Granularity of Prediction for English Verb Continuations
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Introduction

How, and with what degree of specificity, do we predict a verb’s upcoming continuation?

• The brain is sensitive to syntactic properties of verbs encountered in isolation.a,b,c
• Greater subcategorization frame (SCF) entropy (i.e. greater uncertainty about a verb’s upcoming continuation/category) → less LATL activityd

SCF Entropy = \sum_i P(x) \log_2 P(x)

SCF Entropy (Verb) = -(0.4) \log_2 P(0.4) - (0.35) \log_2 0.35 - (0.25) \log_2 0.25

• How do we know that SCFs govern continuation prediction/selection, and not some underlying subtypes?
• Grimshaw⁴ - complement selection achieved through interaction of syntactic frames and semantic subtypes.
• Could a measure calculated from a more granular set of frames (i.e subtypes) outperform traditional SCF entropy?

Methods

• Two new variables to compare with SCF Entropy

1. Granular SCF Entropy
Granularized SCF entropy, with prepositional phase continuations split into subtypes based on individual prepositions

2. Bigram Entropy
Entropy over each lemma that can follow the verb

Behavioral (n = 340) and MEG (n = 19) lexical decision experiments – 400 English verbs
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• Multiple regression on correct verb trials—# of senses, length, log frequency included in models
• MEG analysis – spatiotemporal cluster tests confined to the left temporal lobe.

Behavioral Results

Model 1: Traditional SCF Entropy and Bigram Entropy

Model 2: Granular SCF Entropy and Bigram Entropy

MEG Results

Granular SCF Entropy
• 100-175 ms
• p = .031
• Greater entropy elicits less (negative) activity
• Covers temporal pole and some of medial temporal lobe

Bigram Entropy
• 215-320 ms
• p = .024
• Greater entropy elicits more (negative) activity
• Cluster covers much of STG

Granularity of SCF Entropy better predicts behavioral and neural responses better than traditional—comprehenders’ representations of upcoming categories may be more granular than previously thought.e
• Granular SCF Entropy effects support conservative prediction hypotheses, where low entropy elicits greater commitment to predictions:

Conclusions

• Granular SCF and Bigram Entropy effects—representation of continuations on multiple levels?
  • Sensitivity to categories early, anterior
  • Sensitivity to lexical items later, posterior

• Future investigations:
  • How to further granularize Granular SCF Entropy?
  • Why the opposite RT/MEG effects for Bigram SCF Entropy?

References


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