Universiteit Utrecht

The bits of dependencies, or What makes *zichzelf* be read slower

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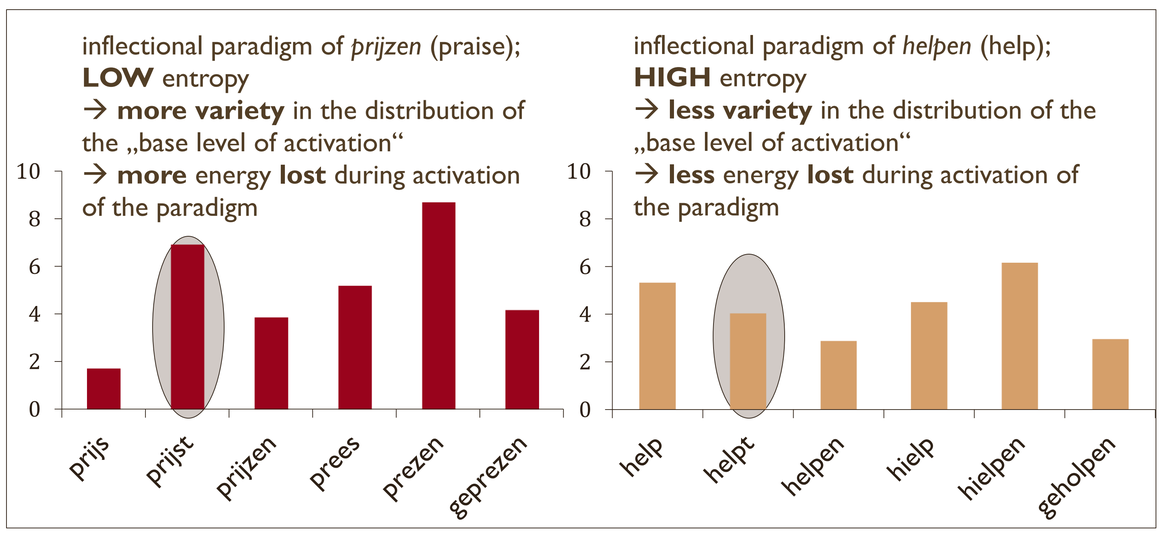
1. Introduction

Information theory

Inflectional Entropy (H) of a verb's **family** is an index of how **uniform** is the distribution of the members in a verbal **paradigm** (adapted from Shannon 1948 by Millin et al. 2009 to express morphology). The more uniform the distribution is the higher is the entropy. It is a function of:

- the frequency of the verb's forms (*F*)
- the functions/ meanings each form appears in (*R*)
- the number of forms of the paradigm (*c*)

$$H = \sum_{i=1}^{c} \frac{F_i}{R_i} log_2 \frac{F_i}{R_i}$$



In comprehension and **word** processing, **high** entropy verbs are retrieved **faster** (Moscoso del Prado et al. 2004, van Ewijk & Avrutin 2010).

Q: Does verbal entropy influence *sentence* processing?

Object integration

Readers anticipate the structure that they will project.

A transitive verb projects a transitive structure and an object is expected.

A **NP fills in** the structure → Maria praises *Kathrin* for the good grades.

A **reflexive** must find an **antecedent** → *Maria* praises *herself* for the good grades.

2. Research questions

a. Maria prijst/ helpt Kathrin (Maria praises/ helps Kathrin).

b. Maria prijst/ helpt zichzelf (Maria praises/ helps herself).

1. Does verbal entropy influence the speed of object integration?

a. Will *Kathrin* be integrated faster in the case of a *praising* than in that of a *helping* event?

b. Will *zichzelf* be integrated faster in the case of a *praising* than in that of a *helping* event?

2. Is there a difference in the way with which, verbal entropy modulates object integration between NP and reflexive?

3. Method & Materials

- Participants: 34 Dutch students (Age range 21; 0-29; 0)
- Method: self-paced reading task with reading time (RT) as a measure
- Material: 12 verbs of low and 12 of high Entropy
  2 conditions; with and without a dependency
  2x2 repeated measures design

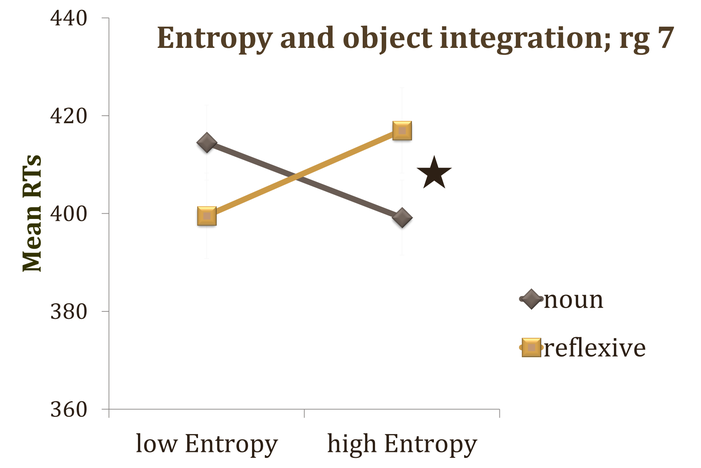
48 items:	He/She VERB, in the most cases, him(her)self/ Kathrin and not the other (noun)										
Reflexive	HIJ/ZIJ verb		in de meeste gevallen				*ZICHZELF*	en niet de andere			
NP							*Kathrin*				
	varying entropy		**constant** entropy				object	spill over			
Region	1	2	3	4	5	6	**7**	8	9	10	11

4. Results

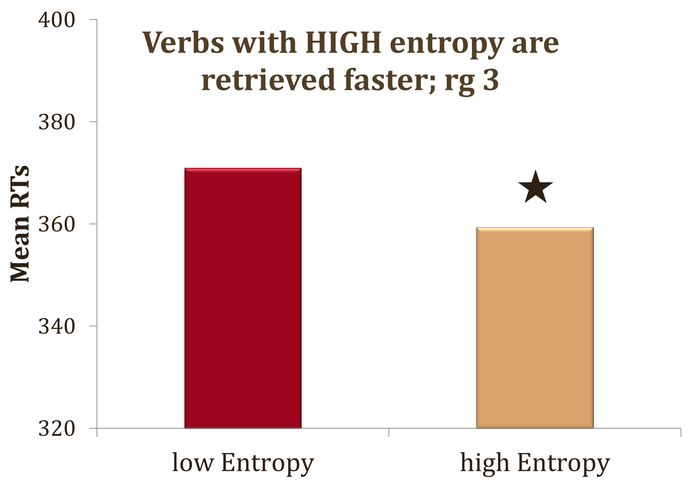
Repeated measures ANOVA revealed a significant interaction ($p<.05$) between entropy and object type ($r = 0.43$).

Post-hoc analyses show that high entropy verbs delay the processing of reflexives.

Multi-level analyses, with item and participant as random factors repeated the same results.



Additionally, in the region of verb retrieval, we replicated the findings of previous studies; high entropy verbs were retrieved significantly faster than low entropy ones ($p<.05$, $r = 0.35$).



Conclusion

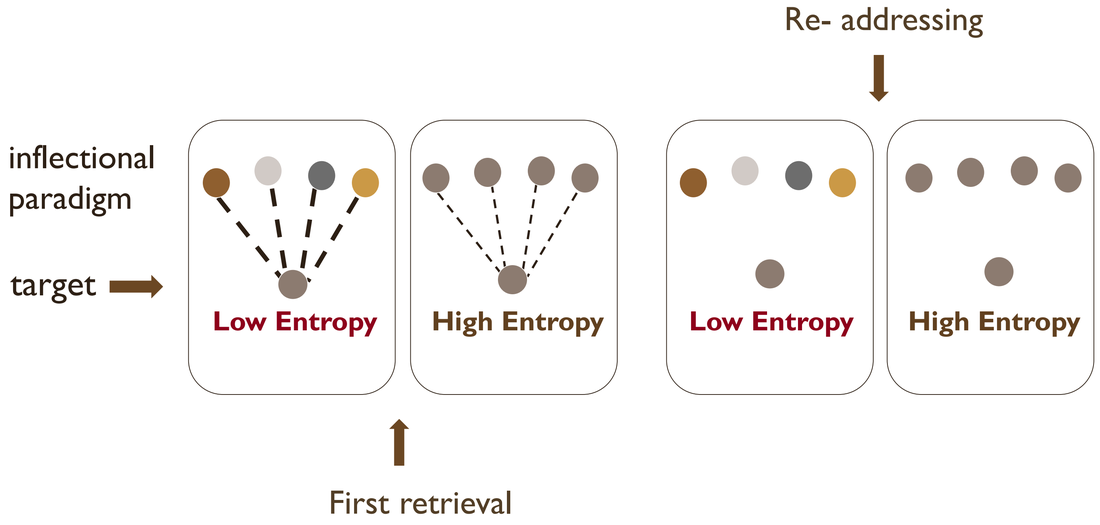
- Verbal entropy **modulates** the complexity of object integration.
- This happens **only** when the object requires an intra-sentential dependency; the case of reflexives.
- **Zichzelf** is processed **faster** when the intervening verb belongs to **low** entropy family.

WHY?

A **reflexive** has to access its referent in the subject position and therefore re-addresses the verb.

In the cases of verbs belonging to **high** entropy paradigms, the high uniformity of the distribution induces competition to the target form and processing is **slower**.

Contrary, when the distribution is more distinct, in the case of **low** entropy families, identifying and re-addressing the target form is easier and hence processing is **faster**.



References

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