Characterising supplementary motor area—primary motor cortex connectivity in younger and older adults.

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Age-related decline in voluntary movement

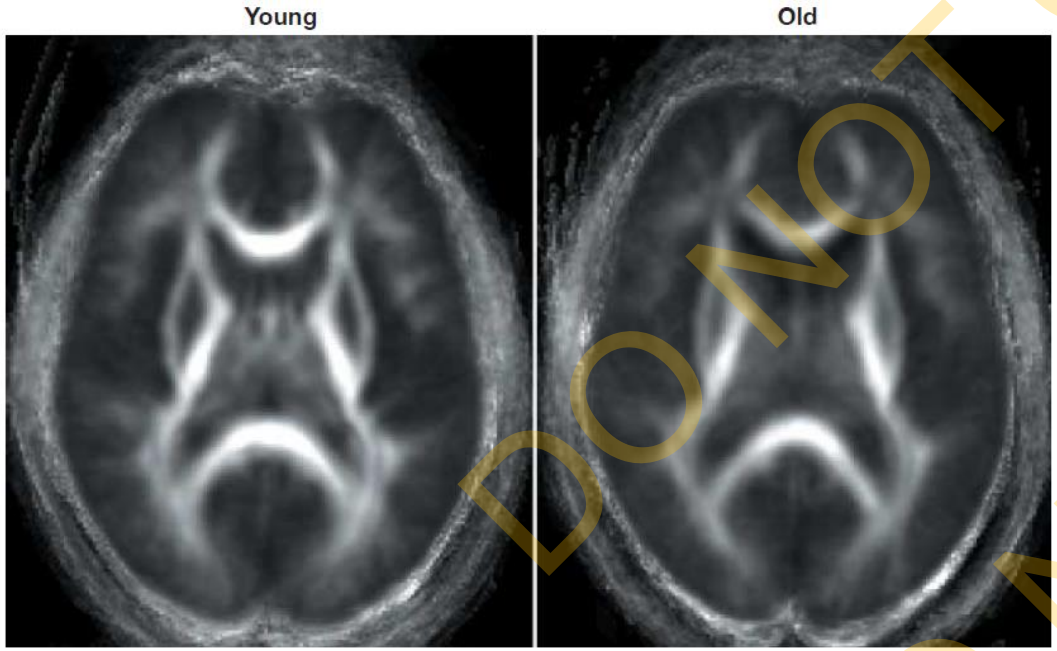
↑ movement variability

↓ movement speed

↓ movement smoothness

Age-related decline in brain structure and function

Age-related decline quantity and quality of white matter



Hedden & Gabrieli 2004 *Nat Rev Neurosci*

Age-related decline in brain structure and function

Age-related decline quantity and quality of white matter

Hedden & Gabrieli 2004 *Nat Rev Neurosci*

Age-related decline functional connectivity between motor areas

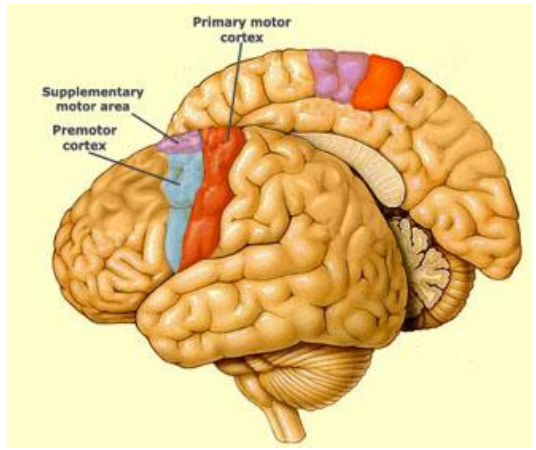
→ associated with motor control

Stančák et al. 2003 *Cerebral Cortex*

Supplementary motor area (SMA)

Planning bilateral movements

Timing and coordination of bilateral movements



Nachev et al. 2008 *Nat Rev Neurosci*

Organization of Nonprimary Motor Cortical Inputs on Pyramidal and Nonpyramidal Tract Neurons of Primary Motor Cortex: An Electrophysiological Study in the Macaque Monkey

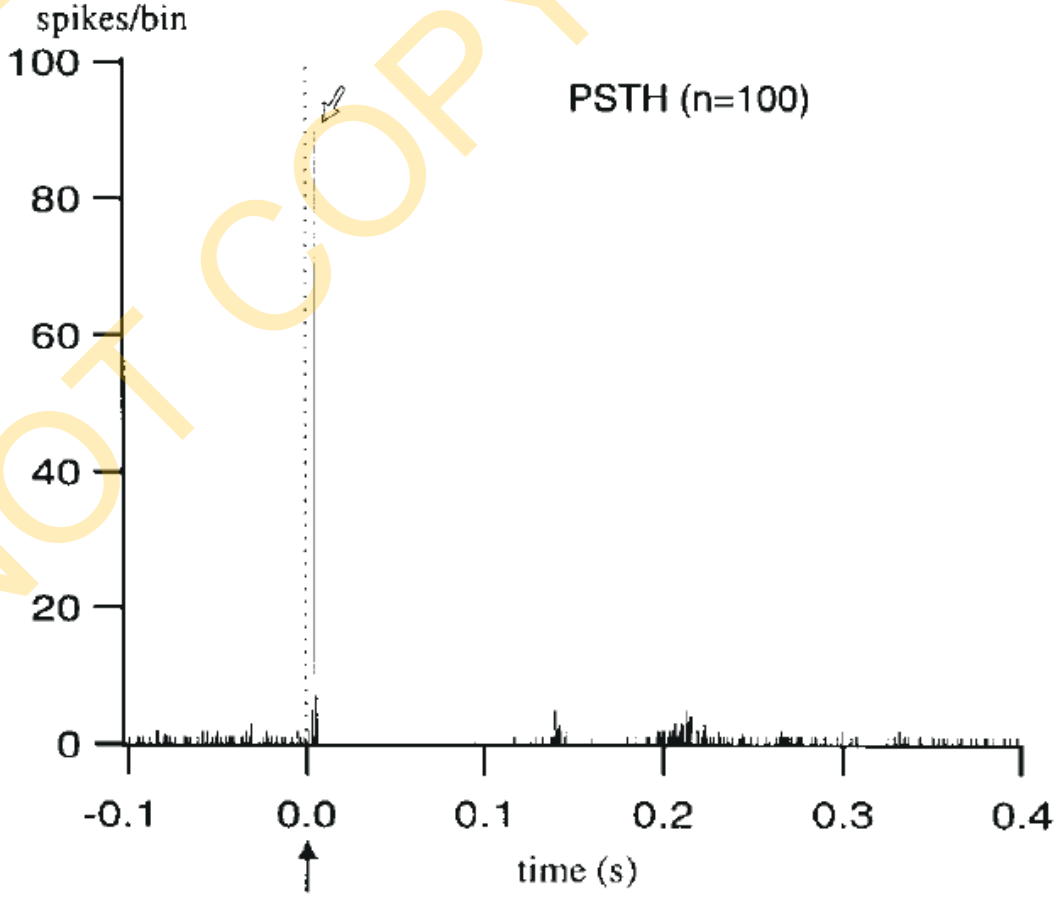
Hironobu Tokuno and Atsushi Nambu[1]

Department of Cell Biology and [1]Department of Neurobiology, Tokyo Metropolitan Institute for Neuroscience, Fuchu, Tokyo 183-8526, Japan

Cerebral Cortex Jan 2000;10:58–68; 1047–3211/00/$4.00

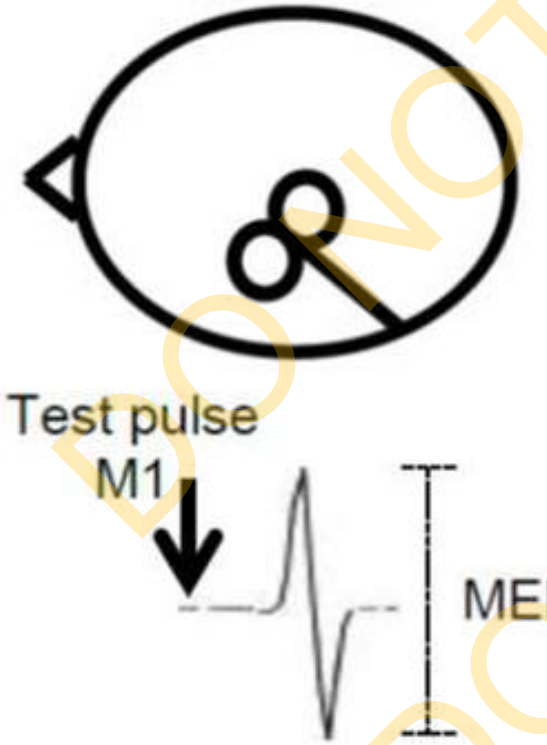
SMA is densely connected to the M1

→ stimulation of SMA evokes short-latency responses in M1



Transcranial magnetic stimulation (TMS) to measure SMA—M1 connectivity

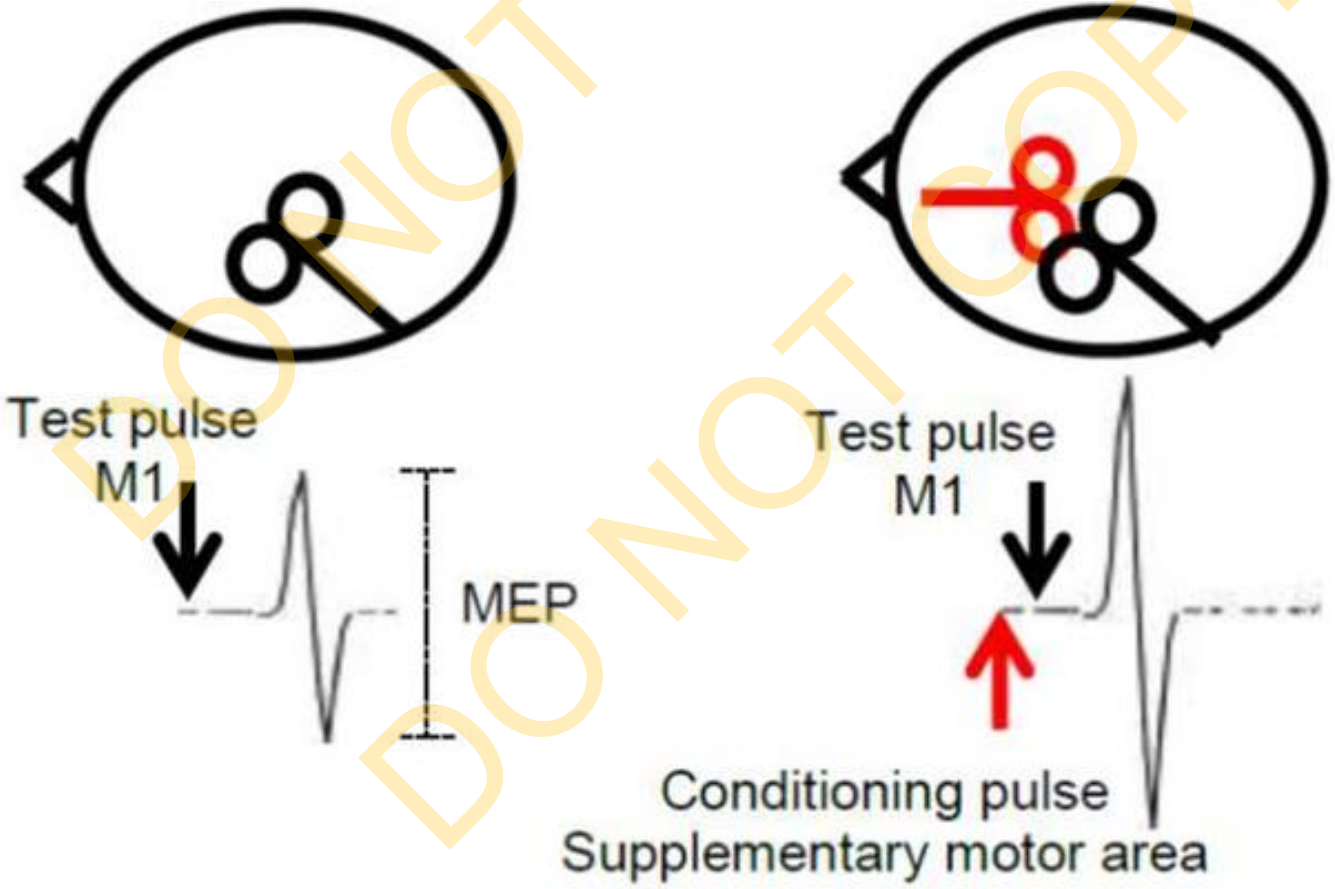
Dual-coil TMS



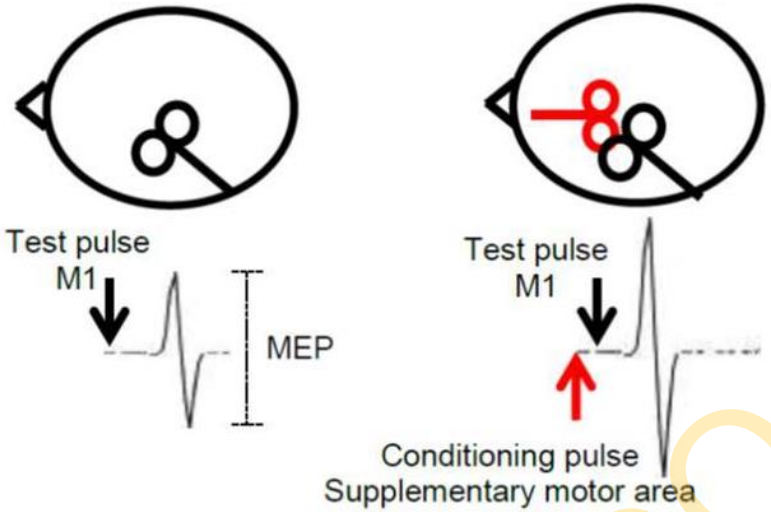
Motor evoked potential

Transcranial magnetic stimulation (TMS) to measure SMA—M1 connectivity

Dual-coil TMS



Transcranial magnetic stimulation (TMS) to measure SMA—M1 connectivity



MEP evoked by dual-coil TMS is facilitated (compared to the MEP evoked by single-pulse TMS)

→ due to the activation (by the conditioning stimulus) of direct facilitatory connections between SMA and M1

→ glutamatergic

Luppino et al. 1993, *J Comp Neurol*

AIM: Characterise SMA-M1 connectivity in younger and older adults.

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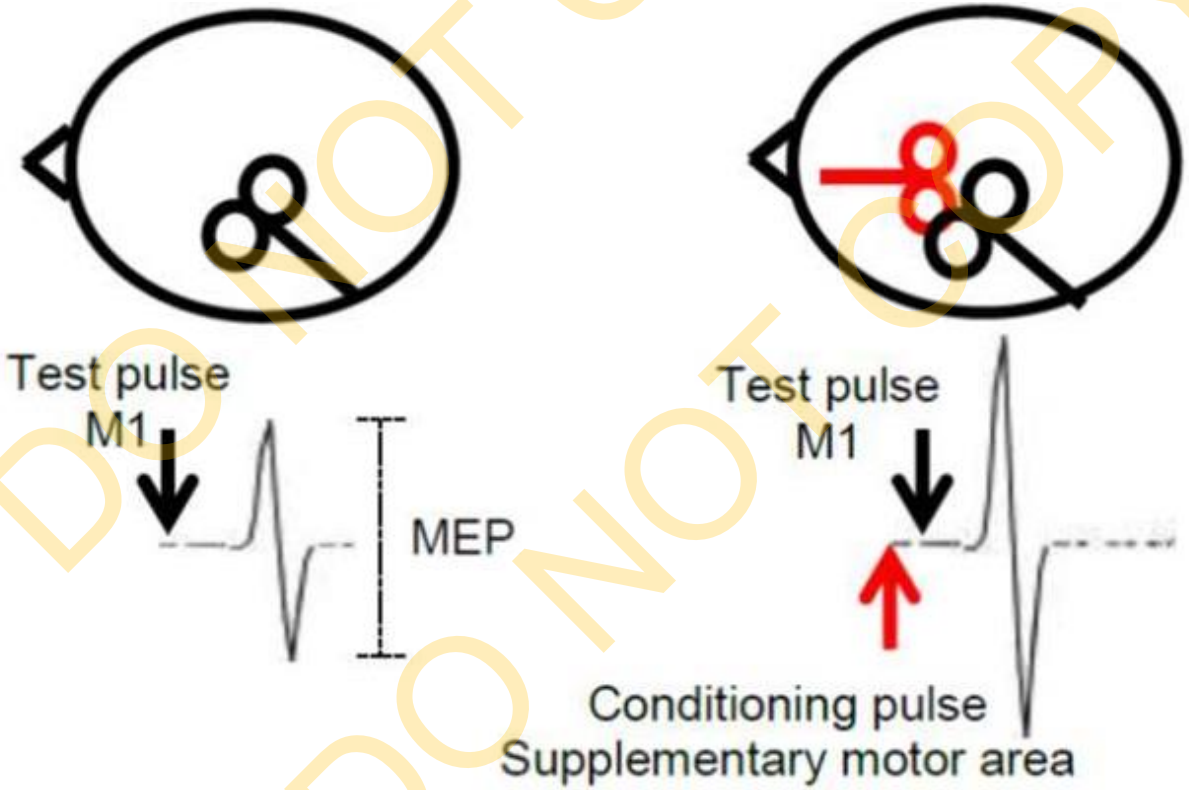
1. Is the dual-coil TMS measure of SMA—M1 connectivity reliable?

Is the TMS measure of SMA—M1 connectivity reliable?

Two identical sessions
Inter-session interval ~7 days



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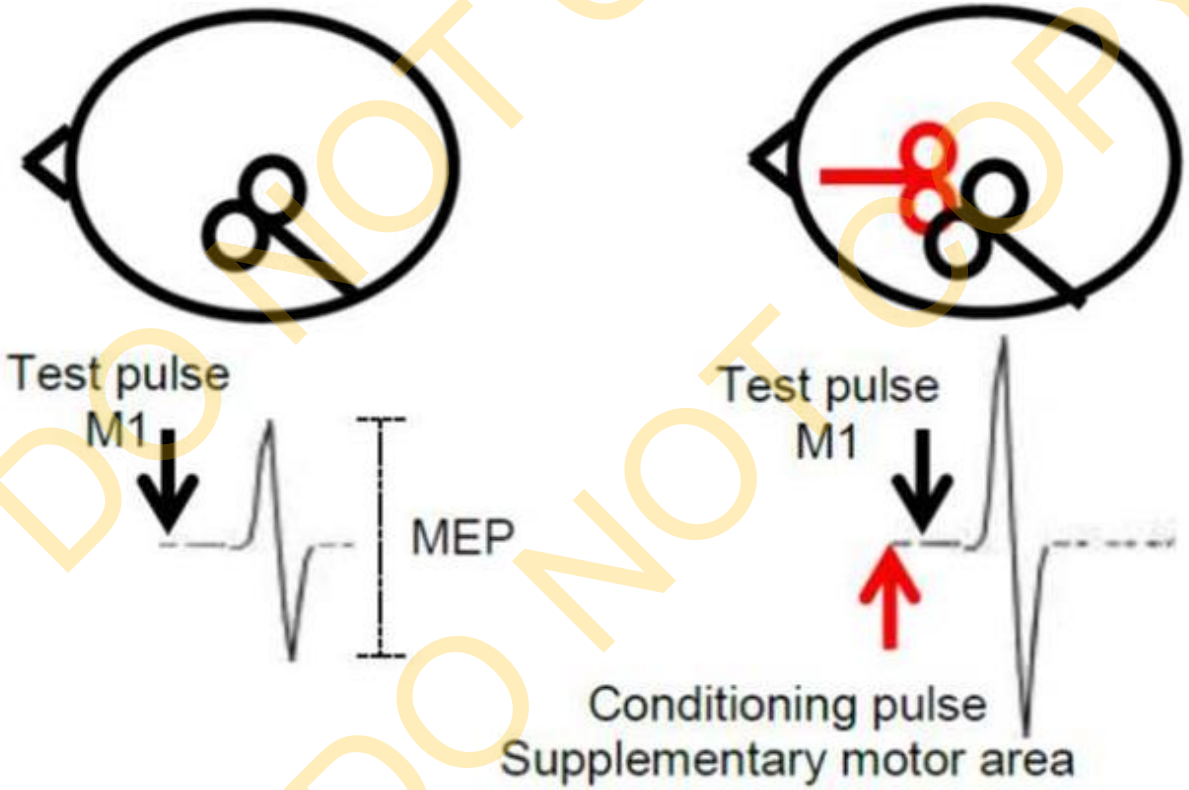
Test stimulus to M1:
intensity to evoke
~1 mV MEP



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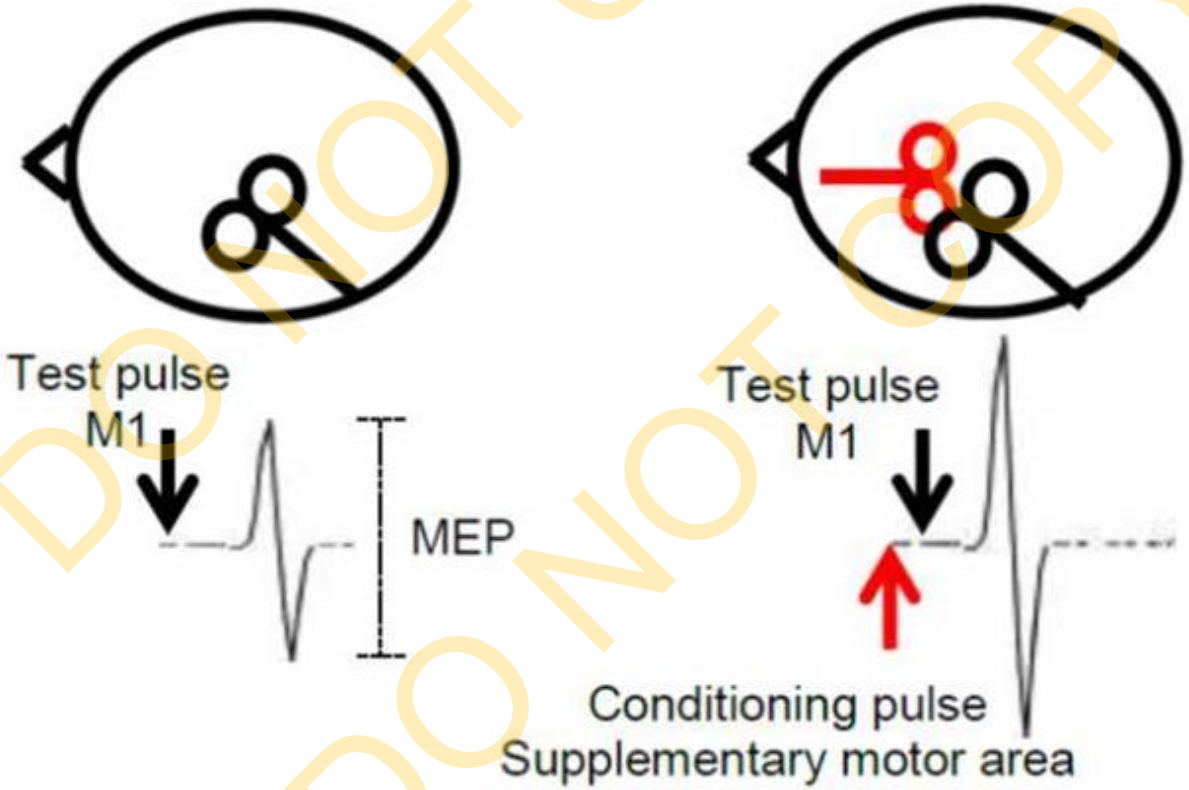

Conditioning stimulus
to SMA:
target SMA site 4 cm
anterior to Cz

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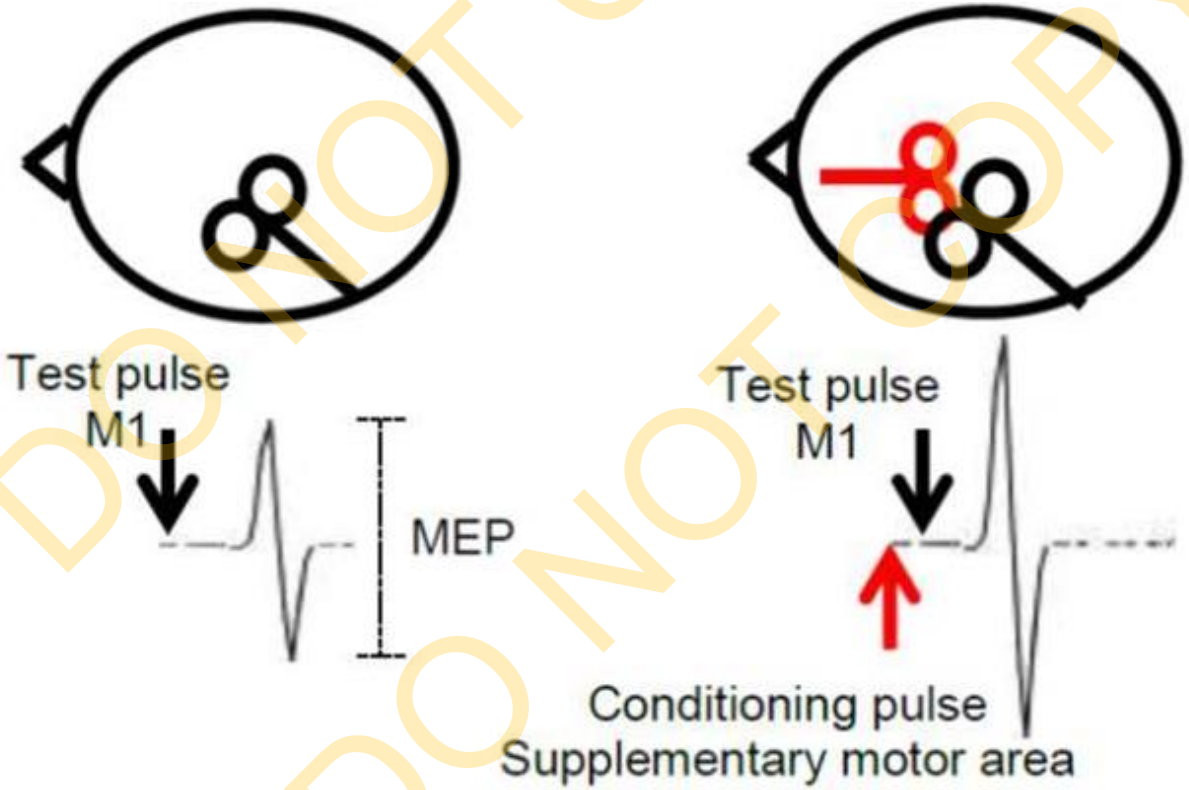
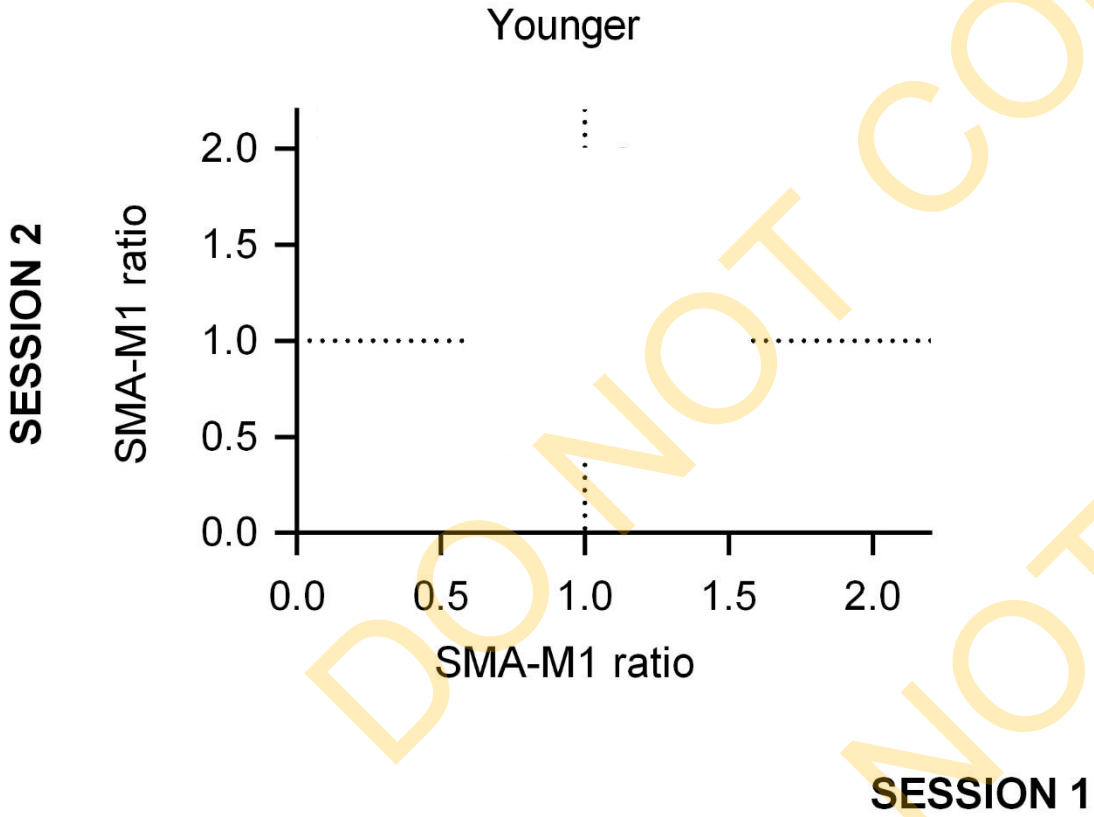


Conditioning stimulus
to SMA:
target SMA site 4 cm
anterior to Cz

Inter-stimulus
intervals:
6 ms and 7 ms

Is the TMS measure of SMA—M1 connectivity reliable?

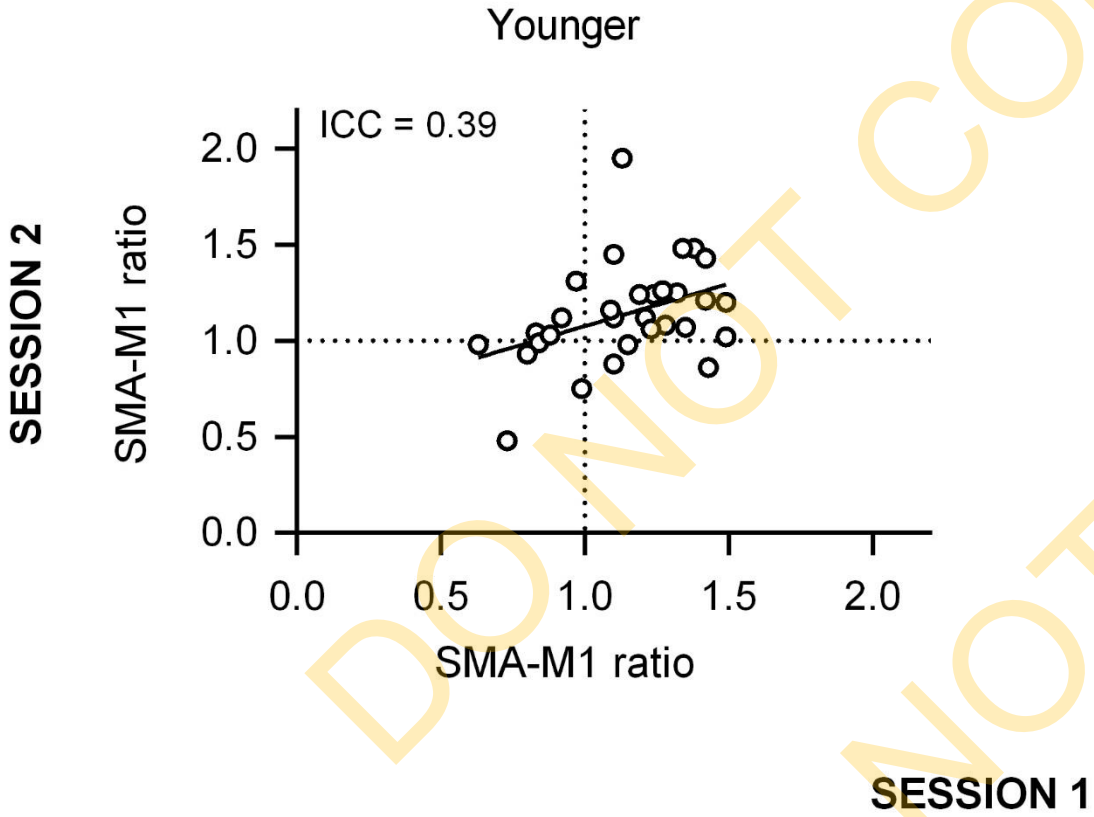
6 ms



Younger adults: N = 30 (18 – 35 years)

Is the TMS measure of SMA—M1 connectivity reliable?

6 ms



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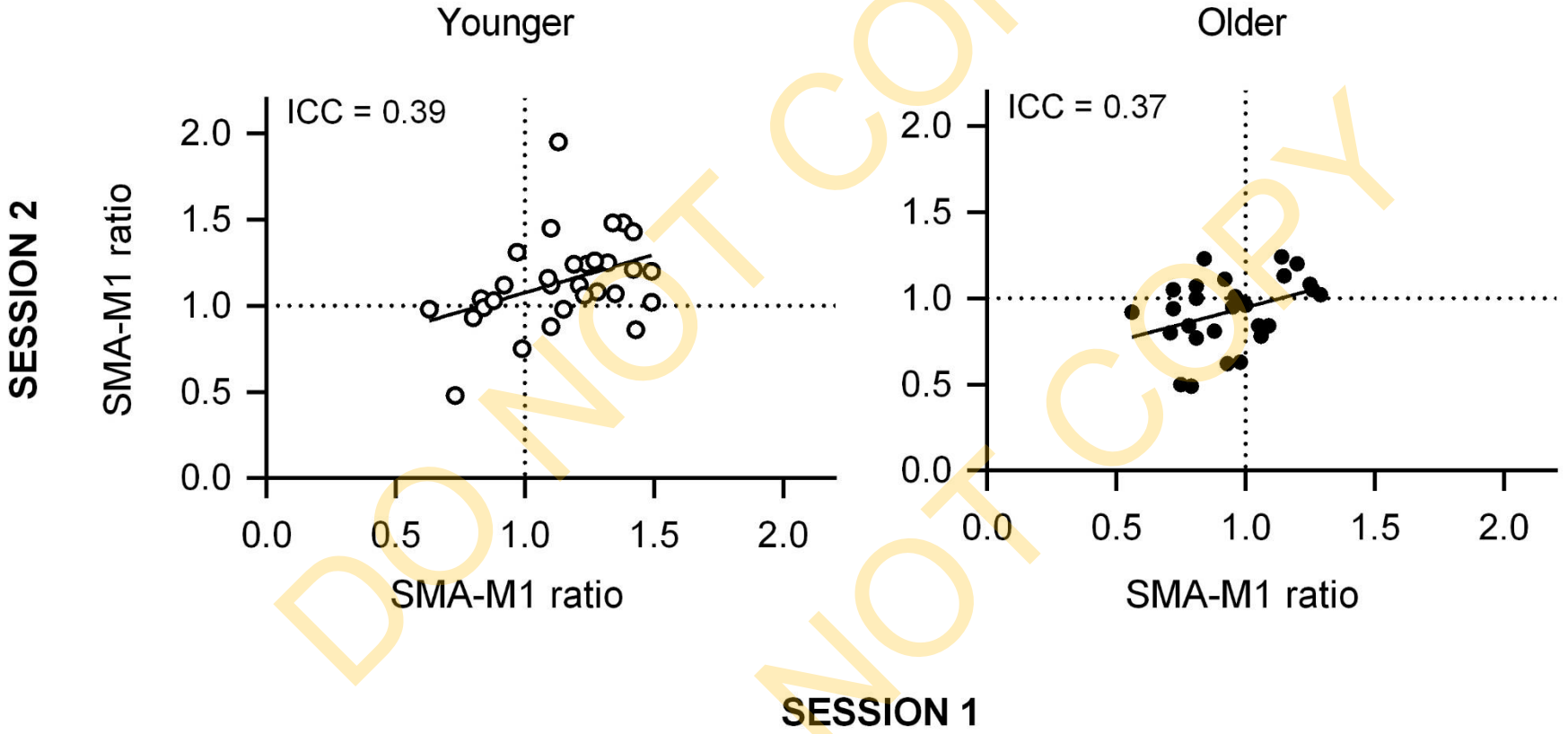
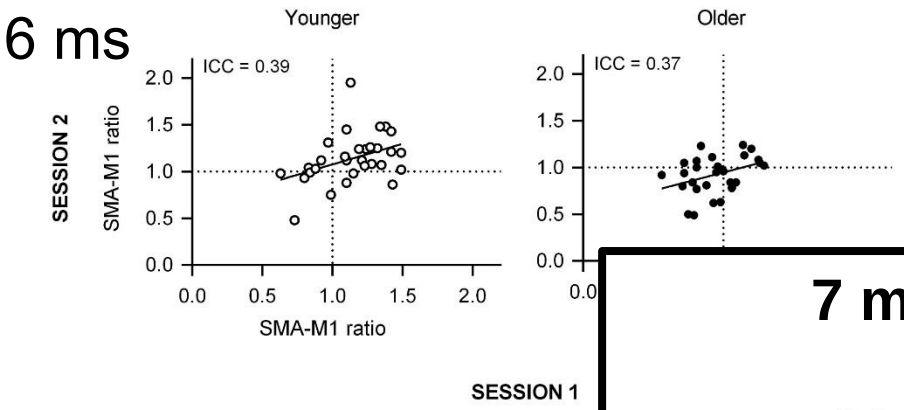
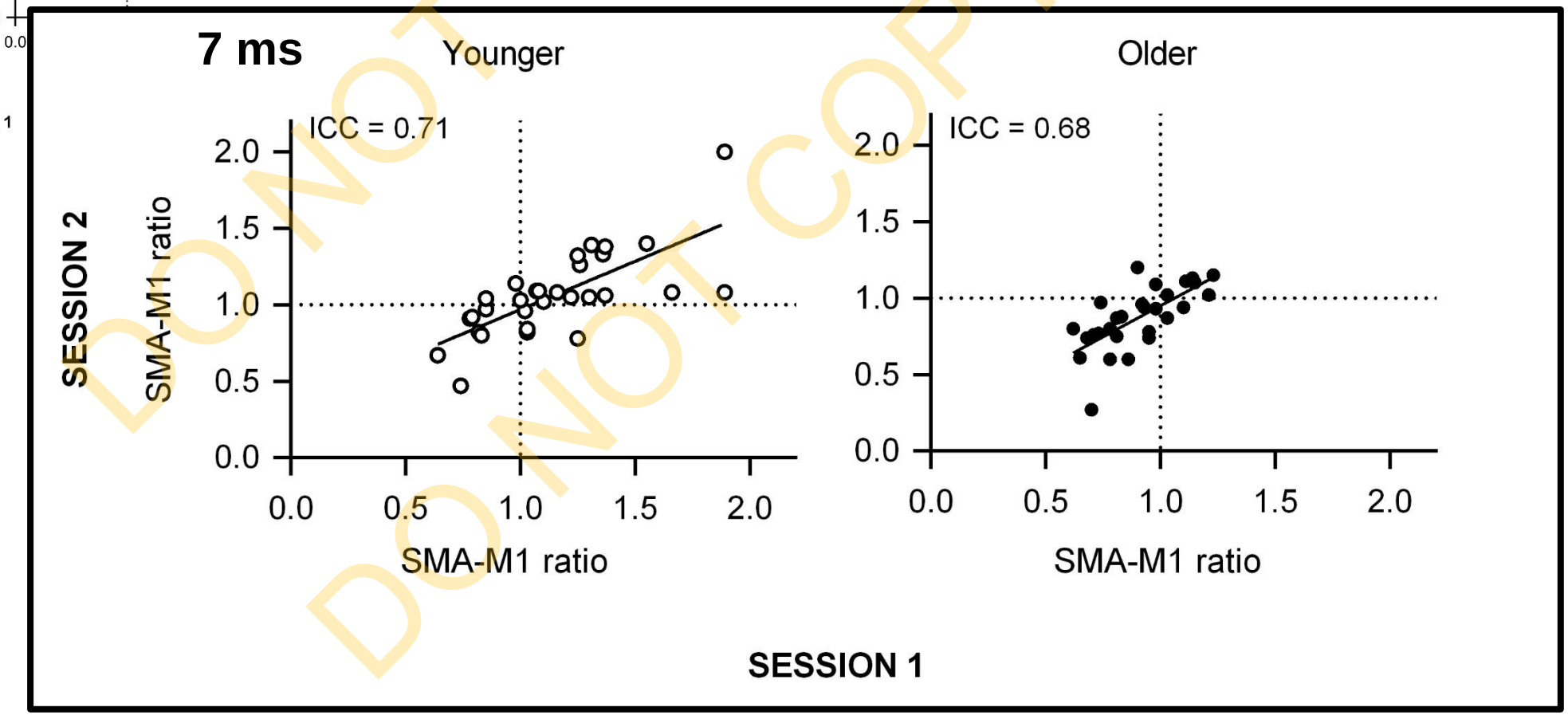


Younger adults: N = 30 (18 – 35 years); older adults: N = 28 (60 – 84 years)

Is the TMS measure of SMA—M1 connectivity reliable?





SMA-M1 connectivity in younger and older adults.

1. Is the dual-coil TMS measure of SMA—M1 connectivity reliable?

   Moderate-to-good test re-test reliability in both younger and older adults

   → dual-coil protocol with 7 ms inter-stimulus interval

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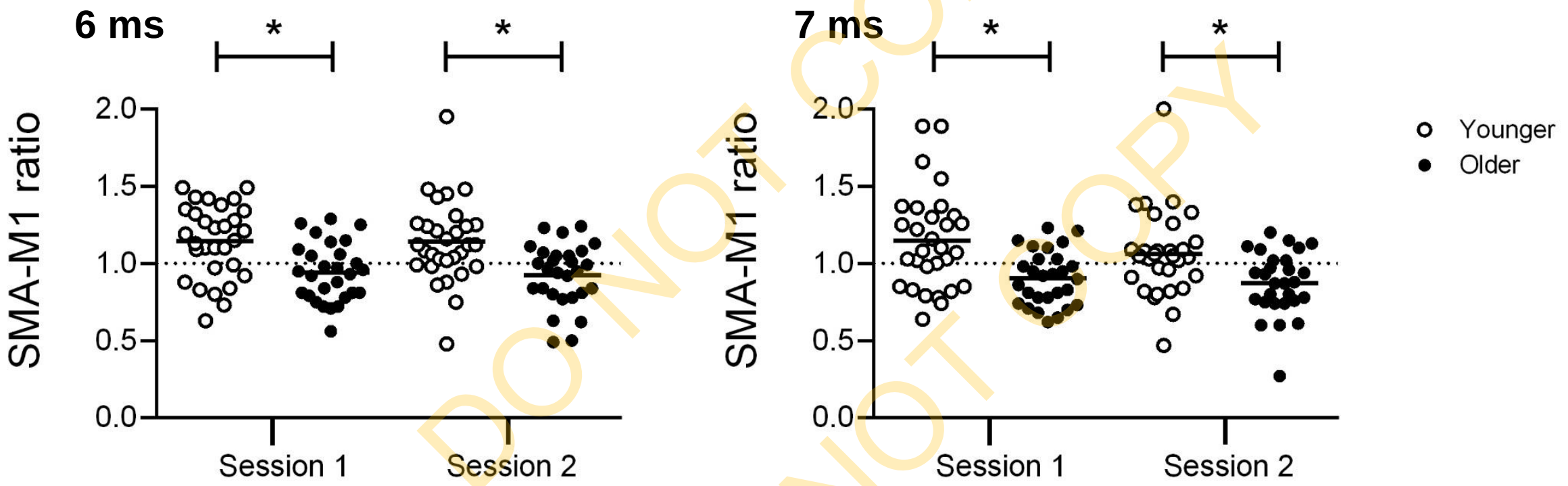
2. Is SMA—M1 connectivity reduced in older compared to younger adults?

Reduced SMA—M1 connectivity in older than younger adults?



Neurobiology of Aging 64 (2018) 1–7

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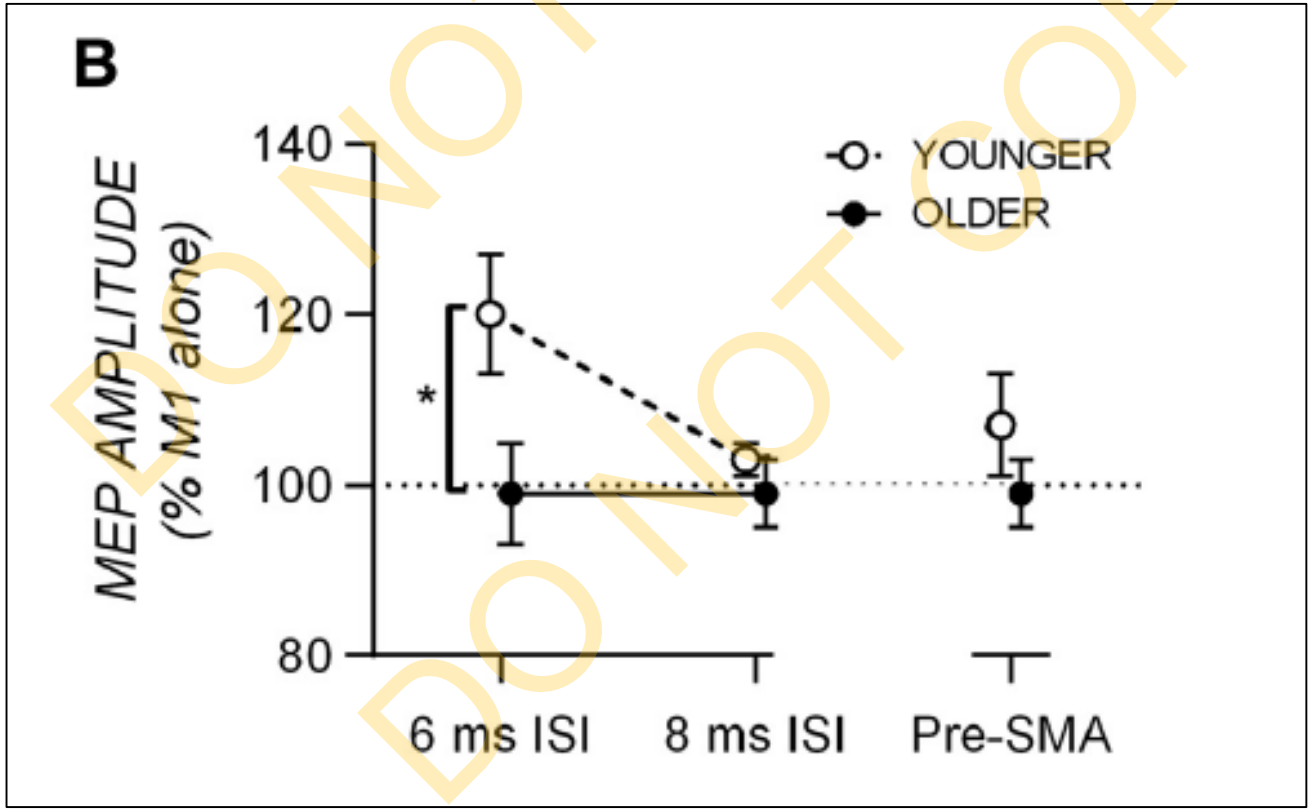

SMA-M1 connectivity in younger and older adults.

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   Moderate-to-good test re-test reliability in both younger and older adults

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2. Is SMA—M1 connectivity reduced in older compared to younger adults?

   Facilitatory interaction evident in younger but not older adults

   SMA-M1 connectivity might decline with age.

SMA-M1 connectivity in younger and older adults.

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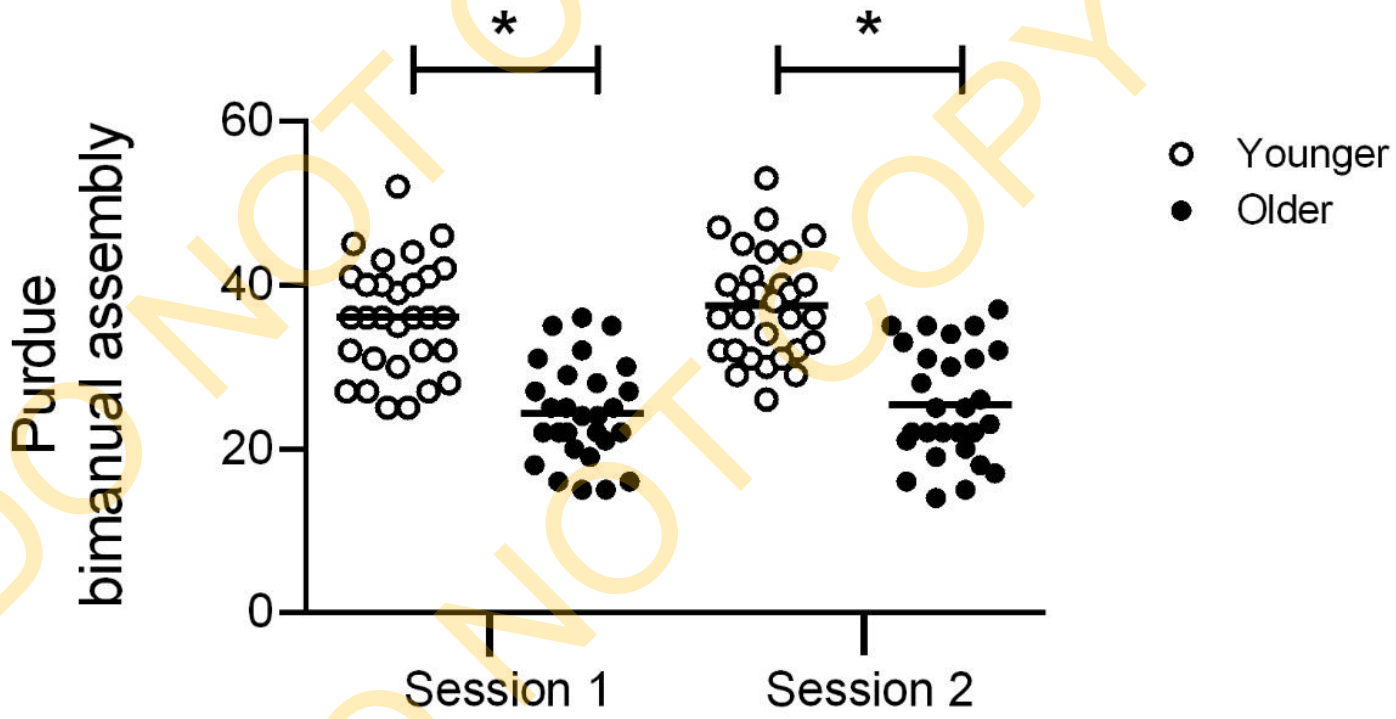
3. Is SMA—M1 connectivity associated with bimanual control?

Is SMA—M1 connectivity associated w bimanual control?

Purdue Pegboard bimanual function

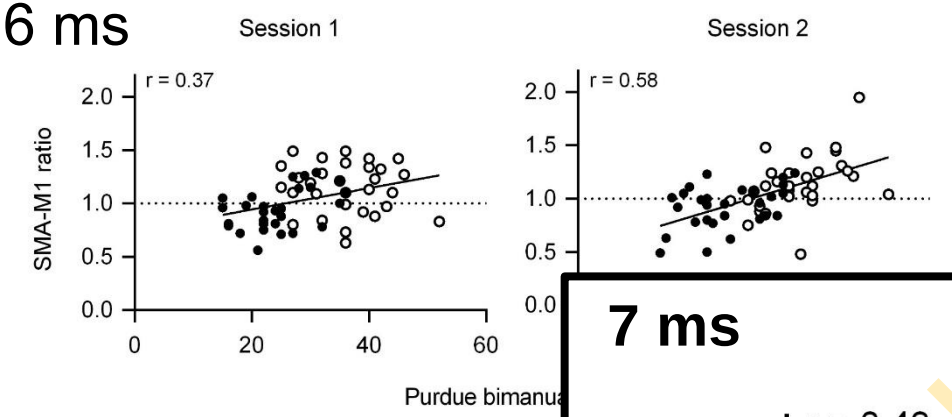
Is SMA—M1 connectivity associated w bimanual control?

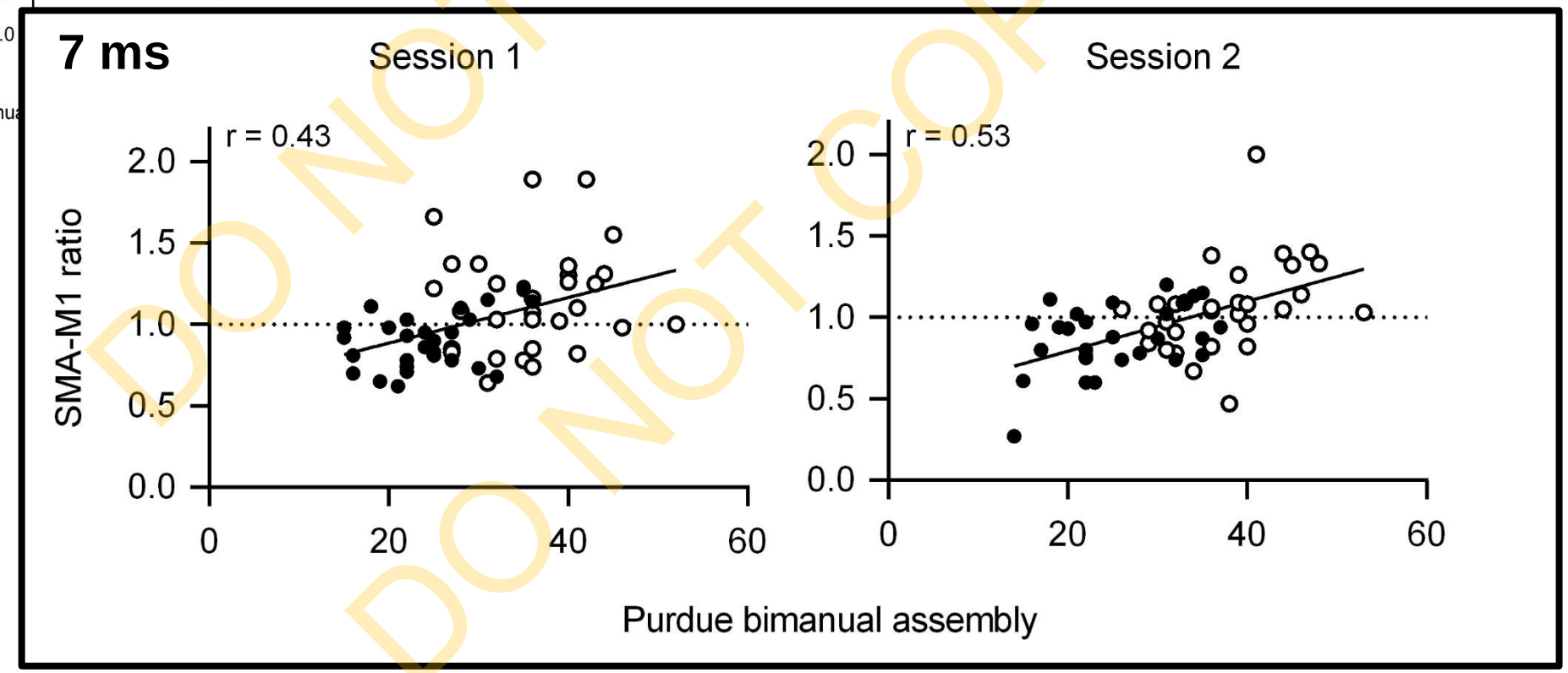
Purdue Pegboard bimanual function



Is SMA—M1 connectivity associated w bimanual control?

6 ms





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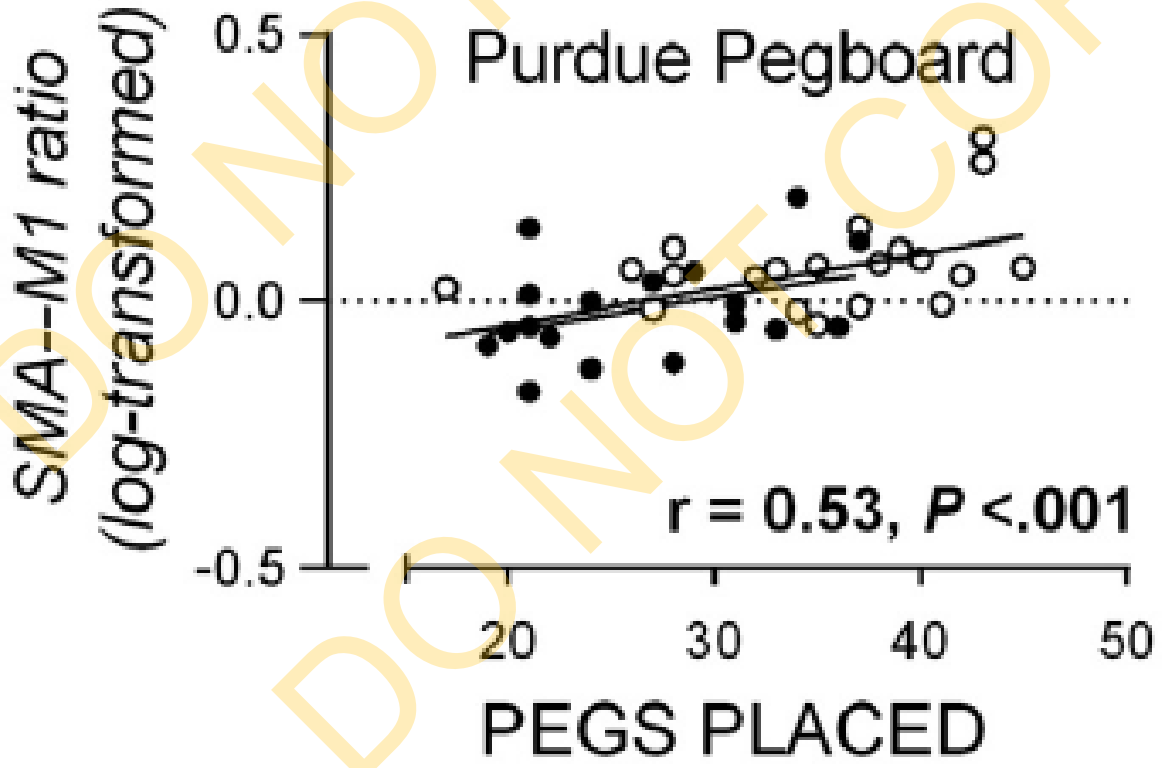

SMA-M1 connectivity in younger and older adults.

- Moderate-to-good test re-test reliability of dual-coil TMS SMA—M1 connectivity (7 ms ISI)
- Facilitatory SMA—M1 interaction in younger but not older adults
- Facilitatory SMA—M1 interaction is functionally important
- Neural correlate of age-related decline in bimanual control

  → target for interventions to improve bimanual control

Collaborators

Brittany Rurak

Prof Peter Drummond

Funding

GNT1088295