NEURAL PREDICTORS OF IMMEDIATE AND DELAYED INTENSE NAMING TRAINING SUCCESS IN CHRONIC APHASIA

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Introduction: The reacquisition of language profits from intense training, particularly in the chronic stage after stroke. To maximize treatment efficacy it is of interest which brain structures mediate treatment success in this late stage. Here we show with functional MRI, which brain regions are involved in immediate versus long-term success of intense naming training.

Methods: Seven chronic stroke patients with single left hemispheric strokes involving both Broca's and Wernicke's areas were trained daily for three hours over a two weeks period in naming of objects. A matched set of untrained object names and the assessment of a healthy control group served to control unspecific effects of task repetition. Prior to, immediately after, and eight months after training, patients overtly named trained and untrained objects during event-related fMRI in a 3 Tesla MR scanner (Gyroscan 3.0T, PMS, Best, NL) with whole brain GE-EPI (TR/TE 3s/30 ms; isotropic voxels, 3.6 mm edge length; Projection of objects to a screen at the rear opening of the magnet bore). Data were analyzed using SPM2 using Automated Anatomical Labeling (1) and the Muenster T2T converter (2) for anatomical localization of activated brain regions.

Results: All patients significantly improved from zero percent to a mean of 73 % correct namings immediately after training.

Treatment success remained highly stable for up to eight months post training. The degree of short-term treatment success was predicted by increased activity bilaterally in the hippocampi, in (pre-) motor areas, attention areas, and in the right occipital lobe. In contrast, long-term training success was predicted by the degree of activity in the left superior temporal lobe perilesionally to Wernicke's area, in the right-sided Wernicke's homologue, and in right attention areas.

a)

Projection on the structural MRI of a representative patient (axial sclice)

b)
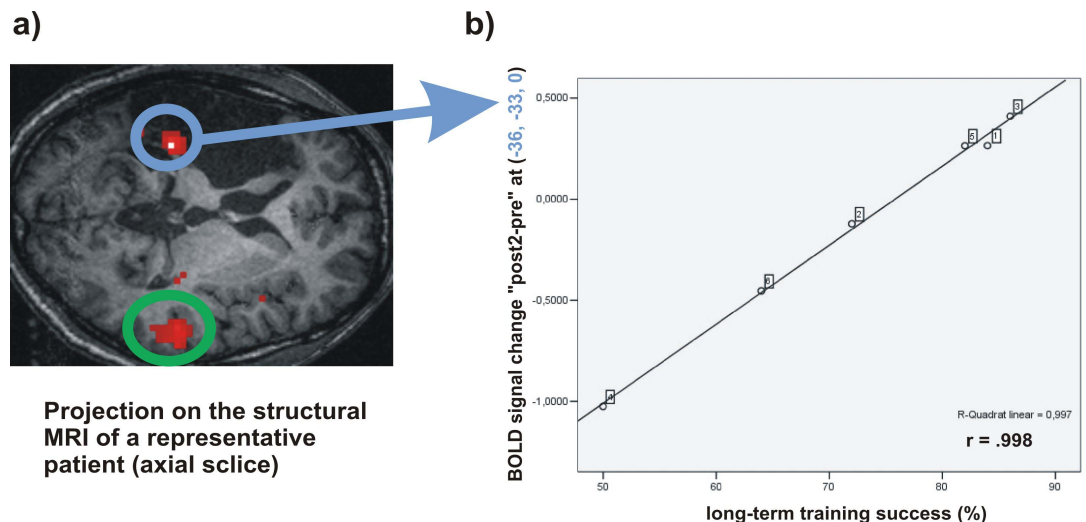
(**a**) Left perilesional (blue circle) and right (green circle) temporal lobe areas showing positive correlations between long-term success and activity changes for trained object names (post vs. pre training) and (**b**) correlation between long term success and activity changes in the region adjacent to the lesion (Wernicke's area)

Discussion: This pattern of results demonstrates that different brain areas participate in initial learning versus long-term consolidation in chronic aphasia. For initial learning, brain regions involved in memory encoding (hippocampus), attention (frontal lobes), and motor control predicted treatment success. Long-term treatment success was mediated by activity increases in bilateral language regions of temporal lobes (perilesionally to Wernicke's area and the right sided homologue). These results help to understand, which brain structures can be activated for successful word learning in the chronic phase of post-stroke aphasia.

References: (1) Tzourio-Mazoyer N et al., Neuroimage 15: 273-289 (2002); (2) Steinsträter O et al., Neuroimage (2007, in press)