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The role of the premotor cortex in multisensory speech perception throughout adulthood: a rTMS study

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INTRODUCTION

SCIENTIFIC CONTEXT

The underlying debate: Is the motor system involved during multisensory integration in speech perception?

SHORT LITERATURE

- 1) a- Speech is multisensorial : we simultaneously perceive speech via **sounds** (i.e., a speaker's utterance) and **visual** cues (i.e., a speaker's articulatory movements and facial expressions).
b- Interestingly, we can also perceive speech via the **tactile** modality [1] (i.e., touching the interlocutor's face during production).
- 2) The premotor cortex (PMv) is involved in speech perception mechanisms, especially in adverse/complex situations, and more activated in audio-visual integration.
- 3) Aging provides a good model for studying the role of the PMv, because of the natural decline in sensory acuity that occurs with aging.

OBJECTIVES AND HYPOTHESES

- Determine the role of the right and left PMv in unimodal and multimodal speech processes and the contribution of the hemispheric differentiation in these processes in aging
- Hyp 1:** Left PMv more impacted by rTMS ...
- Hyp 2:** ... especially during audio-tactile condition (unfamiliar information) ...
- Hyp 3:** ... and stronger effect with age (compensatory mechanism).

METHOD

PARTICIPANTS

24 healthy right-handed participants (16 females; mean 46±19 [19-78] years)

TASK

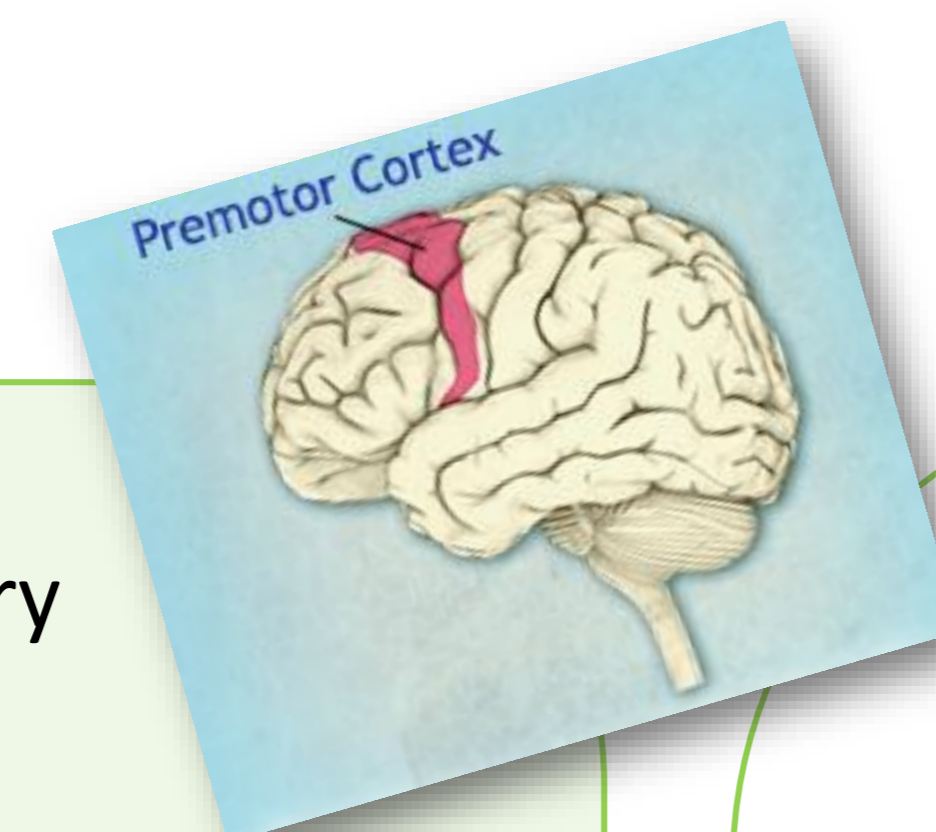
- Force-choice identification task:
/pa/, /ta/ or /ka/ syllables in 5 different sensory modalities : audio, visual, tactile, audiovisual, audiotactile (A, V, T, AV, AT).
- TADOMA method was used to test tactile modality.
- Noise added in one condition (contrasted to a silent condition).

TMS PROCEDURE

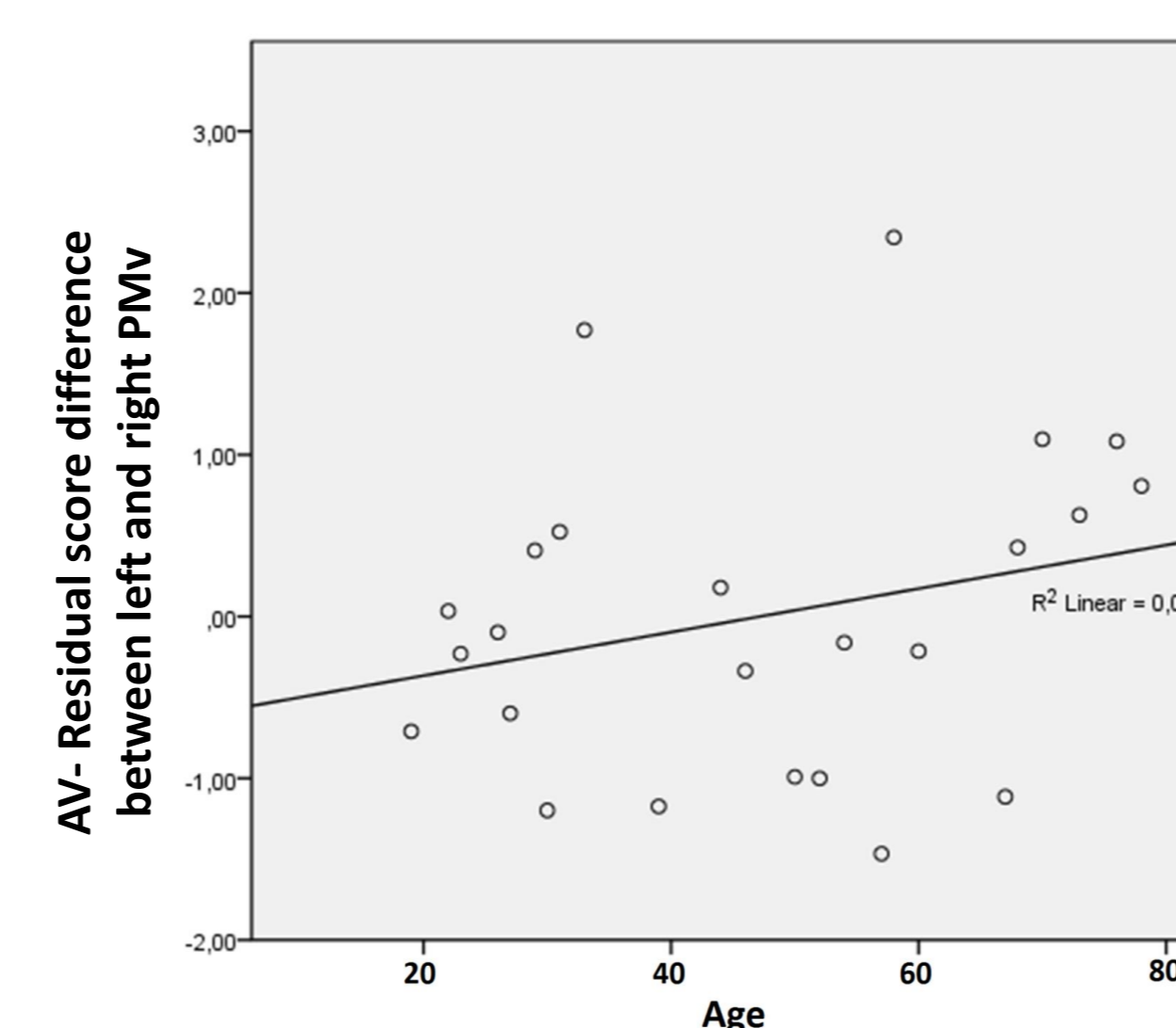
- MRI session (to localize M1 and **left and right PMv**) then 2 rTMS sessions (left and right PMv) separated by 1 hour, and each one was followed by the behavioral task
- 900 pulses, 1 Hz, 115 % of passive motor threshold

DATA ANALYSES

- Score (% of correct responses) and reaction time (RT)
- ANOVAs :
Score: noise (yes/no) * target (left vs right PMv) * modalities (A, AV, AT, V and T) * order of stimulation (right PMv first/ left PMv first)
RT: noise (yes/no) * target (left vs right PMv) * modalities (A, AV, AT) * order of stimulation (right PMv first/ left PMv first)



1) Preservation of multisensorial integration mechanisms

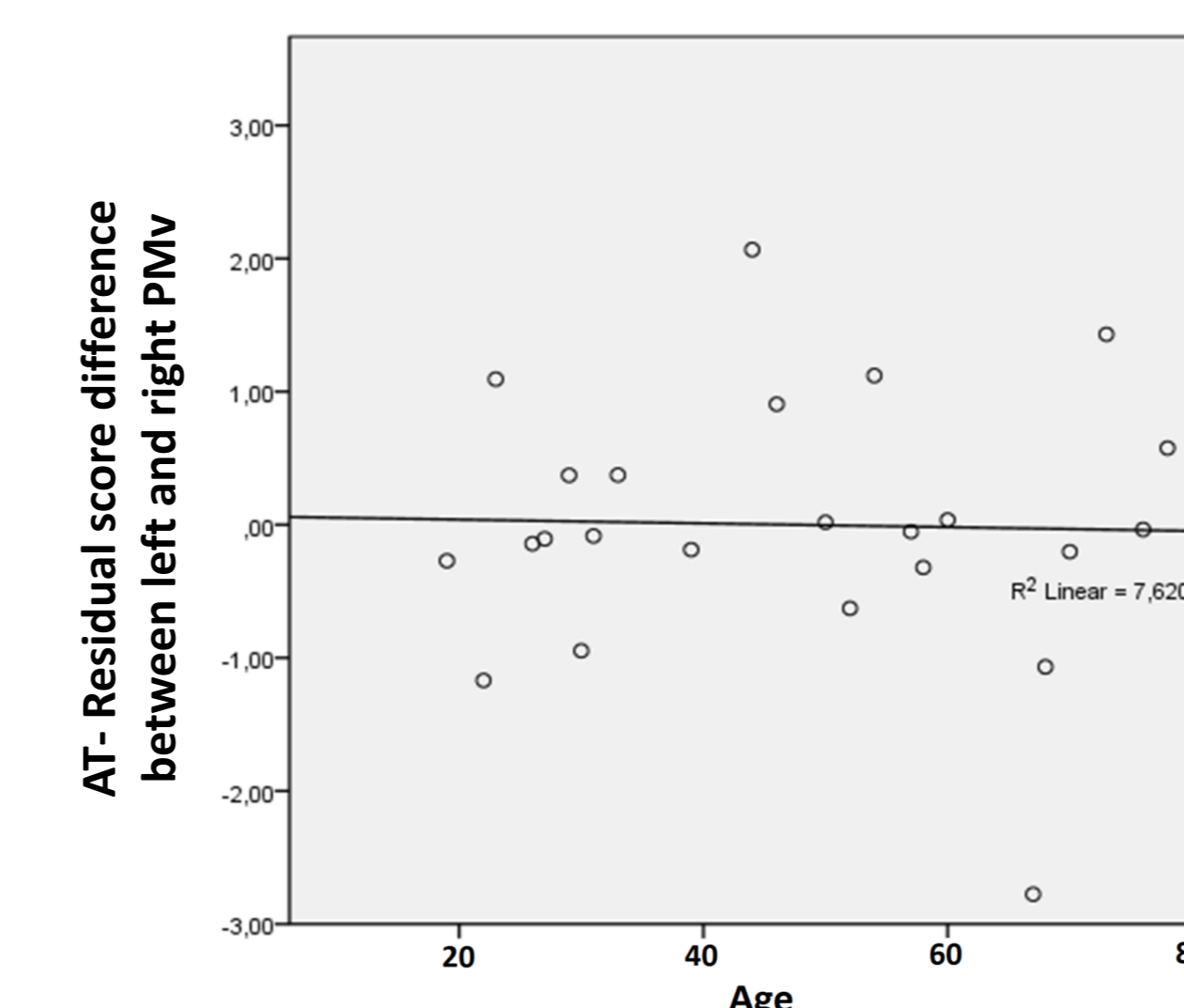


AV: no difference of RT between left and right PMv across age

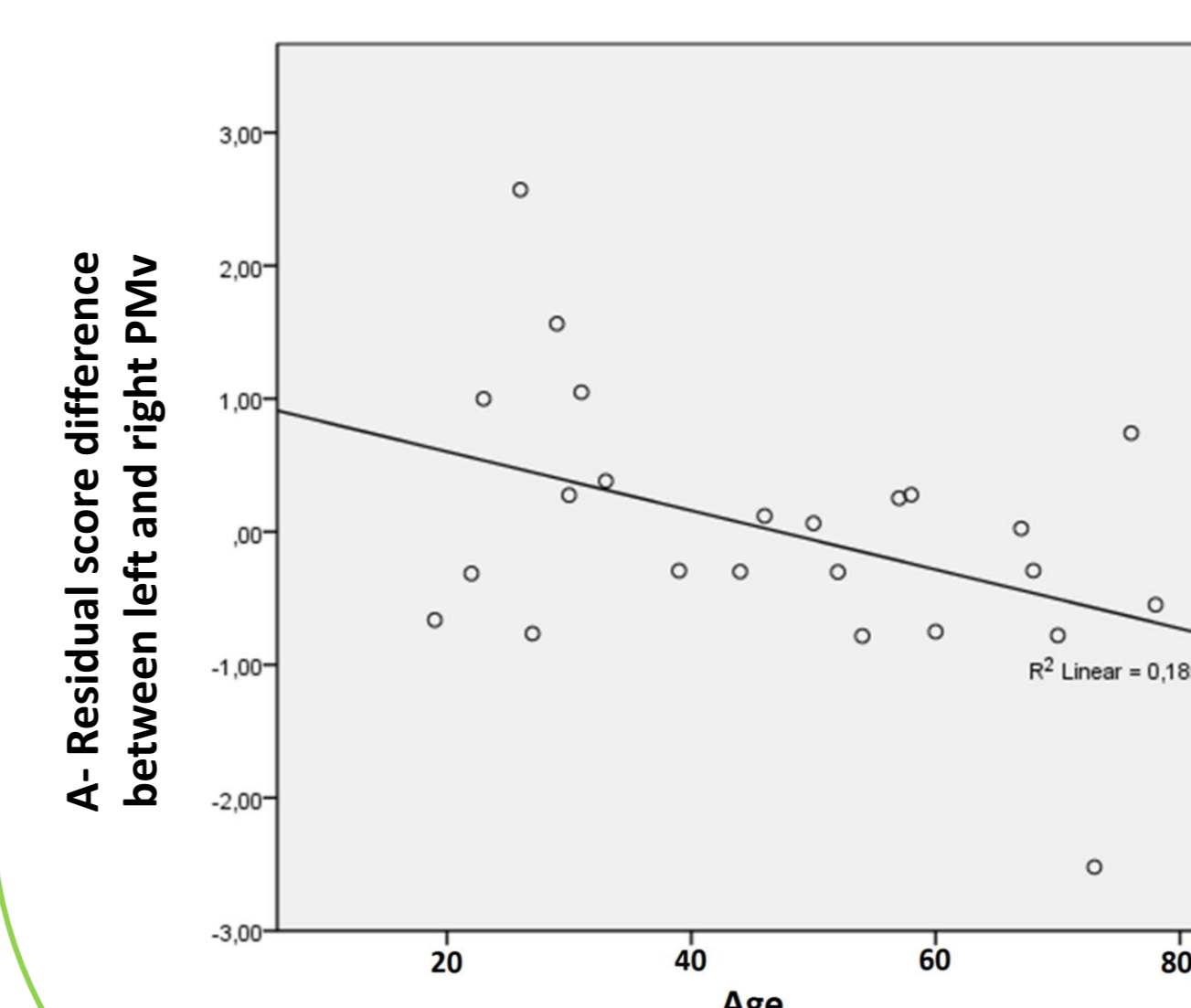
→ AV integration preserved

AT: no difference of RT between left and right PMv across age

→ AT integration is possible



2) Greater recruitment of the right PMv to compensate the decline of auditory acuity during auditory speech perception in older adults

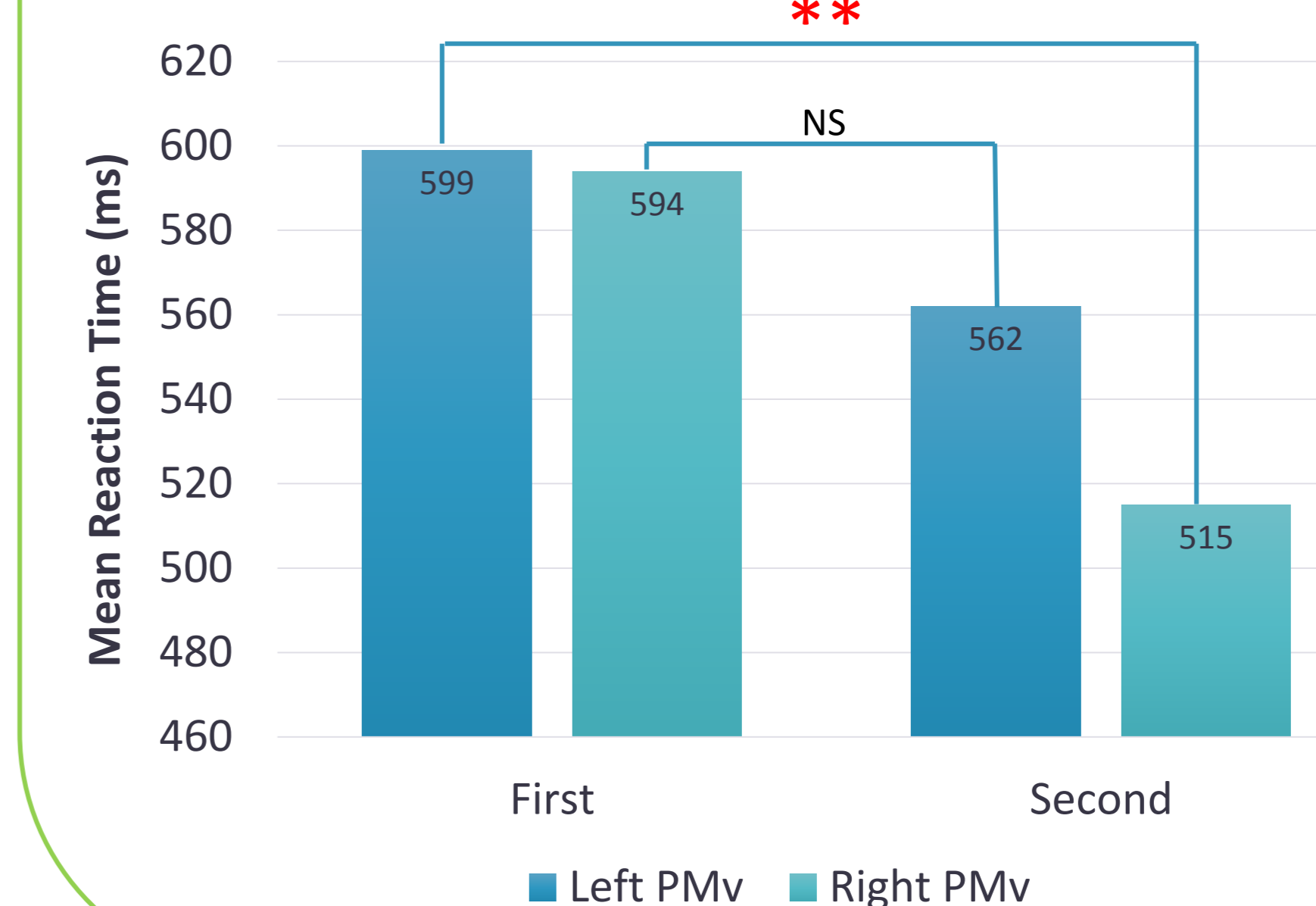


A: difference of RT between left and right PMv decreases with age.

→ Greater recruitment of the right PMv

RESULTS

3) Interaction between stimulation order and target region



First:

No difference between left and right PMv
→ New task, participants are slower / no TMS effect (= no or lower PMv recruitment ?)

Second:

Right PMv : faster RT than first session
→ Learning effect and/or not TMS sensitive
Left PMv: no significant RT difference with first session
→ Left PMv impacted by TMS

DISCUSSION

- 1) **Multimodal integration** is relatively **preserved in aging**, becoming slower but not less accurate
- 2) Age-related reduction in hemispheric asymmetry in the motor system (consistent with the HAROLD model of neurocognitive aging, in which increased laterality is associated with age-related compensation [2])

- Together, these results demonstrate that multisensory integration mechanisms are, at least in part, maintained with age despite a decline in auditory acuity, probably thanks to a more bilateral recruitment of the premotor cortex as a compensatory mechanism
- These results also demonstrate the feasibility of using rTMS in healthy elderly adults to study speech and language processes.

Bibliography:

- [1] Treille et al. (2014). Haptic and visual information speed up the neural processing of auditory speech in live dyadic interactions. *Neuropsychologia*, 57: 71-77.
[2] Cabeza (2002). Hemispheric Asymmetry Reduction in Older Adults : The HAROLD Model. *Psychology and aging*. 17: 85-100.

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