

Moderate test re-test reliability of supplementary motor area-primary motor cortex connectivity measured using dual-site TMS in younger and older adults

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Background

Aging is associated with a decline in:

- bilateral motor control
- quantity and quality of white matter integrity
- functional connectivity between motor areas

Supplementary motor area (SMA) – primary motor cortex (M1) is an important network for bilateral motor control^[1, 3]

SMA-M1 connectivity can be measured using dual-site transcranial magnetic stimulation (TMS)

Aims

1. Is the dual-site TMS measure of SMA-M1 connectivity reliable?
2. Are there age-related differences in SMA-M1 connectivity?
3. Is SMA-M1 connectivity associated with bimanual control in older adults?

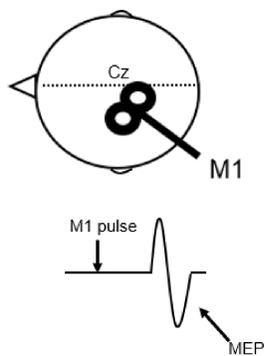
Methods

Participants completed two identical sessions ~7 days apart

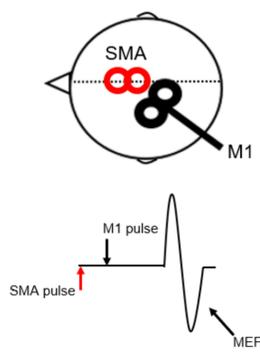
- Younger adults: $n = 30$ (18 – 35 years)
- Older adults: $n = 30$ (60 – 84 years)

Transcranial magnetic stimulation (TMS)

Single-pulse TMS



Dual-site TMS



Dual-site TMS: conditioning stimulus to SMA followed by a test stimulus to M1

Conditioning stimulus to SMA

- Site: 4 cm anterior to Cz
- Intensity: 140% active motor threshold

Test stimulus to M1

- Site: hand representation of M1
- Intensity: Evoke ~1 mV MEP

Dual-site MEP is facilitated compared to the single-pulse MEP^[2, 3]

- Activation of direct facilitatory connections between SMA-M1
- Dual-site MEP is expressed as a ratio of the single-pulse MEP
- Ratio > 1.0 indicate facilitation

Bimanual control: Purdue Pegboard

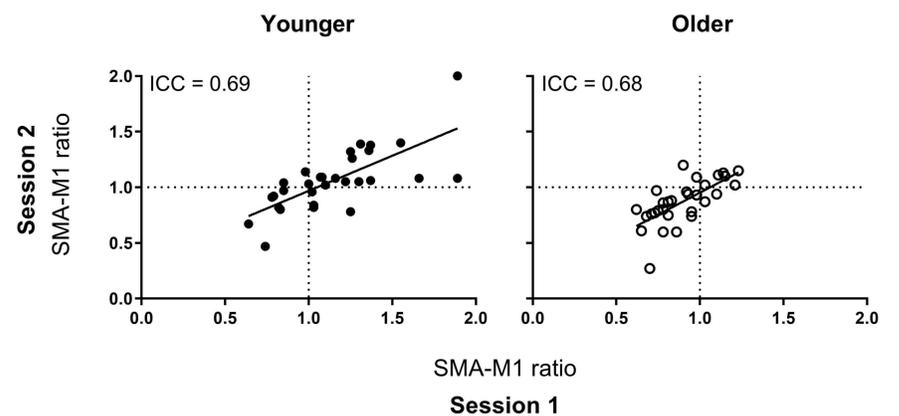
Assembly subtest

- Pick up and insert 4 items to assemble an object on a pegboard
- Number of items placed in 60 s recorded

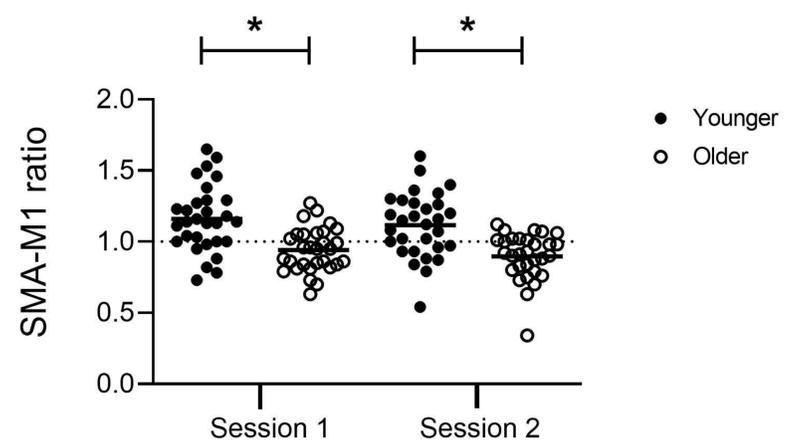


Results

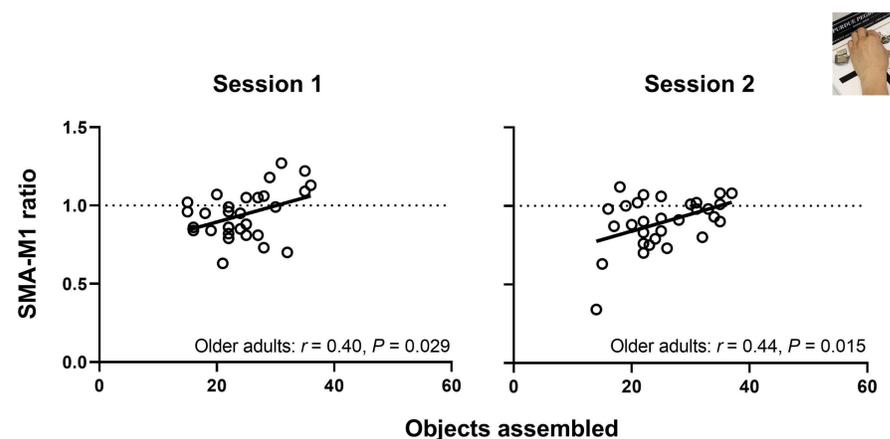
1. Moderate test re-test reliability in younger and older adults



2. Greater SMA-M1 connectivity in younger than older adults



3. Greater SMA-M1 connectivity is associated with better bimanual control performance in older adults



Key findings

1. SMA-M1 connectivity can be reliably measured using dual-site TMS
2. Greater SMA-M1 connectivity in younger than older adults
3. SMA-M1 connectivity might be functionally important

The decline in SMA-M1 connectivity might be a neural correlate of age-related decline in bimanual control

→ Cortical paired associative stimulate (cPAS) is a plasticity-inducing protocol

→ cPAS could be used to strengthen SMA-M1 connectivity in older adults to potentially improve bimanual control

References

[1] Nachev et al. 2008 *Nature Rev. Neurosci.*; [2] Arai et al 2012 *Exp. Brain Res.*; [3] Green et al 2018 *Neurobiology of Aging*