



The influence of speechreading on aphasic comprehension

Dörte Hessler

University of Groningen, Center for Language and Cognition Groningen

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- using auditory and visual input (Rosenblum, 2008)
- in which seeing the speaker facilitates comprehension



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- in which seeing the speaker facilitates comprehension
 - in a noisy environment (Sumby & Pollack, 1954)



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- in which seeing the speaker facilitates comprehension
 - in a noisy environment (Sumby & Pollack, 1954)
 - with demanding contents (Reisberg et al., 1987)



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- using auditory and visual input (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)



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- using auditory and visual input (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)
 - in normal comprehension (McGurk & MacDonald, 1976)





The McGurk Effect

McGurk effect = proof that auditory and visual information are both part of perception!

- Dubbing of different auditory and visual information
 - auditory: /ba/
 - visual: /ga/





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 - auditory: /ba/
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 - perception: /da/





The McGurk Effect

McGurk effect = proof that auditory and visual information are both part of perception!

- Dubbing of different auditory and visual information
 - auditory: /ba/
 - visual: /ga/
 - perception: /da/
- can only be explained by influence of seen on heard speech!





Introduction Study 1 Study 2 Studies 1 & 2 Discussion & Conclusion

McGurk Example

Example video can be found at:

http://ilabs.washington.edu/kuhl/research.html#Auditory-Visual



Models

Auditory perception in neuropsychological models:



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Phonetic Features

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Every phoneme consists of 3 phonetic features:

- place of articulation(/t/ vs. /p/)
- manner of articulation (/t/ vs. /s/)
- voicing (/t/ vs. /d/)

Phonemes can differ in 1, 2 or all 3 features:

- house mouse (3 features)
- lice mice (2 features: place & manner)
- key pea (1 feature: place)
- bath path (1 feature: voicing)





Phonetic features II

Phonetic features influence the perception of speech:

 smaller differences (1 feature) more difficult to detect than bigger ones for English aphasic listeners (Blumstein et al., 1977)



Phonetic Features III

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Features seem differently affected in Dutch aphasia (Klitsch, 2008)

- place of articulation seemed most affected
- but: material used (PALPA, Dutch Version) not designed to investigate that difference:
 - voicing contrasts occured initially
 - other contrasts finally or in metathesis
- Csépe et al. (2001) found for Hungarian that voicing was most affected



Introduction Study 1 Study 2 Studies 1 & 2 Discussion & Conclusion

Voicing I

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Distinctions in Voicing:

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Voicing II

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Voicing Distinctions in Dutch, Hungarian and English¹:



¹taken from Lisker & Abramson (1964)



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Model of audiovisual perception (taken from Campbell (1988; 1990)):



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Campbell's model applied to the McGurk effect:









McGurk Effect and Aphasia

Campbell et al. (1990):

- 4 subjects with braindamage (1 with aphasia)
- aphasic subject had difficulties in auditory processing, lip-reading fine
- showed McGurk effect for consonants



McGurk Effect and Aphasia II

Youse et al. (2004):

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• 1 aphasic subject

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- problems identifying syllables in all conditions
- 100% McGurk responses (/di/), but



McGurk Effect and Aphasia II

Youse et al. (2004):

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1 aphasic subject

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- problems identifying syllables in all conditions
- 100% McGurk responses (/di/), but
- answer bias: answered /di/ almost always in all conditions





Introduction Study 1 Study 2 Studies 1 & 2 Discussion & Conclusion

McGurk Effect and Aphasia III

Klitsch (2008):

- 6 aphasic patients
- investigation of influence of lexical status
 - more McGurk responses if "input" = nonword & "output" = real word
- and age
 - aphasia = age-matched >students



My Study - Questions

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- which phonetic features are integrated in audiovisual processing
- how does AV-integration work in aphasic subjects
 - maybe less influence of visual information



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 - maybe less influence of visual information
 - or maybe even more?



My Study - Questions

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- which phonetic features are integrated in audiovisual processing
- how does AV-integration work in aphasic subjects
 - maybe less influence of visual information
 - or maybe even more?
- how is integration accomplished by the brain



My Study - Overview

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2 experiments and a pilot study:

• Pilot: Evaluation of material



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Introduction Study 1 Study 2 Studies 1 & 2 Discussion & Conclusion







My Study - Overview

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2 experiments and a pilot study:

- Pilot: Evaluation of material
- Discrimination Experiment
- Identification Experiment
- ERP Experiment



My Study - Overview

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2 experiments and a pilot study:

- Pilot: Evaluation of material
- Discrimination Experiment
- Identification Experiment



Materials

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Generally:

- nonwords with CVC(C) structure
- conditions: auditory only, audiovisual, visual only, McGurk
- recording of videos

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- male native speaker of Dutch
- quiet room
- audio via extra microphone
- editing of videos
 - each video: 3 seconds long, speaker 480 ms in rest position initially
 - removing of picture or sound for AO/VO conditions
 - dubbing of different AO & VO stimuli for McGurk items



Pilot Study - Results

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- amount McGurk answers comparable to Klitsch (2008)
- 4 (of 39) items without any McGurk response
- 7 items with comments about quality



Discrimination - Aims

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The current study investigates:

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





Discrimination - Procedure

Nonword discrimination task:

- videos of speaker articulating 2 syllables
- decision whether both were same or different
- button press to answer





Discrimination - Procedure

Nonword discrimination task:

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- videos of speaker articulating 2 syllables
- decision whether both were same or different
- button press to answer

3 conditions of presentation:

- auditory only (AO)
- visual only (VO)
- audiovisual (AV)







Discrimination - Procedure







Discrimination - Material

phonologically possible but non-existing CVC-syllables

- fixed place of difference (initial)
- amount and type of features differing within a pair controlled






Discrimination - Material













Discrimination - Participants

All participants:

- Dutch, right-handed, with normal hearing and (corrected to) normal vision
- \Rightarrow 14 non-brain-damaged controls
- \Rightarrow 6 aphasic subjects



Discrimination - Participants

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





Discrimination - Results

Control Subjects:

- scored at ceiling in AO and AV conditions
- VO worse than AO or AV (Wilcoxon: p<0.01)
 - concerning mainly voicing and manner





Discrimination - Results

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Control Subjects:

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- scored at ceiling in AO and AV conditions
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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 (Wilcoxon: p<.05)
 - AO better than VO (Wilcoxon: p<.05)



Discrimination - Results

| Condition | Controls | Aphasic subj. | Z-Score | p-value |
|-------------------------|----------------|----------------|---------|----------|
| | (avg. contect) | (avg. contect) | | |
| Auditory only condition | 99% | 87% | -3.521 | p < .001 |
| Audiovisual condition | 99% | 90% | -3.545 | p < .001 |
| Visual only condition | 83% | 63% | -3.387 | p < .001 |





Discrimination - Results

Performance of aphasic listeners in 'different' condition:

| Condition | Same (avg. correct) | Different (avg. correct) |
|-------------------------|------------------------|-----------------------------|
| Auditory only condition | 94% | 80% |
| Audiovisual condition | 94% | 85% |
| Visual only condition | 78% | 48% |





Discrimination - Results



Statistic analyses with Wilcoxon, 2-tailed: *:p<.05





Discrimination - Results



- type of feature analysis (place vs. manner vs. voicing):
 - significant influence for the AO condition
 - a trend for the AV condition
- \Rightarrow contrasts in *voicing* were most difficult

Statistic analyses with Friedman Anova: **:p<.01; #:p=.094





Discrimination - Results

Individual Results:

| Initiala | A | uditory o | nly | - | Audiovisu | al |
|---------------|-------|-----------|---------|-------|-----------|---------|
| mutais | Place | Manner | Voicing | Place | Manner | Voicing |
| WB (Wernicke) | 100% | 100% | 50% | 83% | 100% | 67% |
| BB (Global) | 50% | 50% | 17% | 67% | 60% | 17% |
| EK (Amnestic) | 83% | 67% | 67% | 83% | 100% | 17% |
| TB (Global) | 67% | 100% | 50% | 100% | 100% | 83% |
| JH (Mixed) | 100% | 67% | 83% | 100% | 100% | 67% |
| MB (Global) | 50% | 50% | 17% | 50% | 67% | 100% |





- additional lip-reading improves performance
 - replicating results of e.g. Shindo et al. (1991)





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- additional lip-reading improves performance
 - replicating results of e.g. Shindo et al. (1991)
- most difficulties occur with small differences
 - as previously shown by Blumstein et al. (1977) for English





Differences in voicing are most difficult to perceive

- contrary to Klitsch (2008) \rightarrow but: difference in materials
- in line with the results for Hungarian by Csépe et al. (2001)





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Differences between *place of articulation* and *voicing*:





Differences in voicing are most difficult to perceive

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Differences between *place of articulation* and *voicing*:

- place of articulation is conveyed by spectral cues
- *voicing* is conveyed by temporal cues





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Differences in voicing are most difficult to perceive

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Differences between *place of articulation* and *voicing*:

- place of articulation is conveyed by spectral cues
- *voicing* is conveyed by temporal cues
- \Rightarrow This difference could explain the different performance



Identification - Aims

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- replicate previous findings: McGurk also in Aphasia
- show that identification benefits from lip-reading
- determine probability McGurk in specific patient group





Identification - Procedure







Identification - Material









Identification - Example

Small experiment





Your Results

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| Participant | /t/ | /p/ | /k/ |
|-------------|----------|----------|----------|
| 1 | 0,22 | 0,27 | 0,5 |
| 2 | 0,05 | 0,27 | 0,66 |
| 3 | 0,55 | 0,11 | 0,33 |
| 4 | 0,16 | 0,44 | 0,38 |
| 5 | 0,44 | 0,11 | 0,44 |
| 6 | 0,61 | 0,05 | 0,33 |
| 7 | 0,33 | 0,33 | 0,33 |
| 8 | 0,22 | 0,33 | 0,44 |
| 9 | 0,27 | 0,44 | 0,27 |
| 10 | 0,22 | 0,11 | 0,66 |
| 11 | 0,83 | 0,11 | 0,05 |
| 12 | 0,33 | 0,22 | 0,44 |
| 13 | 0,27 | 0,16 | 0,27 |
| mean | 0,346154 | 0,226923 | 0,392308 |

t (McGurk) p (auditory k (visual)







Identification - Participants

- same controls as in discrimination
- 5 patients, namely:

| Initials | Age | Gender | Type of Aphasia | Months post onset | PALPA Nonword Discrimination |
|----------|----------------|--------|-----------------------|----------------------|------------------------------------|
| WB | 57 | male | Wernicke | 148 | 56/72 |
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| *DM | 67 | male | Mixed | 10 | 56/72 |







Identification - Results







Identification - Results







Identification - Reaction Times

Evaluation of the reaction times:

- between conditions
- between given answers in McGurk condition
- Only data of 3 aphasic participants...





Identification - Participants

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Results I

| | Auditory Only | | Audiovisual | McGurk (per answer type) | | |
|--------------------|-------------------|----------------------------|-------------|--------------------------|--|--|
| Initials | correct | RT | | | | |
| WB EK JH | 53% 59% 55% | 2176ms 2718ms 2755ms | | | | |
| Controls (mean) | 99% | 1462ms | | 1 | | |

Results and reactiontimes for the three conditions

• Visual only condition: worse than AO for each participant



Results I

| | Auditory Only | | Audiovisual | | McGurk (pe | r answer type) |
|--------------------|-------------------|----------------------------|-------------------|----------------------------|------------|----------------|
| Initials | correct | RT | correct | RT | | 1 |
| WB EK JH | 53% 59% 55% | 2176ms 2718ms 2755ms | 73% 76% 89% | 1674ms 2516ms 2353ms | | |
| Controls (mean) | 99% | 1462ms | 100% | 1422ms | | |

Results and reactiontimes for the three conditions

• Visual only condition: worse than AO for each participant



Results I

| | Audito | ry Only | Audio | ovisual | | Mc | Gurk (per | answer ty | pe) | |
|--------------------|-------------------|----------------------------|-------------------|----------------------------|-------------------|----------------------------|-------------------|----------------------------|-------------------|----------------------------|
| Initials | correct | RT | correct | RT | McGur Amount | k (/t/) RT | Auditor Amount | y (/p/) RT | Visual Amount | (/k/) RT |
| WB EK JH | 53% 59% 55% | 2176ms 2718ms 2755ms | 73% 76% 89% | 1674ms 2516ms 2353ms | 50% 18% 39% | 1989ms 1912ms 2565ms | 23% 46% 39% | 2316ms 2061ms 2718ms | 27% 36% 22% | 2195ms 2297ms 2693ms |
| Controls (mean) | 99% | 1462ms | 100% | 1422ms | 22% | 2021ms | 33% | 1650ms | 45% | 1644ms |

Results and reactiontimes for the three conditions

• Visual only condition: worse than AO for each participant



Results II

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*: Mann-Whitney-U Test, p<.05

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Results II

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*: Mann-Whitney-U Test, p<.05





Results II

赏



*: Mann-Whitney-U Test, p<.05

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Results II

赏



*: Mann-Whitney-U Test, p<.05







Results - Summary I

- Aphasic subjects perform worse in AO and AV condition than nbd-controls
- Aphasic subjects answer slower in all three conditions
- Aphasic subjects show improved performance in AV condition compared with AO condition
- Faster reactiontimes on AV than AO for aphasic subjects





Results - Summary II

Analyses within McGurk condition:

- Occurence of answertype:
 - non-brain-damaged controls: visual > auditory > fusion
 - aphasic subjects: no significant difference for either subject
- Reactiontimes in respect to answertype:
 - non-brain-damaged controls: sign. increase when fusion-response
 - aphasic subjects: no influence of answertype




Discussion - Proposal

Reactiontimes on fusion percepts

- Nbd-controls slower on fusion than other responses...
 - ... because of additional resources needed!
 - Despite fusion they access unimodal information (Soto-Faraco & Alsius, 2007, 2009)
 - Accessing unimodal information prior to fusion could be the factor that slows down!
- Aphasic subjects might rely solely on automatic multimodal processing without access to unimodal information!
- Therefore no slowdown would occur!





Introduction Study 1 Study 2 Studies 1 & 2 Discussion & Conclusion

Correlations - Results



All correlations are significant! (Spearman: AO: p=.019; AV: p=.001; VO: p=.031)

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Correlations - Discussion

Results of both experiments correlate with each other! However: Improvement by lip-reading (discrimination) does not correlate with McGurk amount(Identification), but... not enough participants yet!



Summing up...

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Aphasic subjects have problems in perception:

- more with AO than AV stimuli (Ident. & Discr.)
- increasingly with smaller differences (Discr.)
- especially of 'voicing' (Discr.)

McGurk is comparable to healthy subjects regarding pattern (Ident.),

• but reaction times differ and suggest different processing strategy





...and looking forward

At the moment: ERP-study to investigate the brain activity during audiovisual integration!







Questions & Comments

Thank you for your attention! e-mail: d.a.hessler@rug.nl website: www.doerte.eu