From language-specific to shared syntactic representations: The influence of second language proficiency on syntactic sharing in bilinguals

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Studies on cross-linguistic syntactic priming suggest that bilinguals can share syntactic representations across languages (e.g., Hartsuiker, Pickering, & Veltkamp, 2004). But how are these representations established in late learners of a second language? Specifically, are representations of syntactic structures in a second language (L2) immediately collapsed with similar structures of the first language (L1), or are they initially represented separately? In order to investigate this, we primed the use of English genitives with Dutch (Experiment 1) and English (Experiment 2) genitives (e.g., het hemd van de jongen/the shirt of the boy vs. de jongen zijn hemd/the boy’s shirt) in late Dutch–English bilinguals with varying levels of proficiency in English (their L2). The head nouns of prime and target constructions either had the same meaning (hemd/shirt – shirt) or a different meaning (duim/thumb – shirt), in order to test whether the use of both genitives was generalized across nouns. Experiment 1 found stronger between-language priming for more than less proficient bilinguals in both conditions, thus suggesting a shift from language-specific to shared syntactic representations. Experiment 2 suggests that these early, language-specific syntactic representations might be item-specific: Less proficient bilinguals showed much weaker priming when the heads of prime and target constructions had different meanings than when they were repeated.

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1. Introduction

Psycholinguistic 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? A number of studies showing cross-linguistic syntactic influences in bilinguals (Bernolet, Hartsuiker, & Pickering, 2007; Desmet & Declercq, 2006; Kantola & Van Gompel, 2011; Loebell & Bock, 2003; Salamoura & Williams, 2006; Salamoura & Williams, 2007; Schoonbaert, Hartsuiker, & Pickering, 2007) support an integrated account in which syntactic and pre-syntactic representations (Bernolet, Hartsuiker, & Pickering, 2009) can be shared in bilingual memory (Hartsuiker et al., 2004). But how are these shared representations established in late learners of a non-native language (L2)? In particular, are the representations of new L2 structures immediately collapsed with the representations of equivalent structures in the native language (L1) or do late bilinguals start with separate L1 and L2 representations before moving 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 syntactic 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). A few behavioral studies suggest that the integration of languages is
influenced by second language proficiency. For instance, Van Hell and Dijkstra (2002) found that L1 words were recognized faster by Dutch–English–French trilinguals when these words were L1–L3 cognates, though only if the participants’ proficiency in the L3 (French) was sufficiently high. Prior, MacWhinney, and Kroll (2007) found that low proficient Spanish–English and English–Spanish bilinguals produced more low-probability translations of categorically ambiguous words (e.g. dress, which can be both a noun and a verb) than high proficient bilinguals, when translating into their L2. Additionally, several neuroimaging and ERP studies have shown influences of L2 proficiency on the overlap between brain areas recruited for lexical, morphological, and syntactic processing in L1 and L2, with highly proficient bilinguals showing native-like patterns for L2 processing, and low proficient bilinguals showing very different patterns for both languages (see Van Hell & Tokowicz, 2010, for a review of ERP-studies and Van Heuven and Dijkstra (2010), for a review of neuro-imaging data). Taken together, the results of these studies suggest that the processes and representations engaged in bilingual language processing may differ according to L2 proficiency, with more integration occurring for high- than low-proficient bilinguals.

The current study investigates whether syntactic integration likewise depends on L2 proficiency. Hence, we investigated between and within-language syntactic priming in the sentence production of bilinguals with varying proficiencies in their L2. Hartsuiker et al. (2004) proposed a lexical-syntactic model for bilingual sentence production in which syntactic information is shared between languages as much as possible. In this model, bilinguals have a single integrated lexicon for both languages. 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 shared categorical and combinatorial nodes capturing syntactic information. For example, the lemmas for the Spanish verb golpear and its translation hit are connected to a shared categorical node that indicates their grammatical category (i.e. verb) and a combinatorial node indicating that both verbs can combine with two noun phrases to form a sentence in the active voice. Because the same combinatorial nodes are accessed during the processing of structures with shared representations, 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.

Hartsuiker et al. (2004) provided support for this model by using syntactic priming. They had Spanish–English bilinguals describe cards to each other in a dialogue game (Branigan, Pickering, & Cleland, 2000). Participants first heard a prime description in their L1 (Spanish) and then described a subsequent picture using their L2 (English). The experiment showed cross-linguistic syntactic priming: Spanish–English bilinguals produced English passive sentences more often following a Spanish passive than following a Spanish active. Hartsuiker et al. thus concluded that Spanish–English bilinguals use the same syntactic rules when producing Spanish or English passives and activate a shared passive node. Bernolet et al. (2009) suggested that priming between passives originates from shared representations at two different levels of production, the conceptual level and the constituent structure level: Dutch passives prime the use of English passives with a different word order, because they use the same binding between emphasis and thematic roles at the conceptual level. However, these results do not change the core assumption of Hartsuiker et al.’s model, namely that bilinguals share

Note: Each lemma node (e.g., hit, golpear) is connected to a conceptual node (HIT (X, Y)), a category node (Verb), combinatorial nodes (Active and Passive), and a language node (indicated with British or Spanish flag).

Fig. 1. Example of lexical entries for “to chase” and “to hit” in Hartsuiker et al.’s (2004) integrated model of bilingual language representation.
processes and representations used during syntactic processing in both their languages as much as possible. Several studies, using different constructions and language pairs, have shown cross-linguistic syntactic priming, and provide support for Hartsuiker et al.'s (2004) model (see Hartsuiker & Pickering, 2008). Schoonbaert et al. (2007) showed that, like within-language priming (Pickering & Branigan, 1998), syntactic priming between languages is boosted if the heads of the prime and target constructions have the same meaning. They tested priming for datives in Dutch–English bilinguals in all four possible 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 had a different meaning or the same meaning in prime and target. In the latter case, stronger priming was obtained within a language than between languages, because the lexical boost of syntactic priming, that was caused by repeating the same verb in prime and target (e.g., give–give), was much larger than the translation equivalence boost that was obtained when translation equivalent verbs (e.g., geven – give) were repeated. When the verb differed (e.g., tonen [show] – give), however, significant between-language priming still occurred (see also Cai, Pickering, Yan, & Branigan, 2011). This does not only suggest that the same syntactic node was accessed during within-language 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.

1.1. The establishment of bilingual representations of syntax

But how do speakers establish shared representations for structures that are similar in their L1 and their L2? The bilinguals who participated in the abovementioned studies were all unbalanced bilinguals (i.e. they learned their native language and their second language consecutively). When they learned their L2, the syntax of their L1 was already well established. In order to investigate how these late bilinguals learn, produce, and represent syntactic structures of the L2, we therefore examined the influence of L2 proficiency on the strength of syntactic priming between the L1 and the L2 of bilinguals, as well as on the strength of syntactic priming within their L2.

Much current research in L1 language acquisition focuses on the extent to which children's language uses item-based schemas rather than abstract general knowledge about a construction (e.g., Fisher, 2002; Tomasello, 2000). It has been 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 quite conservative in their use of novel verbs (Tomasello, 2000). Proponents of usage-based theories of language acquisition (Bybee, 2006; Tomasello, 2005) therefore suggest that the acquisition of L1 syntax is characterized by a shift from concrete, item-based linguistic schemas to more abstract adult-like representations.

Recently, many studies on the acquisition of native syntax have used syntactic priming to investigate the level of abstraction of syntactic representations in children. In a study by Savage, Lieven, Theakston, and Tomasello (2003) 3-, 4- and 6-year-old children were primed to produce active and passive sentences. Whereas 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 (i.e. when there was lexical overlap between prime and target), suggesting that, early on in the development of L1 syntax, children indeed lack abstract syntactic representations. In turn, however, these data are inconsistent with several other studies showing abstract syntactic priming in children younger than 6 (Bencini & Valian, 2008; Branigan, McLean & Jones, 2005; Huttenlocher, Vasilyeva, & Shimpi, 2004; Messenger, Branigan, & McLean, 2011; Shimp, Gámez, Huttenlocher, & Vasilyeva, 2007) and with a recent study indicating that young children actually show stronger abstract and weaker lexically mediated syntactic priming than older children and adults (Rowland, Chang, Ambridge, Pine, & Lieven, 2012). In any case, syntactic priming studies on the acquisition of L1 syntax have shown that syntactic priming is a valid tool to investigate the development and the degree of abstraction of syntactic representations. Furthermore, these studies have shown that priming can help language learners to produce syntactic structures they might not yet produce spontaneously.

As we already mentioned, the acquisition of L2 syntax by late bilinguals might differ from the acquisition of L1 syntax because the L2 learners already know the syntax of another language. The occurrence of between-language syntactic priming for structures that are syntactically similar in a bilingual's two languages suggests that, eventually, bilinguals access shared syntactic representations when comprehending and producing structures that are sufficiently similar in their L1 and their L2 (see Hartsuiker & Pickering, 2008 and above). So what happens if during L2 acquisition an L2 syntactic structure is encountered that is similar to a structure that is used in the L1? One possibility is that bilinguals make an immediate decision about whether an L2 construction should be treated as the same as an existing L1 construction. Consequently, if a new L2 structure is encountered that is sufficiently similar to its L1 counterpart, the existing representation for this structure is immediately accessed when the new L2 structure is first processed. In terms of Hartsuiker et al.'s (2004) model, the combinatorial node representing the structure becomes linked to the L2 lemmas that are encountered in combination with this structure; in time, the node will then be linked to all L1 and L2 lemmas it can be used with. MacWhinney's (1997) Competition Model for second language acquisition represents this ‘optimistic’ view on the acquisition of L2 syntax, which goes from maximal sharing to sharing of that which is similar enough in both languages. According to MacWhinney, L2 learners will initially attempt to comprehend and produce the L2 structure by transferring grammatical rules from the L1. Only if the L2 structure turns out to be different, a new syntactic representation is built up based on the information about the L2 provided by the input.

Alternatively, the processor might treat all new L2 constructions as separate constructions, so that they have their own nodes. It would then assess whether to treat
these constructions as equivalent to an existing L1 construction (i.e., to collapse the nodes). From a learner’s point of view, this alternative will probably lead to fewer errors: 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 few 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 the Dutch *Het meisje geeft de hond een been*, but cannot determine from this one exemplar whether the form of this dative 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, connecting them to the verbs that they have learned can be used with them. If they eventually decide (on the basis of much exposure) that the new L2 structure and its equivalent L1 structure can be used in exactly the same way, they will treat the construction as shared between both languages and all verbs pertaining to these languages. In terms of Hartsuiker et al.’s (2004) account, the ‘new’ combinatorial node disappears and the existing node representing the L1 structure is used during syntactic processing in both languages.

Note that this latter scenario is compatible with the bilingual version of Ullman’s (2001) declarative/procedural model of the mental lexicon. According to Ullman, late bilinguals rely on declarative memory for grammatical processing in the L2 by storing complete syntactic constructions in the mental lexicon. Under influence of practice, late bilinguals become more native-like in terms of syntactic processing and start to use procedural memory for grammatical computations in L2. Although Ullman does not specify whether or not the same grammatical procedures can be used in L1 and L2, the declarative/procedural model predicts that syntactic processing becomes more similar in L1 and L2 as proficiency increases.

To date, only one study used syntactic priming to investigate effects of L2 proficiency on the representation of L2 syntactic structures. Kim and McDonough (2008) investigated the extent to which L2 learners benefit from verb repetition when learning L2 syntax. They obtained within-language syntactic priming for English passive sentences in a group of Korean learners of English and a lexical boost (i.e. stronger priming in the repeated verb condition). The proportion of English passives and the priming effects increased together with the participants’ proficiency. Furthermore, while low proficiency learners hardly produced any passives when they had to use a different verb than the one used in the prime sentence, they showed the largest boost to priming in repeated verb conditions, indicating that they benefited more from verb repetition than middle and high proficiency learners. The results of this preliminary study, which was designed to test L2 teaching methods rather than the development of L2 syntactic representations, thus suggest that L2 syntactic representations develop from concrete, item-based representations into more abstract representations, mirroring what has been found in a number of studies on L1 acquisition (e.g., Savage et al., 2003). As this study focused on the learning of L2 passives, rather than on differences/similarities between Korean and English passives, it tested within-language priming in L2, instead of priming between L1 and L2. Hence, it cannot tell us whether and when these representations are shared with the existing L1 representations.

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 following Dutch and English primes in Dutch–English bilinguals with varying levels of L2 proficiency.

Genitives are similar but not identical in Dutch and English. In both languages, a genitive noun phrase can be formed by 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 languages have an S-genitive that is formed by attaching a possessive morpheme (-s’/’s in Dutch, ’s’/’s’/’s’ in English) to the possessor. In English, this form can be used for all nouns and names (though it is preferred for animate, short possessors; Rosenbach, 2005). In Dutch, however, this form is limited to proper names (Anna’s bike, Anna’s fiets), and common nouns that can be used to address someone (e.g., vaders fiets [father’s bike]). Furthermore, the possessive morpheme is omitted when the noun already ends in a sibilant (Cas’ fiets [Cas’s bike], Bush’ beleid [Bush’s policy]).

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 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, but, unlike the Dutch sibilant S-genitive, it can be used for all animate entities. More importantly, this form is not identical to its English equivalent: Because a possessive pronoun is used instead of a bound morpheme, the Dutch construction involves an extra word. Additionally, the possessive
pronoun has to agree in gender and number with the possessor it refers to, whereas in English the same morpheme is used for all nouns.

In a recent syntactic priming study with Dutch–English bilinguals (which only tested between-language priming between constructions with related head nouns), we found that Dutch S-genitives with a full pronoun primed the use of English S-genitives (Bernolet, Hartsuiker & Pickering, 2012). This suggests that Dutch–English bilinguals use shared syntactic representations when processing Dutch and English S-genitives, despite the slight differences in their morphosyntactic realization. Because of these differences in the realization of Dutch and English S-genitives, however, it might take L2 learners longer to realize that their syntactic representations can be collapsed, compared to when both forms are identical. As the English S-genitive is a more complex structure than the of-genitive, L2 learners might be hesitant to use it before they have determined whether or not it is subject to the same restrictions as its counterpart in Dutch. Hence, Dutch–English bilinguals at different levels of L2 proficiency might display different patterns of within- and between-language priming for genitives.

Consider the possibility that L2 learners initially tend to represent all new L2 constructions separately from L1 constructions, whether or not there are any differences between the constructions. If so, English genitives would initially receive separate representations (Fig. 2a). If similar constructions are later collapsed into a single representation (Fig. 2b), between-language priming will occur for more proficient bilinguals but not (or to a lesser extent) for less proficient ones. Alternatively, L2 learners may immediately represent L1 and L2 constructions together, and would thus access the existing combinatorial nodes to process the L2 construction. If so, between-language priming will occur for all Dutch–English bilinguals, irrespective of their level of L2 proficiency.

Furthermore, if L2 syntactic acquisition, like syntactic acquisition in L1, is characterized by a shift from item-based to more abstract representations (as suggested by Kim & McDonough, 2008), L2 proficiency may not only determine whether or not syntactic structures are shared yet, 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 nouns that have already been encountered with this structure. Therefore we investigate syntactic priming for genitives both in different meaning conditions, in which prime and target constructions contain unrelated head nouns, and in same meaning 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 a different 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 translation equivalent nouns in the same meaning conditions (cf. Schoonbaert et al., 2007). In the absence of an abstract representation for English S-genitives, however, priming might still occur in the same meaning conditions because item-based representations of this structure are repeated.

We now report two experiments that compared syntactic priming for English genitives (of-genitive vs. S-genitive) for less proficient and more proficient late bilinguals with L1 Dutch and L2 English. In Experiment 1, we primed the choice of an English S-genitive or of-genitive by using Dutch pronominal S-genitives and of-genitives. In Experiment 2, we investigated within-language priming with English genitive primes. The participants in the experiments were fairly proficient late Dutch–English bilinguals.

Note: Figure 2a (left hand side) represents a model in which L2 structures initially receive separate representations; Figure 2b (right hand side) represents a model in which the representations of Dutch (Flemish) and English genitives are shared from the outset.

Fig. 2. Hypothetical models for the representation of Dutch (Flemish) and English genitives in Dutch–English late bilinguals in an early stage of acquisition.
who all received 5 years of formal English instruction at high school and live in an L1 dominant environment. Note that English is not the first L2 that Flemish students learn at school. From the age of 10, Flemish students learn French at school, as this is Belgium’s second official language. English lessons start at the age of 13, and because English is not an official language in Belgium, it is studied less elaborately than French. However, as English is very common in daily life and in popular media, most Flemish children come in contact with informal English quite regularly and before they start to learn it at school. The S-genitive is taught at the ages of 13–15. Although all of our participants had a good basic knowledge of English grammar and vocabulary, their L2 proficiency varied depending on how good they are at learning languages and on the amount of exposure to English on holidays abroad, during higher education or by practicing hobbies (e.g., reading in English, watching English movies, listening to English music). In the analyses of both experiments, the participants’ mean self-rated L2 proficiency was added as a continuous covariate (see also Elston-Güttler & Friederici, 2005; Elston-Güttler, Paulmann, & Kotz, 2005), in order to investigate the influence of L2 proficiency on the strength of priming (see Methods). Although self-ratings are a subjective measure of L2 proficiency, a recent study by Lemhöfer and Broersma (2012) showed that, for Dutch–English bilinguals, the mean of their self-ratings of writing, reading, and speaking proficiency in L2 predicted L2 vocabulary knowledge. In fact, for the Dutch–English bilinguals in their study, the correlations between this predictor and L2 vocabulary were only slightly weaker than the correlations between L2 vocabulary and the results of the lexical test of L2 knowledge (LexTALE) developed by the same authors.

In order to make the of- and S-genitives similarly acceptable in our experiments, the names of the possessors in prime and target were always animate and short (Rosenbach, 2005). Furthermore, the possessors had to be named using common nouns (e.g. nun, pirate) in order to justify the use of Dutch pronominal S-genitives with full pronouns in Experiment 1. We had a same and a different meaning condition in both experiments: In the same meaning condition, the possessed object was repeated between prime and target. Consequently, in the between-language priming experiment (Experiment 1), the head nouns of prime and target were translation equivalents; in the within-language priming experiment (Experiment 2), the head noun was repeated between prime and target in the related condition. In the different meaning condition, the head nouns of prime and target constructions were unrelated.

In both experiments, we made use of the confederate scripting technique (Branigan et al., 2000), in which the participant and a confederate of the experimenter take turns to describe pictures and match pictures to these descriptions. Instead of spontaneous picture descriptions, the confederate produced scripted prime sentences. We used this kind of dialogue setting to investigate syntactic priming, because effects obtained with this technique are often larger than in the original paradigm used by Bock (1986), in which participants do not interact with a dialogue partner.

2. Experiment 1: Priming between Dutch (L1) and English (L2) genitives

2.1. Method

2.1.1. Participants

Twenty-four undergraduate students from Ghent University (19 females and 5 males, age range 18–23 years) took part. All participants had L1 Dutch and L2 English. They reported to have at least 5 years of experience with English as their second language (mean of 11 years). A female undergraduate student with L1 Dutch and L2 English acted as confederate.

The participants of this experiment and Experiment 2 rated their L1 and 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, after the experiment (see Table 1 for the means of the self-ratings of L1 and L2 proficiency for Experiments 1 and 2). The participants’ mean self-rated L2 proficiency was calculated from these four numbers and was added to the analyses as a covariate. The participants also indicated on which occasions they had used their L2 most intensively (e.g., reading, conversation, during traveling, ...).

2.1.2. Materials and design

We constructed two different sets of 96 pictures for the participant: a verification set and a description set. All pictures showed black-and-white line drawings of 2 figurines (chosen equally often from a boy, a girl, a nurse, a wizard, a pirate, a nun, a priest, and a witch) in frontal view. The participant’s description set contained 48 critical description pictures and 48 filler pictures. On the critical pictures (i.e. the pictures used to elicit genitive structures), the figurines were both depicted with the same object. One object was always colored (in yellow, red, blue, or green); the rest of the picture was in black and white (see Fig. 3). This way, participants had to use genitive constructions in order to refer to the colored object and to name its color in an unambiguous manner (e.g. the egg of the witch/the witch’s egg is yellow). In the filler pictures, no objects were shown. Instead, one figure was completely colored (thus allowing descriptions such as the nun is green). These filler pictures were added to bring variation in the description and the matching tasks and to divert participants’ attention away from the critical pictures. The four colors were used equally often for the different objects and figures in the pictures. The participant’s response set contained 48 pictures that were comparable to the experimental pictures (i.e. two figurines depicted with the same object, one of which was colored) and 48 filler pictures (one colored figure and one figure in monochrome).

Half of the pictures in the participant’s verification set matched the descriptions in the confederate’s description set (50% “yes” responses), which contained 48 Dutch prime sentences (see Appendix A) and 48 filler sentences. A critical item was defined as the pairing of a confederate’s
prime sentence with the participant’s description of a target picture. The prime descriptions could have an S-genitive structure (2a and 3a) or an of-genitive structure (2b and 3b). In the same meaning conditions, the noun that had to be used to describe the upcoming target object (the target noun) and the noun that was used in the prime description (the prime noun) were translation equivalents with varying phonological overlap (e.g., ei and egg in 2a–b). In the different meaning conditions, the head noun of the prime sentence was semantically and phonologically unrelated to the head noun of the target sentence (e.g., paard [horse] – egg in 3a–b). Thus we had a 2 (Prime Structure) × 2 (Meaning overlap) design; both factors were manipulated within items and participants. The prime nouns and their different meaning controls had the same number of syllables and were matched for prosody. The objects in the prime and target descriptions had the same colour; the owner of the object was different in prime and target descriptions. The remaining 44 sentences in the confederate’s description set were filler sentences that could be used to describe the filler items in the participant’s description set. The confederate’s description set contained 88 further pictures that were similar to the pictures in the participant’s description set.

2.1.3. Procedure

The experimenter treated the participant and the confederate in the same way (so that the confederate appeared to be a real participant). 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. They sat opposite each other, with the PCs between them. Neither of them could see what appeared on their partner’s screen. First, they were familiarized with the materials in a study session, in which all objects and characters that appeared on the pictures in the experiment were presented together with their Dutch and English 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 S-genitives or of-genitives was avoided). The experimenter then assigned a target language to the participant (English [L2]) and the confederate (Dutch [L1]), making it look as if these

<table>
<thead>
<tr>
<th>Language</th>
<th>Skill</th>
<th>Experiment 1 (L1–L2)</th>
<th>Experiment 2 (L2–L2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 (Dutch)</td>
<td>Writing</td>
<td>6.08 (0.83)</td>
<td>6.17 (0.48)</td>
</tr>
<tr>
<td></td>
<td>Speaking</td>
<td>6.38 (0.77)</td>
<td>6.29 (0.69)</td>
</tr>
<tr>
<td></td>
<td>Reading</td>
<td>6.42 (0.72)</td>
<td>6.46 (0.78)</td>
</tr>
<tr>
<td></td>
<td>General proficiency</td>
<td>6.17 (0.56)</td>
<td>6.29 (0.55)</td>
</tr>
<tr>
<td>L2 (English)</td>
<td>Writing</td>
<td>5.25 (0.79)</td>
<td>4.88 (1.30)</td>
</tr>
<tr>
<td></td>
<td>Speaking</td>
<td>5.46 (0.72)</td>
<td>5.13 (1.08)</td>
</tr>
<tr>
<td></td>
<td>Reading</td>
<td>5.83 (0.76)</td>
<td>5.63 (0.97)</td>
</tr>
<tr>
<td></td>
<td>General proficiency</td>
<td>5.54 (0.59)</td>
<td>5.21 (1.06)</td>
</tr>
</tbody>
</table>

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

We constructed four counterbalanced pseudo-random lists so that each target object was preceded by the same object in two lists (same meaning conditions) and by an unrelated control object (different meaning conditions) in the other two lists. Both in the related head noun and the unrelated head noun conditions the target picture was preceded by an S-genitive in two lists and by an of-genitive in the other two lists. For each of the four lists, the trials were presented in the same pseudo-random order. There were four fillers at the beginning of each list; critical trials were separated by 0 to 6 filler trials. Each participant was presented with one of these four lists.

![Fig. 3. Example of a target picture.](image-url)
languages were randomly assigned. 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; it ran simultaneously on the PCs used by the confederate and the participant.

During the experiment, the confederate pretended to be describing pictures. Instead, she read prime sentences from the screen of her computer. Both the participant and the confederate responded to each other’s picture descriptions by pressing ‘1’ if they judged the description to match their own picture or ‘2’ otherwise. When the participants responded, their verification picture was automatically replaced by a description picture for the next trial. When the confederate responded, her verification picture was replaced by a prime sentence for the next trial. In both cases, the response button set off a beep, indicating that the dialogue partner had to press ‘3’ in order to proceed to the next verification picture. Sessions lasted about 35 min.

2.1.4. Scoring

Responses were coded as S-genitives, of-genitives, or Others. A response was coded as an S-genitive if the possessor preceded the possessed object and the appropriate possessive morpheme was added to the possessor. A response was coded as an of-genitive if the sentence began with the possessed object, 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), if the possessed noun was not named correctly\(^5\), or if any other construction was used, the response counted as an Other response.

2.2. Results

Participants produced 656 of-genitives (56.9%), 330 S-genitives (28.6%), and 166 Others (14.4%). Table 2 represents the proportions of S-genitives out of all correct genitives in the different priming conditions.

The participants’ responses were fit using mixed logit models (see Jaeger, 2008, for the use of mixed logit models for categorical data analysis) that predict the logit-transformed likelihood of an S-genitive response. First, we ran a full model, with Prime Type, Meaning overlap and their interactions as fixed factors and random intercepts for participants and items. The mean L2 proficiency of the participants was added as a continuous predictor (this variable was centered to its mean). We added random slope parameters for participants and items using forward selection (Baayen, 2008), but the final model incorporated only those random slope parameters whose inclusion resulted in a better model fit than simpler models. This final, best fit model is summarized in Table 3. As model comparisons indicated that the three-way interaction between Prime Type, Meaning overlap, and L2 proficiency and the two-way interaction between Meaning overlap and L2 proficiency did not improve the fit of the model, these interactions were left out of the final model. Apart from random intercepts for participants and items, the final model included a random effect of Meaning overlap for items. The intercept represents the odds for an S-genitive response in the of-genitive condition for primes and targets with different meaning nouns at the centre of the proficiency variable.

The significant negative intercept indicates that there was an overall bias towards of-genitives: The chance of an S-genitive in the of-genitive condition was significantly below 50% when the head nouns had different meanings. The percentage of S-genitives in this condition (26%) increased to 32% when an S-genitive prime was presented, resulting in a 6% effect of between-language priming that was marginally significant. The significant interaction between Prime Type and Meaning overlap indicates that the priming effect was significantly larger when the head nouns had the same meaning (23%). The effect of Prime Type also interacted with the mean L2 proficiency of our participants: The strength of between-language priming increased together with the participants’ proficiency in their second language. As indicated by the absence of a three-way interaction between Prime Type, Meaning overlap, and L2 proficiency in the full model, this interaction did not differ between the different and same meaning conditions. When the same meaning condition was taken as the reference level, the analysis yielded virtually identical results, except for the fact that the effect of Prime Type was significant (p < .001). Fig. 4 presents the overall between-language priming effect as a function of L2 proficiency.

In order to investigate to which extent learning occurred during the experiment, we explored whether bilinguals produced more S-genitives as the experiment progressed, by splitting the group of participants into equally sized low-proficiency (24% S-genitives) and high-proficiency (44% S-genitives) groups. For these separate groups, we fitted models with random intercepts for participants and items, and Prime Type and Meaning overlap as fixed factors. Following Messenger et al. (2011), we included two variables to measure between-speaker persistence: the number of S-genitives and the number of of-genitives comprehended previously by the participant (i.e. as primes). In order to measure within-speaker persistence, we added the number of S-genitives and the number of of-genitives produced by the participants themselves (i.e. as target descriptions)\(^6\). In the group

\(^5\) As we used only eight different possessors, these were always named correctly.

\(^6\) This method is more precise than adding trial number to the analyses in order to measure learning during the experiment, as S-genitive and of-genitive primes did not exactly alternate during the experiment (e.g. three of-genitives could be followed by one S-genitive).
of high proficient bilinguals, the model was not improved by the addition of any of these variables (p’s > .09). In the group of low proficient bilinguals, including the number of S-genitive primes that was comprehended by the participant significantly improved the fit of the model (\(\chi^2(1) = 46.88, p < .001\)). The final model indicated that the overall proportion of S-genitive responses was negatively correlated with the number of S-genitive primes that was comprehended by the participant (\(\beta = -0.56, SE = 0.13, Wald’s Z = -4.23, p < .001\)). This means that, if the low proficient bilinguals produced S-genitive responses, they did so primarily in the beginning of the experiment.

2.3. Discussion

Overall, we obtained significant between-language priming between Dutch and English genitives: More English S-genitives were produced after Dutch pronominal S-genitives than after Dutch of-genitives. Furthermore, there was a translation equivalence boost: The effect of between-language priming was stronger when the head nouns of prime and target constructions were translation equivalents than when they had different meanings. Both in the same meaning and the different meaning condition the strength of priming increased together with the participants’ L2 proficiency. In fact, there was little to no indication of between-language priming for the participants with a low proficiency in L2 (see Fig. 4). This absence of between-language priming suggests that the less proficient participants had separate representations for English and Dutch S-genitives: Though English S-genitives were sometimes used (in the beginning of the experiment, after which the low proficient bilinguals ceased using them so much), the Dutch primes had virtually no effect on the response patterns. The finding, however, that the strength of between-language priming increased together with the participants’ L2 proficiency suggests that, when L2 learners become more proficient, the representations for Dutch and English S-genitives are collapsed into a single language-neutral representation that is shared between the languages.

The error patterns in this experiment provided some evidence for syntactic transfer from L1 to L2. Forty-two of the 166 Other responses produced in this experiment were transfer errors in which participants used a full form of the possessive pronoun in an English S-genitive (e.g. of high proficient bilinguals, the model was not improved by the addition of any of these variables (p’s > .09). In the group of low proficient bilinguals, including the number of S-genitive primes that was comprehended by the participant significantly improved the fit of the model (\(\chi^2(1) = 46.88, p < .001\)). The final model indicated that the overall proportion of S-genitive responses was negatively correlated with the number of S-genitive primes that was comprehended by the participant (\(\beta = -0.56, SE = 0.13, Wald’s Z = -4.23, p < .001\)). This means that, if the low proficient bilinguals produced S-genitive responses, they did so primarily in the beginning of the experiment.

2.3. Discussion

Overall, we obtained significant between-language priming between Dutch and English genitives: More English S-genitives were produced after Dutch pronominal S-genitives than after Dutch of-genitives. Furthermore, there was a translation equivalence boost: The effect of between-language priming was stronger when the head nouns of prime and target constructions were translation equivalents than when they had different meanings. Both in the same meaning and the different meaning condition the strength of priming increased together with the participants’ L2 proficiency. In fact, there was little to no indication of between-language priming for the participants with a low proficiency in L2 (see Fig. 4). This absence of between-language priming suggests that the less proficient participants had separate representations for English and Dutch S-genitives: Though English S-genitives were sometimes used (in the beginning of the experiment, after which the low proficient bilinguals ceased using them so much), the Dutch primes had virtually no effect on the response patterns. The finding, however, that the strength of between-language priming increased together with the participants’ L2 proficiency suggests that, when L2 learners become more proficient, the representations for Dutch and English S-genitives are collapsed into a single language-neutral representation that is shared between the languages.
"The nurse her shoe is green"). Thirty-two of these errors occurred after an S-genitive prime, in the related head noun condition, that is in the priming condition where the production is most strongly biased towards an S-genitive. Interestingly, in 43% of the cases the correct form of the S-genitive would have had two siblants in a row (e.g., the nurse’s belt is green), which is impossible in Dutch. In fact, for this kind of item, 18% of all S-genitives contained a possessive pronoun, whereas overall transfer errors occurred in 11% of the S-genitives. These errors might be a side effect of having a shared syntactic representation for Dutch and English S-genitives. If the same syntactic node is activated during the processing and the production of Dutch and English S-genitives, there is a risk that the morpho-syntactic rules for the formation of the Dutch S-genitive ‘in-trude’ into the S-genitive that is used to describe the target picture. From this perspective, it is not very surprising that most full pronoun errors occurred in the related head noun conditions, where the target noun re-activates the head noun of the prime sentence (cf. Schoonbaert et al., 2007), and the morpho-syntactic rules that were co-activated with this noun.

The results of this experiment indicated that the representations of Dutch and English genitives are kept separate during earlier stages of acquisition, before they are merged into shared syntactic representations. In order to gain a better understanding of how L2 learners learn these structures, we next studied the production of English (L2) genitives in a within-language syntactic priming experiment, in different and same meaning (i.e. repeated head noun) conditions. In Experiment 1, Dutch–English bilinguals with a low proficiency in L2 hardly produced any English S-genitives. In fact, the finding that low proficiency bilinguals only produced S-genitives in the beginning of the experiment suggests that they were hesitant to use this structure and that the priming experiment was too short to produce learning effects (the proportion of S-genitives did not increase together with the number of S-genitive primes that were comprehended). By studying within-language priming for genitives, we can investigate under which conditions low proficient bilinguals use English S-genitives, and what kind of representations they activate during the production of these genitives. As suggested by Kim and McDonough’s (2008) results (and by research on the development of syntax in L1), we expect that low proficient bilinguals benefit more from lexical repetition than high proficient ones. If our less proficient bilinguals use S-genitives, they might only do this in the same meaning condition, as this condition provides them with an example description they can almost exactly copy. This may result in a strong lexical boost to within-language priming for low proficient bilinguals.

3. Experiment 2: Within-language priming for English (L2) genitives

3.1. Method

3.1.1. Participants

Twenty-four further students from Ghent University (18 females and 6 males, age range 19–27 years) took part. All participants had L1 Dutch and L2 English. They reported to have at least 8 years of experience with English as their second language (mean of 13 years). A female undergraduate student with L1 Dutch and L2 English acted as confederate.

3.1.2. Materials and design

The materials and the design for this experiment were identical to those of Experiment 1, except that the confederate’s description set contained English descriptions instead of Dutch ones.

3.1.3. Procedure

The procedure was identical to that of Experiment 1, except that both dialogue partners were instructed to provide English picture descriptions.

3.2. Results

Participants produced 648 of-genitives (56.3%), 362 S-genitives (31.4%), and 142 Others (12.3%). Table 4 represents the proportions of S-genitives out of all correct genitives in the different priming conditions.

The participants’ responses were again fitted using mixed logit models that predict the logit-transformed likelihood of an S-genitive response. The best fit model is summarized in Table 5. Apart from the random intercepts for participants and items it included random effects of Prime Type for participants and items. The fixed factors were Prime Type and Meaning overlap. In addition, the mean L2 proficiency of the participants was added as a continuous predictor (this variable was centered to its mean). The intercept thus represents the odds for an S-genitive response in the of-genitive condition for different meaning items (head nouns of prime and target are unrelated) at the centre of the proficiency variable.

The significant negative intercept again indicates that there was an overall bias towards of-genitives: In the different meaning condition, participants produced only 13% S-genitives after of-genitive primes. In the S-genitive condition, this percentage increased to 61%, yielding a 48% effect of within-language priming for English genitives in

Table 4

<table>
<thead>
<tr>
<th>Priming condition</th>
<th>of-genitive</th>
<th>s-genitive</th>
<th>Priming effect</th>
</tr>
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<tbody>
<tr>
<td>Different meaning condition</td>
<td>.13</td>
<td>.61</td>
<td>.48</td>
</tr>
<tr>
<td>Same meaning condition</td>
<td>.06</td>
<td>.86</td>
<td>.80</td>
</tr>
<tr>
<td>MEAN</td>
<td>.10</td>
<td>.74</td>
<td>.64</td>
</tr>
</tbody>
</table>

7 Fourteen out of 48 items in our experiments had possessors whose names ended in a sibilant (i.e. all items where nurse or witch were the possessors).
the different meaning condition. We also obtained a large lexical boost: The priming effect was significantly larger when the head nouns in prime and target had the same meaning (i.e., were repeated) than when they were not (80 vs. 48%). In addition, we obtained a three-way interaction between Prime Type, Meaning overlap and L2 proficiency, indicating that the effect of proficiency on the strength of priming was modulated by the meaning overlap between the head nouns. Figs. 5 and 6 show that the effect of proficiency on the strength of priming went in opposite directions in the two conditions. For head nouns with different meanings, we observed a trend towards stronger priming for more proficient participants, as in Experiment 1. For head nouns with the same meaning, however, we obtained a significant negative correlation between priming strength and L2 proficiency: The least proficient participants showed the strongest effects of within-language priming; the effect decreased for more proficient participants. Consequently, the lexical boost was largest for low proficiency participants, and it diminished as the participants became more proficient.

Also for this experiment we explored whether bilinguals produced more S-genitives as the experiment progressed by splitting the group of participants in a low proficiency (32% S-genitives) and a high proficiency group (40% S-genitives) and adding variables to measure between-speaker and within-speaker persistence. In the group of highly proficient bilinguals, adding the number of S-genitive (χ²(1) = 6.36, p < .05) and of-genitive primes (χ²(1) = 7.64, p < .01) that were comprehended by the participant significantly improved the fit of the model. The proportion of S-genitive responses was negatively correlated with the number of S-genitive (β = −0.05, SE = 0.02, Wald’s Z = −2.52, p < .01) and of-genitive primes comprehended by the participant, suggesting an overall decrease in the proportion of S-genitives as the experiment progressed. In the group of less proficient bilinguals the fit of the model was improved by adding the number of of-genitive primes produced by the participants (χ²(1) = 3.93, p < .05) as well as by the number of of-genitive responses produced by the participants (χ²(1) = 6.98, p < .01). More specifically, the proportion of S-genitive responses was negatively correlated with the number of of-genitive primes comprehended by the participants (β = −0.05, SE = 0.02, Wald’s Z = −1.98, p < .01) and with the number of

![Fig. 5. Results of the regression analysis for Experiment 2: priming effects in the different meaning condition as a function of L2 proficiency.](image-url)
of-genitive responses the participants produced themselves ($\beta = -0.05$, $SE = 0.02$, Wald’s $Z = -2.58$, $p < .01$), suggesting an increasing influence of between and within-speaker persistence for of-genitives. The number of S-genitives comprehended and produced by the participants did not influence the response tendencies ($ps > .07$).

3.3. Discussion

We observed significant L2 priming for English genitives and a large lexical boost to this effect. As in Experiment 1, L2 proficiency interacted with the strength of priming. In this experiment, however, L2 proficiency affected the results in the same and different meaning conditions in a different way: When the same noun was used in prime and target the strength of priming decreased significantly as the participants’ L2 proficiency increased; when a different noun was used, there was a non-significant trend towards stronger priming for more proficient bilinguals. The less proficient bilinguals showed very strong priming in the same meaning condition, but much smaller effects in the different meaning condition; more proficient bilinguals showed strong priming both when the head nouns of prime and target constructions had the same meaning, and when they had different meanings. Thus, our results indicate that less proficient bilinguals rely more on the repetition of lexical items for the production of complex L2 syntactic structures than highly proficient bilinguals do. The fact that less proficient bilinguals in our study mainly produced S-genitives in the same meaning condition, when the prime construction could be almost completely copied to describe the target picture (as only the owner of the object differed), suggests that these bilinguals might have several item-specific representations for this construction, instead of a representation that is generalized over different L2 nouns. After bilinguals develop abstract syntactic representations for English genitives, they show lexically mediated as well as abstract syntactic priming for these structures. In fact, because the high proficient bilinguals are more confident about the rules for English genitives, they have a somewhat weaker tendency to copy prime descriptions, resulting in reduced priming in the same meaning condition and as the experiment progresses. In the group of low proficient bilinguals, the proportion of S-genitives was influenced by the number of of-genitives perceived and produced in the course of the experiment (it decreased as more of-genitives were processed), but it didn’t change under the influence of the number of S-genitives that were encountered. This suggests that the low proficient bilinguals rapidly benefited from the lexical repetition in the same meaning conditions and continued to do so throughout the experiment.

Also in this experiment transfer errors were produced, though less frequently than in Experiment 1, probably because the prime sentences were in English instead of in Dutch. Fourteen out of 19 S-genitives containing possessive pronouns were produced after S-genitive primes in the same meaning condition. Again, many of these errors (10 out of 19) were produced in cases where the S-genitive would contain two sibilants in a row. For these items, 9% out of all S-genitives were transfer errors, compared to 5% in the complete set of items.

4. A comparison of within- and between-language priming

Although we also obtained effects of L2 proficiency, the results of our within-language experiment are markedly

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**Fig. 6.** Results of the regression analysis for Experiment 2: priming effects in the same meaning (repeated noun) condition as a function of L2 proficiency.
different from the results obtained in Experiment 1: The overall priming effect and the boost to this effect were much smaller in Experiment 1 than in Experiment 2. In order to compare our within-language and between-language priming results, we carried out a combined analysis of the two experiments.

The data from both experiments were fit using a mixed logit model that included random intercepts for participants and items, a random effect of Prime Type for participants and a random effect of Meaning overlap for items. The fixed factors were Mode (between-language [Experiment 1] or within-language priming [Experiment 2]), Prime Type, and Meaning overlap. The mean L2 proficiency of the participants was added as a continuous predictor. The model is summarized in Table 6.

The interaction between Mode and Prime Type indicates that, in the different meaning condition, the priming effect was significantly larger within L2 (48% priming) than between L1 and L2 (6% priming). When the same meaning condition was used as reference level, the same interaction was found, suggesting that, also in the same meaning condition, the within-language priming effect (80% priming) was significantly stronger than the between-language priming effect (23% priming). The three-way interaction of Mode, Prime Type, and Meaning overlap indicated that the lexical boost to within-language priming (32%) was significantly stronger than the translation-equivalence boost to between-language priming (17%). Effects of L2 proficiency were observed in an interaction with Prime Type, suggesting that, overall, the strength of priming increased together with second language proficiency. Figs. 7 and 8 illustrate the four-way interaction between Mode, Prime Type, Meaning overlap, and Mean Proficiency. Fig. 7 shows within and between-language priming effects in the different meaning condition as a function of L2 proficiency; Fig. 8 shows the same effects for the same meaning condition. In the different meaning condition, the strength of within- and between-language priming increased with the participants’ proficiency in L2. In the same meaning condition, on the other hand, the strength of between-language priming increased with L2 proficiency, whereas the strength of within-language priming decreased. Notice that in both graphs the regression lines for within- and between-language priming converge when L2 proficiency increases, indicating that within and between-language syntactic priming are more similar in more proficient bilinguals than in less proficient bilinguals.

5. General discussion

This study investigated whether the acquisition of L2 syntactic structures involves a shift from representations that are both item- and language-specific to more abstract syntactic representations that are shared between both languages of a bilingual. To this aim, we primed the use of English (L2) genitives (The nurse’s egg is yellow vs. The egg of the nurse is yellow) by presenting Dutch (L1) and English (L2) genitive primes to Dutch–English bilinguals with varying levels of L2 proficiency. The head nouns of prime and target constructions had either the same (ei [egg] – egg) or different meanings (paard [horse] – egg). In Experiment 1, we obtained between-language syntactic priming for these structures and a translation equivalence boost to this effect. The obtained priming effects interacted with the participants’ proficiency in L2: Less proficient bilinguals showed virtually no priming; the priming effects increased for more proficient bilinguals, both in the different and the same meaning conditions. In Experiment 2, we observed within-language priming for English genitives, which was stronger when prime and target constructions used the same head nouns. As in Experiment 1, the priming effects in the different meaning condition increased together with the participants’ proficiency in L2, with less proficient participants showing weaker priming than more proficient ones. When the head nouns of prime and target constructions had the same meaning, however, less proficient bilinguals showed the strongest priming effects. A combined analysis of Experiments 1 and 2 indicated that within-language priming for English genitives was stronger than priming between Dutch and English genitives in same meaning as well as in different meaning conditions.

Taken together, the results of our experiments suggest that L2 learners start out with item- and language-specific

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coefficient</th>
<th>SE</th>
<th>Wald Z</th>
<th>p</th>
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<tbody>
<tr>
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<td>-3.61</td>
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<td>0.605</td>
<td>-0.55</td>
<td>&gt;.1</td>
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<tr>
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<td>0.650</td>
<td>6.04</td>
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<td>Interaction = Mode within-language priming &amp; Same meaning &amp; Mean Proficiency</td>
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<td>0.717</td>
<td>1.47</td>
<td>&gt;.1</td>
</tr>
<tr>
<td>Interaction = Prime s-genitive &amp; Same meaning &amp; Mean Proficiency</td>
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<td>0.788</td>
<td>1.87</td>
<td>&lt;.1</td>
</tr>
<tr>
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<td>-3.54</td>
<td>0.961</td>
<td>-3.68</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Summary of the fixed effects in the mixed logit model (N = 1996; log-likelihood = −712.3).
representations of new L2 syntactic structures. As they encounter more instances of these structures, using a wider variety of lexical items, their representations for these structures become more abstract. This process of abstraction does not only affect the generalization of this structure across lexical items (cf. Kim & McDonough, 2008), but also across different languages: If the L2 structure is similar enough to a structure of the L1 that is

Fig. 7. Results of the combined regression analysis for Experiments 1 and 2: priming effects in the different meaning condition as a function of L2 proficiency.

Fig. 8. Results of the combined regression analysis for Experiments 1 and 2: priming effects in the same meaning condition as a function of L2 proficiency.
already represented in the lexicon, the combinatorial node for the existing structure is used during syntactic processing in L1 and L2. If, on the other hand, the new L2 structure turns out to be structurally different from all syntactic structures that are represented in the lexicon, a new combinatorial node is formed. The fact that this new combinatorial node is not connected to lemmas of the native language, does not, however, imply that this node is language specific: If the speaker learns a further non-native language with a similar construction, this combinatorial node can represent the structures of both non-native languages.

To summarize, our data suggest that the shared syntax model for bilingual language use as developed by Hartsuiker et al. (2004), in which all similar structures are shared between languages and connected to all lemmas they can be combined with, represents the final state of bilingual memory. Initially, L2 learners’ representations of new L2 syntactic structures are lexically specific and not shared between languages. We cannot be certain about the mechanism that is responsible for the abstraction process that eventually leads to abstract, shared representations, but it is very likely that the mechanism is driven by the frequency with which the L2 structure is encountered. This means that the abstract representations are established more rapidly for structures that are very frequent in the L2 than for structures that are less frequent. Furthermore, we cannot be certain whether L2 learners abstract over lexical items and languages at the same time, or in consecutive stages of L2 acquisition. It is, however, not very likely that learners concurrently use a language-specific abstract representation and a language-neutral representation for instances of the same construction. Item-specific syntactic representations that are shared between languages are equally unlikely, because L2 learners have abstract representations for their L1 syntactic structures. Thus we assume that the merging of combinatorial nodes and the linking of L2 heads to the language-neutral node happen in one go.

The data pattern we observed in this study is incompatible with predictions made by MacWhinney’s (1997) Competitor Model. According to this model, L2 learners initially use L1 representations when confronted with new syntactic structures of the L2. If the structure in question is similar enough to the L1 structure, this representation continues to be used, otherwise a new representation has to be formed. Consequently, this model either predicts between-language priming for all participants or a decrease in the strength of priming when the L2 learners become more proficient. One could argue that, for structures that are dissimilar in two languages, between-language priming might only occur in the earliest phases of acquisition and that our participants are beyond the point at which these very early effects can be observed. Still, contrary to MacWhinney’s model, our data suggest a tendency towards more integration and stronger between-language influences with increasing proficiency, even for structures that are not completely identical across languages.

Our data also have repercussions for some of the predictions that were derived from Hartsuiker et al.’s (2004) model. According to Hartsuiker and Pickering (2008), the model predicts no influence of L2 proficiency on the strength of between-language priming. This assumption is only true for the final state of this model, from the moment that syntactic representations are actually shared. Prior to this moment, L2 learners are going through a learning process in which their representations of new syntactic structures evolve from language-specific, item-based linguistic patterns to abstract syntactic representations that are shared between their L1 and their L2. During these phases of L2 acquisition, the strength of between-language priming between new structures and similar structures in the L1 depends on the learners’ level of L2 proficiency.

Note that this adapted version of the Hartsuiker and Pickering model is compatible with Ullman’s view of the bilingual lexicon. According to Ullman (2001), L2 learners initially store complete syntactic structures in their declarative memory. When their L2 proficiency increases, they rely more and more on rule-based, native-like procedures for grammatical processing in L2. This model was supported by fMRI data collected by Golestani et al. (2006) showing a larger overlap in activated brain regions during syntactic processing in L1 and L2 as L2 proficiency increases. Likewise, the comparison between our between-language and within-language priming experiments suggests that syntactic processing in L1 and L2 become more similar as L2 learners become more proficient.

Our findings on the acquisition of new L2 syntactic structures in late, unbalanced bilinguals are in line with results of several studies investigating early bilingual acquisition. In an overview of these studies, De Houwer (2005) discusses data from 12 different language combinations supporting the Separate Development Hypothesis, which states that children raised with two separate languages from birth approach their languages as two distinct, closed sets. Because children acquire separate syntactic rules for the languages they learn, there are no systematic syntactic influences from one language on the other. This in itself seems plausible: Input from the two different languages is often provided by different persons and in different contexts and in order to be able to produce utterances that pertain to each of their languages, children have to attend to the differences in the language input, rather than the similarities between both languages. Recently, a study on syntactic priming in bilingual children (Vasilyeva et al., 2010) showed effects of cross-linguistic syntactic priming for passives in 5–6-year old Spanish–English bilinguals, indicating that, from a certain point in the simultaneous acquisition of their two languages, bilingual children start to make use of shared syntactic representations.

Because we wanted to maximize our chances of finding a modulation of priming strength by L2 proficiency, we chose a target structure that is rather difficult to learn for Flemish learners of English, due to differences with its L1 counterpart. To make sure that enough participants would use this structure, our participants were all university students, who had received at least 5 years of formal training in English. Now that we have established that L2 proficiency influences the use and the representation of L2
syntactic structures that are not completely similar in the L1 and the L2 of bilinguals, future work can investigate whether a similar interaction between L2 proficiency and priming strength can be found for syntactic structures that are structurally identical between languages (e.g. Dutch and English datives). As these structures are easier to learn, it would be possible to test beginning learners of English (at the age of 13), rather than university students. A developmental study investigating cross-linguistic syntactic priming in young bilinguals and the contribution of the repetition of translation equivalents on priming would greatly improve our understanding of how bilinguals acquire shared representations for syntactic structures that are similar in their two languages.

To summarize, like studies investigating conceptual and lexical representations in bilinguals, our study shows an influence of L2 proficiency on the integration of memory representations for words and syntactic structures of a bilingual’s two languages, with more proficient bilinguals showing stronger integration than less proficient ones. Hence, the data obtained in this study indicate that, although proficient late bilinguals share syntactic structures of their two languages as much as possible, less proficient bilinguals start out with separate syntactic representations for new syntactic structures in their L2.

Appendix A.

Prime-target pairs in Experiments 1 and 2. On the first line, the target pictures are described. The possessor of the colored object and the object that is owned are mentioned first, and the person possessing the uncolored object is mentioned in brackets. In the following lines, the S-genitive and the of-genitive primes are given in English (a) and Dutch (b). In each prime sentence, the noun in the same-object condition is mentioned before the slash and the noun in the different-object condition is mentioned after the slash.

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/ijssje] – [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.

3. Nurse with a yellow banjo (nun)
   3a.
   3b.

4. Nun with a yellow flashlight (boy)
   4a.
   4b.

5. Wizard with a red beard (pirate)
   5a.
   5b.

6. Witch with a red duck (wizard)
   6a.
   6b.

7. Witch with a blue bear (priest)
   7a.
   7b.

8. Boy with a blue doll (priest)
   8a.
   8b.

9. Pirate with a green barbecue (nurse)
   9a.
   9b.

10. Girl with a red pineapple (witch)
    10a.
    10b.

11. Nurse with a red bomb (girl)
    11a.
    11b.
12. Nurse with a green belt (pirate)
12b. [De jongen zijn riem/steen] – [De riem/steen van de jongen] is groen.
13. Girl with a green fork (priest)
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)
15b. [De priester zijn giraf/kussen] – [De giraf/het kussen van de priester] is rood.
16. Boy with a yellow jump rope (pirate)
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)
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 schildpad/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)
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)
24b. [De zuster haar kerk/sok] – [De kerk/sok van de zuster] is geel.
25. Girl with a green ladder (boy)
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)
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.

(continued on next page)
29b. [De heks haar pan/jas] – [De pan/jas van de heks] is geel.
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.
32a. [The nurse’s paintbrush/turkey] – [The paintbrush/turkey of witch] is yellow.
32b. [De heks haar penseel/kalkoen] – [De penseel/kalkoen van de heks] is geel.
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.
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.
35b. [Het meisje haar schaap/stoel] – [Het schaap/de stoel van het meisje] is geel.
36b. [De non haar vlieg/zweep] – [De vlieg/zweep van de non] is rood.
37a. [The nurse’s shoe/deer] – [The shoe/deer of the nurse] is red.
37b. [De zuster haar schoen/hert] – [De schoen/hert van de zuster] is rood.
38b. [De zuster haar ei/paard] – [Het ei/paard van de zuster] is geel.
39b. [De non haar skatebord/papfles] – [Het skatebord/de papfles van de non] is blauw.
40b. [De priester zijn palmboom/tafel] – [De palmboom/tafel van de priester] is groen.
41b. [Het meisje haar thermos/wortel] – [De thermos/wortel van het meisje] is geel.
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.
43b. [De piraat zijn jojo/handdoek] – [De jojo/handdoek van de piraat] is geel.
44a. [The girl’s bandaid/pencil] – [The bandaid/pencil of the girl] is red.
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)

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)

48b. [De non haar slang/traan] – [De slang/traan van de non] is geel.

References


