

Evidence for self-other effects and structure-related attentional mechanisms in the primo/secondo performances of clarinetists

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Introduction

- Musicians use a variety of strategies for manipulating acoustic material in order to encode their **expressive intentions** while performing a score.
- The great precision of temporal manipulation of acoustic events has been the object of many studies on musical expressiveness.
- When playing with others, a performer must synchronize the results of his own actions with the actions of the others.
- When playing in a real situation like in an orchestra, performers take advantage of acoustical and visual information in order to improve the synchronization. However, performers are also capable of accompanying another performer solely from an acoustical recording.

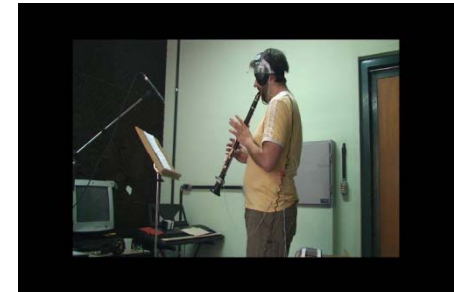
AIM

The study aims at understanding the mechanisms of on-line synchronization of instrument performance in musical ensembles.

- A series of studies have shown that musicians play better with themselves than with others, an effect known as the "self/other effect" in action recognition and simulation.
 - Keller PE, Knoblich G, & Repp BH (2007). Pianists duet better when they play with themselves: on the possible role of action simulation in synchronization. *Conscious Cogn*, 16(1):102–111.
 - Keller PE & Appel M (2010). Individual differences, auditory imagery, and the coordination of body movements and sounds in musical ensembles. *Music Percep* 28:27–46.
 - Keller PE (2001) Attentional resource allocation in musical ensemble performance. *Psychol Music*, 29:20–38.

EXPERIMENT

- 6 professional performers, recruited in Belo Horizonte, played a music excerpt, recorded in two sessions: as *Primo* and as *Secondo*
- *Primo* session: 📢
 - They played in their preferred expressiveness.
 - Tempo was imposed by 3 beats of metronome (in real situation tempo is given by the conductor and/or accompaniment).
- *Secondo* session:
 - They played the same excerpt as *secondo* while hearing all *primo* performances (some days later).
 - They were asked to follow the *primo* the best they could.
 - After hearing each *primo* performance once, they played the *secondo* part 4 times (takes) while hearing the *primo* through a earphone.



(soli a 2 📢)

MUSIC MATERIAL

“Dance of the Peasant and the Bear” of Igor Stravinsky’s ballet *Petrushka*, where “*the peasant plays the pipe and the bear walks on his hind feet*”.
Primo and *secondo* clarinets play soli in unison (soli a 2):

- demands synchronization in every single note;
- unlike in a duet situation, *primo* and *secondo* play the same music;
- professional clarinetists are familiar with this unison situation.



мужикъ играетъ на дудкѣ - медвѣдь ходитъ на заднихъ лапахъ.
The Peasant Plays the Pipe. The Bear Walks on His Hind Feet.

 **Sostenuto.** (♩ = 69)

100 *Soli*
a 2.

Cl. I. II. **ff**

Fag. II. III.

C. Fag.

Cor. II. III. IV.

Tuba. *Solo* **ff**

Viole.

Celli.

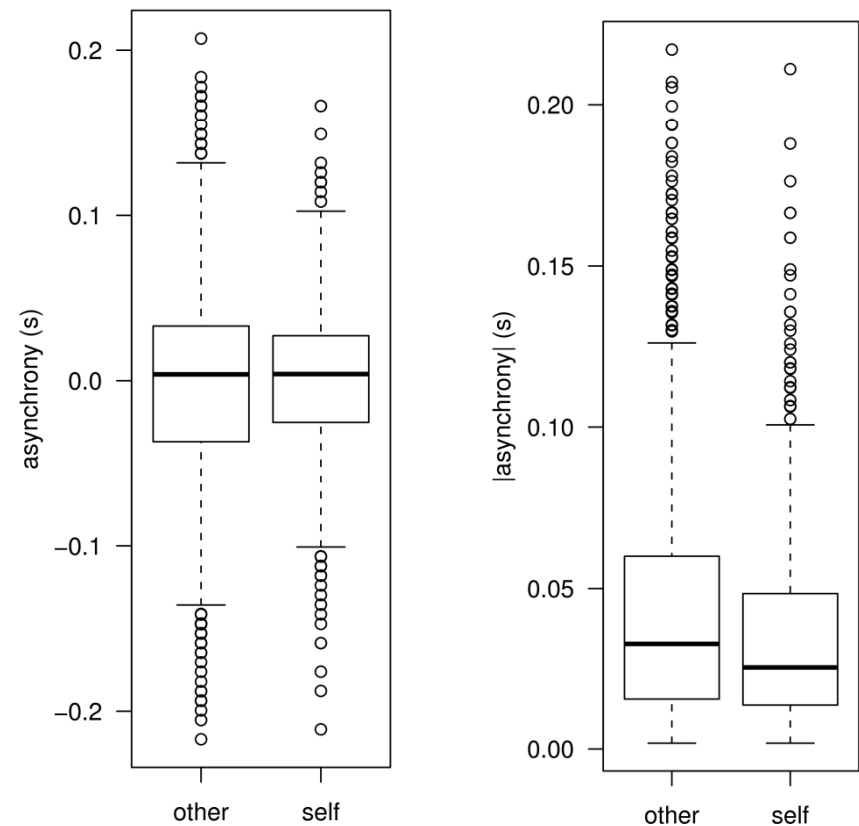
C. B. *div.*

100



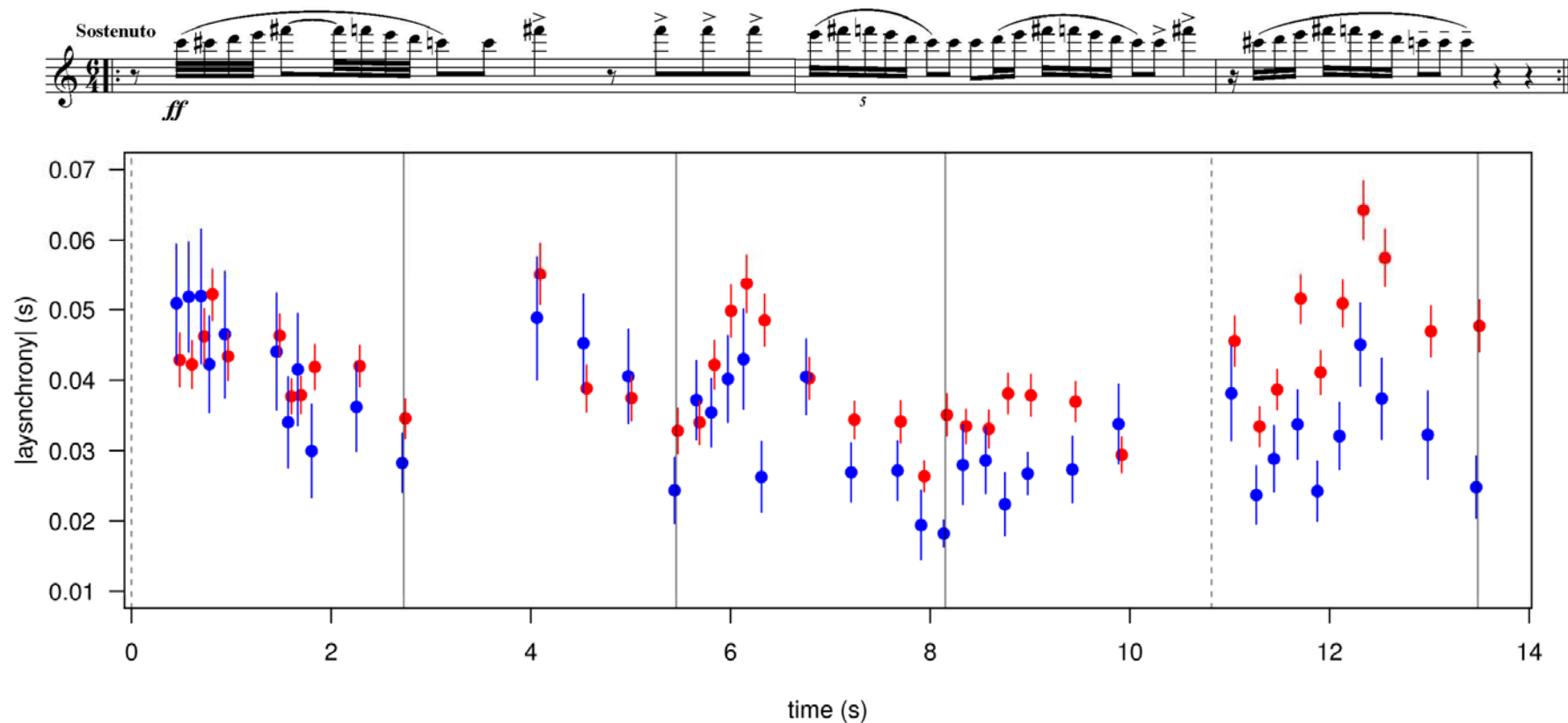
RESULTS

- Onsets of each note were automatically detected using a software developed in a previous study.
- The asynchrony between *primo* and *secondo* was defined as the absolute value of the temporal difference between the onsets for each note.
- signed values showed mean close to zero in both “self” and “other” situations.



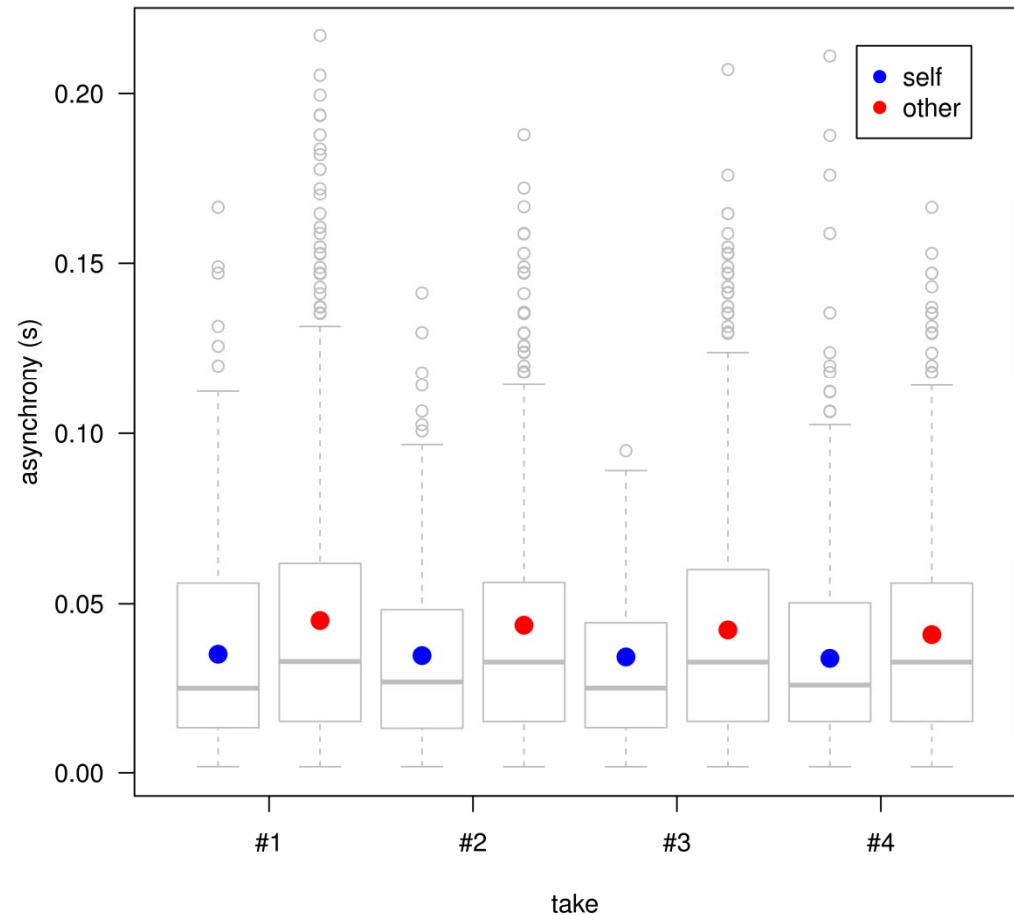
RESULTS

- Assynchrony was significantly higher in *secondo* situation (red) if compared to *primo* situation (blue).
- Lower assynchrony was also observed in strong beat notes (vertical lines correspond to bar lines).



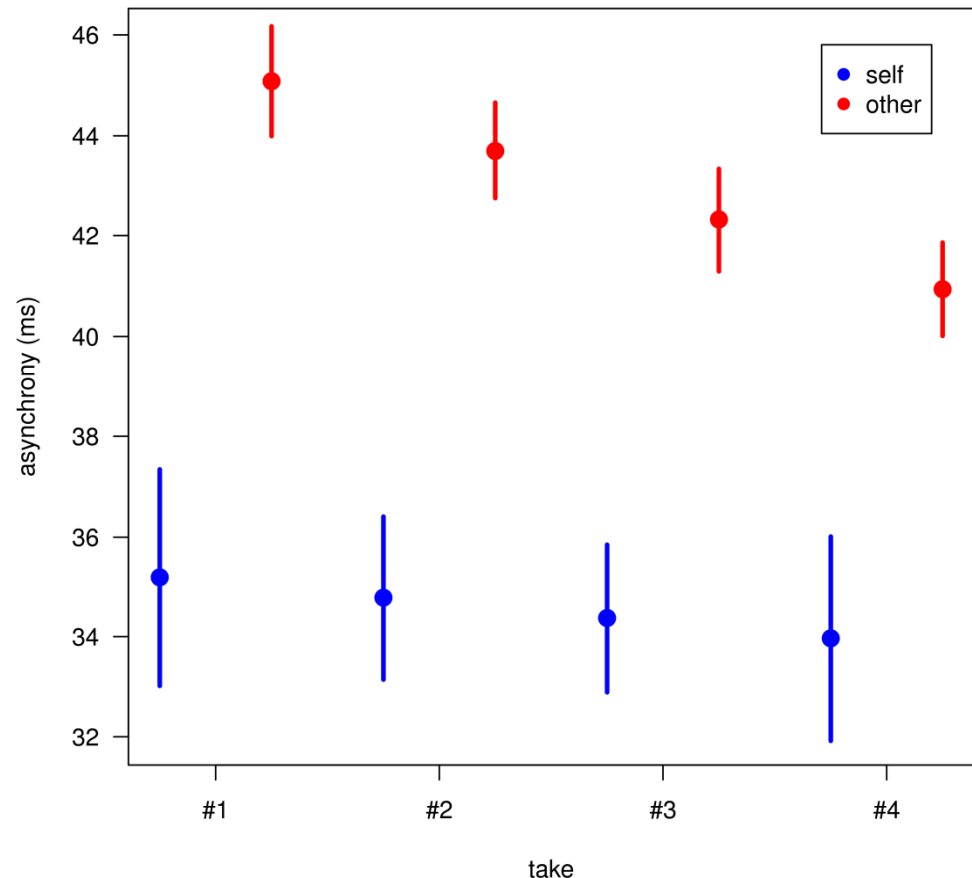
RESULTS

- A GLMM (generalized linear mixed model) was fitted to the data with 2 fixed factors:
 - WHO - discrete factor with levels "self" (blue) and "other" (red);
 - TAKE - continuous factor from 1 to 4.
- Fitted values for the fixed effects are represented with filled circles;
- raw values of the absolute asynchrony in boxplots.



RESULTS

- WHO - self /other effect:
 - difference of 9.9 ms between “self” and “other” assynchronies for TAKE 1 (95% confidence interval: [6.2, 13.7], $p < 0.0001$).
- TAKE:
 - decrease of 1.4 ms per take for the "other" condition (95% confidence interval: [0.6, 2.3], $p < 0.01$).
 - Change of assynchrony due to TAKE is not significant for the "self" condition, although there is a slight decrease of 0.4 ms per take.

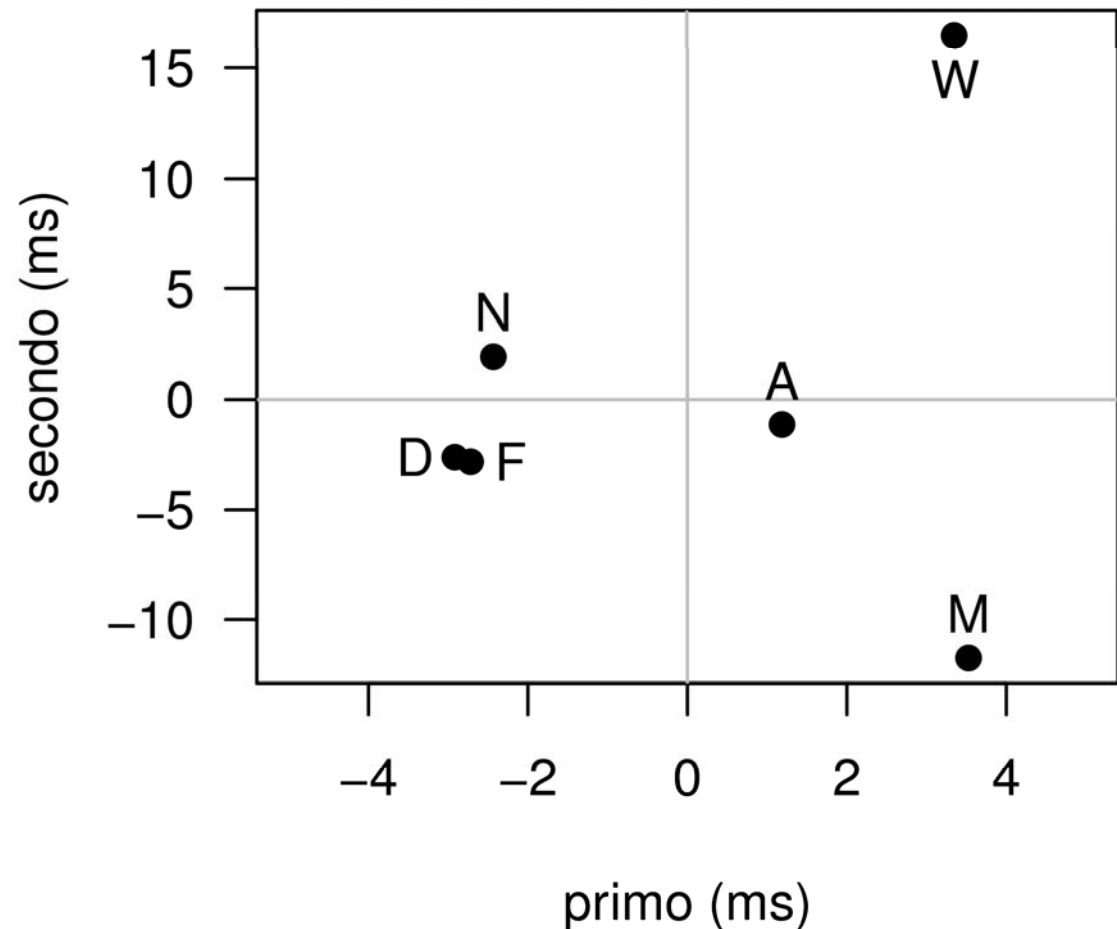


RESULTS

- For testing *Primo* and *Secondo* effects, 2 random factors were considered:
 - PRIMO (influence of the *primo* performer);
 - SECONDO (influence of the *secondo* performer).
- The significance of the random effects were tested using a likelihood ratio test:
 - Both the PRIMO (Chisq [1] = 31.4, $p < 0.0001$) and SECONDO (Chisq [1] = 258.5, $p < 0.0001$) random factors are significant.

RESULTS

- Performer with a positive value for the *primo* effect induces an increase of asynchrony on the other performers, i.e. it is difficult to follow him (or her).
- Performer with a negative value for the *secondo* effect is one who can better follow the *primo*.



Conclusion

- The GLMM fit showed a statistically significant drop on the mean asynchrony when performers played with themselves. This is coherent with results found elsewhere.
- Significant decrease due to TAKE factor might demonstrate that musicians have the ability to learn quickly to better predict their partner's expressive intentions.
- Random effects were significant, which suggests:
 - some performers are easier to follow than others;
 - some performers are better followers than others;
 - performers behave differently as regards the adaptation of the synchronization during the performance.
- An asynchrony of about 5 ms lower for the notes at strong beats was observed, which opens the avenue for investigations under the prospects of the dynamics of attending, as well as for understanding how the synchronization patterns may arise from musical structure.

Thank you