Does listening to non-linguistic rhythm impact speech production?
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Introduction

A growing body of evidence suggests that exposure to rhythmic auditory patterns (i.e., **rhythmic priming**) can modulate the processing of subsequently heard speech at various levels: phonological accuracy (Cason & Schor, 2012), word and sentence production (Cason et al., 2015; Zhang & Zhang, 2019), and grammatical and syntactic correctness (Przybylski et al., 2013; Kotz & Gunter, 2015).

This effect has been associated to three underlying mechanisms common to speech and music processing: precise auditory processing, neural entrainment to external stimuli and sensorimotor coupling (Fivesah, et al., 2021).

In the current study, we aimed to test whether non-linguistic rhythmic priming has an effect on speech production and extends to prosody.

Method

13 native speakers of French (aged 35-63, 8 female, 5 male) were recruited (with Parkinson’s disease and 6 healthy control participants) read aloud 45 sentences under three conditions:

- After listening to a **regular rhythmic prime** consistent with the stress pattern of the sentence.
- After listening to an **irregular rhythmic prime** inconsistent with the stress pattern of the sentence.
- After listening to two seconds of **silence** (no prime).

Recordings were semi-automatically transcribed (Kisler et al., 2017) and syllabified (Reichel & Kissler, 2014), and three types of acoustic data were extracted and calculated:

1. **Reading latency**, i.e. the span of time between the end of the prime and the beginning of elocution.
2. **Prosodic prominence**, automatically detected through F0 and duration measurements with Prosoprom (Goldman & Simon, 2018), based on the distribution of prominence throughout the sentence. Analyzing the global distribution of prominences throughout the sentence might shed more light on these findings.

Rhythm metrics

Pairwise variability indexes (GPVI and VnPVI, Figure 6) show biggest differences between the NO PRIME and IRREGULAR PRIME conditions, mainly throughout vocalic interval variations.

Standard deviations of interval durations (varcoC and varcoV, Figure 7), on the other hand, show more important differences between the NO PRIME and the REGULAR PRIME conditions, both at a vocalic and a consonantal level. Differences across the consonantal axis were also found between the NO PRIME and IRREGULAR PRIME conditions.

Discussion

The most striking result of our study was the correlation between regular priming and shorter **speech latency**, which points towards there being a link between the perception consistent rhythmic patterns and speech planning. This relationship could be further explored to develop therapeutic uses of rhythm for people with speech pathologies or innovative teaching techniques to promote first or second language acquisition.

The lack of **prosodic prominence** differences across conditions went against our hypotheses, but we only targeted expected prominent syllables. Analyzing the global distribution of prominences throughout the sentence might shed more light on these findings.

Variations in rhythm metrics need to be complemented with perceptive tests in order to assess the degree of influence of these differences on the intelligibility and comprehensibility of speakers.

Finally, it is worth noting that these results are part of a broader project exploring the impact of rhythmic priming on the speech of people with Parkinson’s disease; however, this variable was not taken into account in the present study.

References


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