd worden. Het lemma voor het Engelse werkwoord *hit* is bijvoorbeeld verbonden met een categorieknoop die aangeeft dat het een werkwoord is en met een combinatieknoop die aangeeft dat het werkwoord met een subject en

een direct object kan gecombineerd worden tot een actieve zin. De categorie-en combinatieknopen in dit model zijn niet taalspecifiek en zijn dus verbonden met alle lemmas waarmee ze gecombineerd kunnen worden. Een gevolg hiervan is dat de taal van een zin niet bepaald wordt door de combinatieknoop die geactiveerd wordt, maar door de lemmas die in combinatie met deze knoop geactiveerd worden. Als de combinatieknoop voor passieve zinnen in combinatie met het Engelse werkwoord *chase* geactiveerd wordt, zal een Engelse passieve zin geproduceerd worden (bv., *The truck is chased by the taxi*). De activatie van dezelfde knoop in combinatie met het lemma van het Spaanse werkwoord *golpear* resulteert in de productie van een Spaanse passief (e.g., *El camión es perseguido por el taxi*).
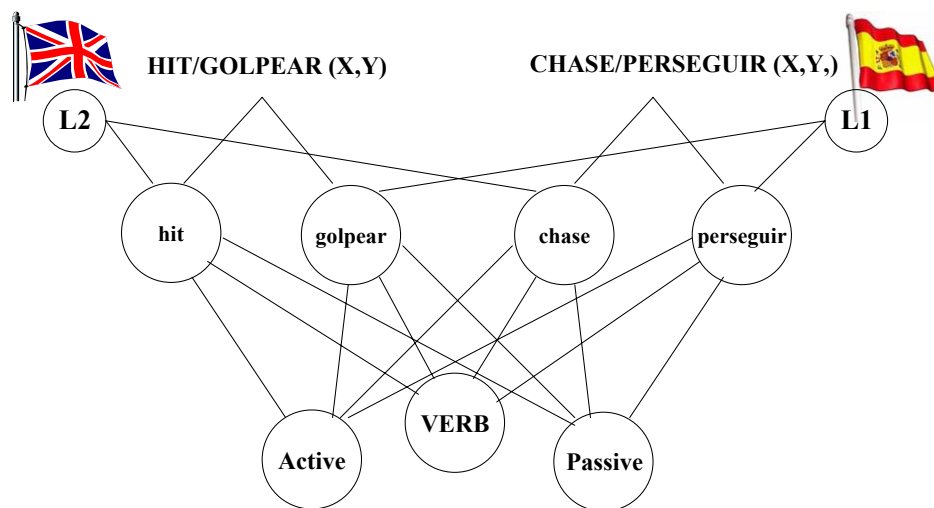
Figuur 1: Het lexicaal-syntatisch model voor tweetalige zinsproductie (Hartsuiker et al., 2004)

Hoewel tal van studies (zie Hartsuiker & Pickering, in press) evidentie boden voor het lexicaal-syntactisch model van Hartsuiker et al. (2004), zijn er hiaten in het model die nog niet ingevuld werden. Ten eerste is het niet duidelijk in welke mate zinsstructuren gelijkaardig moeten zijn vooraleer ze

in aanmerking komen voor een gedeelde representatie. Worden structuren die een verschillende woordvolgorde hebben in beide talen ook gedeeld in het tweetalig productielexicon? Ten tweede werd nog niet onderzocht hoe gedeelde syntactische representaties tot stand komen: Worden nieuwe zinsstructuren uit de tweede taal onmiddellijk gedeeld met gelijkaardige representaties uit de eerste taal of worden ze eerst afzonderlijk opgeslagen voordat ze, in een later stadium, worden samengevoegd met hun tegenhangers in de L1? En tenslotte: wordt de grammaticale structuur van zinnen beïnvloed door de syntactische voorkeur van de werkwoorden die erin gebruikt worden? Dit doctoraatsonderzoek werd uitgevoerd om deze vragen te kunnen beantwoorden.

Zoals vele andere studies die zinsverwerking in tweetaligen bestudeerden (Desmet & Declercq, 2006; Hartsuiker et al., 2004; Loebell & Bock, 2003; Salamoura & Williams, 2006; 2007; Schoonbaert et al., 2007) werd er ook in dit doctoraat gebruik gemaakt van syntactische priming om informatie te verkrijgen over de representaties die actief zijn tijdens het verwerken en produceren van zinnen. Bij syntactische priming vergemakkelijkt het verwerken van een bepaalde uiting (een zin of een zinsdeel) de productie van een andere uiting doordat dezelfde grammaticale structuur gebruikt wordt. Door te onderzoeken tussen welke zinnen priming optreedt, kan achterhaald worden op welke manier syntactische structuren opgeslagen zitten in het geheugen. Aangezien sterkere syntactische priming effecten kunnen verkregen worden als mensen een dialoog voeren, werden alle studies in deze thesis uitgevoerd in een dialoogsetting. In alle experimenten werd de volgende methode gebruikt: een proefpersoon en een pseudo-proefpersoon (in werkelijkheid een medeplichtige van de experimentator) beschrijven afwisselend eenvoudige prentjes aan elkaar. De experimentele prentjes kunnen steeds beschreven worden met twee mogelijke structuren (bijvoorbeeld de zgn. Prepositional Object (PO) datieve structuur, *De kok geeft de schotel aan de kelner*, en de zgn. Double-object (DO) datieve structuur, *De kok geeft de kelner de schotel*). Syntactische priming treedt op als de proefpersoon een bepaalde structuur (bijv. de PO)

significant vaker gebruikte nadat de "medeplichtige" zojuist dezelfde structuur gebruikte dan nadat zij of hij zojuist de andere structuur gebruikte. Als er voor bepaalde structuren cross-linguïstische syntactische priming optreedt (i.e. priming tussen structuren uit verschillende talen), kan er besloten worden dat tijdens de verwerking van die structuren in beide talen dezelfde grammaticale representaties en/of processen actief zijn.

In wat volgt, worden de voornaamste bevindingen van dit doctoraatsonderzoek besproken aan de hand van de drie grote vragen die gesteld werden: Treedt er ook cross-linguïstische priming op tussen zinsstructuren die een verschillende woordvolgorde hebben in beide talen? Hoe komen gedeelde syntactische representaties tot stand? En tenslotte: Wordt de keuze voor een bepaalde zinsstructuur bepaald door de syntactische voorkeur van het hoofdwerkwoord?

DE INVLOED VAN WOORDVOLGORDEVERSCHILLEN OP SYNTACTISCHE PRIMING TUSSEN TALEN

Er werd reeds tussen tal van talen en structuren cross-linguïstische priming gevonden (voor passieven tussen het Spaans en het Engels (Hartsuiker et al., 2004) en tussen het Engels en het Frans (Pickering et al., submitted), voor datieve zinnen tussen het Engels en het Nederlands (Schoonbaert et al., 2007), het Spaans (Meijer & Fox Tree, 2003), het Duits (Loebell & Bock, 2003), het Grieks (Salamoura & Williams, 2007) en het Zweeds (Kantola & Van Gompel, submitted)), wat aangeeft dat tweetaligen gedeelde syntactische representaties hebben voor structuren die gelijkaardig zijn in de talen die ze gebruiken. In de meeste van die studies werden syntactische structuren bestudeerd die identiek zijn in beide talen: De structuren hebben een identieke conceptuele en functionele structuur, ze hebben dezelfde constituentenstructuur en dezelfde woordvolgorde. Bijgevolg kunnen deze studies geen informatie verschaffen over de precieze aard van de representaties die geprimed werden. Om dat te onderzoeken, bestudeerden

wij priming tussen structuren met een verschillende woordvolgorde die dezelfde abstracte zinsstructuur delen (Hoofdstuk 2) en tussen structuren met een verschillende woordvolgorde die funtioneel identiek zijn (Hoofdstuk 3).

In Hoofdstuk 2 bestudeerden we cross-linguïstische syntactische priming voor naamwoordgroepen (AN-structuur: *de rode haai* vs. RC-structuur: *de haai die rood is*) bij Nederlands-Engelse en Nederlands-Duitse tweetaligen. Deze studie toonde aan dat woordvolgordeverschillen een invloed hebben op cross-linguïstische syntactische priming: Cross-linguïstische priming werd wel gevonden tussen het Nederlands en het Duits, talen die dezelfde woordvolgorde hanteren voor beide constructies (*de rode haai / der rote Hai* vs. *de haai die rood is / der hai der rot ist*), maar niet tussen het Nederlands en het Engels, waar de RC-structuur een verschillende woordvolgorde heeft (*de rode haai / the red shark* vs. *de haai die rood is / the shark that is red*). Aangezien er geen priming optrad tussen structuren met dezelfde onderliggende structuur (RCs bestaan in de drie talen uit een substantief dat bepaald wordt door een relatiefzin) wanneer die structuren een verschillende woordvolgorde hadden, concludeerden we dat de abstracte structuur van zinnen en hun woordvolgorde in één en hetzelfde stadium bepaald worden. Structuren met een verschillende woordvolgorde hebben bijgevolg geen gedeelde syntactische representaties in het tweetalige productielexicon.

In Hoodstuk 3 bestudeerden we cross-linguïstische syntactische priming voor transitieve zinnen (actieven en passieven) bij Nederlands-Engelse tweetaligen, om te bepalen of er buiten syntactische representaties ook pre-syntactische representaties kunnen gedeeld worden in het tweetalige geheugen. Nederlandse passieven met een gesplitste werkwoordgroep (*De non wordt door de matroos achtervolgd*) en Engelse passieven waarin het participium meteen volgt op het hulpwerkwoord (*The nun is chased by the sailor*) hebben een verschillende woordvolgorde, maar de zinsdelen hebben in beide zinnen wel dezelfde grammaticale functies: in beide gevallen is de non het subject van de zin; de matroos staat als handelende persoon in een

door-bepaling. Ondanks het verschil in woordvolgorde werd er cross-linguïstische priming gevonden tussen beide structuren, wat aangeeft dat de bepaling van grammaticale functies kan geprimed worden binnen en tussen talen.

DE INVLOED VAN TAALVAARDIGHEID IN L2 OP SYNTACTISCHE PRIMING TUSSEN TALEN

Het lexicaal-syntactisch model van Hartsuiker et al. (2004) voorspelt dat, vanaf het moment dat structuren gedeeld worden in het tweetalige geheugen, priming tussen talen niet beïnvloed wordt door het niveau van taalvaardigheid in L2. Dat 'moment' werd echter nog niet gepreciseerd: Worden nieuwe zinsstructuren in L2 onmiddellijk gedeeld met gelijkaardige structuren in L1 of worden ze aanvankelijk afzonderlijk opgeslagen? Om uit te zoeken welke representaties nieuwe L2 structuren krijgen als ze net geleerd worden, vergeleken we syntactische priming voor Engelse genitieven (*the rose of the boy is blue* vs. *the boy's rose is blue*) voor Nederlands-Engelse tweetaligen met verschillende niveaus van taalvaardigheid in hun tweede taal (Hoofdstuk 4).

In een primingexperiment in het Engels werd syntactische priming gevonden voor vergevorderde tweetaligen en voor tweetaligen met een minder hoog niveau van taalvaardigheid in hun L2, wat erop wijst dat beide groepen abstracte geheugenrepresentaties hebben voor beide vormen van de Engelse genitief. Cross-linguïstische priming tussen Nederlandse (*de roos van de jongen is blauw – de jongen zijn roos is blauw*) en Engelse genitieven (*the rose of the boy is blue* vs. *the boy's rose is blue*) werd echter enkel gevonden voor Nederlands-Engelse tweetaligen met een hoog niveau van taalvaardigheid in het Engels. Deze resultaten wijzen op een invloed van L2 taalvaardigheid op de representatie van zinsstructuren in het tweetalige productielexicon: Aanvankelijk krijgen L2 zinsstructuren afzonderlijke, taalspecifieke representaties in het geheugen. Als na verloop van tijd blijkt

dat de L2 structuur en diens tegenhanger in L1 structureel identiek zijn en op eenzelfde manier gebruikt kunnen worden, worden beide representaties samengevoegd tot één gedeelde syntactische representatie. Het is dus zeker zo dat zinsstructuren, indien mogelijk, gedeeld worden in het tweetalige geheugen. Of er ook daadwerkelijk cross-linguïstische priming optreedt voor die structuren, hangt af van het niveau van taalvaardigheid dat tweetaligen bereikt hebben in hun tweede taal.

DE INVLOED VAN 'VERB BIAS' OP SYNTACTISCHE PRIMING

Lexicaal-syntactische zinsproductiemodellen (Hartsuiker et al. 2004; Pickering & Branigan, 1998; Schoonbaert et al., 2007) voorspellen dat syntactische priming beïnvloed wordt door de herhaling van bepaalde lexicale items: Als de verbindingen tussen de lemmas van naamwoorden en werkwoorden en de combinatieknopen waarmee ze gecombineerd kunnen worden mee geprimed worden (doordat hetzelfde lemma gebruikt wordt in de primezin en de doelzin), kan de voorkeur voor een bepaalde syntactische structuur nog versterkt worden. Deze 'lexicale boost' van priming is meestal van korte duur: Hartsuiker et al. (2008) ontdekten dat dit lexicaal effect verdwijnt als de primezin en de doelzin niet onmiddellijk op elkaar volgen. Aangezien werkwoorden niet altijd even vaak voorkomen met de verschillende syntactische structuren waarmee ze gecombineerd kunnen worden, zou het productiesysteem eigenlijk moeten bijhouden hoe vaak een bepaalde structuur met een bepaald werkwoord gecombineerd wordt. Om na te gaan of taalgebruikers de syntactische voorkeuren van werkwoorden leren en opslaan in hun geheugen, vergeleken we priming effecten veroorzaakt door DO-datieven (*Het meisje geeft de hond een bot*) en PO-datieven (*Het meisje geeft een bot aan de hond*) voor datieve werkwoorden met een verschillende syntactische voorkeur (Hoofdstuk 5).

We ontdekten dat de hoeveelheid DO-priming en PO-priming voor datieve werkwoorden in het Nederlands bepaald wordt door de syntactische

voorkeur van het datieve werkwoord dat gebruikt wordt in de prime: Een PO-prime met een DO-dominant werkwoord (een werkwoord dat in een corpus van geschreven taal vaker voorkomt met een DO dan met een PO, bv.: *aanbieden*) veroorzaakt sterkere priming dan een PO-prime met een neutraal werkwoord (bv.: *tonen*) of een PO-dominant werkwoord (bv.: *verkopen*), omdat de eerste combinatie veel verrassender is dan de andere twee. We beargumenteerden dat dit effect ontstaat doordat taalgebruikers de combinaties van syntactische structuren met bepaalde werkwoorden leren en op basis hiervan syntactische structuren voorspellen voor de werkwoorden die ze horen. Dit lexicaal specifiek leereffect wordt niet voorspeld door de gangbare zinsproductiemodellen (Chang et al., 2006; Pickering & Branigan, 1998); het kan enkel verklaard worden door een impliciet leermodel dat niet alleen de algemene syntactische voorkeur voor syntactische constructies leert, maar ook de voorkeur van aparte lexicale items (Jaeger & Snider, 2007).

BESLUIT

In dit doctoraatsonderzoek werd bijkomende evidentie verkregen voor de hypothese dat syntactische structuren gedeeld kunnen worden in het tweetalige productielexicon. De uitgevoerde studies leidden bovendien tot een verdere specificatie van de representaties die actief zijn tijdens tweetalige zinsproductie en de invloed van specifieke lexicale items op de keuze van deze representaties. Daarmee biedt deze studie een belangrijke bijdrage aan het debat tussen voorstanders van lexicaal-syntactische zinsproductiemodellen (Pickering & Branigan, 1998) en modellen gebaseerd op impliciet leren van abstracte (non-lexicale) regels (Chang, Dell, & Bock, 2006): beide modellen verschillen namelijk in hun assumpties over de representaties die actief zijn tijdens zinsproductie en de betrokkenheid van het lexicon tijdens het formuleren van zinsstructuur. De resultaten van het laatste hoofdstuk tonen aan dat beide modellen mekaar niet noodzakelijk

uitsluiten. Verder onderzoek zal moeten uitwijzen hoe en in welke mate beide modellen met elkaar verzoend kunnen worden.

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APPENDIX 2A

Items for Experiments 1-4 of Chapter 2. On the first line, the RC- and AN-primes are shown in Dutch (these primes were used in Experiments 1, 3, and 4) and on the second line in English (these primes were used in Experiments 2, 3, and 4). On the third line the unrelated and related target pictures are described. In Experiment 4, only the related target pictures were used, and the objects on the unrelated target pictures were used to construct the unrelated prime descriptions.

1.   de platenspeler die rood is/de rode platenspeler
        the record player that is red/the red record player
        red pineapple/red record player
2.   de pan die blauw is/de blauwe pan
        the pan that is blue/the blue pan
        green star/green pan
3.   de hand die geel is/de gele hand
        the hand that is yellow/the yellow hand
        red hat/red hand
4.   de clown die groen is/de groene clown
        the clown that is green/the green clown
        yellow bottle/yellow clown
5.   de muur die geel is/de gele muur
        the wall that is yellow/the yellow wall
        red ax/red wall
6.   de man die geel is/de gele man
        the man that is yellow/the yellow man
        blue owl/blue man
7.   de baby die blauw is/de blauwe baby
        the baby that is blue/the blue baby
        red penguin/red baby
8.   de arm die rood is/de rode arm

the arm that is red/the red arm

yellow comb/yellow arm

9.   de cactus die rood is/de rode cactus

the cactus that is red/the red cactus

green watering can/green cactus

10.   de pizza die rood is/de rode pizza

the pizza that is red/the red pizza

green couch/green pizza

11.   de giraffe die blauw is/de blauwe giraffe

the giraffe that is blue/the blue giraffe

yellow tweezers/yellow giraffe

12.   de wortel die groen is/de groene wortel

the carrot that is green/the green carrot

red kite/red carrot

13.   de heks die rood is/de rode heks

the witch that is red/the red witch

yellow peacock/yellow witch

14.   de zweep die rood is/de rode zweep

the whip that is red/the red whip

yellow train/yellow whip

15.   de ananas die rood is/de rode ananas

the pineapple that is red/the red pineapple

green mushroom/green pineapple

16.   de tank die geel is/de gele tank

the tank that is yellow/the yellow tank

blue scarf/blue tank

17.   de schildpad die rood is/ de rode schildpad

the turtle that is red/the red turtle

yellow hose/yellow turtle

18.   de ring die blauw is/de blauwe ring

the ring that is blue/the blue ring

green flower/green ring

19.   de lamp die rood is/de rode lamp

the lamp that is red/the red lamp

yellow bow/yellow lamp

20. de mixer die groen is/de groene mixer

the mixer that is green/the green mixer

blue wing/blue mixer

21. de bliksem die geel is/de gele bliksem

the lightning that is yellow/the yellow lightning

green strawberry/green lightning

22. de paraplu die rood is/de rode paraplu

the umbrella that is red/the red umbrella

blue telephone/blue umbrella

23. de tent die groen is/de groene tent

the tent that is green/the green tent

yellow spider/yellow tent

24. de riem die geel is/de gele riem

the belt that is yellow/the yellow belt

red boat/red belt

25. de helicopter die blauw is/de blauwe helicopter

the helicopter that is blue/the blue helicopter

green wallet/green helicopter

26. de eskimo die groen is/de groene eskimo

the Eskimo that is green/the green Eskimo

blue painting/blue Eskimo

27. de eekhoorn die geel is/de gele eekhoorn

the squirrel that is yellow/the yellow squirrel

red glove/red squirrel

28. de ezel die rood is/de rode ezel

the donkey that is red/the red donkey

blue car/blue donkey

29. de harp die groen is/de groene harp

the harp that is green/the green harp

red crown/red harp

30. de eend die groen is/de groene eend

the duck that is green/the green duck

blue zipper/blue duck

31.   de haai die geel is/de gele haai

the shark that is yellow/the yellow shark

red pear/red shark

32.   de zebra die rood is/de rode zebra

the zebra that is red/the red zebra

green trumpet/green zebra

33.   de robot die groen is/de groene robot

the robot that is green/the green robot

blue butterfly/blue robot

34.   de schommelstoel die groen is/de groene schommelstoel

the rocking chair that is green/the green rocking chair

yellow mailbox/yellow rockingchair

35.   de piano die rood is/de rode piano

the piano that is red/the red piano

blue medal/blue piano

36.   de doos die groen is/de groene doos

the box that is green/the green box

yellow feather/yellow box

37.   de stoel die blauw is/de blauwe stoel

the chair that is blue/the blue chair

red bicycle/red chair

38.   de barbecue die blauw is/de blauwe barbecue

the barbecue that is blue/the blue barbecue

green lipstick/green barbecue

39.   de spiegel die blauw is/de blauwe spiegel

the mirror that is blue/the blue mirror

red seal/red mirror

40.   de worm die geel is/de gele worm

the worm that is yellow/the yellow worm

blue cake/blue worm

41.   de bus die blauw is/de blauwe bus

the bus that is blue/the blue bus

green arrow/green bus

42. de citroen die groen is/de groene citroen

the lemon that is green/the green lemon

yellow magnet/yellow lemon

43. de wolk die blauw is/de blauwe wolk

the cloud that is blue/the blue cloud

red pliers/red cloud

44. de staart die blauw is/de blauwe staart

the tail that is blue/the blue tail

green lobster/green tail

45. de ladder die blauw is/de blauwe ladder

the ladder that is blue/the blue ladder

green apple/green ladder

46. de boom die geel is/de gele boom

the tree that is yellow/the yellow tree

blue ant/blue tree

47. de schoorsteen die groen is/de groene schoorsteen

the chimney that is green/the green chimney

blue palm tree/blue chimney

48. de steen die geel is/de gele steen

the rock that is yellow/the yellow rock

green pants/green rock

APPENDIX 2B

Items for Experiment 5. On the first line, the related RC and AN primes are shown in Dutch; on the second line, the unrelated RC and AN primes are shown in Dutch; on the third line, the targets are shown in German, followed by their English translation.

1. de platenspeler die geel is/de gele platenspeler [yellow record player]
   de gele ananas/de gele ananas [yellow pineapple]
   der Schallplattenspieler [the record player]

2. de pan die groen is/de groene pan [green pan]
   de ster die groen is/de groene ster [green star]
   die Pfanne [the pan]

3. de hand die rood is/de rode hand [red hand]
   de pet die rood is/de rode pet [red hat]
   die Hand [the hand]

4. de clown die geel is/de gele clown [yellow clown]
   de fles die geel is/de gele fles [yellow bottle]
   der Clown [the clown]

5. de muur die rood is/de rode muur [red wall]
   de bij die rood is/de rode bijl [red axe]
   die Mauer [the wall]

6. de man die blauw is/de blauwe man [blue man]
   de uil die blauw is/de blauwe uil [blue owl]
   der Mann [the man]

7. de baby die rood is/de rode baby [red baby]
   de penguin die rood is/de rode pinguin [red penguin]
   das Baby [the baby]

8. de arm die geel is/de gele arm [yellow arm]
   de kam die geel is/de gele kam [yellow comb]
   der Arm [the arm]

9. de cactus die groen is/de groene cactus [green cactus]
   de gieter die groen is/de groene gieter [green watering can]

der Kaktus [the cactus]

10. de pizza die groen is/de groene pizza [green pizza]

de zetel die groen is/de groene zetel [green couch]

die Pizza [the pizza]

11. de giraffe die geel is/de gele giraffe [yellow giraffe]

de pincet die geel is/de gele pincet [yellow tweezers]

die Giraffe [the giraffe]

12. de wortel die rood is/de rode wortel [red carrot]

de vlieger die rood is/de rode vlieger [red kite]

die Karotte [the carrot]

13. de heks die geel is/de gele heks [yellow witch]

de pauw die geel is/de gele pauw [yellow peacock]

die Hexe [the witch]

14. de zweep die geel is/de gele zweep [yellow whip]

de trein die geel is/de gele trein [yellow train]

die Peitsche [the whip]

15. de ananas die groen is/de groene ananas [green pineapple]

de paddestoel die groen is/de groene paddestoel [green mushroom]

die Ananas [the pineapple]

16. de tank die blauw is/de blauwe tank [blue tank]

de sjaal die blauw is/de blauwe sjaal [blue scarf]

der Panzer [the tank]

17. de schildpad die geel is/ de gele schildpad [yellow turtle]

die tuinslang die geel is/de gele tuinslang [yellow hose]

die Schildkröte [the turtle]

18. de ring die groen is/de groene ring [green ring]

de bloem die groen is/de groene bloem [green flower]

der Ring [the ring]

19. de lamp die geel is/de gele lamp [yellow lamp]

de strik die geel is/de gele strik [yellow bow]

die Lampe [the lamp]

20. de mixer die blauw is/de blauwe mixer [blue mixer]

de vleugel die blauw is/de blauwe vleugel [blue wing]

der Mixer [the mixer]

21.   de bliksem die groen is/de groene bliksem [green lightning]

de aardbei die groen is/de groene aardbei [green strawberry]

der Blitz [the lightning]

22.   de paraplu die blauw is/de blauwe paraplu [blue umbrella]

de telefoon die blauw is/de blauwe telefoon [blue telephone]

der Regenschirm [the umbrella]

23.   de tent die geel is/de gele tent [yellow tent]

de spin die geel is/de gele spin [yellow spider]

das Zelt [the tent]

24.   de riem die rood is/de rode riem [red belt]

de boot die rood is/de rode boot [red boat]

der Guertel [the belt]

25.   de helicopter die groen is/de groene helicopter [green helicopter]

de portefeuille die groen is/de groene portefeuille [green wallet]

der Hubschrauber [the helicopter]

26.   de eskimo die blauw is/de blauwe eskimo [blue Eskimo]

het schilderij dat blauw is/het blauwe schilderij [blue painting]

der Eskimo [the Eskimo]

27.   de eekhoorn die rood is/de rode eekhoorn [red squirrel]

de handschoen die rood is/de rode handschoen [red glove]

das Eichhörnchen [the squirrel]

28.   de ezel die blauw is/de blauwe ezel [blue donkey]

de auto die blauw is/de blauwe auto [blue car]

der Esel [the donkey]

29.   de harp die rood is/de rode harp [red harp]

de kroon die rood is/de rode kroon [red crown]

die Harfe [the harp]

30.   de eend die blauw is/de blauwe eend [blue duck]

de rits die blauw is/de blauwe rits [blue zipper]

die Ente [the duck]

31.   de haai die rood is/de rode haai [red shark]

de peer die rood is/de rode peer [red pear]

der Hai [the shark]

32. de zebra die groen is/de groene zebra [green zebra]

de trompet die groen is/de groene trompet [green trumpet]

das Zebra [the zebra]

33. de robot die blauw is/de blauwe robot [blue robot]

de vlinder die blauw is/de blauwe vlinder [blue butterfly]

der Roboter [the robot]

34. de schommelstoel die geel is/de gele schommelstoel [yellow rocking chair]

de brievenbus die geel is/de gele brievenbus [yellow mailbox]

der Schaukelstuhl [the rocking chair]

35. de piano die blauw is/de blauwe piano [blue piano]

de medaille die blauw is/de blauwe medaille [blue medal]

das Klavier [the piano]

36. de doos die geel is/de gele doos [yellow box]

de veer die geel is/de gele veer [yellow feather]

der Karton [the box]

37. de stoel die rood is/de rode stoel [red chair]

de fiets die rood is/de rode fiets [red bicycle]

der Stuhl [the chair]

38. de barbecue die groen is/de groene barbecue [green barbecue]

de lippenstift die groen is/de groene lippenstift [green lipstick]

der Grill [the barbecue]

39. de spiegel die rood is/de rode spiegel [red mirror]

de zeehond die rood is/de rode zeehond [red seal]

der Spiegel [the mirror]

40. de worm die blauw is/de blauwe worm [blue worm]

de taart die blauw is/de blauwe taart [blue cake]

der Wurm [the worm]

41. de bus die groen is/de groene bus [green bus]

de pijl die groen is/de groene pijl [green arrow]

der Bus [the bus]

42. de citroen die geel is/de gele citroen [yellow lemon]

de magnet die geel is/de gele magneet [yellow magnet]

die Zitrone [the lemon]

43.   de wolk die rood is/de rode wolk [red cloud]
      de tang die rood is/de rode tang [red pliers]
      die Wolke [the cloud]

44.   de staart die groen is/de groene staart [green tail]
      de kreeft die groen is/de groene kreeft [green lobster]
      der Schwanz [the tail]

45.   de ladder die groen is/de groene ladder [green ladder]
      de appel die groen is/de groene appel [green apple]
      die Leiter [the ladder]

46.   de boom die blauw is/de blauwe boom [blue tree]
      de mier die blauw is/de blauwe mier [blue ant]
      der Baum [the tree]

47.   de schoorsteen die blauw is/de blauwe schoorsteen [blue chimney]
      de palmboom die blauw is/de blauwe palmboom [blue palm tree]
      der Schornstein [the chimney]

48.   de steen die groen is/de groene steen [green rock]
      de broek die groen is/de groene broek [green pants]
      der Stein [the rock]

APPENDIX 3A

Prime-target pairs in Experiments 1-3 of Chapter 3. On the first line, the target pictures are described in words (e.g., Item 1 corresponds to Fig. 1). For each target the Dutch prime is given for the active condition (a); the verb-medial passive condition (b); and the baseline condition (c), for Experiment 3. The verb-final passive condition can be constructed by reversing the order of the bracketed expressions. English translations are provided in parentheses. Some baseline items were used for more than one target picture, but never in the same list.

Animate-animate prime-target pairs:

1. sailor chasing boxer
a.　　de politieagent achtervolgt de monnik (the policeman chases the monk)
b.　　de monnik wordt [achtervolgd] [door de politieagent]
　　　(the monk is chased by the policeman)
c.　　boer en matroos (farmer and sailor)

2. pirate chasing boxer
a.　　de politieagent achtervolgt de zwemmer (the policeman chases the swimmer)
b.　　de zwemmer wordt [achtervolgd] [door de politieagent]
　　　(the swimmer is chased by the policeman)
c.　　clown en bal (clown and ball)

3. clown weighing skier
a.　　de dokter weegt de acrobaat (the doctor weighs the acrobat)
b.　　de acrobaat wordt [gewogen] [door de dokter]
　　　(the acrobat is weighed by the doctor)
c.　　dokter en heks (doctor and witch)

4. clown weighing acrobat
a.　　de heks weegt de non (the witch weighs the nun)
b.　　de non wordt [gewogen] [door de heks]
　　　(the nun is weighed by the witch)
c.　　jongen en meisje (boy and girl)

5. pirate chasing skier

a.   de non achtervolgt de bokser (the nun chases the boxer)

b.   de bokser wordt [achtervolgd] [door de non]

        (the boxer is chased by the nun)

c.   gorilla en piraat (gorilla and pirate)

6. judge weighing acrobat

a.   de duiker weegt de matroos (the diver weighs the sailor)

b.   de matroos wordt [gewogen] [door de duiker]

        (the sailor is weighed by the diver)

c.   clown en bal (clown and ball)

7. witch weighing skier

a.   de non weegt de acrobaat (the nun weighs the acrobat)

b.   de acrobaat wordt [gewogen] [door de non]

        (the acrobat is weighed by the nun)

c.   dokter en heks (doctor and witch)

8. judge weighing skier

a.   de politieagent weegt de monnik (the policeman weighs the monk)

b.   de monnik wordt [gewogen] [door de politieagent]

        (the monk is weighed by the policeman)

c.   rechter en vleermuis (judge and bat)

9. Eskimo lifting cricket player

a.   de piraat tilt de duiker op (the pirate lifts the diver)

b.   de duiker wordt [opgetild] [door de piraat]

        (the diver is lifted by the pirate)

c.   clown en bal (clown and ball)

10. diver pulling judge

a.   de cowboy sleept de clown (the cowboy pulls the clown)

b.   de clown wordt [gesleept] [door de cowboy]

        (the clown is pulled by the cowboy)

c.   bus en trein (bus and train)

11. sailor chasing angel

a.   de politieagent achtervolgt de inbreker (the policeman chases the burglar)

b.   de inbreker wordt [achtervolgd] [door de politieagent]

(the burglar is chased by the policeman)

c.   inbreker en draaimolen (burglar and merry-go-round)

12. sailor chasing skier

a.   de non achtervolgt de matroos (the nun chases the sailor)

b.   de matroos wordt [achtervolgd] [door de non]

         (the sailor is chased by the nun)

c.   vogel en matroos (bird and sailor)

Inanimate-animate prime-target pairs

1. bicycle running over man

a.   de taxi rijdt de kleuter aan (the taxi runs over the toddler)

b.   de kleuter wordt [aangereden] [door de taxi]

         (the toddler is run over by the taxi)

c.   monnik en inbreker (monk and burglar)

2. avalanche killing skiers

a.   de rook doodt de man (the smoke kills the man)

b.   de man wordt [gedood] [door de rook]

         (the man is killed by the smoke)

c.   dokter en kat (doctor and cat)

3. truck transporting elephant

a.   het schip vervoert de passagiers (the ship transports the passengers)

b.   de passagiers worden [vervoerd] [door het schip]

         (the passengers are transported by the ship)

c.   boot en hond (boat and dog)

4. arrow hitting bird

a.   de riek raakt de boer (the fork hits the farmer)

b.   de boer wordt [geraakt] [door de riek]

         (the farmer is hit by the fork)

c.   boer en matroos (farmer and sailor)

5. rock hitting boy

a.   de kogel raakt de inbreker (the bullet hits the burglar)

b.   de inbreker wordt [geraakt] [door de kogel]

         (the burglar is hit by the bullet)

c.   monnik en inbreker (monk and burglar)

6. wave hitting swimmer

a.   het water overspoelt de brandweerman (the water hits the fireman)

b.   de brandweerman wordt [overspoeld] [door het water]

(the fireman is hit by the water)

c.   raket en ufo (rocket and UFO)

7. alarm clock waking boy

a.   de trompet wekt de soldaat (the trumpet wakes up the soldier)

b.   de soldaat wordt [gewekt] [door de trompet]

(the soldier is woken by the trumpet)

c.   jongen en meisje (boy and girl)

8. ambulance hitting man

a.   de bus rijdt de fietser aan (the bus runs over the cyclist)

b.   de fietser wordt [aangereden] [door de bus]

(the cyclist is run over by the bus)

c.   bus en trein (bus and train)

9. tank running over soldier

a.   de auto overrijdt de hond (the car runs over the dog)

b.   de hond wordt [overreden] [door de auto]

(the dog is run over by the car)

c.   bus en trein (bus and train)

10. ball hitting boy

a.   de pijl raakt de danseres (the arrow hits the dancer)

b.   de danseres wordt [geraakt] [door de pijl]

(the dancer is hit by the arrow)

c.   danseres en pijl (dancer and arrow)

11. lightning hitting gulfplayer

a.   de pijl treft de monnik (the arrow hits the monk)

b.   de monnik wordt [getroffen] [door de pijl]

(the monk is hit by the arrow)

c.   dokter en heks (doctor and witch)

12. hurricane lifting girl

a.   de piraat tilt de cricketspeler op (the pirate lifts the cricket player)

b.   de cricketspeler wordt [opgetild] [door de piraat]

(the cricket player is lifted by the pirate)

c.   piraat en zeppelin (pirate and blimp)

Inanimate–inanimate prime-target pairs:

1. tank hitting car

a.   de raket raakt de ufo (the missile hits the UFO)

b.   de ufo wordt [geraakt] [door de raket]

(the UFO is hit by the missile)

c.   de ufo en de raket (the UFO and the missile)

2. torpedo destroying ship

a.   de kraan vernietigt het gebouw (the crane destroys the building)

b.   het gebouw wordt [vernietigd] [door de kraan]

(the building is destroyed by the crane)

c.   monnik en inbreker (monk and burglar)

3. train running over bus

a.   de vrachtwagen rijdt de auto aan (the truck runs over the car)

b.   de auto wordt [aangereden] [door de vrachtwagen]

(the car is run over by the truck)

c.   gorilla en piraat (gorilla and pirate)

4. truck pulling car

a.   de boot sleept de vrachtwagen (the boat pulls the truck)

b.   de vrachtwagen wordt [gesleept] [door de boot]

(the truck is pulled by the boat)

c.   rechter en vleermuis (judge and bat)

5. missile destroying plane

a.   de kanonskogel vernietigt het schip (the cannonball destroys the ship)

b.   het schip wordt [vernietigd] [door de kanonskogel]

(the ship is destroyed by the cannonball)

c.   postbode en danseres (mailman and dancer)

6. lightning striking church

a.   de kogel treft het kopje (the bullet hits the cup)

b.   het kopje wordt [getroffen] [door de kogel]

(the cup is hit by the bullet)

c.   gorilla en piraat (gorilla and pirate)

7. arrow hitting apple

a.   de bliksem treft de schuur (lightning strikes the barn)

b.   de schuur wordt [getroffen] [door de bliksem]

(the barn is struck by lightning)

c.   jongen en meisje (boy and girl)

8. avalanche destroying house

a.   de brand vernietigt het flatgebouw (the fire destroys the building)

b.   het flatgebouw wordt [vernietigd] [door de brand]

(the building is destroyed by the fire)

c.   piraat en zeppelin (pirate and blimp)

9. magnet attracting coin

a.   het zwarte gat trekt het ruimteschip aan (the black hole attracts the spaceship)

b.   het ruimteschip wordt [aangetrokken] [door het zwarte gat]

(the spaceship is attracted by the black hole)

c.   rechter en vleermuis (judge and bat)

10. hurricane demolishing barn

a.   de brand verwoest het graan (the fire destroys the corn)

b.   het graan wordt [verwoest] [door de brand]

(the corn is destroyed by the fire)

c.   postbode en danseres (mailman and dancer)

11. bullet breaking bottle

a.   het geluid breekt het kopje (the sound breaks the cup)

b.   het kopje wordt [gebroken] [door het geluid]

(the cup is broken by the sound)

c.   piraat en zeppelin (pirate and blimp)

12. ball knocking over cans

a.   de bowlingbal stoot de kegels omver (the bowling ball knocks over the pins)

b.   de kegels worden [omvergestoten] [door de bowlingbal]

(the pins are knocked over by the bowling ball)

c.   dokter en kat (doctor and cat)

APPENDIX 3B

Extra stimuli used in Experiment 3 of Chapter 3.

Animate-animate prime-target pairs:

1. cowboy pulling judge
a.   de takelwagen sleept de bus (the towing car pulls the bus)
b.   de bus wordt [gesleept] [door de takelwagen]
        (the bus is pulled by the towing car)
c.   postbode en wolf (mailman and wolf)

2. diver pulling clown
a.   de rechter sleept de olifant (the judge pulls the elephant)
b.   de olifant wordt [gesleept] [door de rechter]
        (the elephant is pulled by the judge)
c.   rechter en olifant (judge and elephant)

3. clown killing sailor
a.   het meisje doodt de monnik (the girl kills the monk)
b.   de monnik wordt [gedood] [door het meisje]
        (the monk is killed by the girl)
c.   monnik en meisje (monk and girl)

4. diver killing doctor
a.   de boer doodt de ballerina (the farmer kills the dancer)
b.   de ballerina wordt [gedood] [door de boer]
        (the dancer is killed by the farmer)
c.   ballerina en boer (dancer and farmer)

Inanimate-animate prime-target pairs:

1. shoe hitting bird
a.   de schoen raakt de vogel (the shoe hits the bird)
b.   de vogel wordt [geraakt] [door de schoen]
        (the bird is hit by the shoe)
c.   hond en acrobaat (dog and acrobat)

2. arrow hitting knight

a.   de harpoen raakt de duiker (the harpoon hits the diver)

b.   de duiker wordt [geraakt] [door de harpoen]

        (the diver is hit by the harpoon)

c.   dokter en duiker (doctor and diver)

3. flyswatter killing fly

a.   de bom doodt de jongen (the bomb kills the boy)

b.   de jongen wordt [gedood] [door de bom]

        (the boy is killed by the bomb)

c.   jongen en soldaat (boy and soldier)

4. lightning striking gorilla

a.   de baseballbat raakt de politieagent (the baseball bat hits the policeman)

b.   de politieagent wordt [geraakt] [door de baseballbat]

        (the policeman is hit by the baseball bat)

c.   politieagent en verpleegster (policeman and nurse)

Inanimate-inanimate prime-target pairs

1. bicycle pulling chart

a.   de takelwagen sleept de bus (the towing car pulls the bus)

b.   de bus wordt [gesleept] [door de vrachtwagen]

        (the bus is pulled by the towing car)

c.   draak en matroos (dragon and sailor)

2. rock breaking window

a.   de bal breekt de vaas (the ball breaks the vase)

b.   de vaas wordt [gebroken] [door de bal]

        (the vase is broken by the ball)

c.   zeppelin en spook (blimp and ghost)

3. bat hitting ball

a.   de bom raakt de soldaat (the bomb hits the soldier)

b.   de soldaat wordt [geraakt] [door de bom]

        (the soldier is hit by the bomb)

c.   bokser en clown (boxer and clown)

4. fire destroying house

a.   de storm vernietigt het beeld (the storm destroys the statue)

b.   het beeld wordt [vernietigd] [door de storm]

(the statue is destroyed by the storm)

c.   vogel en gorilla (bird and gorilla)

APPENDIX 4A

Prime-target pairs in Experiments 1 & 2 of Chapter 4. On the first line, the target pictures are described. The possessor of the object and the object that is owned are mentioned first, the 'context person' is mentioned between brackets. In the following lines, the *s*-genitive and the *of*-genitive are given in English (a) and Dutch (b). In each prime sentence the nouns that were used in the same-object condition and the different object condition are mentioned.

1. wizard with a blue apple (+ witch)
1a.   [The girl's apple/ice cream] – [The apple/ice cream of the girl] is blue.
1b.   [Het meisje haar appel/ijsje] – [De appel/het ijsje van het meisje] is blauw.
2. nurse with a blue bucket (+ wizard)
2a.   [The girl's bucket/rabbit] – [The bucket/rabbit of the girl] is blue.
2b.   [Het meisje haar emmer/konijn] – [De emmer/het konijn van het meisje] is blauw.
3. nurse with a yellow banjo (+ nun)
3a.   [The pirate's banjo/mirror] – [The banjo/mirror of the pirate] is yellow.
3b.   [De piraat zijn banjo/spiegel] – [De banjo/spiegel van de piraat] is geel.
4. nun with a yellow flashlight (+ boy)
4a.   [The pirate's flashlight/bullet] – [The flashlight/bullet of the pirate] is yellow.
4b.   [De piraat zijn zaklamp/kogel] – [De zaklamp/kogel van de piraat] is geel.
5. wizard with a red beard (+ pirate)
5a.   [The boy's beard/corn] – [The beard/corn of the boy] is red.
5b.   [De jongen zijn baard/maïs] – [De baard/maïs van de jongen] is rood.
6. witch with a red duck (+ wizard)
6a.   [The boy's duck/cheese] – [The duck/cheese of the boy] is red.
6b.   [De jongen zijn eend/kaas] – [De eend/kaas van de jongen] is rood.
7. witch with a blue bear (+ priest)
7a.   [The nun's bear/brush] – [The bear/brush of the nun] is blue.
7b.   [De non haar beer/kwast] – [De beer/kwast van de non] is blauw.

8. boy with a blue doll (+ priest)

8a.   [The wizard's doll/rope] – [The doll/rope of the wizard] is blue.

8b.   [De tovenaar zijn pop/touw] – [De pop/het touw van de tovenaar] is blauw.

9. pirate with a green barbecue (+ nurse)

9a.   [The witch's barbecue/clothespin] – [The barbecue/clothespin of the witch] is green.

9b.   [De heks haar barbecue/wasknijper] – [De barbecue/wasknijper van de heks] is groen.

10. girl with a red pineapple (+ witch)

10a.   [The nurse's pineapple/umbrella] – [The pineapple/umbrella of the nurse] is red.

10b.   [De ananas/paraplu van de zuster] – [De ananas/paraplu van de zuster] is rood.

11. nurse with a red bomb (+ girl)

11a.   [The wizard's bomb/cake] – [The bomb/cake of the wizard] is red.

11b.   [De tovenaar zijn bom/taart] – [De bom/taart van de tovenaar] is rood.

12. nurse with a green belt (+ pirate)

12a.   [The boy's belt/stone] – [The belt/stone of the boy] is green.

12b.   [De jongen zijn riem/steen] – [De riem/steen van de jongen] is groen.

13. girl with a green fork (+ priest)

13a.   [The nurse's fork/tree] – [The fork/tree of the nurse] is green.

13b.   [De zuster haar vork/boom] – [De vork/boom van de zuster] is groen.

14. priest with a yellow scarf (+ nun)

14a.   [The boy's scarf/saw] – [The scarf/saw of the boy] is yellow.

14b.   [De jongen zijn sjaal/zaag] – [De sjaal/zaag van de jongen] is geel.

15. pirate with a red giraffe (+ wizard)

15a.   [The priest's giraffe/pillow] – [The giraffe/pillow of the priest] is red.

15b.   [De priester zijn giraf/kussen] – [De giraf/het kussen van de priester] is rood.

16. boy with a yellow jump rope (+ pirate)

16a.   [The priest's jump rope/trophy] – [The jump rope/trophy of the priest] is yellow.

16b.   [De priester zijn springtouw/beker] – [Het springtouw/ de beker van de priester] is geel.

17. nurse with a blue glass (+ boy)

17a.   [The witch's glass/axe] – [The glass/axe of the witch] is blue.

17b.   [De heks haar glas/bijl] – [Het glas/de bijl van de heks] is blauw.

18. nurse with a green bag (+ witch)

18a.   [The girl's bag/screw] – [The bag/screw of the girl] is green.

18b.   [Het meisje haar zak/schroef] – [De zak/schroef van het meisje] is groen.

19. wizard with a green guitar (+ priest)

19a.   [The boy's guitar/donkey] – [The guitar/donkey of the boy] is green.

19b.   [De jongen zijn gitaar/ezel] – [De gitaar/ezel van de jongen] is groen.

20. priest with a blue turtle (+ girl)

20a.   [The witch's turtle/airplane] – [The airplane/turtle of the witch] is blue.

20b.   [De heks haar schilpad/vliegtuig] – [De schilpad/het vliegtuig van de heks]
        is blauw.

21. priest with a yellow hand (+ witch)

21a.   [The wizard's hand/box] – [The hand/box of the wizard] is yellow.

21b.   [De tovenaar zijn hand/doos] – [De hand/doos van de tovenaar] is geel.

22. witch with a green eye (+ nun)

22a.   [The girl's eye/snail] – [The eye/snail of the girl] is green.

22b.   [Het meisje haar oog/slak] – [Het oog/de slak van het meisje] is groen.

23. girl with a blue heart (+ boy)

23a.   [The nun's heart/ant] – [The heart/ant of the nun] is blue.

23b.   [De non haar hart/mier] – [Het hart/de mier van de non] is blauw.

24. pirate with a yellow church (+ girl)

24a.   [The nurse's church/sock]- [The church/sock of the nurse] is yellow.

24b.   [De zuster haar kerk/sok] – [De kerk/sok van de zuster] is geel.

25. girl with a green ladder (+ boy)

25a.   [The priest's ladder/snowman] – [The ladder/snowman of the priest] is green.

25b.   [De priester zijn ladder/sneeuwpop] – [De ladder/sneeuwpop van de priester]
        is groen.

26. boy with a blue lemon (+ nurse)

26a.   [The nun's lemon/kettle] – [The lemon/kettle of the nun] is blue.

26b.   [De non haar citroen/ketel] – [De citroen/ketel van de non] is blauw.

27. wizard with a red nest (+ nun)

27a.   [The nurse's nest/bone] – [The nest/bone of the nurse] is red.

27b.   [De zuster haar nest/bot] – [Het nest/bot van de zuster] is rood.

28. pirate with a red cage (+ girl)

28a.   [The nun's cage/dog] – [The cage/dog of the nun] is red.

28b.   [De non haar kooi/hond] – [De kooi/hond van de non] is rood.

29. pirate with a yellow pan (+ boy)

29a.   [The witch's pan/coat] – [The pan/coat of witch] is yellow.

29b.   [De heks haar pan/jas] – [De pan/jas van de heks] is geel.

30. priest with a green knife (+ nurse)

30a.   [The nurse's knife/tooth] – [The knife/tooth of the nurse] is green.

30b.   [De zuster haar mes/tand] – [Het mes/de tand van de zuster] is groen.

31. nurse with a red robot (+ nun)

31a.   [The wizard's robot/suitcase] – [The robot/suitcase of the wizard] is red.

31b.   [De tovenaar zijn robot/koffer] – [De robot/koffer van de tovenaar] is rood.

32. nurse with a yellow paintbrush (+ girl)

32a.   [The witch's paintbrush/turkey] – [The paintbrush/turkey of witch] is yellow.

32b.   [De heks haar penseel/kalkoen] – [De penseel/kalkoen van de heks] is geel.

33. priest with a blue rose (+ wizard)

33a.   [The boy's rose/hook] – [The rose/hook of the boy] is blue.

33b.   [De jongen zijn roos/haak] – [De roos/haak van de jongen] is blauw.

34. boy with a blue shirt (+ girl)

34a.   [The pirate's shirt/thumb] – [The shirt/thumb of the pirate] is blue.

34b.   [De piraat zijn hemd/duim] – [Het hemd/de duim van de piraat] is blauw.

35. priest with a yellow sheep (+ nurse)

35a.   [The girl's sheep/chair] – [The sheep/chair of the girl] is yellow.

35b.   [Het meisje haar schaap/stoel] – [Het schaap/de stoel van het meisje] is geel.

36. girl with a red fly (+ boy)

36a.   [The nun's fly/whip] – [The fly/whip of the nun] is red.

36b.   [De non haar vlieg/zweep] – [De vlieg/zweep van de non] is rood.

37. witch with a red shoe (+ girl)

37a.   [The nurse's shoe/deer] – [The shoe/deer of the nurse] is red.

37b.   [De zuster haar schoen/hert] – [De schoen/het hert van de zuster] is rood.

38. witch with a yellow egg (+ pirate)

38a.   [The nurse's egg/horse] – [The egg/horse of the nurse] is yellow.

38b.   [De zuster haar ei/paard] – [Het ei/paard van de zuster] is geel.

39. pirate with a blue skateboard (+ priest)

39a.   [The nun's skateboard/bottle] – [The skateboard/bottle of the nun] is blue.

39b.   [De non haar skatebord/papfles] – [Het skatebord/de papfles van de non] is blauw.

40. nun with a green palmtree (+ pirate)

40a.   [The priest's palmtree/table] – [The palmtree/table of the priest] is green.

40b.   [De priester zijn palmboom/tafel] – [De palmboom/tafel van de priester] is groen.

41. boy with a yellow thermos (+ witch)

41a.   [The girl's thermos/carrot] – [The thermos/carrot of the girl] is yellow.

41b.   [Het meisje haar thermos/wortel] – [De thermos/wortel van het meisje] is geel.

42. nun with a blue gift (+ priest)

42a.   [The wizard's present/closet] – [The present/closet of the wizard] is blue.

42b.   [De tovenaar zijn cadeau/kleerkast] – [Het cadeau/de kleerkast van de tovenaar] is blauw.

43. nun with a yellow yoyo (+ girl)

43a.   [The pirate's yoyo/towel] – [The yoyo/towel of the pirate] is yellow.

43b.   [De piraat zijn jojo/handdoek] – [De jojo/handdoek van de piraat] is geel.

44. boy with a red bandaid (+ wizard)

44a.   [The girl's bandaid/pencil] – [The bandaid/pencil of the girl] is red.

44b.   [Het meisje haar pleister/potlood] – [De pleister/het potlood van het meisje] is rood.

45. pirate with a green zebra (+ nurse)

45a.   [The wizard's zebra/trashcan] – [The zebra/trashcan of the wizard] is green.

45b.   [De tovenaar zijn zebra/vuilbak] – [De zebra/vuilbak van de tovenaar] is groen.

46. witch with a green hippo (+ wizard)

46a.   [The priest's hippo/necklace] – [The hippo/necklace of the priest] is green.

46b.   [De priester zijn nijlpaard/ketting] – [Het nijlpaard/de ketting van de priester] is groen.

47. boy with a red pipe (+ wizard)

47a.   [The priest's pipe/lock] – [The pipe/lock of the priest] is red.

47b.   [De priester zijn pijp/slot] – [De pijp/het slot van de priester] is rood.

48. pirate with a yellow snake (+ priest)

48a.   [The nun's snake/tear] – [The snake/tear of the nun] is yellow.

48b.   [De non haar slang/traan] – [De slang/traan van de non] is geel.

APPENDIX 5A

Distribution of responses for all verbs used in Experiment 1 and alternations biases (% DO-datives) based on the frequency data from the Colleman corpus and on the data obtained in Experiment 1. The verb groups (PO-biased, Neutral, DO-biased) were determined on the basis of the alternation biases obtained in Experiment 1.

Verb	DO-dative	PO-dative	Shifted dative	Other	Alternation bias Colleman	Pretest	Group
doorgeven	0	42	1	9	10,0%	0,0%	
schrijven	0	10	14	29	15,9%	0,0%	
uitreiken	0	38	0	14	25,8%	0,0%	PO-BIASED
verklappen	0	19	0	35	57,1%	0,0%	VERBS
verkopen	1	40	0	11	12,9%	2,4%	
voorstellen	1	33	1	19	51,7%	2,9%	
voorlezen	3	22	0	29	72,7%	12,0%	
geven	6	42	0	5	70,1%	12,5%	
schenken	6	41	0	6	37,7%	12,8%	NEUTRAL
tonen	5	31	0	16	62,7%	13,9%	VERBS
overhandigen	7	34	0	10	35,0%	17,1%	
voorleggen	6	29	4	15	25,4%	17,1%	
teruggeven	7	24	3	16	42,1%	22,6%	
meegeven	13	20	3	15	77,4%	39,4%	
betalen	4	5	0	44	40,0%	44,4%	DO-BIASED
laten zien	17	20	8	7	74,4%	45,9%	VERBS
bezorgen	24	18	0	8	88,5%	57,1%	
aanbieden	27	14	3	9	74,1%	65,9%	
AVERAGE	7,06	26,78	2,06	16,50	48,5%	20,3%	

APPENDIX 5B

Experimental items used in Experiment 2 of Chapter 5. The (a) and (b) lines indicate the prime conditions: (a) was used in the DO- and PO- conditions; (b) was used in the baseline condition (English translations are given between square brackets). The prime sentences for the PO-conditions can be derived by replacing the slash by the preposition *aan* (to) in (a). For the DO-primes, the order of the two noun phrases separated by the slash needs to be reversed. The constituents of the target pictures are indicated in (c) in the order agent-beneficiary-theme-verb.

1a.   De kok biedt een pistool/de dokter aan [The cook offers a gun/the doctor]

1b.   De kok scheldt de dokter uit [The cook scolds the doctor]

1c.   Policeman-painter-book-offer

2a.   De piraat biedt een boek/de dokter aan [The pirate offers a book/the doctor]

2b.   De piraat scheldt de dokter uit [The pirate scolds the doctor]

2c.   Cook-swimmer-jug-offer

3a.   De politie-agent biedt een banaan/de dokter aan [The policeman offers a banana/the dancer]

3b.   De politieagent scheldt de danseres uit [The policeman scolds the dancer]

3c.   Nun-soldier-book-offer

4a.   De dokter betaalt 30 euro/de schilder [The doctor pays 30 euros/the painter]

4b.   De dokter kietelt de schilder [The doctor tickles the painter]

4c.   Dancer-cook-30 euros-pay

5a.   De serveerster betaalt losgeld/de monnik [The waitress pays a ransom/the monk]

5b.   De serveerster kietelt de monnik [The waitress tickles the monk]

5c.   Sailor-painter-30 euros-pay

6a.   De soldaat betaalt zwijggeld/de leraar [The soldier pays hush money/the teacher]

6b.   De soldaat kietelt de leraar [The soldier tickles the teacher]

6c.	Clown-dancer-30 euros-pay
7a.	De bokser bezorgt een appel/de bokser [The boxer delivers an apple/the doctor]
7b.	De bokser achtervolgt de dokter [The boxer chases the doctor]
7c.	Monk-cowboy-hat-deliver
8a.	De kok bezorgt een hoed/de matroos [The cook delivers a hat/the sailor]
8b.	De kok achtervolgt de matroos [The cook chases the sailor]
8c.	Dancer-soldier-jug-deliver
9a.	De non bezorgt een kan/de matroos [The nun delivers a jug/the sailor]
9b.	De non achtervolgt de matroos [The nun chases the sailor]
9c.	Painter-cowboy-ball-deliver
10a.	De danseres geeft een kan/de matroos door [The dancer passes a jug/the sailor]
10b.	De danseres slaat de zwemmer [The dancer hits the swimmer]
10c.	Cook-clown-ball-pass
11a.	De cowboy geeft een kopje/de zwemmer door [The cowboy passes a cup/the swimmer]
11b.	De cowboy slaat de zwemmer [The cowboy hits the swimmer]
11c.	Pirate-sailor-cake-pass
12a.	De inbreker geeft een kopje/de bokser door [The burglar passes a cup/the boxer]
12b.	De inbreker slaat de bokser [The burglar hits the boxer]
12c.	Cowboy-monk-apple-pass
13a.	De serveerster geeft een hoed/de inbreker [The waitress give a hat/the burglar]
13b.	De serveerster schopt de inbreker [The waitress kicks the burglar]
13c.	Pirate-clown-book-give
14a.	De danseres geeft een kopje aan de dokter [The dancer gives a cup/the doctor]
14b.	De danseres schopt de dokter [The dancer kicks the doctor]
14c.	Cowboy-boxer-pie-give
15a.	De gevangene geeft een taart/de danseres [The prisoner gives a pie/the dancer]

15b.   De gevangene schopt de danseres [The prisoner kicks the dancer]

15c.   Cook-monk-apple-give

16a.   De kok toont een appel/de zwemmer [The cook shows an apple/the swimmer]

16b.   De kok doodt de zwemmer [The cook kills the swimmer]

16c.   Nun-doctor-pie-show

17a.   De piraat toont een pistool/de clown [The pirate shows a gun/the clown]

17b.   De piraat doodt de clown [The pirate kills the clown]

17c.   Cowboy-swimmer-hat-show

18a.   De dokter toont een hoed/de non [The doctor shows a hat/the nun]

18b.   De dokter doodt de non [The doctor kills the nun]

18c.   Pirate-boxer-jug-show

19a.   De leraar geeft een boek/de danseres mee [The teacher gives a book/the dancer]

19b.   De leraar achtervolgt de danseres [The teacher chases the dancer]

19c.   Prisoner-clown-hat-give [issue]

20a.   De non geeft een appel/de matroos mee [The nun gives an apple/the sailor]

20b.   De non achtervolgt de matroos [The nun chases the sailor]

20c.   Cook-swimmer-pie-give [issue]

21a.   De leraar geeft een banaan/de soldaat mee [The teacher gives a banana/the soldier]

21b.   De leraar achtervolgt de soldaat [The teacher chases the soldier]

21c.   Dancer-cowboy-apple-give [issue]

22a.   De soldaat overhandigt een pistool/de soldaat [The pirate hands a gun/the soldier]

22b.   De piraat slaat de soldaat [The pirate hits the soldier]

22c.   Cook-boxer-gun-hand

23a.   De kok overhandigt een kopje/de danseres [The cook hands a cup/the waitress]

23b.   De kok slaat de danseres [The cook hits the dancer]

23c.   Pirate-swimmer-ball-hand

24a.   De schilder overhandigt een bal/de bokser [The painter hands a ball/the boxer]

24b.	De schilder slaat de bokser [The painter hits the boxer]
24c.	Nun-doctor-pie-hand
25a.	De serveerster schenkt een taart/de dokter [The waitress donates a pie/the doctor]
25b.	De serveerster achtervolgt de dokter [The waitress chases the doctor]
25c.	Cowboy-burglar-banana-donate
26a.	De non schenkt een appel/de soldaat [The nun donates an apple/the soldier]
26b.	De non achtervolgt de soldaat [The nun chases the soldier]
26c.	Pirate-clown-gun-donate
27a.	De kok schenkt een pistool/de bokser [The cook donates a gun/the boxer]
27b.	De kok achtervolgt de bokser [The cook chases the boxer]
27c.	Monk-doctor-book-donate
28a.	De jongen schrijft een postkaart/de bokser [The boy writes a postcard/the boxer]
28b.	De jongen kust de bokser [The boy kisses the boxer]
28c.	Man-nun-letter-write
29a.	De man schrijft een ode/zijn geliefde [The man writes an ode/his girlfriend]
29b.	De man kust zijn geliefde [The man kisses his girlfriend]
29c.	Boy-girl-love letter-write
30a.	De non schrijft een brief/de bokser [The nun writes a letter/the boxer]
30b.	De non kust de bokser [The nun kisses the boxer]
30c.	Boy-parents-letter-write
31a.	De non geeft een boek/de soldaat terug [The nun gives back a book/the soldier]
31b.	De non schopt de soldaat [The nun kicks the soldier]
31c.	Cook-boxer-gun-give back
32a.	De politie-agent geeft een bal/de bokser terug [The policeman gives back a ball/the boxer]
32b.	De danseres schopt de bokser [The dancer kicks the boxer]
32c.	Pirate-burglar-pie-give back
33a.	De danseres geeft een banaan/de dokter terug [The dancer gives back a banana/the doctor]
33b.	De danseres schopt de dokter [The dancer kicks the doctor]

33c.   Nun-swimmer-hat-give back

34a.   De schilder toont een bal/de cowboy [The painter shows a ball/the cowboy]

34b.   De schilder scheldt de cowboy uit [The painter scolds the cowboy]

34c.   Nun-boxer-banana-show

35a.   De inbreker toont een pistool/de cowboy [The burglar shows a gun/the cowboy]

35b.   De inbreker scheldt de cowboy uit [The burglar scolds the cowboy]

35c.   Prisoner-swimmer-gun-show

36a.   De politie-agent toont een kan/de monnik [The policeman shows a jug/the monk]

36b.   De politie-agent scheldt de monnik uit [The policeman scolds the monk]

36c.   Dancer-waitress-jug-show

37a.   De non reikt een medaille/de clown uit [The nun awards a medal/the clown]

37b.   De non kust de clown [The nun kisses the clown]

37c.   Pirate-boxer-trophy-award

38a.   De piraat reikt een diploma/de bokser uit [The pirate awards a diploma/the boxer]

38b.   De piraat kust de bokser [The pirate kisses the boxer]

38c.   Cook-swimmer-medal-award

39a.   De kok reikt een medaille/de soldaat uit [The cook awards a medal/the soldier]

39b.   De kok kust de soldaat [The cook kisses the soldier]

39c.   Teacher-clown-diploma-award

40a.   De non verklapt een geheim/de danseres [The nun gives away a secret/the dancer]

40b.   De non achtervolgt de danseres [The nun chases the dancer]

40c.   Businessman-man-secret-give away

41a.   De serveerster verklapt een geheim/de monnik [The waitress gives away the solution/the monk]

41b.   De serveerster achtervolgt de monnik [The waitress chases the monk]

41c.   Lawyer-construction worker-secret-give away

42a.   De politie-agent verklapt het recept/de bokser [The policeman gives away

the recipe/the boxer]

42b.   De politie-agent achtervolgt de bokser [The policeman chases the boxer]

42c.   Nun-boxer-secret-give away

43a.   De piraat verkoopt een appel/de soldaat [The pirate sells an apple/the soldier]

43b.   De piraat sleept de soldaat [The pirate pulls the soldier]

43c.   Prisoner-sailor-pie-sell

44a.   De non verkoopt een kan/de danseres [The nun sells a jug/the dancer]

44b.   De non sleept de danseres [The nun pulls the dancer]

44c.   Painter-swimmer-book-sell

45a.   De piraat verkoopt een hoed/de inbreker [The pirate sells a hat/the burglar]

45b.   De piraat sleept de inbreker [The pirate pulls the burglar]

45c.   Monk-dancer-jug-sell

46a.   De cowboy legt een schatkaart /de zwemmer voor [The cowboy presents a treasure map/the swimmer]

46b.   De cowboy slaat de zwemmer [The cowboy hits the swimmer]

46c.   Burglar-boxer-contract-present

47a.   De leraar legt een oplossing/de monnik voor [The teacher presents a solution/the monk]

47b.   De leraar slaat de monnik [The teacher hits the monk]

47c.   Slave-pharaoh-plans-present

48a.   De inbreker legt een contract/de politie-agent voor [The burglar presents a contract/the policeman]

48b.   De inbreker slaat de politie-agent [The burglar hits the policeman]

48c.   Architect-contractor-plans-present

49a.   De vrouw leest een boek/het meisje voor [The woman reads a book/the girl]

49b.   De vrouw schopt het meisje [The woman kicks the girl]

49c.   Newpaperboy-boxer-paper-read

50a.   De serveerster leest een verhaal/de inbreker voor [The waitress reads a story/the burglar]

50b.   De serveerster schopt de inbreker [The waitress kicks the burglar]

50c.   Frog-little frog-book-read

51a.   De krantenjongen leest een grap/de non voor [The newspaperboy reads a joke/the nun]

51b.   De krantenjongen schopt de non [The newspaperboy kicks the nun]

51c.   Teacher-children-fairytale-read

52a.   De serveerster stelt de clown/de monnik voor [The waitress presents the clown/the monk]

52b.   De serveerster achtervolgt de monnik [The waitress chases the monk]

52c.   Painter-burglar-boxer-present

53a.   De non stelt de bokser/dedokter voor [The nun presents the boxer/the doctor]

53b.   De non achtervolgt de bokser [The nun chases the boxer]

53c.   Cowboy-soldier-dancer-present

54a.   De politie-agent stelt de non/de bokser voor [The policeman presents the nun/the boxer]

54b.   De politie-agent achtervolgt de bokser [The policeman chases the boxer]

54c.   Waitress-swimmer-clown-present

APPENDIX 5C

Experimental items used in Experiment 3 of Chapter 5. The (a) and (b) lines indicate the prime conditions: (a) was used in the DO- and PO- conditions; (b) was used in the baseline condition (English translations are given between square brackets). The prime sentences for the PO-conditions can be derived by replacing the slash by the preposition *aan* (to) in (a). For the DO-primes, the order of the two noun phrases separated by the slash needs to be reversed. The constituents of the target pictures are indicated in (c) in the order agent-beneficiary-theme-verb.

1a.   De politie-agent biedt een boek/de schilder aan [The policeman offers a
        book/the painter]
1b.   De politie-agent schopt de schilder [The policeman kicks the painter]
1c.   Dancer-cook-30 euros-pay
2a.   De monnik bezorgt een hoed/de cowboy [The monk delivers a hat/the
        comboy]
2b.   De monnik achtervolgt de cowboy [The monk chases the cowboy]
2c.   Sailor-painter-25 euros-pay
3a.   De kok geeft een bal/de non door [The cook passes a bal/the nun]
3b.   De kok kietelt de clown [The cook tickles the clown]
3c.   Clown-dancer-60 euros-pay
4a.   De serveerster geeft een tas/de inbreker [The waitress gives a cup/the
        burglar]
4b.   De serveerster slaat de inbreker [The waitress hits the burglar]
4c.   Clown-painter-50 euros-pay
5a.   De non laat een taart/de dokter zien [The nun shows a pie/the doctor]
5b.   De non bijt de dokter [The nun bites the doctor]
5c.   Soldier-teacher-10 euros-pay
6a.   De ballerina geeft een appel/de cowboy mee [The dancer issues an
        apple/the sailor]
6b.   De ballerina doodt de cowboy [The dancer kills the cowboy]

6c.	Swimmer-boxer-20 euros-pay
7a.	De non overhandigt een taart/de zwemmer [The nun hands a pie/the swimmer]
7b.	De non kust de zwemmer [The nun kisses the swimmer]
7c.	Monk-burglar-100 euros-pay
8a.	De non schrijft een brief/de bokser [The nun writes a letter/the boxer]
8b.	De non kust de bokser [The nun kisses the boxer]
8c.	Dancer-teacher-60 euros-pay
9a.	De piraat reikt een beker/de bokser uit [The pirate awards a trophy/the boxer]
9b.	De piraat schopt de bokser [The pirate kicks the boxer]
9c.	Sailor-dancer-10 euros-pay
10a.	De gevangene verkoopt een taart/de matroos [The prisoner sells a pie/the sailor]
10b.	De gevangene scheldt de matroos uit [The prisoner scolds the sailor]
10c.	Soldier-boxer-25 euros-pay
11a.	De werkman legt zijn plannen/de non voor [The worker presents his plans/the nun]
11b.	De werkman volgt de non [The worker follows the nun]
11c.	Swimmer-cook-100 euros-pay
12a.	De serveerster leest een verhaal/de inbreker voor [The waitress reads a story/the burglar]
12b.	De serveerster schopt de inbreker [The waitress kicks the burglar]
12c.	Monk-painter-30 euros-pay
13a.	De kok biedt een kan/de zwemmer aan [The cook offers a jug/the swimmer]
13b.	De kok scheldt de zwemmer uit [The cook scolds the swimmer]
13c.	Cowboy-burglar-banana-donate
14a.	De ballerina bezorgt een taart/de soldaat [The dancer delivers a pie/the soldier]
14b.	De ballerina sleept de soldaat [The dancer pulls the soldier]
14c.	Pirate-clown-gun-donate
15a.	De cowboy geeft een boek/de zwemmer door [The cowboy passes a

book/the swimmer]

15b.   De cowboy slaat de zwemmer [The cowboy hits the swimmer]

15c.   Monk-doctor-book-donate

16a.   De cowboy geeft een taart/de bokser [The cowboy gives a pie/the boxer]

16b.   De cowboy kietelt de bokser [The cowboy tickles the boxer]

16c.   Painter-soldier-apple-donate

17a.   De cowboy laat een hoed/de zwemmer zien [The cowboy shows a hat/the swimmer]

17b.   De cowboy slaat de zwemmer [The cowboy hits the swimmer]

17c.   Cook-boxer-gun-donate

18a.   De matroos geeft een banaan/de monnik mee [The sailor issues a banana/the monk]

18b.   De matroos achtervolgt de monnik [The sailor chases the monk]

18c.   Nun-soldier-book-donate

19a.   De schilder overhandigt een banana/de soldaat [The painter hands a banana/the soldier]

19b.   De schilder slaat de soldaat [The painter hits the soldier]

19c.   Pirate-doctor-banana-donate

20a.   De jongen schrijft een brief/de non [The boy writes a letter/the nun]

20b.   De jongen doodt de non [The boy kills the nun]

20c.   Cowboy-doctor-apple-donate

21a.   De leraar reikt een diploma/de clown uit [The teacher awards a diploma/the clown]

21b.   De leraar volgt de clown [The teacher chases the clown]

21c.   Cook-sailor-hat-donate

22a.   De dokter verkoopt een boek/de zwemmer [The doctor sells a book/the swimmer]

22b.   De dokter slaat de zwemmer [The doctor hits the swimmer]

22c.   Painter-soldier-apple-donate

23a.   De leraar legt een oplossing/de monnik voor [The teacher presents a solution/the monk]

23b.   De leraar slaat de monnik [The teacher hits the monk]

23c.   Burglar-cowboy-banana-donate

24a.	De krantenjongen leest een krant/de bokser voor [The newspaper boy reads a newspaper/the boxer]
24b.	De krantenjongen achtervolgt de bokser [The newspaper boy chases the boxer]
24c.	Monk-clown-pie-donate
25a.	De piraat biedt een banana/de bokser aan [The pirate offers a banana/the boxer]
25b.	De piraat kietelt de bokser [The pirate tickles the boxer]
25c.	Monk-nun-jug-return
26a.	De non bezorgt een appel/de soldaat [The nun delivers an apple/the soldier]
26b.	De non volgt de soldaat [The nun follows the soldier]
26c.	Pirate-burglar-pie-return
27a.	De serveerster geeft een pistool/de bokser door [The waitress passes a gun/the boxer]
27b.	De serveerster bijt de bokser [The waitress bites the boxer]
27c.	Nun-swimmer-hat-return
28a.	De kok geeft een appel/de monnik [The cook gives an apple/the monk]
28b.	De kok achtervolgt de monnik [The cook chases the monk]
28c.	Burglar-boxer-cup-return
29a.	De piraat laat een kan/de clown zien [The pirate shows a jug/the clown]
29b.	De piraat sleept de clown [The pirate pulls the cown]
29c.	Dancer-boxer-banana-return
30a.	De piraat geeft een boek/de matroos mee [The pirate issues a book/the sailor]
30b.	De piraat achtervolgt de matroos [The pirate chases the sailor]
30c.	Burglar-nun-hat-return
31a.	De kok overhandigt een pistool/de zwemmer [The cook hands a gun/the swimmer]
31b.	De kok sleept de zwemmer [The cook pulls the swimmer]
31c.	Dancer-doctor-cup-return
32a.	De jongen schrijft een brief/zijn vriendin [The boy writes a letter/his girlfriend]
32b.	De jongen kust zijn vriendin [The boy kisses his girlfriend]

32c.   Cook-clown-ball-return

33a.   De kok reikt een medaille/de ballerina uit [The cook awards a medal/the dancer]

33b.   De kok slaat de ballerina [The cook hits the dancer]

33c.   Pirate-swimmer-ball-return

34a.   De piraat verkoopt een kan/de soldaat [The pirate sells a jug/the soldier]

34b.   De piraat sleept de soldaat [The pirate pulls the soldier]

34c.   Cook-burglar-jug-return

35a.   De slaaf legt een bouwplan/de farao voor [The slave presents a building plan/the pharaoh]

35b.   De slaaf kietelt de farao [The slave tickles the pharaoh]

35c.   Teacher-dancer-book-return

36a.   De juf leest een verhaaltje/de kleuters voor [The teacher reads a story/the pre-schoolers]

36b.   De juf kietelt de kleuters [The teacher tickles the pre-schoolers]

36c.   Cowboy-monk-apple-return

37a.   De politie-agent biedt een pistool/de ballerina aan [The policeman offers a gun/the dancer]

37b.   De politie-agent scheldt de ballerina uit [The policeman scolds the dancer]

37c.   Nun-boxer-banana-show

38a.   De schilder bezorgt een bal/de cowboy [The painter delivers a ball/the cowboy]

38b.   De schilder schopt de cowboy [The painter kicks the cowboy]

38c.   Prisoner-swimmer-gun-show

39a.   De cowboy geeft een appel/de matroos door [The cowboy passes an apple/the sailor]

39b.   De cowboy achtervolgt de matroos [The cowboy chases the sailor]

39c.   Dancer-waitress-jug-show

40a.   De dokter geeft een tas/de non [The doctor gives a cup/the nun]

40b.   De dokter schopt de non [The doctor kicks the nun]

40c.   Painter-cowboy-ball-show

41a.   De kok laat een pistool/de zwemmer zien [The cook shows a gun/the swimmer]

41b.   De kok doodt de zwemmer [The cook kills the swimmer]

41c.   Nun-doctor-pie-show

42a.   De kok geeft een taart/de clown mee [The cook issues a pie/the clown]

42b.   De kok sleept de clown [The cook pulls the clown]

42c.   Cook-swimmer-pie-show

43a.   De kok overhandigt een tas/de ballerina [The cook hands a cup/the dancer]

43b.   De kok kust de ballerina [The cook kisses the dancer]

43c.   Pirate-monk-book-show

44a.   De bokser schrijft een brief/zijn ouders [The boxer writes a letter/his
        parents]

44b.   De bokser slaat zijn ouders [The boxer hits his parents]

44c.   Burglar-doctor-pie-show

45a.   De non reikt een beker/de clown uit [The nun awards a trophy/the clown]

45b.   De non kust de clown [The nun kisses the clown]

45c.   Waitress-sailor-gun-show

46a.   De inbreker verkoopt een tas/de ballerina [The burglar sells a cup/the
        dancer]

46b.   De inbreker doodt de ballerina [The burglar kills the dancer]

46c.   Monk-pirate-banana-show

47a.   De inbreker legt een contract/de bokser voor [The burglar presents a
        contract/the boxer]

47b.   De inbreker sleept de bokser [The burglar pulls the boxer]

47c.   Prisoner-clown-hat-show

48a.   De krantenjongen leest een boek/de monnik voor [The newspaper boy
        reads a book/the monk]

48b.   De krantenjongen scheldt de monnik uit [The newspaper boy scolds the
        monk]

48c.   Prisoner-pirate-pie-show