

# Fractal analysis of the movement-inducing effects of music during standstill



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## Introduction

Previous research has found multi-scale correspondences between music and body sway (Ross et al., 2016; González et al., 2018), shedding light on the complex mechanisms that underlie music-induced movement. At the same time, research on the non-linear dynamics of cognitive and perceptual processes has provided evidence of fractal fluctuations in perceptual-motor exploration and behavioral responses to demanding tasks (Bassingthwaight et al., 2013; Kelty-Stephen and Dixon, 2014).

## Methods

Eighty seven participants were asked to stand as still as possible for 500s while being presented with alternating silence and music stimuli. The music stimuli ranged from a metronome track to complex electronic dance music. The head position of each participant was captured with an optical motion capture system. Long-range correlations of head movement were estimated by detrended fluctuation analysis (DFA).

## Results

Mean  $\alpha$  exponents from DFA in the AP, ML, and 3D directions across conditions (music and silence) were significantly consistent with fractal fluctuations and are in line with typically observed ranges of healthy physiological control processes. Long-range correlations of head movement were estimated by detrended fluctuation analysis (DFA).

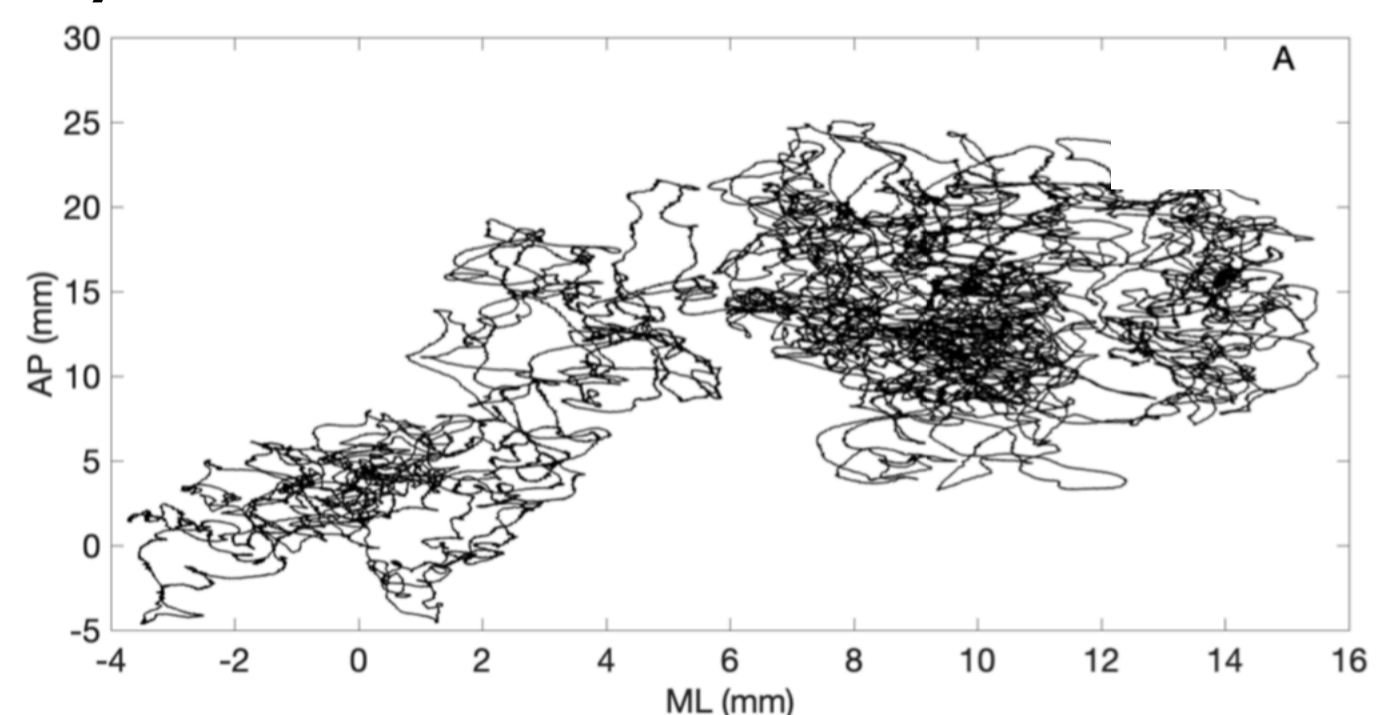


Fig. 2 Typical head sway path in the XY plane

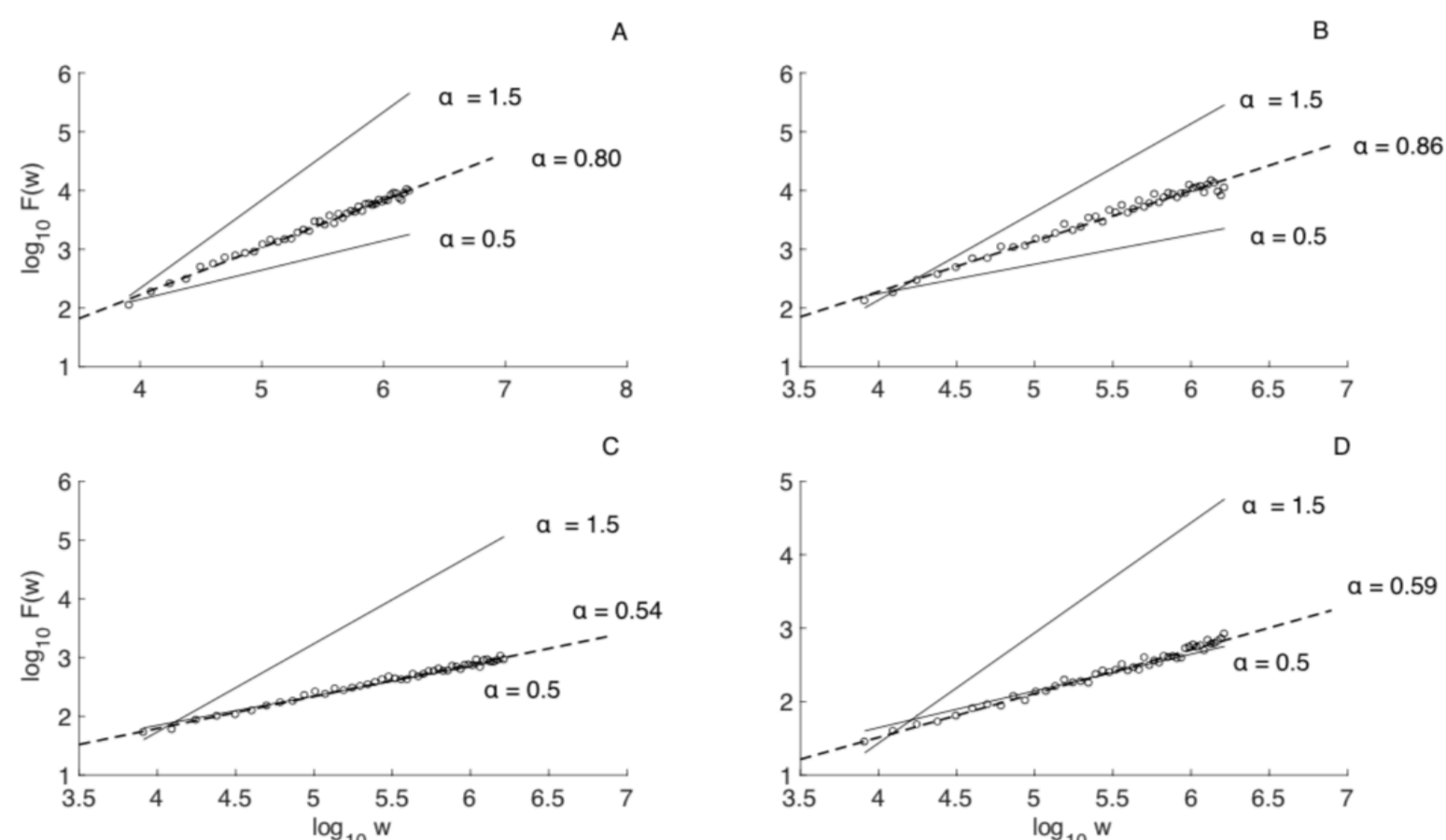


Fig. 3 Fluctuation functions from DFA on a sample QoM time series during a single segment of music for a single participant. Points are overlaid with the trend line with a slope corresponding to the scaling exponent  $\alpha$ . The solid lines indicate the linear fits of white and Brownian noise for comparison.

## Conclusions

Results revealed the existence of fractal-like organization and long-range correlations in music-induced head sway during standstill. This suggests that the effects of music on head movement during standstill extend over a range of timescales. Such fractal dynamics are characterized by an interplay of flexibility and adaptability.

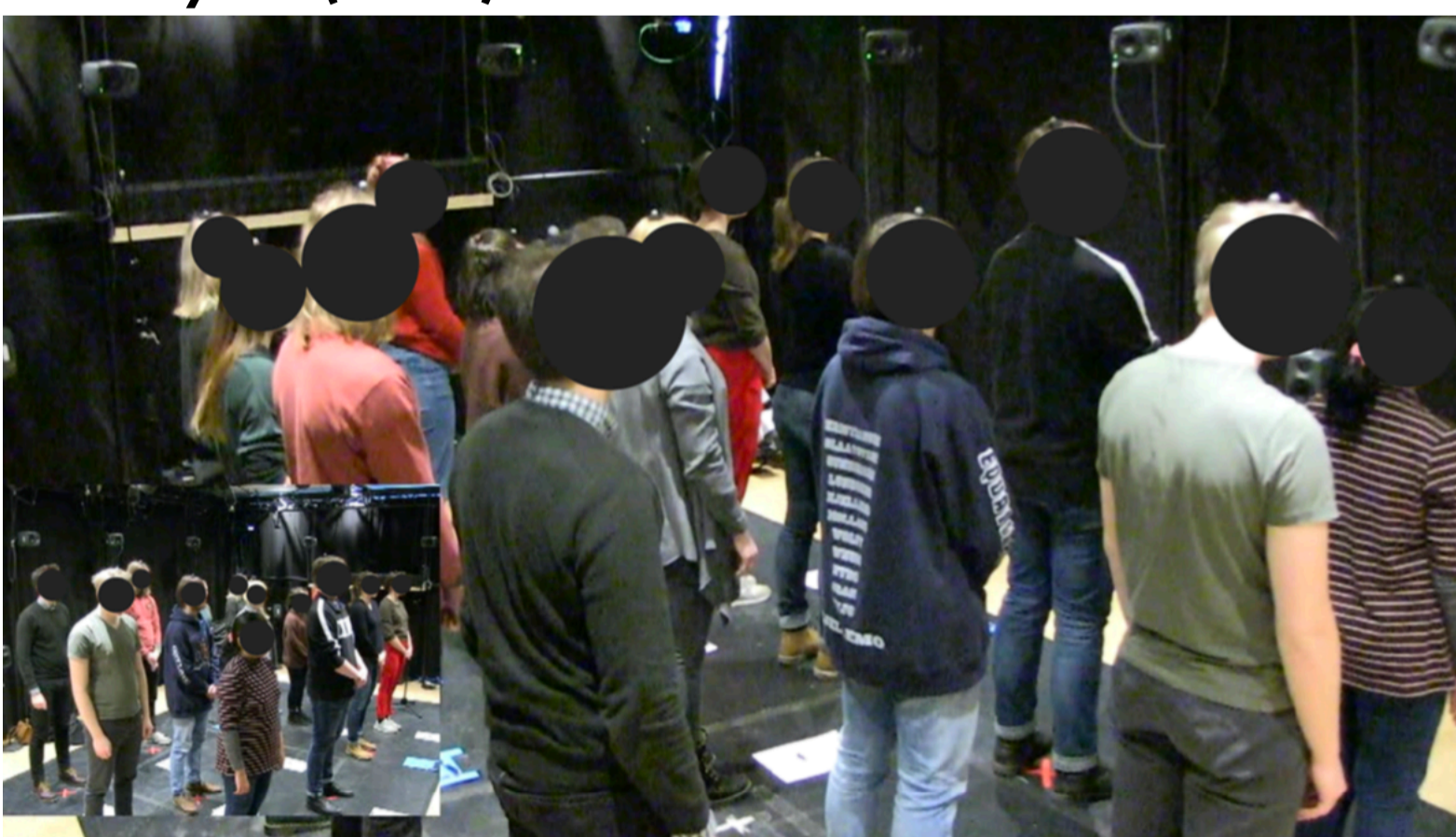


Fig. 1 Norwegian Championship of Standstill, 2018

## References

- Bassingthwaight JB, Liebovitch LS, West BJ (2013) Fractal physiology. Springer
- Gonzalez-Sanchez VE, Zelechowska A, Jensenius AR (2018) Correspondences between music and involuntary human micromotion during standstill. *Frontiers in psychology* 9
- Kelty-Stephen DG, Dixon JA (2014) Interwoven fluctuations during intermodal perception. *J. Exp. Psychol* 40(6):2289
- Ross JM, Warlaumont AS, Abney DH, Rigoli LM, Balasubramaniam R (2016) Influence of musical groove on postural sway. *J. Exp. Psychol.* 42(3):308