Estimating processing time of online semantic interpretation components

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Summary.

- ## Research context.
    Multiple levels of representation and time constrained processing.
    Natural language processing.

- ## Estimating processing time components of online semantic interpretation.
    Syntactic grouping and predicate structure composition.
    Reference identification.

Semantic interpretation and reference.

- Semantic interpretation as predicate structures composition.

- Semantic interpretation as reference assignment.

- Reference assignment and anaphora resolution: Interpretation of predicate structures into discourse models.

Some cognitive constraints
on modelling semantic interpretation.

- Modularity.

    Autonomy of processing components (parsing and interpretation).
    Search for a discourse referent follows automatic reading processes (Greene, McKoon, & Ratcliff 1992).

- Incremental interpretation.

    Semantic interpretation proceeds with minimal delay.

Parsing with categorical grammars.

- Syntactic grouping and predicate structure composition is best modelled with a categorical grammar parser.

- Categories represent both the combinatorial properties of word types and predicate structure valence.

- Phrase structure grammar is replaced by functional categories.

- One rule (production) per parsing cycle (when no reanalysis is necessary).

  Right and left application, type raising, composition, and substitution.

Example of a parsing production.

```
IF
=focus>
isa            parse-chunk
beg            =middle
end            =end
operator       left.term1
operand        =operand
resultant      =resultant
pred-structure =head-pred-struct

=previous-parse-chunk>
isa            parse-chunk
end            (!eval! (- =middle 1))
beg            =beg
category       =operand
pred-structure =comp-pred-struct

=resultant>
isa            category
operator       =new-operator
operand        =new-operand
resultant      =new-resultant
```

```
THEN
=head-pred-struct>
isa            pred-structure
term1          =comp-pred-struct

=parse-chunk>
isa            parse-chunk
beg            =beg
end            =end
category       =resultant
operator       =new-operator
operand        =new-operand
resultant      =new-resultant
pred-structure =head-pred-struct

!focus-on! =parse-chunk
```

Interpretation of predicate structures into discourse models.

- The case of pronouns (Greene, McKoon, & Ratcliff 1992).

- Parallel retrieval process of potential discourse entities in memory.

- Identification of a unique discourse entity that best matches the constraints provided by a pronoun and its surrounding predicate structure.

- If a single entity cannot be found then the pronoun is left without an interpretation.

Retrieval of potential antecedents.

```
IF                                    THEN
=focus>                               =focus>
isa            retrieve-check         de1-reference    =de1-reference
cue-features    =cue-features         de1-features     =de1-features
de1-reference   nil                   de2-reference    =de2-reference
de2-reference   nil                   de2-features     =de2-features

=de1>
isa            discourse-entity
reference      =de1-reference
features       =cue-features
features       =de1-features

=de2>
isa            discourse-entity
-  reference   =de1-reference
reference      =de2-reference
features       =cue-features
features       =de2-features
```

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Checking retrieved values.

```
;commit-different-discourse-entities      ;do-not-commit-ambiguous
IF                                        IF
=focus>                                   =focus>
isa              retrieve-check           isa              retrieve-check
cue-dis-ent      =cde                     cue-features     =cue-features
cue-features     =cue-features            de1-features     =cue-features
de1-features     =cue-features            de2-features     =cue-features
- de2-features   =cue-features            de1-reference    =de1-reference
de1-reference    =de1-reference           - de2-reference  =de1-reference
- de2-reference  =de1-reference

                                          THEN
THEN

                                          !pop!
=cde>
isa              discourse-entity
reference        =de1-reference

!pop!
```
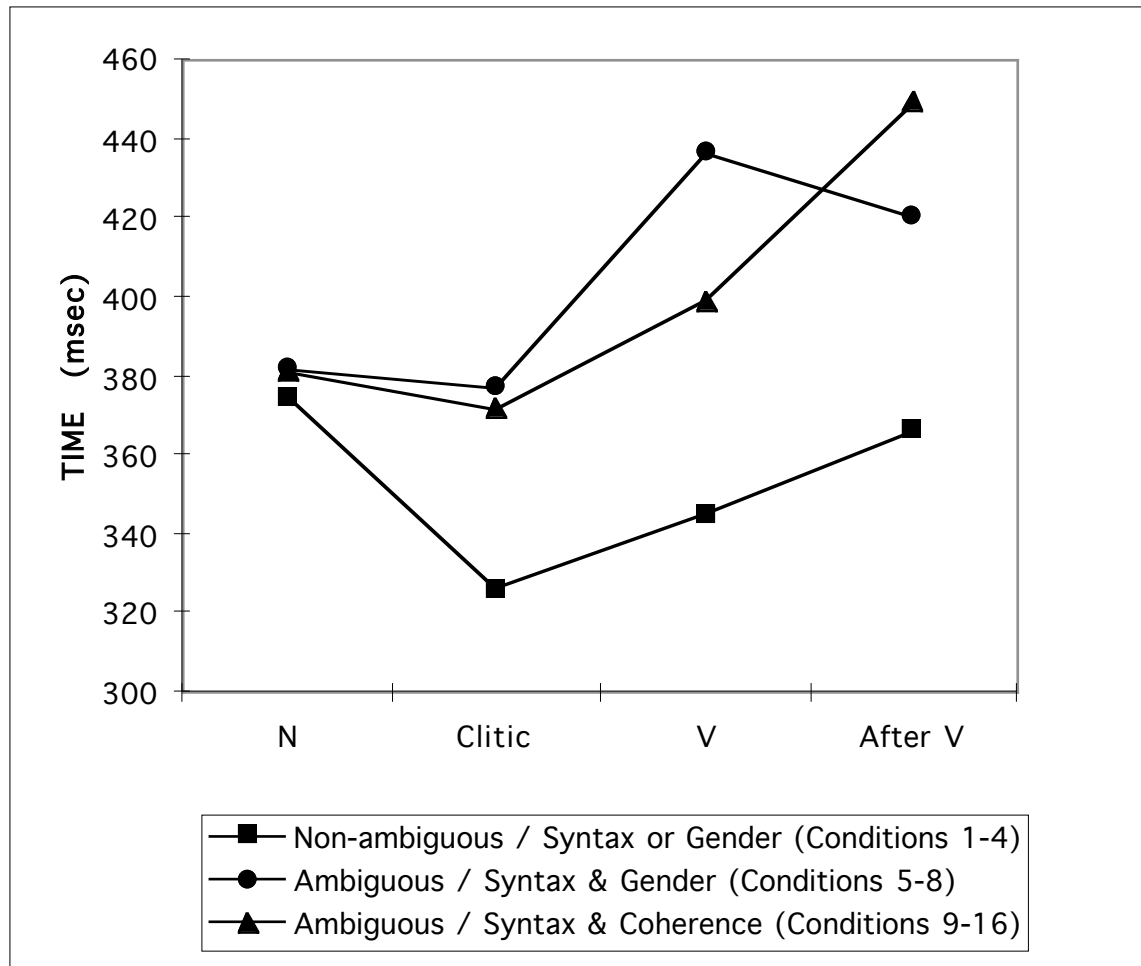
Modelling results from (Garrod, Freudenthal, & Boyle, 1993).

Differences of fixation time between consistent and inconsistent stories
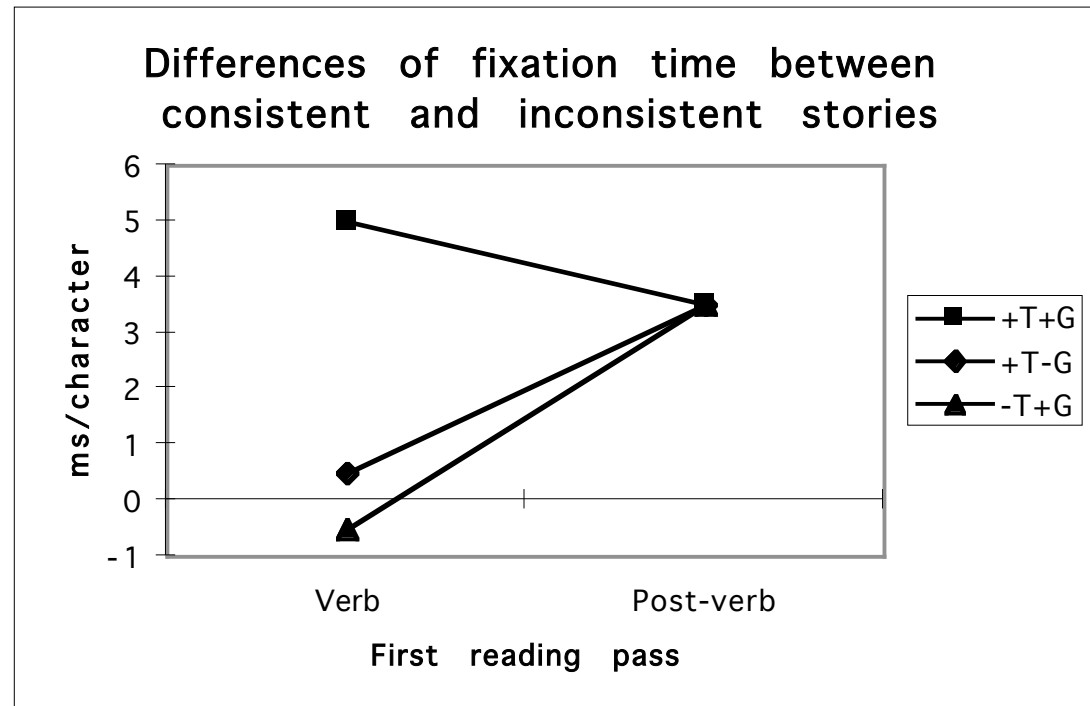
- ■ +TOPIC+GENDER -> Commit-only-one-discourse-entity
- ■ +TOPIC-GENDER -> Do-not-commit
- ■ -TOPIC+GENDER -> Do-not-commit

# *Reading time profile of pronominal clitics (Emond, in progress).*

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Estimated parameters.

■ Base level constant.

■ Parsing productions (Effort, min, 200ms).

Pronoun in the context of a adjacent NP

Pronoun in the context of a adjacent proper noun

Transitive verb in the context of a adjacent pronoun

Ditransitive verb in the context of a adjacent pronoun.

Sentence complement in the context of a transitive verb
inflected phrase.

Verb complement in the context of a ditransitive verb
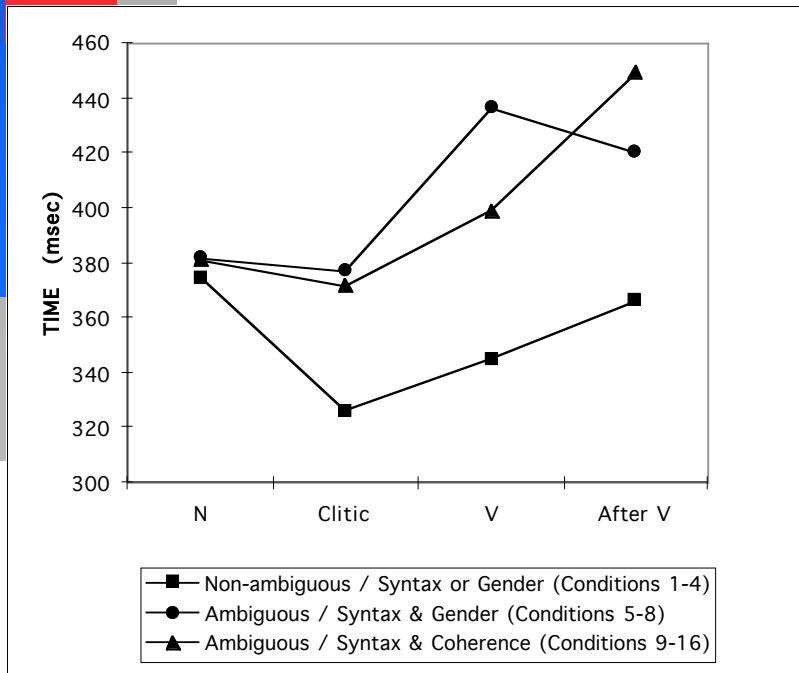inflected phrase.

Data and model.

Syntax or gender
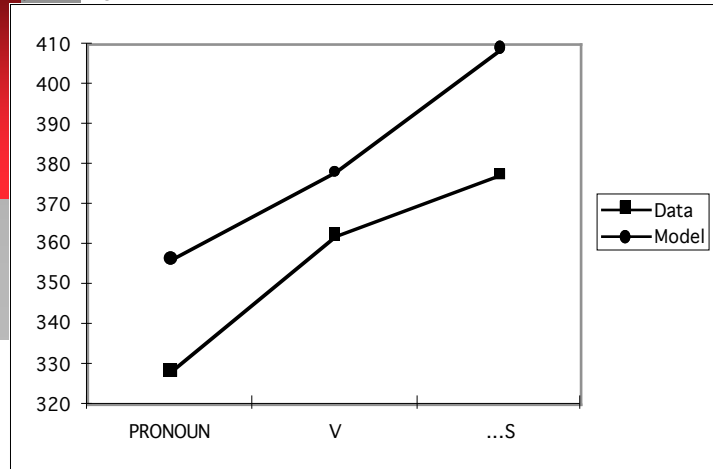
Syntax & coherence
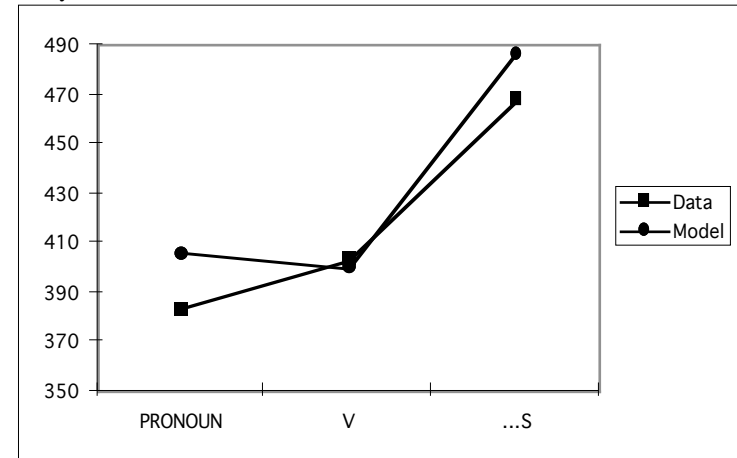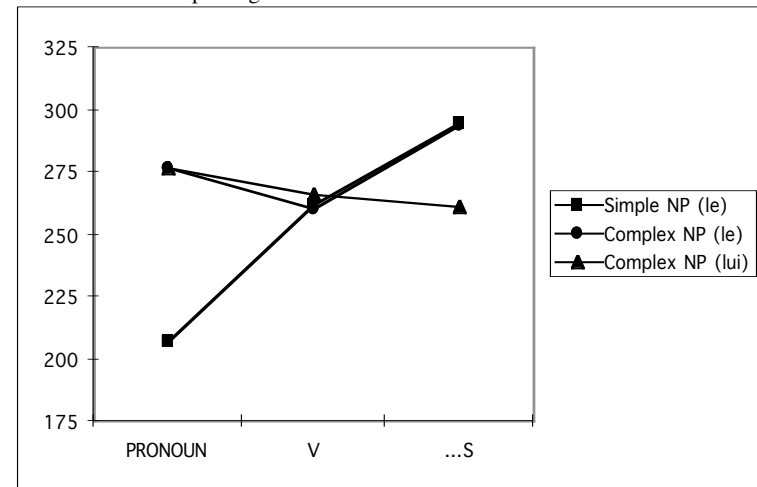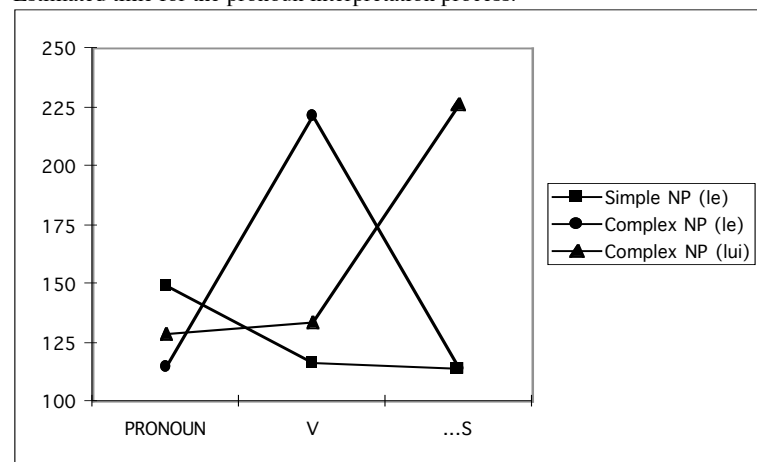
Syntax & Gender
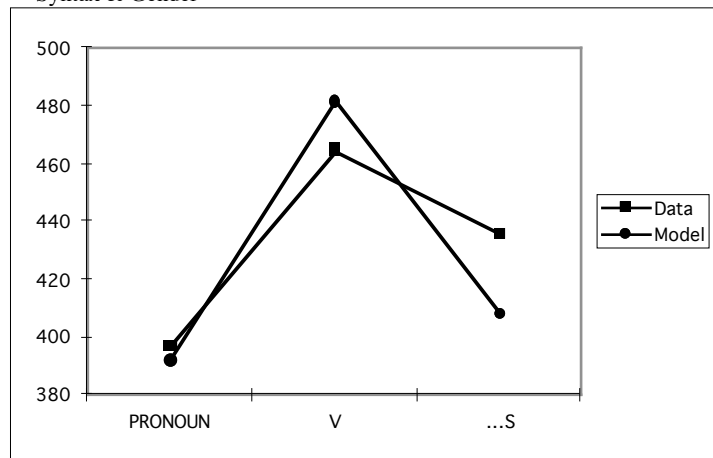
Parsing and interpretation.

Estimated time for parsing

Estimated time for the pronoun interpretation process.

Further work.

- Categorical grammars and reanalysis.

- Application of the retrieve-check control structure to other noun phrases.

- Comparaison of ACT-R with CI.
  - Reading time and processing cycle.
  - Similarities and latent semantic analysis.