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To cite this version:
Avril Treille, Marc Sato, Jean-Luc Schwartz, Coriandre Emmanuel Vilain, Pascale Tremblay. The role of the premotor cortex in multisensory speech perception throughout adulthood: a rTMS study. SNL 2016 - 8th Annual Meeting of the Society for the Neurobiology of Language, Society for the Neurobiology of Language, Aug 2016, Londres, United Kingdom. hal-02074942v2

HAL Id: hal-02074942
https://hal.science/hal-02074942v2
Submitted on 14 Nov 2017

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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 multisensory: 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:
• 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, V, T, AV and AT) * order of stimulation (right PMv first/ left PMv first)
  RT: noise (yes/no) * target (left vs right PMv) * modalities (A, V, AT) * order of stimulation (right PMv first/ left PMv first)

RESULTS

1) Preservation of multisensory 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

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 neuropsychological 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:

Acknowledgement: This study was supported by research funds from the European Research Council to J.L.S., by a grant from La Région Rhône-Alpes to A.T., and by an infrastructure grant from the Canadian Foundation for Innovation, to P.T., who also holds a Career Awards from the “Fonds de Recherche du Québec- Santé” (FRQS).