Self-regulation of local brain activity using real-time functional magnetic resonance imaging

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In the last two years, we developed fMRI-based brain-computer interfaces providing on-line neurofeedback to the subjects in the sanner. In our first studies we showed that subjects are able to learn to self-regulate brain activity in various brain areas, including SMA, FFA, PPA, and V5. In subsequent studies, we showed that subjects are able to voluntarily modulate two areas simultaneously, i.e. increasing the activity in SMA while decreasing the activity in PPA. More recently, we could show that subjects are also able to learn to activate brain areas to various prespecified target levels.
Based on the outcome of these studies, we currently explore whether it is possible to couple the brains of two subjects while they compete in a simple video game (ping pong). In the first pilot studies, subjects saw the same screen depicting the tennis field, the moving ball and the two rackets. Each subject was instructed to move her racket to the correct position using the fMRI signal. The measurements were performed simultaneously on two MRI scanners (Siemens 1.5 T Sonata and 3 T Trio). Before running the pong game, each of the participating subjects was trained to modulate regional brain activity to reach specific target levels and to adapt to the hemodynamic response delay. The region-of-interest (ROI) with the best modulation results was seletect in each subject for controlling the racket in the subsequent video game. Subjects succeded in controlling the up and down movement of the racket by regulating voluntarily the activity in the selected ROIs achieving a hit rate of 60 to 80 %. The results revealed that with extensive practice, subjects learned to reach and maintain intermediate levels of brain activity with high accuracy.
This study demonstrates that it is possible to simultaneously measure with fMRI two subjects engaged in joined attention during social interactions and to use brain activity signals from the subjects in real-time during these interactions. This might inspire further real-time fMRI investigations of the neural substrate of social cognitive processes.

References

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