

Neural correlates of planning and execution of everyday tool use: Comparison of pantomime and actual tool use in an fMRI study



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1. Introduction: Damage to the language-dominant left hemisphere, especially to the left parietal lobe, is often accompanied by a disorder called apraxia. In order to diagnose apraxia, a very sensitive clinical test is common in which the patient is asked to pantomime everyday tool use. Strikingly, quite a large number of apraxic patients though having severe problems with a pantomime, successfully perform the same action when actually handed the tool involved. This observation gives rise to the assumption that different motor plans might subserve these two apparently similar actions [1]. In this study we aim at analysing this dissociation by differentially characterizing the neural correlates of pantomime and actual tool use.

2. Methods: fMRI scanning (using a Siemens Symphony 1.5T-scanner) was performed on 24 healthy volunteers. The 2x2-factorial event-related design consisted of the factors: Pantomime (PAN) or Object use (OBJ), and use of right (RH) or left hand (LH) for execution. Each of the 4 factors consisted of 3 events in a row occurring after an instructive cue: Viewing of the object (ev1), pause (ev2), and execution of object-related movements (ev3) (Fig. 1) [2]. In condition OBJ the subject was handed the respective object during ev3 (Fig. 2). Statistical analysis was performed using spm [3] and SPM2. Results are reported at $p_c < 0.05$ (corrected for multiple comparisons). Small volume correction (SVC) was performed using the WFU pickatlas. Results are reported at $p_{SVC} < 0.05$, corrected on cluster-level, in the coordinate space of the Montreal Neurological Institute (MNI).

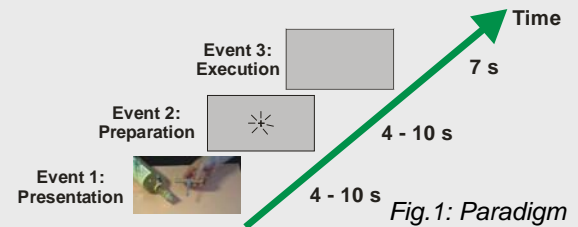


Fig. 2: Tools and Objects used

For a different analysis of the same data set see Poster 58 TH-PM.

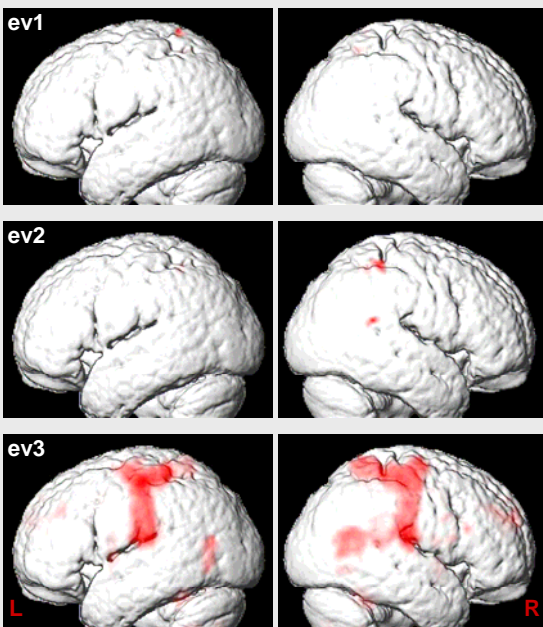


Fig. 2: Object Use vs. Pantomime (OBJ vs. PAN) during three successive events (ev1: viewing the tool, ev2: pause, ev3: execution) at $p_c < 0.05$

3. Results: For each of the three events (ev1, ev2, and ev3) the contrast OBJ vs. PAN showed significant activation in the parietal cortex. In ev3 there was strong additional differential activation bilaterally in the frontal cortex and the cerebellum, due to the sensory feedback provided by the object.

The opposite contrast PAN vs. OBJ was analysed especially focussing on the left parietal cortex. A region of interest analysis revealed significant differential activation in the left parietal cortex at $-36, -57, 48$ (see Fig. 3).

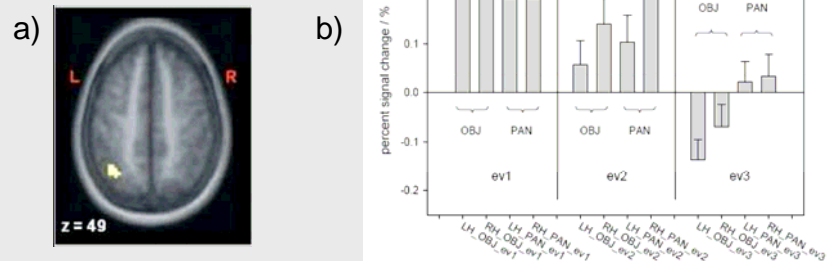


Fig. 3: Pantomime vs. Object Use (PAN vs. OBJ) during action execution (ev3) at $p_{SVC} < 0.05$ (small volume corrected for the left parietal lobe). a) Region of the activation, b) Percent Signal Change Plots with standard error of mean at coordinate of peak activation according to experimental condition.

6. Conclusion: Our data indicate that execution of pantomimic movements and movements which are actually performed on objects rely on partially different neural networks. Influence from areas which participate in planning the movement might be suppressed in case sensory feedback from the object is present during execution.