Are Neural Networks Compositional, and How Do We Even Know?

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Location Attention for Extrapolation to Longer Sequences

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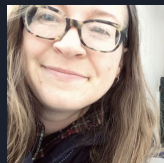**Elia Bruni***
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Do Language Models Understand *Anything*?
On the Ability of LSTMs to Understand Negative Polarity Items

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Language Models Use Monotonicity to Assess NPI Licensing

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Under the Hood: Using Diagnostic Classifiers to Investigate and Improve how Language Models Track Agreement Information

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Compositionality Decomposed: How do Neural Networks Generalise?

Generalising to German Plural Noun Classes, from the Perspective of a Recurrent Neural Network

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The Paradox of the Compositionality of Natural Language: A Neural Machine Translation Case Study

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Masked Language Modeling and the Distributional Hypothesis: Order Word Matters Pre-training for Little
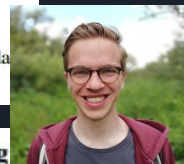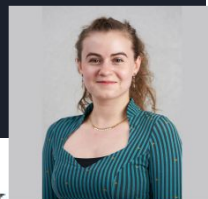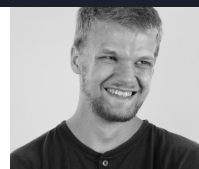
Koustuv Sinha[†‡] **Robin Jia**[†] **Dieuwke Hupkes**[†] **Joelle Pineau**[†‡]

Adina Williams[†] **Douwe Kiela**[†]
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Language Modelling as a Multi-Task Problem

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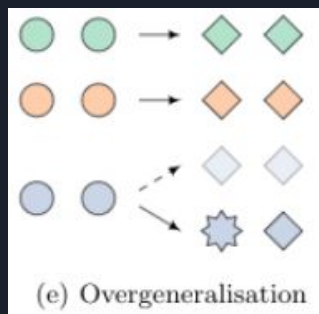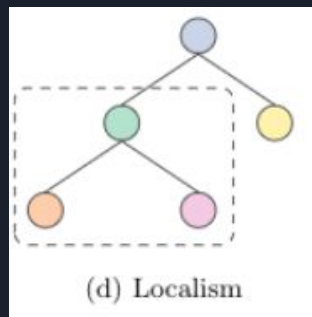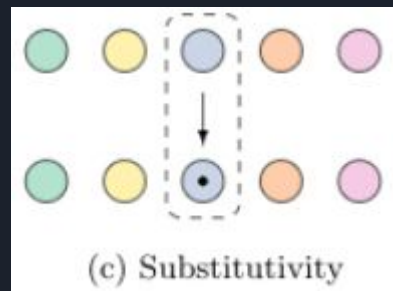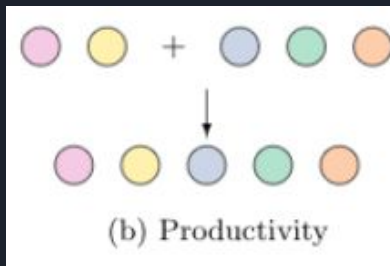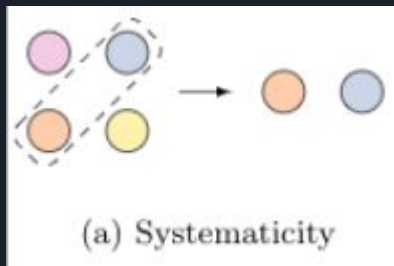Facebook AI Research
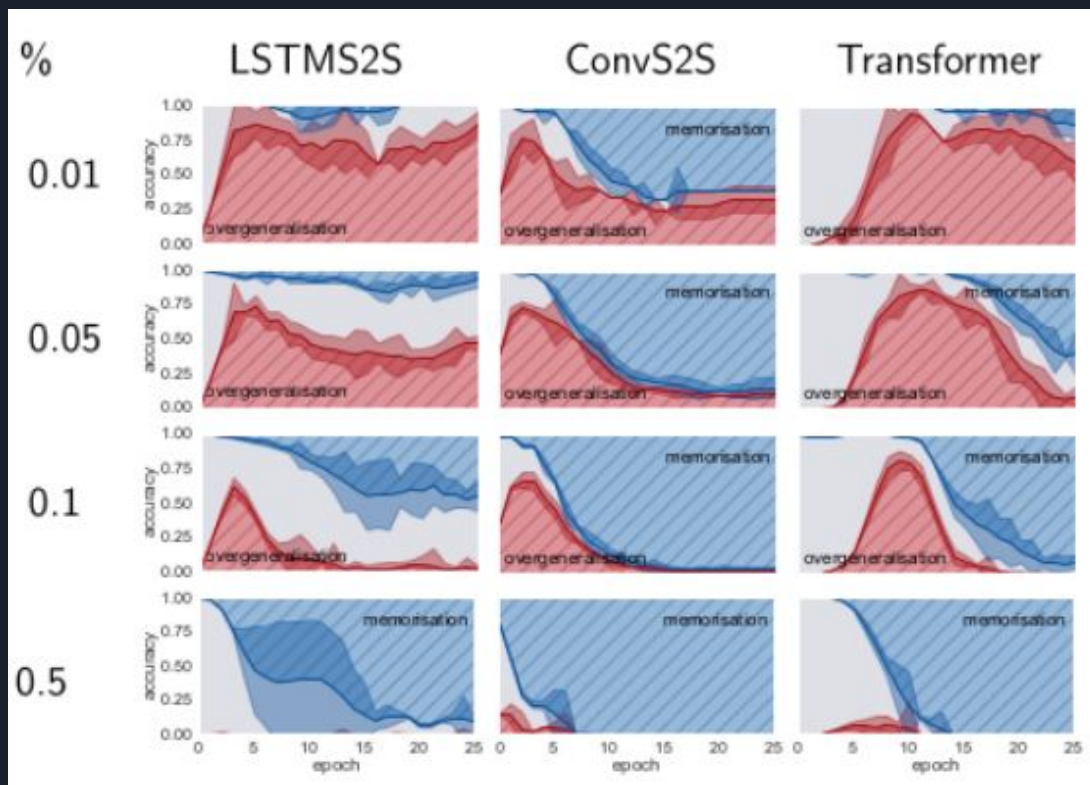dieuwkehupkes@fb.com

Lucas Weber

In translation between other domains (logical languages, programming languages), compositional translation is almost trivially a sound approach, as the expressions of such languages are completely unambiguous and the compositional system according to which the meaning can be derived is known. Natural language has neither of these qualities, which does not only complicate the construction of a compositional translation system, but also renders the existence of such a system uncertain
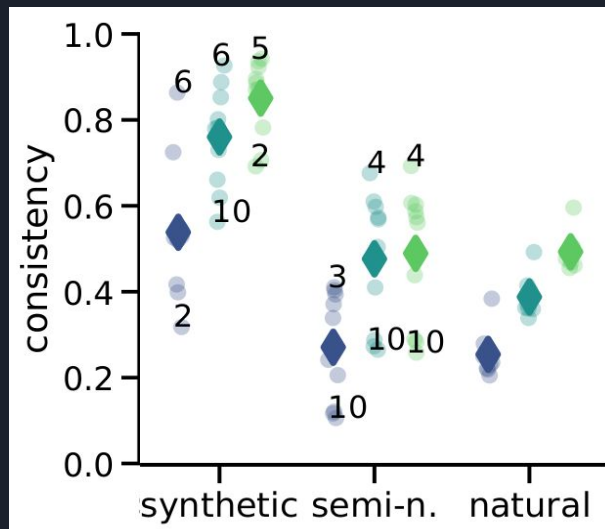
How do you evaluate compositionality?

(a) Systematicity

(b) Productivity

(c) Substitutivity

(d) Localism

(e) Overgeneralisation

Hupkes, Dankers, Mul,Bruni, E. (2020). Compositionality decomposed: How do neural networks generalise? JAIR

Overgeneralisation profiles

Compositionality in natural language

The father avoids the director , and the boys criticise the leader .

The lawyers think that the boys cry , and the boys criticise the leader .

S1 → S3

An example of our substitutivity test

The mother that travels by (aeroplane|airplane) wants to facilitate the development of innovative practices in education and training at tertiary level, and their transfer, including from one participating country to others.

De moeder die per vliegtuig reist wil de ontwikkeling van innovatieve praktijken op de gebied van onderwijs en opleiding op tertiair niveau, en de overdracht daarvan, ook van de ene deelnemende land naar de andere, vergemakkelijken.
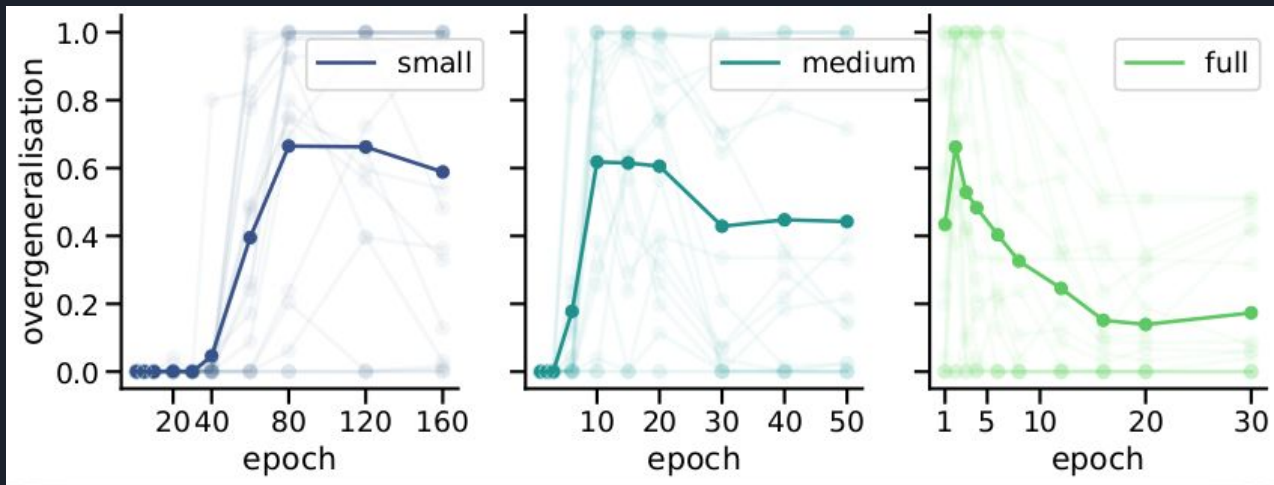
De moeder die per vliegtuig reist wil de ontwikkeling van innovatieve praktijken op de gebied van onderwijs en opleiding op tertiair niveau, en hun overdracht, waaronder van de ene deelnemende land naar de andere, vergemakkelijken.

Overgeneralisation

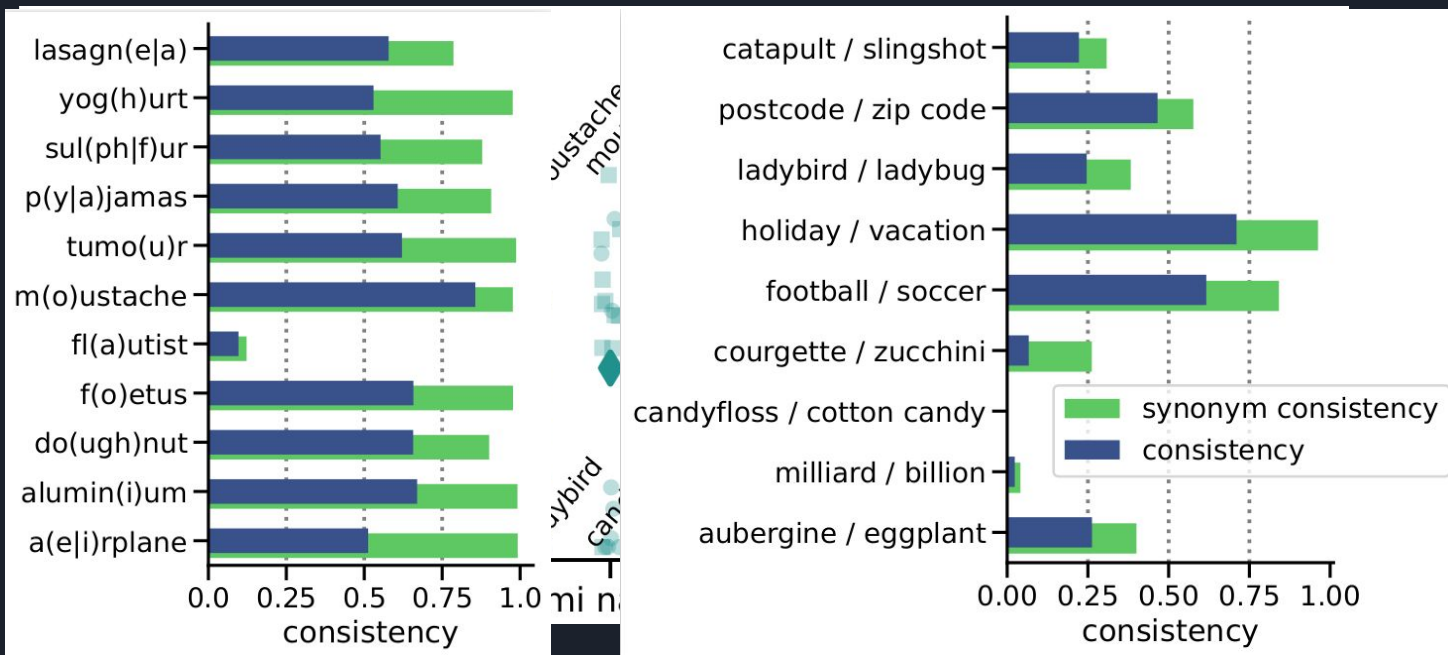You guys are out of your minds!

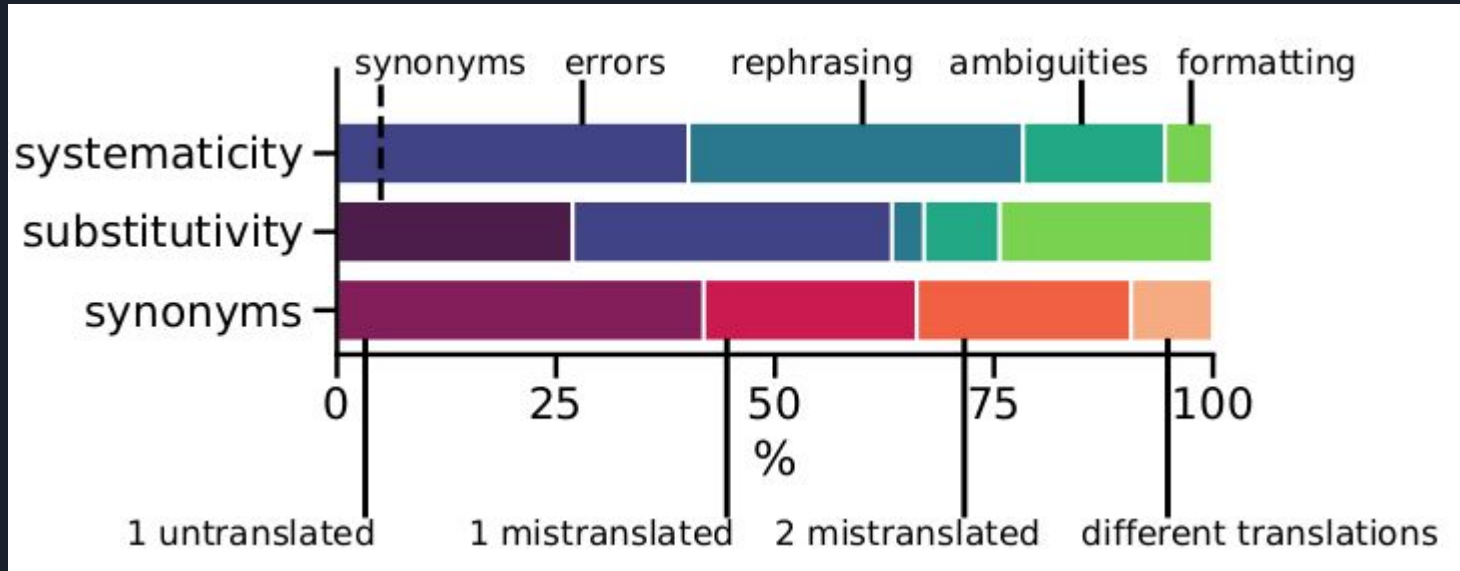Jullie zijn niet goed wijs.

Jullie zijn uit je hoofd.

Substitutivity

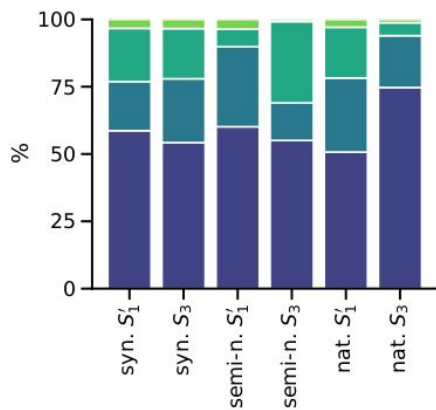Okay , this is not as sensational as a radio-control aeroplane , but it's a lot quieter.

Okay , this is not as sensational as a radio-control airplane , but it's a lot quieter.
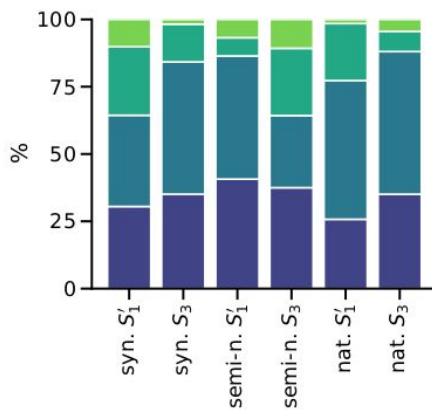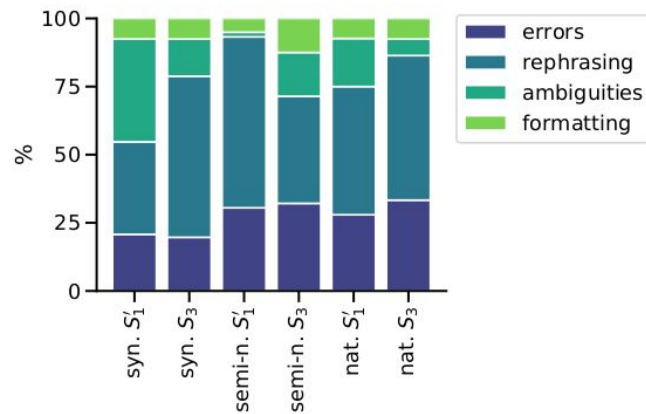
What are those inconsistencies?

How many of these changes are wrong?

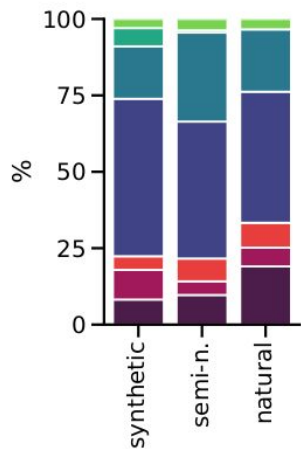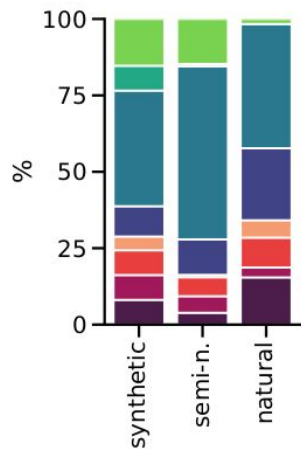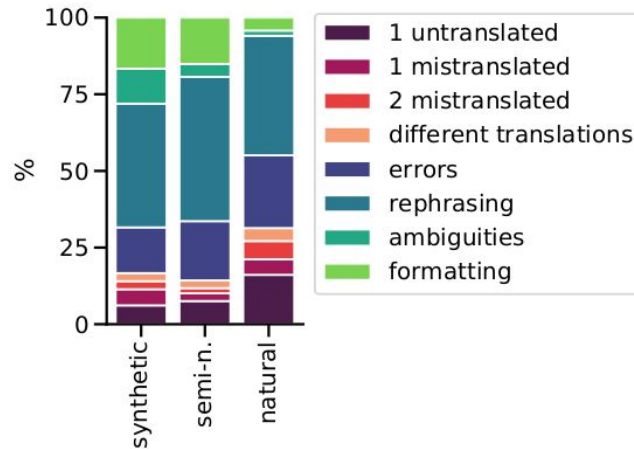(a) Small training set size   (b) Medium training set size   (c) Full training set

How many of these changes are wrong?

(a) Small training set size   (b) Medium training set size   (c) Full training set

Legend:
- 1 untranslated
- 1 mistranslated
- 2 mistranslated
- different translations
- errors
- rephrasing
- ambiguities
- formatting

So?

- *How do we distinguish problematic uncompositional behaviour from unproblematic uncompositional behaviour.*

- *How do we distinguish "needed" uncompositional behaviour from "unneeded" uncompositional behaviour?*

- *Are the models trained on more data really more compositional, or is compositionality just not needed as much when we have tons of data?*

- *How compositional is language, really?*

Thank you

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