# How aphasic listeners perceive different phonetic features

Dörte Hessler[1], Roel Jonkers and Roelien Bastiaanse

Center for Language and Cognition Groningen, University of Groningen, The Netherlands
The School for Behavioral and Cognitive Neurosciences

## Introduction

Speech perception is a multimodal process:

- using auditory **and** visual input (seen speech) (Rosenblum, 2008)
- in which seeing the speaker facilitates comprehension
  - in a noisy environment (Sumby & Pollack, 1954)
  - with demanding contents (Reisberg et al., 1987)
  - in aphasia (Shindo et al., 1991).

Phonetic features *place of articulation, manner of articulation* and *voicing* (the segments forming speech sounds (phonemes)) influence the perception of speech:

**Phonetic Features**

- *place of articulation*: e.g. /t/ vs. /p/
- *manner of articulation*: e.g. /t/ vs. /s/
- *voicing*: e.g. /t/ vs. /d/

- smaller differences (1 feat.) more difficult to detect than bigger ones (2 or 3 feat.) in English aphasic listeners (Blumstein et al., 1977)
- Features seem differently affected in aphasic listeners (Klitsch, 2008)
  - *place of articulation* seemed affected most
  - However: in the pre-existing materials used, *voicing* contrasts occurred initially (/pe:p/ - /be:p/) and the other contrasts finally (/lyp/ - /lyl/) or in metathesis (/syt/ - /tys/)

The current study investigates

- the influence of lip-reading on (aphasic) perception of speech
- whether Dutch aphasic subjects can also detect wider distinctions more easily than narrow ones
- which phonetic features are most vulnerable in aphasia if manipulated in the same position

## Method & Materials

**Task:**

- Nonword discrimination:
  - video's of speaker articulating 2 syllables
  - decision whether both syllables were same or different
  - button press (on response box) to answer
- 3 conditions of presentation
  - auditory only (AO)
  - visual only (VO)
  - audiovisual (AV)

**Materials:**

- phonologically possible but non-existing CVC-syllables
  - fixed place of difference (initial)
  - amount & type of features differing within a pair controlled (Fig. 1)

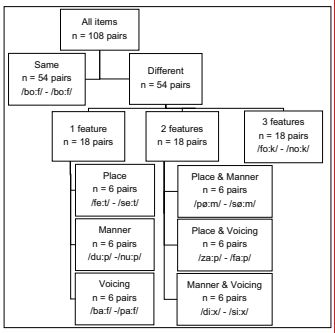


Figure 1: Schematic overview of material design (with examples)

## Participants

All participants are Dutch, right-handed, with normal hearing and (corrected to) normal vision

- 14 non-brain-damaged control subjects
  - with no neurological problems or (history) of language disorders
- 6 aphasic subjects with comprehension disorders (Details in Table 1)

| Initials | Age | Gender | Type of Aphasia | Months post onset | PALPA Nonword Discrimination | PALPA Word Discrimination |
|---|---|---|---|---|---|---|
| WB | 57 | male | Wernicke | 148 | 56/72 | 65/72 |
| BB | 64 | male | Global | 5 | 53/72 | 56/72 |
| EK | 48 | male | Amnestic | 16 | 58/72 | 70/72 |
| TB | 47 | female | Global | 8 | 68/72 | 70/72 |
| JH | 51 | female | Mixed | 44 | 66/72 | 67/72 |
| MB | 47 | female | Global | 4 | 64/72 | 65/72 |

TABLE 1: Overview of aphasic participants

## Results

**Control subjects:**

- scored at ceiling in AO and AV conditions
- worse in VO condition than AO or AV (concerning mainly *voicing* or *manner*) (Wilcoxon: $p<0.1$)

**Aphasic subjects:**

- worse than controls in all 3 conditions (Mann-Whitney-U: $p<.001$)
- performance differed between the 3 conditions (Friedman: $p<.01$): AV better than AO and VO, AO better than VO (Wilcoxon: $p<.05$)
- number of features differing within a pair matters in AO and AV conditions (Friedman: $p<.05$): least correct responses for 1 feature
- type of feature analysis (*place* vs. *manner* vs. *voicing*)
  - showed a significant influence for the AO condition (Friedman: $p<.01$) and a trend for the AV condition (Friedman: $p=.094$)
  - Contrasts in *voicing* appeared to be most difficult (Figure 2)

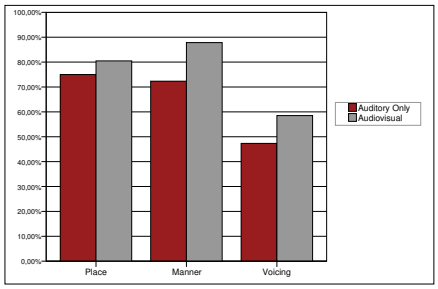


Figure 2: Percentage of correct aphasic responses to different features in auditory only and audiovisual conditions

## Discussion

- additional lip-reading improves perception
- most difficulties occur with small differences (1 feature)
- differences in voicing are most difficult to perceive (when differences are manipulated in initial position)

## References

Blumstein, S. E., Baker, E., & Goodglass, H. (1977). Phonological factors in auditory comprehension in aphasia. *Neuropsychologia*, *15*(1), 19-30.

Klitsch, J. (2008). Open your eyes and listen carefully. auditory and audiovisual speech perception and the mcgurk effect in dutch speakers with and without aphasia (Doctoral dissertation, University of Groningen). *Groningen Dissertations in Linguistics (GRODIL)*, *67*.

Reisberg, D., McLean, J., & Goldfield, A. (1987). Easy to hear, but hard to understand: a lipreading advantage with intact auditory stimuli. In B. Dodd & R. Campbell (Eds.), *Hearing by eye: The psychology of lipreading* (p. 97-114). London: Lawrence Erlbaum.

Rosenblum, L. D. (2008). Speech perception as a multimodal phenomenon. *Current Directions in Psychological Science*, *17*(6), 405-409.

Shindo, M., Kaga, K., & Tanaka, Y. (1991). Speech discrimination and lipreading in patients with word deafness or auditory agnosia. *Brain and Language*, *40*(2), 153-161.

Sumby, W. H., & Pollack, I. (1954). Visual contribution to speech intelligibility in noise. *The Journal of the Acoustical Society of America*, *26*(2), 212-215.

[1] *e-mail:* d.a.hessler@rug.nl *website:* http://www.doerte.eu