

Predictability and implicit communicative content

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Language is indeterminate

- (1) a. Jane wrote an article for the newspaper.
b. Chris did too.

Language is indeterminate

- (1)
- a. Jane wrote an article for the newspaper.
 - b. Chris did too.
 - c. *Chris wrote an article for the newspaper.*

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- (1)
 - a. Jane wrote an article for the newspaper.
 - b. Chris did too.
 - c. *Chris wrote an article for the newspaper.*

- (2)
 - a. The library was giving away old tapes from its VHS collection.
 - b. Sameer only took some science documentaries.

Language is indeterminate

- (1)
 - a. Jane wrote an article for the newspaper.
 - b. Chris did too.
 - c. *Chris wrote an article for the newspaper.*

- (2)
 - a. The library was giving away old tapes from its VHS collection.
 - b. Sameer only took some science documentaries.
 - c. *Sameer took some science documentaries; he didn't take any other kind of VHS tape.*

How is implicit content recovered?

construction-specific licensing constraints, interpretation rules

VP ellipsis

Jane wrote an article for the newspaper.

Chris did ____ too.

How is implicit content recovered?

construction-specific licensing constraints, interpretation rules

VP ellipsis

Jane [*VP* write an article for the newspaper].

Chris did [*VP* write an article for the newspaper] too.

LF-identical VP antecedent
[e.g. Sag & Hankamer 84]

How is implicit content recovered?

construction-specific licensing constraints, interpretation rules

focus alternatives

The library was giving away old tapes from its VHS collection. Sameer only took some science documentaries.

How is implicit content recovered?

construction-specific licensing constraints, interpretation rules

focus alternatives

The library was giving away old tapes from its VHS collection. Sameer **only** took some **[science documentaries]_F**.

How is implicit content recovered?

construction-specific licensing constraints, interpretation rules

focus alternatives

The library was giving away old tapes from its VHS collection.
Sameer *only* took some [science documentaries]_F.

λx . Sameer took some x

$x \in \text{Alts}$

$\text{Alts} \approx$ kinds of VHS tapes

focus alternatives + interpret w.r.t. context set
[e.g. Rooth 1992, von Stechow 1996]

An alternative hypothesis

languages/speakers communicate content implicitly when communicative success isn't at risk

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VP ellipsis

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leave out VP when it can be recovered
more predictable VPs are easier to recover

An alternative hypothesis

languages/speakers communicate content implicitly when communicative success isn't at risk

VP ellipsis

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leave out VP when it can be recovered
more predictable VPs are easier to recover

focus alternatives

The library was giving away old tapes from its VHS collection.
Sameer only took some science documentaries.

don't specify alternatives when recoverable from context
more predictable alternative sets are easier to recover

An alternative hypothesis

be efficient: leave stuff out when you know it can be recovered/it won't risk communicative success

→ construction-specific constraints mediated by predictability

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→ **construction-specific constraints mediated by predictability**

- Language input/experience determines current estimates of likelihood of occurrence
(e.g. relative likelihood of double object v. prepositional dative)

An alternative hypothesis

be efficient: leave stuff out when you know it can be recovered/it won't risk communicative success

→ **construction-specific constraints mediated by predictability**

- Language input/experience determines current estimates of likelihood of occurrence
(e.g. relative likelihood of double object v. prepositional dative)
- Predictability affects ease of comprehension
- Predictability affects production choices

predictable combinations of elements are easier to process/more acceptable

- surprisal (how much information is conveyed by a word) predicts behavioral measures of parsing complexity [Hale 2001; Levy 2008]
- people predict specific words based on prior discourse message during reading [Otten & van Berkum 2008]
- expectations about coherence relations influence resolution of temporary structural ambiguity [Rodhe, Levy & Kehler 2011]

predictability affects production choices

- more predictable words/more predictable instances of the same word produced with shorter duration; speakers reduce more predictable instances of contractible words more often [Aylett & Turk 2004; Gahl & Garnsey 2004; Bell et al 2009; Jaeger & Tily 2010]
- short words chosen over longer ones in more predictive contexts [Mahowald, Fedorenko, Piantadosi & Gibson 2012]

Outline

- Do languages shift explicit:implicit load (of construction classes) to maximize efficiency? [see e.g. Hawkins 1994 on dependency length minimization]

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Production choice:

Exp1a-b: VP ellipsis

Exp2: focus alternatives

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Production choice:

Exp1a-b: VP ellipsis

Exp2: focus alternatives

- Do comprehenders shift their expectations based on the assumption that speakers behave efficiently?

Acceptability:

Exp3: VP ellipsis

Exp4: focus alternatives

Exp 1a-b

Is likelihood of VP ellipsis sensitive to predictability?

Predictability in VP ellipsis

The baker woke up early every morning, just like the newspaper delivery truck driver did _____.

- **structural predictability** → **parallelism**

connectives like *just like*, particles like *too* signal parallel relation between clauses

Subject_{agent} VP_{active}

- **lexical predictability** → **cooccurrence probability of subject with VP**

$P([VP \textit{ wake up early}]|[Subj \textit{ newspaper delivery truck driver}])$

Predictability in VP ellipsis

Structurally predictable

Jane wrote an article for the newspaper, just like Chris did.

Structurally unpredictable

Jane wrote an article for the newspaper, and as a result Chris did.

Predictability in VP ellipsis

Structurally predictable

Jane wrote an article for the newspaper, just like Chris did.

Structurally unpredictable

Jane wrote an article for the newspaper, and as a result Chris did.

Lexically predictable

The baker woke up early every morning, just like the newspaper delivery truck driver did.

Lexically unpredictable

The baker woke up early every morning, just like the bartender did.
Jane woke up early every morning, just like Chris did.

Exp1 – production

Exp1a

predictable *The baker woke up early every morning, just like the newspaper delivery truck driver did.*

unpredictable *Jane woke up early every morning, and as a result, Chris did.*

antipredictable *The baker woke up early every morning, and as a result, the bartender did.*

Exp1b

	parallel	non-parallel
lexically predictable	<i>baker...just like ...newspaper delivery</i>	<i>baker...as a result ...newspaper delivery</i>
lexically unpredictable	<i>baker...just like ...bartender</i>	<i>baker...as a result ...bartender</i>

Exp1 – production

Mechanical Turk experiment (Exp1a n=18, Exp1b n=24)
Choose the completion that sounds most natural to you.

The baker woke up early every morning, just like
the newspaper delivery truck driver...

- 1 ...did.
- 2 ...always had.
- 3 ...always woke up early.
- 4 ...wakes up at the crack of dawn.

Exp1 – production

Exp1a

predictable *The baker woke up early every morning,
just like the newspaper delivery truck driver did.*

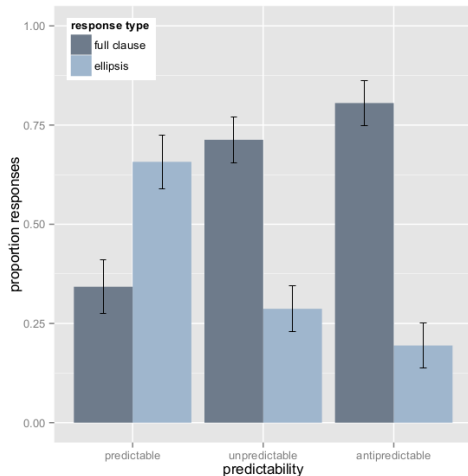
unpredictable *Jane woke up early every morning,
and as a result, Chris did.*

antipredictable *The baker woke up early every morning,
and as a result, the bartender did.*

Exp1b

	parallel	non-parallel
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Exp1a results

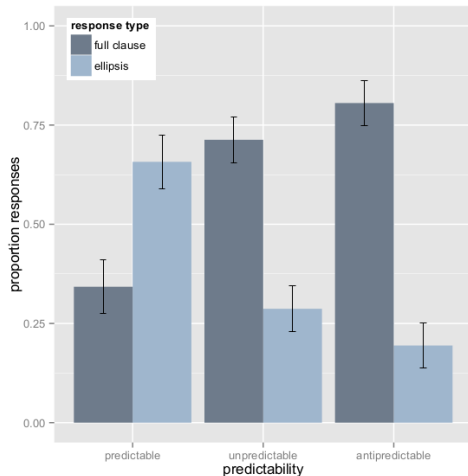


predictable VPs are elided more often

pred.>unpred. ($\beta=.19$, $p<.0001$)

pred.>antipred. ($\beta=.093$, $p=.05$)

Exp1a results



predictable VPs are elided more often

pred.>unpred. ($\beta=.19$, $p<.0001$)

pred.>antipred. ($\beta=.093$, $p=.05$)

is structural or lexical predictability pulling more weight?

Exp1 – production

Exp1a

predictable *The baker woke up early every morning, just like the newspaper delivery truck driver did.*

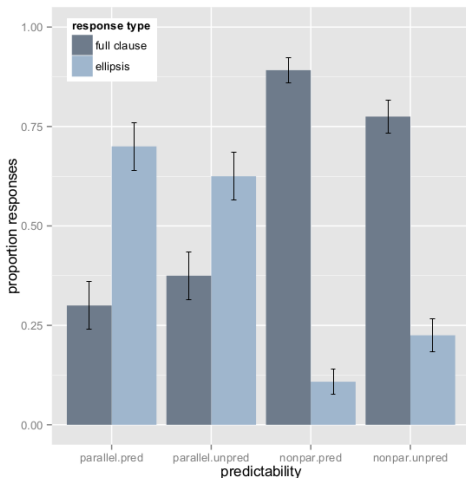
unpredictable *Jane woke up early every morning, and as a result, Chris did.*

antipredictable *The baker woke up early every morning, and as a result, the bartender did.*

Exp1b

	parallel	non-parallel
lexically predictable	<i>baker...just like ...newspaper delivery</i>	<i>baker...as a result ...newspaper delivery</i>
lexically unpredictable	<i>baker...just like ...bartender</i>	<i>baker...as a result ...bartender</i>

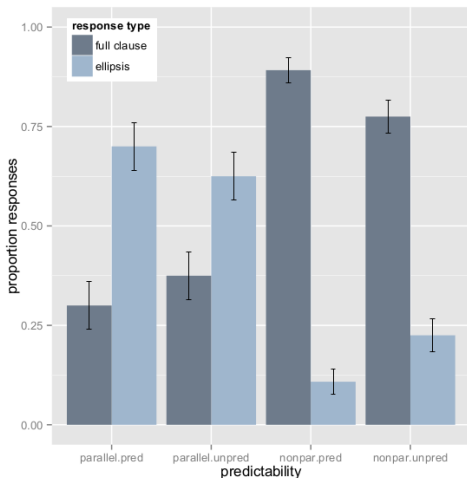
Exp1b results



structurally predictable VPs
are elided more often

parallel > nonpar. ($\beta = .25$,
 $p < .0001$)

Exp1b results



structurally predictable VPs
are elided more often

parallel > nonpar. ($\beta = .25$,
 $p < .0001$)

when structural parallelism
holds, **lexically predictable**
VPs elided more often than
lexically unpredictable ones

parallel \times lex. predictability
interaction ($\beta = .048$, $p < .01$)

Exp 2

Is likelihood of leaving alternatives implicit sensitive to predictability?

Predictability for focus alternatives

The library was giving away old tapes from its VHS collection. Sameer only took some science documentaries.

- **lexical predictability** → **cooccurrence probability of focus value, alternatives**
- **category predictability** → **cooccurrence probability of items as members of a category**

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$P(\text{alternatives} | \text{science documentaries})$

$P(\text{category} | \text{science documentaries})$

Predictability for focus alternatives

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- **lexical predictability** → **cooccurrence probability of focus value, alternatives**
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$$P(\text{alternatives} | \text{science documentaries})$$

$$P(\text{category} | \text{science documentaries})$$

$Alts = \{\text{science documentaries, foreign language films, comedies, crime dramas...}\}$

Predictable alternatives

The library was giving away old tapes from its VHS collection./

The library was getting rid of some science documentaries and foreign language films from their VHS collection.

Sameer only took some science documentaries.

Predictable alternatives

The library was giving away **old tapes from its VHS collection.**/

The library was getting rid of some science documentaries and foreign language films from their VHS collection.

Sameer only took some science documentaries.

Exp2 – production

Predictable alternatives

The library was giving away **old tapes from its VHS collection.**/

The library was getting rid of some **science documentaries** and **foreign language films** from their VHS collection.

Sameer only took some science documentaries.

Exp2 – production

Predictable alternatives

The library was giving away **old tapes from its VHS collection.**/

The library was getting rid of some **science documentaries** and **foreign language films** from their VHS collection.

Sameer only took some science documentaries.

Unpredictable alternatives

The library and the physics building are undergoing renovations over the summer.

Sameer only took some science documentaries.

Exp2 – production

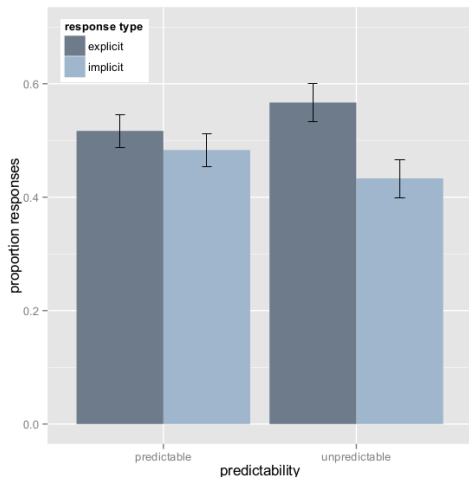
Mechanical Turk experiment (n=70)

Choose the completion that sounds most natural to you.

The library was giving away old tapes from its VHS collection.
Sameer...

- 1 ...only took some science documentaries.
- 2 ...only took some foreign language films.
- 3 ...took some science documentaries, but not any other kind of tape.
- 4 ...didn't take many tapes, but he took some science documentaries

Exp2 results



given the option of explicitly specifying an alternative set, speakers do so more often than leaving it out

but **alternatives from predictable categories** are left out more often than those from unpredictable categories

predictable > unpred. ($\beta = .16$, $p < .05$)

Outline

- Do speakers shift explicit:implicit load (within classes of constructions) to maximize efficiency?

Production choice:

Exp1a-b: VP ellipsis

Exp2: focus alternatives

- Do comprehenders shift their expectations based on the assumption that speakers behave efficiently?

Acceptability:

Exp3: VP ellipsis

Exp4: focus alternatives

Exp 3

**Do comprehenders expect VP ellipsis when
VP is predictable?**

Exp3 – acceptability

Predictable + Ellipsis

The baker woke up early every morning,
just like the newspaper delivery truck driver did.

Exp3 – acceptability

Predictable + Ellipsis

The baker woke up early every morning,
just like the newspaper delivery truck driver did.

Predictable + Full clause

The baker woke up early every morning,
just like the newspaper delivery truck driver always woke up early.

Exp3 – acceptability

Predictable + Ellipsis

The baker woke up early every morning,
just like the newspaper delivery truck driver did.

Predictable + Full clause

The baker woke up early every morning,
just like the newspaper delivery truck driver always woke up early.

Unpredictable + Ellipsis

The baker woke up early every morning,
and as a result, the bartender did.

Unpredictable + Full clause

The baker woke up early every morning,
and as a result, the bartender always woke up early.

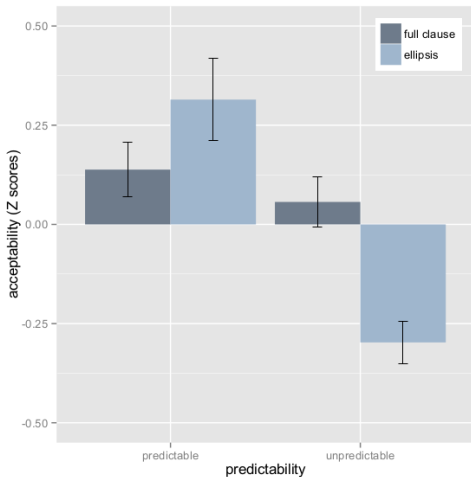
Exp3 – acceptability

Mechanical Turk experiment (n=36)

Choose a number from 1 to 100 to indicate how natural each sentence sounds to you. 1=worst/I would never say something like this; 100=perfect/I could easily say something like this.

The baker woke up early every morning,
and as a result, the bartender always woke up early.

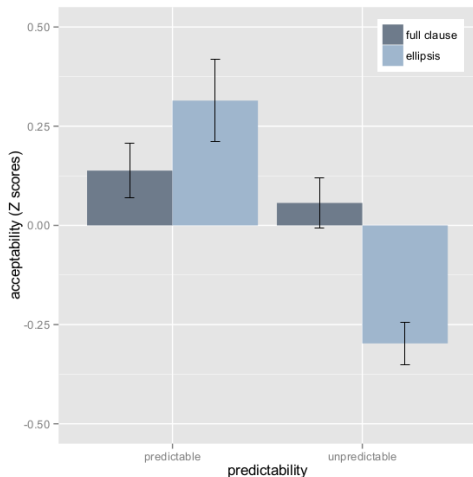
Exp3 results



predictable VPs rated more acceptable

predictable > unpred. ($\beta = .15$, $p < .0001$)

Exp3 results



predictable VPs rated more acceptable

predictable > unpred. ($\beta = .15$, $p < .0001$)

with unpredictable VPs, ellipsis dispreferred to full clause; ellipsis 'penalty' reverses when VP is predictable

predictability \times ellipsis interaction ($\beta = .11$, $p < .01$)

Exp 4

**Do comprehenders expect implicit alternatives
when alternative set is predictable?**

Exp4 – acceptability

Predictable + Implicit alternatives

The library was giving away old tapes from its VHS collection.

Sameer only took some science documentaries.

Exp4 – acceptability

Predictable + Implicit alternatives

The library was giving away old tapes from its VHS collection.

Sameer only took some science documentaries.

Predictable + Explicit alternatives

The library was giving away old tapes from its VHS collection.

Sameer took some science documentaries, but not any other kind of tape.

Exp4 – acceptability

Predictable + Implicit alternatives

The library was giving away old tapes from its VHS collection.

Sameer only took some science documentaries.

Predictable + Explicit alternatives

The library was giving away old tapes from its VHS collection.

Sameer took some science documentaries, but not any other kind of tape.

Unpredictable + Implicit alternatives

The library and physics building are undergoing renovations over the summer.

Sameer only took some science documentaries.

Unpredictable + Explicit alternatives

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Exp4 – acceptability

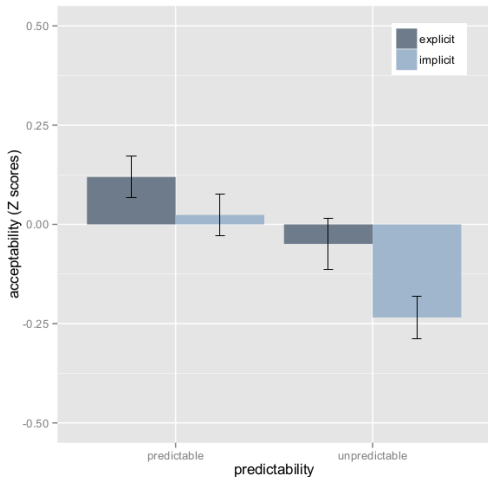
Mechanical Turk experiment (n=60)

Choose a number from 1 to 100 to indicate how natural each pair of sentences sounds to you. 1=worst/I would never say something like this; 100=perfect/I could easily say something like this.

The library was giving away old tapes from its VHS collection.
Sameer only took some science documentaries.

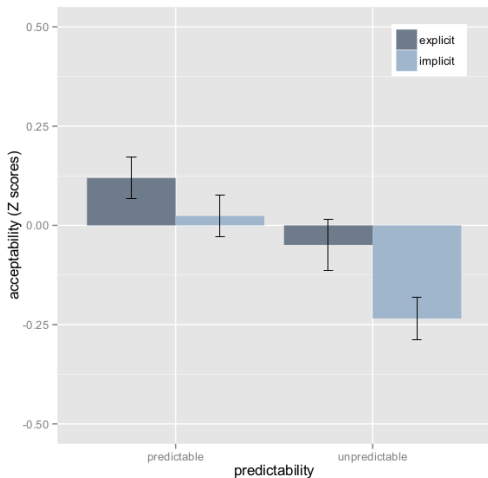
85

Exp4 results



no main effect of predictability
pred.>unpred. ($\beta=.084$, $p>.1$)

Exp4 results



no main effect of predictability
pred.>unpred. ($\beta=.084$, $p>.1$)

with **unpredictable categories**, speakers prefer to spell alternatives out; implicit 'penalty' eliminated when **category is predictable**

marginal predictability \times implicit interaction ($\beta=.08$, $p=.07$)

Summary

- Do speakers shift explicit:implicit load to maximize efficiency?
 - ✓ **Exp1a-b: VP ellipsis**
 - ✓ **Exp2: focus alternatives**
- Do comprehenders shift their expectations based on the assumption that speakers behave efficiently?
 - ✓ **Exp3: VP ellipsis**
 - ?/✓ **Exp4: focus alternatives**

Some open questions

What are the relevant units to keep track of?

- structural configuration
- lexical cooccurrence
- category probability (what things are likely to cooccur as members of a category?)

Some open questions

What are the relevant units to keep track of?

- structural configuration
- lexical cooccurrence
- category probability (what things are likely to cooccur as members of a category?)

Differ in

- how much abstraction is required to get to the right level of generalization
- what kind of (linguistic or non-linguistic) experience is informative

Some open questions

Do *languages* shift explicit:implicit load (of constructions? classes?) to maximize efficiency?

What is the relationship between individual behavior/learning/adaptation and language-level change/grammaticization?

Thanks!

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