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Is rhythmic spontaneous motor tempo common across individuals and conditions? A systematic review of the literature.

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Introduction. Many daily and leisure activities produce spontaneous rhythm (walking, talking, writing, reading, dancing, pedaling, etc.). However, rhythmic skills can be deficient and rehabilitative interventions based on sensorimotor synchronization (SMS) to external rhythms are used to improve motor control, especially for patients with neurological diseases (e.g., Parkinson, Cerebral Palsy) or neurodevelopmental disorders (e.g., Dyslexia, Developmental Coordination Disorder). During these interventions, individuals are required to synchronize their movements with an external rhythm, usually with an auditory metronome. The sensory modality and the tempo of the external stimuli can modulate SMS (see Repp & Su, 2013). Notably, SMS is less accurate and stable when the tempo is far from the participant's spontaneous motor tempo (SMT), i.e., the tempo at which he or she produces spontaneous, regular, natural, and pleasant rhythmic movements in the absence of external stimuli. Thus, the measure of the individual SMT appears essential before any intervention in order to facilitate synchronization to the metronome presenting a personalized rhythm. Early studies identified by Fraisse (1974) suggested that the SMT would be approximately 600 ms in adults without disorder. However, a growing literature suggests that the value of the SMT is not as fixed as previously described and that several factors could modulate the SMT. The purpose of this systematic review is (1) to characterize the range of values of the SMT in healthy human adults and (2) to identify all the factors modulating the values of the SMT in human.

Methods. We conducted a systematic review according to PRISMA recommendations (Page et al., 2021) and used the PICO strategy (McKenzie et al., 2022) in selecting studies. Studies were identified from relevant databases related to motor behavior (PubMed, Science Direct, and Web of Science) and from citation searching. There was no restriction to the year of publication. Only articles in English and French were selected.

Results. After removal of duplicates and selection of articles according to the eligibility criteria, 107 studies were included in the systematic review. 13 studies identified the range of SMT values (333 to 3160 ms), generally measured as a baseline for a SMS task. 94 studies investigated the effect of factors on SMT values, including 59 on the effects of intrinsic factors related to personal characteristics (pathology, age, effector/side, expertise/predisposition, genotype) and 36 on the effects of extrinsic factors related to environmental characteristics (physical training, external constraints, observation training, time of testing, internal state, type of task, dual task).

Discussion. Our results show that the reference value of 600 ms is not so common in adults without disorder. The wide range of values identified is probably related to important differences in the paradigm used. The majority of studies show that intrinsic and extrinsic factors modulate SMT values. The effector, the task, the characteristics of the participants (age, laterality, musical expertise), the number of repetitions, the instruction, the measure (inter-responses interval, frequency, cadence) are very varied. For greater specificity, it would be relevant to use the term Spontaneous Motor Tempo unanimously and to report the intra- and inter-individual variability of SMT values.

Conclusion and perspectives. Our systematic review shows a large intra- and inter-individual variability in SMT values, which should be taken into account when interpreting the results and especially in future studies about performance in rhythmic production and perception tasks, as well as in personalized rehabilitative and training interventions involving rhythmic skills.

References.

Fraisse, P. (1974). Psychologie du rythme. (Presses Universitaires de France).

McKenzie, J.E., Brennan S.E., Ryan R.E., Thomson H.J., Johnston R.V., Thomas J. (2022). Chapter 3: Defining the criteria for including studies and how they will be grouped for the synthesis. In: Higgins J.P.T., Thomas J., Chandler J., Cumpston M., Li T., Page M.J., Welch V.A. (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.3 (updated February 2022). Cochrane, 2022. Available from www.training.cochrane.org/handbook.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement : An updated guideline for reporting systematic reviews. Systematic Reviews, 10(1), 89. https://doi.org/10.1186/s13643-021-01626-4

Repp, B. H., & Su, Y.-H. (2013). Sensorimotor synchronization : A review of recent research (2006-2012). Psychonomic Bulletin & Review, 20(3), 403-452. https://doi.org/10.3758/s13423-012-0371-2.