Neural correlates of motor influence on the perception of ambiguous figures: an fMRI study

A.M. Wohlschläger[$], A. Wohlschläger[*], L. Schilbach[†,‡,‡‡], K. Vogeley[†,‡,‡‡]

[$]Departments of Neurology, Nuclear Medicine and Radiology, TU Munich, Germany
*Max-Planck-Institute of Human Cognitive & Brain Sciences, Department of Psychology, Munich, Germany
[†]Institute of Medicine, Research Center Jülich, Germany
[‡]Brain Imaging Center West (BICW), Research Center Jülich, Germany
[‡‡]Department of Psychiatry, University of Cologne, Germany

1. Introduction: The model of efference copies in action execution suggests that information on an expected sensory input caused by ones actions is generated in the brain during action planning or execution. Supporting evidence for such a mechanism comes from the observation that rotational hand movements influence the perception of an animated ambiguous display [1]. In this fMRI study we investigate the neural correlates of this motor influence.

2. Methods: fMRI scanning (Siemens Vision 1.5T-scanner) was performed on 20 healthy volunteers. Subjects viewed frames of small circles on a circular path which changed in such a way that the motion was **ambiguous** with respect to its direction (clock-wise or counter-clock-wise; *AM*). The animation was started by the subjects themselves by rotating a knob with their **right hands** when prompted. Subjects were asked to rotate the knob **back and forth**, and then had to answer the question whether they **saw a switch** in the rotating visual stimulus by button press with their left hands. The button press stopped a single trial. Trials were mixed with non-ambiguous animations (*SW*,*NS*, together: ***non-AM***) according to the **blocks** (B1,B2,B3) of the paradigm. Baseline was a blank screen. Analysis was performed within SPM2, results are stated at $p_{FDR} < 0.05$ (false discovery rate corrected).

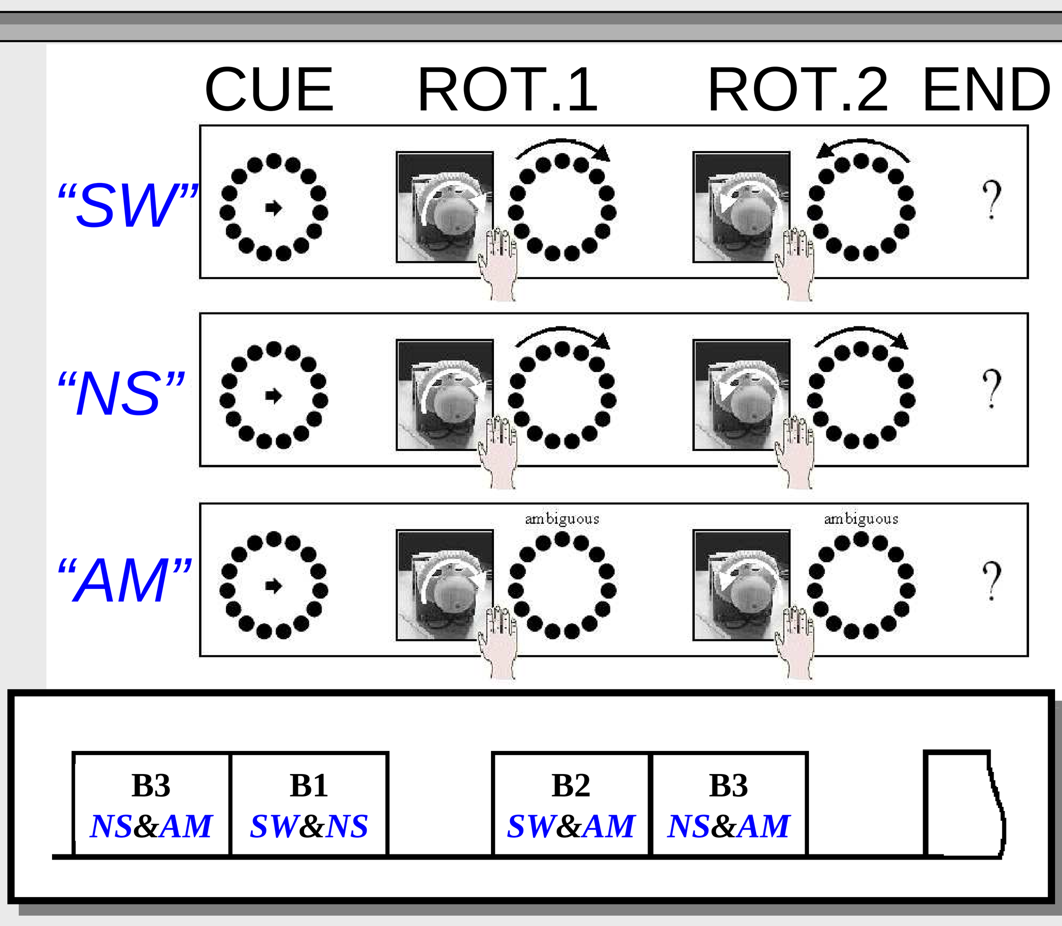

Fig.1: Trials AM,non-AM(SW,NS) and their arrangement in the block types B1,B2,B3

3. Results: **Perceived switches:** 98.4% in all SW trials, 2.3% in all NS trials, 75.5% in all AM trials.
non-AM>AM: significant activation in the **basal ganglia** (-27/-18/3, Z=4.98; 27/-15/48, Z=4.59)
AM>non-AM: no activation after correction for multiple comparisons

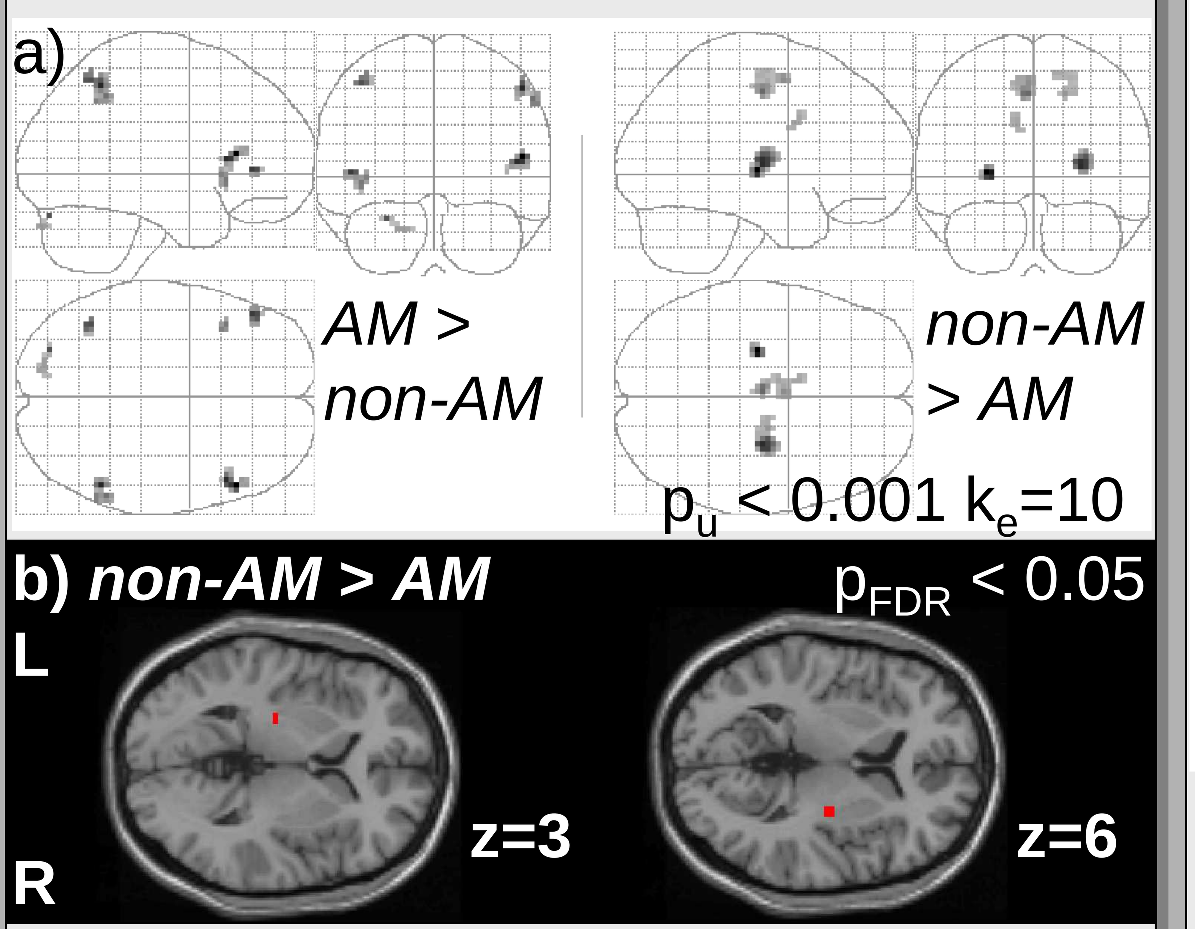

Fig.2: no functional morphing

4. Functional Morphing: Normalization of contrast maps *AM+non-AM*>baseline to custom template; application of the transformation to *AM>non-AM*

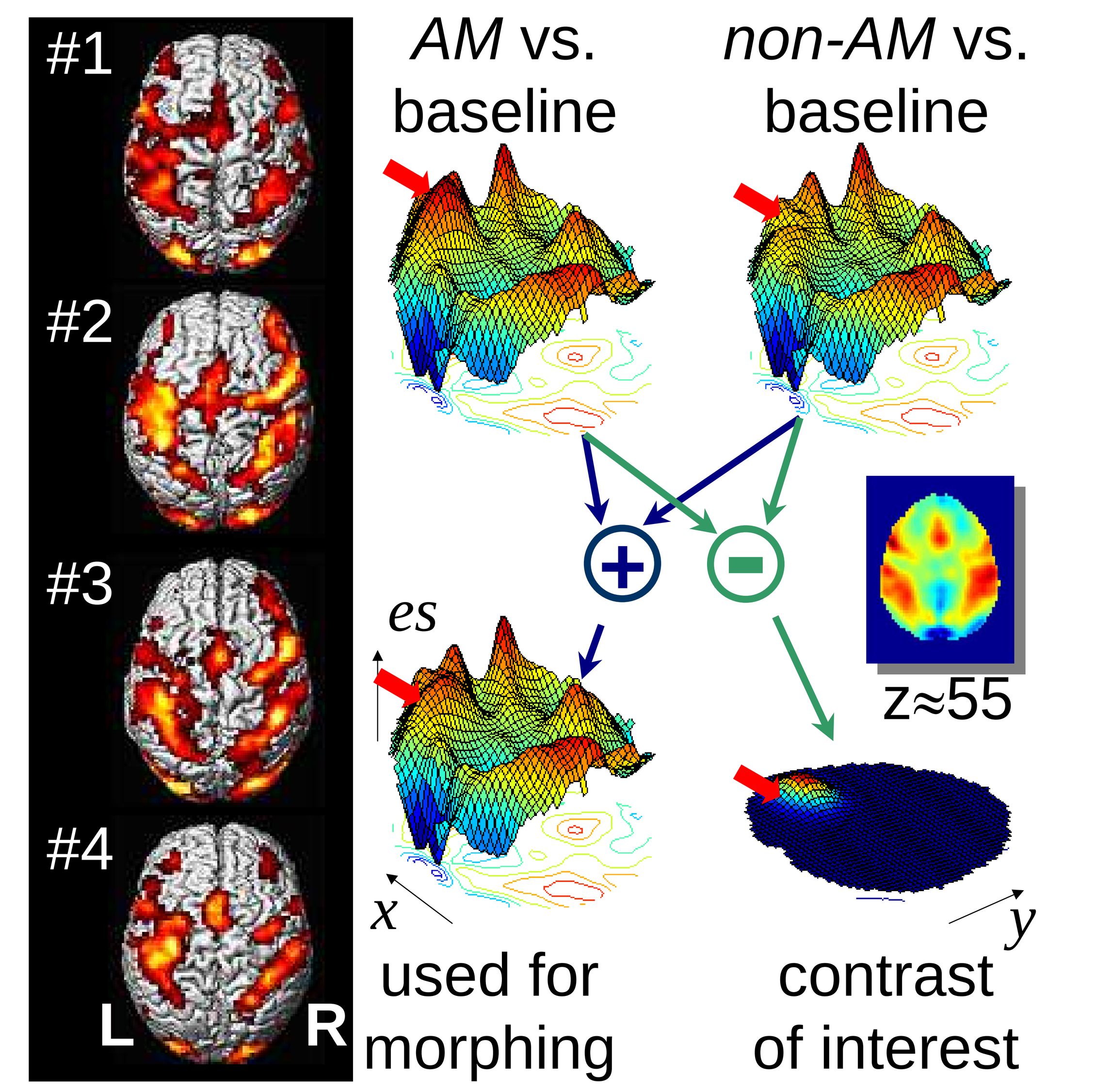

*Fig.3:, 4 **single subject results**, (AM+ non-AM)>baseline; **sketch**, x,y: MNI-coordinates; es: BOLD signal intensity*

5. Results (functional morphing):
AM>non-AM: significant activation in **left parietal cortex** (-36/-60/57, Z=4.68)
non-AM>AM: no activation after correction for multiple comparisons
⇒ increased contrast in areas of strong activation vs. baseline

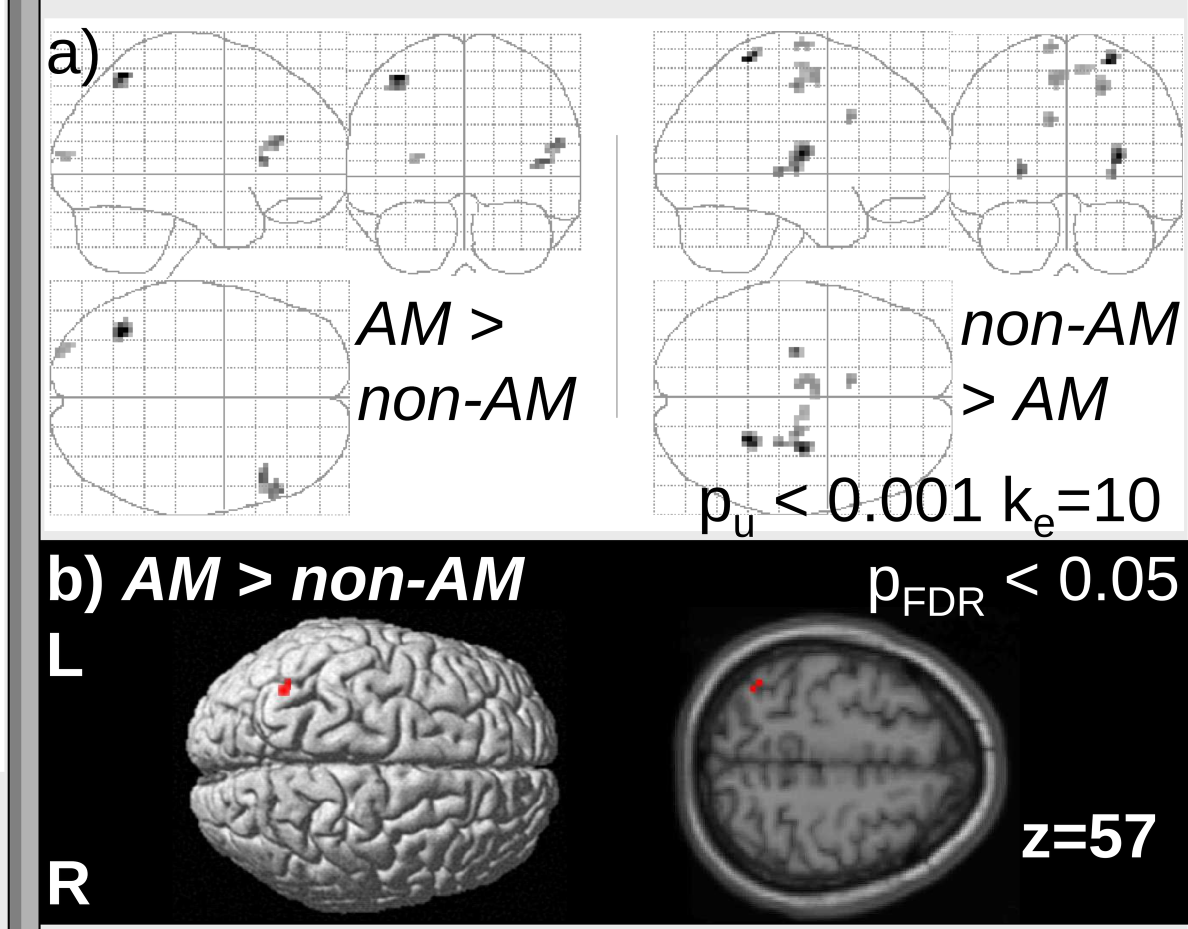

Fig.4: functional morphing

6. Conclusion: Like functional localizer measurements, functional morphing facilitates statistical comparison of areas with similar functional characteristics with respect to a special task. It is important to note, that normalization in the functional morphing step was performed on a contrast, independent of the contrast of interest.

The displayed study shows that the respective task required close reconciliation between motor plan and perception in the subjects. The results support the hypothesis that top-down influences are exerted while an action is performed, which are mediated by the parietal cortex. In case of ambiguous stimuli in which the bottom-up-flow of information is underspecified, the top-down influence can be measured with fMRI.

1. Wohlschläger, A. (2000) Vision Research 40:925-930