

Cross-Linguistic Prosodic Priming

E. Ciereszynski, Anne Meisner

McGill University

Abstract

The occurrence of priming has been observed in multiple linguistic domains, namely syntax and prosody. This paper reports on an experiment investigating whether stress patterns can be primed crosslinguistically. The results indicate that crosslinguistic prosodic priming is possible albeit fairly weak, and that its main acoustic correlate appears to be pitch. Further work in this area will be necessary in order to fully characterize the effect.

1. Introduction

Priming is a phenomenon in which one stimulus subconsciously alters or influences a subsequent behaviour or response to a subsequent stimulus. The occurrence of this process has been observed in multiple linguistic domains. Various aspects of syntax, such as sentence structure (Bock 1986) and null subject usage (Cacoullos & Travis 2014; 2016), appear to be able to be primed, although this seems to extinguish quickly and to be tied to memory and contextual features. This conclusion has been drawn for both within-language contexts (Bernolet, Collina, & Hatsuiker 2016) as well as code-switching contexts (Fricke & Kootstra 2016; Travis, Cacoullos, & Kidd 2017). There is also a significant body of research on prosodic priming, which has generally found that some aspects of prosody can be primed while others are more resistant. It appears to be difficult or impossible to prime purely linguistic aspects of prosody such as pitch accents and intonational phrase boundaries. Recent work has found that speakers will repeat a phrase with its original prosodic structure but that this structure does not influence how novel stimuli are phrased prosodically (Tooley, Konopka, & Watson 2014) and that speaking rates can be consistently primed while pitch accents and intonation cannot be (Tooley, Konopka, & Watson 2018). Thus, it has typically been concluded that paralinguistic aspects of speech such as speaking rate can be primed but linguistic aspects are impervious to the phenomenon. Additionally, this ability to prime paralinguistic aspects of speech has been found to be somewhat persistent, and resistant to extinction (Jungers & Hupp 2009).

In terms of prosodic priming, less work has been performed in terms of bilingual contexts. It is largely agreed upon that the prosody of a person's first language often influences that of their subsequent languages, particularly when the person is not entirely fluent. However, minimal research has been performed regarding whether or not the prosody of one of a bilingual's languages can prime for that of their other language. Research undertaken in 2012 concluded that the prosodic patterns of a person's native language may prime for prosodic patterns of their second language in a dialogue-like setting, but this was unable to be definitively teased apart from possible confounds (Turco & Gubian 2012). Thus, there are few definitive answers regarding crosslinguistic prosodic priming in bilinguals.

This experiment is designed to directly investigate this,

and examine whether it is possible to crosslinguistically prime prosody between English, which is rich in intonational prosody, and French, which mostly lacks it. Can the lack of prosody in French prime for a lack of prosody in English, and can the rich prosody of English bring about the appearance of intonational prosody in French? This experiment attempts to determine first and foremost whether the crosslinguistic priming of intonational prosody is possible, and subsequently its strength and characteristics if it is observed. We hypothesize that priming will be observed in both directions, but that it will be weak and will extinguish quickly.

2. Methods

This experiment consisted of three blocks: an English block, a French block, and then a second English block. Each block contained twelve item sets, which in turn were subdivided into three conditions: syntactic parallelism, corrective focus, and a control condition. The stimuli were arranged in alternating blocks so that they would be able to prime for each other: the first English block would prime for the French block, and, if our hypothesis that the priming effect would extinguish quite early was correct, the French block would prime for the second English block. Twelve people participated and were compensated for their participation, and were run on multiple experiments as to avoid order effects.

2.1. Procedure

Participants sat in front of a screen and were given headphones. They were told that they would participate in a series of dialogues between two people, and were instructed to read the dialogue before beginning the experimental trials. In each trial, the first half of the dialogue was played over the headphones, and the participant was given a response to speak out loud. These instructions were given at the start of each block. Each participant was instructed to speak as naturally as possible. This direction was given so that the results would reflect actual human speech prosody and intonation in order for the results to truly analyze and report on whether or not prosodic priming could subconsciously take place in everyday speech. If participants were artificially changing their prosody, or were overly consciously aware of their own prosodic patterns, it would be difficult to characterize and measure the priming effect. A Latin square design was used, and every participant saw one possible condition for each of the twelve items in the block. Thus, for example, in the first block, the participant spoke four responses in the control condition, four responses in the corrective focus condition, and four responses in the syntactic parallelism condition, randomized among the twelve items in the block.

2.2. Conditions

Each item was subdivided into three phrases, corresponding to our three conditions: syntactic parallelism, corrective focus, and a control condition. The null hypothesis for this experiment was that we would not observe priming in either direction in any of the three conditions, and there were specific experimental hypotheses for each condition. The figure below gives an example of a response in each of the three conditions.

Text

Yeah, yesterday he bought a red bike.

No, yesterday he bought a red bike.

Yeah, the other day, he bought a blue bike and a red bike.

2.2.1. Control

In the control condition, the participant agrees with the phrase that they heard and specifies an adjective and a noun relevant to the dialogue. Neither English nor French naturally displays a prominence shift here, so we do not expect to see differences after priming. We hypothesize that rates of prominence shifts in this condition will remain constant throughout the experiment.

2.2.2. Corrective focus

In the corrective focus condition, the participant corrects the phrase that they heard, and specifies a different adjective than that which was present in the prompt. We expect to see prominence shifts in English as well as French in this condition, and therefore we hypothesize that rates of prominence shifts will be similar in all blocks.

2.2.3. Syntactic parallelism

Syntactic parallelism comprises a parallel construction consisting of one noun separately paired with two different adjectives. In this condition, the participant agrees with the phrase that they heard and specifies two adjectives and a noun, relevant to the dialogue. This was our key condition, as English naturally demonstrates prominence shifts in sentences such as these, but French does not. Thus, the experimental hypothesis for this condition is that French would show prominence shifts in this condition after an English prime, and that English would show reduced prominence shifts in this condition following a French prime. However, we expect this to quickly extinguish and return to a baseline level of stress.

2.3. Measures

In the control and corrective focus conditions, the adjective and noun were marked as words of interest, and in the syntactic parallelism condition, both adjective-noun combinations were marked as words of interest. Thus, there were two words of interest in the first two conditions and four in the last condition. Responses were annotated using the Montreal Forced Aligner, which provided numerical data on relative intensity, pitch, and duration. Responses were also annotated by hand using Praat. Each spoken response was marked as to whether a prominence shift took place or not, and was marked as problematic or acceptable in terms of the quality of the speech and recording. In

order to reject the null hypothesis, that no priming in either direction would be observed, it would be necessary for at least one of the differences in the numerical results across blocks to reach significance, or for the differences across blocks in prominence shifts in the hand-annotated data to reach significance.

3. Results

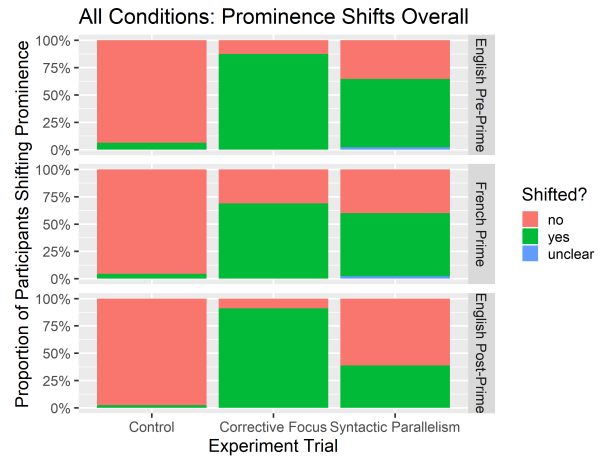


Figure 1: Prominence shift data over all conditions, experiments

Figure 1 describes the annotated prominence shifts over the three blocks of the experiment. As anticipated, the pre- and post-prime English blocks show very different rates of prominence shifts in the syntactic parallelism condition while the prominence shift rates stay the same in the control and corrective focus conditions. The effect appears to be quite strong here: prominence is 1.8 times less likely to be shifted after the French priming block.

Unexpectedly, the French data appears to have a *higher* rate of prominence shifts in the syntactic parallelism condition. This may be due to an English priming effect extinguishing slowly during the block, or attributable to fluency issues in several participants.

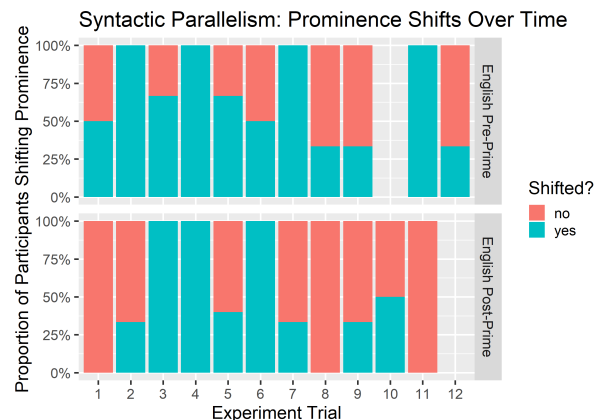


Figure 2: Prominence shift data over experiment trial in syntactic parallelism condition

Another key goal of the experiment was to observe the

extinction point of the priming effect. Fig. 2 summarizes the syntactic parallelism condition over each trial in the experimental blocks, giving a temporal perspective on the priming effect's strength over time. Due to randomization of the conditions under the Latin square model, there was a non-uniform number of utterances in the syntactic parallelism condition at each time step, and there were several holes in the data. This data is then obviously limited by the sparsity of information associated. However, some key conclusions are still available – namely, that the extinguishing of the effect is much less apparent than expected. While we anticipated a quick return to the pre-prime block average rates of prominence shifts, what we found was a far less clear return to the mean.

The Montreal Forced Aligner automatically annotated the words of interest for relative intensity, relative duration, and relative pitch in both of the English blocks. Unfortunately, we were unable to obtain these measures for the French data, and as a result the numerical data cannot be discussed on that dimension. However, this is not an impediment to drawing conclusions as we can still compare the two English blocks to observe whether the words of interest were impacted after the prime.

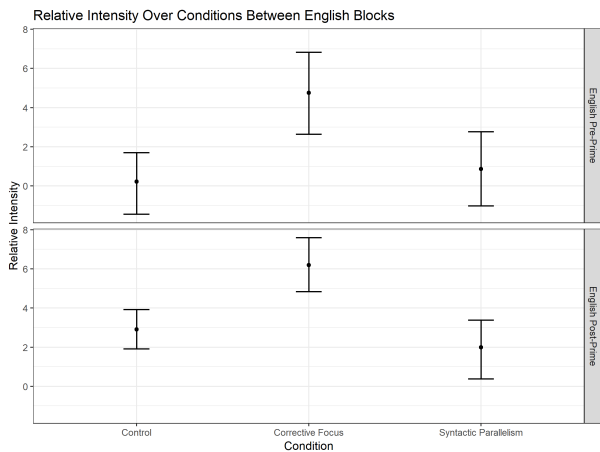


Figure 3: Distributions of relative intensity over words of interest

The most puzzling piece of data was that the relative intensity in the post-prime block did not only not decrease but in fact, *increased*. Fig. 3 summarizes the distribution over all three conditions, showing a rise occurs in the mean score across control, corrective focus, and syntactic parallelism (respectively, by 1.12, 1.24, and 2.69 decibels each). While the increase in syntactic parallelism is much greater, the increase across the other two conditions does indicate there may be some other confound at play here as we do not expect to see a change transpire – and we do not observe this in either pitch or duration.

In the case of the relative pitch changes, a large decrease in mean Hz was observed in the syntactic parallelism condition, while the means for the control and corrective focus conditions were quite similar (mean changes of -1.4094, -0.3844, and 0.27285 respectively). While a t-test on these differences in means did not reach significance ($p = 0.266$), this is an anticipated result of the small dataset size. However, this does underscore the size of these differences being rather non-notable under the circumstances, and additional data would be necessary in order for significance to be established.

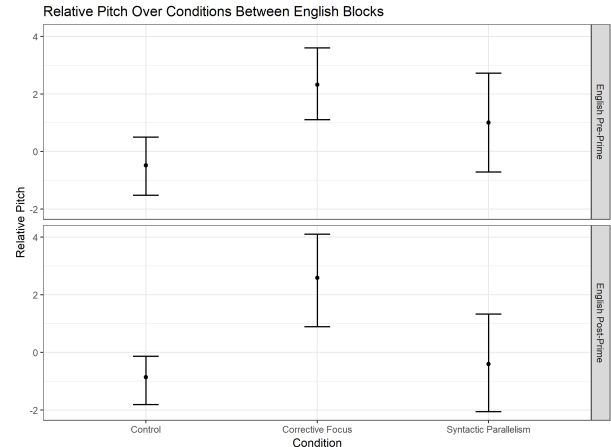


Figure 4: Distributions of relative pitch over words of interest

The duration data shows little variation between the con-

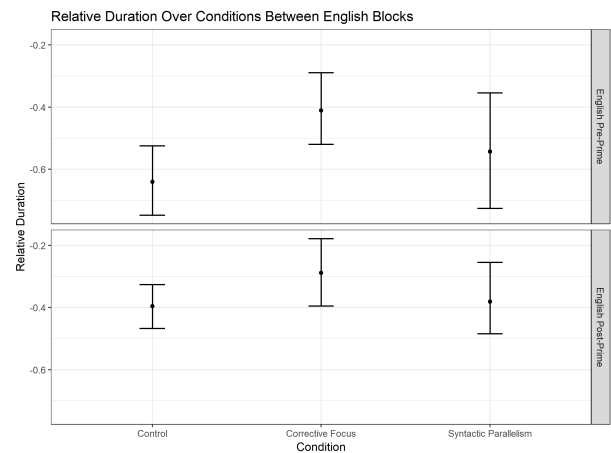


Figure 5: Distributions of relative duration over words of interest

ditions, indicating it may not be a strong correlate to prosodic shifts. All conditions show a slight increase in duration post-prime, well within the bounds of the error of the pre-prime English distribution.

4. Discussion and conclusion

The prominence shift annotation results showed a strong effect that correlates with the results of the relative pitch distribution, suggesting there is some priming effect at play in the syntactic parallelism condition. However, the temporal data does not clearly outline the prosodic priming extinguishing point.

We have demonstrated an effect appears to exist on some dimensions more than others. The relevant research in this area does align with these findings; namely, we predict a weak effect (as observed in the pitch acoustic measures). The clear noise in the temporal data makes it hard to come to conclusions regarding the anticipated extinction of the effect, which is reflected in the main limitations of the data. Despite this, we can conclude from a theoretical perspective that some linguistic aspects of speech such as prosody are likely able to be primed although

the effect is relatively weak, that this effect can act crosslinguistically, and that pitch appears to be the most accurate acoustic correlate of the phenomenon.

The most obvious limitation to the conclusions we can draw is related to the dataset size. Working with only twelve participants greatly reduced the amount of data available, particularly in each experiment trial time-step. However, the difficulty of locating bilinguals was more of an impediment than anticipated, and the study was not able to compensate for this limiting factor. The fluency of many speakers presented a problem. Approximately half of the participants showed significant and noticeable disfluencies in their French production, which presumably impacted their susceptibility to priming. It is difficult to tease apart the likely competing influences of their lack of fluency and the English priming effect on their production during the French block, and to rigorously determine how well, if at all, the French block was able to prime for the second English block for these participants. A way to address these limitations in a future study would be to recruit a larger population of participants while more stringently screening for fluency in French.

5. Bibliography

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