Discourse status of possessed nouns affects interpretation of VP ellipsis

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Bound variable vs. coreferential (i.e. sloppy vs. strict identity)

**John likes his apartment, and Bill does, too.**

**Bound Variable:**  
“John likes John’s apartment, and Bill likes Bill’s apartment, too.”  
John $[\lambda x(x \text{ likes } x’s \text{ apartment})]$ and Bill $[\lambda x(x \text{ likes } x’s \text{ apartment})]$  

**Coreference:**  
“John likes John’s apartment, and Bill likes John’s apartment, too.”  
John $[\lambda x(x \text{ likes } \text{John’s apartment})]$ and Bill $[\lambda x(x \text{ likes } \text{John’s apartment})]$  

**Coreference #2:**  
“John likes Fred’s apartment, and Bill likes Fred’s apartment, too.”  
John $[\lambda x(x \text{ likes } \text{Fred’s apartment})]$ and Bill $[\lambda x(x \text{ likes } \text{Fred’s apartment})]$
Bound variable vs. coreferential (i.e. sloppy vs. strict identity)

**John likes his apartment, and Bill does, too.**

**Bound Variable:**  
“John likes John’s apartment, and Bill likes Bill’s apartment, too.”  
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**Coreference #2:**  
“John likes Fred’s apartment, and Bill likes Fred’s apartment, too.”  
John \[\lambda x(x \text{ likes Fred’s apartment})\] and Bill \[\lambda x(x \text{ likes Fred’s apartment})\]
Resolving BV/coreferential ambiguity

John likes his apartment, and Bill does, too.

Bill likes John’s apartment?  Bill likes his own apartment?

What influences the choice between bound variable and coreferential interpretations for this elliptical utterance?
Roadmap

- Background literature
- Research questions and predictions
- Experiment 1
  - Replications (Experiments 2 & 3)
- A theoretical proposal
- A possible concern and alternative analysis
  - Resolved in Experiment 4
- Conclusions
Resolving BV/coreferential ambiguity

John likes his apartment, and Bill does, too.

Bill likes John’s apartment?  Bill likes his own apartment?

What influences the choice between bound variable and coreferential interpretations for this elliptical utterance?

- Context
- Innate bound variable bias
- Lexical semantics (of verb and possessed noun)
Innate bound variable bias

- A number of studies have claimed that the bound variable interpretation is innately preferred and/or computationally easier

- Evidence from child language studies for early bound variable bias and increase in coreferential interpretations over development (Foley et al., 2003; Guo et al., 1997)

- Evidence from studies of agrammatic Broca’s aphasia that coreferential interpretations are disproportionately impaired (Vasić et al., 2006)

- Evidence from studies of unimpaired adults also confirms bound variable preference (e.g. Frazier & Clifton, 2000; Koornneef et al., 2011)
Lexical semantics

- Properties of lexical items within the sentence may affect BV preference
  - Verbs
    - Self-directed verbs (e.g. *scratch*) boost BV preference vs. other-directed verbs (e.g. *move*) (Foley et al., 2003; Guo et al., 1997)
    - Implicit causality (Ong & Brasoveanu, 2014)
  - Nouns
    - Inalienable possessions (e.g. *his arm*) boost BV preference vs. alienable (ownership) possessions (e.g. *his apple*) (Foley et al., 2003; Guo et al., 1997)
Typology of possessives

- Previous work has shown that the possessed noun’s alienability matters
  - Inalienable possessions boost BV bias relative to alienable possessions
- Possessives can also express relationships other than ownership and part/whole
  - Kinship (e.g. her father)
  - Non-kinship relations between animates (e.g. her friend)
- Many languages encode different possessive relationships with different morphosyntactic mechanisms (Haspelmath, 2017)
  - Maltese:
    - id ‘hand’ → id-i [hand-1SG.POSS] ‘my hand’
The effect of possessions’ animacy

- A possession’s animacy (and therefore possession type) may affect BV/coreferential preference in non-ellipsis contexts (Dahl & Fraurud, 1996)

  (a) John sent his paycheck to his mother, and Bill sent it to his wife. (biases BV interpretation: Bill sent his own paycheck)

  (b) John sent his daughter to his mother, and Bill sent her to his wife. (biases coreferential interpretation: Bill sent John’s daughter)

- Dahl & Fraurud (1996:57): “It seems plausible that this has to do with differences in individuation between animates and inanimates.”
Research questions

● Effect of possession type not systematically examined in VP ellipsis literature

● Do different possession types modulate preference for bound variable vs. coreferential interpretations?

● Previous research with children (e.g. Foley et al., 2003) identified alienability as an important factor
  ○ How does alienability’s effect of compare to animacy’s?
Predictions

- Basic prediction: Possession type modulates BV/coreferential preference
- Differing hypotheses based on prior work
  - Alienability hypothesis
    - Inalienable possessions result in more BV interpretations than alienables
  - Animacy hypothesis
    - Inanimate possessions result in more BV interpretations than animates
Experiment 1: Design

- 2-alternative forced choice, offline, ellipsis interpretation task
- Tested how different possession relations modulate BV/coreferential preference
  - 4 possession types:
    - Inalienable (e.g. nose, reputation, haircut)
    - Ownership (e.g. bicycle, shoes, newspaper)
    - Animate relational (e.g. classmate, opponent, partner)
    - Kinship (e.g. father, aunt, cousin)
- 24 Targets + 40 Fillers (8 of which are unambiguous catch trials)
  - All targets contain nonce verbs; many fillers also contain nonce words
    - Nonce verbs help to abstract away from influence of lexical semantics
Experiment 1: Targets

- All 24 target items (6 per condition) have the same frame:

  [Name 1] [nonce verb in simple past] his/her [noun], and [Name 2] did, too.

  e.g. Helen chabbled her jacket, and Amanda did, too.

  (a) Amanda chabbled her own jacket. (bound variable)
  (b) Amanda chabbled Helen's jacket. (coreferential)

- Participants instructed to select the answer they thought was most compatible with the meaning of the sentence; position of BV/coref. choice is counterbalanced

- Other nonsense verbs: *dreezed, jepped, swudged*

- Names of sentence “characters” are always gender-matched
Experiment 1: Example Target (1 of 24)

**Inalienable**: Helen chabbed her *nose*, and Amanda did, too.

**Ownership**: Helen chabbed her *jacket*, and Amanda did, too.

**Animate Relational**: Helen chabbed her *boss*, and Amanda did, too.

**Kinship**: Helen chabbed her *son*, and Amanda did, too.

NB: Latin square design → Participants saw only one condition per target item
Experiment 1: Participants

- 48 adult native speakers of American English
  - All self-identified as native English speakers born in the US
  - Recruited through Amazon Mechanical Turk
  - Completed experiment in Qualtrics
Experiment 1: Example of task

Jason jolfed his bicycle, and Ronald did, too.

- Ronald jolfed his own bicycle.
- Ronald jolfed Jason's bicycle.
Results: Proportion of BV responses by condition

**Inalienable:** [inanimate]
Helen chabbed her **nose**, and Amanda did, too.

**Ownership:** [inanimate]
Helen chabbed her **jacket**, and Amanda did, too.

**Animate Relational:** [animate]
Helen chabbed her **boss**, and Amanda did, too.

**Kinship:** [animate]
Helen chabbed her **son**, and Amanda did, too.
Results: Proportion of BV responses by condition

**Inalienable**: [inanimate]
Helen chabbed her *nose*, and Amanda did, too.

**Ownership**: [inanimate]
Helen chabbed her *jacket*, and Amanda did, too.

**Animate Relational**: [animate]
Helen chabbed her *boss*, and Amanda did, too.

**Kinship**: [animate]
Helen chabbed her *son*, and Amanda did, too.
Results: Proportion of BV responses by condition

**Inalienable**: [inanimate]
Helen chabbed her nose, and Amanda did, too.

**Ownership**: [inanimate]
Helen chabbed her jacket, and Amanda did, too.

**Animate Relational**: [animate]
Helen chabbed her boss, and Amanda did, too.

**Kinship**: [animate]
Helen chabbed her son, and Amanda did, too.
Results: Proportion of BV responses by condition

**Inalienable:** [inanimate]
Helen chabbed her **nose**, and Amanda did, too.

**Ownership:** [inanimate]
Helen chabbed her **jacket**, and Amanda did, too.

**Animate Relational:** [animate]
Helen chabbed her **boss**, and Amanda did, too.

**Kinship:** [animate]
Helen chabbed her **son**, and Amanda did, too.

\[ \text{not significant: } \text{glmer, } p = 0.24 \]
Results: Proportion of BV responses by condition

**Inalienable:** [inanimate]
Helen chabbed her **nose**, and Amanda did, too.

**Ownership:** [inanimate]
Helen chabbed her **jacket**, and Amanda did, too.

**Animate Relational:** [animate]
Helen chabbed her **boss**, and Amanda did, too.

**Kinship:** [animate]
Helen chabbed her **son**, and Amanda did, too.

*significant: glmer, p < 0.001*
Results: Proportion of BV responses by condition

**Inalienable**: [inanimate]
Helen chabbed her *nose*, and Amanda did, too.

**Ownership**: [inanimate]
Helen chabbed her *jacket*, and Amanda did, too.

**Animate Relational**: [animate]
Helen chabbed her *boss*, and Amanda did, too.

**Kinship**: [animate]
Helen chabbed her *son*, and Amanda did, too.

significant: glm, p < 0.001
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**Inalienable**: [inanimate]
Helen chabbed her *nose*, and Amanda did, too.

**Ownership**: [inanimate]
Helen chabbed her *jacket*, and Amanda did, too.

**Animate Relational**: [animate]
Helen chabbed her *boss*, and Amanda did, too.

**Kinship**: [animate]
Helen chabbed her *son*, and Amanda did, too.

significant: 
**glmer, p < 0.001**
Summary of Exp. 1 results

- Inalienable and ownership nouns produce similar rates of BV interpretation
- Inalienable and ownership nouns produce more BV interpretations than animate relational and kinship nouns
- Animate relational nouns produce more BV interpretations than kinship nouns
Replications: Experiments 2 & 3
Replications: Experiments 2 & 3

Cross-study comparison
- Ownership nouns produce similarly high BV rates in Exps. 1 & 2
  - glmer, $p = 0.22$
Replications: Experiments 2 & 3

Cross-study comparison
- Animate relational and kinship nouns produce even lower BV rates in Exp. 3 relative to Exp. 1
  - glmer, p < 0.01
Replications: Experiments 2 & 3

Cross-study comparison
- Animate relational nouns produce higher BV rates than kinship nouns in Exp. 3, just as in Exp. 1
  - glmer, $p < 0.01$
# Predictions

<table>
<thead>
<tr>
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<th>Alienability hypothesis</th>
<th>Animacy hypothesis</th>
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Analysis

- Animacy seems to be the driving force behind the differences observed in Exp. 1

![Graph showing Animacy and Alienability](image)
Analysis

- A working proposal [in the spirit of file change semantics (Heim, 1982)]
  - Animate possessions more likely to receive fully independent discourse representations (cf. “file card”)
  - Inanimate possessions less privileged; more likely processed/conceptualized as parasitic/dependent on the representation of the possessor
  - Independent discourse entities are available for coreference
  - Dependent discourse entities not available for coreference → BV interpretation
Analysis: A potential model (offline decision)

“John likes his jacket, and Bill does, too.”

<table>
<thead>
<tr>
<th>Syntax/Semantics</th>
<th>Bound variable</th>
<th>Coreferential</th>
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<tr>
<td>John [(\lambda x(x \text{ likes } x\text{'s jacket}))] and Bill [(\lambda x(x \text{ likes } x\text{'s jacket}))]</td>
<td>John [(\lambda x(x \text{ likes John’s jacket}))] and Bill [(\lambda x(x \text{ likes John’s jacket}))]</td>
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Discourse:
- John
  - jacket
- Bill
  - jacket
- John
  - John’s jacket
- Bill
Ownership

“John likes his jacket, and Bill does, too.”

Bound variable
John $[\lambda x (x \text{ likes } x\text{'s jacket})]$ and Bill $[\lambda x (x \text{ likes } x\text{'s jacket})]$

Coreferential
John $[\lambda x (x \text{ likes John's jacket})]$ and Bill $[\lambda x (x \text{ likes John's jacket})]$

Ownership

Kinship

“John likes his jacket, and Bill does, too.”

Ownership

Kinship

“John likes his father, and Bill does, too.”
Ownership

“John likes his jacket, and Bill does, too.”

**Bound variable**

John [\(\lambda x (x \text{ likes } x\text{’s jacket})\)]

and Bill [\(\lambda x (x \text{ likes } x\text{’s jacket})\)]

**Coreferential**

John [\(\lambda x (x \text{ likes John’s jacket})\)]

and Bill [\(\lambda x (x \text{ likes John’s jacket})\)]

Bound variable more likely

(Bill likes his own jacket)
Ownership

“John likes his jacket, and Bill does, too.”

Bound variable

John \[\lambda x(x \text{ likes } x\text{'s jacket})\]
and Bill \[\lambda x(x \text{ likes } x\text{'s jacket})\]

Coreferential

John \[\lambda x(x \text{ likes John's jacket})\]
and Bill \[\lambda x(x \text{ likes John's jacket})\]

Bound variable more likely
(Bill likes his own jacket)

Kinship

“John likes his father, and Bill does, too.”

Bound variable

John \[\lambda x(x \text{ likes } x\text{'s father})\]
and Bill \[\lambda x(x \text{ likes } x\text{'s father})\]

Coreferential

John \[\lambda x(x \text{ likes John's father})\]
and Bill \[\lambda x(x \text{ likes John's father})\]

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Ownership

“John likes his jacket, and Bill does, too.”

Bound variable

John \[\lambda x(x\text{ likes } x’s\text{ jacket})\]
and Bill \[\lambda x(x\text{ likes } x’s\text{ jacket})\]

Coreferential

John \[\lambda x(x\text{ likes } John’s\text{ jacket})\]
and Bill \[\lambda x(x\text{ likes } John’s\text{ jacket})\]

Bound variable more likely
(Bill likes his own jacket)

Coreference more likely
(Bill likes John’s father)

Kinship

“John likes his father, and Bill does, too.”

Bound variable

John \[\lambda x(x\text{ likes } x’s\text{ father})\]
and Bill \[\lambda x(x\text{ likes } x’s\text{ father})\]

Coreferential

John \[\lambda x(x\text{ likes } John’s\text{ father})\]
and Bill \[\lambda x(x\text{ likes } John’s\text{ father})\]

Bound variable more likely
(Bill likes his own father)

Coreference more likely
(Bill likes John’s father)
Ownership

“We John likes his jacket, and Bill does, too.”

Bound variable

John [\(\lambda x(x \text{ likes } x\text{'s jacket})\)]

and Bill [\(\lambda x(x \text{ likes } x\text{'s jacket})\)]

Coreferential

John [\(\lambda x(x \text{ likes } x\text{'s jacket})\)]

and Bill [\(\lambda x(x \text{ likes } x\text{'s jacket})\)]

Bound variable more likely
(Bill likes his own jacket)

Bill

does, too.”

Kinship

“John likes his father, and Bill does, too.”

Bound variable

John [\(\lambda x(x \text{ likes } x\text{'s father})\)]

and Bill [\(\lambda x(x \text{ likes } x\text{'s father})\)]

Coreferential

John [\(\lambda x(x \text{ likes } x\text{'s father})\)]

and Bill [\(\lambda x(x \text{ likes } x\text{'s father})\)]

Coreference more likely
(Bill likes John’s father)

This is probabilistic, not deterministic!
An alternative analysis

- BV/Coreferential preference determined simply based on real-world plausibility?

  "John likes his jacket, and Bill does, too."
  
  - Bill is likely to have his own jacket → **variable binding**
  
  - Bill is less likely to have his own jacket → **coreference**

- Interpretation may be influenced by high-level assumptions about the likelihood of an average person possessing the relevant noun

- We tested this hypothesis in Exp. 4
Experiment 4

- 28 adult native speakers of American English recruited via MTurk
- Experiment implemented in Qualtrics
- Rated “how likely an average person is to have at least one” of the nouns in Exp. 1
  - Ratings were on a 1-to-6 scale
    - 1 = an average person is not likely at all to have at least one
    - 6 = an average person is extremely likely to have at least one
Experiment 4: An example item

How likely is the average person to have at least one:

father

Not likely at all
1 2 3 4 5 6
Extremely likely

→
Experiment 4: Results

![Graph showing the proportion of BV interpretations against mean z-scored possession likelihood, with two conditions: low possession likelihood and high possession likelihood.](image-url)
Experiment 4: Results

[hypothetical support for alternative account]

[low possession likelihood]  [high possession likelihood]

Proportion of BV interpretations

Mean z-scored possession likelihood
Experiment 4: Results

No correlation between a noun’s likelihood of possession and the rate of bound variable responses in Exp. 1 ($r = 0.13, p = 0.38$)
Experiment 4: Results

No correlation between a noun’s likelihood of possession and the rate of bound variable responses in Exp. 1 ($r = 0.13$, $p = 0.38$)

BV/Coreferential preference is not influenced by real-world knowledge pertaining to the noun’s likelihood of possession by an average person.
Experiment 4: Analysis

- People have high-level knowledge/assumptions that certain nouns are more likely to be possessed by the second “character” in sentences from Exps. 1-3
- No evidence that these assumptions influence rates of bound variable interpretation
- Now, the same data, broken down by possession type...
Inalienable and ownership nouns span the full range of likelihood of possession, but have similar BV bias.
However, animacy nicely divides the data into higher/lower rates of BV interpretation.
If we treat the data like a clustering problem, it's clear that alienability is not a helpful feature.
However, animacy divides the data reasonably neatly.
Returning to predictions

- Basic prediction: Possession type modulates BV/coreferential preference
  - Differing hypotheses based on prior work:

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Conclusions

● Why the seemingly robust difference between animate relational and kinship?
  ○ Kinship relations are highly socially salient
  ○ Perhaps this lends them increased discourse prominence/independence

● Overt possession’s animacy and consequent discourse status are important factors in resolution of the elided possessive pronoun

● Animacy seems to contribute more strongly than alienability
  ○ Animacy is still only one of multiple contributing factors
Conclusions

The core proposal:

- Animate possessions $\rightarrow$ independent discourse status $\rightarrow$ weaker bound variable bias
- Inanimate possessions $\rightarrow$ dependent discourse status $\rightarrow$ stronger bound variable bias
Thank you for listening!

Thanks to the USC Language Processing Lab!

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Selected References


