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Treatment-Induced Neuroplasticity following Intensive Speech Therapy and a Home Practice Program in Four Cases of Chronic Aphasia

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Introduction

Evidence increasingly suggests that intensive speech therapy (e.g., ILAT; Pulvermuller & Berthier, 2008) can take advantage of the brain’s potential to ‘overcome learned non-use’ even in chronic aphasia. While significant language improvements have been demonstrated in many patients, few studies have examined the extent to which these short-term gains are maintained over time, or methods for enhancing the likelihood of retention. The current longitudinal study examined changes in behavior and fMRI BOLD activation in four individuals with chronic, moderate-to-severe aphasia who underwent two weeks of intensive therapy followed by six months of home practice.

Methods

Four participants with chronic aphasia completed a 2-week intensive program of PACE (Davis & Wilcox, 1980) or ILAT, plus six months of home practice (HP) on individualized programs that provided visual/auditory semantic/phonemic/orthographic cueing using iPad devices. Home practice included half of treated and half of untreated words. Participant characteristics included: chronic moderate-to-severe fluent and nonfluent aphasia (MPO range:12-84; mean=35; sd=33.2); auditory comprehension (BDAE-3: 18th-82nd; mean=49th; sd=32.4); BNT Naming (12-47; mean=30; sd=15.4); sentence repetition (0-7; mean=4; sd=3.4). All had unilateral L MCA infarctions that included varying degrees of frontal, temporal, and parietal cortex and subjacent white matter, as well as extension to insula and some basal ganglia structures.

Functional MRI was acquired (Phillips 3T) at three time-points (S1:pre-treatment; S2:post-treatment; and S3:post-HP), while participants overtly named blocks of trained (TR), untrained (UNTR), and consistently correct (CORR) pictures of common objects (Snogass & Vanderwart, 1980) and picturable actions (Masterson & Druks, 1998). Ten healthy age-matched controls (NCs) were also tested twice, 3-4 weeks apart, with this paradigm.

Results

NCs showed high inter- and intrasubject reliability, with response decrements from S1 to S2 and during naming of TR as opposed to UNTR pictures. Both TR and UNTR pictures recruited bilateral posterior temporal gyri in all NCs, while a subset also activated middle frontal cortex.

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Aphasic participants made significant gains in naming TR targets during the treatment phase and both TR/UNTR practiced (PR) targets during the HP phase. BOLD contrasts by training condition (TR/UNTR/CORR) revealed partially overlapping ‘signature’ neural activation patterns, unique to each aphasic individual.

We present here the results of the first participant to complete the six months post-HP testing following ILAT (see Figure). Her ‘signature’ pattern of activation (p<.05, FWE corrected) during picture naming included the following:

- Bilateral activation in cuneus, posterior temporal, inferior frontal, prefrontal, and cingulate gyri with less degree and spatial extent post-treatment;
- Strongest effects of training seen during S3/post-HP, with greatest left lateralization and recruitment of posterior cerebellum during S3 PR and CORR sets

**Conclusion**

Short-term intensive treatment plus a home practice program can produce enduring language improvements that provide rich opportunity for investigating treatment-induced neuroplasticity, even in chronic, moderate-to-severe aphasia.

**References**

