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Lexical activation of cross-language syntactic priming*

ANGELIKI SALAMOURA
JOHN N. WILLIAMS
Research Centre for English and Applied Linguistics
University of Cambridge

Cross-language (L1-to-L2) syntactic priming is the repetition of utterance structure from one language to another independently of meaning and has motivated models of language-shared representations of L1-L2 equivalent structures (Salamoura and Williams, submitted; Schoonbaert, Hartsuiker and Pickering, submitted). These models assume that the phenomenon is the result of residual activation of syntactic features encoding verb structural preferences and they, therefore, predict its initiation by a single verb prime (cf. Pickering and Branigan, 1998, for L1). This prediction was confirmed in a sentence completion task where we obtained syntactic priming from L1 Dutch to L2 English with Prepositional Object (PO) and Double Object (DO) datives upon presentation of single Dutch verbs that take either PO or DO only.

Introduction

Syntactic priming is a paradigm that has been increasingly used to investigate structural processing and representation during sentence production. It concerns the tendency to repeat the same structure from utterance to utterance independently of sentence meaning or morphophonological form. Syntactic priming has been repeatedly obtained within L1 with various languages (e.g. English: Bock, Loebell and Morey, 1992; Dutch: Hartsuiker and Westenberg, 2000; German: Scheepers, 2003), using different structures (e.g. datives and passives: Bock and Loebell, 1990; co-ordinate noun phrases: Smith and Wheeldon, 2001; simple and complex noun phrases: Cleland and Pickering, 2003), tasks (e.g. picture description: Bock, 1986; sentence completion: Pickering and Branigan, 1998; dialogue task: Branigan, Pickering and Cleland, 2000; sentence recall: Potter and Lombardi, 1998) and populations (e.g. aphasics: Saffran and Martin, 1997; Hartsuiker and Kolk, 1998; SLI children: Leonard et al., 2002; healthy children: Huttenlocher, Vasilyeva and Shimpi, 2004; children who stutter: Anderson and Conture, 2004).

Recently, syntactic priming has also been reported across languages from L1 to L2 (Heydel and Murray, 2000; Loebell and Bock, 2003; Hartsuiker, Pickering and Veltkamp, 2004; Salamoura and Williams, submitted; Schoonbaert et al., submitted). In a sentence completion task, for instance, Salamoura and Williams (submitted) showed that Greek advanced learners of English who completed an L1 prime sentence fragment with a particular structure, e.g. Prepositional Object (PO) such as *Ο πρόεδρος έδωσε το χρυσό μετάλλιο ... στο νικητή* (= *The president gave the gold medal ... to the winner*), were more likely to fill in an L2 target fragment such as *The hotel receptionist gave ...* with the same structure, e.g. *... the keys to the customer*, rather than a semantically alternative Double Object (DO) structure, e.g. *... the customer the keys*. To minimise any lexical or discourse level influences from primes to targets, Salamoura and Williams used an intransitive filler fragment between the prime and target items of this paradigm. This manipulation ensures that the observed cross-linguistic priming reflects structural repetition from L1 to L2 independently – to a large extent – of lexical and discourse factors. L1-to-L2 syntactic priming – with adjacent primes-targets though – has also been observed during picture description from Dutch to English with PO and DO structures (Schoonbaert et al., submitted), from Spanish to English with passive constructions only (Hartsuiker et al., 2004) and from German to English with actives and passives (Heydel and Murray, 2000), and DOs (Loebell and Bock, 2003). Finally, structural repetition has been found in L2 English (Schoonbaert et al., submitted). (For a review and critical evaluation of these studies see Salamoura and Williams, submitted.)

Despite its extensive use within L1 and lately across languages, a number of issues about the workings of this phenomenon await further enquiry. One main question regards the nature of the mechanism underlying syntactic priming. Pickering and Branigan (1998, see also Branigan, et al., 1995; Pickering, Branigan, Cleland and Stewart, 2000) attribute syntactic priming to feature-based activation at the lemma level. Verb lemmas, for instance, are linked to "combinatorial" nodes that encode

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Address for correspondence
Angeliki Salamoura, Centre for Speech and Language, Dept. of Experimental Psychology, University of Cambridge, Downing Site, Cambridge CB2 3EB, UK
E-mail:*as350@cam.ac.uk*

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their different possible combinations with postverbal constituents. The activation of a particular feature ("combinatorial") node does not dissipate immediately and can therefore influence the processing of a following utterance that includes a verb which can opt for that particular combination. For example, the use of the verb *give* in the utterance *She gave a tip to the waiter* results in the activation of the lemma node for *give* and the combinatorial node for the Prepositional Object structure (NP_PP) as opposed to the combinatorial node for the Double Object structure (NP_NP) which is also linked to the lemma *give*. Subsequent utterances that can employ the previously selected PO combinatorial node and its corresponding structure will be more likely to do so as its activation level will be higher than normal, or at least higher than the activation of the DO node. (But see also Bock and Griffin (2002) for an implicit learning explanation of the phenomenon within L1, which we will consider in the Discussion section below.)

Supporting evidence for the lexicalist nature of syntactic priming in L1, and hence of the Pickering and Branigan (1998) model, derives from a recent study (Melinger and Dobel, 2005) which showed that syntactic priming in L1 is not only phrasally-driven but can also be lexically-triggered, as a feature-based account of syntactic priming would assume. Using picture description in L1 Dutch and German in which the prime was a single verb presented in isolation, Melinger and Dobel (2005) obtained more PO descriptions following the presentation of a single prime verb that could take only a PO structure than following a prime verb that could take only a DO structure. DO descriptions yielded complementary results. They explain this priming as activation spreading from the single verb prime to the associated structural frame (PO or DO) which becomes more accessible for subsequent selection due to residual activation. These findings show that syntactic priming in L1 sentence production can occur in the context of a single prime verb, suggesting that it is lexically-driven and thus lending support to the feature-based account. Similar results have also been reported in L1 sentence comprehension. Trueswell and Kim (1998) found that during sentence reading in L1 the syntactic preferences activated by a briefly displayed single verb were enough to bias the readers' resolution of temporary syntactic ambiguities. In neither of the studies were the prime verbs repeated in the target utterances, suggesting that the effects were due to activation of abstract syntactic information.

In the bilingual literature, based on findings of cross-language (L1-to-L2) priming, Salamoura and Williams (submitted) as well as Schoonbaert et al. (submitted) proposed models of shared structural representations for L1 and L2 verbs. The models are based on Pickering and Branigan's (1998) monolingual model of the representation of syntactic information of verbs and by extension on Roelofs' (1993) and Levelt, Meyer and Roelofs' (1999) models of lexical access for verbs. Both bilingual models assume that structural information associated with verbs is represented at the lemma level and is linked to and activated by verb lemmas, the abstract representation of a word.[1] Lemmas in the bilingual lexicon are also associated with a language tag (e.g. Green, 1998). Structural information that is equivalent across languages is encoded once in the bilingual mental lexicon by means of language-independent combinatorial nodes that are shared between L1 and L2 verb lemmas. According to these models, cross-language priming is explained as follows. When bilinguals listen to or produce an utterance[2] with a particular structure (e.g. PO) in one language, they activate the appropriate verb lemma in that language and then activation spreads to the language-shared combinatorial nodes that encode the PO structure (e.g. NP-Theme & PP-Recipient in Salamoura and Williams, submitted; the PO node in Schoonbaert et al., submitted). This activation does not dissipate immediately and makes it more likely that bilinguals reselect the PO structure rather than the semantically alternative DO structure when producing an utterance in the other language with a ditransitive verb that can take either PO or DO to express the intended message.

Leaving aside the differences between the two bilingual models (which regard the amount of information encoded in the combinatorial nodes), what is relevant for current purposes is that both models assume a feature-based activation account of cross-language (L1-to-L2) syntactic priming – the structural information is linked to and activated by verb lemmas. They therefore predict that cross-language (L1-to-L2) syntactic priming can be lexically activated. This prediction, however, has not been empirically tested. Thus, the aim of this study is to elaborate further the claims of the lexicalist account in the bilingual lexicon by testing one of its main predictions – that cross-language syntactic priming can be initiated by a single verb. We therefore used the cross-language (L1-to-L2) oral sentence completion task with dative alternation as the test structure (Salamoura and Williams, submitted) but we modified it so that the primes were single verbs which had to be read silently (as part of a recognition memory task) instead of sentence fragments

[1] Within the lemma stratum lemmas also have links to and can activate other syntactic information such as syntactic category, tense, person, number and mood (cf. Roelofs, 1993). Beyond this level, lemmas are also linked to semantic information at the semantic/conceptual level and morphophonological information at the lexeme or word-form level. The discussion of these other information and levels is, however, beyond the scope of the present paper and will not be detailed here.

[2] The lemma level is shared between comprehension and production, accounting for priming resulting either from listening to or producing prime utterances (Branigan, Pickering and Cleland, 2000).

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which participants had to complete. The L1 was Dutch and the L2 English. Melinger and Dobel's (2005) Dutch prime materials were used. Dutch was chosen as the prime language because it has two subcategories of ditransitive verbs that do not participate in the dative alternation. One subcategory can be used with a PO structure only (PO-only verbs, see example 1) whereas the other subcategory can take a DO only (DO-only verbs, see example 2).

(1) *PO-only verb (e.g. schreeuwen "yell (out), scream")*
De brandweerman schreeuwde een waarschuwing naar de drenkeling.
"The fireman yelled out a warning to the drowning person."
*De brandweerman schreeuwde de drenkeling een waarschuwing.
*"The fireman yelled out the drowning person a warning."

(2) *DO-only verb (e.g. kosten "cost")*
Het harde rijden kostte de jonge man zijn rijbewijs.
"Driving fast cost the young man his driving licence."
*Het harde rijden kostte zijn rijbewijs aan de jonge man.
*"Driving fast cost his driving licence to the young man."

The target items were still L2 sentence fragments designed to induce either a PO or DO (e.g. *The hotel receptionist gave* . . .). Oral sentence completion with datives and full sentence primes has been successfully used to obtain syntactic priming effects both within L1 (Branigan, Pickering, Stewart and McLean, 2000) and from L1 to L2 (Salamoura and Williams, submitted). Assuming that the combinatorial information of verbs can be activated by a single verb (cf. Melinger and Dobel, 2005), the processing of a PO-only or DO-only Dutch verb prime should be sufficient to bias speakers' structural preferences in a subsequent English target sentence according to the feature-based account of cross-language syntactic priming. Note also that this prediction holds on the basis of three additional assumptions: i) L1 and L2 equivalent syntactic structures can be shared between languages, ii) activation cascades from the verb lemma to syntactic representations, and iii) this cascading seems to activate certain syntactic representations, even if these representations are not the most dominant one for a given verb (e.g. the PO structure for a PO-only ditransitive verb even if this verb also has a – possibly more frequent – transitive frame). These assumptions are also implicit in the two lexicalist models of bilingual syntactic representation (Salamoura and Williams, submitted; Schoonbaert et al., submitted). Note finally that Dutch and English ditransitive structures are sufficiently equivalent to induce cross-language syntactic priming – Schoonbaert et al. (submitted) obtained such priming with full sentence primes.

Experiment

Method

Participants

Twenty-six native Dutch-speaking advanced learners of English took part. A detailed profile of the participants was gained through a language history questionnaire that they filled in at the beginning of the experimental session. Participants were either students or academic staff at the University of Cambridge in a variety of subjects. All had an advanced level language certificate in English, such as TOEFL, IELTS, A-levels or the Dutch equivalent of British A-levels. On average they started learning English at the age of 10.6 (*SD* 2.2) and they had received 7.5 years (*SD* 3.4) of formal instruction; they had lived in an English-speaking country an average of 2.6 years ($SD = 4.29$). Nine of them reported learning English through formal instruction and seventeen through a combination of classroom instruction and exposure to an English-speaking environment. All spoke at least one other foreign language apart from English ($M = 2.2$) but none were balanced bilingual in any of them. They scored a mean of 3.06 (*SD* 0.39) on Bachman and Palmer's (1989) self-assessment 4-point scale measuring L2 communicative competence and a mean of 8.38 (*SD* 0.88) when asked to rate their L2 oral proficiency on a 10-point scale.

Materials

The critical experimental material consisted of Dutch PO-only or DO-only ditransitive verbs (the same as in Melinger and Dobel's (2005) Experiment 2) and English sentence fragments whose main verb was a ditransitive (e.g. *give*, *send*) that alternates between the two dative structures. These verbs and sentence fragments were incorporated into 16 sets of items (see Appendix). Each set included two filler items (e.g. a single noun and an intransitive filler fragment), a prime item consisting of a single verb, and a target sentence fragment. Table 1 provides an example set of items.

The prime items (verbs) were always in Dutch (L1) and the target sentence fragments always in English (L2).

Table 1. *Example set of critical material.*

FILLER:		taal (= language)
PRIME:	(a):	schreeuwen (= yell, scream) [PO-only verb]
	(b):	kosten (= cost) [DO-only verb]
FILLER:		The team captain cheered . . .
TARGET:		The hotel receptionist gave . . .

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To preclude any lexical influences from primes to targets, an intransitive filler fragment intervened between them. These intervening items were always English sentence fragments to avoid having a language or a trial type switch just before the target fragment completion. Every target fragment contained a subject NP followed by a ditransitive verb and it could be completed either with a DO construction (i.e. NP NP) or a PO construction (i.e. NP PP). The filler items preceding the prime items were always Dutch nouns.

The prime fragments included a single ditransitive verb that could be of two types: a ditransitive verb that can be used in the PO – but not the DO – structure (e.g. (a)) or a ditransitive verb that can be used in the DO – but not the PO – structure (e.g. (b)). Thus, each of the 16 target fragments occurred with 2 different prime types: a) PO-only prime and b) DO-only prime. All prime verbs were presented in the infinitive form, which is the most natural form when a single verb is presented in isolation in Dutch. The target verbs were in past tense, perfective aspect and single number. However, differences in tense, aspect and number between prime and target verbs do not affect the magnitude of priming as shown by Pickering and Branigan (1998).

Eight PO-only and eight DO-only Dutch ditransitive verbs were included in the prime items. Their subcategorisation restrictions were identified in a sentence production pre-test conducted by Melinger and Dobel (2005).[3] Four English ditransitive verbs (*give*, *send*, *offer*, *lend*) were the main verbs of the target sentence fragments. All four verbs had been used in previous sentence completion tasks and were reported to produce relatively low proportions of other (i.e. non-PO or non-DO) completions (Pickering and Branigan, 1998; Branigan, Pickering and Cleland, 1999; Branigan, Pickering, Stewart and McLean, 2000, for L1 English; Salamoura and Williams, submitted, for L2 English).

Apart from the filler items incorporated in the 16 sets of critical items described above, 88 additional filler items were constructed. Forty-four of them were single words (22 nouns and 22 verbs) and 44 sentence fragments of various syntactic form, e.g. noun phrase, noun phrase + verb, noun phrase + verb + noun phrase. Half of these fillers were in Dutch and half in English. None of the filler fragments included a ditransitive verb that could be completed with a DO or PO construction. Including the fillers in the critical sets, there were 120 fillers in total, half of which were words and half sentence fragments. Overall, half of the total material (including primes and targets) were in Dutch (38 words (19 nouns and 19 verbs) and 38 sentence fragments) and the other half in English (38 words (19 nouns and 19 verbs) and 38 sentence fragments). The order of the presentation of filler items resembled that of the items in the critical sets as closely as possible.

As in Melinger and Dobel's (2005) monolingual study, a secondary recognition memory task was incorporated into the main task to prompt participants to read and pay attention to the word stimuli, and to ensure that they were actually doing so. There were 3 "word recognition memory" sections, one after every 51 trials (including 5–6 critical sets of items). In each of these sections participants were asked to indicate whether a number of words occurred in the previous "presentation" section or not. Each "word recognition memory" section had 14 trials. Half of the trials contained Dutch words and half English words. Half contained nouns and half verbs. Half had been included in the previous "presentation" section and half had not been included in the previous "presentation" section or anywhere else in the whole task. The Dutch recognition memory items always preceded the English and participants were notified about it by screen instructions.

The experimental items were allocated into two presentation lists. Each list contained the 16 sets of items (i.e. 16 primes, 16 targets and 32 fillers), 88 filler items and 10 practice items, a total of 162 items. Each list contained 8 sets of items from each condition so that each set appeared in only one of its two versions in each list. The order of items was individually randomised for each participant under the constraints that no more than 3 sets of items from the same condition occurred in succession, and that at least 5 filler items intervened between targets and the following primes.

Procedure

Participants were individually tested and were randomly allocated to one of the two lists. For the word trials, participants were instructed to read silently and pay attention to the single words appearing on the screen because they would be asked to recognise some of them at a later stage. For the fragment trials, participants were asked to repeat aloud and complete sentence fragments in any way they wished provided that the resulting sentence was grammatically correct and semantically plausible. It was also stressed that they should start repeating each fragment as soon as it appeared on screen and subsequently complete it with the first completion that came to mind as there was a limited time to respond. A beep sound warned them that the next fragment was to appear soon. In the "word recognition memory" sections participants were presented with single words and they had to press the YES button on the response box if they

[3] Post-experimentally it was found that some native Dutch speakers also accept a DO version for one of the verbs that was classified as PO-only (*uitreiken*). A possible reason is regional variation. But even if one takes into account that *uitreiken* might have activated two alternative syntactic frames for some participants, or else, even if *uitreiken* might have functioned as a neutral item triggering both structures, this obviously did not eliminate the priming effect.

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had seen the word in the previous presentation section and the NO button if they had not seen it in the previous presentation section. The dominant hand was always used for the YES responses.

The SuperLab software controlled the presentation of the experimental material and the recording of YES and NO responses in the "word recognition memory" sections. Responses in the fragment trials were recorded externally into a tape recorder. In the sentence trials, a fixation point (*) was presented for 1000 ms followed by the sentence fragment for 5000 ms. After an interval of 1000 ms a beep sound was played. The next trial started 1000 ms later. In the word trials, instead of a sentence fragment, a word was presented for 850 ms. The location of the fixation point on the PC screen was the same in both sentence and word trials and marked the beginning of the following sentence fragment or single word. Each sentence trial lasted about 8000 ms whereas each word trial about 4000 ms.

The experimental task was preceded by a short practice section consisting of 10 presentation trials (5 sentence fragments and 5 single words) and a very brief "word recognition memory" section including 4 trials. Each experimental session lasted approximately 30 minutes including three breaks that occurred after the "word recognition memory" sections. After the session, participants were asked whether they had tried to incorporate the single words in phrases or sentences to help later recognition. Two participants who reported having sometimes used such a strategy were replaced.

Scoring

Each experimental session was recorded, transcribed and scored. Branigan, Pickering, Stewart and McLean's (2000) scoring method was followed. Target completions were scored as PO, DO, or Other. A completion was scored as PO if it met the following criteria: a) if the ditransitive verb was followed by a noun phrase with the thematic role of theme or patient and then a prepositional phase with the preposition *to* and the thematic role of recipient/goal (V NP PP); b) if the ditransitive verb was not part of a phrasal verb construction (e.g. *show off*; this is a standard exclusion criterion employed in previous syntactic priming studies in English which used the sentence completion task, e.g. Pickering and Branigan, 1998; Pickering, Branigan and McLean, 2002); and c) if its DO alternative was grammatical. Similarly, a completion was scored as DO under the following conditions: a) if the ditransitive verb was followed by a noun phrase with the thematic role of recipient/goal and then by a second noun phrase with the thematic role of theme or patient (V NP NP); b) if the ditransitive verb was not part of a phrasal verb construction; and c) if its PO alternative was grammatical. All other completions were scored as Other.

Table 2. *The PO target ratio (standard deviation) and proportion of Other target completions from the participants analysis (N = 26).*

	Target completions	
Prime Type	PO target ratio	Other target completions
PO-only	.63 (.31)	.41 (.23)
DO-only	.45 (.37)	.36 (.28)

Data analysis

The data analysis was based on the method outlined by Pickering, Branigan and McLean (2002). The dependent variable was the "PO target ratio", i.e. the number of PO target completions divided by the sum of the number of PO and DO target completions in each condition; Other target completions were not included in these calculations. The PO target ratio provides a fairer basis for comparison because it permits comparison of priming between and among conditions even when the proportion of Other completions in these conditions differs (Pickering et al., 2002). The use of the PO rather than the DO proportions in the analyses is arbitrary, as the proportions of PO and DO target ratio are complementary.

Before the main analysis of PO versus DO completions, an analysis of the proportion of Other target completions in each of the four conditions was performed. The relevant proportions were derived by dividing the number of Other target completions in each condition by the total number of prime verbs in the same condition. In all sets of analyses, the proportions were calculated per participant and per item and all experimental factors were within-participants and within-items.

Results

There were 416 prime trials in total. The percentage of the target fragment completions on these trials was: 33% PO completions (138 trials), 29% DO completions (119 trials), and 38% Other completions (159 trials).[4] Table 2 displays the PO target ratio and the proportion of Other target completions in the two prime conditions. In the "word recognition memory" sections the mean of correct responses was 80% (*SD* 9.5%).

The proportion of the Other target completions did not differ across prime conditions (both Fs < 1.41). The PO

[4] Although the observed rate of Other target completions is rather high (.38), it falls within the range of Other target responses reported for L2 English (.27–.38, Salamoura and Williams, submitted) and slightly above the range reported for L1 English (.23–.37, Branigan and Pickering, 1998; Branigan et al., 1999; Branigan, Pickering, Stewart et al., 2000; Pickering et al., 2002) using PO and DO target structures in a sentence completion task.

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target ratio analysis yielded a significant effect of Prime Type ($F_1(1,25) = 9.21$, $MSe = .045$, $p < .01$; $F_2(1,15) = 6.86$, $MSe = .019$, $p < .05$). The mean PO target ratios in Table 2 show that participants produced more PO target completions following a PO-only prime verb than following a DO-only prime verb (and vice versa for the DO target completions).

Discussion

The present experiment demonstrates that L1-to-L2 syntactic priming can also be obtained from a single prime verb. The production of PO target completions (as expressed by the PO target ratio) was 18% higher after PO-only verb primes than after DO-only verb primes, and vice versa. Prime and target trials employed different (non-translation equivalent) verbs. These findings are in accordance with Melinger and Dobel's (2005) L1 data and support the view that cross-language syntactic priming is not only phrasally but also lexically activated. Consequently, they also lend support to a feature-based approach to cross-language syntactic priming and Salamoura and Williams' (submitted) as well as Schoonbaert et al.'s (submitted) models.

We interpret the cross-language syntactic priming effect as follows: upon presentation of a PO-only or DO-only verb prime, activation cascades from the verb lemma to the compatible PO or DO syntactic representation. The residual activation of this frame makes it more accessible and hence, more likely to be selected during the construction of a subsequent utterance that can be expressed with this syntactic frame. Here, we also assume that L1 and L2 equivalent syntactic structures, such as for example the PO and DO structures in English and Dutch, can have shared representations across languages in the bilingual mental lexicon.

Note also that the PO- and DO-only verb primes used in this study are compatible with structures other than the ditransitives (e.g. transitive structure, etc.; cf. Melinger and Dobel, 2005). We cannot therefore exclude that in addition to the ditransitive structure, some activation may also cascade to other syntactic representations linked with the Dutch verb primes, thus resulting in the priming of more than one syntactic frame. This might indeed explain the relatively high proportion of Other target completions in our experiment (38% across the two experimental conditions). Crucially, however, the prime verbs were compatible with only one of the two ditransitive structures and activation could have spread to either one or the other ditransitive frame but not to both. When, therefore, participants completed the target fragment with a ditransitive structure, only one of the two possible ditransitive representations would have been more accessible due to residual activation from the preceeding prime verb, thus explaining the priming of PO and DO structures observed in our task.

It is worth pointing out that although syntactic priming in the present task was lexically activated, it cannot be interpreted as lexical priming because prime and target verbs were not translation equivalents. The effect, therefore, is genuinely structural – repetition of the structural preference of the prime verb – rather than lexical – repetition of a specific lexical item. Note also that priming was obtained between Dutch infinitival verb forms and English verb forms inflected for tense and aspect. These findings suggest that the priming effect is independent of closed-class elements such as inflections and hence does not take place at the word-form or lexeme level but at a level where representation of syntactic structure is void of morpho-phonological details, such as the lemma level. They also add to previous evidence that lemmas are abstract, morpho-phonologically unspecified forms of words.

It might be argued that the priming obtained in this task is due to a memory strategy whereby participants incorporated the single verb primes into a specific sentence context to aid later recognition, thus producing phrasal rather than lexical priming. There are a number of reasons why this argument is not plausible. First, the initial instructions and the instructions in the recognition memory sections explained that participants would be asked to decide whether a particular word had occurred as a single word – not as part of a sentence fragment – in the previous presentation section. Memorising the words along with a specific sentence would have made this recognition task much harder. Second, single words were presented for only 850 ms on screen followed by a 1000 ms blank before the next stimulus. (Sentence fragments were presented for 5000 ms followed by a 1000 ms blank.) The rate of single word presentation, therefore, did not allow participants much time to form sentences. Third, as Melinger and Dobel (2005) note, the Dutch verb primes are also compatible with structures other than the PO or DO, as demonstrated in pre-tests of the verbs in which datives were only a fraction of the structures produced by native speakers. If participants were generating sentences from the single verb primes in this task, one would expect significantly less priming than we obtained, or no priming at all. Finally, at the end of the experimental session participants were asked whether they used the single words to construct sentences that would help subsequent word recognition. Only participants who answered "no" were included in the sample.

The magnitude of syntactic priming obtained in the present cross-language task (18%) is greater than that of Melinger and Dobel's L1 task (5%). It is unlikely, however, that this difference is related to the direction of priming (i.e. within L1 as opposed to L1-to-L2) since there is some evidence suggesting that within- and between-language

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syntactic priming with different prime and target verbs are comparable (Salamoura, 2004, Experiments 4.1 (L1-to-L1: 15%) and 5.1 (L1-to-L2: 14%); Schoonbaert et al., submitted, Experiments 1 (L2-to-L2: 9%) & 2 (L1-to-L2: 8%), although comparisons in both studies are between participants). It is intuitively more plausible that this difference in magnitude relates more to the type of task used – picture description in the target trials in Melinger and Dobel (2005) versus oral sentence completion in this study. The fact that speakers are restricted to describe a three-participant event in picture description as opposed to sentence completion where they are free to generate a target structure with any number of participants[5] may influence the robustness of priming. Indeed, Melinger and Dobel's (2005) priming from single verbs (5%) is comparable to full sentence priming results in L1 Dutch that used picture description (e.g. 6% for DOs and 8% for POs in Hartsuiker and Kolk, 1998, Experiment 3). On the other hand, the present effect (18%) is more similar in magnitude to the syntactic priming effect observed during oral sentence completion in L1 English (e.g. 26% in Branigan et al., 1999; 24% in Pickering et al., 2002, Experiment 4). Of course, further research is needed to investigate the exact source of this difference.

Not surprisingly for languages that belong to the same family, the majority of the English translations of the Dutch verbs also allow PO-only or DO-only structures in correspondence to their Dutch counterparts – with few exceptions, e.g. *nomineren* (PO-only) = *nominate* (DO-only); *toeroepen* (DO-only) = *call* (*out*) (PO-only). Since the nature of the task placed participants in a bilingual mode, it is possible that the Dutch prime verbs also activated the lemma of their English translation (directly or indirectly via conceptual mediation). This means that the structure associated with the prime verb might have received additional activation from its L2 lemma. However, it is highly unlikely that the prime structure was primed via the putatively activated L2 verb lemma only, resulting in within-language priming – as opposed to being activated by the L1 verb lemma only or both the L1 and L2 lemmas – for a number of reasons. Firstly, participants were L1-dominant but not balanced bilinguals; they started learning English at the age of 10.6 years on average. Since the prime verbs were presented in L1 Dutch, it is rather implausible that the prime structure was activated only via the L2 English translation of the L1 prime verb. Secondly, the lemma of the English translation of the L1 verb prime may also be activated but less so than the L1 verb lemma. Converging evidence for this argument comes from Schoonbaert et al. (submitted) who found that within L1 syntactic priming with the same prime and target verbs was significantly greater than L1-to-L2 syntactic priming with translation equivalent verbs. Their interpretation of this finding is that the lemma of the L2 translation of the L1 prime verb and its link to the prime structure receive less activation than the lemma of the L1 prime verb and its link to the prime structure. By analogy then, the prime structure in the present task would receive the bulk of its activation from the L1 verb lemma and less activation from the L2 translation. Thirdly and most importantly, recall that an intransitive filler trial always intervened between primes and targets to preclude lexical and/or discourse influences from the former to the latter. These intervening fillers appear to also minimise any translation priming from primes to targets. Using an intervening trial, Salamoura and Williams (submitted, Experiment 1) found no significant difference between L1-to-L2 syntactic priming with translation equivalent or different prime-target verbs, in contrast to Schoonbaert et al. (submitted, Experiment 2) who found a significant priming boost with translation equivalent as opposed to different prime-target verbs when targets immediately followed primes. Thus, any priming of the lemma of the L2 translation of the verb prime in this task would have also dissipated by the time of producing the target.

The results of the present task reinforce the lexicalist nature of Salamoura and Williams' (submitted) as well as Schoonbaert et al.'s (submitted) model, derived from the view that the construction of utterances is by virtue of the semantic and syntactic properties of words, i.e. their lemmas (cf. Levelt, 1989). These findings are more in accordance with the feature-based activation rather than a procedural account of syntactic priming as exemplified by Bock and Griffin (2000; based also on work by Bock, 1986; Bock and Loebell, 1990; Bock et al., 1992; Dell, Chang and Griffin, 1999; Chang, Dell, Bock and Griffin, 2000). Bock and Griffin argue for an implicit learning account and a procedural mechanism "that is manifest only in performances of tasks that make use of the same PROCESSING OPERATIONS that were engaged during the original language experience" (Bock and Griffin, 2000, p. 179, our emphasis). In keeping with this approach, the procedures for sentence assembly entail the involvement of more than one word. In fact, since they pertain to the way different constituents combine with each other to form an utterance, they refer by definition to the phrase level. If syntactic priming was solely derived from the activation and reuse of sentence assembly processes, it could not have been triggered by a single word prime. It should be underscored here that the present data do not suggest that a procedural account of structural repetition is at odds with the phenomenon of cross-language syntactic priming. They indicate only that cross-language syntactic priming can be lexically activated as well, lending support to a feature-based activation

[5] This task difference is reflected in the proportion of Other target completions which were much lower in Melinger and Dobel (14%) than in this study (38%).

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account of the effect. Note also that there is evidence of syntactic priming effects, such as relative clause attachment priming (Scheepers, 2003), which cannot be readily explained in lexical terms unless one makes the additional assumption that the sequence of syntactic rule applications retains residual activation like the syntactic rules and representations (Scheepers, 2003). A direct comparison of lexically and phrasally activated priming in future research will undoubtedly help clarify any relationship and/or interaction between the two.

In summary, the current study showed that cross-language syntactic priming can also be lexically activated by a single prime verb, lending support to a feature-based activation account of the phenomenon. These findings provide strong evidence for a model of the bilingual mental lexicon in which verb lemmas at the lemma stratum are linked to combinatorial nodes which encode the structural properties of postverbal argument phrases. Structural properties that are common in L1 and L2 are represented once and are shared between L1 and L2 verb lemmas.

Appendix: *The experimental material*

In each set, the first verb appeared in the PO-only prime condition, the second verb in the DO-only prime condition and the sentence fragment was the target. In each experimental list no prime verb was repeated.

1. uitreiken (= present) / besparen (= spare).
   The secretary gave . . .
2. uithuwelijken (= give in marriage) / toedragen (= bear (e.g. hatred, love, etc.) towards).
   The waiter gave . . .
3. schreeuwen (= yell, scream) / kosten (= cost).
   The hotel receptionist gave . . .
4. meenemen (= bring, take with you) / weigeren (= deny, refuse).
   The father sent . . .
5. doorverwijzen (= refer, pass on) / toeroepen (= call out).
   The journalist sent . . .
6. nomineren (= nominate) / noemen (= name).
   The passer-by offered . . .
7. transporteren (= transport) / garanderen (= guarantee).
   The shop assistant gave . . .
8. overlaten (= leave (e.g. sth for somebody else to do)) / ontzeggen (= deny).
   The enthusiastic teenager sent . . .
9. uitreiken (= present) / besparen (= spare).
   The anonymous admirer sent . . .
10. overlaten (= leave (e.g. sth for somebody else to do)) / ontzeggen (= deny).
    The bartender offered . . .
11. schreeuwen (= yell, scream) / kosten (= cost).
    The fashion designer lent . . .
12. meenemen (= bring, take with you) /weigeren (= deny, refuse).
    The guide lent . . .
13. doorverwijzen (= refer, pass on) / toeroepen (= call out).
    The classmate lent . . .
14. nomineren (= nominate) / noemen (= name).
    The elderly man lent . . .
15. transporteren (= transport) / (garanderen (= guarantee).
    The film producer offered . . .
16. uithuwelijken (= give in marriage) / toedragen (= bear (e.g. hatred, love, etc.) towards).
    The airhostess offered . . .

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