An fMRI Investigation of Semantic and Phonological Naming Treatment in Aphasia

van Hees, S.1,2 Angwin, A.2 McMahon, K.2 de Zubicaray, G.3 Copland, D.1,2

1University of Queensland, Centre for Clinical Research, Brisbane, Australia
2University of Queensland, School of Health and Rehabilitation Sciences, Brisbane, Australia
3University of Queensland, School of Psychology, Brisbane, Australia

INTRODUCTION

Treatments for naming impairments typically employ phonological or semantic based approaches. Although individuals can show greater benefit from one approach over the other, the relationship between an individual's symptoms, lesion site/size, pattern of recovery and response to a particular treatment approach remains unclear.

AIM

To examine brain activity associated with successful phonological versus semantic based treatments for word retrieval using functional Magnetic Resonance Imaging (fMRI), with a goal towards more targeted treatment of naming impairments in people with aphasia post-stroke.

METHODS

Five participants with chronic aphasia post-stroke (4 female) received 12 treatment sessions to improve object naming, with fMRI scans before and after treatment.

PARTICIPANTS

<table>
<thead>
<tr>
<th>Years Post-Stroke</th>
<th>Lesion Location</th>
<th>Aphasia Type</th>
<th>Severity</th>
<th>Boston Naming Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Temporal</td>
<td>Conduction</td>
<td>Mild-Med</td>
<td>35/60</td>
</tr>
<tr>
<td>P2</td>
<td>Fronto-Temporal</td>
<td>Anomic</td>
<td>Mild</td>
<td>57/60</td>
</tr>
<tr>
<td>P3</td>
<td>Frontal</td>
<td>Anomic</td>
<td>Mild</td>
<td>44/60</td>
</tr>
<tr>
<td>P4</td>
<td>Frontal</td>
<td>Anomic</td>
<td>Mild</td>
<td>59/60</td>
</tr>
<tr>
<td>P5</td>
<td>Temporal</td>
<td>Conduction</td>
<td>Moderate</td>
<td>9/60</td>
</tr>
</tbody>
</table>

IMAGING

• A naming battery (476 items) was administered prior to scanning to determine known and unknown items.
• During the scan, participants overtly named 30 known items, and attempted to name 60 unknown items.
• Imaging data were acquired with a 4T MRI scanner, using a behavioural interleaved gradient acquisition sequence.

TREATMENT

• 60 unknown items were divided into two treatment sets.
• One set was treated using Phonological Components Analysis (PCA) [1] and the other set using Semantic Feature Analysis (SFA) [2].
• Each participant received the 12 treatment sessions over four weeks, where PCA and SFA tasks were alternated each session.

RESULTS

Activations for successfully treated items were compared with incorrect items pre-treatment as well as correct items pre-treatment (clusters >20 voxels; p < 0.01 uncorrected).

P1

• Compared to incorrectly named items pre-treatment, items treated with PCA were associated with increased left peri-lesional activity and decreased right contra-lesional activity.
• In contrast, SFA was associated with increased right contra-lesional activity.
• No significant differences were found between treated items and correct naming pre-treatment.

P2

• Compared to incorrectly named items pre-treatment, both treatments were associated with increased right temporal activity.
• Compared to correctly named items pre-treatment, items treated with SFA were associated with increased activity in bilateral temporal regions.

P3

• Compared to correctly named items pre-treatment, both treatments were associated with increased left peri-lesional activity.
• PCA was also associated with decreased right fronto-temporal activity and SFA with decreased activity in right motor regions.
• No significant differences were found between treated items and correct naming pre-treatment.

P4

• Compared to incorrectly named items pre-treatment, both treatments were associated with increased activity the right middle temporal gyrus.
• PCA was also associated with decreased right superior temporal activity, and SFA with decreased contra-lesional fronto-lesional activity.
• Compared to correct naming pre-treatment, PCA was also associated with decreased activity in right fronto and temporal regions.

P5

• Compared to incorrectly named items pre-treatment, both treatments were associated with increased activity in left peri-lesional regions, as well as right contra-lesional activity for SFA.
• PCA were also associated with decreased right contra-lesional activity.
• No significant differences were found between treated items and correct naming pre-treatment.

DISCUSSION

• The results varied across participants, with changes in both ipsi-lesional and contra-lesional activity associated with naming of successfully treated items compared to incorrectly and correctly named items pre-treatment.
• However, all five participants showed decreased right temporal activity associated with successfully named items treated using PCA, compared to incorrectly named items.
• Decreased activity may represent increased efficiency of these regions following treatment.
• Additionally, both participants classified with Conduction type aphasia showed increased peri-lesional activity with naming items treated with PCA compared to incorrectly named items, as well as increased right hemisphere contra-lesional activity associated with naming items treated with SFA.
• Increased activity associated with successful treatment may represent the recruitment of additional regions which were not already recruited to perform the task following treatment.
• Three of the five participants showed no significant differences between successfully treated items and correctly named items pre-treatment, which suggests that treated items were activating a pre-existing language network.
• Overall, the results suggest that different approaches to naming therapy may rely on different underlying mechanisms, and may also differ depending on an individual’s lesion site and type of language impairment.

REFERENCES


Contact: s.vanhees@uq.edu.au