

Thesis abstract

Auditory-motor entrainment: Behavioural and cerebral dynamics

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We often synchronise our movements to auditory rhythms in our environment without the intention to do so. Such coordination influences the stability of movement performance, and, therefore, can be used to our benefit in sport and therapeutic contexts. Research to date has largely reached a consensus about the mechanisms underlying intentional sensory-motor coordination, but spontaneous auditory-motor entrainment is still under exploration. This thesis addresses the dynamics of unintentional synchronisation towards various frequency relationships between periodic movement and auditory rhythm frequencies. It presents four complementary studies questioning the role of multiple metrical levels and their accentuation (relative salience) on the emergence and stability of simple vs. complex synchronisation in healthy adults. The first study confirms quantitatively the emergence of spontaneous synchronisation between periodic movement and auditory rhythms at frequency ratios different from 1:1. The second study introduces the benefit of a congruent accentuation pattern on the emergence of various frequency ratios. It leads to the observation that a ternary accentuation pattern facilitates synchronisation more than a binary accentuation pattern. The third study examines this new finding more extensively through the

recording of neural responses to various accented patterns using Electroencephalography, confirming a differential response to ternary and binary patterns linked to behavioural performance. The fourth and final study focuses on the benefit of accentuation patterns for the production of a more complex type of movement coordination: a multi-frequency bimanual coordination performance. This study also measured neural tracking of the accentuation pattern relative to the congruence of the motor coordination performed, showing that both sensory and motor systems influenced rhythm perception. All together, these results demonstrate that spontaneous auditory-motor entrainment can emerge at various frequency ratios in accordance with the predictions of the dynamical systems approach to action and perception. Furthermore, spontaneous auditory motor entrainment is modulated (i.e., increased or decreased) by the addition of simple accentuation patterns, depending on congruence with the auditory-motor frequency mode and the neural response to the accents. In addition, more complex multi-limb motor coordination performance responds similarly to accentuation, underpinned by auditory-motor coupling and sensory processing of the auditory rhythms. Therefore, the findings of this thesis open

new avenues for future research on spontaneous auditory-motor coordination and its application in the training and rehabilitation of motor performance.

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