Neural correlates of expertise in radiology and surgery: Towards ecological validity in fMRI research

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Rationale

Functional Magnetic Resonance Imaging (fMRI) is a non-invasive neuroimaging method to measure brain function. 'Active' brain regions need more oxygen, so changes in blood oxygenation as measured with fMRI indicate alterations in regional brain activation. Thus, fMRI could provide a useful method to reveal differences in brain activation between experts, intermediates and novices in a specific medical domain (e.g., radiology or surgery), which could allow us to refine and extend our theories of visual and motor expertise. FMRI research, however, poses several challenges to expertise research: Traditionally, experiments performed in an MR scanner are highly artificial, and tasks are restricted and repetitive. Further, the possibilities for collecting behavioral responses other than button presses are extremely limited. On the other hand, expertise research stresses the importance of ecologically valid tasks. In two running fMRI studies, aiming at high ecological validity, we investigate brain-activation differences related to different expertise levels in radiology and surgery.

Methods

We investigate expertise differences using fMRI in two real-life tasks: diagnosing chest radiographs, and passive viewing of conducting surgical procedures. For both tasks, we included participants of three expertise levels. In radiology, we look at differences between laypeople (n = 11), beginning residents (n = 10) and senior residents (n = 7). In surgery, we contrast novices, medical students (n = 10), residents (n = 10) and surgeons (n = 10). We use localizer tasks to localize brain regions of interest that were selected based on literature. These brain regions are expected to demonstrate differences in brain-activation related to the different expertise levels during the performance of the ecologically valid tasks. In the radiological experiment, 66 chest radiographs were presented for two seconds each. After presentation, participants were presented with a possible diagnosis and were asked to indicate whether this diagnosis was correct (or not) via button presses. All 66 chest radiographs were subsequently presented again but now for ten seconds each, and participants were again required to indicate the correctness of the diagnosis. For the surgery task, we video-taped three different surgical procedures in orthopedic surgery from the perspective of the surgeon (using a go-pro camera). We selected 60 five-second fragments that showed a single

movement (e.g., stitching a wound). As a control condition, we also video-taped and presented in the scanner 60 fragments of everyday activities (e.g., opening a jar).

Conclusions

We collected data of 58 participants in total. Data analysis is ongoing. In this presentation, we will discuss our methodological approach for acquiring high-quality fMRI data while aiming for high ecological validity, and provide some preliminary results.