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Title: sigma-lognormal model: a proof of concept

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Supplementary Material

Table 1 | Resume of the parameters extracted and their signification

| Input level: central system | |
|---|--|
| t_0 | It is the time that takes the brain to perceive the stimulus and emit the command to the musculoskeletal system. It refers to the moment when a population of neurons sends a motor command, it occurs after the audible stimulus is perceived and the motor command prepared. |
| $\Delta(t_0)$ | It reflects the rhythmicity of an input command. It represents the time elapsed between two successive t_0 and is used in the oscillations only. |
| D | It corresponds to the distance covered by the resulting lognormal. |
| θ_s | It is the starting angle of the lognormal. |
| θ_e | It is the ending angle of the lognormal. |
| Timing properties of the neuromuscular system: peripheral system | |
| μ | Also known as the logtime delay, it represents the time taken to reach half of the distance movement on a logarithmic scale. It corresponds to the rapidity of a reaction to a command by a system. |
| σ | Also known as the logresponse time, it represents the time taken from the neuromuscular system to respond to a command on a logarithmic scale. It is also linked to the movement duration and is a measure of the asymmetry of the lognormal. |
| Global state of the neuromotor system | |
| Nblog | It is the number of lognormals required to reconstruct the velocity profile of the movement. |
| SNR | It is the measure of the quality of the movement reconstruction. |
| SNR/Nblog | It is a performance criterion and represents the motor control fluency of a gesture. The lognormality principle predicts that the ideal movement converges toward a lognormal profile. When the SNR/Nblog is higher, the movement is more similar to the ideal one, as postulated by the lognormal behavior. |

Motor program execution ($\Delta(t_0)$ is used instead of t_0 for the calculus in the oscillations)

Mode It is the time at which the maximum value of the lognormal impulse response is reached.

$$M = t_0 + e^{\mu - \sigma^2}$$

Median It corresponds to the time at which the half value of the integral under the lognormal curve (50% of the covered distance) is reached.

$$m = t_0 + e^{\mu}$$

Time delay It represents the rapidity of a neuromuscular system to respond to a command.

$$\bar{t} = t_0 + e^{\mu + 0.5\sigma^2}$$

Response time It is a measure of the spread of the impulse response.

$$s = (\bar{t} - t_0) \sqrt{(e^{\sigma^2} - 1)}$$

Asymmetry It characterizes the shape of the lognormal.

$$A_c = 1 - e^{-\sigma^2}$$

Other parameters

Reaction time It is the time needed to start the movement after a stimulus. In the present study, it was computed as the time required to reach 10% of the maximal velocity during the test

Command propagation It is the duration of the command propagation

$$CP = RT - t_0$$
