The Influence of Prosody and Ambiguity on English Relativization Strategies

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Interdisciplinary Approaches to Relative Clauses, Sept07

SRCs vs. NSRCs

- The guy who/that likes me just smiled
- The guy who/that/0 I like e just smiled

Complexity:
Distance between ‘filler’ and ‘gap’
Unbounded dependencies potentially complex

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NSRCs and Ambiguity

- The guy who I think you want e? to succeed e? just smiled
- The guy who I want e? to think that the boss will succeed e?

succeed = win / replace, intrans / trans

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1. Linguistic Variation +
2. Language Acquisition +
3. Linguistic Selection =
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Linguistic Selection

1. Learnability – frequency, interpretability, learning bias...
2. Expressiveness – economy of production, memorability, prestige...
3. Interpretability – ease of perception, resolution of ambiguity...

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A Lexicon Fragment

who(m)	(N\N)/(S/NP)	
I	S/(S\NP)	
want	((S\NP)/NP)/VP	(S\NP)/VP
succeed	(S\NP)/NP	S\NP
...		

Combinatory Categorial Grammar

Forward Application (FA):

$X/Y\ Y \Rightarrow X \qquad \lambda\ y\ [X(y)]\ (y) \Rightarrow X(y)$

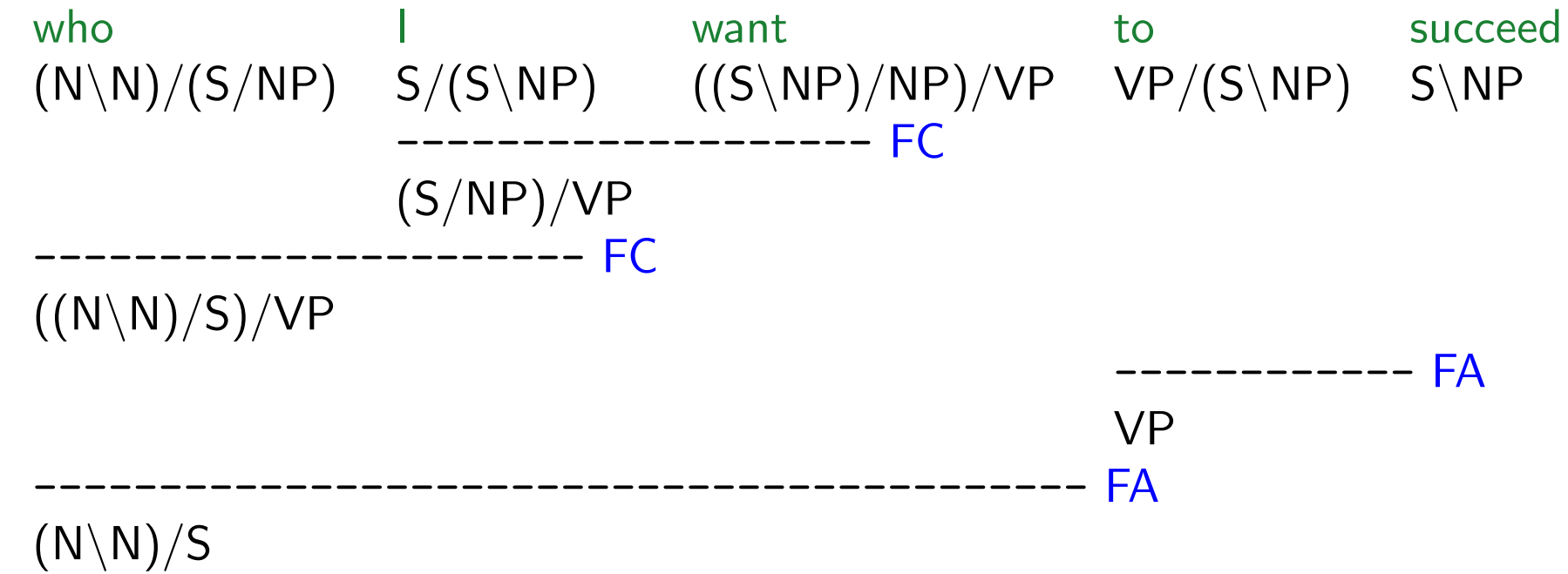
Backward Application (BA):

$Y\ X\backslash Y \Rightarrow X \qquad \lambda\ y\ [X(y)]\ (y) \Rightarrow X(y\ )$

Forward Composition (FC):

$X/Y\ Y/Z \Rightarrow X/Z \quad \lambda\ y\ [X(y)]\ \lambda\ z\ [Y(z)] \Rightarrow \lambda\ z\ [X(Y(z))]$

A Derivation



. . . who I want e to succeed

Parsability

Stack Cells		Lookahead	Input Buffer
2	1		
(who) (N\N)/(S/NP)	(you want) (S/NP)/VP S/VP	to VP/(S\NP)	succeed
Costs / cell			
4	2		

3 Shifts, 1 Reduce to reach this configuration

Onset of the shift-reduce ambiguity at the first potential gap

Working Memory Cost Metric

After each parse step (Shift, Reduce, Halt):

1. Assign any new Stack entry in the top cell (introduced by Shift or Reduce) a cost of 1 multiplied by the number of CCG categories for the constituent represented (Recency)
2. Increment every Stack cell's cost by 1 multiplied by the number of CCG categories for the constituent represented (Decay)
3. Push the sum of the current costs of each Stack cell onto the Cost-record (complexity at each step, sum = tot. Complexity)

Optimal Ambiguity Resolution

- Default Parsing Preference: Prefer Shift over Reduce when Lookahead item can be integrated with cell 1 by Reduce
- Predicts preference for more costly late gap analysis (contra Gibson, 1998)
- This is the optimal strategy if the extrasyntactic information required to override the default action is available at the onset of the ambiguity
- Other things being equal, we expect languages and usage to evolve via linguistic selection for Interpretability using the optimal strategy

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Structural vs. Lexical Preferences

- The guy who you wanted to give the present to Sue refused
- The guy who you asked to give the present to Sue refused

$P((S\backslash NP)/VP \mid want) >> P(((S\backslash NP)/NP)/VP \mid want)$

$P((S\backslash NP)/VP \mid ask) << P(((S\backslash NP)/NP)/VP \mid ask$

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Gibson '98 vs. Us

1. I gave the guy who you wanted e? to give the books to e? three books
2. The guy who you think you want e? to succeed e? just smiled

On-line resolution at onset + late gap predicts 1) GP, 2) not-GP
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Marking the 'outer' RC boundary

- I gave the guy who you wanted to give the books to tath three books
- I wouldn't give the guy who was reading tath three books
- I wouldn't give the guy who was reading three books tath another one

Resolves some ambiguity at cost of increased complexity if tath is (S|XP)\(N\N), as this introduces an additional unbounded dependency with the modifiee – not attested typologically (Kuno '74, Hawkins '94).

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- PBs occur at 'outer' ends of RCs (e.g. Venditti, Jun & Beckman '96)
- PBs are exploited on-line during interpretation (e.g. Warren '99)
- Actual gaps are always marked by PBs?
  - Intonational/Major PB if coincides with outer end (e.g. Nagel *et al.*, '94)
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Prosodic Predictions

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- (unambiguous NSRCs < ambiguous NSRCs)
- (short NSRCs < long NSRCs)

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BNC (90+10M) and SEC (50K)

- Automatically parsed (RASP)
- Extract and categorize wh-SRCs/NSRCs
- Manually analyse sample of that(-less) RCs
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Results

1. Ambiguous non-actual medial gaps not marked by PBs (35/35 egs)
2. Ambiguous actual medial gaps are marked with inter./minor PBs (39/40 egs)
3. SRCs/NSRCs: 6.9/1 (sp), 6.4/1 (wr), $\chi^2_1 = 3.2 p = 0.07$
4. Unambig/Ambig NSRCs: 4.4/1 (sp), 6.3/1 (wr), $\chi^2_1 = 1.61 p = 0.20$
5. Long/Short: av. lgth 2.81 (sp), 4.07 (wr), t-test, $p = 0.0005$

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1. Trade-off between en/de-coding (grammar) and inference
2. Parallel coding reduces ambiguity without increasing complexity or inference (predicting typological facts)
3. Optimal strategy creates linguistic selection for lgs & utts. which are organised to support it
4. On-line overriding of default late gap preference correctly predicts location of PBs in ambiguous NSRCs
5. Written and spoken usage reflects the predicted costs
6. Are ambiguous medial attachment NSRCs in writing resolved at onset by lexical, semantic or contextual information?
7. Direct testing of on-line processing of ambig. NSRCs with(out) appropriate PBs

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Not quite the end

Draft Paper: http://www.cl.cam.ac.uk/users/ejb1/rel-cls.pdf

Questions?