Neural reality of argument structure constructions

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Overview

We find evidence of argument structure constructions in neural language models.

Adapting psycholinguistic studies is a promising way of probing LMs.

Argument structure constructions

Transitive S V O	*Bob cut the bread* S acts on O
Ditransitive S V O1 O2	*Bob cut Joe the bread* S transfers O2 to O1
Caused motion S V O Path	*Bob cut the bread into the pan* S causes O to move via Path
Resultative S V O State	*Bob cut the bread apart* S causes O to become State

Lexicalist view: Main verb of sentence determines meaning.

X kicks Y Z (John kicks Mary the ball)
KICK(agent=X, recipient=Y, theme=Z)

Constructionist view: Syntactic structures can have meaning (eg: ditransitive = transfer).

X Verb Y Z
X transfers Z to Y (with manner Verb)

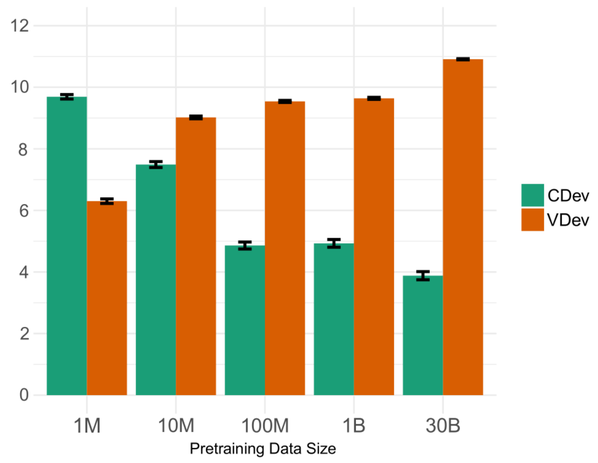
Case study #1: Sentence sorting

Based on Bencini and Goldberg (2000)

Human experiment: Participants sorted 16 sentences (4 verbs x 4 constructions) into 4 groups, analyze whether they sorted by verb or construction.

Human result: L1 speakers sorted by construction; L2 learners sorted by verb (beginners) => construction (advanced).

LM experiment: Use RoBERTa (30B tokens) and MiniBERTas (1M, 10M, 100M, 1B tokens), cluster sentence embeddings, measure construction and verb sorting deviation.



LM result: Constructions contribute to sentence meaning more than verbs. Bigger LMs increasingly prefer construction sort, similar to humans.

Case study #2: Jabberwocky constructions

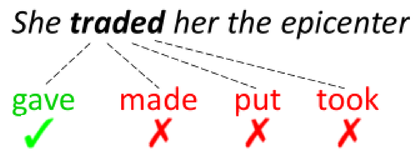
Based on Johnson and Goldberg (2013)

Human experiment: Structural priming:

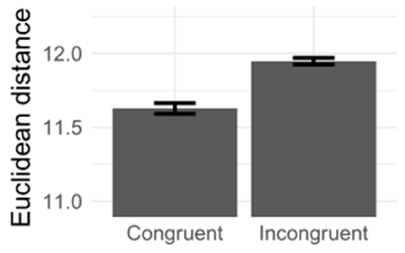
He daxed her the norp

Is "gave" or "tobe" a real word?

Human result: Faster response times when verb meaning matches construction (ie, construction primed the associated verb).



LM experiment: Generate "Jabberwocky" sentences from construction templates, measure RoBERTa semantic distance between Jabberwocky verb and prototype verb.



LM result: Lower embedding distance in congruent condition. RoBERTa can associate meaning to Jabberwocky constructions without help from lexical overlap.