Something to talk about: Enhancement of linguistic cohesion through tdCS in chronic non fluent aphasia

Marangolo (2014)

Hiba Suleiman

37-977-01

Acquired language and reading impairments
To investigate whether cohesion analysis can be used to evaluate changes in the language of individuals with chronic nonfluent aphasia after an intensive rehabilitation treatment based on a Conversational Therapy approach.
Hypothesis

Aphasic patients engaged in conversational settings tend to use egocentric speech and do not tailor their utterances to avoid ambiguity for their addressee.
What is Aphasia?

Aphasia is an acquired disorder of language that results from damage to portions of the brain that are responsible for language. For most people, these are areas on the left side (hemisphere) of the brain.

What types of aphasia are there?
fluent and non-fluent.
Transcranial Direct Current Stimulation (tDCS)

- **What is tDCS**
  - Non-invasive, painless brain stimulation
  - Constant, low-intensity DC by 2 electrodes

- **Types of Stimulation**
  - Anodal: Excites neural activity
  - Cathodal: Inhibits neural activity

- **Advantages**
  - Cheap, non-invasive, painless and safe
  - Easy to administer and equipment is portable
cohesive devices: “reference”

- Exophoric reference- (e.g., “Put it here” or “I don't believe it”).

- Endophoric reference –
  * lexical repetitions (e.g., “I saw a boy in the garden. The boy was climbing a tree”)
  * Anaphoras “he [the boy] was about to fall”),
  * Cataphoras “I had told him, but Marco did not listen to me”),
  * lexical substitutions (e.g., “I was worried about the child [the boy])
  * ellipses “I ran 5 miles on the first day and 8 [miles] on the second)
  * conjunctions (e.g., “and”, “or”)  
  * words sharing some semantic relation with previously uttered lexical items (e.g., “The little man [the boy] was climbing a tree”)
Background

- Non fluent aphasic individuals tend to produce fewer (and shorter) complex sentences with a general reduction of information.

- Cohesive ties might be used to distinguish among different syndromes.

- Noninvasive brain stimulation, such as transcranial magnetic stimulation (TMS) or transcranial direct current stimulation (tDCS), coupled with language training can exert beneficial effects in the treatment of naming deficits.
Participants

Control group
- Twenty healthy individuals (10 males and 10 females)
- Age (40 to 75 years)
- Education level (13 to 17 years)
- Native Italian speakers with no history of neurological or psychiatric illness
Participants

Aphasic group

- Eight participants (5 males and 3 females)
- left hemisphere stroke
- native Italian proficiency
Neuropsychological Assessment

Their linguistic skills were assessed using standardized language tests (the Battery for the analysis of aphasic disorders, BADA and the Token test).

They were also administered a Neuropsychological Battery, which excluded the presence of attention and memory deficits that might have confounded the data.
<table>
<thead>
<tr>
<th>Subjects</th>
<th>Sex</th>
<th>Age</th>
<th>Ed. Level</th>
<th>Time post-onset</th>
<th>Type of aphasia</th>
<th>Attentional abilities (scores in percentile &gt; 5 unimpaired)</th>
<th>Memory</th>
<th>Token Test (correct responses)</th>
</tr>
</thead>
</table>
| B.C.     | F   | 63  | 8         | 3 Year and 5 months | Non fluent | Alertness (tot): 80  
Sustained Att (tot): 81  
Selective Att (tot): 57 | WM (cut/off 5 ± 2)  
STM (cut/off 7 ± 2)  
LTM (cut/off 5.5) | 16/36 |
| F.S.     | F   | 71  | 5         | 1 Year and 8 months | Non fluent | Alertness (tot): 30  
Sustained Att (tot): 25  
Selective Att (tot): 35 | WM: 5  
STM: 6  
LTM: 11 | 22/36 |
| P.C.     | M   | 65  | 9         | 1 Year 7 Months   | Non fluent | Alertness (tot): 59  
Sustained Att (tot): 75  
Selective Att (tot): 55 | WM: 4  
STM: 6  
LTM: 12 | 9/36  |
| P.F.     | M   | 44  | 13        | 7 Years          | Non fluent | Alertness (tot): 99  
Sustained Att (tot): 66  
Selective Att (tot): 84 | WM: 5  
STM: 7  
LTM: 13 | 17/36 |
| A.C.     | M   | 64  | 13        | 4 Years 5 Months | Non fluent | Alertness (tot): 20  
Sustained Att (tot): 24  
Selective Att (tot): 18 | WM: 4  
STM: 6  
LTM: 6  | 19/36 |
| N.M.     | F   | 65  | 13        | 3 Years 7 Months | Non fluent | Alertness (tot): 97  
Sustained Att (tot): 68  
Selective Att (tot): 86 | WM: 6  
STM: 6  
LTM: 11 | 18/36 |
| P.M.     | M   | 52  | 13        | 1 Year 2 Months  | Non fluent | Alertness (tot): 87  
Sustained Att (tot): 52  
Selective Att (tot): 63 | WM: 5  
STM: 5  
LTM: 11 | 12/36 |
| R.L.     | M   | 61  | 11        | 4 Years 7 Months | Non fluent | Alertness (tot): 96  
Sustained Att (tot): 57  
Selective Att (tot): 52 | WM: 5  
STM: 6  
LTM: 12 | 10/36 |
Procedure

Prior to the experiment, the five videoclips and the cartoons were shown to the control group. Each subject was asked to freely describe each context accurately, with no interference from the examiner. Each language sample was tape-recorded and transcribed verbatim.
Experiment

They were administered five short videoclips representing everyday life contexts and two picture description tasks. Three videoclips were used to elicit spontaneous conversation during the treatment, while the remaining tasks were presented to the patients only before and after the therapy.
Language treatment

- At the beginning and at the end of the treatment sessions, all patients were asked to describe the correspondent videoclip without the therapist's help.

- Both patient and therapist were left free to use any communicative means (e.g., gestures, drawings, orthographic or phonological cues) to exchange salient information about the videoclip.

- At the beginning and at the end of each experimental condition, the participants were readministered the language tests and asked to describe the three G-videoclips and the cartoon-picture stories without the therapist's support.
<table>
<thead>
<tr>
<th></th>
<th>Anaphoras</th>
<th>Conjunctions</th>
<th>Ellipses</th>
<th>Word repetition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartoons Flower pot</td>
<td>5 (73)</td>
<td>4 (72)</td>
<td>5 (71)</td>
<td>3 (72)</td>
</tr>
<tr>
<td>Quarrel</td>
<td>5 (72)</td>
<td>6 (74)</td>
<td>3 (73)</td>
<td>3 (71)</td>
</tr>
<tr>
<td>G-Videoclips</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shopping at the supermarket</td>
<td>2 (71)</td>
<td>4 (73)</td>
<td>4 (73)</td>
<td>1 (71)</td>
</tr>
<tr>
<td>The housekeepers</td>
<td>3 (72)</td>
<td>3 (72)</td>
<td>10 (74)</td>
<td>0</td>
</tr>
<tr>
<td>T-Videoclips</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Around the city</td>
<td>6 (71)</td>
<td>11 (77)</td>
<td>20 (76)</td>
<td>0</td>
</tr>
<tr>
<td>At the seaside</td>
<td>3 (73)</td>
<td>11 (75)</td>
<td>5 (72)</td>
<td>1 (71)</td>
</tr>
<tr>
<td>At school</td>
<td>7 (73)</td>
<td>10 (75)</td>
<td>6 (71)</td>
<td>0</td>
</tr>
</tbody>
</table>
Results

- Only after Broca's stimulation, patients showed a greater improvement in producing words that enhanced the cohesion of their speech samples (i.e., pronouns, ellipses, word repetitions, conjunctions).
- Beneficial effects of the stimulation were generalized also to contexts presented to the patients at the beginning and at the end of the therapy sessions.
- The data confirm the key role of the left inferior frontal gyrus in binding words into a coherent speech.
- Positive tDCS effects may be further extended to different linguistic domains, useful to promote language recovery.
Discussion

• The main finding is that after the treatment the patients produced descriptions with an increased number of words and, most importantly, a more accurate use of cohesive devices.

• after the stimulation over the left inferior frontal gyrus, the patients’ ability to produce cohesive speech showed the greatest improvement.

• tDCS has enhanced the capacity of the left hemispheric spared areas close to the stimulated region to make compensatory plastic changes resulting in improved performance.
The linguistic outcome of non fluent aphasic patients can be successfully improved by coupling specific treatment approaches with tDCS.
Thank you!