Representation of hand shape in the human resting-state activity

El Rassi Y., Handjaras G., Leo A., Papale P., Corbetta M., Ricciardi E., Betti V.

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Background - Aim: At rest, regions of similar functionality show spontaneous slow-frequency fluctuations that are temporally coherent. Recent studies, mainly in visual areas, suggest that these functional topographies at rest retain striking similarities with the patterns elicited by specific tasks, suggesting that ongoing activity encodes behaviorally relevant information, in the form of internal representations or *prior* expectations. Here we test whether a similar mechanism exists for the human hand area in the somatomotor cortex by measuring the coherence between topographies obtained at rest and during a visual task comprising pictures of the hand shape at decreasing levels of animacy. We expect a coherent internal representation strongest for the stimuli of natural hands, specifically in the cortical area devoted to hand representation.

Methods: We acquired two 8-minute eyes-opened resting-state scans, before and after a working memory visual 1-back task, where subjects processed stimuli classified in four categories on a scale based on animacy (natural hand, robot hand, gloves, and food as a control condition). We selected three regions of interest (ROIs): the left and right somatomotor area and the bilateral early visual cortex as a control region. We then extracted the patterns of activity elicited by the four stimulus categories in each subject and ROI to correlate them with the ones extracted from each time point of resting state. We considered the upper 90% (U90) from the distribution of correlation coefficients for each stimulus category, ROI, and subject to measure task/rest congruency. We performed a 2-way ANOVA (rest by stimulus categories) and a post hoc trend analysis ($p<0.05$).

Results : In the left somatomotor area, results showed a significant main effect of stimulus categories, but no effect on rest over the two scans, and no interaction between rest and categories. A trend analysis on stimulus categories demonstrated a significant linear trend; the similarity between topographies obtained at rest and during the task were ordered according to the level of animacy (i.e., hand>robot>glove>food). No significant results were found in the right somatomotor area or early visual cortex. In short, multi-voxel activity of natural hand stimuli in the left sensorimotor area was most represented in resting-state activity compared to the robot hand, glove, and food.

Conclusion. In conclusion, spontaneous activity, despite its apparently noisy structure, reliably encodes the natural human hand. Overall, this study may suggest that the human hand represents a *prior* for the effective motor interaction with the external environment.