

Aging modifies beta oscillation during tapping tasks

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Background & Aim

Even for relatively simple movements, elderly activated additional areas reflecting integration of somatosensory information to guide motor actions [1]. In tapping task, within-hand timing variability is reduced during bimanual as compared to unimanual movement [2]. This « bimanual advantage » has been attributed, in part, to enhanced tactile and kinesthetic reafferences [3]. However, age-related changes in motor production and brain activation of two basic self-paced tapping (unimanual and bimanual) have not been examined. Using analyses of EEG oscillatory activity coupled with distributed electrical source estimation, this study aims at comparing age-related changes in the neural correlates of unimanual and bimanual internally triggered tapping.

Design: Age Group x Tapping Task

Factor Age Group

- 29 YOUNG [24.4 years] and 27 OLD [69 years] right-handed healthy adults

Factor Tapping Task

- Participants performed symmetric Bimanual (BM) and Unimanual (UM) tapping movements without visual and auditory feedback.

- Dependent Measures:

1. Mean and Standard deviation of within-hand timing for BM and UM (MeanITT and SdITT).
2. Global Power Spectra (GPS) in Alpha (8-10Hz & 10-12Hz) and Beta band (14-20Hz & 20-30Hz).
3. Inverse solution for each significant results in GPS (see additional material).

Behavioral results

Intertapping Time (ITT)

MeanITT showed no difference neither between groups nor between tasks.

SdITT revealed a higher variability in OLD compared to YOUNG participant ($p=0.06$) and an interaction between Group and Task ($p<0.05$) driven by a greater variability in UM than BM in the YOUNG group ($p<0.05$. Table 1 & Figure 1).

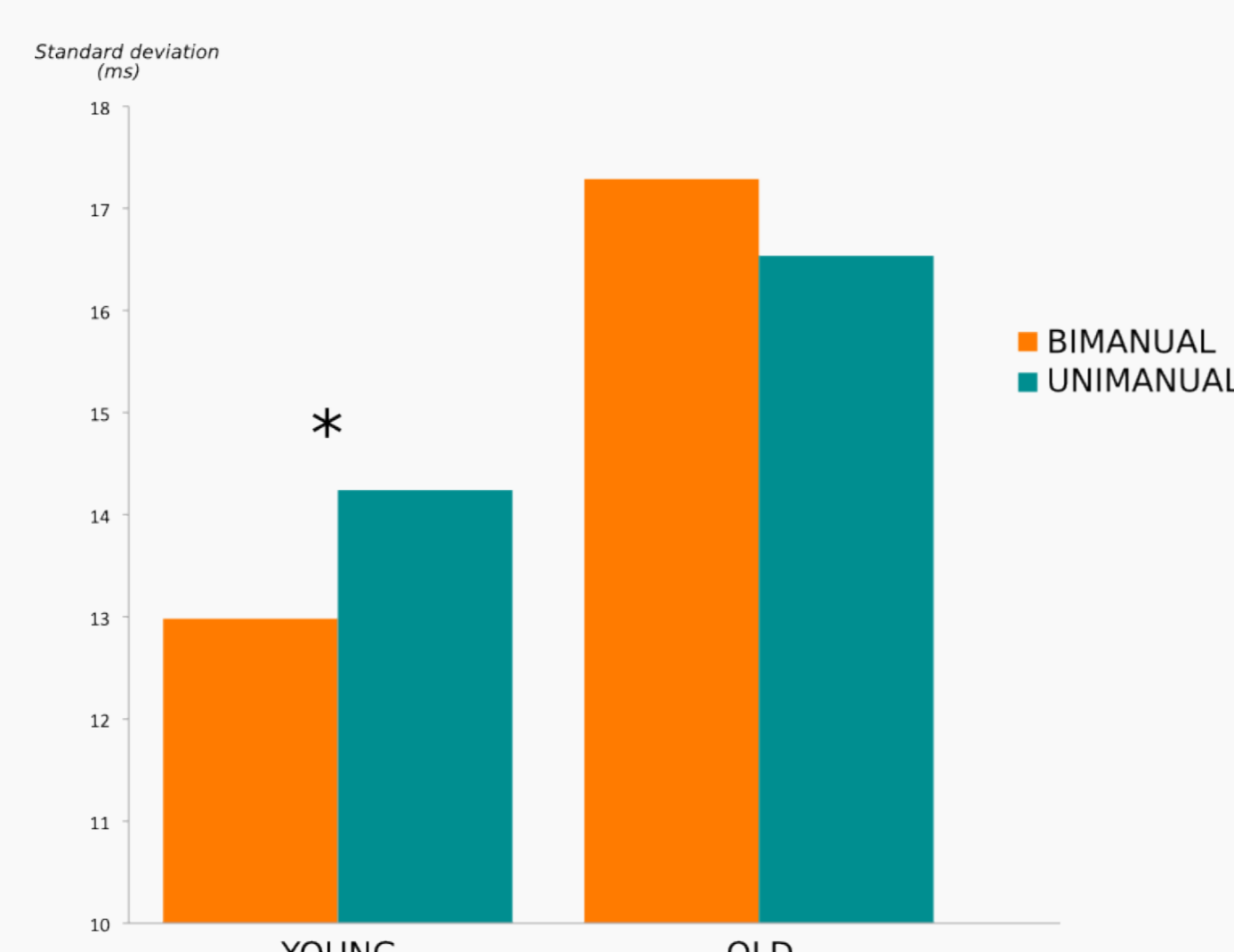


Figure 1. ITT variability during UM and BM movement for YOUNG and OLD group.

Oscillatory Activity

Global Power Spectra (GPS)

GPS is calculated by averaging the absolute value of the frequency power of all electrodes. Results revealed an increase of power in UM compared to BM with a :

- **Task effect** ($p<0.01$. Figure 2)
- **Interaction: Group * Task** ($p<0.05$. Figure 2)
- **Task effect** ($p<0.05$ Figure 2).

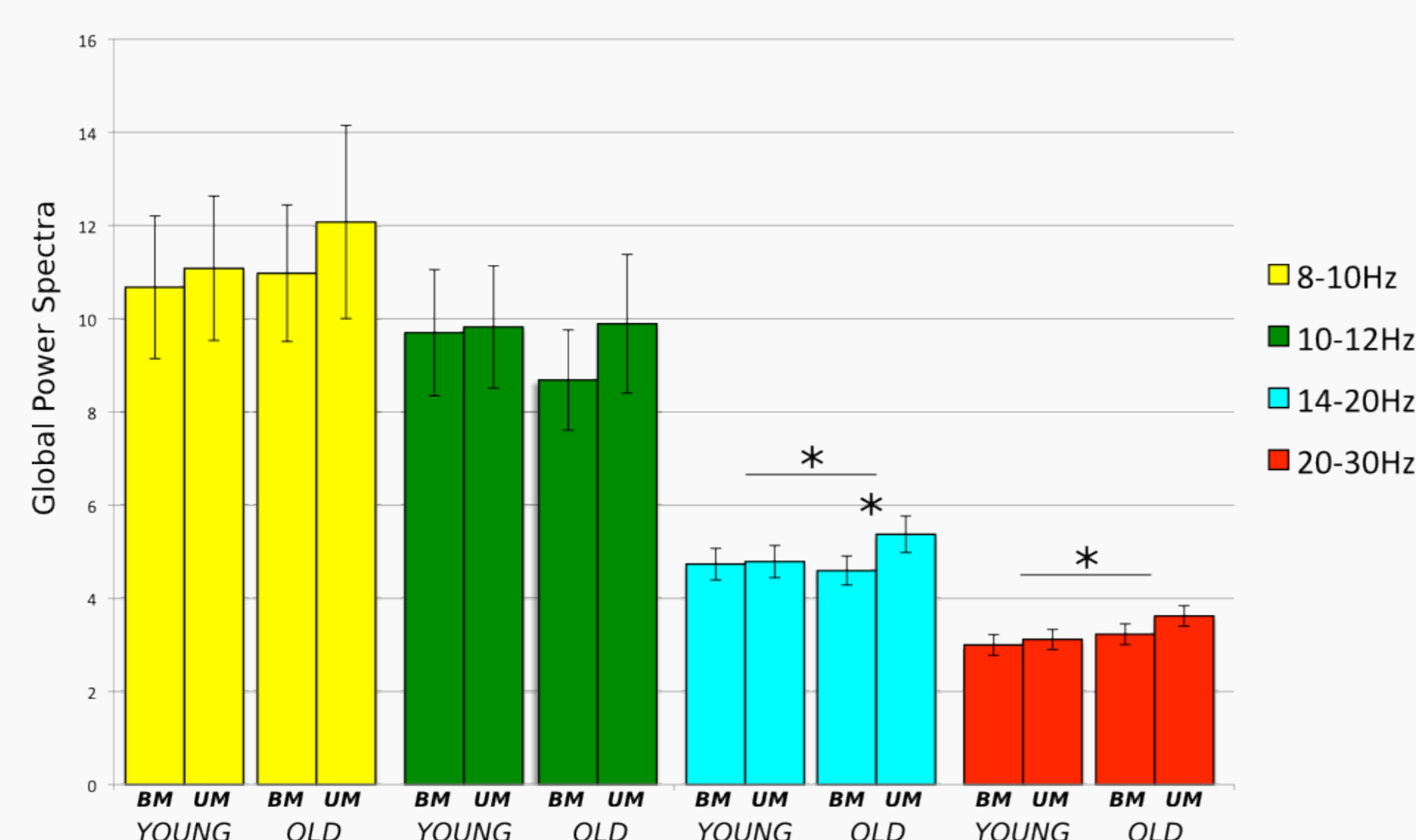


Figure 2. GPS represented in each frequency band for YOUNG and OLD group during BM and UM condition.

Electrical Source Estimation

Inverse solutions (IS)

The neural generators of the frequency bands showing a significant interaction were estimated and submitted to the same Task x Group ANOVA as the GPS. The significant interaction in the beta band originated from an increase of activation during UM compared to BM in :

- **Right M1, S1, precuneus and Somatosensory Association Cortex**, for both groups (figure 3.a) **Beta band 14-20Hz**
- **Left inferior parietal lobe** for OLD group (figure 3.b)
- **Right M1, S1, precuneus and Somatosensory Association Cortex** for both groups (figure 3.c) **Beta band 20-30Hz**

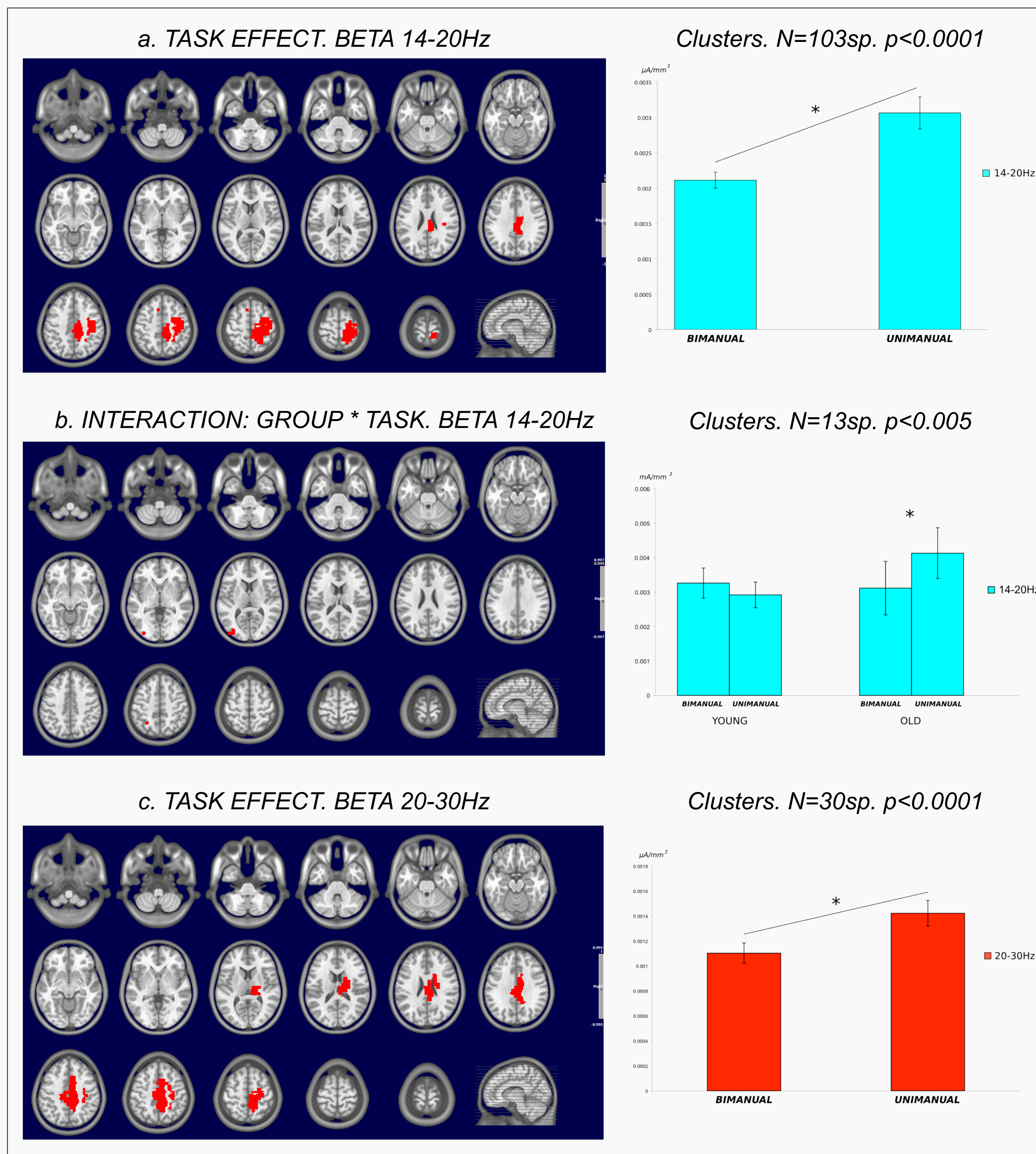


Figure 3. a. and c. Topographic results of ANOVA IS showed higher activity in right M1, S1, precuneus and Somatosensory Association Cortex (14-20Hz & 20-30Hz) during UM compared to BM for both groups. b. ANOVA interaction result of beta generators (14-20Hz). Post hoc showed stronger beta generator in OLD group during UM compared to BM condition localized in left inferior parietal lobe.

Conclusions

- Contrary to young adults, bimanual advantage was not observed in elderly.
- In this simple motor task, UM tapping requires enhanced cerebral activity compared to BM tapping.
- In elderly, the increased activity in left parietal lobe observed during UM could reflect additional of somatosensory control of hand movement [4].

References

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- [2] Helmuth LL & Ivry RB, 1996. Journal of experimental psychology. Human perception and performance.
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- [4] Lin YY & Forss N, 2002. Behavioral Brain Research.135, 141-145.

Additional material

Participants performed the tasks by pressing the button(s) of joysticks held in each hand on each side of the body.

Tapping Task : The intertap tempo was fixed to 500ms by an auditory metronome at the beginning of each block. An unpredictable high-pitched tone prompted tapping switches.

EEG recorded from 64 surface electrodes (BioSemi), off-line analyses using Cartool.

Power analyses (Fast Fourier Transform Approximation) of alpha (8.0 – 10.0 Hz & 10.0 – 12.0 Hz) and beta frequency band (14.0 – 20.0 Hz & 20.0 – 30.0 Hz)

ANOVAs 2 * 2 (Group * Task) with repeated measure were computed

Funding: Region Rhône Alpes, Research Cluster Fund n° 08 013981 0100

