Understanding Ellipsis: Internal Structure and Incremental Processing

Hyosik Kim

KSLI 한국언어정보학회, Seoul, May 25, 2024

Outline

- Introduction
  - Goals & Background
- Antecedent Complexity Effect
  - Experiment: Backward Sluicing
- Summary & Conclusion

Outline

- Introduction
  - Goals & Background
- Antecedent Complexity Effect
  - Experiment: Backward Sluicing
- Summary & Conclusion

Goals

- To examine the grammatical structure associated with clausal ellipsis constructions, such as *sluicing*, focusing on both syntactic representation and online sentence processing.

  (i) Is there unpronounced syntactic structure in the ellipsis site?

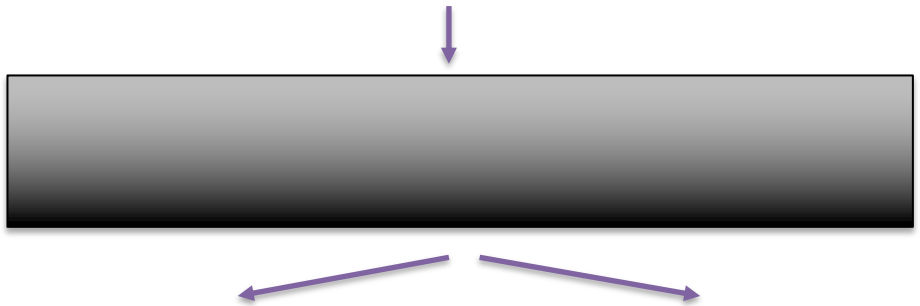
  (ii) If so, what structure does it look like?

  (iii) Does the parser compute the structure of the missing parts during the processing of ellipsis sites?

Parsing

- *Parsing* refers to the way that human beings analyze a sentence or phrase (in spoken language or text) in terms of grammatical constituents, identifying the parts of speech, syntactic relations, etc.

INP: *The man saw the burglar with the binoculars.*



The man saw the burglar
by using the binoculars.
OTP1

The man saw the burglar
who is holding the binoculars.
OTP 2

What is ellipsis?

- ***Ellipsis***: the omission of words and phrases that are grammatically necessary but can be inferred from contexts.

(1) John met someone, but I don't know who.

=

(2) John met someone, but I don't know who John met.

- *Sluicing*: the omission of a clause, usually in the form of a question, leaving behind a wh-word (Ross 1969).

- What process transforms INP (1) into OTP (2)?

What is ellipsis?

John met someone, but I don't know who [e].

antecedent ellipsis site

- *Ellipsis site*: the position of the omission
- *Antecedent*: preceding words and phrases that can supply for the content of the ellipsis site.
- Sluicing remnant: remnant of the omission of a clause, e.g., who.

Approaches

- **The Structural Approach**
  Ellipsis sites contain unpronounced syntactic structure.

Deletion

John met someone, but I don't know who <$_{TP}$ John met>

John met someone, but I don't know who <$_{TP}$ ~~John met~~> (PF)

Copy/Recycling

John met someone, but I don't know who <$_{TP}$ e>

John met someone, but I don't know who <$_{TP}$ John met> (LF)

PF-Deletion Approach (Hankamer 1979, Lasnik 2001, Merchant 2001, Ross 1969, Sag 1976)
LF-Copy Approach (Fiengo and May 1994, Chung et al. 1995, Williams1977)

Approaches

- **The Non-Structural Approach** (WYSIWYG)
  Ellipsis sites do not contain unpronounced syntactic structure.

- *Indirect Licensing*: an item related to an antecedent can be syntactically licensed via its semantic role in relation to the antecedent.

John met someone, but I don't know [$_{NP=S}$ who].

→ 'met' take 'someone' INDEF, 'who' aligns in the semantics with INDEF, and IL allows 'who' to be licensed by 'met'.

Indirect Licensing (Culicover and Jackendoff 2005)
Ginzburg and Sag 2000 - for a different machinery that yields the expected interpretation

The Structure Question

- ***Is there unpronounced syntactic structure in the ellipsis site?***

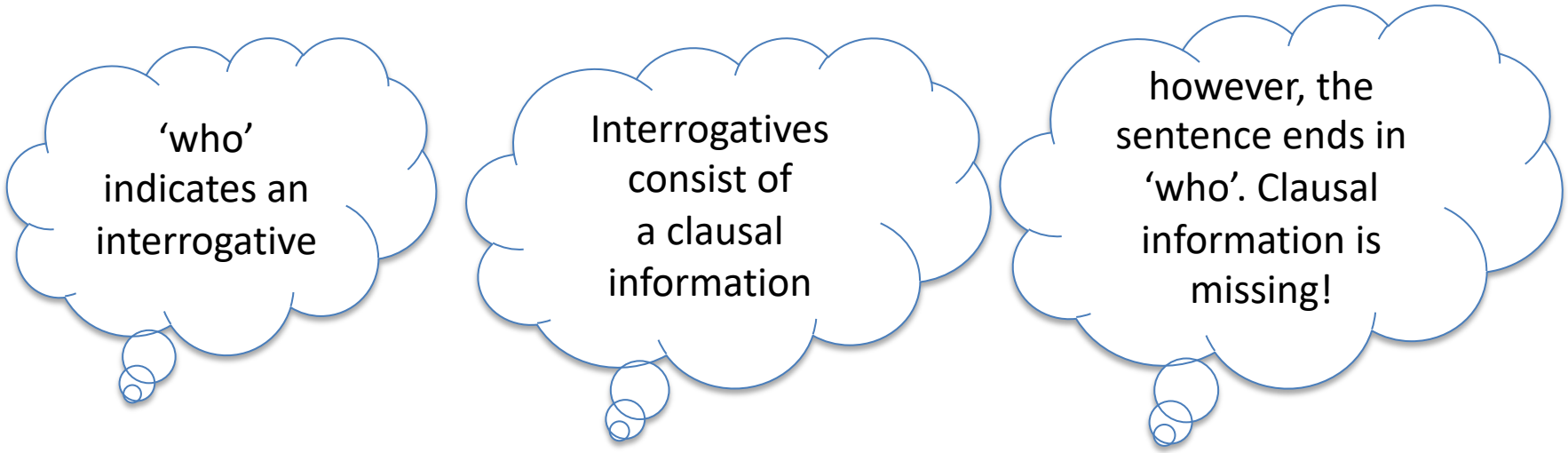
The Structure Question in Processing

- In online sentence processing, does the parser compute the structure of antecedents for the resolution of ellipsis sites?
- If it does, how?

Steps for the ellipsis processing

1. **Recognize** the ellipsis site (Yoshida, 2018).

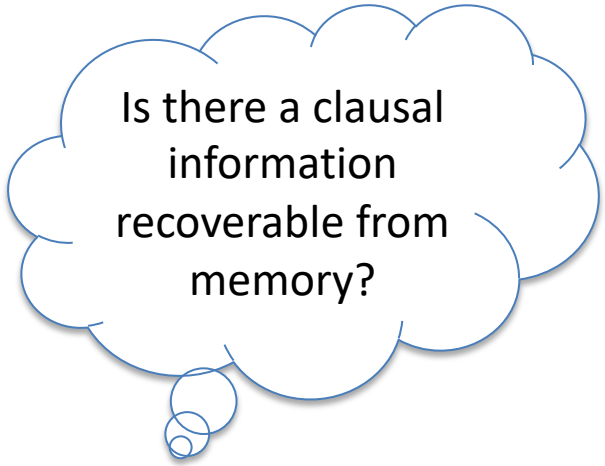
John met someone, but I don't know who.



Steps for the ellipsis processing

2. **Search** for the antecedent.

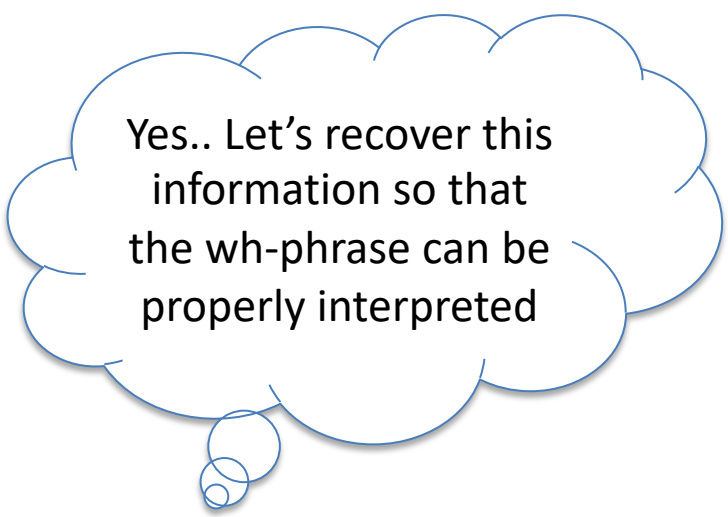
John met someone, but I don't know who [e].

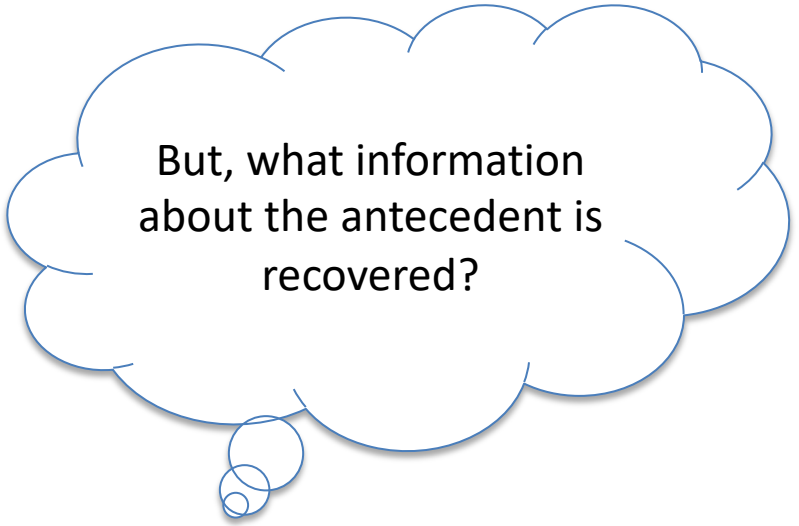


Steps for the ellipsis processing

3. **Recover** the antecedent.

John met someone, but I don't know who.

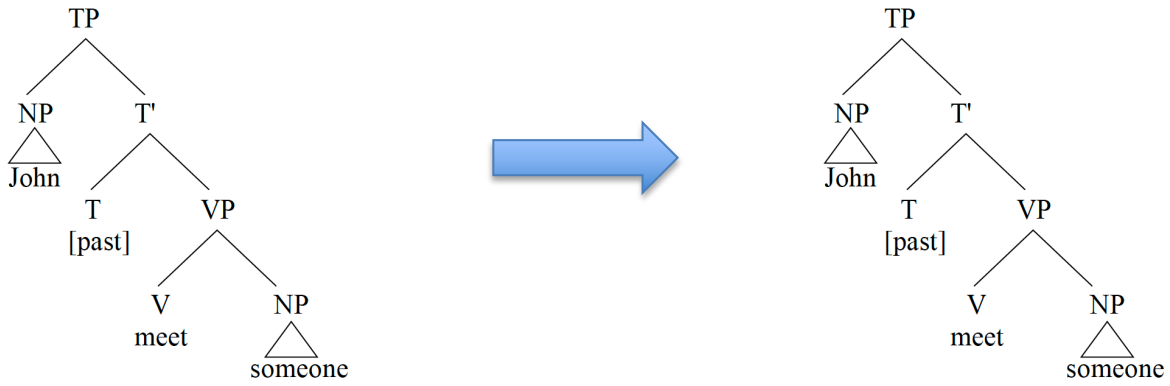




Two Competing Models

- **Copy Model (Copy and Paste)**
  Search short-term memory for an antecedent and copy the structural information onto the ellipsis site.

John met someone, but I don't know who [e].



Copy Model (Frazier and Clifton 2000, 2001, 2005; Murphy 1985)

Two Competing Models

- **Pointer Model (Cue-based memory retrieval)**
  views ellipsis as a **pointer (or a retrieval cue)** to a preexisting memory information.

John met someone, but I don't know who [e].

cat: NP	cat: VP	cat: NP
num: sing	num: sing	num: sing
case: nom	tense: past	case: acc
head: *John*	head: *met*	head: *someone*

Based on the model proposed by Lewis and Vasishth (2005)

Proposal

- **Predictive Structure Building (PSB)**
  A basic structure of TP is built based on the information that clausal information is missing. Corresponding lexical items are recovered.

  John met someone, but I don't know who $[_{TP}$ T $[_{VP}$ $[_{V}$ $(_{NP})]]]$.
  John met someone, but I don't know who $[_{TP}$ John T $[_{VP}$ $[_{V}$ met]]]

Why PSB?

- **Predictive Structure Building Model** can be compatible with the copy and pointer models.

  Compatible with Copy: structure is built (not as part of the recovery)

  Compatible with Pointer: recovery of lexical items

- PSB model is necessary when it comes to understanding the online processing of **Backward Sluicing**.

Summary: Models

	Copy Model	Pointer Model	PSB Model
Recognize E			Structure built
Search A			
Recover A	Structure recovery	Lexical recovery (semantic/discourse)	Lexical recovery

Outline

- Introduction
  - Goals & Background
- Antecedent Complexity Effect
  - Experiment: Backward Sluicing
- Summary & Conclusion

Backward Sluicing

- In Backward Sluicing, the ellipsis site precedes the antecedent.

I don’t know who [e], but John talked to Mary about someone.
ellipsis site antecedent

I don’t know who John talked to Mary about.

Backward Sluicing

- Both copy and pointer models require finding clausal information in memory before recovering it in the ellipsis site.
- A problem is, during the online sentence processing, there is no antecedent available to recover as the ellipsis site is encountered.

I don’t know who [e], …

- Neither model provides a clear way to handle situations like (1).

Questions

(i) Is there unpronounced syntactic structure in the ellipsis site?

(ii) If so, what structure does it look like?

(iii) Does the parser compute the structure of the missing parts during the processing of backward sluicing?

Antecedent Complexity Effect

Hypothesis

- If the parser builds the antecedent structure in the ellipsis site, building a more complex structure will be more difficult than building a simpler one.
- If no structure is built, the structural complexity of the antecedent would not affect the processing difficulty.

Antecedent Complexity Effect in WhFGD processing

- Processing wh-gap dependency is easier when the dependency is intervened by CP than by NP (Gibson & Warren 2004).

CP

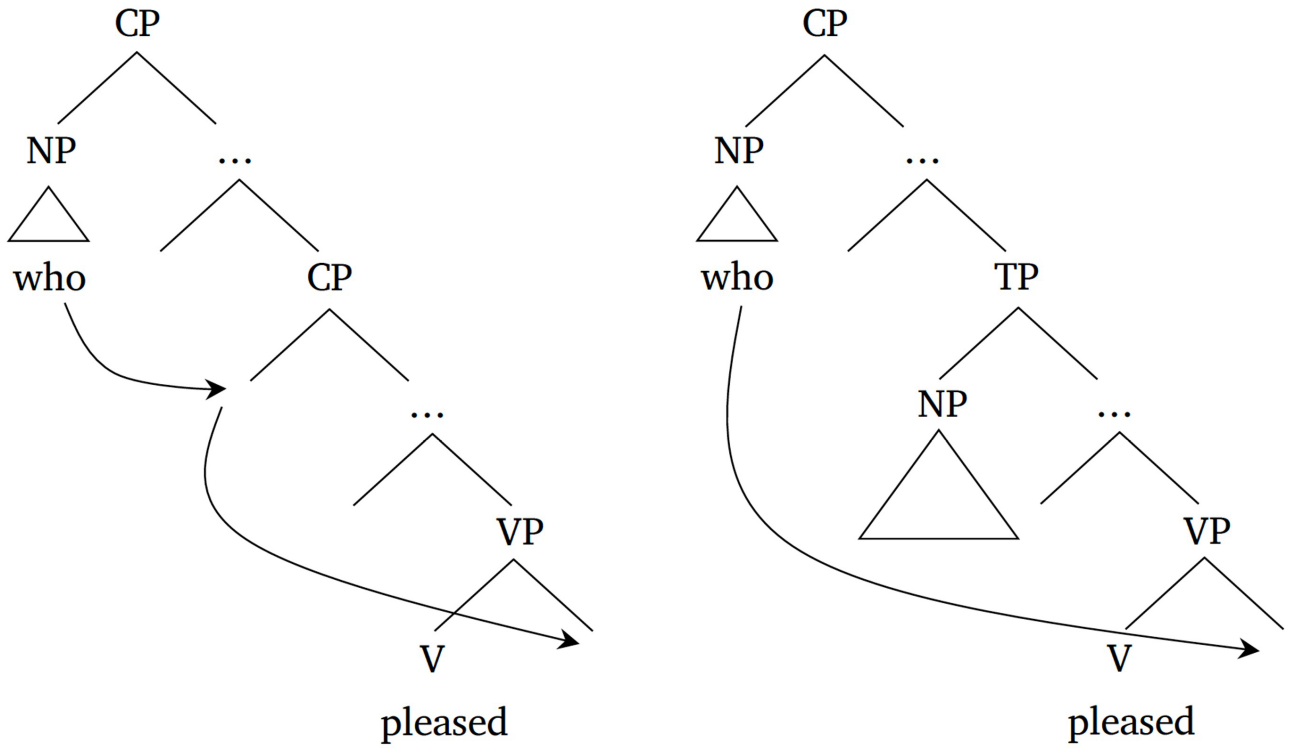
The manager ***who*** the consultant claimed [$_{CP}$ that the new proposal had **pleased**] will hire five workers tomorrow.

NP

The manager ***who*** [$_{NP}$ the consultant's claim about the new proposal] had **pleased**] will hire five workers tomorrow.

→ slower reading time

Antecedent Complexity Effect



1. **“Linear”** distance of WhFGD impacts the processing cost: the shorter the easier.
2. **“Successive Cyclic movement”** makes WhFGD in the CP structure **“linearly”** shorter than in the NP structure.

Antecedent Complexity Effect

who is reactivated/retrieved due to successive cyclic movement

CP-structure

The manager ***who*** the consultant claimed [$_{CP}$ (***who***) that the new proposal had **pleased** _] …

NP-structure

The manager ***who*** [$_{NP}$ the consultant's claim about the new proposal] had **pleased** _ …

- The structural manipulation makes the "LINEAR" distance between the filler the gap is longer in the NP-conditions than in the CP-condition. → slower RT

Antecedent Complexity Effect in Backward Sluicing

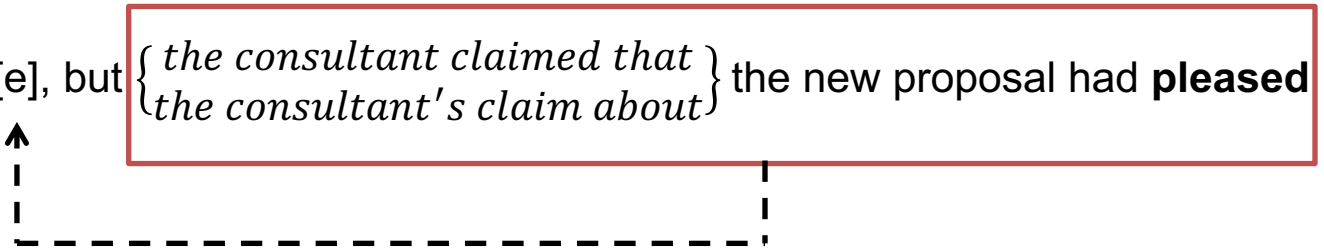
G&W configuration in WhQ and BwS

WhQ

I don't know **which manager** $\left\{\begin{matrix} the\ consultant\ claimed\ that \\ the\ consultant's\ claim\ about \end{matrix}\right\}$ the new proposal had **pleased**.

BwS

I don't know **which manager** [e], but $\left\{\begin{matrix} the\ consultant\ claimed\ that \\ the\ consultant's\ claim\ about \end{matrix}\right\}$ the new proposal had **pleased** one of the managers.

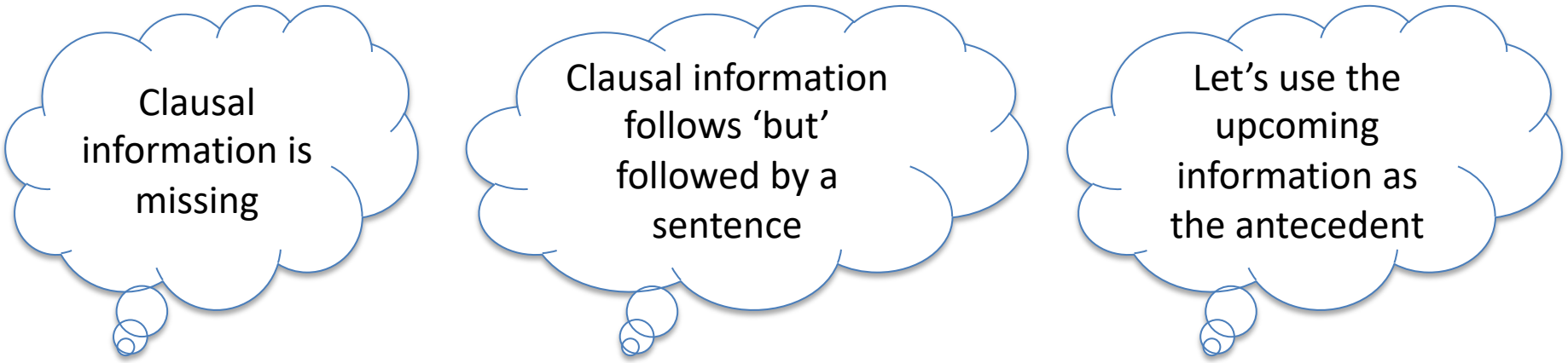


- If the antecedent structure is built in the ellipsis site, the WhFGD formed in WhQ should be formed in BwS as well, thus the structural complexity effect should be observed in both constructions.

Antecedent Complexity Effect

- Scenario 1: Active Search & Incremental Processing

I don't know **which manager** [e], but …



Antecedent Complexity Effect

- Scenario 1: Active Search & Incremental Processing (PSB)

I don't know **which manager** [the consultant], but the consultant

I don't know **which manager** [the consultant claimed], but the consultant claimed

I don't know **which manager** [the consultant claimed that], but the consultant claimed that

…

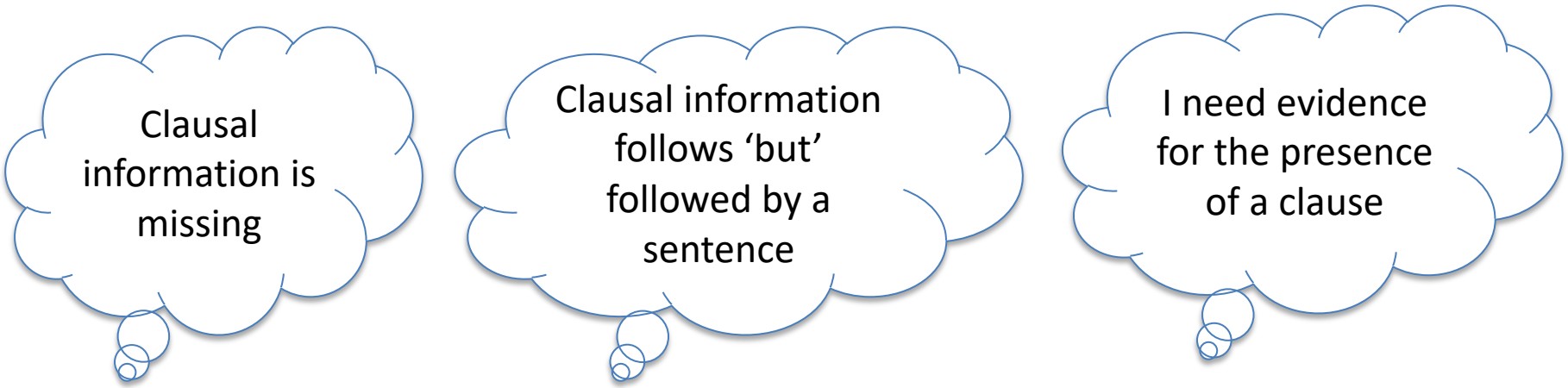
I don't know **which manager** [{the consultant claimed that / the consultant's claim about} the new proposal had pleased], but

{the consultant claimed that / the consultant's claim about} the new proposal had pleased …. Complexity effect at the verb

Antecedent Complexity Effect

- Scenario 2: Delayed Search & Non-Incremental Processing
- The recovery is delayed until the entire antecedent is identified

I don't know **which manager** [e], but



Antecedent Complexity Effect

- Scenario 2: Delayed Search & Non-Incremental Processing

I don't know **which manager** […], but the consultant

I don't know **which manager** […], but the consultant claimed

I don't know **which manager** […], but the consultant claimed that

…

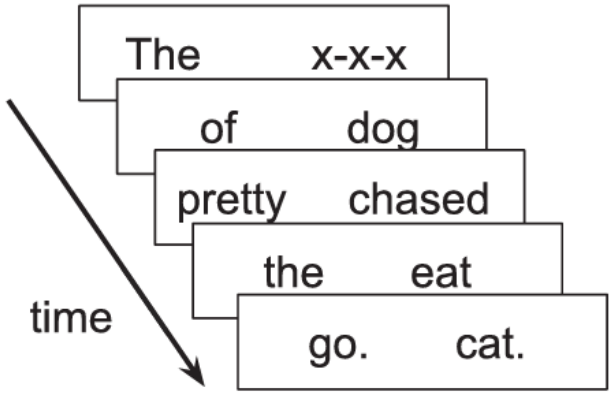
I don't know **which manager** [{the consultant claimed that / the consultant's claim about} the new proposal had pleased one of the managers], but

{the consultant claimed that / the consultant's claim about} the new proposal had pleased one of the managers ….

→ Complexity effect at the indefinite

Antecedent Complexity Effect in BwS

- 120 native speakers of English recruited from Prolific
- A 2 x 2 factorial design: Antecedent Structure (CP vs. NP) and Construction Type (BwS vs. WhQ)
- A G-maze reading experiment



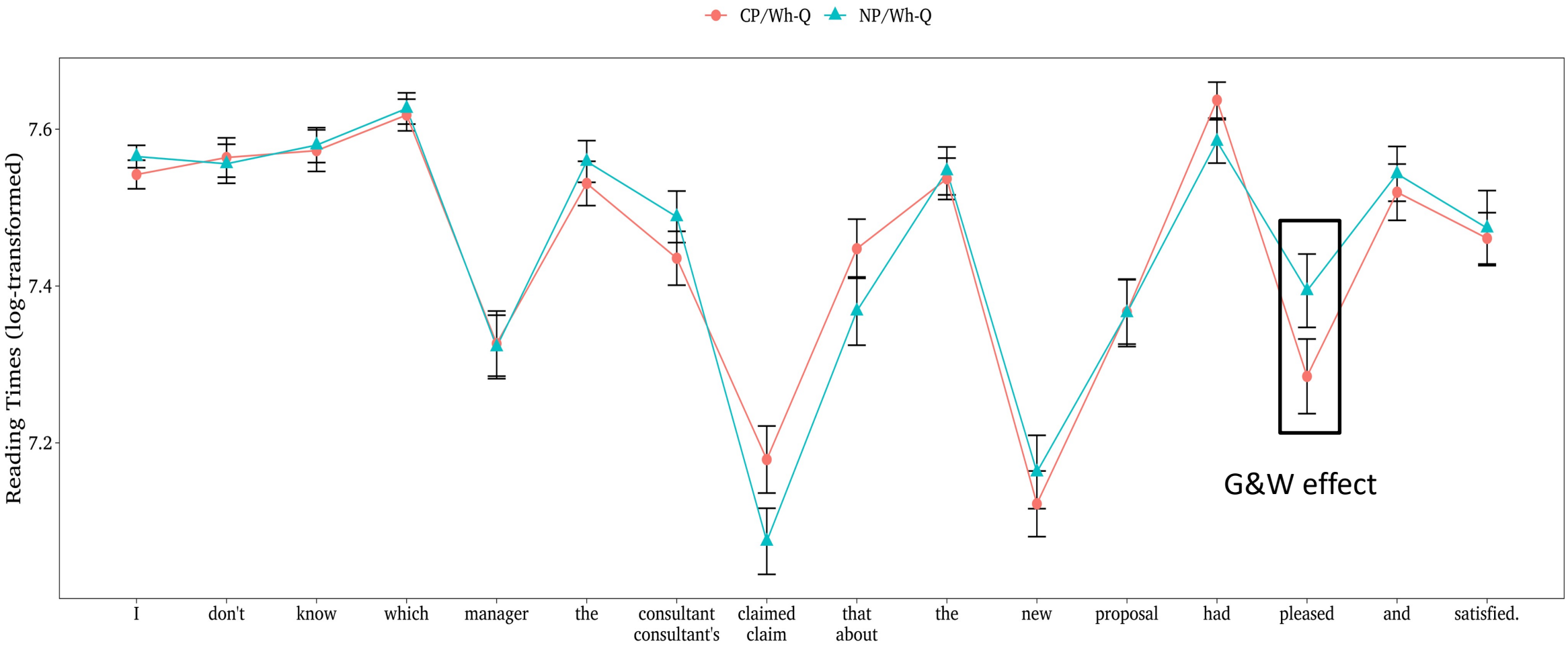
(a) Sample G-maze

Antecedent Complexity Effect in BwS

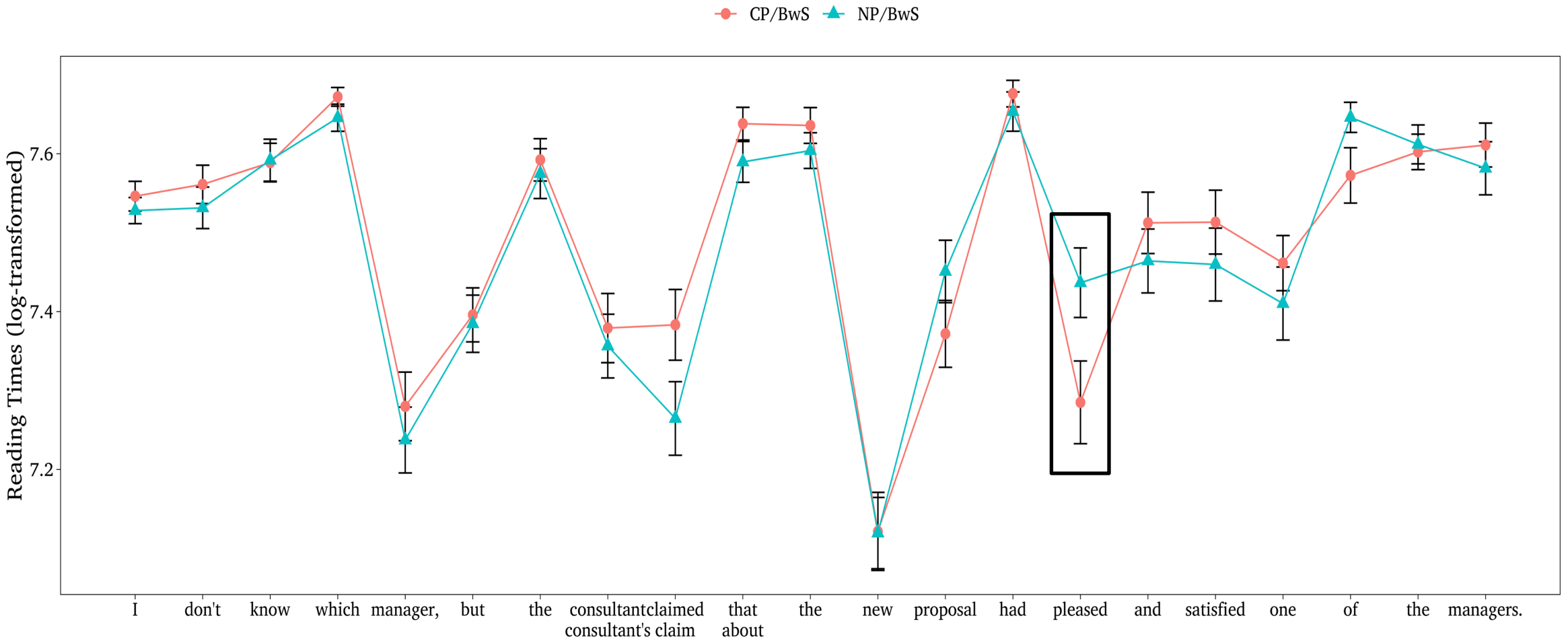
- A sample set of stimuli

Condition	Sample Stimuli
(a) CP/Wh-Q	I don't know which manager the consultant claimed that the new proposal had pleased and satisfied.
(b) NP/Wh-Q	I don't know which manager the consultant's claim about the new proposal had pleased and satisfied.
(c) CP/BwS	I don't know which manager, but the consultant claimed that the new proposal had pleased and satisfied one of the managers.
(d) NP/BwS	I don't know which manager, but the consultant's claim about the new proposal had pleased and satisfied one of the managers.

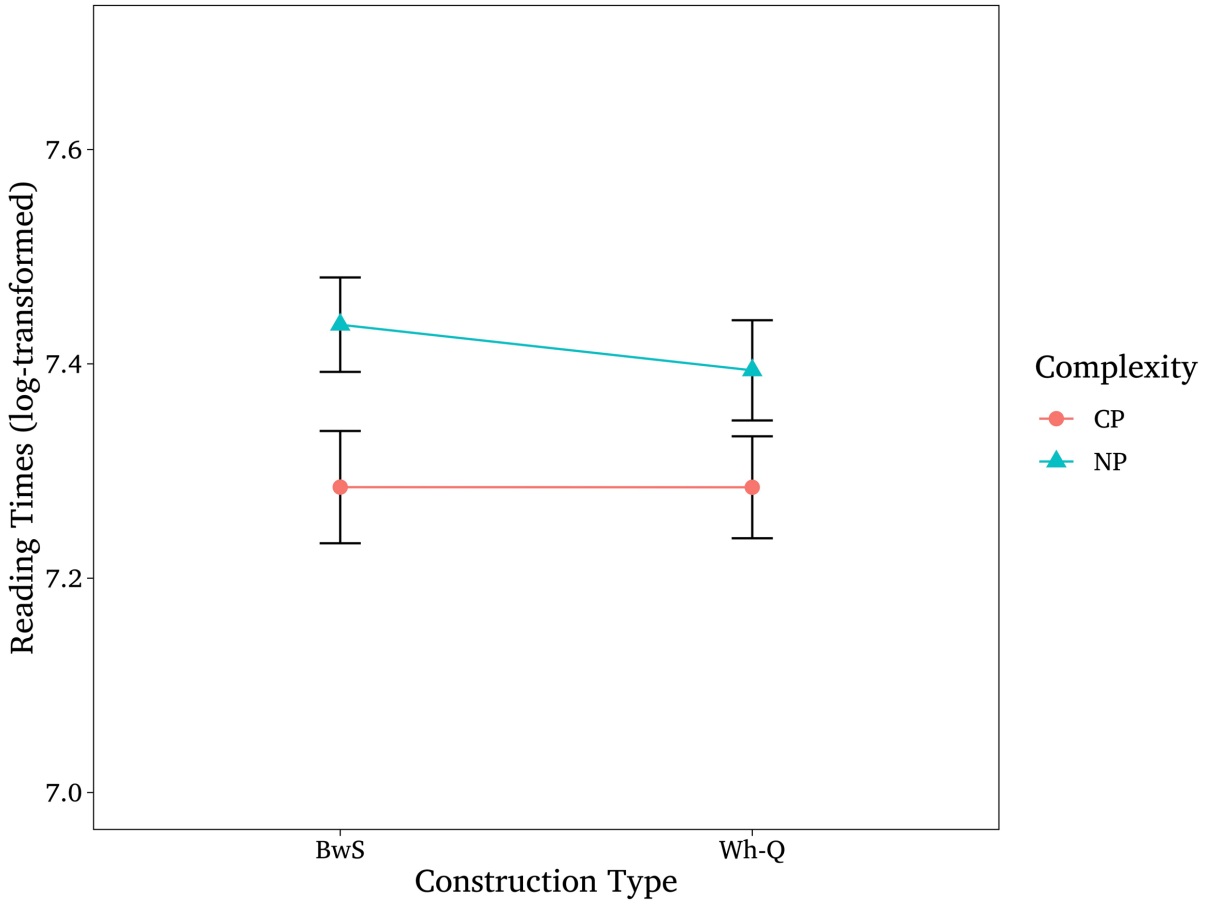
Results


CP/Wh-Q
NP/Wh-Q
Reading Times (log-transformed)
7.6
7.4
7.2
I
don't
know
which
manager
the
consultant
consultant's
claimed
claim
that
about
the
new
proposal
had
pleased
and
satisfied.
G&W effect

Results


CP/BwS
NP/BwS
Reading Times (log-transformed)
7.6
7.4
7.2
I
don't
know
which
manager,
but
the
consultant's claim
claimed
that
about
the
new
proposal
had
pleased
and
satisfied
one
of
the
managers.

Results



	β	SE	T	P
Ant.S	0.09	0.03	2.59	**<0.05**
C.Type	-0.01	0.01	-0.81	>0.05
Ant.S* C.Type	-0.02	0.03	-0.69	>0.05

model = lmer(log(rt) ~ BwS * Complexity + (1|subj) + (1|item), data = md_target)

Discussion

- The same processing mechanism for WhFGD and BwS: *Incremental structure building*
- PSB model is exclusively compatible with this result.
- This result does not eliminate the possibility that the reading time difference is due to the difference in the length of the subject.

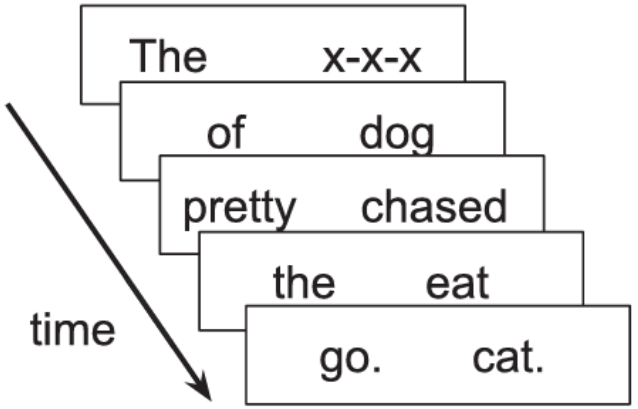
→ CP: *the new proposal pleased*

→ NP: *the consultant's claim about the new proposal pleased*

i.o.w, the dependency length of subject (head) and verb may affect the RT.

Antecedent Complexity Effect in BwS - P2

- 160 native speakers of English recruited from Prolific
- A 2 x 2 factorial design: Antecedent Structure (CP vs. NP) and Construction Type (BwS vs. Adjunct)
- A G-maze reading experiment



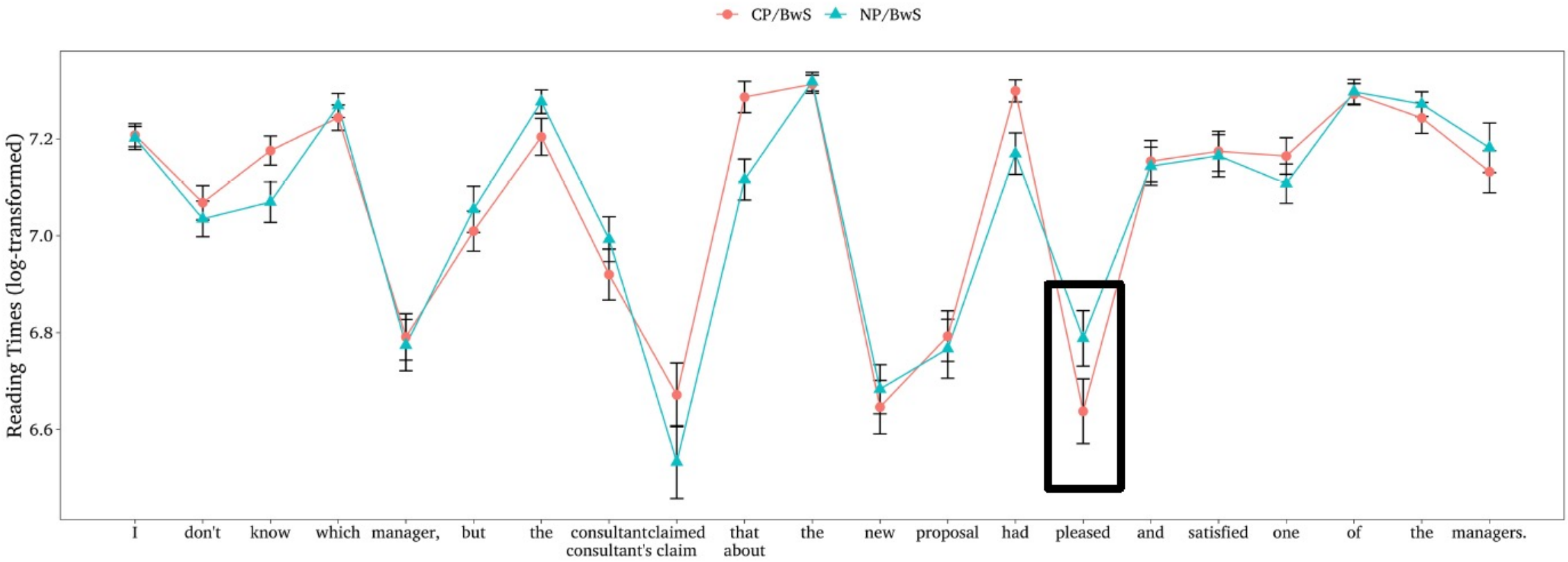
(a) Sample G-maze

Antecedent Complexity Effect in BwS - P2

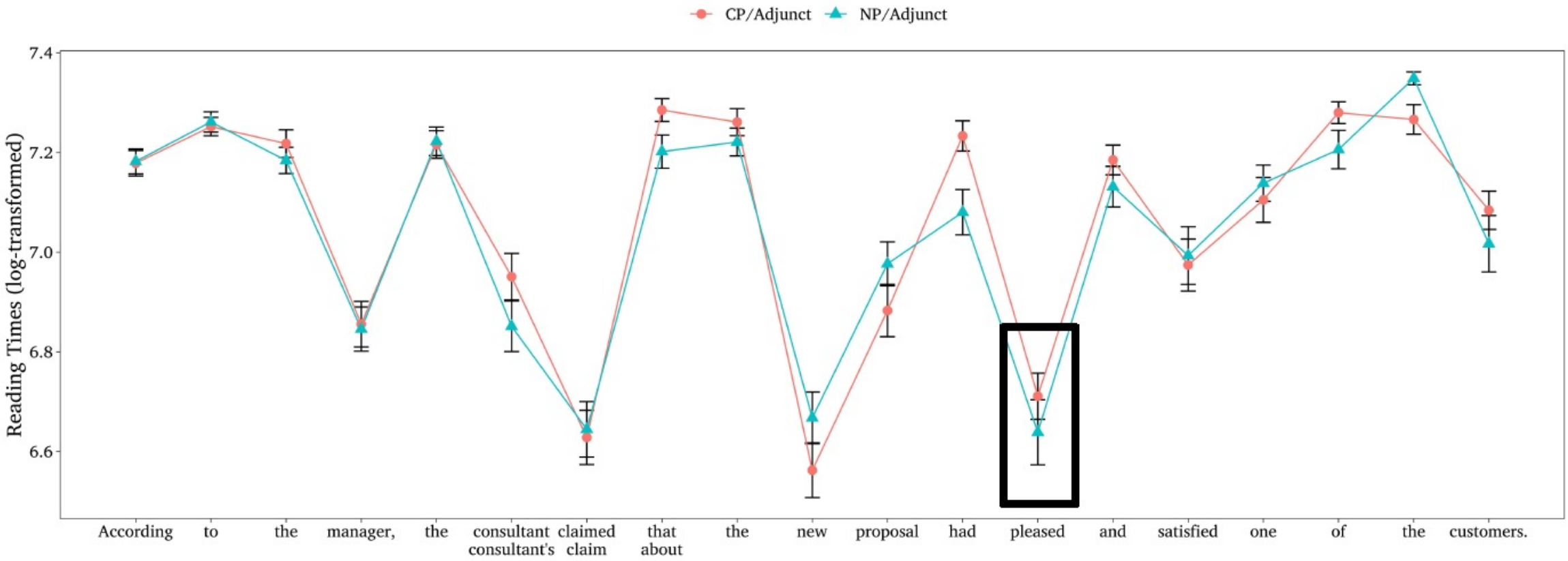
- A sample set of stimuli

Condition	Sample Stimuli
(a) CP/BwS	I don't know *which manager*, but the consultant claimed that the new proposal had pleased and satisfied one of the managers.
(b) NP/BwS	I don't know *which manager*, but the consultant's claim about the new proposal had pleased and satisfied one of the managers.
(c) CP/Adj	According to *the manager*, but the consultant claimed that the new proposal had pleased and satisfied one of the customers.
(d) NP/Adj	According to *the manager*, but the consultant's claim about the new proposal had pleased and satisfied one of the customers.

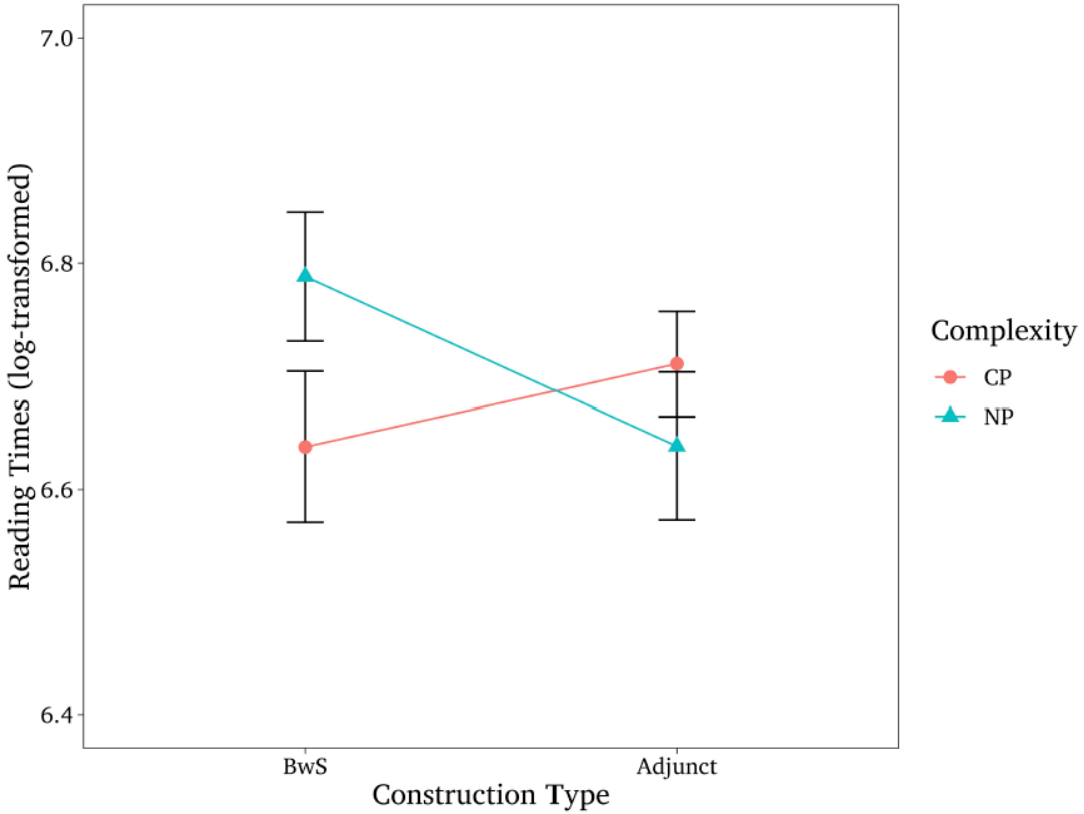
Results


CP/BwS
NP/BwS
Reading Times (log-transformed)
7.2
7.0
6.8
6.6
I
don't
know
which
manager,
but
the
consultant's claim
claimed
that
about
the
new
proposal
had
pleased
and
satisfied
one
of
the
managers.

Results


CP/Adjunct
NP/Adjunct
Reading Times (log-transformed)
7.4
7.2
7.0
6.8
6.6
According
to
the
manager,
the
consultant
consultant's
claimed
claim
that
about
the
new
proposal
had
pleased
and
satisfied
one
of
the
customers.

Results



	β	SE	T	P
Ant.S	**0.06**	**0.02**	**2.35**	**<0.05**
C.Type	-0.04	0.07	-0.67	>0.05
Ant.S* C.Type	**-0.11**	**0.05**	**-2.19**	**<0.05**

model = lmer(log(rt) ~ BwS * Complexity + (1+BwSIsubj) + (1+BwSIitem), data = md_target)

Discussion

- The dependency length of subject (head) and verb did not impact the time course for the verb in the adjunct condition.

- Based on this result, we reject the alternative explanation that the antecedent complexity effect stems from the dependency length of subject (head) and verb.

Outline

- Introduction
  - Goals & Background
- Antecedent Complexity Effect
  - Experiment: Backward Sluicing
- Summary & Conclusion

Summary & Conclusion

- The structural complexity hypothesis was confirmed in both BwS and WhFGD processing.
- The same processing profile for both BwS and WhFGD constructions: *incremental structure building*.
- The Copy and Pointer models are not really compatible with the results, but the Predictive Structure Building (PSB) model is.
- Predictive Structure Building: a basic TP spine is built without having lexical items filled

  I don't know who < $[_{TP}\ T\ [_{VP}\ [_{V}\ NP]]]$ >, but….
- Corresponding lexical items from the antecedent are recovered.

  I don't know who < $[_{TP}$ John $T\ [_{VP}\ [_{V}$ met $NP]]]$ >, but John met someone.

Conclusion

(i) Is there unpronounced syntactic structure in the ellipsis site?

→ Yes. It must be a full-fledged syntactic structure.

(ii) If so, what structure does it look like?

→ Same as the structure of antecedent.

(iii) Does the parser compute the structure of the missing parts during the processing of ellipsis sites?

→ Yes. Some operation that allows the parser to build syntactic structure in the ellipsis site is necessary (like Copy).

Traditional Copying: Copy and paste the whole chunk of antecedent

Alternative Copying: Copy and past parts of the antecedent one by one.

Thank you!