Movement vs. tree-size as predictor of difficulty for agrammatics: Evidence from Northern Norwegian aphasics

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Thanks to

• Naama Friedmann
Tree-size

  – Broca’s agrammatics’ have difficulties with certain sentence types because they fail to represent the higher part of the tree
  – Their trees are “pruned” above agreement projections
    • No CP or TP-projections
• This hypothesis concerns the “size” of the tree that the agrammatic speaker is able to project
Sentences that want large trees

• \([_{AgrP} \text{I ate ice cream}]\)
  – *That ice cream, \([_{AgrP} \text{I ate (it)}] \)*
  – *What have \([_{AgrP} \text{you eaten}]\)?*
  – *Did \([_{AgrP} \text{you eat ice cream}]\)?
Sentences that want large trees
Evidence

Wh-question:
Ma Miri mecayeret ti?
What Miri paints
“What does Miri paint?”

Correct: 13/100

Yes/no-question (intonation):
Miri mecayeret kivsa?
Miri paints sheep
“Does Miri paint sheep?”

Correct: 81/84

$\chi^2=127.16; p<<0.0001$

(Friedmann, 2002)
Alternative: Number of movements

• Verb movement in combination with XP-movement to SpecCP is harder than just XP-movement to SpecCP

• Bastiaanse & Thompson (2002):
  – Compared English vs. Dutch agrammatic production
  – Found that sentences which required verb-movement were significantly more impaired than sentences not requiring verb movement
  – Tree-size was not a factor
Two general alternatives

• **Tree-size** (generalization of Tree-Pruning)
  - Size of the tree matters and predicts production difficulties
    • E.g. sentences requiring CP harder than sentences requiring just TP, etc

• **Movements**
  - The number of movements required matters and predicts production difficulties
    • E.g. sentences requiring verb movement in addition to Wh-movement harder than just verb-movement sentences, etc
A test of the two theories

• Wh-questions in Northern Norwegian
  – differ along both tree size and the number-of-movements dimensions
  – 3 types: CP + V-movement; CP w/o V-movement, and C’ w/o V-movement

• The two theories can therefore be compared within-subject (within-language)
  – greater statistical power than group comparisons (between-language)
  – better experimental control
A. Large tree, 2 movements

- Adjunct questions and object questions with "heavy" Wh-phrases: "When did you arrive?"
B. Large tree, 1 movement

- Subject Wh-question: “Who arrived?”
C. Small tree, 1 movement

- Morphologically simple object question: “What did you say?”

- Special construction: Wh-word undergoes head movement to $C^0$ (Taraldsen, 1986)
The (small) size difference

One extra node!

A:

\[
\begin{align*}
&\text{DP} \quad \text{katti}_k \\
&\quad \text{C}^0 \quad \text{kom}_v \\
&\quad \text{DP} \quad \text{du} \\
&\quad \text{VP} \\
&\quad \text{VP}' \\
&\quad \text{AdvP} \\
&\quad \text{V}' \\
&\text{CP} \\
\end{align*}
\]

Wh-movement + verb movement

C:

\[
\begin{align*}
&\text{C}^0 \quad \text{ka}_i \\
&\quad \text{DP} \quad \text{du} \\
&\quad \text{VP} \\
&\quad \text{V}' \\
&\quad \text{DP} \\
&\quad \text{D}^0 \\
&\quad \text{t}_i \\
\end{align*}
\]

Only Wh-movement
Predictions

• *Tree-size theory predicts*

  A: 2 movements and a **CP**
  – Adjunct questions and object questions with V2

  B: 1 movement and a **CP**
  – subject questions with overt complementizer

  *should be harder than:*

  C: 1 movement and a **C’**
  – object questions without V2
Predictions

• *Movements theory predicts*

A: 2 movements and a CP
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*should be harder than:*

B: 1 movement and a CP
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C: 1 movement and a C’
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Experiment

• Subjects
  • 7 patients from rehabilitation center in Tromsø, Norway
  • classified as Broca’s by “Norsk Grunntest for Afasi“ (Reinvang & Engvik)
  • agrammatic speech
  • under 75 years

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Method

[Adapted from Friedmann (2000, 2002)]

• Elicitation task
  – Experimenter: “You want to ask what John had for dinner, so you ask: ......”
  – Subject: “What did John have for dinner?”

• Repetition task
  – simple repetition of target sentence

• Dependent measure
  – success or failure on individual trials
  – % correct calculated for repeated measures conditions
Materials

A: 2 movements and a CP
  • 12 elicitation/17 repetition trials of adjunct questions with V2
  • 10/18 trials object questions with V2

B: 1 movement and a CP
  • 20/18 trials of subject questions with overt complementizer

C: 1 movement and a C’
  • 20/18 trials of object questions without V2
Inferential statistics

• For ANOVA:
  – Data contains near-ceiling/floor effects for some conditions/subjects
  – percent correct data were transformed to “continuous” data scale
    • log-odds: take the natural logarithm of the odds of the percentages
      – Odds = percentage/(1-percentage)
Results

• ANOVA
  – Main effect of CONDITION
  – Main effect of TASK
  – Interaction TASK + CONDITION
Main effect CONDITION

ANOVA: $F(2,10)=5.3, \ p = .026$
Main effect CONDITION

ANOVA: F(2,10)=5.3, p = .026
ANOVA: $F(1,5)=7.85$, $p<.037$
Main effect of TASK

ANOVA: $F(1,5)=7.85$, $p<.037$
Main effect of TASK

• Discussion
  – increased performance in repetition task probably means that subjects repeat a string
  – elicitation is probably a better test of their “creative” syntactic abilities
  – Is there is interaction between task and condition?
F(2,10)=4.5, p=.039

TASK x CONDITION

No Verb Movement

Verb Movement

C'

CP

CP

elicitation

repetition
Discussion

- Given the interaction between task and condition, it is justifiable to analyze the two data sets separately.
Testing predictions

- **A**: 2 movements (Wh + V-mvt) and a CP
  - Adjunct questions and object questions with V2
- **B**: 1 (XP-) Wh-movement and a CP
  - Subject questions without V2
- **C**: 1 (X₀-) Wh-movement and a C’
  - Object questions without V2

Hypotheses expressed as orthogonal contrasts:
- \( H_{A\text{-treesize}} \): \( (A+B)/2 < C \)
- \( H_{A\text{-movements}} \): \( A < (B+C)/2 \)
Tree-size?

- Is performance on CP-questions \((A + B)\) worse than on C’-questions (“what you said”)?

\[
p = 0.08
\]

\[
p = 0.57
\]
Tree-size?

• Both tasks together:
  – $F(1,5)=4.37, \ p=0.09$
Number-of-movements?

• Is performance on questions with two movements (A) worse than questions with one movement (B & C)?

- p=.03
- p=.15
Number-of-movements?

- both tasks together:
  - $F(1,5)=6.96$, $p=0.045$
Discussion

• verb movement (in combination with Wh-movement) seems to have greater negative impact on production than mere tree size

• Caveat: statistical effects probably too dependent on individual subject effects

• Larger N?
  – More in-depth analysis of each subject (logistic regression models and HLM)
Further orthogonal contrasts

1. Vary just verb movement:
   Are CP+V2 harder than CP-V2?
   - Heavy object question vs subject questions
   - treesize: predicts no difference
   - movements: predicts a difference
1. Tree-size constant, vary V-mvt

CP subject questions without V2 vs. CP adj/obj questions with V2

p=.03

p=.22

Supports Movements theory!
Further orthogonal contrasts

2. Vary just tree-size:

Are CPs without V2 harder than C’ without V2?

- Subject questions vs light object questions
  - treesize: predicts a difference
  - movements: predicts no difference
2. V2 constant, vary tree-size

- subject (CP) vs light object questions (C’)
- No significant difference
2. Alternative interpretation

- tree size is in fact identical; Taraldsen-analysis of light object questions wrong (cf. Åfarli, 2000)
- but this analysis is not allowed by e.g. Optimality theory
Conclusions

• For Wh-questions
  – tree-size matters less for predicting agrammatic speakers production problems
    • But both properties could be relevant—results here could be related to low power
  – but verb movement, in particular in combination with XP-movement, is a significant factor
Declaratives

• Declaratives in Scandinavian: CP+V2!?
Declaratives

• Declaratives should be just as hard as the hardest Wh-questions

• However:
  – OT-like theories would postulate smaller structure for declaratives (Grimshaw)
Declaratives
Two different size declaratives?

- **Big declarative**
  - Same size string/types of words

- **Small declarative**

```
CP
  C
    C'
      VP
        V
          DP
            t_i
          V
            DP
              kaffe
              "coffe"
        VP
          V
            DP
              mye
              "a lot"
              QP
                V
                  "drinks"
                    DP
                      "drinks"
                      Klara_i
```
Movement in nominals

- NPs in Scandinavian:
  - Definite article is a suffix, N moves
  - Indefinite article is a word, no movement

jent+a
“girl+DEF” = “the girl”

ei jente
“a girl”
Movement in nominals

- **DP+movement:**

  \[
  \text{DP} \rightarrow \text{DP}
  \]

- **DP – movement:**

  \[
  \text{DP} \rightarrow \text{DP}
  \]

  same size, diff moves