Syntax drives phonological choice – even independently of word choice

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Abstract

We report the results of three experiments designed to test priming percolation ('alignment boost effects') from one grammatical level to another. In the first two experiments, we set off to replicate in Dutch the results of Branigan, Pickering & Cleland (2000) for lexical boosts of syntactic alignment, adding a baseline control condition without priming. In the third experiment, we tested direct syntactic boosts of phonological alignment, using invented verbs. The direct link between syntax and phonology (without any interference from the lexicon) has been postulated in the past, but so far no empirical evidence has been offered in its favor. Our experimental results so far largely confirm the predictions of the Alignment Model (Pickering & Garrod, 2004), including the relation between syntax and phonology. Speakers, who were instructed to use the same syntactic structure as their dialogue partner did, also invented a verb that resembled more their partner's invented verb.

Keywords: Priming; alignment; phonology; syntax; boost effect.

Introduction

Speakers in all age categories adapt their speech to their linguistic environment. They order coffee with milk as 'caffè latte', 'cappuccino' or 'café au lait', depending on what they perceive to be the addressee's choice and they do so even if their personal preference would be to use a different expression (Garrod & Anderson, 1987; Metzing & Brennan, 2003; Branigan et al., in press). Speakers are also likely to copy the syntactic structure previously used by their interlocutor (Levelt & Kelter, 1982; Bock, 1986; Pickering & Branigan, 1999). Even babies only a few months old have been observed to use a higher pitch when interacting with their mother and lower pitch when interacting with their father (Liberman, 1967) and also older children appear to adopt the intonation patterns (low/high boundary tone) when naming pictures, depending on the tone they previously heard from their dialogue partner (Nilsenová, Swerts, Houtepen & Dittrich, 2008). Other documented cases of phonetic/phonological alignment include pronunciation of vowels and consonants, pitch, accent and speech rate (Natale, 1975; Gregory & Hoyt, 1982; Giles, Coupland & Coupland, 1992; Gregory & Gallagher, 2002; Pardo, 2006; Delvaux & Soquet, 2007).

Interestingly, it appears that if the experimental task forces participants to use the same form or structure as their dialogue partner, it increases the likelihood that they will also align on other forms/structures. In other words, alignment on one level of representation "boosts" alignment on other levels. For example, Branigan, Pickering and Cleland (2000; see also Branigan, Pickering, McLean & Cleland, 2007) found that in English, adaptation on lexical level significantly increases the frequency of aligned syntactic structures. In particular, if the subject is instructed to use the same verb as the confederate in the sentence she produced to describe a picture, the subject will be more likely to also use the syntactic structure the confederate did rather than an alternative one. In another series of experiments, Hartsuiker et al. (2008) illustrated the existence of boosts effects in written and spoken computer-mediated communication (see also Raffray, Pickering & Branigan, 2008).
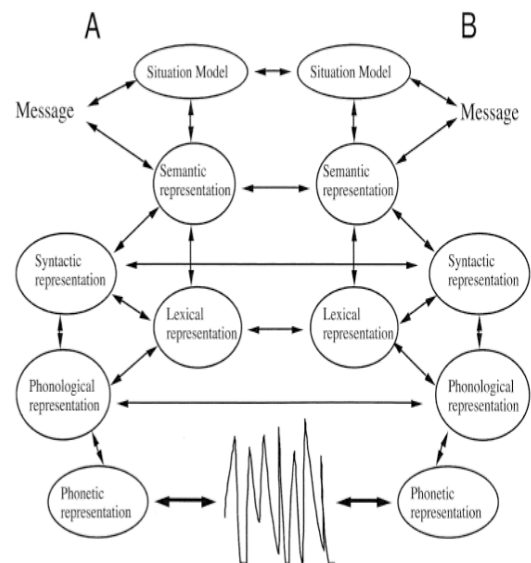

Figure 1: The Interactive Alignment
Model (Pickering and Garrod, 2004:177).

Pickering and Garrod (2004) used the phenomenon of alignment boosts to support their (Interactive) Alignment Model. Although the model has been subjected to a number of critical remarks (e.g., Krauss & Pardo, 2004; Schiller & de Ruiter, 2004, and others in the volume), it offers a useful theoretical background for the testing of relations among

various levels of representations. In particular, the vertical lines that stand for possible percolation effects between linguistic representations have for the most part not been tested on empirical data.

Current project

What is of particular interest to us in our current study is the postulated direct link between the syntactic representation and the phonological representation, which in the model appears to be possible even without the intervention of the lexicon (see figure 2). To our knowledge, empirical evidence supporting this relationship is lacking. This is, perhaps, not surprising, since even the expectation of a phonological alignment appears to be rather far-fetched. At least on the level of phonemes, it is unlikely that speakers should be producing strings with identical phonemes (or even strings with comparable phonemic properties, e.g., with respect to the place or manner of articulation). If we exclude the lexical representation, we should be able to observe speakers producing utterances with identical syntactic structures and phonemic properties, turning a conversation into a game of anagrams. In our project, we thus set off to test what appeared to be the 'weakest link' of the Alignment Model, starting with a reproduction of the already established lexical boosts on syntactic alignment.
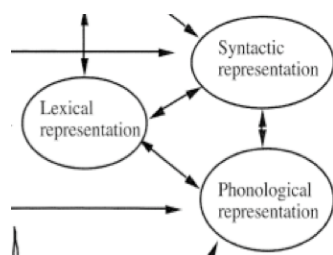

Figure 2: The part of Pickering & Garrod's Alignment Model predicting a direct boost effect of syntactic alignment on the phonological representation (and *vice versa*).

Experiment I.

In the first experimental study, we sought to extend the results of Branigan, Pickering & Cleland (2000) for English by adapting their experimental design for Dutch (for another contribution, see Hartsuiker et al., 2008). Contrary to previous studies, apart from two experimental conditions with a confederate, we also measured the preferred syntactic choices of Dutch speakers in a baseline condition without priming.

Methodology Thirty-nine Dutch speakers were randomly divided into three experimental conditions (A, B, C).

In condition A, **the 'base' condition**, the participants were describing drawings depicting either monotransitive events (one agent only, e.g., a woman drawing a picture; 16 drawings in total), or ditransitive events (including an agent and a recipient, e.g., a woman handing an apple to a boy; 12 drawings in total), viz. figure 3. All the drawings included either a monotransitive (for pictures with an agent only) or a ditransitive verb and the participants were instructed to use the verb in a simple sentence when describing the event.

In condition B, **without lexical alignment**, the participants took part in a confederate-governed task of describing 28 drawings (12 ditransitive stimuli + 16 monotransitive fillers, same as in the baseline study), while being primed alternatively with a syntactic structure of the form 'ditransitive verb + direct object + prepositional indirect object' and a structure of the form 'ditransitive verb + (nonprepositional) indirect object + direct object'. For their description, they were asked to use the verb given under the drawing. Each time, the verb differed from the verb used in the confederate's prime.

In condition C, **with lexical alignment**, participants performed the same task but they were asked to use the verb indicated to them underneath each drawing, identical to the immediately preceding confederate prime. To balance for order effects and verb effects, in both conditions, there were 4 confederate variants with structures alternating per verb.

During the experimental session in conditions B and C, the participant was seated opposite to the confederate who pretended to be ignorant as to the purpose of the experiment. The experimental leader was present in the same room to answer questions and make sure that the participant followed the experimental instructions. The experiment was presented as a game of describing and finding pictures, where both the correctness of the response (picture found) and the time needed to do so would be compared across conditions. The participants were explicitly told that rather than performing the task quickly, they should attempt to be as precise as possible. The output for all the three conditions was recorded on paper (by the participant in condition A and by the confederate in condition B and C), as well as digitally for the spoken dialogue. After each experimental session, the transcripts were compared to the audio recording and corrected if necessary.

The confederate and the participant were taking turns in describing the pictures (see figure 3), with the confederate always initiating the turn (in other words, priming the participant). The confederate picture set included full sentence descriptions of the pictures but in order to maintain the appearance of being a participant as well, the confederate pretended to be making up the descriptions on the spot. The participant was not aware of what was in the confederate set but assumed that it resembled his/her own.

After the experimental session, the experimental leader asked both the confederate and the participant if they noticed anything unusual. Only after that did she disclose

the real purpose of the experiment and the role of the confederate.
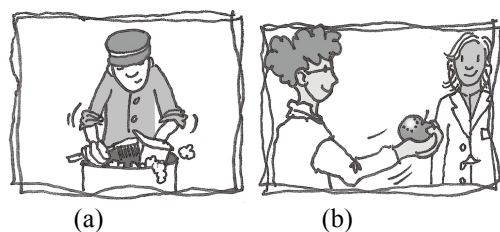

(a)   (b)

Figure 3: The drawings which the participants were describing depicted either monotransitive (a) or ditransitive events (b). The monotransitive items were used as fillers.

Results In the experimental conditions (B and C), there was a significant effect of lexical alignment on alignment in syntactic structure (t(21)=3.344, p<.005, eta squared = .035). The participants in the condition C (with lexical alignment) aligned their verbal syntax more frequently (M=9, SD=1.9) than the participants in the condition B (without lexical alignment; M=6.7, SD=1.4). When compared to the condition A (baseline without priming), it turned out that the participants in the condition B and C used the primed constructions significantly less frequently (F(1.9, 49.403)=5.146 (sphericity not assumed), p<.05, partial eta squared = .165), see figure 4.
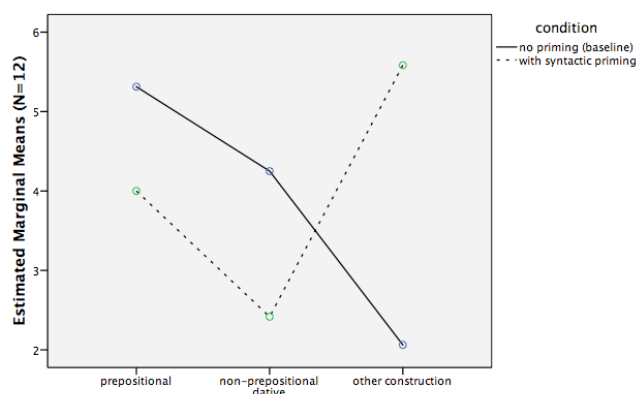

Figure 4: In the experimental conditions with syntactic priming (B and C), participants chose the primed structures less frequently than in the baseline condition without priming (A).

Discussion The comparison of the experimental conditions extends the results of Branigan, Pickering & Cleland (2000) for English to Dutch. We observed that syntactic priming received a lexical boost in the condition in which participants were using the same verb as the confederate in his/her prime. However, the puzzling outcome of the comparison of the experimental conditions with the baseline seems to suggest that syntactic alignment as such does not occur: speakers were more likely to use the prepositional and dative ditransitive constructions spontaneously than when actually primed with them. One possible explanation for the result could be the fact that the ditransitive verbs used in the experiment, such as 'give' (*geven*), 'hand' (*overhandigen*) or 'send' (*sturen*), can be used in monotransitive constructions in Dutch. Unlike in the English version of the task, our Dutch participants in the condition B and C could thus have been influenced by the monotransitive fillers. In fact, they were interpreting them as primes, albeit not in the immediately following turn. To test this hypothesis, we adapted the stimuli from experiment I. in a second experiment.

Experiment II.

In the second experiment, we attempted to account for the outcome of experiment I. (syntactic priming in conditions B and C resulted in less of the primed constructions being used than in condition A with no priming) by changing the structure of the fillers from simple monotransitive clauses of the form 'agent – finite verb – direct object' to clauses containing an adverbial phrase with a preposition, i.e., of the form 'agent – finite verb – direct object – adverbial phrase' (e.g., "The man is painting a picture on the wall" instead of "The man is painting a picture").

Methodology The procedure was the same as in experiment I., only with a different set of fillers as described above. Twenty-two Dutch speakers were randomly divided into one of the two experimental conditions either without or with lexical boost (B and C, respectively).

Results As in experiment I, participants in the condition without lexical boost (B) aligned less frequently (M=6.6, SD=.84) with the syntactic prime than participants in the condition with lexical boost (C; M=9.1, SD=1.38), t(20)=4.963, p<.001, eta squared = .55. Contrary to experiment I, this time we observed no uses of monotransitive constructions in descriptions that involved ditransitive events. In other words, once we replaced the monotransitive fillers with fillers involving a prepositional phrase (e.g., a locative), the participants used no alternative constructions on the experimental trials to describe the ditransitive events; they always chose either the prepositional dative construction or the non-prepositional dative.

Discussion On the basis of the results obtained in the second experiment, we concluded that participants in experiment I were, in fact, adapting to the monotransitive fillers used by the confederate in the turn preceding the ditransitive prime. When the monotransitive fillers were adapted to longer sentences resembling the experimental primes, their effect disappeared.

Experiment III.

In the third experiment, we explored the effect of a syntactic boost on phonological alignment. In order to test for the relationship directly, it was necessary to exclude the effects of the lexicon that is likely to facilitate phonological alignment in spontaneous data.

Methodology In the baseline condition, twelve drawings depicting a ditransitive event were presented to 17 Dutch speakers who were asked to describe the picture using a monoclausal sentence and a verb they would invent on the spot. In the experimental conditions, the participants again engaged in a confederate-steered task during which they were describing 24 drawings (same as in experiment I and II) with an invented verb, following a syntactic prime by the confederate which also involved an invented but Dutch-sounding verb (with correct morphology). The participants were being primed alternatively by a monotransitive construction or a structure with a direct object followed by a prepositional indirect object, or a structure with a non-prepositonal indirect object followed by a direct object. The phonological primes (i.e., the invented verbs) were alternatively monosyllabic and disyllabic words with a systematically varied phonological structure.

In the pilot version of the experiment, twenty-two participants received no instructions regarding the syntactic structure they were expected to use to describe the pictures. One third of the invented verbal primes contained two plosives (in the onset and the coda for the monosyllabic primes, or in the onsets of the two syllables of the disyllabic primes), another third contained two nasals, and yet another third contained two fricatives. There was no systematic variation of vowels and liquids which were inserted freely to make the verb appear Dutch-like.

When we compared the syntactic output of the participants to the baseline condition, however, we observed that there was no significant difference in the use of the three alternative structures to describe the depicted events (viz. figure 5). In other words, the participants in the experimental conditions were not aligning syntactically and hence it was not possible to measure the effect of a syntactic boost on phonology. Moreover, while the participants appeared to be taking over some phonological features of the verbal prime, the manner of articulation of the consonants did not appear to be a perceptually prominent feature.

Twenty-three speakers of Dutch took part in the third experiment. On the basis of the outcome of the pilot experiment, with respect to syntactic alignment, we adapted the task in such a way as to force the speakers to use the same structure as the confederate. In particular, we instructed them to start describing the picture by a clue that was given to them as an NP + relative clause underneath the drawing. In practice, the speakers were filling in an invented verb into a blank of the form NP – who – IO – DO (e.g., *De man die de non een appel...* – "The man who … the nun an apple.") or NP – who – DO – PO (e.g., *De man die een*

appel aan de non… - "The man who … an apple to the nun"). Furthermore, we changed the phonological primes so that the systematic variation in the confederate's verbs consisted (1) in the number of syllables (one or two) and the initial phoneme (a vowel or a consonant), see table 1.
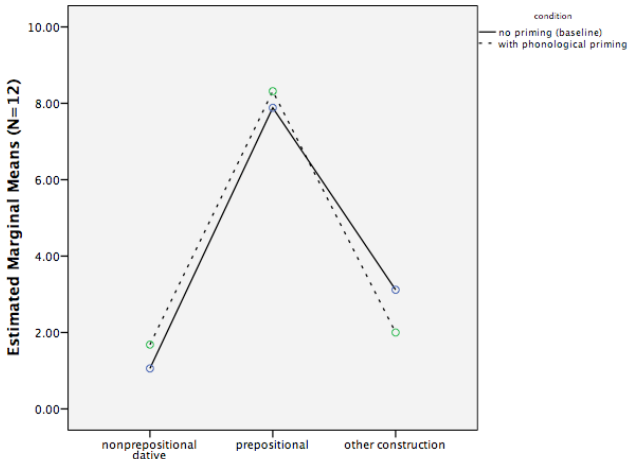

Figure 5: In the pilot version of the experiment, participants in the condition with phonological priming did not differ from the participants in the baseline condition (without priming) in their choice of syntactic structures, $F(2,74)=.825$, $p=.442$.

Table 1: Nonsense verbs used as primes in experiment III.

Initial phoneme	Monosyllabic	Bisyllabic
Vowel	*oeft*	*oegert*
	aapt	*eivelt*
	oot	*affelt*
	iert	*uitert*
	eift	*iemelt*
	eemt	*okkelt*
Consonant	*proest*	*manilt*
	kniert	*pippelt*
	bort	*lippert*
	vlaapt	*zachelt*
	slinkt	*poenkert*
	loept	*niesert*

Results The nonsense verbs created by the participants were transcribed by the experimental leader during the experimental session, as well as recorded digitally. The transcriptions were made in such a way as to reflect the rules of the Dutch spelling system and checked against the audio recordings first by the experimental leader and

subsequently by another linguist. We calculated the proportion of phonological alignment by (i) comparing the number of syllables in the prime and the verb created by the participant, (ii) comparing the initial phoneme of the verb (vowel or consonant), and (iii) comparing the Levenshtein distance between the prime and the participant's verb. The Levenshtein distance between two strings A and B is the (uniform) cost for insertion, deletion and substitution of characters in string B needed to make it identical to string B. The comparison was used to account for cases where the participant did not align phonologically on the systematically manipulated features (number of syllables and initial phoneme) but still appeared to create a new verb strongly influenced by the prime (consider, for instance, the invented verb 'choeft', which was independently created by three experimental participants as a response to the prime 'achelt').

When we compared the two experimental conditions, there was no significant difference between the group that aligned syntactically and the group that did not with respect to the initial phoneme of the invented verbs they created. Regarding the number of syllables, we observed a trend in the data suggesting some effect of the syntactic boost (t(21)=1.855, p=.095, eta squared=.14). The boost effect, however, was clearly present when we measured the Levenshtein distance between the prime and the participants' responses, with verbs created in the syntactic boost condition resembling the primes more (M=108.42, SD=12.42) than the verbs created in the condition without boost (M=126.882, SD=24.31; a lower mean stands for less operations needed to make the strings identical), t(14.597)=-2.255, p<.05, equal variances not assumed, eta squared=.26.

Discussion The results of the third experiment indicate that there is a link between the syntactic and the phonological component that does not have to be mediated by the lexicon. In particular, when speakers align on the syntactic level with their dialogue partner, they are also more likely to align phonologically. The phonological adaptation, however, is rather subtle and, at least in this experiment, was not obvious when we looked at traditional phonological features like the number of syllables or the word-initial phoneme. However, the resemblance between the prime and the response could be detected by calculating the Levenshtein distance between the two strings.

Conclusion

There is evidence that conversational participants adapt to each other's language use at various grammatical levels. This phenomenon has been well documented in a number of experiments, as well as studies of corpus data (Gries, 2005). The focus of our current study was the nature of percolation effects, which have been documented in priming experiments with lexical boost where participants who were forced to use the same verb as the confederate turned out to be more likely to use the same syntactic construction as well, compared to participants who could use a different verb. The evidence for other kinds of boosts has so far been lacking, despite the fact that these effects are interesting in that they offer insights into the architecture of the language model.

In the current study, we examined the link between the syntactic and the phonological component, which at first blush appeared to be rather arbitrarily postulated in the Alignment Model of Pickering and Garrod (2004). In order to approach the topic of alignment boosts in Dutch in a systematic manner, we started with a replication of Branigan, Pickering and Cleland's (2000) study concerning the effect of lexical alignment on syntax, enriched with a baseline study involving no primes. The results of the first experiment were more complex than the English findings due to the difference in selection properties of the Dutch ditransitive verbs, but both the first and the second experiment confirmed that alignment on the lexical level increases the frequency of aligned syntactic structures.

Finally, our data confirmed the prediction of the Alignment Model regarding a direct boost effect of syntax on phonological alignment. The role of the lexicon was excluded in the setup by making use of invented verbs that the participants had to come up with on the spot.

One open question that needs to be answered in follow-up studies concerns the relation between the spoken and the written form of the invented verbs (for example, the combination of graphemes 'oe' is pronounced as /u/ in Dutch but when calculating the Levenshtein distances, we based ourselves on the graphic representation rather than the pronunciation). In general, experimental evidence is needed for other types of boosts apart from the lexical and the syntactic one explored in the current study.

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