

# Online Comprehension of Anaphor and Pronoun Constructions in Broca's Aphasia: Evidence from Eyetracking

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## Summary

### Comprehension probes

•Aphasic individuals equally impaired in comprehension of anaphor and pronoun constructions.

### Eyetracking

•Normal controls and correct aphasic trials showed **similar** pattern of eye movements for both anaphor and pronoun constructions.

- Increase in looks to the target in the **PP region**.
- Maintain fixations to target at sentence end.
- No delay for aphasic subjects.

•Aphasic subjects showed a different pattern for incorrect trials.

- Increase in looks to the target in the **pro region**.
- Increase in looks toward competitor sentence end
- No delay

## Conclusion

Broca's aphasics exhibited

•**Deficits in comprehending anaphor/pronoun constructions.**

•**Intact automatic coreference processing**

•**No delay in processing**

•**Different eye-movement pattern at end of sentence in incorrect trials.**

Aphasic comprehension deficit with anaphor/pronoun construction seems

- Not** due to a delay in syntactic processing
- Not** due to a deficit in automatic coreference processing
- Possibly due to deficit in integrating thematic information. (Nakano and Blumstein, 2003) or deficit in post-lexical integration process (Hagoort, 1997).

Close relation between online and offline tasks.

- Impaired comprehension reflected in eye-movements

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## Introduction

### Agrammatic Comprehension

- Mild comprehension deficits in Broca's aphasia
- Comprehension deficits largely limited to syntactic movement structures (Grodzinsky, 1995; Thompson et al., 1999; Swinney & Zurif, 1995)

### Theories of Agrammatic Comprehension

- Representational account
  - Trace deletion hypothesis (Grodzinsky, 1995)
- Processing account
  - Slowed syntactic processing (Burkhardt et al. 2003)

### Agrammatic comprehension deficits may extend to anaphor (e.g. *himself*) and pronoun constructions (e.g. *him*)

<Table 1> Results of studies testing anaphors and pronouns in Broca's aphasia

	Jarema et al. (1994)	Grodzinsky (1995)	Love et al. (1998)	Avrutin et al. (1999)	Pinango & Burkhardt (2001)
Anaphor		✓	X		X (delay)
Pronoun	X	X	X	X	
Task	Sentence-picture	Sentence-picture	Sentence-picture CMLP	Sentence-picture	CMLP

Problems:

- Mostly off-line tasks: indirect evidence.
- Cross-modal lexical priming (CMLP): Priming possibly impaired in Broca's aphasia.

### Coreference processing

- Movement and anaphor/pronoun constructions both involve coreference processing

The man<sub>i</sub> shaved himself<sub>i</sub>.  
Who<sub>i</sub> did the man shave t<sub>i</sub>.

→Agrammatic comprehension deficits can possibly be due to a deficit in coreference processing.

## Research Questions

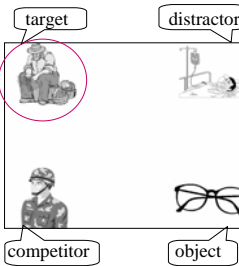
1. Are aphasic individuals able to process and comprehend anaphor and pronoun constructions?
2. If there is a deficit, what is the pattern of deficit?
  - Is there a delay in processing?
  - Are anaphors and pronouns equally impaired?
3. Do aphasic individuals show differences in performance between online and offline tasks?
4. Which account of agrammatic comprehension can explain the deficit patterns in Broca's aphasia?

## Methods

- An off-line comprehension probe task and an online eyetracking task were tested in the same experiment.
  - Eye-movements were monitored by an ASL remote eyetracker during simultaneous auditory story and visual stimuli presentation.
  - Comprehension probes asked at end of each story
- 3 story conditions: anaphor, pronoun, filler (n=20 each)

### Task and Predicted Pattern

#### Visual Stimuli



#### Auditory stimuli

Story  
Some soldiers and farmers were in a house.  
A soldier told the farmer with glasses to shave **himself** in the bathroom.  
And he did.

Comprehension Probe  
Did the farmer shave the soldier in the bathroom?

We expected subjects to look at the correct antecedent (target), which is the farmer on hearing the anaphor, himself.

Expected regions

<Table 2> Sentence regions

		V	pro	PP	200ms
Anaphor	The soldier told the farmer	shave	himself	in the bathroom	...
Pronoun	with glasses to	shave	him	in the bathroom	...

- Eye movements to each item on the visual panel were compared across sentence regions.

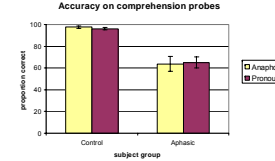
### Subjects

- 8 Broca's aphasic individuals (Age: 35-78; WAB AQ: 62.0-84.2; 1-14 years post onset)
- 8 age-matched controls (Age: 34-76)
- 12 young normal controls (Age: 18-28)

\*Note: The two normal control groups showed no statistical difference in both comprehension probes and eyetracking. Therefore, the two groups were analyzed as one group.

## Results

### Comprehension probes:



Control subjects > Aphasic subjects  
 $t(27)=7.775, p<.001$  for anaphors,  $t(27)=8.960, p<.001$  for pronouns  
Aphasic subjects: anaphors = pronouns.  
 $t(7)=.306, p=.769$  (paired t-test)

### Patterns of eye movements:

#### Object Control

ex) A soldier told the farmer with glasses to shave himself/him.

the farmer is the subject of shave

Overall, subjects showed more fixations toward the **object** of the matrix verb (*the farmer*) in the regions of interest. (target for anaphors and competitor for pronouns).

Hence, we analyzed the **increase in fixations** in each region.

