

Modulation of Human Locomotion Dynamics Using Persistent Rhythmic Cue Sequences

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Background

A UNIQUE MATHEMATICAL MEASURE CALLED "PERSISTENCE" REFLECTS THE NATURAL FLOW OF RHYTHMIC HUMAN MOVEMENTS.

HEALTHY RHYTHMIC HUMAN MOVEMENTS ARE PERSISTENT.
Gait and finger tapping are examples of rhythmic human movements. In neurologic diseases such as Huntington's disease, the persistence level of movement breaks down and trends towards randomness.

A HEALTHY DOSE OF PERSISTENCE IS MEASURED IN HEALTHY BRAINS THROUGH THE EEG.
In neurologic diseases, the persistence in EEG also breaks down.

METRONOME MUSIC CUES CAN BREAK PERSISTENCE.
While metronomic cues have positive impact on certain aspects of gait such as stride variability, walking to a metronome can disturb the natural level of persistence in gait dynamics.

BETTER MUSIC CUES ARE NEEDED.
Music cues can make gait rehabilitation more engaging and effective for children. However, better music cues are needed.

In movement rehabilitation, persistent music cues can be used to enhance finger tapping dynamics to closely resemble those associated with a healthy state.







Research Question

WE AIM TO INVESTIGATE NEW RHYTHMIC CUES THAT ARE EITHER NEUTRAL OR POSITIVE TO THE PERSISTENCE LEVEL OF HUMAN LOCOMOTION.

- 1 The primary aim of this study is to establish the relationship between persistence levels of rhythmic cues and their effect of the persistence of locomotion.
- 2 The secondary aim is to identify EEG brain waves that govern the persistence in human locomotion.

Methods

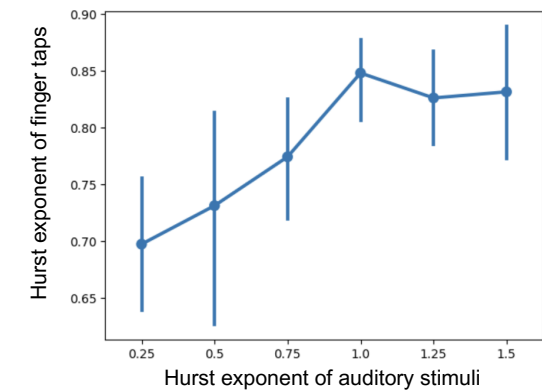
-  Thirty healthy adults with normal hearing aged 18 to 35 years are recruited for one session of 1.5 hours.
-  Rhythmic cue sequences are generated as fractional Gaussian noise or fractional Brownian motion of Hurst exponents of 0.25, 0.5, 1, 1.25 or 1.5 with the exact Davies-Harte algorithm.
-  Participants tap their fingers to rhythmic cue sequences of a metronome or of 6 different Hurst exponents.
-  The rhythmic cue sequences, finger taps, and EEG brain waves are collected and analyzed.

Results

Data collection is ongoing. Eight participants have completed the study.

Finger Taps

Preliminary data analysis has shown that the Hurst exponent of between-tap intervals is positively correlated with the Hurst exponent of rhythmic cues.



Next step is to analyze EEG brain data.