The impact of cognitive functioning on sensorimotor synchronisation with simple and complex rhythmic sequences

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Introduction and aims

Motor impairment is increasingly recognised as a feature of neurocognitive disorders (NCDs), and yet there is mixed evidence regarding the nature and extent of sensorimotor decline in this group. 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. In line with past findings, we also expected lower consistency when tapping with music as compared to a metronome.

Methods

<table>
<thead>
<tr>
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<th>Mild NCD</th>
<th>Major NCD</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Age (mean ± SD)</td>
<td>79.4 ± 6.1</td>
<td>80.8 ± 6.2</td>
<td>n.s.</td>
</tr>
<tr>
<td>Gender (Women/Men)</td>
<td>15/8</td>
<td>16/5</td>
<td>n.s.</td>
</tr>
<tr>
<td>Years of education (mean ± SD)</td>
<td>9.1 ± 2.9</td>
<td>10.6 ± 4.0</td>
<td>n.s.</td>
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<tr>
<td>Mini-Mental State Examination (±SD)</td>
<td>25.1 ± 2.8</td>
<td>24.1 ± 4.2</td>
<td>n.s.</td>
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<tr>
<td>Activities of Daily Living (±SD)</td>
<td>5.0 ± 1.2</td>
<td>5.1 ± 1.1</td>
<td>n.s.</td>
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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

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 tempo higher consistency when tapping to a metronome than to music.

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, 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 literature, but might depend on choice of song and its beat salience.

References


We thank the staff and the patients of the geriatric hospital Les Bateliers in Lille as well as the teams of IPREM, Ghent University, and IRCAM, who developed the experimental setup.