Converging evidence from neuropsychology for the semantic function of Pred
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Introduction

Baker’s hypothesis

Baker 2005: The defining property of category V is that verbs alone license a specifier, and therefore can assign thematic roles to external arguments without grammatical support.

We will offer evidence for Baker’s hypothesis from the error patterns of two post-stroke patients, GFE and AES.

Summary: reversal errors with non-verbal predicational structures.

Core data:

- Predicative spatial PPs.
- Predicative comparatives.

No reversal errors with regular VPs.

Conclusion: what is selectively impaired is Pred, under Baker’s conception.
The grammar of predication

Frege’s conjecture: Semantic composition is the saturation of a predicate with an argument. (Frege, Concept and Object)
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Central linguistic question

What is the *grammar* of predication? What determines the mapping between syntax and predicate-argument structure?
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A null (Fregean) hypothesis: the mapping is uniformly determined purely by (compositional) semantics and constituent structure.

```
Caeser
  \_ DP
  \_ Argument
  \_ individual of type e

conquered Gaul
  \_ VP
  \_ Predicate
  \_ function of type ⟨et⟩

TP : truth value, type t
```
The grammar of predication

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**Diagram:***

```
    TP : truth value, type t
      /    \
     /      \
    DP      VP
  /  \  /  \  \
Caesar conquered Gaul

Predicate
function of type \langle et\rangle

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\[ \text{TP : truth value, type } t \]

\[ \text{DP : Argument} \]

\[ \text{The book} \]

\[ \text{individual of type } e \]

\[ \text{VP : type } \langle \text{et} \rangle \]

\[ \text{V} \]

\[ \text{is} \]

\[ \text{PP : Predicate} \]

\[ \text{on the newspaper} \]

\[ \text{function of type } \langle \text{et} \rangle \]
The grammar of predication

Central linguistic question

What is the grammar of predication? What determines the mapping between syntax and predicate-argument structure?

A grammatical hypothesis: predication is reified less trivially at the syntax/semantics interface.

- Thematic role assignment to the argument of a predicate is grammatical, i.e. independent of the predicate itself.
- Bowers’s 1993 Pred, Kratzer’s 1996 Voice / Chomsky’s little-v.
The grammar of predication

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A grammatical hypothesis: predication is reified less trivially at the syntax/semantics interface.
A further distinction within the grammatical hypothesis

Do all predicates behave the same?

- Bowers: yes, all predication is mediated by \textit{Pred}.
  - Cf. Null Fregean hypothesis: all predication is Function Application.
- Kratzer: no, only eventive predicates involve little-v.
- Baker: no...

Baker’s hypothesis

The defining property of category V is that verbs license a specifier, and therefore can assign thematic roles to external arguments without grammatical support.

⇒ Predication is grammatically mediated for non-verbal predicates.

We will offer evidence for Baker’s hypothesis!
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- Other predicates require grammatical support.
- Baker: thematic role assigned by Bowers-style Pred that selects non-verbal predicate.

Semantic function of Pred: bind theta role from predicate to specifier.

- How to test? Challenging...
- General strategy: look for differential behavior...
- Selective impairment of thematic role assignment to subjects of non-verbal predicates??
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Three syntactic arguments for Baker’s hypothesis

(Baker 2005 ch. 2)

- Languages with overt (non-verbal/copular) Pred morphemes that do not combine with Vs. (Edo, Chichewa, ...)
- Differential conjunction patterns with bare predicates:
  1. I consider John crazy and a fool. (Bowers)
  2. * Eating poisoned food made John sick and die. (Baker ex. 36a)
- Differential licensing of post-object floated quantifiers (Maling / Bowers).
So...

How could this be investigated by looking at selective impairments?
A “typical” agrammatic error pattern

Verbal

(3) The cheetah chases the tiger.

• Agrammatic patients are often similarly impaired with both types of sentences.


Prepositional

(4) The circle is on the square.
PPs as complements of Pred

We will assume, contra Baker, that Pred takes PPs too. (Standard assumption, see e.g. Bowers 1993; Adger and Ramchand 2003.)

- Baker: PPs are even weaker predicates, requiring a full V to license subject. (Baker, appendix A.)
- Primary evidence: Overt Pred morphemes cannot combine with PPs in Edo. Will not have anything to say about this here.

Our assumption: PPs (in English) pattern with non-V predicates in combining with Pred.

- Differential behavior in present study.
- Conjunction data.

(5) (Context: arguing about some experimental materials re: the in/inside distinction.) I consider the cup green and in the bowl.

(6) I consider John slightly sick but in good hands.

Questions remain...
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Questions remain...
Case GFE

- Born 1954
- Left-handed, male, worked as attorney
- Middle cerebral artery infarct (2007)
- Damage to the left frontal lobe affecting the posterior regions of the inferior-frontal and middle gyri, insula, sub-cortical structures
- Testing started 1 year post
Case AES

- Age: 50s.
- Right-handed, female
- Stroke, left lateralized lesion, affecting cortical and subcortical areas of frontal and parietal lobes.
Case GFE

- Non-fluent speech, occasional morphological errors, mild anomia
- Picture naming: nouns/objects 70% (Boston picture naming test), verbs / events 87%
- Word repetition 100%
- PPVT: 94th percentile (match target word to picture vs. 3 semantically related foils)
- Verbal short term memory, within normal range
- Grammaticality judgment tasks: normal.
Case AES

- Non-fluent speech, morphological errors, anomia, short term memory problems.
- Picture naming: nouns 40%. (Most errors: phonologically similar to target.)
- PPVT: 39th percentile – note sharp contrast with GFE.
- Grammaticality judgment tasks: normal.
- Forward repetition of digit sequences, failed len > 4. (GFE correct up to 6, normal range.)
- Overall: greater difficulties with lexical access.
Spatial PPs vs. verbs (selection task)

Matching task, two alternatives

Verbal predicates (46 Vs)

Spatial PPs (7 Ps x 10 pics)

(7) The woman interviews the man.

AES: 97%
GFE: 96%

(8) The circle is on the square

GFE: 78% \( (\chi^2 = 18.39, \ p < .0001) \)
AES: 70% \( (\chi^2 = 42.5, \ p < .001) \)

Normals at ceiling (in all tasks unless otherwise noted).
Preconditions for reversal errors?

- Transitive predicate.
- No substantial figure/ground imbalance.
- No world knowledge biasing one way or the other.
Spatial PPs vs. verbs (manipulation task)

Verbal predicates

(9) The helicopter crashes the airplane.

AES: see later version of task.
GFE: 92% correct (40/42)

- No differentiation of stative vs. eventive Vs.

Spatial PP predicates

(10) The sheep are around the cows.

AES: see later version of task.
GFE: 72% correct (58/80)
\(\chi^2 = 9.01, \ p = .002\)
Example reversal errors (manipulation task)

Both images from GFE:

Preposition= “between”

(11) The cars are between the hippos

Preposition= “above”

(12) The clip is above the dvd
Example reversal errors (manipulation task)

Both images from GFE:

Preposition = “between”

(11) The cars are between the hippos

Preposition = “above”

(12) The clip is above the dvd
Is the problem spatial reasoning or spatial language more generally?
Spatial reasoning tests

Rey-Osterreith Complex Figure test: reproduce a complicated line drawing.

- Copying, immediate recall, delayed recall.
- Both subjects: mid-high normal range. GFE very high, AES shows more difficulty with recall.
Spatial reasoning / language tests

Knowledge of spatial relations, part-whole structure:

- Objects in non-canonical orientation: “Mark the top/bottom/front/back”. (160 items) AES: 88% correct, GFE: 99% correct

- “Mark the inside/outside”.
  both 100% correct (80/80)

- “Point to the left/right/top/bottom object”
  both 100% correct (40/40)
Spatial reasoning / language tests

Knowledge of locative preposition meaning?

- E.g. [on] relates two objects, entails contact + gravitational support (or a similar relation).
- Knowledge of the content of “on”, as opposed to the relational component?
- Two-alternative matching task, no possible reversal errors (80 items):

\[ \text{An Impairment for Locatives?} \quad (\text{Matching Task, 2-alternatives}) \]

96% correct (46/48)

The circle is on the square

(13) The circle is on the square.

AES: 83% correct, GFE: 95% correct
Spatial reasoning / language

- Locative choice: “Are the eggs in or on the carton?” (45 items)
  AES: 96% correct, GFE: 96% correct

- Locative naming: “Where are the girls?”

  GFE: 100% correct (62/62)
Spatial meaning in Vs

Test verbs that describe spatial relations matched to prepositions.

- Also, match number of tested verbs and Ps in task, in contrast to previous tasks.

<table>
<thead>
<tr>
<th>Verb</th>
<th>Spatial P</th>
</tr>
</thead>
<tbody>
<tr>
<td>follow</td>
<td>behind</td>
</tr>
<tr>
<td>cover</td>
<td>on</td>
</tr>
<tr>
<td>lead</td>
<td>in front of</td>
</tr>
<tr>
<td>surround</td>
<td>around</td>
</tr>
<tr>
<td>contain</td>
<td>in</td>
</tr>
<tr>
<td>support</td>
<td>below</td>
</tr>
</tbody>
</table>

Example:

(14) The man follows the woman.
(15) The man is behind the woman.

- Examples presented in simple present: stative reading.
Spatial meaning in Vs: manipulation task

Spatial Vs (6 Vs x 12 pics)

(16) The elephant follows the giraffe.

AES: 93% correct
GFE: 92% correct

Spatial Ps

(17) The tractor is behind the trailer.

AES: 65% ($\chi^2 = 7.2, p < .01$)
GFE: 77% ($\chi^2 = 5.36, p < .02$)
Verbal vs. locative predicates

Binding of thematic roles to arguments differentially impaired in verbal predicates vs. PPs.
Other predicates?

What about other types of predicates?

- Reminder: most core types of predicates don’t meet preconditions for this error type.
Adjectival comparatives

Predicative use of adjectival comparatives:

(18) The dog is fatter than the cat.

- Meets preconditions for reversal errors.
Adjectival comparatives

True/false matching task

(19) The cat is fatter than the dog.

AES: 80% correct (Vs. verbal T/F: $\chi^2 = 23.2, p < .001$)  
GFE: 88% correct (vs. verbal T/F: $\chi^2 = 7.11, p < .01$)
Adjectival comparatives

Fill-in production task

(20) The ______ is riper than the ______

AES: 76% ($\chi^2 = 14.5, p < .001$)
GFE: 79% ($\chi^2 = 3.1, p = .06$)
All errors are role reversal errors!
Comparative errors

Problems with adjective meanings or with degrees?
Adjectival meaning

- Presented 3 images corresponding to degrees on some scale, e.g. 3 buildings of different heights.
- Asked to pick the superlative, e.g. “tallest”.
- Both subjects at ceiling.
Adverbial comparatives

(21) Clinton laughs more emphatically than Elvis.

- (Pretty hard task!)

AES: 86% correct
GFE: 97% correct (102/106)

- No significant difference from verb selection task.
- Vs. adjectival comparatives: AES $\chi^2 = 7.8, p = .005$, GFE $\chi^2 = 8.8, p = .002$. 
Embedded cases

- Possible prediction: should expect errors with embedded predicational structures, i.e. small clauses. (Harley etc.)
- Vs neutral as to spatial relation.
- True/false task (140 items):

(22) The woman puts the notebook on the clipboard.

AES: 72% correct
GFE: 77% correct
## Data summary

<table>
<thead>
<tr>
<th>Task</th>
<th>Verbs</th>
<th>Locatives</th>
<th>Adj. Comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AES</td>
<td>GFE</td>
<td>AES</td>
</tr>
<tr>
<td>Sentence-picture matching</td>
<td>95%</td>
<td>96%</td>
<td>70%</td>
</tr>
<tr>
<td>Manipulation / selection (paired)</td>
<td>83%</td>
<td>92%</td>
<td>65%</td>
</tr>
<tr>
<td>Fill-in production</td>
<td>96%</td>
<td>89%</td>
<td>52%</td>
</tr>
</tbody>
</table>

Verbal vs. non-verbal predicates
Conclusions

Clear pattern: Verbal predicates, vs. prepositional and comparative predicates.

- Mechanism for thematic role assignment with Vs is intact, but not so for other predicates.
- I.e. selective impairment targets possibility of thematic role assignment from non-verbal predicates.
- What could explain this pattern?
  - Processing vs. grammatical explanation?
Conclusions

Takeaway point

Selective impairment in AES and GFE targets possibility of thematic role assignment from non-verbal predicates.

Uniform hypotheses?

- Not consistent with the null Fregean hypothesis.
- Not consistent with uniform Pred or uniform v hypothesis.

Stative vs. eventive hypothesis?

- Not explained by v present only for eventive predicates: unimpaired stative Vs.
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Baker’s hypothesis?

- Data consistent with Baker’s hypothesis: what characterizes Vs is their ability to assign a thematic role to external argument.
- Baker’s hypothesis ⇒ grammatical explanation for this data.
- Theta-marking from Vs is intact, but Pred is impaired!
- If this explanation is right, the theta-role-marking property of Pred is distinctly instantiated in the brain.
- Question: what is the right representation of Pred’s thematic role binding? (Standard Chierchia-style approach is tricky!)

Final point: evidence from cognitive neuropsychology can be extremely valuable!
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Acknowledgements

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- GFE and AES for their participation!
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Passives

Active VPs (64 items)

(23) The woman interviews the man.

AES: 97%  GFE: 92%

Passive VPs (32 items)

(24) The man was interviewed by the woman.

AES: 50%  GFE: 93%

