

# Synchronization and timing of professional musicians: A comparison between orchestral brass and string players

## Background

Musicians have to coordinate complex rhythmic movements when playing their musical instruments. They need years of deliberate practice to learn how to adjust their timing behaviour as good as possible to the acoustic characteristics of their own instrument as well as to the spatial position in the orchestra respectively. Since most research on sensorimotor synchronization behaviour has mainly focused on the analysis of finger tapping tasks (see Repp, 2005, for a review), we conducted an experiment using a novel experimental paradigm to investigate the timing skills of professional musicians by playing their own musical instruments.

## Aims

Two different experimental paradigms were used to investigate the timing skills of professional musicians. The aim was to examine whether orchestral brass and string players show differences in synchronization performance under varying conditions.

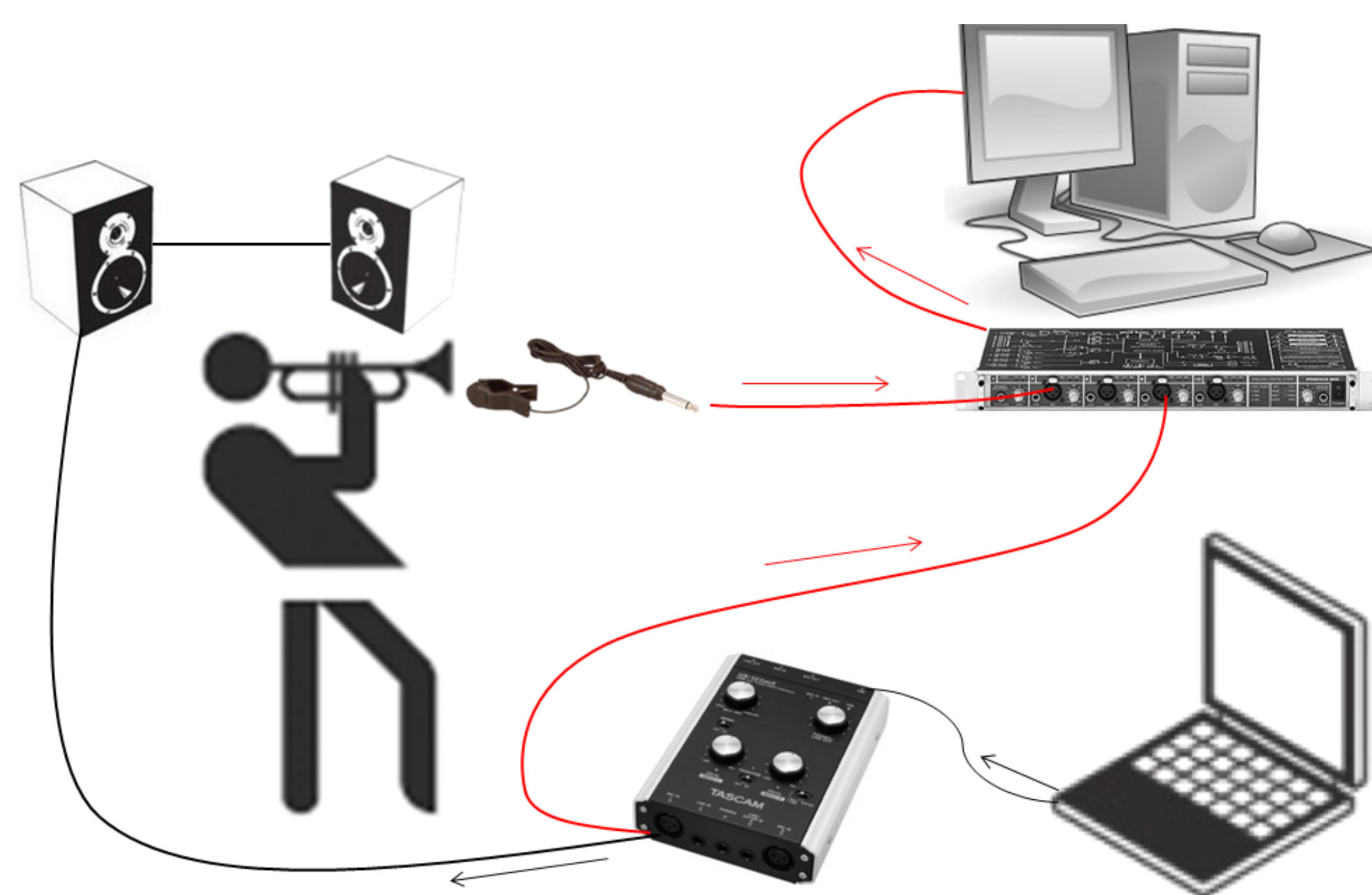


Figure I. Experimental setup for experiment 1.



Strings: Violin & Viola



Brass: Trumpet & Trombone

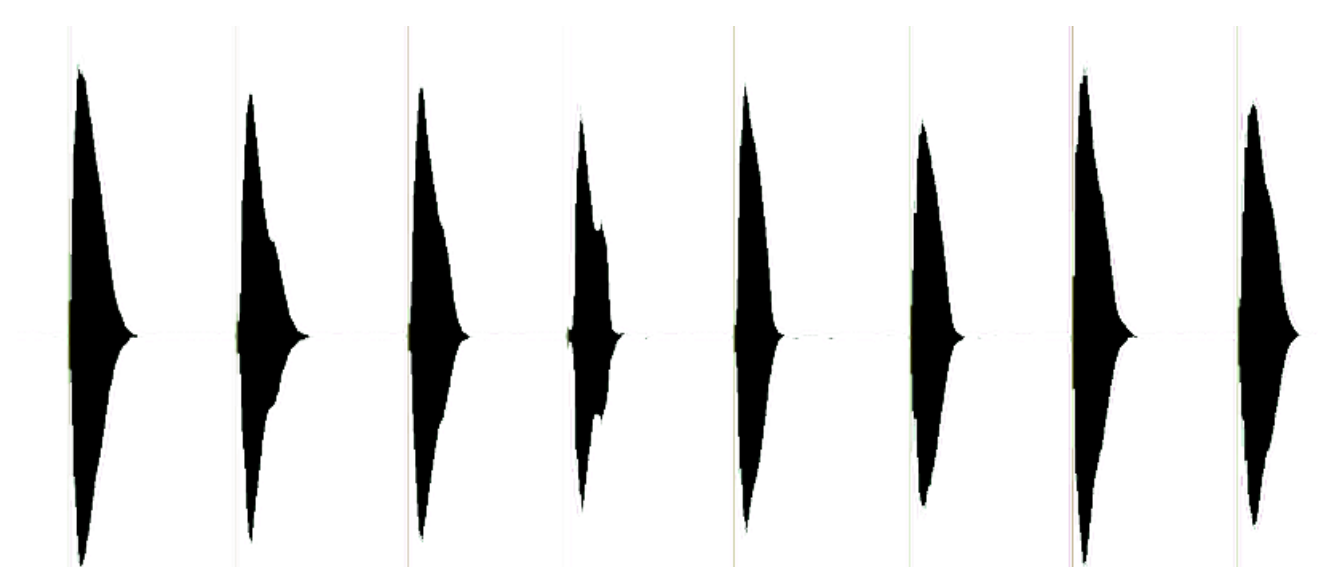


Figure II. Sound envelopes of amplitudes (Cubase hitpoint onset detection).

## Method

21 professional musicians from a professional orchestra in Germany were asked to participate in the study. In the first experiment subjects had to synchronize by playing their own instrument (violin, viola, trumpet, trombone) with a simple metronome sequence (in each case the stimulus sound was the same as the instrument sound) in varying trials with different interstimulus-onset intervals (IOI) = 300, 400, 500, 600, and 1000 ms. In a second experiment, subjects had to perform the classical finger tapping synchronization task to metronome sequences on a drum pad (same IOI's as in the first experiment, for setup details, see Fischinger, 2011).

## Results

Overall, the results show considerable differences in synchronization performance: Subjects show a very low synchronization error in the first experiment, when they have to synchronize by playing their own instrument compared to the second experiment with the classical tapping task. The results also show that brass players perform slightly more precise than string players (Exp.1: brass: -1.78 ms; strings: -2.42 ms; Exp. 2: brass: -9.71 ms; strings: -14.25 ms).

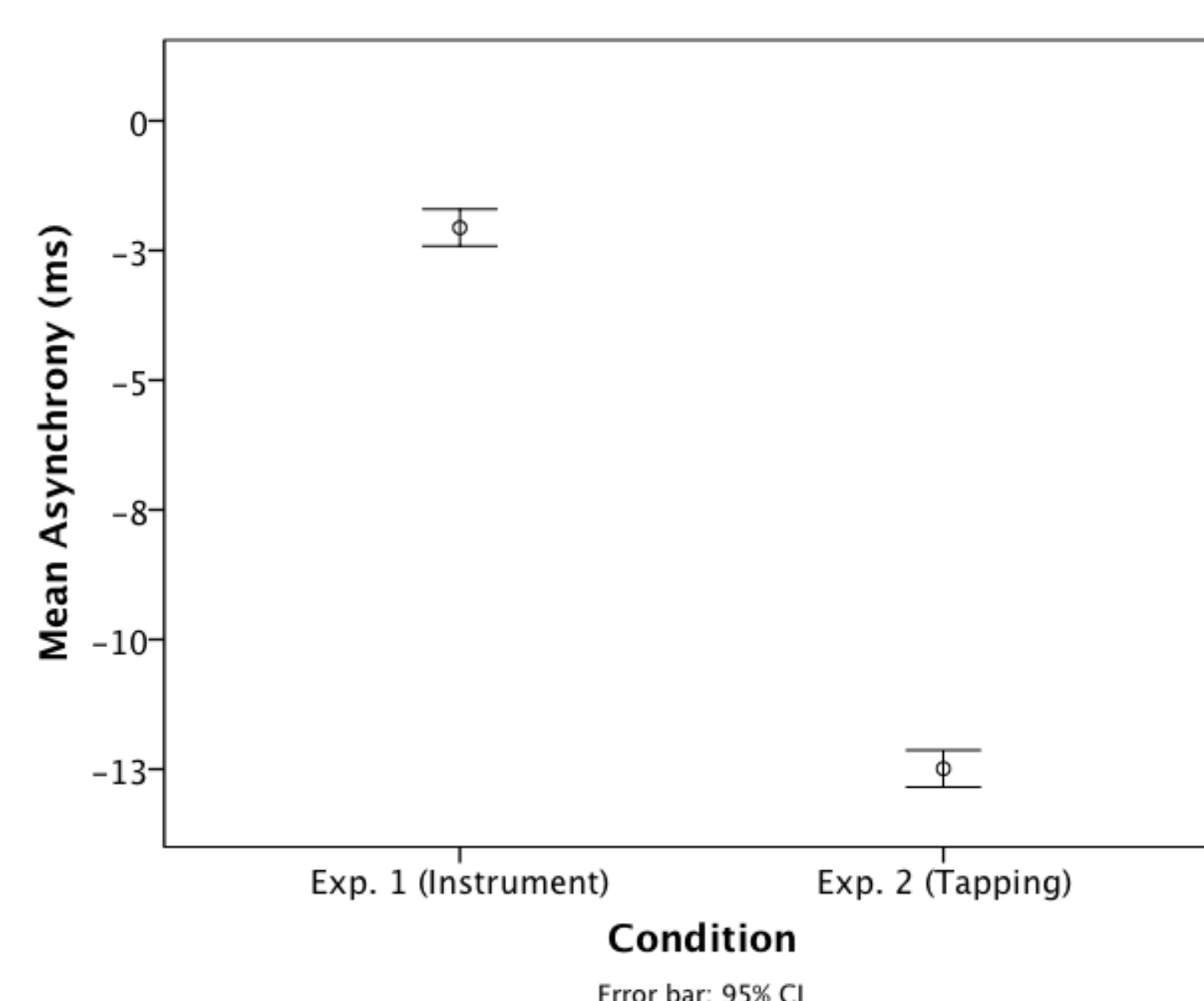


Figure III. Error bars of the mean asynchronies for Exp.1 and Exp. 2.

Instrument	-2.06 (10.92)
Tapping	-12.60 (8.38)
IT-Diff	-10.54
<i>t</i> test	$p < 0.002$
Effect size	0.78
N	21

Table I. Means of the asynchronies in ms (with standard deviations), IT-Diffs (differences between Instrument and Tapping condition), *t* test for paired samples on the mean values of the asynchrony among subjects and effect sizes for all IOIs together.

## Conclusions

Timing skills of professional musicians differ with regard to experimental conditions. This could be due to the fact that subjects are highly trained experts on their own musical instrument, but are not used to the classical tapping condition respectively. Synchronization precision of professional musicians also seems to be depending on the acoustic characteristics of their instrument (transients and perceptual onsets) as well as on the spatial position in the orchestra (see Hall, 1997 and Meyer, 1999).

## References

- Fischinger, T. (2011). An integrative dual-route model of rhythm perception and production. *Musicae Scientiae*, 15 (1), 97-105.
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- Meyer, J. (1999). *Akustik und musikalische Aufführungspraxis. Leitfaden für Akustiker, Tonmeister, Musiker, Instrumentenbauer und Architekten*. Frankfurt am Main: Edition Bochinsky.
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