Quantitative analysis of verb valency

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Quantitative analysis of verb valency

• verb valency
• quantification of verb valency properties – what does it can bring?
• verb valency properties as a result of general mechanisms which rule language behaviour
• full valency approach
Verb valency (VV)

• VV has a decisive impact on a sentence structure
• valency is seen as the capacity a verb has for combining with particular patterns of other sentence constituents
• VV „denotes the property of the verb to claim or to admit, respectively, particular kinds and forms of complements. The verb opens up slots, in which the complements enter as arguments.” (Heringer 1993)
• complement = a unit which is obligatory demanded by VV
• VV determines
  • number
  • form
  • meaning of complements
VV analysis

• valency dictionaries
  • Vallex:
• classification of verbs
• description of verb valency patterns
• typology of sentences
• analyses of relationship between a word meaning and grammar
• attempts to find criteria for a distinguishing complements and adjuncts
• ...
Quantitative analysis of VV

• „simple“ quantification
  • it brings information about typicality (or nontypicality) of given pattern for a particular verb
  • for instance: PDT Vallex

• more general approach
  • identification of typical patterns for particular construction, e.g. double object verbs
    • cf. J. Mukherjee: English Ditransitive Verbs (2005)
Quantitative analysis of VV

- testing of hypotheses
  - hypotheses derived from general mechanisms ruling/influencing language behaviour
  - the goal is to reveal and model systematic relationships between various language properties and try to explain them
  - standard statistical tools
Distribution of VV patterns (frames)

- hypothesis: a distribution of VV patterns follows regular distribution
- generally, there is no uniform distribution of language units in language
- non-uniform distribution can be seen as a result of diversification process (Altmann 2005)

- operationalization:
  - language data: treebank (with valency annotation), valency dictionary
  - form of the pattern
    - \textit{pit} [Sb/nominative, Obj/accusative]
absolvovat  biasp.

1 absolvovat₁ = zakončit, končit
- frame: ACT₁obl PAT₁obl
- example: absolvovat studium
- class: phase verb

2 absolvovat₂ = zažít, zažívat
- frame: ACT₁obl PAT₁obl
- example: absolvovat operaci
\[ P(e^x) = 12. \]
\[ a = 0.6562 \]
\[ p = 0.6034 \]
\[ P = 0.9693 \]
<table>
<thead>
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<th>x - number of valency frames</th>
<th>number of verbs with x valency frames</th>
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<td>1</td>
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<tr>
<td>2</td>
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<td>14</td>
<td>1</td>
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<td>1</td>
</tr>
</tbody>
</table>
VV and verb frequency

• hypothesis: **the more frequent the verb, the more valency frames it has**

• a more frequent verb occurs in more contexts, so it seems reasonable to expect that it should have more valency frames

• “... the more frequent a verb is, the less likely it is to have any fixed number of ‘argument structures’” (Thompson, Hopper 2001: 49)

• “...the more frequent a verb type, the less predictable the number of arguments; a rare verb like to elapse is limited to a single argument, whereas a common verb like to get appears in discourse with one, two, or three of the traditional arguments...” (Bybee, Hopper 2001: 5).
The number of valency frames and the frequency of verbs
VV and other verb properties

- length of verb
  - the shorter verb, the more verb valency frames it has
- polysemy of verb
  - the more meanings verb has, the more valency frames it has
- synonymy of verb
  - the greater the valency of a verb, the more synonyms it has
- polytextuality
  - the greater the polytextuality of a verb, the more valency frames it has
Verb valency frame as a language unit

- VV frame (pattern) can be considered to be a language unit
- consequently, it is possible to analyze its properties (e.g. analogically to word, lemma, morpheme etc.)
  - frequency
  - length
  - complexity
  - "productivity"
  - Menzerath law
Explanation of the interrelationships

• principle of least effort (G. K. Zipf)
  • speaker
    • minimisation of production effort
    • minimisation of coding effort
    • minimisation of memory effort
  
  • it leads to unification (generally): one „type“ of valency pattern, as short as possible, high polysemy – i.e. one verb + one pattern for more than one meaning

• hearer/reader
  • minimisation of decoding effort
    • it leads to diversification (generally): more „types“ of valency patterns, short, no polysemy
    • minimisation of memory effort

• both
  • communicative needs – to achieve a goal of communication
Synergetic model

- Usg
- Min P
- Min C
- Min D

freq. of V → length of V → valency of V → synonymy of V

polysemy of V → valency of V → synonymy of V
Full valency

- full valency (FV): concept of valency without distinguishing between complements and adjuncts

- it is a reaction on one fundamental deficiency of traditional valency approach
  - the absence of clear criteria for distinguishing complements (obligatory arguments governed by the verb) and adjuncts (optional arguments)
  - “...the criteria for classifying an argument as a complement or an adjunct are anything but clear” (Rickheit & Sichelschmidt, 2007)
  - „it is fair to say that over the years valency grammarians have spent a considerable amount of time and effort in an attempt to clarify and operationalise the distinction without arriving at a solution which could be generally considered satisfactory“ (Herbst & Klotz, 2012)

- gradient distinction between complements and adjuncts (Faulhaber 2012)
Full valency frame of the lemma GIVE, based on sentence

My father gave four books to Mary yesterday evening

- GIVE

[Sb/nominative; Obj/accusative; AuxP/dative/TO; Adv]
Testing method

• full valency frames were counted for particular verb *lemmas*, not word forms
• only *formally unique* full valency frames are calculated
• *Tom comes late; Mary came early*
  • COME[Sb/nominative; Adv]
Hypotheses

• the distribution of full valency frames
  • H: if full valency represents the ‘theoretically prolific’ class, it should have a regular distribution

• the relationship between the number of full valency frames and the verb frequency
  • H: the more frequent the verb, the more full valency frames

• the relationship between the length of the verb and the number of full valency frames
  • H: the shorter the verb, the more full valency frames
\[ P_x = C \frac{P^x}{x^a} \]

\[ a = 1.3289 \]

\[ p = 0.98 \]

\[ P = 0.8167 \]
$f(x) = cx^a$

$c = 1.0226$

$a = 0.6464$

$R^2 = 0.9778$
Conclusions & Discussion

- quantification does not only „bring“ information about frequency characteristics which are added to description (grammar books, valency dictionary etc.)
- quantification allows to test hypotheses
  - systematic modelling of relationships among language properties
- explanation

- full valency
  - it can be applied on any language unit in a syntactic tree
  - it can reveal general properties of dependency characteristics
Thank you!

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