

# KEEPING TIME WITH DYSTONIA

## Comparing timing and sound control in drumming for healthy and dystonic drummers.

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*Focal dystonia*, or musicians' cramp, can be defined as (painless) **loss of voluntary motor control in highly trained movements**. For drummers, symptoms are typically loss of fine motor control of the flexion and extension movement of the wrist with co-contraction of wrist flexor and extensor muscles, leading to compromised timing performance.

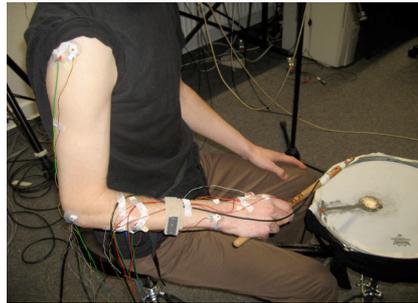
*Are dystonic movement patterns specific for more demanding combinations of tempo and dynamic level, or can an effect be discerned already for playing at slow tempi?*

### Experiment

Recording:  
Motion capture of player's arm and **stick movements**; **contact time** between stick and drum head, and **audio**.

Participants:  
Four right handed, classically trained percussionists (19-24 yrs experience).  
•Two "healthy" players without problems,  
•Two "dystonics" with left arm affected by focal dystonia.

Task:  
Continuous playing of single strokes at different dynamic levels (p, mf, f) and tempi (50, 120, and 300 bpm)



### Analysis

*Movement analysis* focused on the **vertical position and peak acceleration of the drumstick marker** (the vertical acceleration being the most important to transfer energy at impact).

Functional data analysis (Ramsey and Silverman, 2005) was used to smooth data, (following Goebel and Palmer 2008)

*Timing analysis* concentrated on the **main inter-onset intervals (IOI)**. Extra bounces after strokes were removed from the analysis, as well as missing strokes (eight in total). The **Coefficient of variability (CV)** was calculated as  $\text{std}/\text{mean}$  of IOIs.

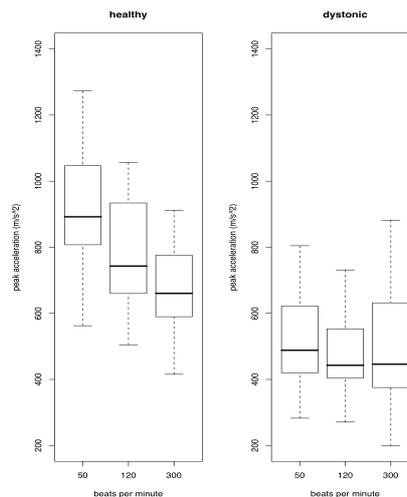
### Results

All players initiated strokes at slow tempo from a greater height compared to faster tempi, but the healthy players produced higher peak acceleration than the dystonic. There was also an influence of tempo, in particular for healthy players.

Compared to the healthy players dystonic players on average generated softer and longer strokes.

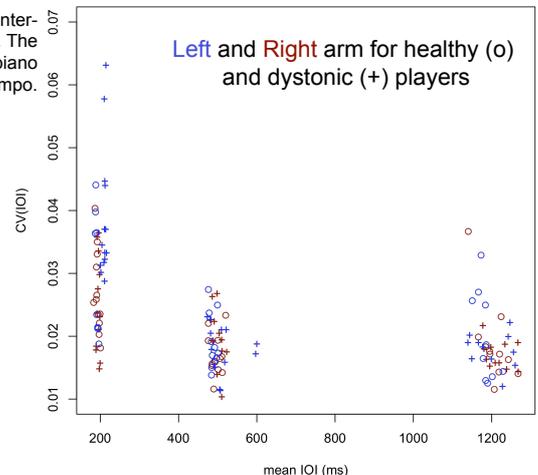
All players showed increased variability in loudness and timing when playing at 300 bpm. The dystonic players displayed considerable lack of control in for the affected arm, often resulting in unintended extra strokes.

With extra strokes removed, the CV(IOI) was similar between players. In particular, performance was the same at intermediate tempo.



Peak acceleration for mf strokes at different tempi. Note the influence of tempo for the healthy compared to dystonic players.

Coefficient of variability of main inter-onset intervals at different tempi. The highest variability was seen for piano strokes at fast tempo.



### Conclusion

As expected, extreme combinations of tempo and dynamic level resulted in increased variability for both healthy and dystonic players. Considerable altered movement patterns were observed for the dystonic players' affected arm at the fastest tempo.

Despite the deteriorated movement patterns, dystonic players maintained main timing intervals with a variability close to that produced by their left arm and by healthy players.

We found no clear indicators of dystonic behavior at slow and intermediate tempi. However, at slower tempi, the healthy players appeared to use the additional time between strokes to increase their dynamic range to a greater extent than did the dystonic player.

This work was supported by the European Commission through a MOBILITY-2 Marie Curie Intra-European Fellowship (MEIF-2006-039429).

