



# Speech and song synchronization: a comparative study



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## Introduction

- Speaking together is a familiar task for all of us...and synchronization is achieved effortlessly. We seem to synchronize easily when singing/making music too.
- Speech is coordinated movement, structured in time.
- Dynamic perspective: synchronization can be viewed as entrainment.

### Broad questions

- ✓ Does synchronization among speakers or singers require the presence of a beat?
- ✓ Would singing behave differently from speech in terms of synchronization?

## Purpose

- To examine synchronization among speakers **comparing** different types of speech.
- To answer the **essential questions**:
  1. Will synchronization be facilitated by the presence of strong metrical structure in spoken texts (Nursery rhyme versus prose)?
  2. Will rhythmic complexity affect the degree of synchronization observed (Rock versus *Samba*)?
  3. Will synchronization be facilitated by the presence of an underlying, implied, musical beat (Singing versus Speaking)?

## Methods

- 6 text units repeated one time by 10 pairs of subjects, Brazilian Portuguese native speakers.
- All subjects were competent singers.
- Recordings done in sound attenuated booth with Shure head-mounted microphones.
- Text units segmented into sentences.
- Quantitative estimation of asynchrony computes the amount of temporal warping required to map one utterance onto another. More warping → more asynchrony [1]
- Asynchrony scores are normalized by utterance length, so we can compare asynchrony for sentences of different duration.

Table 1: Texts

Text unit	Title	Number of sentences
Prose	"Sente-se no relógio..."	7
Nursery rhyme	"Hoje é domingo"	6
Spoken Rock	"Aluga-se"	18
Spoken Samba	"Preciso me encontrar"	13
Rock	"Aluga-se"	18
Samba	"Preciso me encontrar"	13
		Total 75

## Results

- Asynchrony scores shown in Figure 1.
- Asynchrony values log transformed due to non-normal distribution.

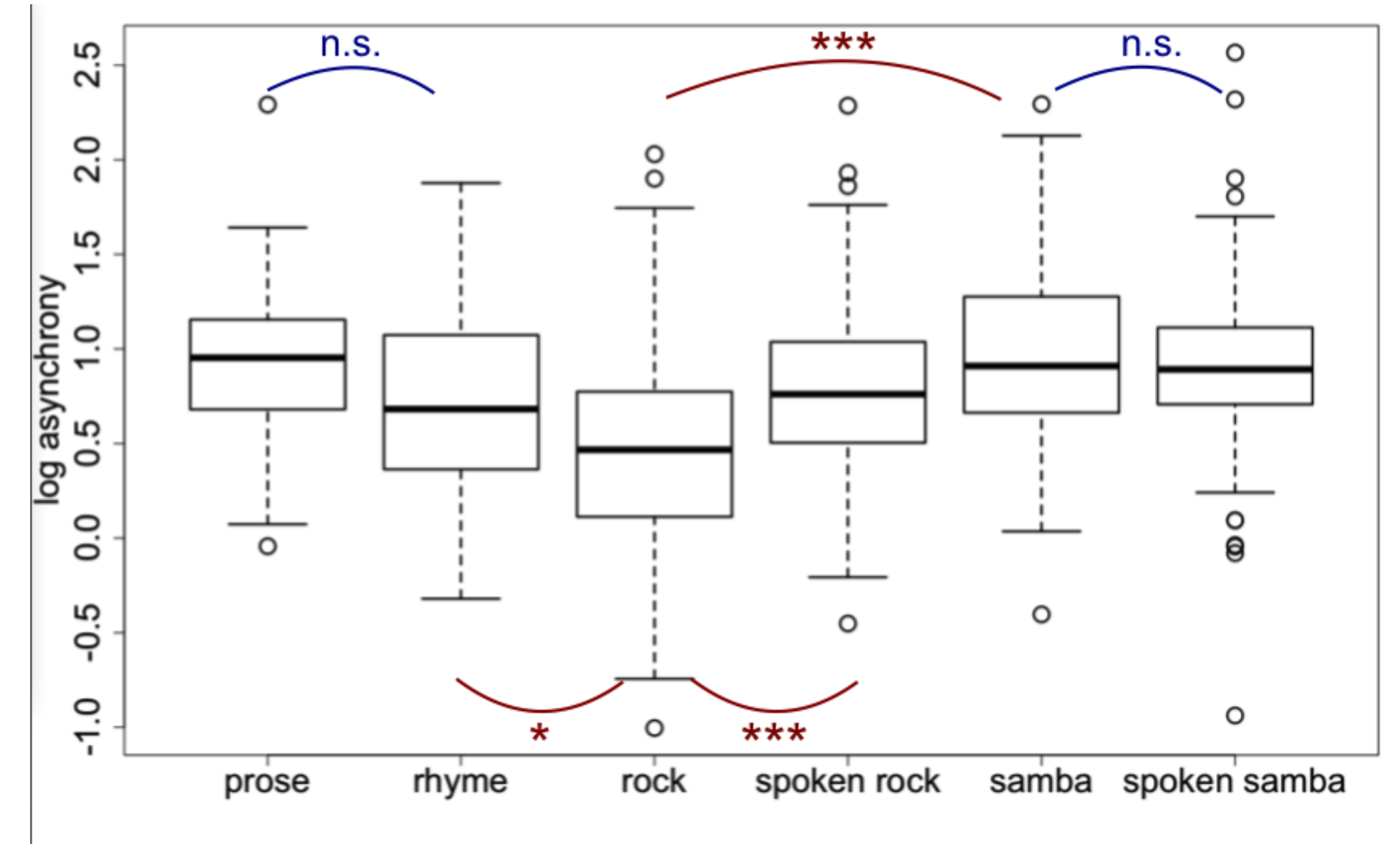


Figure 1: Boxplot of distribution of asynchrony scores for 6 texts

- Planned comparisons as in Table 2
- Simple T-Tests with conservative Bonferroni correction

Table 2: Statistical results. Sung rock (Rock) showed greater synchrony in specific comparisons.

Comparisons	Value of t	p
Nursery rhyme <i>versus</i> prose	t(116)=2.4	n.s.
Sung rock <i>versus</i> sung samba	t(294)=8.1	p < .001
Sung rock <i>versus</i> spoken rock	t(345)=5.8	p < .001
Spoken samba <i>versus</i> sung samba	t(255)=1.0	n.s.
Nursery rhyme <i>versus</i> sung rock	t(118)=3.4	p < .05

## Discussion

### Common sense *versus* study finding

Answer to Q1: periodicity does not greatly facilitate synchronization among speakers.

### In the song domain, the picture changes

Answer to Q2: Sung rock is more synchronous than sung samba.

### When singing becomes a spoken text

Sung rock is more synchronous than spoken rock.

### When speech is compared to singing

Answer to Q 3: The implied beat of music seems to help, as sung rock synchronization is greater than nursery rhyme synchronization.

### Periodicity is different from rhythmicity

### Song rhythmicity is different from speech rhythmicity

Further studies needed to address how speech and music readily combine their temporal structures.

## References

1. Cummins, Fred. Rhythm as entrainment: The case of synchronous speech. *Journal of Phonetics*. 37(1):16-28. 2009.