The usage basis of verb valency

Evidence from a language comprehension experiment

Florent Perek
Universität Basel
florent.perek@unibas.ch
Overview

- Topic: cognitive representation of verbs in construction grammar
- Questions:
  - How much information is stored with verbs?
  - In particular, how many arguments (valency)?
- Hypothesis: valency is determined by usage
- Experiment testing this hypothesis
Preliminaries

- In cognitive terms, the meaning of a verb evokes an **event schema**
  - Rich conceptual structure about common situations and events as they typically occur in the world
  - Makes reference to a number of ‘actors’ and ‘props’

- Constructions impose different construals on the event schema
  - “Windowing of attention” (Talmy 1996)
  - Results in different valencies (i.e., sets of arguments)
‘pay’
commercial transaction event schema

BUYER

GOODS

MONEY

SELLER
The man pays for the milk.
The man pays one dollar for the milk.
The man pays.
The man pays one dollar to the shopkeeper for the milk.
What’s (in) a verb?

- Verb = event schema?
  - We could not distinguish between verbs with the same schema
    - e.g., *buy, sell, pay, charge* (commercial transaction)
  - Lexical entry = a (conventional) construal of the event schema
    - i.e., profiling a specific set of arguments

- How to determine which arguments?
What’s (in) a verb?

- In Construction Grammar:
  - Constructions can delete or contribute arguments
  - Ideally, a verb has a single lexical entry (Goldberg 1995)
  - All other valencies derived by combination with constructions

- Question: How do we decide which valency is “basic”?

  *John sold books.*
  - 2-participant verb?
  - 3-participant verb with deleted recipient?

  *John sold books to the students.*
  - 3-participant verb?
  - 2-participant verb construed as transfer?
The usage-based valency hypothesis

- Proposal: verb valency is determined by usage (cf. Langacker 2009)
  - i.e., the cognitive status of a given valency of a verb is related to the frequency of that valency in usage

- Cognitive status:
  - Either a conventional construal stored with the verb
  - Or one derived compositionally via combination with a construction
  - ... probably with intermediate degrees of entrenchment
  - There can be several valencies stored with a given verb

- Prediction: more frequent valencies of a verb are more easily processed in language comprehension
Testing the usage-based valency hypothesis

- Incremental reading experiment (Perek 2012: Ch. 3)
- Goal: measure difference in processing time of different valency sets
- Does the integration time of a third argument for the following verbs vary according to its participant role?
  - \textsc{buyer} \textit{buy} \textsc{goods} \{ \textit{from} \textsc{seller} \textit{vs.} \textit{for} \textsc{money} \}
  - \textsc{buyer} \textit{pay} \textsc{money} \{ \textit{for} \textsc{goods} \textit{vs.} \textit{to} \textsc{seller} \}
  - \textsc{seller} \textit{sell} \textsc{goods} \{ \textit{to} \textsc{buyer} \textit{vs.} \textit{for} \textsc{money} \}
- Do these differences correlate with differences in the frequency of the corresponding valency sets?
Stimuli

- Eighteen stimuli sentences: 3 verbs × 3 direct objects × 2 valency sets

Lisa bought:
- a camera for seventy euros from the department store
- a painting for two hundred euros from an art gallery
- a sandwich for three euros from a takeaway

Jane paid:
- forty euros for the meat to the butcher
- ninety euros for a necklace to the jeweler
- ten euros for a cake to the baker

Mike sold:
- his bike for seventy euros to the neighbor
- his sculpture for one grand to an old woman
- his watch for sixty euros to the landlord

Dependent variable: reading time of the preposition (measured in a maze task; cf. Forster 2010)
Participants

- 25 native speakers of English (11 male, 14 female)
- All students at the University of Freiburg
- Pseudo-randomized stimuli list for each participant
  - Consecutive occurrence of the same verb was avoided
  - Interspersed with blocks of three filler sentences with different verbs and constructions (to avoid priming effects)
  - 72 items in each list
Results: sell

Linear regression analysis:

- Main effect of Valency (to-BUYER): 88.57 msec, $p = 0.0002$
- No significant interactions with DO
Results: *pay*

- Main effect of **Valency (to-seller)**: 45.18 msec, \( p = 0.0324 \)
- Significant interaction with **DO** (forty euros): \( p = 0.469 \)
- But it disappears at the sixth word
Results: *buy*

- No effect of **Valency** ($p = 0.3479$)
- No interactions with **DO**
Results: summary

- For sell
  ‘SELLER sell GOODS to BUYER’ more cognitively accessible than
  ‘SELLER sell GOODS for MONEY’ (shorter reaction time)

- For pay
  ‘BUYER pay MONEY for GOODS’ more cognitively accessible than
  ‘BUYER pay MONEY to SELLER’ (shorter reaction time)

- For buy
  No difference in cognitive accessibility between ‘BUYER buy GOODS from SELLER’ and ‘BUYER buy GOODS for MONEY’ (no difference in reaction time)
Comparison with usage data

- Do these differences correlate with differences in frequency?
  - Analysis of the usage of *buy*, *pay* and *sell*
    - BrE: BNC conversations (4MW; only half the tokens were kept)
    - AmE: several corpora of conversations (~600,000 words)
  - All instances annotated for overtly expressed participants:
    BUYER, GOODS, MONEY, SELLER
## Frequency distribution of pay

<table>
<thead>
<tr>
<th>Valency</th>
<th>BrE</th>
<th>AmE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>%</td>
</tr>
<tr>
<td>BUYER-MONEY</td>
<td>366</td>
<td>36.35%</td>
</tr>
<tr>
<td>BUYER-GOODS</td>
<td>252</td>
<td>25.02%</td>
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<tr>
<td>BUYER</td>
<td>125</td>
<td>12.41%</td>
</tr>
<tr>
<td>BUYER-MONEY-GOODS</td>
<td>111</td>
<td>11.02%</td>
</tr>
<tr>
<td>BUYER-SELLER</td>
<td>67</td>
<td>6.65%</td>
</tr>
<tr>
<td>BUYER-MONEY-SELLER</td>
<td>43</td>
<td>4.27%</td>
</tr>
<tr>
<td>BUYER-SELLER-GOODS</td>
<td>17</td>
<td>1.69%</td>
</tr>
<tr>
<td>MONEY-GOODS</td>
<td>7</td>
<td>0.69%</td>
</tr>
<tr>
<td>BUYER-RECIPIENT</td>
<td>5</td>
<td>0.50%</td>
</tr>
<tr>
<td>BUYER-SELLER-MONEY-GOODS</td>
<td>4</td>
<td>0.40%</td>
</tr>
<tr>
<td>BUYER-MONEY-RECIPIENT</td>
<td>4</td>
<td>0.40%</td>
</tr>
<tr>
<td>MEANS-MONEY-GOODS</td>
<td>2</td>
<td>0.20%</td>
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<tr>
<td>MEANS-MONEY</td>
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<td>0.20%</td>
</tr>
<tr>
<td>BUYER-GOODS-RECIPIENT</td>
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<td>0.10%</td>
</tr>
<tr>
<td>MEANS-GOODS</td>
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<td>0.10%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1007</td>
<td></td>
</tr>
</tbody>
</table>

BrE: $\chi^2 = 30.03$, $p < 0.0001$

AmE: $\chi^2 = 5.83$, $p = 0.0157$
Frequency distribution of *sell*

<table>
<thead>
<tr>
<th>Valency</th>
<th>BrE</th>
<th></th>
<th>AmE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>%</td>
<td>F</td>
<td>%</td>
</tr>
<tr>
<td>SELLER-GOODS</td>
<td>271</td>
<td>70.20%</td>
<td>46</td>
<td>55.42%</td>
</tr>
<tr>
<td>SELLER-GOODS-BUYER</td>
<td>59</td>
<td>15.28%</td>
<td>18</td>
<td>21.69%</td>
</tr>
<tr>
<td>SELLER</td>
<td>24</td>
<td>6.22%</td>
<td>7</td>
<td>8.43%</td>
</tr>
<tr>
<td>SELLER-GOODS-MONEY</td>
<td>16</td>
<td>4.15%</td>
<td>1</td>
<td>1.20%</td>
</tr>
<tr>
<td>SELLER-BUYER</td>
<td>5</td>
<td>1.29%</td>
<td>2</td>
<td>2.40%</td>
</tr>
<tr>
<td>SELLER-GOODS-BUYER-MONEY</td>
<td>4</td>
<td>1.04%</td>
<td>4</td>
<td>4.82%</td>
</tr>
<tr>
<td>GOODS</td>
<td>4</td>
<td>1.04%</td>
<td>1</td>
<td>1.20%</td>
</tr>
<tr>
<td>SELLER-BUYER-MONEY</td>
<td>1</td>
<td>0.26%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GOODS-MONEY</td>
<td>1</td>
<td>0.26%</td>
<td>4</td>
<td>4.82%</td>
</tr>
<tr>
<td>SELLER-MONEY</td>
<td>1</td>
<td>0.26%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>386</td>
<td></td>
<td>83</td>
<td></td>
</tr>
</tbody>
</table>

BrE: $\chi^2 = 25.65$, $p < 0.0001$
AmE: $\chi^2 = 15.22$, $p = 0.0001$
# Frequency distribution of *buy*

<table>
<thead>
<tr>
<th>Valency</th>
<th>BrE</th>
<th>AmE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>%</td>
</tr>
<tr>
<td>BUYER-GOODS</td>
<td>1013</td>
<td>71.39%</td>
</tr>
<tr>
<td>BUYER-GOODS-RECIPIENT</td>
<td>248</td>
<td>17.48%</td>
</tr>
<tr>
<td>BUYER</td>
<td>56</td>
<td>3.95%</td>
</tr>
<tr>
<td><strong>BUYER-GOODS-SELLER</strong></td>
<td>50</td>
<td>3.52%</td>
</tr>
<tr>
<td><strong>BUYER-GOODS-MONEY</strong></td>
<td>32</td>
<td>2.26%</td>
</tr>
<tr>
<td>BUYER-RECIPIENT</td>
<td>5</td>
<td>0.35%</td>
</tr>
<tr>
<td>BUYER-GOODS-MONEY-RECIPIENT</td>
<td>4</td>
<td>0.28%</td>
</tr>
<tr>
<td>BUYER-GOODS-SELLER-RECIPIENT</td>
<td>3</td>
<td>0.21%</td>
</tr>
<tr>
<td>BUYER-SELLER</td>
<td>3</td>
<td>0.21%</td>
</tr>
<tr>
<td>MONEY-GOODS</td>
<td>2</td>
<td>0.14%</td>
</tr>
<tr>
<td><strong>BUYER-GOODS-SELLER-MONEY-RECIPIENT</strong></td>
<td>1</td>
<td>0.07%</td>
</tr>
<tr>
<td><strong>BUYER-GOODS-SELLER-MONEY</strong></td>
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<td>0.07%</td>
</tr>
<tr>
<td>BUYER-MONEY</td>
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<td>0.07%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1419</td>
<td></td>
</tr>
</tbody>
</table>

BrE: $\chi^2 = 3.95$, $p = 0.0468$

AmE: $\chi^2 = 4$, $p = 0.0455$
Conclusion

- For *pay* and *sell*:
  - The predictions of the usage-based valency hypothesis hold
  - The more cognitively accessible valency is also in each case the more frequent one

- Not for *buy*:
  - But the difference in frequency is weaker (barely significant)
  - Both relative frequencies are low
    - It is a plausible explanation: relative frequency was shown to be the relevant factor in derivational morphology (Blumenthal 2013)
Conclusion

- These results confirm the usage-based valency hypothesis
  - i.e., frequency appears to shape the structure of the verbal lexicon

  “Grammars code best what speakers do most” (Du Bois 1985: 363)

- Some prospects:
  - Use a wider range of verbs
  - Evaluate the effect of relative (vs. absolute) frequency

- Theoretical and methodological implications:
  - Usage-based conception of verb meaning: event schema shaped by occurrence in constructions
  - Invalidates the introspection-based methodology to define lexical entries of verbs: it is necessary to look at usage
Special thanks to:
Lars Konieczny, Sascha Wolfer, Daniel Müller-Feldmeth (Uni Freiburg)
Dunja Gross (International Office Freiburg)
... and all the participants.

And thank you for your attention!


The maze task design

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The maze task design

The --
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test, organic.