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ItsAllAboutMotion: Functional organization of the multisensory motion system

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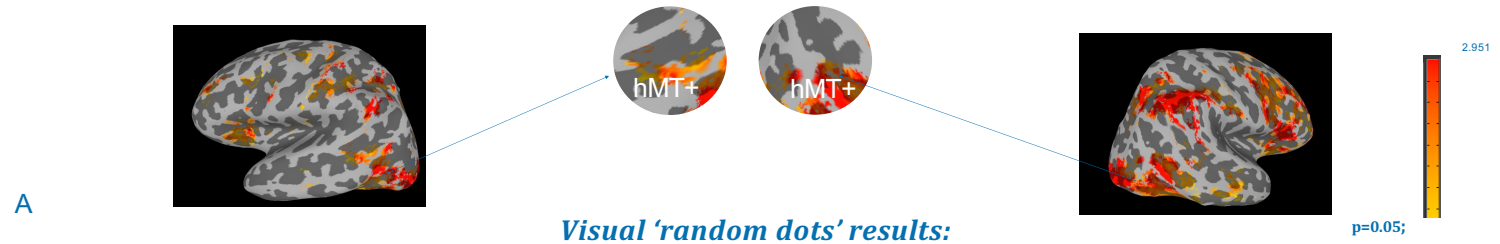
INTRODUCTION

The ability to detect and understand motion is essential to human beings. Detecting motion properly means having autonomy in orienting ourselves in the environment, moving through the spaces and also communicating and understanding other's actions. As it is well known, hMT5/V5 is the area assigned to visual motion perception in human[1]. The response to visual motion stimuli in this area depends on the spatiotemporal frequency properties of the stimuli[2]. Along with the progressive interest in the MT/V5 area, and the knowledge about the multisensory property of visual cortex[3], several other studies investigated whether this area could also detect motion from other senses, such as touch[4] and audio[5]. Indeed, the results of these studies demonstrated the ability of MT/V5 to encode movement through tactile[6] and auditory stimuli as well[7], reinforcing the idea that MT/V5 can be considered a multisensory area. **Aim the of study**: Using 7T fMRI we investigated BOLD responses in healthy human brains in response to different spatial features of moving stimuli delivered via auditory, visual and tactile motion stimulation.

MATERIAL & METHODS

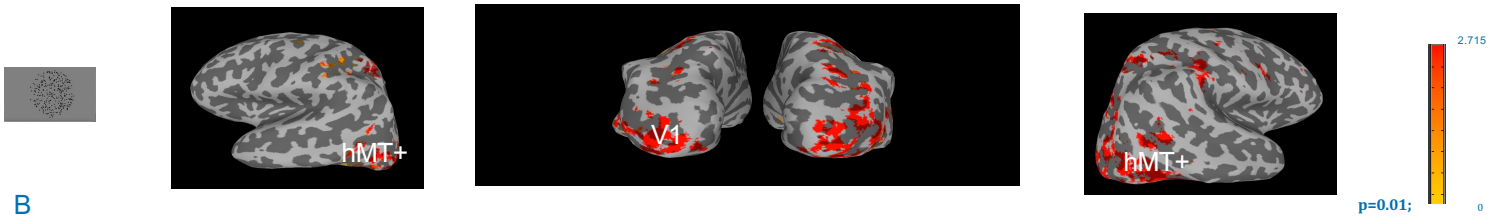
Experiment. Experiments were conducted on fifteen healthy human volunteers using a 7T MRI scanner (Siemens Healthineers). For each participant an anatomical image (MP2RAGE sequence, 1mm) and a main experiment consisting of five runs were acquired (2D-EPI sequence, multiband (R=3), spatial resolution=1.5x1.5x1.5 mm 3 and TR=1500 ms). A visual motion localizer (moving dots vs static) was performed at the beginning of the first session. Each run comprised 12 motion blocks (3 stimuli features x 2 modalities). Each motion block had either visual or auditory stimuli moving from left to right and right to left for 10 sec. For the visual condition, three set of stimuli were employed (full field random dots and two sine wave gratings at low and high spatial frequency respectively and, **see Figure 1**). Each condition was randomly interleaved in a single run ending with 3 trials per condition per run. The same set of stimuli was reproduced in the auditory sensory domain using an audio setup constituted by one vertical and one horizontal semi-circular sound bar of 31 speakers each described in [7]. **Preprocessing and Analysis:** Three participants were excluded for poor-quality data. Data preprocessing was made with AFNI and included: motion correction, linear detrending, alignment to standard MNI space and smoothing. In this first stage of analysis a GLM (General Linear Model) analysis was conducted for the localizer contrasting moving dots vs static, to localize the hMT/V5 area and to the main experiment to identify the activation to the random dots condition for the visual and auditory stimulation.

Localizer Results:



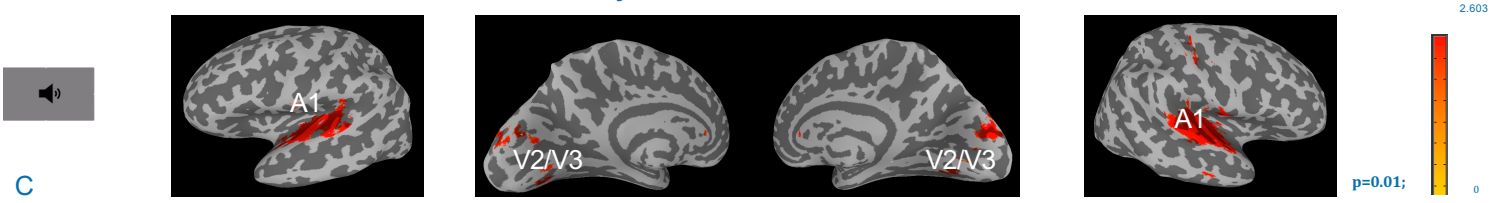
A

Visual 'random dots' results:



B

Auditory 'random dots' results:



C

CONCLUSION

During the visual motion localizer, subjects consistently exhibited positive BOLD responses in the human MT complex (hMT+) and early visual cortex **(panel A).** As expected, the random condition during the visual stimulation task elicited strong activation in hMT+ and early visual cortices. **(panel B)** Using the same motion stimulation in the auditory domain we found two clusters of significant activations, one located in the primary auditory cortex A1 and the second located in the third visual cortex V2/V3. **(panel C)** Using univariate analysis, we did not find an engagement of hMT+ during auditory motion conditions. Further analysis are needed to elucidate the fundamental mechanism of multisensory motion perception in the human brain.

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