SFB 1102
Information Density and Linguistic Encoding

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Inaugural Colloquium

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UNIVERSITÄT
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Research Focus

Language use

Language offers a wide range of options of how to encode a message

Linguistic variation

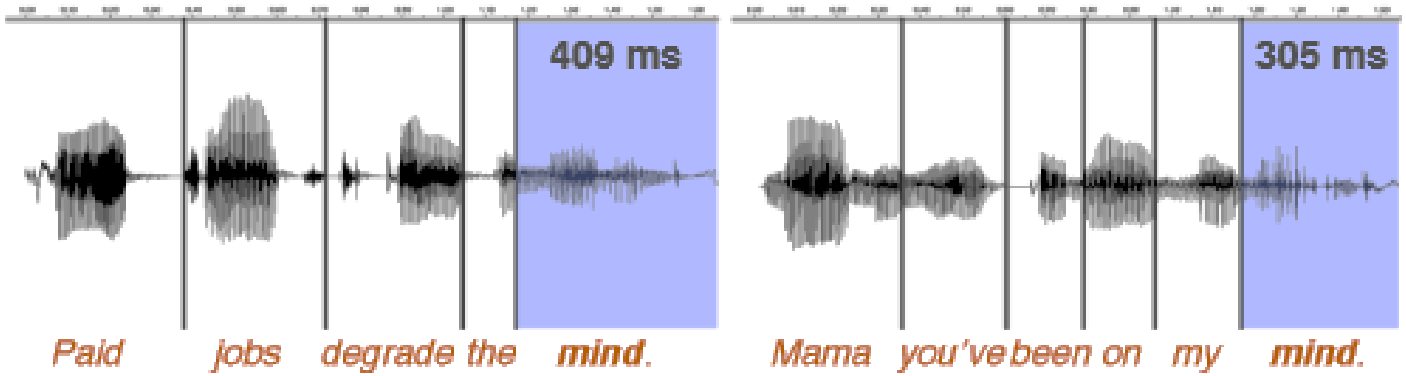
Variation is an inherent property of the linguistic system

1. a. *My boss confirmed that he is absolutely crazy.*
   b. *My boss confirmed he is absolutely crazy.*

2. a. *Wo soll ich das Zeugs hintun?*
   b. *Wohin mit dem Zeugs?*

3. a. *If this method of control were to be used, trains would operate more safely.*
   b. *The use of this control method leads to safer train operation.*

4. a. *Paid jobs degrade the mind.*
   b. *Mama you've been on my mind.*



Observations and Main Question

- Options are available at all levels of the linguistic system: phonetic, morphological, lexical, syntactic, discourse
- Choices are dependent on different kinds of context: local (e.g. syntactic, phonetic) vs. global (e.g. situation, text type)

Is there a unifying explanation?

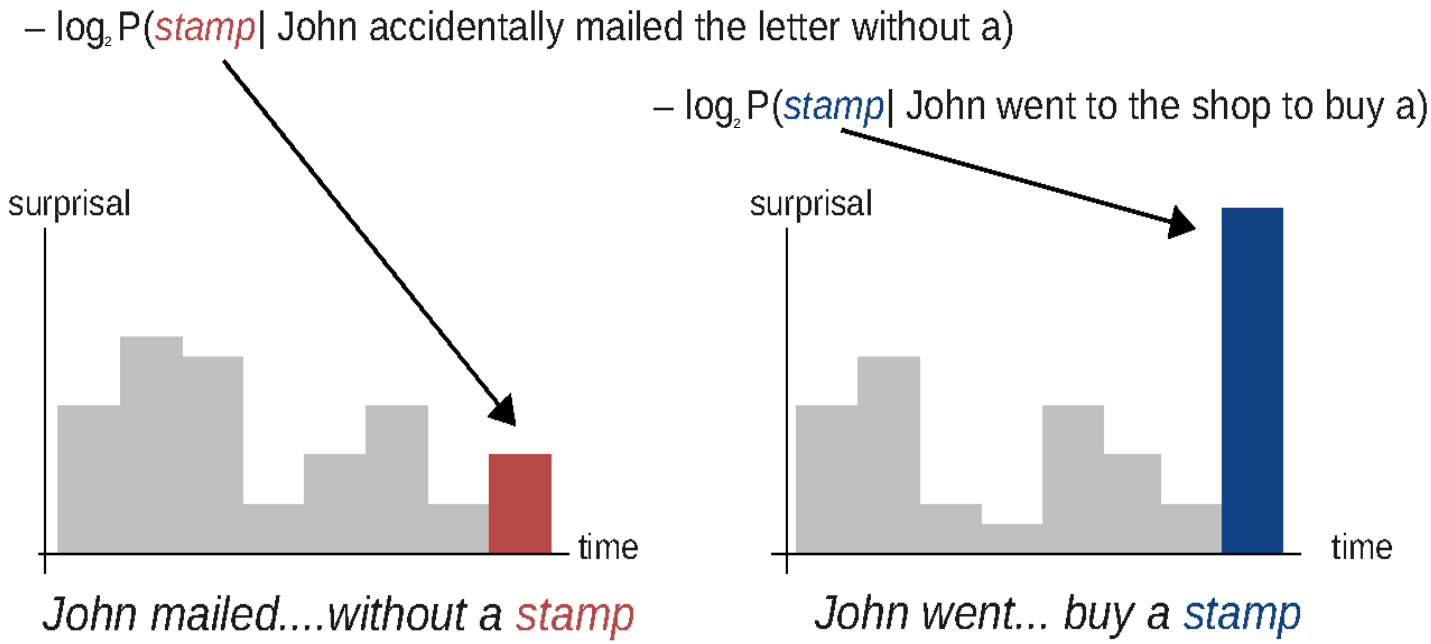
Hypothesis

- Language processing relies on predictability in context
- Contextually determined predictability can be appropriately indexed by the notion of information

Information Density
Surprisal

$$Surprisal(unit) = \log_2 \frac{1}{P(unit \mid \text{Context})} = -\log_2 P(unit \mid \text{Context})$$

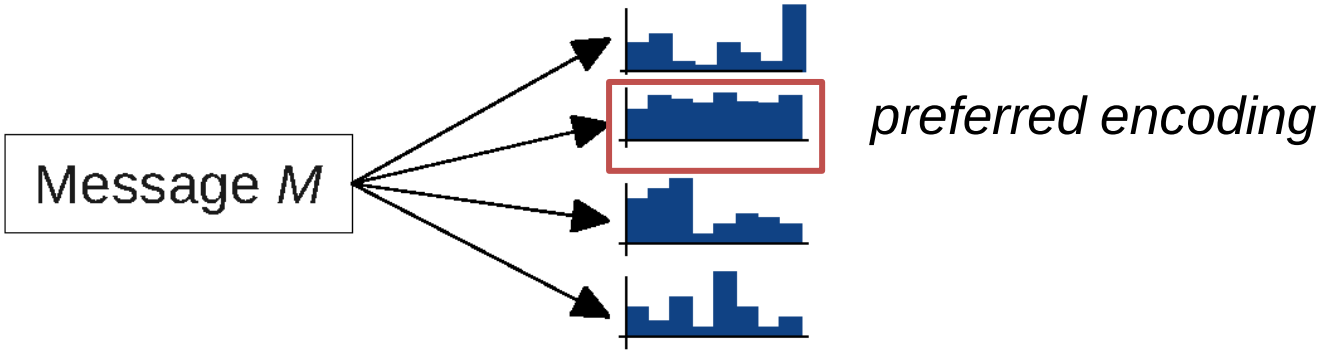
5. a. *John accidentally mailed the letter without a stamp.*
   b. *John went to the shop to buy a stamp.*



$$Effort(unit) \propto Surprisal(unit)$$

Uniform Information Density

- Speakers exploit linguistic variation to avoid peaks and troughs in information density
- Speakers modulate the order, density and specificity their linguistic encoding

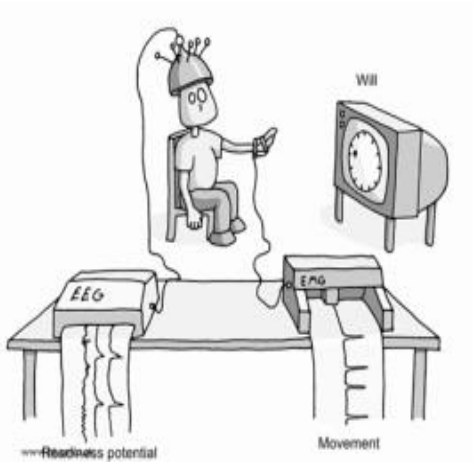


Goals

- Investigate the extent to which the notion of optimal distribution of information offers a common explanation of patterns of variation
- Investigate the role of different kinds of context as determinants of predictability
- Investigate linguistic encodings at different linguistic levels

$$
\begin{aligned}
Surprisal(unit) &= -\log_2 P(unit \mid \text{Context}) \\
&= -\log_2 P(word \mid \text{Script}) \\
&= -\log_2 P(syntactic\_unit \mid \text{Discourse}) \\
&= -\log_2 P(phone \mid \text{Collocation})
\end{aligned}
$$

Methods



experiment/corpus

derive

P(*unit* | Context)

design

validate

experiment

compare

analyze

corpus

production/comprehension

register, languages, diachrony

Contributions

Information theory for linguistic inquiry

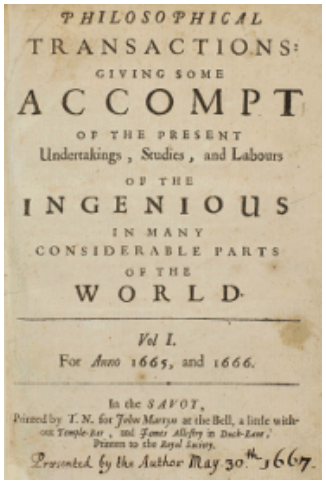
- Find communicative explanations for aspects of language use, variation and change
- Transcend disciplinary boundaries through one unifying approach: psycholinguistics, computational linguistics, phonetics, socio-linguistics, contrastive linguistics, historical linguistics, semantics

Research areas

A *Situational Context and World Knowledge*
Brings non-linguistic context into characterizations of surprisal

B *Discourse and Register*
Examines the relation between encoding and information density at the level of text

C *Variation in Linguistic Encoding*
Offers information density explanations for encoding choices across linguistic levels and languages



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Today's Program

11:00 Guest talk: **Ted Gibson** (MIT)
Language for communication: Language as rational inference

lunch break

13:00 **Francesca Delogu** (Projekt A1)
Script-based surprisal: Evidence from event-related potentials

13:20 **Ekaterina Kravtchenko** (Projekt A3)
The processing of predictable events in a script context

13:40 **Hannah Kermes** (Projekt B1)
Information density and scientific literacy in English – preliminary analyses using language modeling

14:00 **Vera Demberg** (Projekt B2)
On the information conveyed by discourse connectives

14:20 **Zofia Malisz** (Projekt C1)
The relationship between information rate and speech rate in several European languages

coffee break

15:00 SFB 1102 Poster Session

16:00 Guest talk: **Florian Jaeger** (Rochester)
Processing efficiency shapes language: Natural languages have lower than expected information density

Evening event