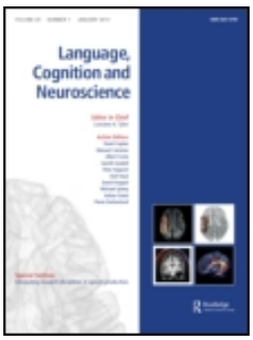

Routledge
Taylor & Francis Group

Language, Cognition and Neuroscience

ISSN: 2327-3798 (Print) 2327-3801 (Online) Journal homepage: http://www.tandfonline.com/loi/plcp21

The effect of linguistic nativeness on structural priming in comprehension

Sanjo Nitschke, Ludovica Serratrice & Evan Kidd

To cite this article: Sanjo Nitschke, Ludovica Serratrice & Evan Kidd (2014) The effect of linguistic nativeness on structural priming in comprehension, Language, Cognition and Neuroscience, 29:5, 525-542, DOI: 10.1080/01690965.2013.766355

To link to this article: http://dx.doi.org/10.1080/01690965.2013.766355

Language, Cognition and Neuroscience, 2014
Vol. 29, No. 5, 525–542, http://dx.doi.org/10.1080/01690965.2013.766355

Routledge
Taylor & Francis Group

The effect of linguistic nativeness on structural priming in comprehension

Sanjo Nitschke[a]*, Ludovica Serratrice[a] and Evan Kidd[b]

[a]*School of Psychological Sciences, The University of Manchester, Manchester, UK;* [b]*Research School of Psychology, The Australian National University, Canberra, ACT, Australia*

(*Received 10 October 2011; final version received 21 December 2012*)

The role of linguistic experience in structural priming is unclear. Although it is explicitly predicted that experience contributes to priming effects on several theoretical accounts, to date the empirical data has been mixed. To investigate this issue, we conducted four sentence-picture-matching experiments that primed for the comprehension of object relative clauses in L1 and proficient L2 speakers of German. It was predicted that an effect of experience would only be observed in instances where priming effects are likely to be weak in experienced L1 speakers. In such circumstances, priming should be stronger in L2 speakers because of their comparative lack of experience using and processing the L2 test structures. The experiments systematically manipulated the primes to decrease lexical and conceptual overlap between primes and targets. The results supported the hypothesis: in two of the four studies, the L2 group showed larger priming effects in comparison to the L1 group. This effect only occurred when animacy differences were introduced between the prime and target. The results suggest that linguistic experience as operationalised by nativeness affects the strength of priming, specifically in cases where there is a lack of lexical and conceptual overlap between prime and target.

Keywords: structrural priming; nativeness; comprehension; animacy

Introduction

Structural priming refers to the persistent use of syntactic structures or interpretative strategies following their use in recent discourse. For example, speakers are more likely to produce a passive such as *The girl was kissed by the boy* after encountering another passive than after encountering an active, such as *The boy kissed the girl* (Bock, 1986). Priming of interpretations can be found in the case of ambiguous expressions. For instance, Branigan, Pickering and McLean (2005) primed the comprehension of sentences that contained ambiguity of prepositional phrase (PP) attachment, such as *The clown prodding the doctor with the banana*. They showed that participants were more likely to attach the ambiguous PP to the verb phrase (VP) after previous exposure to a prime sentence that disambiguated a similar sentence in the same manner, as opposed to attaching the PP to the second noun phrase (i.e. *the doctor*, see also Pickering, Branigan, & McLean, 2012).

Structural priming has been attributed to residual activation of the syntactic structures (Pickering & Branigan, 1998), but has also been explained as implicit learning (Bock & Griffin, 2000; Chang, Dell, Bock, & Griffin, 2000). Modelled on Levelt's (1989) model of sentence production, the residual activation explanation of priming contends that structural representations (*combinatorial nodes*) are activated following the processing of a primed structure, which subsequently leads to a greater-than-normal (but temporary) tendency to use the primed structure. This account explains short-term effects of priming that appear after the exposure to single primes, and is supported by the finding that open-class lexical overlap between primes and targets enhances priming effects (Branigan et al., 2005; Pickering & Branigan, 1998), as well as by the observation that the retrieval of semantically related words can be facilitated through structural priming (Nicol & Pickering, 1993). The implicit learning account of priming attributes priming to long-term changes in representations that support syntactic processing. Strong evidence for implicit learning comes from the finding that priming can last over various filler items, even in the absence of open-class lexical overlap (Bock, Dell, Chang, & Onishi, 2007; Bock & Griffin, 2000). Additionally, Ferreira, Bock, Wilson, and Cohen (2008) reported priming in patients with anterograde amnesia. Since these patients have a compromised explicit memory yet intact implicit learning abilities, the data support the implicit learning explanation. Finally, Kidd (2012a) reported that performance on an implicit learning task was directly associated with long-term structural priming in five-year-old children, whereas explicit learning was not.

*Corresponding author. E-mail: sanjo.nitschke@gmail.com

Since evidence has been reported in support of both the activation and implicit learning accounts, newer proposals suggest that activation and learning are complementary facets of structural priming (Branigan, 2006; Chang, Dell, & Bock, 2006; Ferreira & Bock, 2006; Hartsuiker, Bernolet, Schoonbaert, & Speybroek & Vanderelst, 2008; Pickering & Ferreira, 2008; Reitter, Keller, & Moore, 2011; Tooley, Traxler, & Swaab, 2009).

If structural priming is a form of learning, then it may be a crucial force in language acquisition. Experience-based learning accounts of language claim that speakers register frequency information throughout their developmental history. In Chang et al.'s (2006) connectionist model, greater experience with a given structure equates to less error associated with the sequencing of each word, which in turn leads to less weight change resulting from error-based learning. The magnitude of priming is directly related to the amount of error in the model, such that greater error equates to greater priming. This mechanism explains the *inverse frequency effect* – the common finding that low frequency structures lead to greater priming effects than comparable higher frequency structures (e.g. passive versus active: see Pickering & Ferreira, 2008). There are alternative explanations for this effect. Whereas Chang et al. attribute it to the relative frequency weightings of mapping between form and meaning, Jaeger and Snider (2013) invoke the concept of 'surprisal', where low frequency primes result in structural persistence because their initial use is unexpected. A recent model proposed by Reitter et al. (2011) provides a unified account of short-term (i.e. activation-based) and long-term priming (i.e. learning) by linking these phenomena to short-term and long-term memory, respectively. According to this approach, priming can be lexical or structural. In the former case, the effect is short-lived and caused by spreading activation from lexical forms that are retained in memory buffers. In the latter, priming is caused by adjustments of retrieval probabilities of linguistic chunks. These chunks are thought to be stored in declarative memory and their retrieval probability is continuously readjusted through usage. Similar to Chang et al.'s error-based learning mechanism, this model assumes that weight adjustment is greater for low frequency than for high frequency chunks.

These approaches predict that experience with a structure matters for priming, and that there should be observable differences in the magnitude of priming between speakers who differ substantially in their accumulated linguistic experience. Some recent studies that have compared L1 language learners and adults have observed higher priming effects in children compared to adults (Messenger, Branigan, & McLean, 2011; Rowland, Chang, Ambridge, Pine, & Lieven, (2012). Additionally, Hartsuiker and Kolk (1998a) reported greater priming effects in persons with agrammatic aphasia in comparison to healthy age-matched controls, suggesting further that weakly represented syntactic knowledge is more susceptible to priming. In the current paper, we investigated whether experience-based effects are present in a different population – second language (L2) learners. Specifically, we explored the effect of linguistic experience on structural priming by comparing native L1 speakers of German with L2 speakers of German across four experiments that primed comprehension.

Past L2 Priming Research

A small literature on L2 priming exists; however, the majority of this research has used the priming method to investigate the degree to which multilingual speakers possess shared syntactic representations across their L1 and L2. Loebell and Bock (2003) found cross-linguistic priming in English–German bilinguals for dative but not passive structures. Hartsuiker, Pickering, and Veltkamp (2004) reported cross-linguistic priming from Spanish to English for the passive. Since Spanish and English but not German share the same word order for passives, these data suggest that the shared surface order between languages facilitates cross-linguistic priming. This was confirmed by Bernolet, Hartsuiker, and Pickering (2007), who reported priming between Dutch and German relative clause (RC) structures, which share the same word order, but not between English and Dutch RCs, which do not share the same word order. Schoonbaert, Hartsuiker, and Pickering (2007) reported similar results priming the use of datives in L1–L2 Dutch–English speakers.

This previous research on L2 priming has largely been concerned with shared syntactic representations across languages and using cross-linguistic similarities and differences in structure to identify the representational loci of priming effects. The results suggest that priming effects are similar within L2 and from L1 to L2, although within-language priming shows higher lexical boost effects. This research has not directly compared L1 and L2 speakers using the same language. Such a comparison is important: following reports of higher priming in L1 children (Messenger et al., 2011; Rowland et al., 2012), experience-based approaches predict higher priming in less experienced speakers. Only two studies have directly compared L1 and L2 speakers on the same target language[1]; the results concerning the experience-based prediction are mixed.

Flett, Branigan, and Pickering (in press) primed L1 and L2 speakers of English through production using the dative alternation. Their L2 speakers had either

Spanish or German as a first language. Spanish only allows prepositional object (PO) datives, whereas German allows both PO and double object (DO) datives. Despite this fact, the German and Spanish L2 speakers of English were equally likely to produce DO targets following DO primes, suggesting that their L1 did not influence their L2 performance. Importantly, the L2 speakers were not primed more than L1 speakers, which is inconsistent with the experience-based prediction.

Flett et al. (in press) primed through production, as have most studies that have compared priming effects in different populations of speakers who differ in linguistic knowledge (Hartsuiker & Kolk, 1998a; Messenger et al., 2011; Rowland et al., 2012). Production is a deliberate and predominantly time-insensitive process that might not be overly sensitive to differences in speakers' experience once a constructional pattern has been acquired. It could be that experience-based differences in priming might be clearer in comprehension. In a previous study, we primed comprehension in L1 and L2 speakers of German and L1 and L2 speakers of Italian, and found that L2 speakers were primed more than L1 speakers (Nitschke, Kidd, & Serratrice, 2010). Participants were primed to interpret ambiguous relative clauses (RCs) as object RCs, as in (1).

(1) German: Hier ist die Ballerina, die das Mädchen erschreckt.
'Here is the ballerina$_{[Subj/Obj]}$ that the girl$_{[Obj/Subj]}$ scares.'
Italian: Ecco la ballerina che spaventa la ragazza.
'Here is the ballerina$_{[Subj/Obj]}$ that scares the girl$_{[Obj/Subj]}$.'

These German noun-noun-verb (NNV) RCs and the Italian NVN RCs have ambiguous subject and object role assignments, but are preferably interpreted as subject RCs by L1 speakers of each language (see Mak, Vonk & Schriefers, 2002; Zubin, 1979). Nitschke et al. (2010) used a forced choice sentence-picture-matching task to prime for the interpretation of object relative clauses (German: OSV, Italian: OVS), and observed higher priming in L2 speakers. However, a closer analysis of the data showed that the effect of nativeness was mainly driven by the Italian L1 and L2 speakers. For the German speakers there was a strong priming effect in L1 and L2 speakers, but the increase due to nativeness was suggestive yet not significant. This is problematic for an experience-based explanation of priming.

In the current paper, we report on a series of priming experiments that follow-up Nitschke et al. (2010). Since the current evidence for experience-based effects in L2 priming is currently weak, we begin with the working hypothesis that experience-based differences between L1 and L2 speakers might be observable in instances where L1 priming is weak or non-existent. This is consistent with Nitschke et al.'s finding that L2 but not L1 Italian speakers were primed. Object-verb-subject (OVS) interpretations of ambiguous NVN RCs are extremely rare in Italian, and evidently not primeable in L1 speakers. In contrast, Nitschke et al. observed clear priming effects in L2 Italians. In contrast, OSV interpretations of ambiguous NNV RCs are not unattested in German, since all German RCs have NNV word order. To investigate our hypothesis we manipulated the conditions that may contribute to the likelihood of finding a priming effect: (1) the lexical boost, (2) the presence of negative feedback, (3) frequency of the prime structure and (4) animacy differences. We consider each of these issues in turn.

The *lexical boost* refers to the fact that open-class lexical overlap between prime and target items results in larger priming effects. It is arguably the most consistently reported influence on structural priming. The effect has been shown in comprehension (Arai, van Gompel, & Scheepers, 2007; Branigan et al., 2005) as well as in production (Cleland & Pickering, 2006; Corley & Scheepers, 2002; Pickering & Branigan, 1998). *Negative feedback* refers to the process whereby feedback regarding an incorrect utterance or interpretation results in representational changes in the linguistic system (Carroll & Swain, 1993; McDonough, 2005). Following the inverse frequency effect, lower frequency primes generally lead to larger priming effects than higher frequency primes, an effect that has been reported in both production and comprehension across a range of structural types (e.g. Bock & Loebell, 1990; Hartsuiker et al., 2004; Hartsuiker & Kolk, 1998b; Hartsuiker, Kolk, & Huiskamp, 1999; Hartsuiker & Westenberg, 2000; Wells, Christiansen, Race, Acheson, & MacDonald, 2009). Finally, noun phrase (NP) *animacy* has been shown to affect language processing (Kidd, Brandt, Lieven, & Tomasello, 2007; Gennari & MacDonald, 2008; Mak, Vonk, & Schriefers, 2002; Prat-Sala & Branigan, 2000; Prat-Sala, Shillcock, & Sorace, 2000). With respect to priming, Bock, Loebell, and Morey (1992) reported that participants prefer to assign the same grammatical function to NPs in their descriptions of targets depending on the animacy configuration of the prime. That is, primes with inanimate subject arguments elicited more target descriptions that contained inanimate subject arguments. Given these results, it can be assumed that if animacy does affect priming in comprehension then priming effects are more likely to be observed in cases where the NPs in primes and targets have the same animacy properties than when they do not (see Snider, 2008, 2009).

Taking into consideration these three variables, it is reasonable to suggest that Nitschke et al.'s (2010) study provided the optimum conditions to observe a priming effect. Firstly, the prime and target sentences contained verb overlap. Secondly, the sentence-picture-matching task employed ambiguous RC primes but only allowed a non-dominant object RC interpretation, which may have provided negative feedback to participants, thereby alerting them to the aim of this study. Thirdly, their primes had low type frequency because the object RCs they tested contained an animate head noun, which are the rarest kind of object RCs in both German and English (Fox & Thompson, 1990, 2007; Gennari & MacDonald, 2008; Roland, Dick, & Elman, 2007). Finally, all prime and target sentences contained animate NPs. The suggestion here is that no effect of nativeness was observed in the case of the German speakers because the optimal conditions with which to observe a priming effect were met.

In the current paper, we explore the hypothesis that linguistic experience does have an effect on priming, but that it is only detectable in instances where priming effects are weak or non-existent in highly experienced speakers (i.e. L1 adults). To test this, the following four experiments systematically eliminated open-class lexical overlap, removed the potential influence of negative feedback, increased type frequency and introduced animacy differences to prime-target pairs. It was hypothesised that the manipulation of these three variables should weaken the overall priming effect. As a consequence, we predicted that an effect of nativeness and therefore of linguistic experience would be observed, such that L2 speakers of German would be primed in instances where L1 speakers of German would not.

Experiment 1: No open-class overlap

Following Nitschke et al. (2010), Experiment 1 primed L1 speakers of German and L2 speakers of German with L1 English to interpret ambiguous German NNV relative clauses (RCs) as object RCs; i.e. an object–subject–verb (OSV) mapping. An example for an ambiguous German NNV RC is provided in (2).

(2) Hier ist die Ballerina, die das Mädchen erschreckt.
'Here is the ballerina$_{[Subj/Obj]}$ that the girl$_{[Obj/Subj]}$ scares.'

In German, syntactic roles are overtly marked for case on determiners and, in the case of RCs, on relative pronouns. Sentence (2) is ambiguous between a subject and object RC because feminine and neuter NPs have the same form for nominative and accusative case. However, L1 German speakers prefer the NP1 to be interpreted as the subject (= subject reading) rather than as the object (= object reading). As discussed, Nitschke et al. (2010) successfully primed L1 and L2 speakers of German to significantly increase the numbers of OSV RCs. Experiment 1 replicated Nitschke et al.'s (2010) method with one important difference: there was no verb overlap between prime and target, thus removing one likely contributing factor to the priming effect.

Methods

Participants

Forty-eight (N = 48) German-speaking adults participated: 24 L1 German speakers and 24 L1 English speakers with L2 German. All participants were university students. The L1 German speakers were on average 21 years old (min 18 years, max 27 years). Eighteen were female. None of them had started learning any L2 before school age. Testing took place in Germany at their home university. Six of the initial 24 L2 German speakers failed a vocabulary test and were replaced (see Materials section). The final 24 L2 German speakers made on average 13 mistakes in the vocabulary test (min 0, max 19). All were native English speakers and all were university students (Mean age = 22 years; min: 19 years, max: 27 years). Eighteen were tested at their home universities in the UK. Six were tested in Germany where they were studying as foreign students. Fifteen were female. One reported to have started learning German and French at the age of five in primary school, the other 23 had not started learning any second language before the age of seven. On average, the L2 speakers had studied German for nine years (min: 4 years, max: 16 years). One L2 participant reported to have lived in Germany for 5.5 years at the time of testing, one had not been to a German-speaking country for longer than four weeks at a time, and the others had spent an average of seven months (min: 1.5, max: 12) working or studying in Germany or Austria.

Materials and Procedure

The experimental items in the picture-matching task were 64 syntactically ambiguous German NNV relative clauses that could be interpreted either with an SOV or an OSV mapping, as in example (2). Each sentence was followed by a pair of pictures (see Figure 1). In 48 of these 64 sentences, one picture displayed the OSV mapping and the other picture displayed the SOV mapping. These sentences were used as target items. The remaining 16 sentences were also followed by two pictures, but only the picture depicting the OSV

Figure 1. Example for items of prime trial (top) and target trial (bottom).

mapping was provided. The other picture showed the same characters in the same thematic roles but engaging in a different action that did not correspond to the verb in the sentence. These sentences were used as prime items. The experiment also contained 102 Filler sentences that were also followed by two pictures. The fillers comprised an array of different syntactic structures (e.g. active, passive, intransitive and transitive sentences with ambiguous prepositional phrase attachments). The fillers were interspersed to disguise the aim of this study. The 64 experimental NNV RCs were assembled out of 16 different human characters and 16 different verbs. All 16 human characters were of feminine or neuter gender, where there is ambiguity between nominative and accusative cases.

The picture-selection task was presented using E-Prime (MacWhinney, James, Schunn, Li, & Schneider, 2001). The task was divided into three continuous phases: (1) a baseline phase, (2) a prime phase and (3) a post-test phase. All three phases contained pairs of ambiguous NNV relative clauses separated by two to five fillers. The baseline phase and the post-test phase contained 16 target items. The baseline phase served to measure each participant's preferred interpretation of the ambiguous sentence. The post-test phase served to measure the long-term maintenance of any potential priming effects. Any significant increase in OSV readings following the baseline phase would indicate a genuine priming effect.

The prime phase contained 16 prime-target pairs, an example of which is shown in Figure 1. Following Branigan et al. (2005), the prime item presented an ambiguous sentence but only one permissible interpretation, in this case the OSV mapping. The logic is that, by restricting the choice to OSV mappings in the prime items, participants would be primed to select the OSV picture of the ambiguous NNV RCs in the target items, even though the normally preferred SOV mapping was also available. Following Nitschke et al. (2010) and past studies by Kaschak (2007) and Thothathiri and Snedeker (2008), we only primed one reading of the ambiguous sentence – the dispreferred OSV reading. Priming for one interpretation is likely to lead to the accumulation of priming effects. If, as argued in the introduction, potential differences between L1 and L2 speakers in comprehension priming are subtle, then priming for one interpretation may exacerbate these differences between the two speaker groups. The presentation of experimental items over the three phases of the experiment was counterbalanced across eight lists. Furthermore, the positions of the pictures to be selected (left vs. right) were counterbalanced across the lists.

We also prepared a vocabulary questionnaire for the L2 participants. The function of the questionnaire was twofold: (1) to assess the L2 participants' lexical knowledge and (2) to familiarise L2 participants with unknown words prior to the experiment. The list comprised of 50 nouns and verbs that occurred in the test items (see Appendix). Participants were excluded if they failed to correctly translate 30 of those 50 words. We made the relatively high allowance of 20 mistakes in the vocabulary test because the words occurred in random order without any contextual cues. If participants made no more than 20 mistakes, they were told the meanings of the words they did not know and were asked to write them down for practice.

The L2 participants were given the vocabulary questionnaire to complete before participating in the priming task. Participants were told that this study investigated second-language processing, and that they would be required to read sentences which they would then be required to match to one of two pictures by pressing a button on a button box. Pictures and sentences did not time out; therefore opting out from

making a choice was not possible. Prior to the task, each participant was presented with six unambiguous practice items.

Results

The proportions of OSV choices are displayed in Figure 2. For both speaker groups, the graph shows an increase in OSV choices from the baseline phase to the prime phase and from the baseline phase to the post-test phase. The L2 German speakers made more OSV choices at baseline than the L1 German speakers. This is likely to reflect L1 transfer from English, where the NNV surface order is unambiguously an OSV relative clause (for detailed discussion on L1 transfer see Nitschke et al. 2010).

The data were analysed using Generalized Linear Mixed Models (GLMM) (Baayen, Davidson, & Bates, 2008; Jaeger, 2008), which were calculated using the lme4 package (version 0.999999-0) for Linear Mixed Effects (Bates & Maechler, 2010) in R, version 2.15.1 (R Development Core Team, 2009). Mixed logit models were run because our dependent variable was binary (i.e. SOV or OSV reading) (Jaeger, 2008). Since we were interested in priming as defined by increased OSV interpretations above baseline, factor labels were kept for phase and baseline was selected as the reference level to which prime phase and post-test were compared. All other factor labels were centred at 0 with a range of 1 to reduce collinearity (Baayen, 2008). Random slopes were selected by model comparisons (forward selection) using likelihood ratio tests ($\alpha \leq 0.05$). Collinearity (i.e. when IVs are strongly correlated) can make it difficult to tease apart the effects of single predictors (Baayen, 2008). We tested for collinearity by calculating the condition number K using the kappa.mer()[2]function. There is no collinearity when K lies between 0 and 6. Medium collinearity is identified when $K \geq 15$; severe collinearity when $K \geq 30$. The K of the final model of Experiment 1 was 3.9; therefore, collinearity was not an issue.

The final model for the data in Experiment 1 is shown in Table 1. The main effect of phase significantly improved model fit: both groups made significantly more OSV interpretations in the test and post-test phase than in the baseline. The main effect of nativeness was also significant. Overall, the L2 speakers made more OSV mappings than did the L1 speakers. However, the phase by nativeness interaction was not significant, suggesting that the magnitude of priming did not differ between the two groups.

Discussion

In Experiment 1, L1 and L2 speakers of German were primed to interpret ambiguous German NNV RCs as object relatives (OSV) in the absence of open-class lexical overlap. Consistent with Nitschke et al. (2010), the results showed a priming effect in L1 and L2 speakers that lasted over the post-test phase, where no additional primes were administered. These findings add to earlier work where structural priming in comprehension has been found in the absence of open-class lexical overlap between prime and target (Pickering et al. 2012; Scheepers & Crocker, 2004; Thothathiri & Snedeker, 2008), but is inconsistent with studies that found open-class lexical overlap to be essential for structural priming to occur (Arai et al., 2007; Branigan et al., 2005).

However, Experiment 1 provided no indication that priming was affected by nativeness. We predicted that the effect of nativeness may only be observed in instances where the priming effect is weak. The priming effect in Experiment 1 persevered over the post-test phase in both speaker groups, suggesting that the effect was relatively strong.

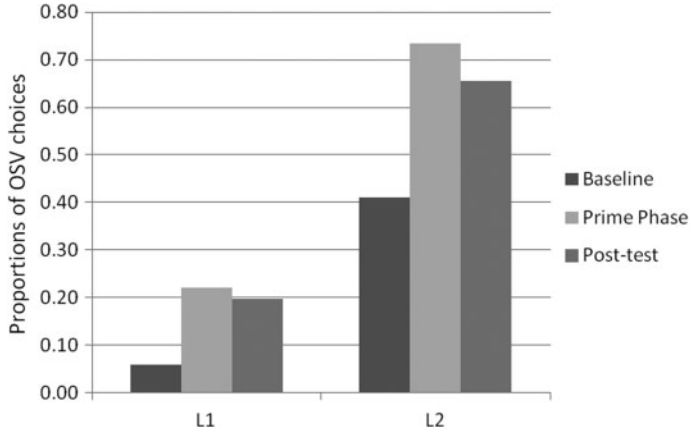

Figure 2. Proportions of object reading choices over the three phases of Experiment 1.

Table 1. Final model for the data of Experiment 1. In this and the following tables, the column *slope* shows whether the parameter has been included into the model as random slope in participants (p) or in items (i).

	Estimate	Standard error	Wald z	p	Slope
(Intercept)	2.02	0.26	7.81	<.001	
Phase: baseline vs. prime phase	−1.72	0.35	−4.89	<.001	(p)
Phase: baseline vs. post-test	−1.25	0.42	−2.99	=.003	(p)
Nativeness	−3.03	0.38	−7.88	<.001	

Experiments 2–4 made further attempts to reduce the priming effect by manipulating (1) the ambiguity of the prime, which may have provided negative feedback to participants, (2) the animacy properties of the NPs in the prime sentences and (3) the frequency of prime sentences in the ambient language.

Experiment 2: Morphologically disambiguated primes

The unambiguous primes in Experiment 1 may have alerted the participants to the experimental manipulation and thus may have increased the chances of observing a priming effect. The dominant interpretation of ambiguous German NNV RCs is an SOV reading (Mak et al., 2002; Nitschke et al., 2010); therefore, the participants were likely to have interpreted the prime sentences as subject RCs during reading. However, in this case there would be a mismatch between their initial interpretation and the subsequent pictures, as during the prime trials the pictures only provided scenes corresponding to the object reading (OSV) of the sentence. This mismatch may have alerted participants to the manipulation. Such indirect negative feedback could have been a powerful source of error, leading to the priming effect in Experiment 1 (see Carroll & Swain, 1993; McDonough, 2005). It may also have contributed to priming effects found in other studies that have used the same method (e.g. Branigan et al., 2005; Nitschke et al., 2010; Pickering et al. 2012; Raffray, Pickering, & Branigan, 2007). Experiment 2 primed participants using unambiguous object RCs in order to rule out this possible explanation.

The sentences used as primes in Experiment 2 were disambiguated by case marking. In German, case marking on the masculine definite article and the masculine relative pronoun is morphologically distinct between the accusative case (*den*) and the nominative case (*der*), and therefore disambiguates transitive constructions. For example, consider (3) and (4).

(3) a OSV: Hier ist die Frau, die **der** Mann küsst.
'Here is the woman$_{[Obj]}$ that the man$_{[Subj]}$ kisses'
b SOV: Hier ist die Frau, die **den** Mann küsst.
'Here is the woman$_{[Subj]}$ that the man$_{[Obj]}$ kisses'
(4) a OSV: Hier ist der Mann, **den** die Frau küsst.
'Here is the man$_{[Obj]}$ that the woman$_{[Subj]}$ kisses'
b SOV: Hier ist der Mann, **der** die Frau küsst.
'Here is the man$_{[Subj]}$ that the woman$_{[Obj]}$ kisses'

Experiment 2 used object RCs such as (3a) and (4a) to prime for OSV mappings of ambiguous NNV RCs (such as *Hier ist die Ballerina, die das Mädchen erschreckt.* 'Here is the ballerina$_{[Subj/Obj]}$ that the girl$_{[Obj/Subj]}$ scares'.). The positions of the disambiguating male NP are different in sentences (3a) and (4a). Experiment 2 used both of these variations in order to balance potential semantic biases.

Because of the unambiguous case marking in the primes, participants were expected to read the sentences as OSV RCs and subsequently choose the picture with the OSV scene without first interpreting the prime sentence as an SOV. It has been shown that listeners anticipate upcoming syntactic roles and that this can happen even before a verb is encountered (see Kaiser & Trueswell, 2004; Kamide & Mitchell, 1999; Knoeferle, Crocker, Scheepers, & Pickering, 2005). Thus, participants should predict the OSV structure well before seeing the pictures. Additionally, since these prime sentences were unambiguous, it was unlikely that reanalysis was necessary upon the presentation of the pictures. Thus, the likelihood that the participants would become aware of the experimental aims was strongly reduced in Experiment 2 as compared to Experiment 1. If the priming effects observed in Experiment 1 and Nitschke et al. (2010) depended on indirect negative feedback through the mismatch between the prime sentence and its pictorial representation, the priming effect in Experiment 2 should be diminished. If, however, a priming effect comparable to Experiment 1 is observed then we can be confident that (1) the potential negative feedback provided in Experiment 1 did not drive the priming effect and (2) the picture-selection task used in Experiment 1 and other forced choice picture-matching tasks elicit genuine (i.e. unconscious, Seger, 1994) priming effects. If we observe an effect of nativeness on priming (i.e. an interaction between phase and nativeness) then this would suggest that speakers with different amounts of experience (L1 vs. L2 speakers) are differently sensitive to feedback cues or that L2 speakers are simply less sensitive to morphological information such as case marking. In particular, it is conceivable that, whereas the negative feedback provided in Experiment 1 was powerful enough to prime both L1 and L2 speakers, the lack

of this mechanism in Experiment 2 might decrease priming in L1s.

Methods

Participants

Twenty-four (N = 24) new L1 German speakers were tested (mean age = 20 years; range: 18–24). Seventeen were female. None reported to have learned any second language before the age of eight. The L1 German speakers were all university students; testing took place at a university in Germany. None had learned any L2 before school age. Twenty-four (N = 24) new L2 German speakers were also tested. Two were replaced because they made more than 20 mistakes in the vocabulary pre-test. The final 24 L2 German speakers made on average 11 mistakes in the vocabulary test (min: 0, max: 18) and had a mean age of 22 years (min: 20, max: 24). None had studied any second language before the age of seven and the average time of studying German was eight years at the time of testing (min: 2 years, max: 12 years). The L2 German speakers were all university students and had spent an average of eight months in Germany or Austria (min: 2 months, max: 24 months). Testing took place at their home university in the UK (22) or in Australia (2). Fifteen were female.

Materials and Procedure

Experiment 2 differed from Experiment 1 in that the 16 prime items were replaced by new items with morphologically disambiguated object RCs. In eight of these prime sentences, the NP1 was grammatically (and semantically) female and the NP2 was grammatically (and semantically) male (as in 3a), and in the other eight the NP1 was male and the NP2 female (as in 4a). All other items were identical to those in Experiment 1 and again there was no open-class lexical overlap between primes and targets. The procedure was identical to that of Experiment 1. The order of the 16 new prime items was balanced over eight lists.

Results

The mean proportions of OSV readings of the test sentences across the three phases of the experiment for both groups are shown in Figure 3. There was an increase in object readings from the baseline phase to the prime phase for both speaker groups. From the prime phase to the post-test, the number of OVS readings slightly decreased in both groups but these were still larger than in the baseline phase.

The data were analysed using the same statistical methods used to analyse Experiment 1. The final model of the data from Experiment 2 is shown in Table 2. There was no collinearity ($\kappa = 3.9$). There was a significant main effect for phase: the number of OSV interpretations during the test and post-test phase was significantly higher than at baseline for both L1 and L2 speakers. The effect of nativeness was again significant, indicating that the L2 speakers made significantly more OSV choices than the L1 speakers. However, as in Experiment 1, there was no phase by nativeness interaction, suggesting that the magnitude of priming did not differ between L1 and L2 speakers.

Experiments 1 and 2 were compared directly to investigate whether using ambiguous or disambiguated prime sentences had an effect on the magnitude of priming. We again established random slope parameters and added experiment as a fixed effect. The results of the final model are shown in Table 3. The factor of experiment did not improve the model and was therefore removed. There was no interaction between phase and nativeness. This suggests that the priming effect did not differ according to whether ambiguous or morphologically disambiguated primes were used, and that L1 and L2 speakers were not

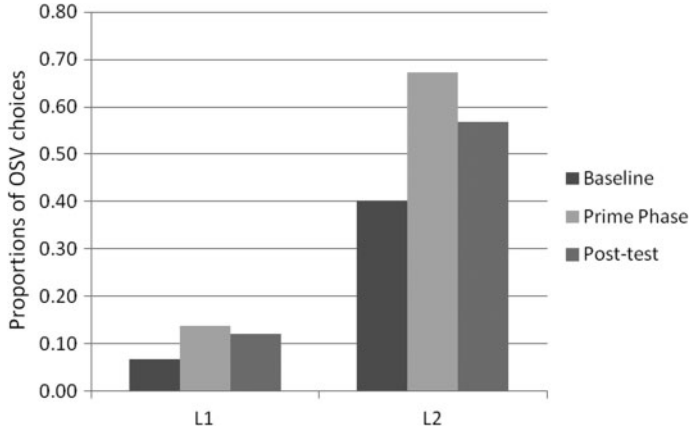

Figure 3. Proportions of object reading choices over the three phases of Experiment 2.

Table 2. Final model for the data of Experiment 2.

	Estimate	Standard error	Wald z	p	Slope
(Intercept)	2.07	0.30	6.97	<.001	
Phase: baseline vs. prime phase	−1.44	0.30	−4.78	<.001	(p)
Phase: baseline vs. post-test	−0.92	0.35	−2.65	=.008	(p)
Nativeness	−3.07	0.36	−8.43	<.001	

differentially sensitive to these prime types. An anonymous reviewer asked us to repeat that analysis but to exclude the prime phase of the experiment under the assumption that a phase by experiment interaction might be difficult to detect when the variable of phase has three levels. We did so, but again only found main effects of phase ($p < .001$) and nativeness ($p < .001$), and no interactions.

Discussion

Experiment 2 showed priming effects in both L1 and L2 speakers despite using syntactically unambiguous primes, which reduced the likelihood that negative feedback could affect priming. The priming effect lasted over the post-test phase, where no further primes were administered. This outcome was similar to that of Experiment 1, where the prime sentences were ambiguous and potentially first analysed by the participants as SOV structures. The results of Experiment 2 therefore suggest that the potential negative feedback provided in Experiment 1 was not the driving force of the priming effect. Furthermore, since there was no significant difference in priming magnitude between L1 and L2 speakers, this feedback mechanism was not found to differentially affect the two speaker groups.

On a methodological level, the results of Experiment 1 show that forced choice picture-matching tasks that use ambiguous prime sentences, as in Experiment 1, yield genuine priming effects (see also Branigan et al., 2005; Nitschke et al., 2010; Pickering et al. 2012; Raffray, Pickering, & Branigan, 2007).

Table 3. Comparison between Experiments 1 and 2.

	Estimate	Standard error	Wald z	p	Slope
(Intercept)	2.038	0.1967	10.36	<.001	
Phase: baseline vs. prime phase	−1.5869	0.23	−6.90	<.001	(p)
Phase: baseline vs. post-test	−1.0735	0.2683	−4.00	<.001	(p)
Nativeness	−3.0823	0.2733	−11.28	<.001	

Experiment 3: Animacy disambiguation, high-type frequency primes

Experiments 3 and 4 investigated the role of type frequency and animacy information in priming in L1 and L2 speakers. Experiment 3 used 16 NNV RC primes that were syntactically ambiguous but semantically disambiguated to OSV RCs because they contained an inanimate head noun, as in sentence (5).

(5) Hier ist das Eis, das die Frau isst.
'Here is the ice cream$_{[Obj]}$ that the woman$_{[Subj]}$ eats'

Despite its syntactic ambiguity, sentence (5) can only be plausibly interpreted with *the ice cream* as the patient (i.e. grammatical object) and *the woman* as the agent (i.e. subject). Previous research has shown that NP animacy affects the comprehension of RCs (Brandt, Kidd, Lieven, & Tomasello, 2009; Mak et al., 2002; Traxler, Morris, & Seely, 2002). Furthermore, there are indications that the animacy distribution between the prime and the target items affects the outcome of priming (Bock et al. 1992; Snider, 2008): animacy repetition is more likely to yield a priming effect, whereas differences in animacy between primes and targets should reduce the effect. As such, there is a chance that the animacy manipulation in the prime sentences will reduce the overall strength of the priming effect, which could therefore reveal an effect of nativeness.

Not only does sentence (5) differ in animacy, it also differs in type frequency. Corpus studies of German have shown that object RCs with inanimate head nouns are the most common type of German OSV RCs (Kidd et al., 2007; Mak et al., 2002; Zubin, 1979). This also means that the NNV RC primes used in Experiments 1 and 2 had low type frequency and were therefore atypical. According to the experience-based approach (e.g. Chang et al., 2006; Mitchell, Cuetos, Corley, & Brysbaert, 1995), structures that are low in frequency result in greater priming because there is a greater difference between the predicted structure and what is processed, thus leading to greater updating of usage statistics via error-based learning (Bock & Loebell, 1990; Hartsuiker & Kolk, 1998b; Hartsuiker et al., 1999, 2004; Wells et al., 2009). Therefore, in comparison to Experiments 1 and 2, Experiment 3 manipulated two variables: animacy and type frequency. Again, the assumption was that both increasing the type frequency of the prime and providing an animacy mismatch between prime and target would weaken the

overall priming effect, thus increasing the likelihood that we would observe a differentiating effect of nativeness in our data.

Methods

Participants

Twenty-four L1 German speakers were tested, none of whom participated in any of the earlier experiments. The mean age was 23 years (range: 20–28). Seventeen were female. The L1 German speakers were all university students and had not learned any L2 before school age. Testing took place in Germany at their home university. Twenty-four new L2 German speakers were also tested. One L2 participant was replaced because he made more than 20 mistakes in the vocabulary pre-test. The final 24 L2 German speakers made a mean of 13 mistakes in the vocabulary pre-test (min: 1, max: 19) and had a mean age of 21 years (min: 19 years, max: 23 years). One started learning French at the age of five; the remaining 23 had not studied any second language before the age of seven. On average, the L2s had studied German for eight years (min: 3, max: 11). Two reported to have stayed in Germany or Austria for no longer than one month at a time, while the remaining 22 L2 German speakers had worked or studied for an average of eight months in Germany or Austria (min: 2 months, max: 12 months). Twelve of the final 24 L2 German speakers were female. All L2 participants were university students. One of them was studying in Germany and tested there. The other 23 were tested at their home universities in the UK (22) or in Australia (1).

Materials and Procedure

The 16 prime items of Experiment 1 were replaced by new items with semantically unambiguous object RCs that had an inanimate NP1, such as sentence (5). Since the prime sentences had animate agents that acted on inanimate patients, different verbs were needed. While Experiment 1 and 2 used verbs that can have animate patients/themes, such as *scare* or *chase*, Experiment 3 used verbs that have inanimate themes, such as *eat* or *read*. One of the two item pictures displayed the correct object reading interpretation and the other picture was again unrelated. The remaining test items were identical to those of Experiment 1.The procedure was identical to that of Experiment 1. The order of the 16 new prime items was balanced over the eight lists. The target items were the same as in Experiments 1 and 2. There was no open-class overlap between the primes and the targets.

Results

The results of Experiment 3 are displayed in Figure 4. The graph shows that the number of OSV readings decreased over the course of the experiment for L1 speakers. For L2 speakers, the numbers of OSV readings increased from the baseline phase to the prime phase, but slightly decreased from the prime phase to the post-test phase. However, for this group the proportions of OSV choices were still higher in the post-test phase than they were in the baseline phase.

Once again collinearity was not an issue in the dataset ($\kappa = 4.30$). The final model for Experiment 3 is shown in Table 4. The phase by nativeness interaction shows that the development of OSV picture selection over the course of the experiment differed for L1 and L2 speakers: L2 speakers were primed whereas L1 speakers were not.

Discussion

In Experiment 3, participants received primes that (1) were high in type frequency compared to those used in Experiments 1 and 2 and (2) contained animacy mismatch with the target structure. The phase by

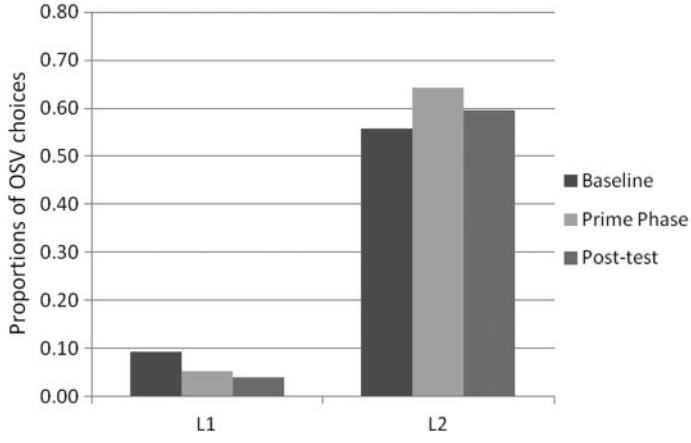

Figure 4. Proportions of object reading choices over the three phases of Experiment 3.

Table 4. Full model of Experiment 3.

	Estimate	Standard error	Wald z	p	Slope
(Intercept)	1.36	0.24	5.61	<.001	
Phase: baseline vs. prime phase	0.07	0.26	0.29	=.78	(p)
Phase: baseline vs. post-test	0.52	0.24	2.17	=.03	(p)
Nativeness	−3.22	0.47	−6.89	<.001	(i)
Interaction:					
Phase: base vs. prime × nativeness	−1.71	0.51	−3.36	<.001	
Phase: base vs. post × nativeness	−1.72	0.48	−3.55	<.001	

nativeness interaction supports our hypothesis that non-native speakers should be more susceptible to priming than L1 speakers: a difference likely to reflect linguistic experience. However, it is unclear from Experiment 3 whether the difference between the groups was due to the type frequency of the prime or to the animacy mismatch between prime and target. Experiment 4 aimed to tease apart the effects of animacy distribution and prime-type frequency.

Experiment 4: Animacy disambiguation, low-type frequency primes

Experiment 4 primed participants with sentences such as (6), which contained an inanimate subject.

(6) Hier ist die Königin, die das Telefon weckt.
'Here is the queen$_{[Obj]}$ that the telephone$_{[Subj]}$ wakes'

As in the prime sentences in Experiment 3 (see example 5), the syntactic ambiguity in (6) is resolved by semantic cues. However, since the head noun is animate, sentence (6) has comparatively low type frequency for an object RC (Kidd et al., 2007; Mak, Vonk, & Schriefers, 2002; Zubin, 1979). The frequency of the prime sentences used in Experiment 4 is therefore comparable to Experiments 1 and 2. However, in contrast to Experiments 1 and 2, Experiment 4 contains an animacy mismatch between primes and targets (all targets contained two animate NPs), as was the case in Experiment 3. If it was the high type frequency of the prime sentences that led to the interaction between phase and nativeness in Experiment 3, then Experiment 4 should yield a priming effect similar to that observed in the first two experiments. If, however, the interaction between phase and nativeness was Experiment 4 was caused by the difference between animacy from the primes to the targets, we should also observe a similar an interaction in Experiment 4, where the numbers of OSV choices increase in the L2 speakers but not in the L1 speakers.

Methods

Participants

Twenty-four (N = 24) new L1 German speakers were tested. All were university students, none had learned any L2 before school age, and all were tested at a university in Germany. None had participated in the earlier experiments. The mean age was 23 years (range: 20–26). Sixteen were female. Twenty-four (N = 24) new L2 German speakers were tested. One L2 participant was replaced because of insufficient vocabulary knowledge. The final 24 L2 German speakers made on average 13 mistakes in the vocabulary pre-test (min: 7, max: 20) and were 22 years old on average (min: 21 years, max: 23 years). None had studied any second language before the age of eight and the average time they had studied German was eight years (min: 3 years, max: 11 years). The L2 German speakers had spent a mean of eight months in Germany or Austria (min: 4 months, max: 12 months). Fifteen were female. All of them were university students and were tested at their home university in the UK.

Materials and Procedure

The prime items of Experiment 1 were replaced by items with semantically disambiguated sentences that had an inanimate NP2 as the subject, as in example (6). The accompanying pictures again offered the only plausible object reading interpretation and an unrelated situation in the other picture. All other items were the same as in Experiment 1. The procedure was identical to that of Experiments 1–3.

Results

The data of Experiment 4 are displayed in Figure 5. As in Experiment 3, the L1 and L2 speakers responded differently over the course of the experiment. While OSV choices decreased slightly in the L1 speakers, the number rose from the baseline phase to the prime phase in the L2 speakers and remained stable over the post-test.

The analysis of Experiment 4 was carried out in the same manner as those of the previous Experiments. Once again, there was no collinearity in the data-set (κ = 4.3). The best-fitting model is shown in Table 5. As in all previous experiments, a significant main effect of nativeness showed that the L2 group made more OSV choices overall than did the L1 group. The significant interactions involving phase and nativeness

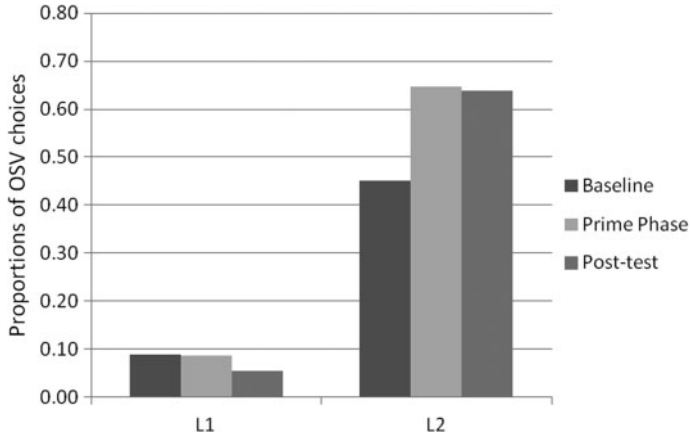

Figure 5. Proportions of object reading choices over the three phases of Experiment 4.

indicate that the development of OSV from the baseline to the prime phase and from the baseline phase to the post-test differed between L1 and L2 speakers. As in Experiment 3, the L1 participants' preference for a SOV interpretation on test trials decreased across the three phases of the experiment. In contrast, the L2 group showed an increase in OSV readings from the baseline to the prime phase and from the baseline to the post-test phase.

Experiment 4 aimed to tease apart the potential influence of type frequency and NP animacy on the priming of German OSV RCs, which were confounded in Experiment 3. The results were similar to those in Experiment 3: the L2 speakers showed an effect of OSV priming, whereas the L1 speakers showed an increase of SOV mappings across the experiment. Since Experiments 3 and 4 differed only in the type frequency of the prime sentence, the results suggest that it was the animacy mismatch between prime and target sentences that resulted in the phase by nativeness interaction in the two experiments. However, the results did seem to be stronger in Experiment 4. To investigate whether these differences were statistically robust we compared Experiments 3 and 4 directly. The variable of the experiment turned out to be nonsignificant as a main effect ($p = 0.25$) and there was no significant interaction involving the experiment (Experiment × Nativeness: $p = 0.60$; phase: base vs. prime: $p = 0.22$; phase: base vs. prime: $p = 0.11$). We can therefore conclude that different type frequencies of the prime items in Experiments 3 and 4 had no effect.

Table 5. Full model of Experiment 4.

	Estimate	Standard error	Wald z	p	Slope
(Intercept)	1.52	0.20	7.58	<.001	
Phase: baseline vs. prime phase	−0.32	0.28	−1.15	0.25	(p)
Phase: baseline vs. post-test	−0.07	0.35	−0.19	0.85	(p)
Nativeness	−2.50	0.40	−6.32	<.001	
Phase: base vs. prime × nativeness	−1.76	0.55	−3.20	=.001	
Phase: base vs. post × nativeness	−2.22	0.70	−3.17	=.002	

Discussion

Experiment 4 replicated the effect of nativeness on priming found in Experiment 3. There was a significant interaction between nativeness and phase, which was due to the fact that the numbers of OSV choices rose in L2 speakers but not in the L1 speakers. This supports our hypothesis that nativeness can affect susceptibility to structural priming. As in Experiment 3, the L1 speakers showed a decrease in OSV mappings across the course of the experiment. In contrast, as in Experiments 1–3, the OSV choices increased in L2 speakers, supporting our hypothesis.

Experiments 3 and 4 differed in the type frequency of the primes but were similar in that they both had an animacy mismatch between prime and target. Since the results did not differ statistically across the two experiments, we can conclude that type frequency within a constructional pattern does not have an appreciable effect on priming, but that animacy affects priming in a significant way. Bock et al. (1992) reported that animacy properties in the prime items were more likely to be reproduced in the target items than alternative animacy distributions. In Bock et al., actives with an inanimate subject such as *The lightning struck the golfer* were more likely to elicit targets that also contain inanimate subjects (e.g. *The boat carried five people*) than a target with an animate subject (e.g. *Five people carried the*

boat). This result suggests that speakers prefer to map thematic roles from prime to target using animacy cues, if available. This same preference may account for the absence of an effect of OSV priming in the L1 speakers in Experiments 3 and 4. In contrast, the fact that the L2 speakers were still primed in both experiments suggests that L2 speakers show stronger priming than L1 speakers across a broader range of linguistic contexts. We will discuss the role of animacy in more detail in the General Discussion.

That type frequency was found not to affect priming is inconsistent with earlier findings that the specific frequency of the prime structure also affects the outcome of priming (see Bock & Loebell, 1990; Hartsuiker & Kolk, 1998b; Hartsuiker et al., 2004, 1999; Harsuiker & Westenberg, 2000; Wells et al. 2009). However, the current research differs from previous in that it manipulated frequency within one single structural type. As such, this suggests a potential limit on frequency effects in priming, which may be limited to competing structures (e.g. active, passive) that can be used to describe the same event.

Additional individual differences analyses

We hypothesised that priming should be stronger in L2 speakers than in L1 speakers because L2 speakers have less experience with the language and are therefore more susceptible to priming (see also Chang et al., 2006; Jaeger & Snider, 2007; Reitter et al., 2011). There is often large within-group variability in priming studies, which in first language acquisition has been linked to linguistic mastery (Kidd, 2012b). An anonymous reviewer suggested that we might also find similar variability in our L2 groups by correlating their vocabulary scores and number of years learning German with the magnitude of their priming effects. None of the correlations was significant (all p values >0.25). Although significant correlations would have provided further support for our argument that experience significantly influences priming, these null results are ambiguous, particularly since we did not have an independent measure of grammatical knowledge. Future research should further explore this type of individual differences design.

General discussion

In the current paper, we presented four structural priming experiments in which prime items were systematically manipulated to investigate whether priming is influenced by a speaker's experience with the language (i.e. whether the participants are L1 or L2 speakers). Our hypothesis, drawing from experience-based approaches to language (Chang et al., 2006; MacDonald, Pearlmutter, & Seidenberg, 1994; Mitchell et al., 1995), was that L2 speakers should be more susceptible to priming than L1 speakers because they have less experience with the language. Since the existence of a nativeness effect on priming in the past literature is unclear (e.g. Flett et al., in press; Nitschke et al., 2010; Shin & Christiansen, 2012), we also hypothesised that such an effect might be subtle, and only likely to be identified when the overall priming effect is weak in L1 speakers. We predicted that there should be instances where L2 speakers would be primed in conditions where L1 speakers are not, and that these conditions should diverge from contexts in which priming has been shown in the literature to be robust. That is, we expected the effect of nativeness on priming to emerge when priming was weakened because of (1) lack of verb overlap, (2) absence of negative feedback, (3) higher type frequency of the prime sentences and (4) animacy mismatches between prime and target. In the case of our particular design, we expected to find the significant experimental phase by nativeness interactions. These were observed in Experiments 3 and 4, where only the L2 groups were primed, but where the L1 groups were not. Thus, our hypothesis was supported.

The data therefore suggest that it was the mismatch in animacy between prime and target that led to the differences in priming between the two groups. Animacy influences speakers' tendency to persist in assigning thematic roles across prime and target (Bock et al., 1992). As such, we can conclude that, in comparison to L1 speakers, less experienced L2 speakers persist in their thematic role assignment across prime and target despite differences that alter the priming effect in L1 speakers. This suggests that L2 speakers cast a wider 'linguistic net' than do L1 speakers, where they more rigidly map thematic roles across prime-target pairs. This does not appear to be related to structural frequency, as shown in Experiments 3 and 4.

We next consider two important issues. Firstly, what is the locus of priming in our data? Secondly, how can we explain the difference in priming in our two groups? Concerning the first issue, although there are some results that suggest priming is purely structural (Bock & Loebell, 1990), considerable evidence now exists to suggest that non-syntactic elements contribute to priming effects. Although it is possible that the effects were structural, the lack of priming for L1 speakers in Experiments 3 and 4, where the primes had the same structure as those in Experiments 1 and 2, suggests an alternative explanation. We suggest two possible sources of the effect. The first appeals to thematic role persistence (Chang, Bock, & Goldberg, 2003), the second appeals to thematic emphasis (Bernolet, Hartsuiker, & Pickering, 2009; Vernice, Pickering, & Hartsuiker, 2012).

Four previous studies have reported thematic role priming in production (Cai, Pickering, & Branigan, 2012; Chang, Bock, & Goldberg, 2003; Hare & Goldberg, 1999; Salamoura & Williams, 2007), all of which tested production. The results of these studies suggest that conceptual information like animacy might be an important modulating influence in thematic role persistence. All four observed thematic role priming in instances of conceptual overlap (i.e. animacy). Hare and Goldberg (1999) showed that the *provide-with* construction (e.g. *The army provided the soldiers with blankets*) primed the DO dative (e.g. *The army gave the soldiers the blankets*). Similarly, Chang et al. (2003) observed priming of thematic role order using the spray/load alternation. In both cases, there was conceptual overlap in the NPs between prime and target. In the case of Hare and Goldberg, there were animate recipients and inanimate themes; in the case of Chang et al., the theme and location were both inanimate. Salamoura and Williams (2007) reported similar effects in L1–L2 Greek–English bilinguals. Cai et al. (2012) observed priming thematic role to linear order (e.g. theme-recipient order primed theme-recipient order) and grammatical function mapping (e.g. theme-direct object, recipient-indirect object) in Mandarin di-transitive sentences, all of which had animate recipients and inanimate themes. In the current research, either thematic role to linear order or thematic role to grammatical function mapping could explain the higher rate of OSV RC interpretations following priming.

Alternatively, the data could be explained with reference to persistence of thematic emphasis (Bernolet et al., 2009; Vernice et al., 2012). Thematic emphasis persistence refers to the tendency to persist in the assignment of particular thematic roles, which subsequently leads to the selection of syntactic structure that is consistent with that initial emphasis. In the context of the current research, thematic emphasis can explain the results by suggesting that OSV primes led to an object- or patient/theme-first emphasis. The current data do not decide between explanations that appeal to either thematic role persistence and thematic emphasis; future research is required to decide between the two.

We now consider the group differences observed in Experiments 3 and 4. Whereas the L1 speakers required both a semantic and a surface structure match across prime-target pairs to pursue the same interpretation, the L2 groups required only the same surface structure, ignoring NP semantics. Snider (2009) argued that similarity between prime and target drives priming, such that the magnitude of priming is directly proportional to the overlap between prime and target. In two analyses of naturalistic speech from the Switchboard Corpus (Marcus, Santorini, & Marcinkiewicz, 1994), Snider showed that the degree of similarity between prime and target, as measured by a formal similarity metric that calculated distance between structures based on features such as *inanimate recipient* and *plural theme*, predicted the choice of di-transitive construction use. Interpreted in this manner, the lack of priming in L1 in Experiments 3 and 4 can be attributed to dissimilarity between prime and target; the animacy mismatch was enough to prevent L1 participants from pursuing the dispreferred OSV reading of the target sentence. The consistent priming effects observed in the L2 group suggests that this group was insensitive to manipulations of animacy, and as such calculate similarity differently to more experienced speakers.

Why does being a less experienced L2 speaker lead to greater persistence in the use of interpretative strategies across dissimilar contexts, and is there a functional explanation for the effect? Consistently mapping NP sentence position to argument roles (or maintaining thematic emphasis) may be a useful language learning strategy, for a number of reasons. Firstly, languages provide a number of cues that constrain interpretation, one of which is word order (see Bates & MacWhinney, 1989). Speakers will be differentially sensitive to such cues depending on their availability and their reliability in a given language. Our L2 speakers all had English as their L1, a language that relies on word order to mark thematic roles; therefore, part of what we are observing may be transfer of language processing strategies from L1 to L2.[3] At the same time, less experienced language users are also likely to experience a processing bottleneck, leading to an inability to coordinate all cues to comprehension that may exist in the language. In such circumstances, it might be useful to persist in the use of comprehension strategies that have been successful in the past. Since our prime trials only provided an OSV reading of prime sentence, the participants were assured of correctly interpreting the sentence. This may then have led to the persistent use of the same interpretive strategy in the test trial. It remains to be seen whether these results generalise across different learners and different linguistic and experimental contexts. The relevant research with L1 and L2 learners has yet to be done, although we note that in unpublished work Thothathiri and Snedeker (2011) reported thematic role persistence in 4-year-old English-speaking children independent of potentially confounding syntactic and conceptual factors (i.e. animacy).

We predicted and found differences in priming according to nativeness, which appears to be due to differences in the two groups' sensitivity to conceptual overlap between prime and target. Following experience-based explanations of priming (e.g. Chang et al., 2006), we originally predicted that any difference between L1 and L2 speakers would be due to differences in representational strength across groups, an explanation

which argues that changes in representational strength as a result of prime processing lead to priming effects. Our results do not rule out the possibility that prime processing was different across groups; however, they are also consistent with the possibility that the group differences were attributable to differences in target processing (e.g. Schoonbaert et al., 2007). That is, it is possible that our L1 and L2 speakers were *equally* affected by prime processing, but that differences in their baseline preferences for OSV interpretations led to differences in their interpretations of the target items. The L2 group had a higher baseline preference for OSV interpretations than the L1 group, a preference that is likely to reflect L1 transfer: all L2 participants had English as their L1, and in English NNV RCs are unambiguously OSV (see Nitschke et al., 2010). Therefore it is possible that, when processing the target sentence, the L2 participants exhibited greater priming because the OSV reading was already more readily available to them. This explanation can be accommodated by experience-based explanations of priming, but can equally be explained by activation-based accounts (e.g. Hartsuiker & Pickering, 2008). Future research is required to decide between these two possibilities.

Conclusion

The present paper investigated whether L2 speakers are more susceptible to priming than L1 speakers. Our L2 participants were primed in Experiments 3 and 4 despite the fact that the primes were fairly dissimilar from the targets, containing different verbs and different animacy configurations. The fact that the L2 participants were primed in a larger and broader set of linguistic contexts than were the L1s suggests that they cast a wider 'linguistic net' than native speakers, where they more rigidly map thematic roles (or persist in thematic emphasis) across prime-target sequences. The data suggest that, although L1 and L2 speakers do not appear to show differences in priming effects in production (e.g. Flett et al., in press), such differences might be clearer in comprehension.

Acknowledgements

Participants for this study were tested at the following universities and we owe the named persons a debt of gratitude for providing testing space and advertising our research to L1 and L2 speakers: The University of Manchester, UK (Wiebke Brockhaus-Grand); Universität Erfurt, Germany (Gerhard Blanken, Tilmann Betsch, Margret Seyboth, Manuela Linde); The University of York, UK (Marilyn Vihman); Liverpool University, UK (Ulrike Bavendiek); The University of Lancaster, UK (Birgit Smith), The University of Bangor, UK (Susanne Schiemenz); Friedrich Schiller Universität, Germany (Holger Diessel); Australian National University, Canberra, Australia (Louise Jansen); The University of Salford, UK (Juliet Wigmore, Charlotte Hofmann). We also thank Roger Mundry (Max Planck Institute for Evolutionary Anthropology) and Neal Snider (University of Rochester) for invaluable statistical advice.

Notes

1. Shin and Christiansen (2012) recently published a study very similar to Bock and Griffin (2000), but with L2 learners of English. In the condition most comparable to Bock and Griffin (dative priming, lag 4), they reported a priming effect of 19.92% versus Bock and Griffin's 7% for their L1 participants. While suggestive, the data between the two studies are not directly comparable because Shin and Christiansen only primed for one structure, and did not include an L1 comparison group.
2. Function kappa.mer() on https://github.com/aufrank/R-hacks/blob/master/mer-utils.R
3. This differs from transfer of structure, which we address below.

References

Arai, M., van Gompel, R. P. G., & Scheepers, C. (2007). Priming ditransitive structures in comprehension. *Cognitive Psychology*, *54*(3), 218–250. doi:10.1016/j.cogpsych.2006.07.001

Baayen, R. H. (2008). *Analyzing linguistic data. A practical introduction to statistics using R*. Cambridge: Cambridge University Press.

Baayen, R. H., Davidson, D. J., & Bates, D. M. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language*, *59*(4), 390–412. doi:10.1016/j.jml.2007.12.005

Bates, E., & MacWhinney, B. (1989). Functionalism and the competition model. In B. MacWhinney & E. Bates (Eds.), *The cross-linguistic study of sentence processing* (pp. 3–76). Cambridge: Cambridge University Press.

Bates, D., & Maechler, M. (2010). lme4: Linear mixed-effects models using S4 classes. R package version 0.999375-33.

Bernolet, S., Hartsuiker, R. J., & Pickering, M. J. (2007). Shared syntactic representations in bilinguals: Evidence for the role of word-order repetition. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *33*(5), 931–949. http://psycnet.apa.org/journals/xlm/33/5/931/

Bernolet, S., Hartsuiker, R. J., & Pickering, M. J. (2009). Persistence of emphasis in language production: A cross-linguistic approach. *Cognition*, *112*(2), 300–317. doi:10.1016/j.cognition.2009.05.013

Bock, J. K. (1986). Syntactic persistence in language production. *Cognitive Psychology*, *18*(3), 355–387. doi:10.1016/0010-0285(86)90004-6

Bock, K., Dell, G. S., Chang, F., & Onishi, K. H. (2007). Persistent structural priming from language comprehension to language production. *Cognition*, *104*(3), 437–458. doi:10.1016/j.cognition.2006.07.003

Bock, K., & Griffin, Z. M. (2000). The persistence of structural priming: Transient activation or implicit learning? *Journal of Experimental Psychology: General*, *129*(2), 177–192. doi:10.1037/0096-3445.129.2.177

Bock, K., & Loebell, H. (1990). Framing sentences. *Cognition*, *35*(1), 1–39. doi:10.1016/0010-0277(90)90035-I

Bock, K., Loebell, H., & Morey, R. (1992). From conceptual roles to structural relations: Bridging the syntactic cleft. *Psychological Review*, *99*(1), 150–171. doi:10.1037/0033-295X.99.1.150

Brandt, S., Kidd, E., Lieven, E., & Tomasello, M. (2009). The discourse bases of relativization: An investigation of young German and English-speaking children's comprehension of relative clauses. *Cognitive Linguistics*, *20*(3), 539–570. doi:10.1515/COGL.2009.024

Branigan, H. (2006). Syntactic priming. *Language and Linguistics Compass*, *1*, 2–16. http://onlinelibrary.wiley.com/doi/10.1111/j.1749-818X.2006.00001.x/abstract

Branigan, H. P., Pickering, M. J., & McLean, J. F. (2005). Priming prepositional-phrase attachment during comprehension. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *31*(3), 468–481. doi:10.1037/0278-7393.31.3.468

Cai, Z. G., Pickering, M. J., & Branigan, H. P. (2012). Mapping concepts to syntax: Evidence from structural priming in Mandarin Chinese. *Journal of Memory and Language*, *66*(4), 833–849. doi:10.1016/j.jml.2012.03.009

Carroll, S., & Swain, M. (1993). Explicit and implicit negative feedback: An empirical study of the learning of linguistic generalizations. *Studies in Second Language Acquisition*, *15*(03), 357–386. doi:10.1017/S0272263100012158

Chang, F., Bock, K., & Goldberg, A. E. (2003). Can thematic roles leave traces in their places? *Cognition*, *90*(1), 29–49. doi:10.1016/S0010-0277(03)00123-9

Chang, F., Dell, G. S., & Bock, K. (2006). Becoming syntactic. *Psychological Review*, *113*(2), 234–272. doi:10.1037/0033-295X.113.2.234

Chang, F., Dell, G. S., Bock, K., & Griffin, Z. M. (2000). Structural priming as implicit learning: A comparison of models of sentence production. *Journal of Psycholinguistic Research*, *29*(2), 217–230. doi:10.1023/A:1005101313330

Cleland, A. A., & Pickering, M. J. (2006). Do writing and speaking employ the same syntactic representations? *Journal of Memory and Language*, *54*(2), 185–198. doi:10.1016/j.jml.2005.10.003

Corley, M., & Scheepers, C. (2002). Syntactic priming in English sentence production: Categorical and latency evidence from an Internet-based study. *Psychonomic Bulletin & Review*, *9*(1), 126–131. doi:10.3758/BF03196267

Ferreira, V. S., & Bock, K. (2006). The functions of structural priming. *Language and Cognitive Processes*, *21*(7–8), 1011–1029. doi:10.1080/01690960600824609

Ferreira, V. S., Bock, K., Wilson, M. P., & Cohen, N. J. (2008). Memory for syntax despite amnesia. *Psychological Science*, *19*(9), 940–946. doi:10.1111/j.1467-9280.2008.02180.x

Flett, S., Branigan, H. P., & Pickering, M. J. (in press). Are non-native structural preferences affected by native language preferences? *Bilingualism: Language and Cognition*.

Fox, B. A., & Thompson, S. A. (1990). A discourse explanation of the grammar of relative clauses in English conversation. *Language*, *66*(2), 297–316. doi:10.2307/414888

Fox, B. A., & Thompson, S. A. (2007). Relative clauses in English conversation: Relativizers, frequency, and the notion of construction. *Studies in Language*, *31*(2), 293–326. doi:10.1075/sl.31.2.03fox

Gennari, S. P., & MacDonald, M. C. (2008). Semantic indeterminacy in object relative clauses. *Journal of Memory and Language*, *58*(2), 161–187. doi:10.1016/j.jml.2007.07.004

Hare, M. L., & Goldberg, A. E. (1999). Structural priming: Purely syntactic? In M. Hahn & S. C. Stones (Eds.), *Proceedings of the 21st annual meeting of the Cognitive Science Society* (pp. 208–211). Mahwah, NJ: Lawrence Erlbaum Associates.

Hartsuiker, R. J., Bernolet, S., Schoonbaert, S., Speybroeck, S., & Vanderelst, D. (2008). Syntactic priming persists while the lexical boost decays: Evidence from written and spoken dialogue. *Journal of Memory and Language*, *58*(2), 214–238. doi:10.1016/j.jml.2007.07.003

Hartsuiker, R. J., & Kolk, H. H. J. (1998a). Syntactic facilitation in agrammatic sentence production. *Brain and Language*, *62*(2), 221–254. doi:10.1006/brln.1997.1905

Hartsuiker, R. J., & Kolk, H. H. J. (1998b). Syntactic persistence in Dutch. *Language and Speech*, *41*(2), 143–184. http://las.sagepub.com/content/41/2/143.full.pdf+html

Hartsuiker, R. J., Kolk, H. H. J., & Huiskamp, P. (1999). Priming word order in sentence production. *Quarterly Journal of Experimental Psychology*, *52A*(1), 129–147. www.tandfonline.com/doi/abs/10.1080/713755798

Hartsuiker, R. J., & Pickering, M. J. (2008). Language integration in bilingual sentence production. *Acta Psychologica*, *128*(3), 479–489. doi:10.1016/j.actpsy.2007.08.005

Hartsuiker, R. J., Pickering, M. J., & Veltkamp, E. (2004). Is syntax separate or shared between languages? Cross-linguistic syntactic priming in spanish-english bilinguals. *Psychological Science*, *15*(6), 409–414. doi:10.1111/j.0956-7976.2004.00693.x

Hartsuiker, R. J., & Westenberg, C. (2000). Word order priming in written and spoken sentence production. *Cognition*, *75*(2), B27–B39. http://www.sciencedirect.com/science/article/pii/S0010027799000803

Jaeger, T. F. (2008). Categorical data analysis: Away from ANOVAs (transformation or not) and towards logit mixed models. *Journal of Memory and Language*, *59*(4), 434–446. doi:10.1016/j.jml.2007.11.007

Jaeger, T. F., & Snider, N. (2007). Implicit learning and syntactic persistence: Surprisal and cumulativity. In L. Wolter & J. Thorson, *University of Rochester working papers in the language sciences* (Vol. 3(1), pp. 26–44). Rochester, NY.

Jaeger, T. F., & Snider, N. (2013). Alignment as a consequence of expectation adaptation: Syntactic priming is affected by the prime's prediction error given both prior and recent experience. *Cognition*, *127*(1), 57–83. doi:10.1016/j.cognition.2012.10.013

Kaiser, E., & Trueswell, J. C. (2004). The role of discourse context in the processing of a flexible word-order language. *Cognition*, *94*(2), 113–147. doi:10.1016/j.cognition.2004.01.002

Kamide, Y., & Mitchell, D. C. (1999). Incremental pre-head attachment in Japanese parsing. *Language and Cognitive Processes*, *14*s(5–6), 631–662. doi:10.1080/016909699386211

Kaschak, M. P. (2007). Long-term structural priming affects subsequent patterns of language production. *Memory & Cognition*, *35*(5), 925–937. doi:10.3758/BF03193466

Kidd, E. (2012a). Implicit statistical learning is directly associated with the acquisition of syntax. *Developmental Psychology*, *48*(1), 171–184. doi:10.1037/a0025405

Kidd, E. (2012b). Individual differences in syntactic priming in language acquisition. *Applied Psycholinguistics*, *33*(02), 393–418. doi:10.1017/S0142716411000415

Kidd, E., Brandt, S., Lieven, E., & Tomasello, M. (2007). Object relatives made easy: A cross-linguistic comparison of the constraints influencing young children's processing of relative clauses. *Language and Cognitive Processes*, *22*(6), 860–897. doi:10.1080/01690960601155284

Knoeferle, P., Crocker, M. W., Scheepers, C., & Pickering, M. J. (2005). The influence of the immediate visual context on incremental thematic role-assignment: Evidence from eye-movements in depicted events. *Cognition*, *95*(1), 95–127. doi:10.1016/j.cognition.2004.03.002

Levelt, W. J. (1989). *Speaking: From intention to articulation*. Cambridge, MA: MIT Press.

Loebell, H., & Bock, K. (2003). Structural priming across languages. *Linguistics*, *41*(5), 791–824. doi:10.1515/ling.2003.026

MacDonald, M. C., Pearlmutter, N. J., & Seidenberg, M. S. (1994). Lexical nature of syntactic ambiguity resolution. *Psychological Review*, *101*(4), 676–703. doi:10.1037/0033-295X.101.4.676

MacWhinney, B., James, J. S., Schunn, C., Li, P., & Schneider, W. (2001). STEP—A system for teaching experimental psychology using E-Prime. *Behavior Research Methods, Instruments, & Computers*, *33*(2), 287–296. doi:10.3758/BF03195379

Mak, W. M., Vonk, W., & Schriefers, H. (2002). The influence of animacy on relative clause processing. *Journal of Memory and Language*, *47*(1), 50–68. doi:10.1006/jmla.2001.2837

Marcus, M. P., Santorini, B., & Marcinkiewicz, M. A. (1994). Building a large annotated corpus of English: The Penn Treebank. *Computational Linguistics*, *19*(2), 313–330. http://acl.ldc.upenn.edu/J/J93/J93-2004.pdf

McDonough, K. (2005). Identifying the impact of negative feedback and learners' responses on ESL question development. *Studies in Second Language Acquisition*, *27*(01), 79–103. doi:10.1017/S0272263105050047

Messenger, K., Branigan, H. P., & McLean, J. F. (2011). Evidence for (shared) abstract structure underlying children's short and full passives. *Cognition*, *121*(2), 268–274. doi:10.1016/j.cognition.2011.07.003

Mitchell, D. C., Cuetos, F., Corley, M. M. B., & Brysbaert, M. (1995). Exposure-based models of human parsing: Evidence for the use of coarse-grained (nonlexical) statistical records. *Journal of Psycholinguistic Research*, *24*(6), 469–488. doi:10.1007/BF02143162

Nicol, J. L., & Pickering, M. J. (1993). Processing syntactically ambiguous sentences: Evidence from semantic priming. *Journal of Psycholinguistic Research*, *V22*(2), 207–237. http://link.springer.com/article/10.1007/BF01067831

Nitschke, S., Kidd, E., & Serratrice, L. (2010). First language transfer and long-term structural priming in comprehension. *Language and Cognitive Processes*, *25*(1), 94–114. doi:10.1080/01690960902872793

Pickering, M. J., & Branigan, H. P. (1998). The representation of verbs: Evidence from syntactic priming in language production. *Journal of Memory and Language*, *39*(4), 633–651. doi:10.1006/jmla.1998.2592

Pickering, M. J., & Ferreira, V. S. (2008). Structural priming: A critical review. *Psychological Bulletin*, *134*(3), 427–459. doi:10.1037/0033-2909.134.3.427

Pickering, M. J., McLean, J. F., & Branigan, H. P. (in press). Persistent structural priming and frequency effects during comprehension. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, doi:10.1037/a0029181

Prat-Sala, M., & Branigan, H. P. (2000). Discourse constraints on syntactic processing in language production: A cross-linguistic study in English and Spanish. *Journal of Memory and Language*, *42*(2), 168–182. doi:10.1006/jmla.1999.2668

Prat-Sala, M., Shillcock, R., & Sorace, A. (2000). Animacy effects on the production of object-dislocated descriptions by Catalan-speaking children. *Journal of Child Language*, *27*(1), 97–117. doi:10.1017/S0305000999004031

R Development Core Team. (2009). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing.

Raffray, C. N., Pickering, M. J., & Branigan, H. P. (2007). Priming the interpretation of noun-noun combinations. *Journal of Memory and Language*, *57*(3), 380–395. doi:10.1016/j.jml.2007.06.009

Reitter, D., Keller, F., & Moore, J. D. (2011). A Computational Cognitive Model of syntactic priming. *Cognitive Science*, *35*(4), 587–637. doi:10.1111/j.1551-6709.2010.01165.x

Roland, D., Dick, F., & Elman, J. L. (2007). Frequency of basic English grammatical structures: A corpus analysis. *Journal of Memory and Language*, *57*(3), 348–379. doi:10.1016/j.jml.2007.03.002

Rowland, C. F., Chang, F., Ambridge, B., Pine, J. M., & Lieven, E. V. M. (2012). The development of abstract syntax: Evidence from structural priming and the lexical boost. *Cognition*, *125*(1), 49–63. doi:10.1016/j.cognition.2012.06.008

Salamoura, A., & Williams, J. N. (2007). Processing verb argument structure across languages: Evidence for shared representations in the bilingual lexicon. *Applied Psycholinguistics*, *28*(04), 627–660. doi:10.1017/S0142716407070348

Scheepers, C., & Crocker, M. W. (2004). Constituent order priming from reading to listening: A visual-world study. In M. Carreiras & C. Clifton Jr (Eds.), *The on-line study of sentence comprehension: Eye-tracking, ERP and beyond* (pp. 167–185). New York: Psychology Press.

Schoonbaert, S., Hartsuiker, R. J., & Pickering, M. J. (2007). The representation of lexical and syntactic information in bilinguals: Evidence from syntactic priming. *Journal of Memory and Language*, *56*(2), 153–171. doi:10.1016/j.jml.2006.10.002

Seger, C. A. (1994). Implicit learning. *Psychological Bulletin*, *115*(2), 163–196. doi:10.1037/0033-2909.115.2.163

Shin, J. -A., & Christianson, K. (2012). Structural priming and second language learning. *Language Learning*, *62*, 931–964.

Snider, N. (2008). *An exemplar model of structural priming* (PhD thesis). Stanford University, CA, Stanford.

Snider, N. (2009). Similarity and structural priming. In N. A. Taatgen & H. van Rijn (Eds.), *Proceedings of the 31st Annual Conference of the Cognitive Science Society* (pp. 815–820). Austin, TX: Cognitive Science Society.

Thothathiri, M., & Snedeker, J. (2008). Give and take: Syntactic priming during spoken language comprehension. *Cognition*, *108*(1), 51–68. doi:10.1016/j.cognition.2007.12.012

Thothathiri, M., & Snedeker, J. (2011). *The role of thematic roles in sentence processing: Evidence from structural priming in young children*. Unpublished manuscript.

Tooley, K. M., Traxler, M. J., & Swaab, T. Y. (2009). Electrophysiological and behavioural evidence of syntactic priming in sentence comprehension. *Journal of Experimental Psychology: learning, Memory, & Cognition*, *35*(1), 19–45. doi:10.1037/a0013984

Traxler, M. J., Morris, R. K., & Seely, R. E. (2002). Processing subject and object relative clauses: Evidence from eye movements. *Journal of Memory and Language*, *47*(1), 69–90. doi:10.1006/jmla.2001.2836

Vernice, M., Pickering, M. J., & Hartsuiker, R. J. (2012). Thematic emphasis in language production. *Language and Cognitive Processes*, *27*(5), 631–664. doi:10.1080/01690965.2011.572468

Wells, J. B., Christiansen, M. H., Race, D. S., Acheson, D. J., & MacDonald, M. C. (2009). Experience and sentence processing: Statistical learning and relative clause comprehension. *Cognitive Psychology*, *58*(2), 250–271. doi:10.1016/j.cogpsych.2008.08.002

Zubin, D. A. (1979). Discourse function of morphology: The focus system in German. In T. Givón (Ed.), *Syntax and semantics: Discourse and syntax* (Vol. 12, pp. 469–504). New York: Academic Press.

APPENDIX

Vocabulary of the pre-test: German/English

Kellnerin/waitress
Sängerin/singer (f)
Fotografin/photographer (f)
Krankenschwester/nurse (f)
Räuber/robber (m)
Großmutter/grandmother
Malerin/painter (f)
Polizist/police man
Königin/queen
Hexe/witch
Koch/chef (m)
Nonne/nun
Tennisspielerin/tennis player (f)
Violinistin/violinist (f)
Stock/stick
Fernglas/binoculars
Hut/hat
Karotte/carrot
Kegel/cone
Blume/flower
Leine/leash
Schläger/racquet
Sonnenbrille/sun glasses
Regenschirm/umbrella
Pistole/gun
Lineal/ruler
Schal/scarf
Spritze/syringe
Bürste /brush
Röhre/tube
umarmen/to hug
suchen/to search
rufen/to call
schlagen/to hit
kratzen/to scratch
wählen/to chose
verfolgen/to follow
beschimpfen/to insult
bedrohen/to threaten
kämmen/to comb
kneifen/to pinch
grüßen/to wave
erschrecken/to scare
schubsen/to shove
bespritzen/to splash
strangulieren/to strangle
wecken/to wake
berühren/to touch
sehen/to see
halten /to hold