Scope ambiguity in Broca’s aphasia: A comparative approach

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LCQ, Budapest 2015
The overall project

- Syntax and beyond in Broca’s aphasia
- Comparative approach
Focus of today

• Comprehension of ambiguous sentences with every and negation

(1) Every elephant didn’t collect coconuts

a. No elephant collected coconuts (every>not)

b. Not every elephant collected coconuts (not>every)
Focus of today

- Comparing Individuals with Broca’s aphasia (BAs) to
  - Neurotypical adults (TAs)
  - 4-6 year old children
Main goals
First goal

1. To shed light on the nature of the comprehension impairment in BA

• Novel data

• Specific deficit vs. Domain general deficit

• A comparative approach
Main results: first goal

• BAs performed significantly worse on the IS condition than the SS condition
Discussion: first goal

- We discuss how this result relates to the specific-general debate in a non-trivial way

- it can be straightforwardly accounted for by a specific-deficit account

- it is compatible with a general account, but only if we assume an asymmetry between the two readings
Second goal

2. Investigate which aspects of scope ambiguity resolution are specific to acquisition

- Learnability (e.g. Moscati et al 2015) vs. pragmatics/processing

- Role of implicatures in interpreting every-negation sentences (Musolino and Lidz 2006)
Main results: second goal

- Both BAs and children showed worse performance on IS
- TAs behaved in the same way in the two conditions
Discussion: second goal

- BAs and Children behaviour was parallel and different from that of TAs

- This suggests
  - an explanation not based on learnability constraints
  - implicatures do not play an important role contra Musolino and Lidz (2006)
  - a unified explanation of the behaviour of both populations
Today

• Background
  • Scope ambiguity
  • Broca’s aphasia
  • Acquisition

• Experiment

• Results

• Discussion

• Conclusions and implications
Background
Scope ambiguity: Quantifier-neg interactions
Quantifier-Neg interactions

• Sentences containing scope-bearing elements often associated with more than one meaning

• One particular case: Every and negation

(2) Every elephant didn’t collect coconuts

a. No elephants collected coconuts ($\forall > \neg$)
b. Not every elephant collected coconuts ($\neg > \forall$)
Quantifier-Neg interactions

• Theoretically there have been different ways of capturing the difference between these two readings

• One traditional approach assumes a *covert displacement operation* (e.g. QR/reconstruction) (e.g. May 1977, 1985, Fox 2000)
Quantifier-Neg interactions

SS involves QR of the subject into Spec TP

For IS we then need to ‘reconstruct’ the subject under negation
Quantifier-Neg interactions

• Under most accounts, the only difference between the two readings is in the grammatical operations involved (e.g. May 1977, 1985, Fox 2000, Reinhart 2006)

• In the account sketched this difference is that only the IS reading involves an extra grammatical operation (e.g. reconstruction)
Broca’s aphasia
Broca’s aphasia

- Well-documented difficulty with ‘complex’ grammatical constructions
- Most research has focused on overt movement
- Initial debate
  - Grammar vs. processing
Broca’s aphasia

- Difficulties dissociating the predictions of the two accounts
Broca’s aphasia

• More recently, 2 major ways of accounting for this

• **Specific processing deficit** affecting grammatical operations (e.g. Grodzinsky 2000, Avrutin 2006, Burkhardt et al 2008)

• **General processing deficit** affecting cognitive resources more globally (e.g. Dick et al 2000, Caplan and Hildebrandt 1988, Caplan et al 2007a, b)
Why scope ambiguity?

Novelty

- Same lexical items
- Only variable is a difference in the grammatical operations between the two readings
- The relevant operation is not directly related to
  - \textit{theta role assignment}
  - \textit{changes in surface word order}
Why scope ambiguity?

- Very little research on scope ambiguity in BA
- **Recent study**: Varkanitsa et al (2012) showed that BAs could access SS and IS of doubly quantified sentences (in fact they accepted IS more than TAs)
- No research on sentences involving *every* and negation
Acquisition
Why the comparison?

• Looking at ‘non-typical’ populations can tell us something that TAs often cannot

• Children do not appear to consistently access both readings of sentences with *every* and negation (e.g. Musolino 1998, 2000)

• TAs on the other hand can access both the SS and IS reading
Why the comparison?

• Both BAs and Children show similar limitations in linguistic performance but differ developmentally.

• Comparing these populations can:
  • illuminate which aspects of children’s performance are specific to acquisition;
  • help to constrain our hypotheses about comprehension breakdown in BA.
Why the comparison?

Musolino (1998, 2000)

(3) Every horse didn’t jump over the fence ($\forall \neg, \neg \forall$)

Context: 2 out of 3 (IS reading)

- Adults accept
- Children reject
Acquisition

Initial conclusions: Children’s grammars do not generate IS

- ‘Observation of isomorphism’
- children rely on surface scope in resolving scope ambiguities (e.g. Musolino 2008, Musolino et al. 2000, O’Grady 2013)
Acquisition

• Later research indicated that under careful contextual manipulation, children can access IS (e.g. Hulsey et al 2004, Gualmini 2004, Gualmini et al 2008)

• An account based on grammatical differences was no longer tenable

• Pragmatic factors are now assumed to play a crucial role in scope assignment
Acquisition

The role of pragmatics

- Performance of children on IS and SS is due to non-grammatical factors (Gualmini et al 2008, Musolino and Lidz 2003)

- Felicity of negative sentences
- Principle of Charity
- Question Under Discussion
Acquisition

The role of pragmatics

• The QAR model (e.g. Gualmini et al 2008)
  • Children prefer interpretations that are a ‘good’ answer to the QUD
  • In previous studies the IS interpretation was not a good answer to the salient QUD
Acquisition

The role of pragmatics

• We control for three pragmatic factors argued to play a crucial role in children’s (and adults’) performance on every-neg sentences

  • Felicity of negative sentences
  • Principle of Charity
  • Question Under Discussion
Acquisition

• In recent times, the difference between children and adults is explained either by **pragmatics alone** (e.g. the QAR model) or **pragmatics plus**

  - Learnability considerations
  - Processing mechanisms
Learnability

- Children always start from the logically strongest reading (e.g. Moscati and Crain 2014, Moscati et al 2014)
- In this case the logically stronger happens to be the SS reading
  - $\text{every} > \text{not} \rightarrow \text{not} > \text{every}$
Acquisition

• We know an account based on *learnability* cannot extend to BA in a straight forward manner
Acquisition

Pragmatics/processing

• One such account proposes a role for implicatures in quantifier-negation sentences (Musolino and Lidz 2006)

• Opposite patterns for children and adults on IS

• Adults use implicature-type reasoning to reach the IS reading (and may even prefer it, see Musolino and Lidz 2002)
Acquisition

Musolino and Lidz (2006)

• Speaker says (a) instead of (b)
  
  (a) Every elephant didn’t collect coconuts
  
  (b) No elephant collected coconuts

• (b) corresponds to the SS reading so adults reason that the IS is true

• Adults but not Children are able to exploit this pragmatic strategy
Acquisition

- This result resonates with children’s performance with other implicatures e.g. Scalar implicatures
- Children are less likely than adults to compute scalar implicatures (e.g. Noveck 2001; Papafragou & Musolino 2003; Chierchia et al. 2004)
Contribution of BA

• If implicatures play a role we would expect BAs to also struggle with SIs
  • Previous study indicates BAs are like TAs and different from children on SIs
Previous study

‘Not all of the giraffes have scarves’

\[ \sim \textit{Some of the giraffes have scarves} \]

Children accept

\textbf{BAs and Adults} reject
Results: SIs

- BAs adult-like on SIs
Results and Conclusions

• Processes underlying implicature computation appear unimpaired in BA

• A story involving implicatures does not extend to BAs
Main goals
First goal

1. Shed light on the nature of the comprehension impairment in BA

- Novel data
- Specific deficit vs. Domain general deficit
- A comparative approach
Second goal

2. Investigate which aspects of scope ambiguity resolution are specific to acquisition

- Learnability vs. pragmatics/processing
- Role of implicatures in interpreting every-negation sentences
Design

- 2x3
- Condition (IS vs SS) vs Group (TAs vs BAs vs Children)
Participants

- 16 TAs
- 9 BAs
- 12 4-6 year old children
- All English speaking
Participants

• All BAs showed typical pattern of asymmetric performance on active/passives, subject/object clefts
Design

- 20 test trials (10 IS, 10 SS)
- 12 controls (4 QNT and 4 NEG in T and F contexts)
- 8 fillers
Methods and materials

• TVJT
• Context story + pictures
• Experimenter asks explicit QUD to a second experimenter
• Participants evaluate whether the target sentence is a true description of the context story
Example context story

‘The elephants are bored and they can’t decide what to do today. They can collect bananas or they can collect coconuts’
Test conditions: SS

‘In the end, all of the elephants decide to collect bananas and not to collect coconuts’
Test conditions: SS

QUD: Did every elephant collect coconuts?
Sentence: ‘Every elephant didn’t collect coconuts’

True!
(no! they collected bananas instead)
IS condition

‘In the end, some elephants decide to collect coconuts and some elephants decide to collect bananas’
IS condition

QUD: Did every elephant collect coconuts?

Sentence: ‘Every elephant didn’t collect coconuts’

True!
(no! some collected bananas)
Results
Results

Rate of acceptance of 3 groups on SS and IS conditions

- Main effect of group
- Main effect of condition
- No interaction (group x condition)
Results: first goal

BAs accept at a lower rate overall

NB: BAs could successfully accept and reject the control sentences in the relevant contexts
Results: first goal

However, they accepted significantly less on IS than SS condition.
Results: first goal

Difference was only marginally significant for TAs
Results: second goal

Both BAs and children accepted less on IS condition

BAs accepted less than children
Discussion
First goal

- BAs show a specific difficulty with the IS condition
- *Prima facie* this result appears more consistent with a **specific deficit account** of comprehension in BA
- Problem with covert movement operations (e.g. reconstruction)
First goal

• Parallels with previous work related to overt movement operations in BA

• Parallels with early grammatical accounts for acquisition (e.g. ‘Isomorphism’)

  - Although we know a grammatical account for children cannot be right!
First goal

Alternatively

- Our results could be compatible with a more general-deficit account if we assume that the SS is the initial parse (e.g. Musolino and Lidz 2006)

- This could explain the apparent preference/bias for SS for children and BAs
First goal

• Evidence that TAs show a processing bias for SS on doubly quantified sentences (e.g. Kurtzman & McDonald 1993, Marsden 2004 inter alia)

• however ? for every-neg sentences
First goal

- One expectation of a more general account is that BAs should also struggle with the IS reading on doubly quantified sentences.
  - Varkanitsa et al. (2012) appear to show that this is not the case.
First goal

• Alternatively, this could point to differences between doubly quantified vs. every-neg sentences (e.g. differences in underlying operations, QR vs. reconstruction)

• Interestingly, this difference has also recently been shown for children (e.g. Szendroi et al 2014, Kiss and Zétényi 2015)
Second goal

• Children and BAs struggle with IS hence this is not uniquely a developmental effect

• An explanation based on learnability constraints for children cannot extend to BAs

• unless we make assumptions connecting acquisition and loss of language
Second goal

• If implicatures play a crucial role in interpreting every\textgreater neg (e.g. Musolino and Lidz 2006) sentences we would expect BAs to be adult-like

• BAs can compute traditional SIs

• BAs struggle with IS

• This account does not extend to BA performance
Second goal

- Children’s performance was better on IS than previously found in studies not controlling for the QUD (replicating Gualmini et al 2008)

- However, children still access the SS reading more frequently than IS

- Pragmatics alone cannot fully account for this performance
A possible unified account

- A processing explanation based on difficulties with ‘reanalysis’ (e.g. Musolino and Lidz 2006, Lidz 2014) could provide a natural unified explanation of both BAs and children’s performance
A possible unified account

• Sketch

• SS is the initial default /parse for children and BAs (syntax or lexical bias)

• SS not compatible with the IS context

• ‘reanalysis’ requiring cognitive resources (e.g. WM)

• For TAs pragmatic factors can override initial parsing commitments e.g. based on surface structure
A possible unified account

• Potential differences in sensitivity to pragmatic/contextual manipulation for children and BAs

• For children, pragmatic manipulation facilitates re-analysis (e.g. Liz 2014)

• BAs rely on initial parse based on syntax/lexical cues

• Parallels with ‘canonicity effect’ for overt movement
Conclusions and Extensions
Conclusions

• Novel data on the interpretation of *every*-neg sentences in BA

• Traditional impairment with overt movement appears to extend to covert operations at the syntax-semantics interface
Conclusions: first goal

• On the face of it the results appear more consistent with a specific-deficit account

• However can be made compatible with a general-deficit account if we assume that SS is the initial parse
Conclusions: second goal

• Both BAs and Children show worse performance on IS:

  • A learnability-based account does not extend to BAs
  
  • An implicature-based account does not extend to BAs
Conclusions

• A unified processing account based on ‘re-analysis’ could potentially explain both BAs and children’s performance

• However we need additional assumptions on the role of pragmatics for these groups
Extensions

• Further research required to determine whether there are differences in terms of processing for the IS and SS readings of every-neg sentences

• Direct comparison with doubly quantified sentences to investigation potential differences
Thank you!