

Auditory Motor Entrainment: Influence of a Beat on Children's Locomotion

The Laboratory for Infant Studies



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BACKGROUND

- Synchronization of the auditory and motor systems can occur during the presence of an auditory rhythmic stimuli (Thaut, 2003).
- Auditory-motor entrainment found in spatiotemporal and temporal walking parameters in adults, but not for spatial walking parameters.
- 14- to 24-month-old infants will show modulation in their gait when presented with a single auditory input that was faster than their natural walking cadence (Schmuckler & Paolozza, 2023).

AIM

To explore graduated responses in motor entrainment to fine gradations of change in rhythmic input.

METHODOLOGY

Baseline Walking condition (1st condition)
 - No metronome clicks
 - Calculation of natural cadences

Modified Walking conditions (randomized)
 - 75%, 87.5% (*slower*)
 - 100% (*natural cadence*)
 - 112.5%, 125% (*faster*)

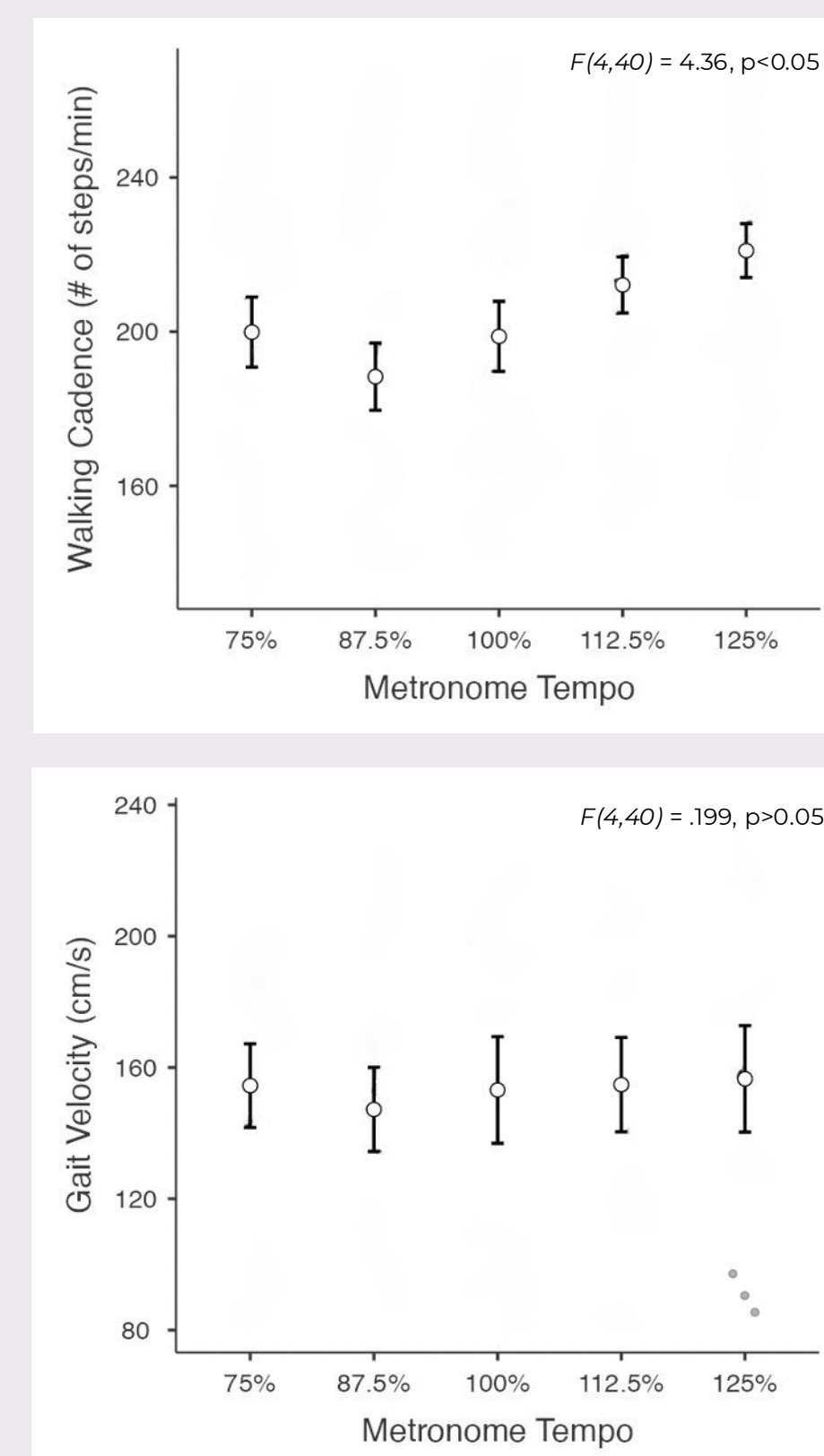
Experimental Condition	Participant 1	Participant 2
Baseline Walking (Natural Cadence)	100 (steps/min)	120 (steps/min)
Metronome Setting		
75% of Natural Cadence	75 (beats/min)	90 (beats/min)
87.5% of Natural Cadence	87.5 (beats/min)	105 (beats/min)
100% of Natural Cadence	100 (beats/min)	120 (beats/min)
112.5% of Natural Cadence	112.5 (beats/min)	135 (beats/min)
125% of Natural Cadence	125 (beats/min)	150 (beats/min)

Table 1: Example of metronome modifications for two participants

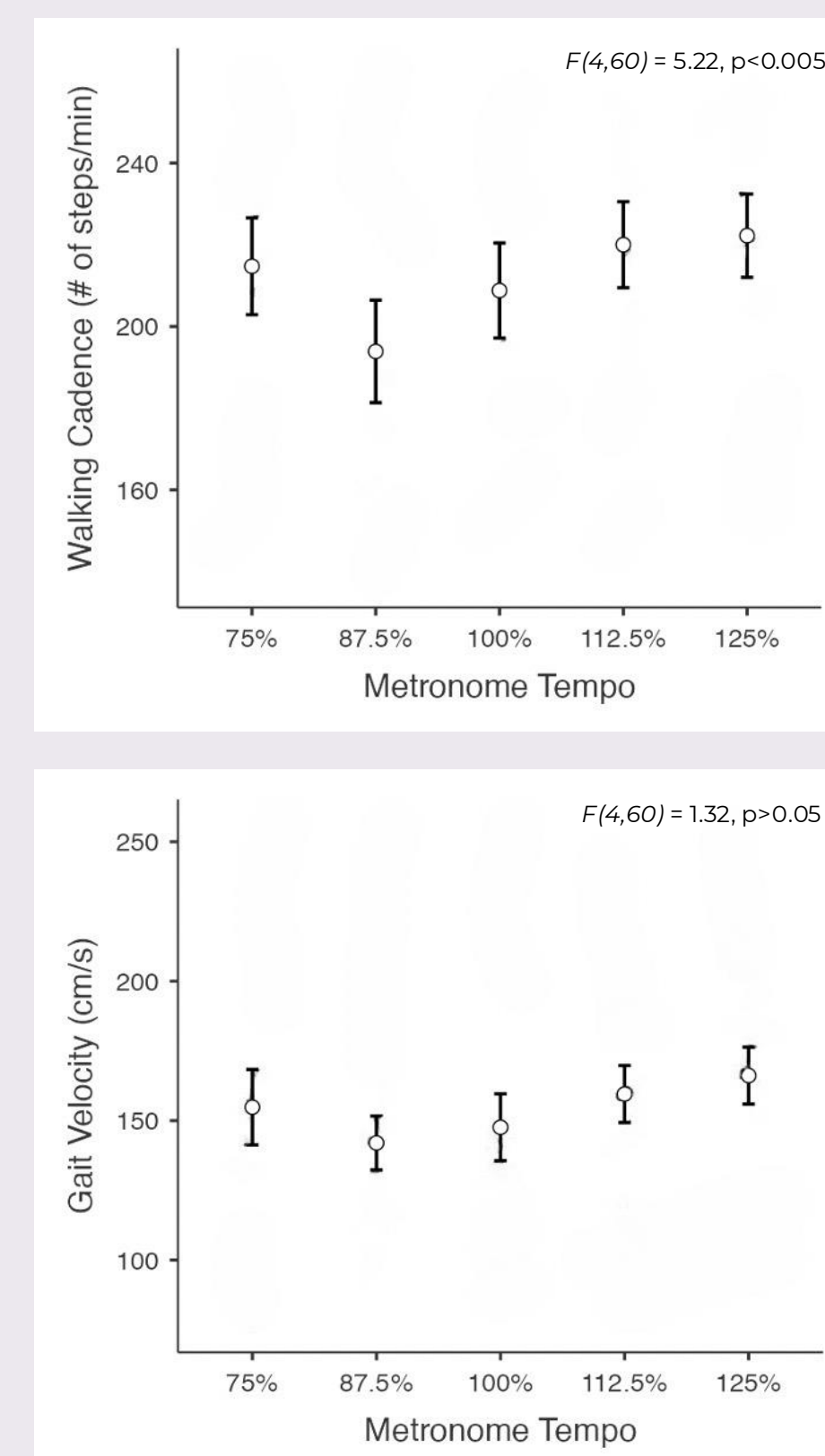
RESULTS

Spatiotemporal Parameters

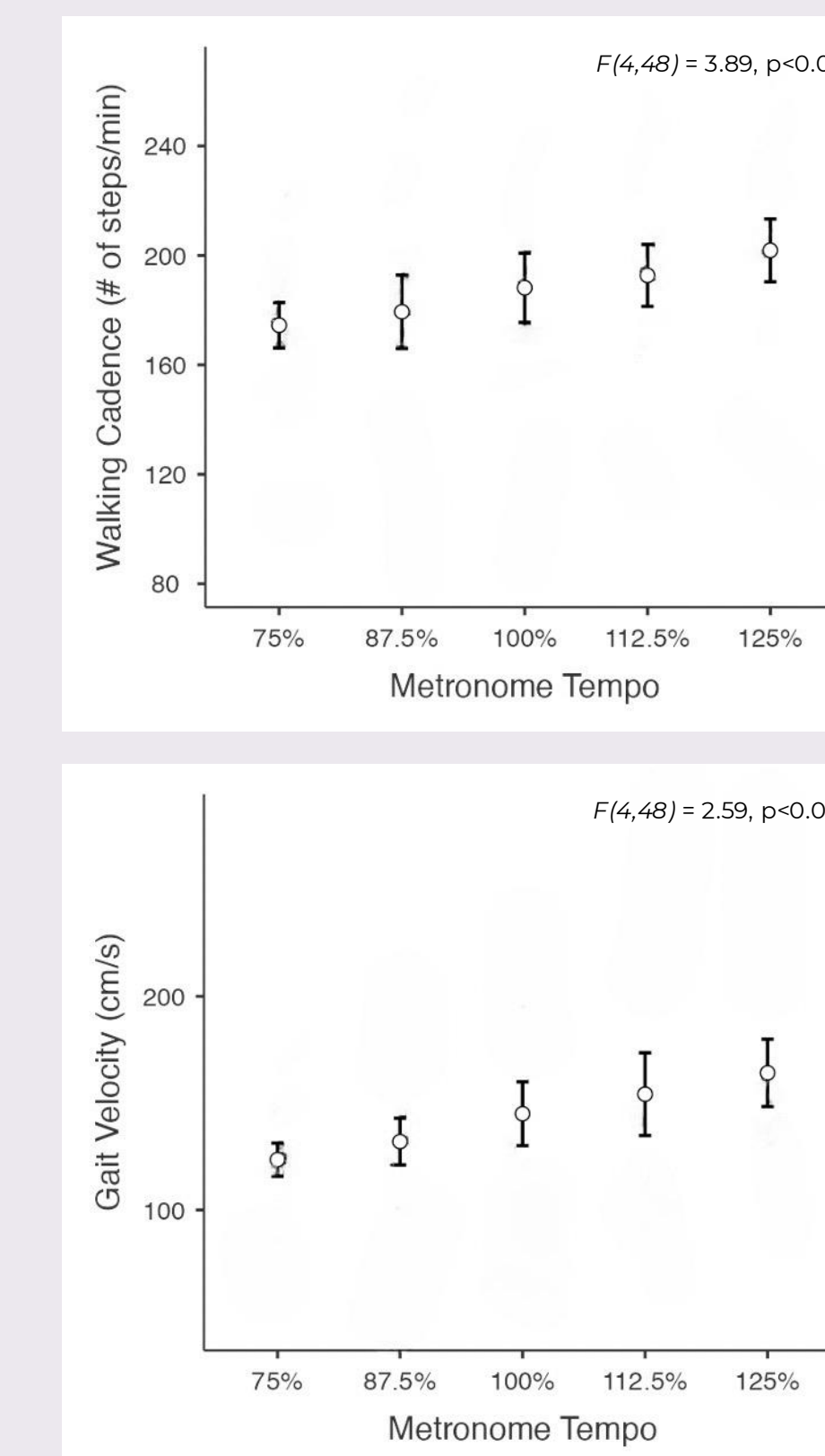
3 YEAR OLDS



4 YEAR OLDS



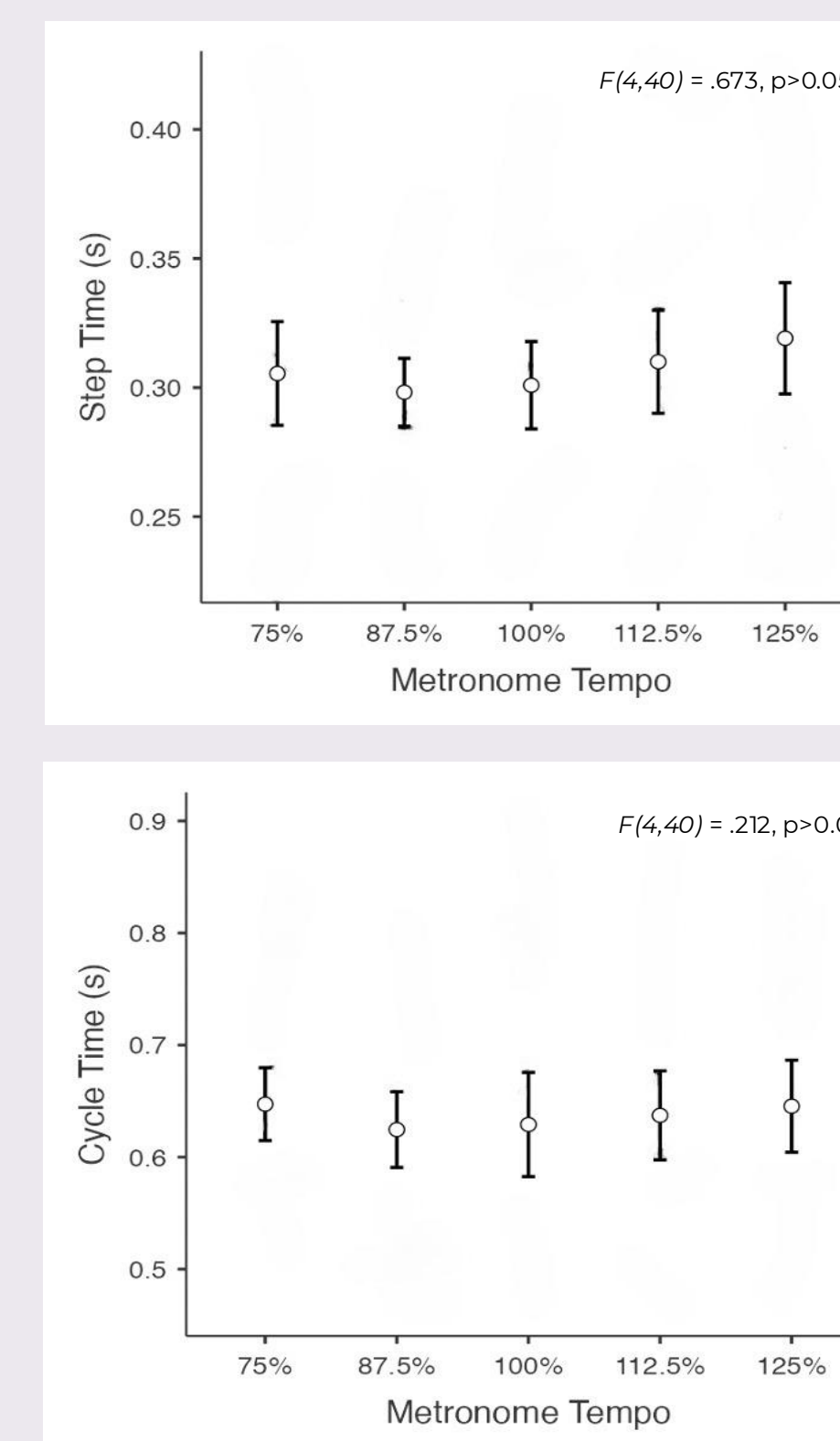
5 YEAR OLDS



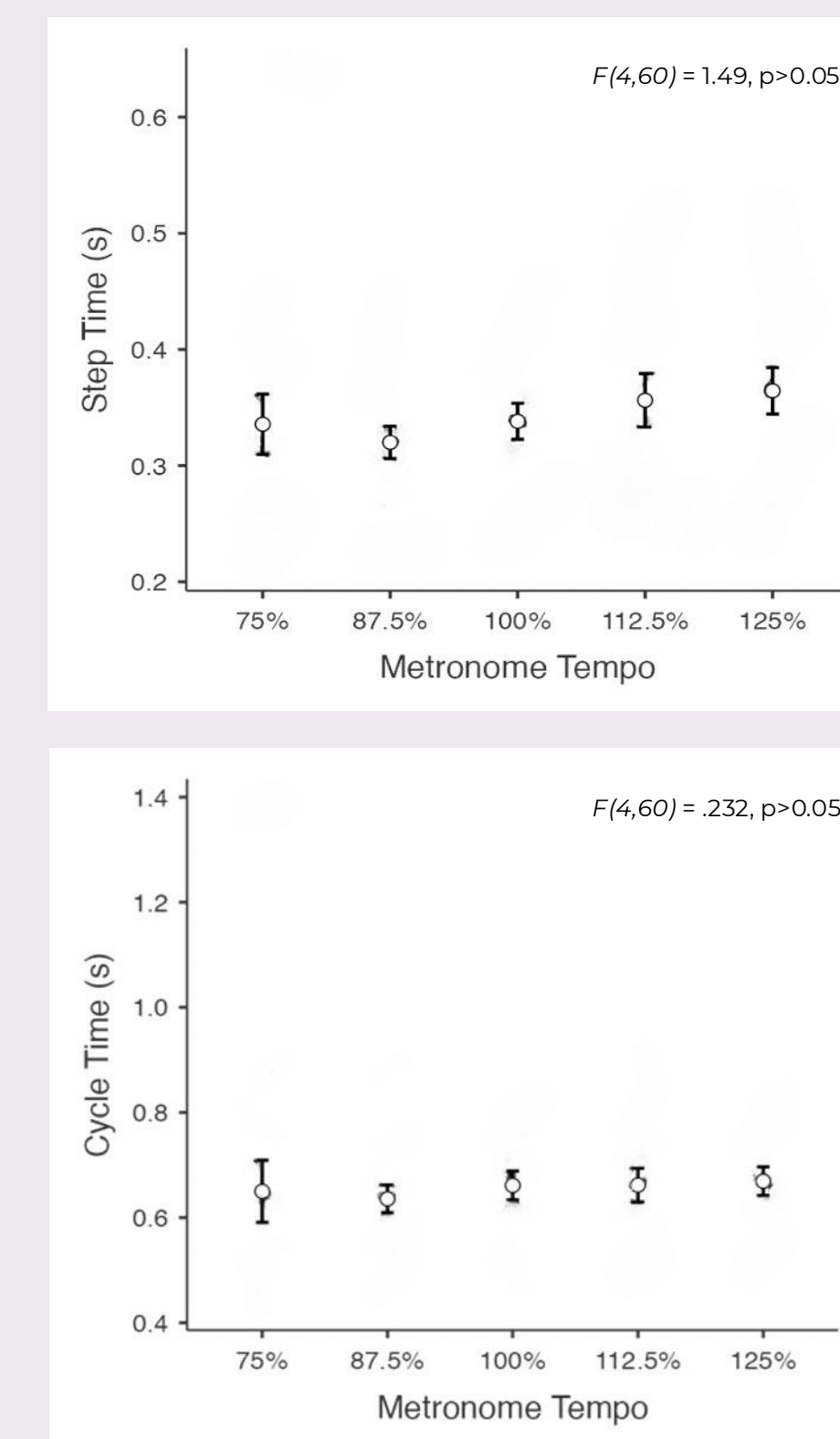
- With age, children show increased sensitivity to metronome tempo changes, displaying a graduated increase in the number of steps per minute taken to travel across the mat (*walking cadence*).
- 5-year-olds show a graduated increase in walking speed as a function of metronome tempo (*gait velocity*).

Temporal Parameters

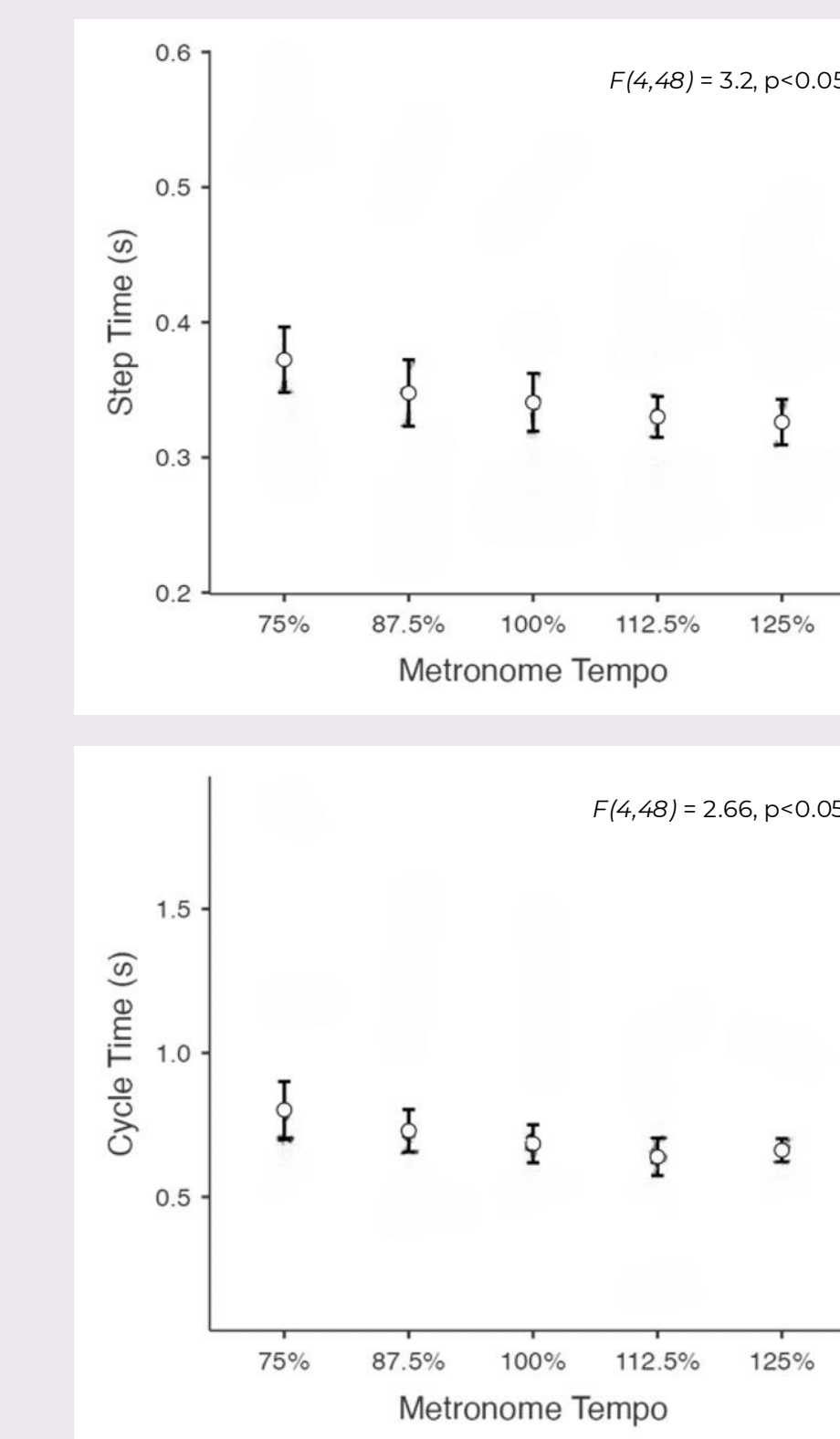
3 YEAR OLDS



4 YEAR OLDS



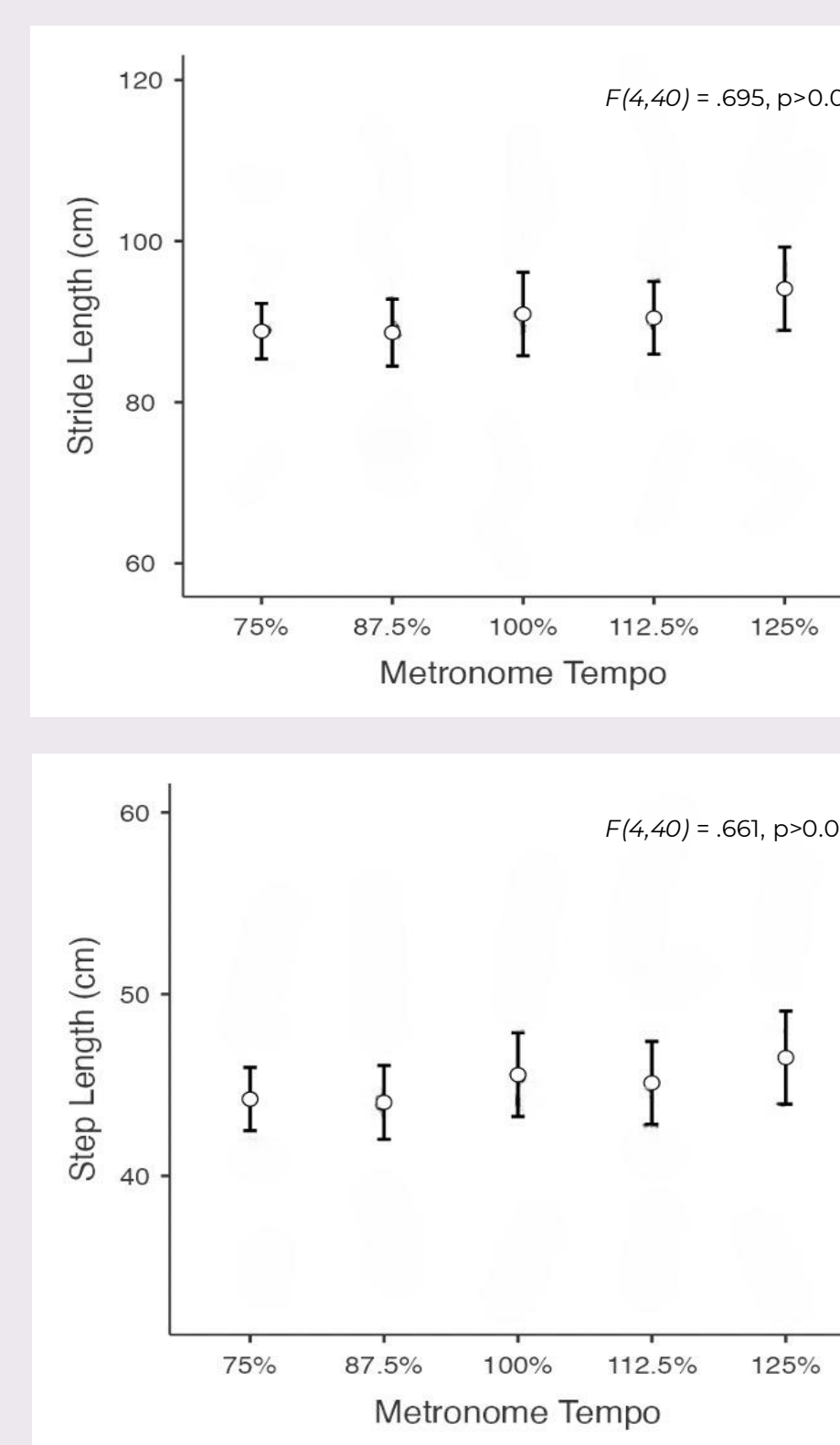
5 YEAR OLDS



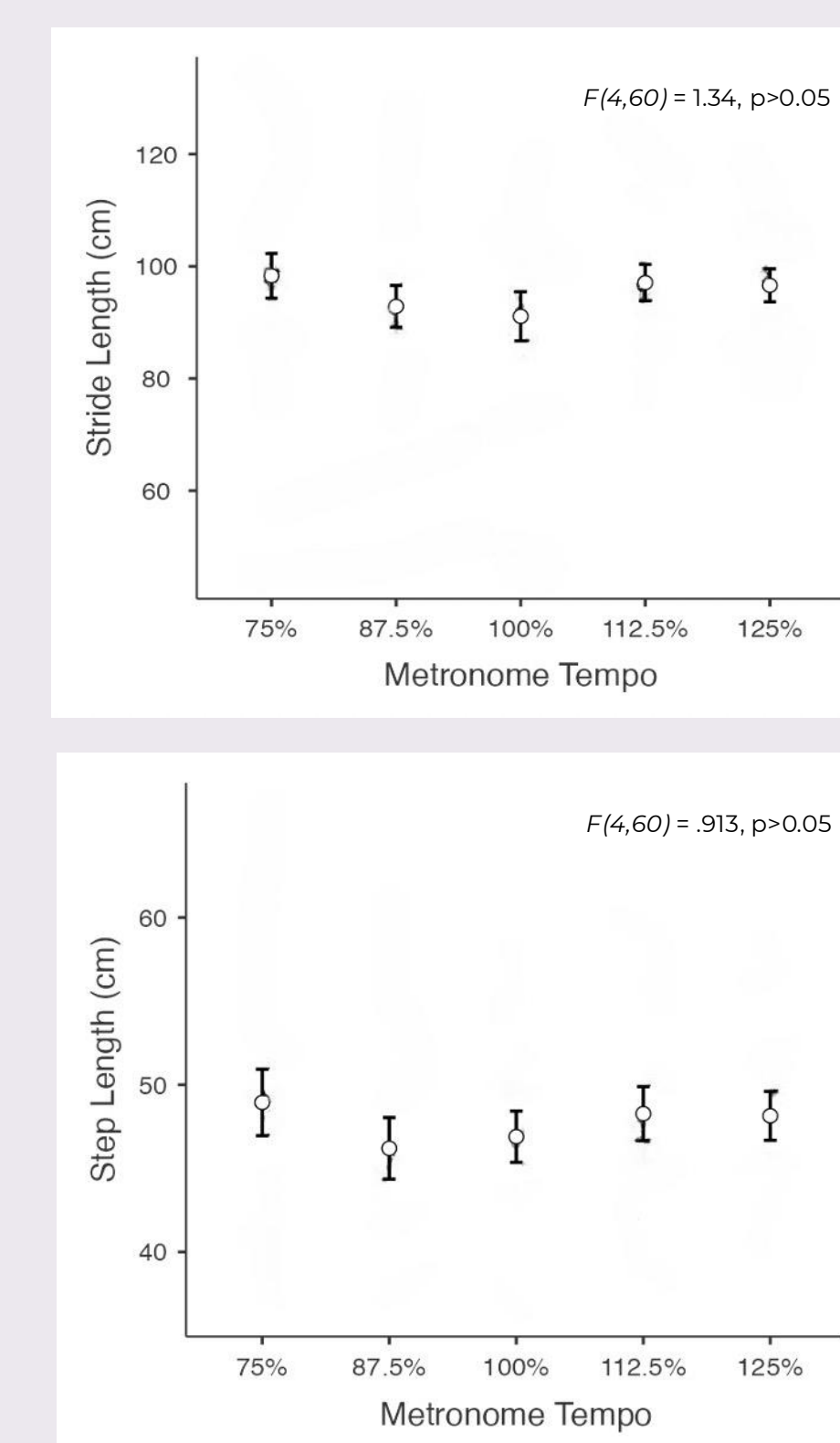
- 5-year-olds show a graduated decrease in the time between the heel strike of each foot (*step time*).
- 5-year-olds show a graduated decrease in the time between two consecutive heel strikes of the same foot (*cycle time*).

Spatial Parameters

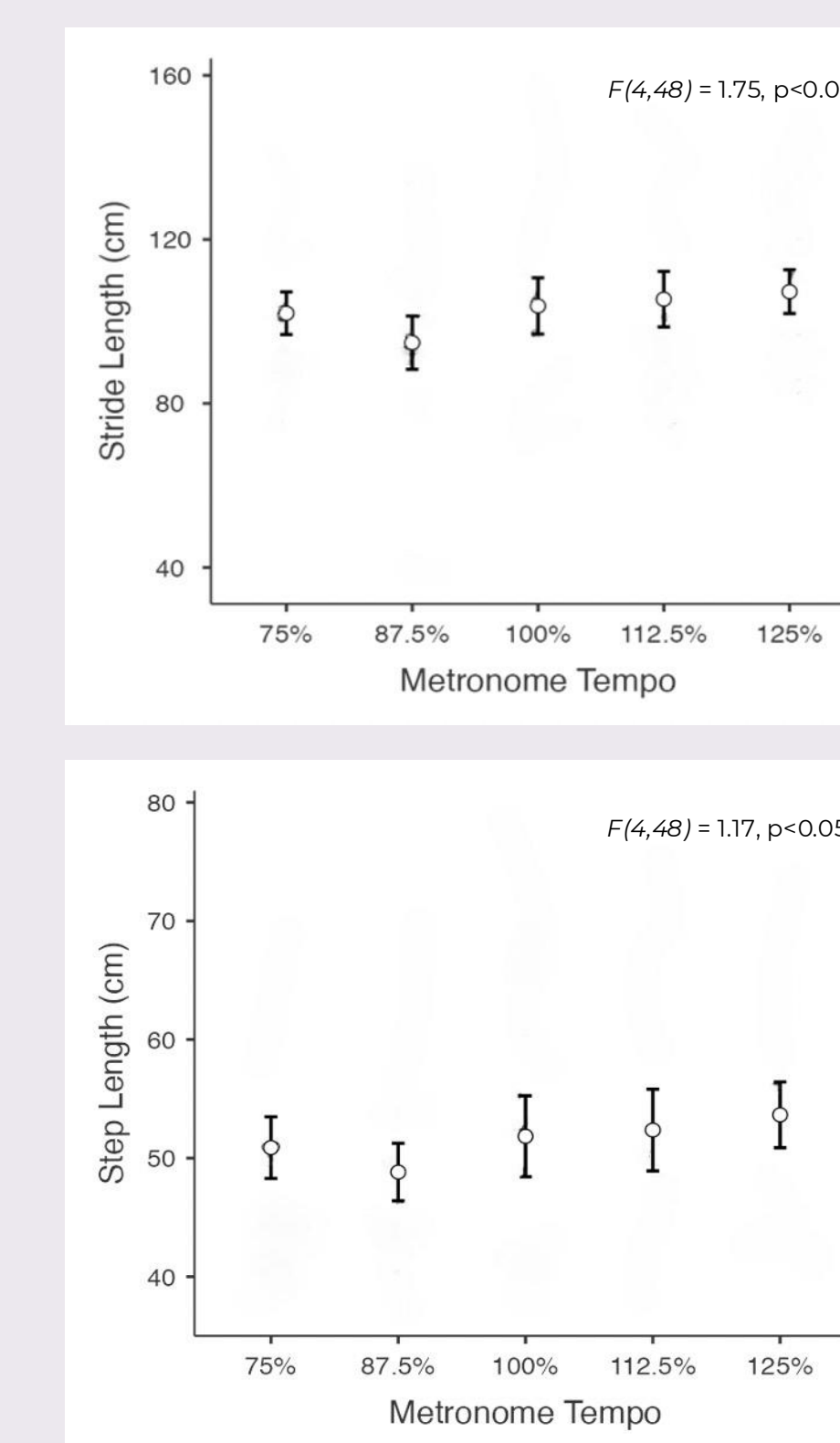
3 YEAR OLDS



4 YEAR OLDS



5 YEAR OLDS



- Across ages, there are no significant difference in the distance between the heel strike of the same foot (*stride length*).
- Across ages, there are no significant difference in the distance between the heel strike of each foot (*step length*).

SUMMARY & FUTURE DIRECTIONS

- With age, children show increased sensitivity in their walking cadence in response to fine gradations of change in metronome tempo.
- Only 5-year-olds display changes in their gait velocity, step time and cycle time as a function of metronome tempo.
- These findings highlight the developmental progression and sophistication of perceptual-motor integration during locomotion.

Reference:
 Choi, S., Choi, J., & Efferberg, A. O. (2017). Effect of rhythmic auditory cueing on gait in cerebral palsy: A systematic review and meta-analysis. *Neurospastic Disease and Treatment*, 14, 43-53. <https://doi.org/10.2147/NDT.S148053>
 Thaut, M. H. (2003). Neural basis of rhythmic timing networks in the human brain. *Annals of the New York Academy of Sciences*, 999(1), 364-373.
 Thaut, M. H., & Albin, M. (2010). Rhythmic auditory stimulation in rehabilitation of movement disorders: a review of current research. *Music Perception*, 27(6), 263-269.