Phillips & Wong:
How the Parser Solves a Look-Ahead Problem
LSA, January 5th 2001

Island Constraints in Parsing: How the Parser Solves a Look-Ahead Problem
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POINT OF THE TALK

Certain parasitic gap constructions create a look-ahead problem, challenging the parser to sacrifice either accuracy or incrementality. We show that the parser gives up neither.

Island Constraints in Parsing

- Parser builds structure quickly and incrementally (e.g., Marslen-Wilson, 1973, 1975; Neville et al., 1991; Tanenhaus et al., 1995)
- Question: is parser grammatically accurate, as well as being fast?
- Relevance of island constraints: advanced proving ground for accuracy of parser
- Conflicting reports on how accurately parser implements island constraints
- Especially relevant for incremental grammatical models, which aim to minimize the distinction between grammar and parser (e.g., Phillips, 1996; Richards, 1999; Boeckx, 1999; Steedman, 2000; Kempson et al., 2001)

Parasitic Gaps

(1)

- Subject NPs are islands for extraction
- Parasitic Gaps: problematic parasitic gaps in complex subject NPs pose a look-ahead problem
- Parasitic Gaps are only supported in a subset of island environments, e.g. (5a), not (5b).
- Aside: many classic examples of parasitic gaps inside subject NPs involve relative clauses, which we have marked here as impossible. However, almost all examples of this kind involve relative clauses headed by quantificational NPs, e.g. a man who everyone who meets ends up fascinated with.
- Examples with definite NPs do not support parasitic gaps inside relative clauses (cf. Frampton, 1990). The reason for this quantifier/definite contrast remains somewhat mysterious.

- Parsing Problem: parasitic gaps in complex subject NPs pose a look-ahead problem – forming a wh-dependency involves crossing a syntactic island (Condition on Extraction Domains: Huang 1982), but the island violation may be rescued at a later point in the sentence.

- Fully incremental approach to parsing parasitic gaps (cf. Schneider, 1999): form dependencies across islands that may involve a parasitic gap, but do not mark the dependency as completed until after the island has been crossed.

- In order to give up neither full incrementality nor accuracy, parser must be:
- Risky – construct gaps inside islands that don't support parasitic gaps
- Not reckless – avoid constructing gaps inside islands that don't support parasitic gaps

- In normal situations, it is known that the parser actively searches for gap sites, e.g. an object gap will be constructed as soon as an applicable verb is encountered; in normal situations, it is known that the parser actively searches for gap sites, e.g. an object gap will be constructed as soon as an applicable verb is encountered. We show that the parser gives up neither.

Island Constraints in Parsing

How the Parser Solves a Look-Ahead Problem

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Contrary to the experimental subjects' never say a parasitic gap - they merely saw
overhead.

Figure 1: Mean Grammaticality Ratings for PG-related sentences

RESULTS

• Sentences with both a parasitic gap and an object gap were rated almost exactly the
same as sentences that contained only the object gap (PG-gap filled by an overt NP), when the PG-gap was inside an infinitival clause.

• PG-gap without O-gap rated much worse; combination of PG-gap and O-gap rated lower when PG-gap is in finite relative clause.

• Conclusion: the phenomenon is real.

SELF-PACED READING

Question: do speakers show evidence of actively creating a wh-dependency inside an island in exactly the environments where P-gaps will be licensed?

Participants: 56 U. of Delaware students (10 excluded for low comprehension scores)

Materials: 2 x 2 design (+finite x ±gap) 2x4 conditions, restricted set of nouns as heads of complex subject NP:

plan, scheme, request, campaign, attempt, bid, endeavor, lawsuit, temptation, power, evidence, efforts, idea

Critical verb immediately preceding parasitic gap site was always obligatorily transitive:

cheapen, embarrass, remove, nominate, alter, order, aid, preserve, entertain, heal, secure, destroy, rehabilitate, reclaim, liberate, remove, upset, impress, uplift, convict, instruct, astonish, develop, overprice.

Note: in the experiment subjects never saw a parasitic gap - they merely saw overhead.

Sentence initially appears as window display', Just et al. 1982). Reading time is the time between space bars (no possibility of back-tracking).

Reading Time of Sentence before Space bars (1) excluding low comprehension scores (5) excluding low comprehension scores (10). Place Ps near where parasitic gap could potentially occur.

Sentence: A parasitic gap could potentially occur.

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RESULTS

Comprehension accuracy: 87.8% on comprehension questions (~33 word sentences!) Analyses exclude trials on which comprehension question answered incorrectly; outlier residual reading times trimmed to 1000ms.

Figure 2: Residual Reading Times for PG Self-paced Reading Experiment

...to investigate what the local campaign to preserve the important habitats... 5         6           7      8     9           10     11
12
13
14            15

At verb inside complex subject (region 12):

Infinitive conditions: significant effect of gap/no-gap: (F1(1,45) = 4.02, p < 0.05; F2(1,35) = 5.01, p < 0.05)

Finite conditions: no difference between gap/no-gap conditions.

- Slowdown in reading times at verb reflects wh-dependency formation, but this only occurs in the infinitive conditions, where a P-gap is possible.
- Wh-dependencies are formed across islands – in exactly the ways that the grammar allows.

CONCLUSION: Structural analysis is fully incremental, and quite sophisticated!

- Caveat: this experiment found slowdown due to wh-dependency formation at the verb where the wh-dependency is created, rather than when it needs to be retracted at the following NP. Although this is not a 'filled-gap' effect per se, it is consistent with other results in the literature (e.g. Pickering et al. 1994).

Explaining Variability

- Does grammatical search in parsing respect island constraints immediately?

Yes!

Caveats:

- Freedman & Forster 1985 [sentence-matching] NP w/ possessor
- Neville et al. 1991 [ERP violation paradigm] NP w/ possessor
- Stevenson 1993 [comprehension, matching] complex NP

Studies with marginal results…


Conclusions:

- The kinds of island contexts examined in the different studies appear to be fairly good predictors of whether or not the island was immediately respected by the parser.
In studies testing milder islands, with similar acceptability ratings to our infinitival conditions, evidence of positing gaps inside islands is reported. In studies testing more severe islands, with acceptability ratings similar or lower than our finite conditions, evidence of gaps inside islands is typically not found. (9) Local: The observant resident saw who the local policeman arrested. Embedded: The cynical skeptic knew what the spiritual woman thought the psychic advisor saw. Complex NP + Possessor: The gymnastics coach saw what a talent scout had recognized Michelle's strength in. Complex NP: The dismayed manager was saddened to hear what the accountant admitted the fact that he needed. PP-in-Subject: The bookstore clerk knew who the new book about aimed to make respectable once again. Complex NP + RC: The steep mountain trails reminded the weary pioneers of what they already knew that it was the right time to leave behind in the valley.

Conclusions

• Parasitic gaps inside subjects pose a look-ahead problem for the parser – an interesting test of incrementality and/or accuracy.
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Relevance to Grammar-Parse Relations

The contrast between milder and more severe islands can also account for much of the variability in the results of previous studies of island constraints in parsing.

Does support notion that the parser is an extremely sophisticated implementation of the grammar.

Does support notion that all island constraints derive from constraints on the parser's search window – since this would predict no island violations.

But…

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References


