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Introduction and aims

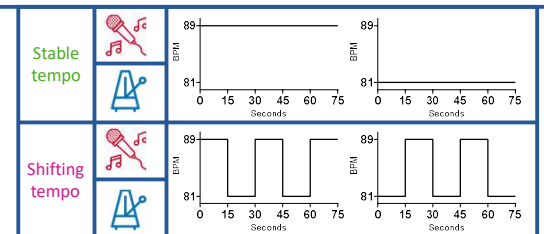
Motor impairment is increasingly recognised as a feature of neurocognitive disorders (NCDs)¹, and yet there is mixed evidence regarding the nature and extent of sensorimotor decline in this group². Some evidence points to a particular impairment of people with NCDs on more cognitively demanding tasks, but no research has been done investigating the effect of NCDs on adaptation to tempo changes in SMS. The present study aimed at evaluating sensorimotor synchronisation (SMS) performance in older adults tapping to metronomic and musical

sequences, some of which contained tempo changes. We expected lower performance when people tapped to sequences with shifting tempi, an effect we expected to be magnified in people with NCD. Moreover, we expected more efficient adaptation to decelerations than accelerations^{3,4}. In line with past findings^{5,6}, we also expected lower consistency when tapping with music as compared to a metronome.

How is sensorimotor synchronisation influenced by neurocognitive disorders?

Methods

| | Mild NCD N = 23 | Major NCD N = 21 | p |
|-------------------------------------|--------------------|---------------------|------|
| Age (mean ± SD) | 79.4 ± 6.1 | 80.8 ± 6.2 | n.s. |
| Gender (Women/Men) | 15/8 | 16/5 | n.s. |
| Years of education (mean ± SD) | 9.1 ± 2.9 | 10.6 ± 4.0 | n.s. |
| Mini-Mental State Examination (/30) | 25.1 ± 2.8 | 24.1 ± 4.2 | n.s. |
| Activities of Daily Living (/6) | 5.0 ± 1.2 | 5.1 ± 1.1 | n.s. |

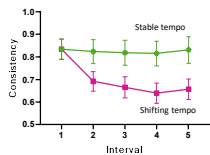


Task: Patients tapped their hand to rhythmic sequences while watching a video recording of a musician doing the same. The stimuli were a **musical excerpt** or a **metronomic sequence**, a fast and a slow tempo were employed and within a trial, the tempo either

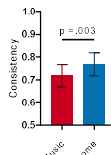
remained **stable** or **shifted between the two** every 15 seconds. Tapping consistency was analysed per condition and its relation to cognitive impairment was examined.

Results

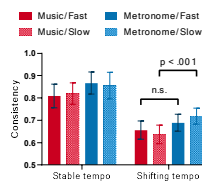
Experimental manipulation



As expected, with a **shifting tempo**, reduced consistency from the time of the first tempo change onwards.

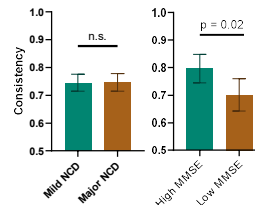


Higher level of consistency with the **metronome** than with **music**

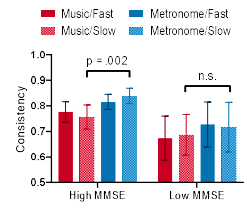


Tempo * tempo stability * stimulus type interaction:
At slow/shifting tempo, higher consistency when tapping to a **metronome** than to **music**.

Neurocognitive disorder



No difference between people with **Major** and **Mild NCD**, however higher consistency in people with a **high MMSE** (≥ 25) than those with a **low MMSE**.



MMSE * tempo * stimulus type interaction:
At slow tempo, people tapped with higher consistency to **music** than to a **metronome**, but only in the **High MMSE** group.

Discussion

Our findings suggest that the way people react to accelerations and decelerations depends on stimulus type:

> Decelerations might be easier to detect and adapt to with a metronome, in line with previous literature^{3,4,7}, which might not be the case for music.

Different results based on how cognitive status was defined: No difference between Major/Mild NCD but higher consistency in people with high MMSE compared to low MMSE.

> Surprising since MMSE does not necessarily measure motor function, although it does measure attention and language, which implicates a fine motor element.

> A next step will consist of analysing neuropsychological data not yet included in this analysis. Stimulus type (music/metronome) affected consistency only at the slow tempo. Our hypothesis of an interaction between cognitive status and tempo stability was not confirmed, but this latter effect only held in the High MMSE group.

> The large overall variances in Low MMSE group deserve to be further studied. As expected, lower consistency when tapping to music than to a metronome.

> This is generally in line with the literature⁶, but might depend on choice of song and its beats salience⁸.

References

- Martin, E., Blais, M., Albaret, J. M., Pariente, J. & Tallet, J. Alteration of rhythmic unimanual tapping and anti-phase bimanual coordination in Alzheimer's disease: A sign of inter-hemispheric disconnection? *Hum. Mov. Sci.* **55**, 43–53 (2017).
- von Schnehen, A., Hobeika, L., Huvent-Grelle, D. & Samson, S. Sensorimotor Synchronization in Healthy Aging and Neurocognitive Disorders. *Front. Psychol.* **13**, 838511 (2022).
- Repp, B. H. Processes underlying adaptation to tempo changes in sensorimotor synchronization. *Hum. Mov. Sci.* **20**, 277–312 (2001).
- Versaci, L. & Laje, R. Time-oriented attention improves accuracy in a paced finger-tapping task. *Eur. J. Neurosci.* **54**, 4212–4229 (2021).
- Ghilain, M. et al. Sensorimotor synchronization and non-verbal behaviors in Alzheimer's disease: The influence of social and musical context. *Geriatr. Psychol. Neuropsychiatr. Vieil.* **18**, 213–222 (2020).
- Sowiński, J. & Dalla Bella, S. Poor synchronization to the beat may result from deficient auditory-motor mapping. *Neuropsychologia* **51**, 1952–1963 (2013).
- Palmer, C., Lidji, P. & Peretz, I. Losing the beat: deficits in temporal coordination. *Philos. Trans. R. Soc. B Biol. Sci.* **369**, 20130405 (2014).
- Dalla Bella, S. et al. BAASTA: Battery for the Assessment of Auditory Sensorimotor and Timing Abilities. *Behav. Res. Methods* **49**, 1128–1145 (2017).

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