Some Innate Characteristics of Neural Models of Morphological Inflection

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Overview

Neural Network Models of Morphological Inflection (NNMIs)

- Deep relevance to cognitive science stemming from **Past Tense Debate**

Criticisms of Connectionism

- Don't learn from **realistic input**
- **Over-irregularize** too much
- No developmental **regression**

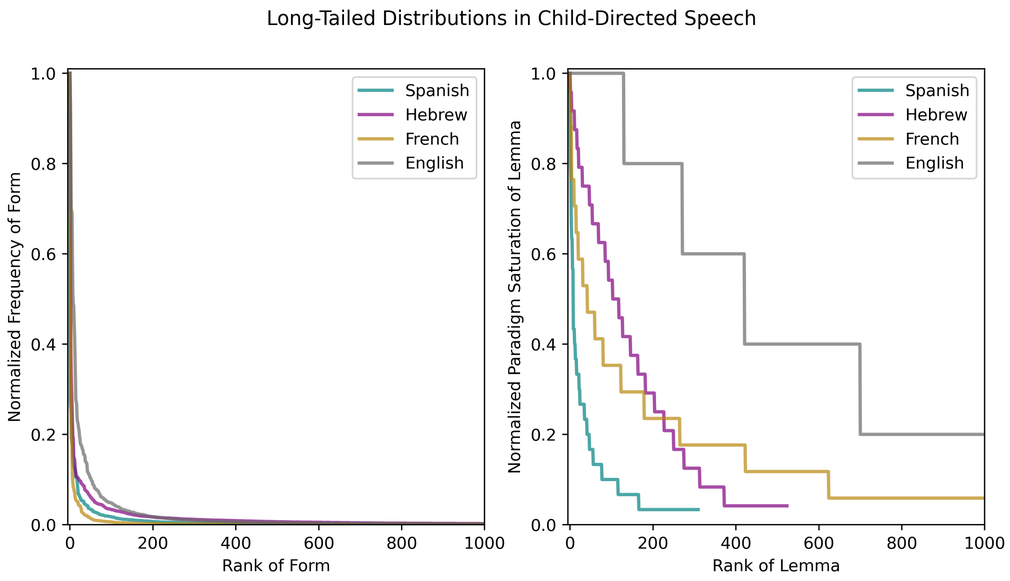
Impressive improvements in NNMI **architecture and accuracy** since the 1990s.

Have modern NNMIs solved the old problems of developmental realism?

Problem 1: Sparsity of the Input

Input to the Child

- **500-1,000** word types total

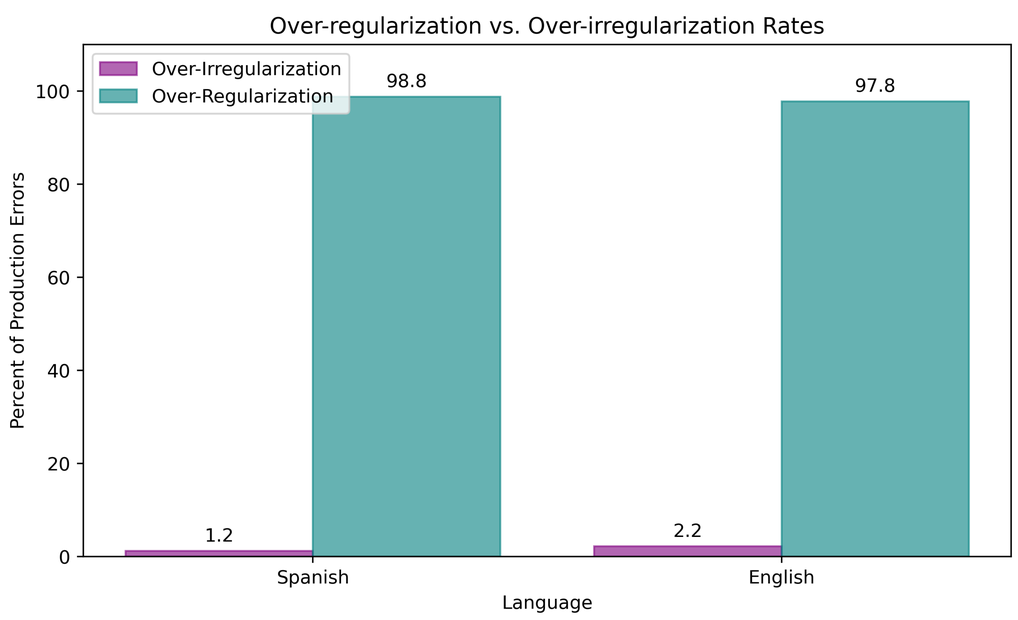


Input to NNMIs

✅ Rumelhart & McClelland 1986: **420 verb lemmas**
❌ Kirov & Cotterell 2018: **3,500 verbs in full paradigm**
❌ Dankers et al. 2021: **46,000 noun plurals**
❌ Warstadt & Bowman 2022: **100 million word tokens**

Problem 2: Over-Irregularization

Child Error Distributions



Error Distributions by NNMIs

Corkery et al. 2019:

❌ **KC2018 ED** over-irregularizes regular test items ***(thin-thun)***
❌ Overproduces irregularized forms compared to humans

Gorman et al. 2019:

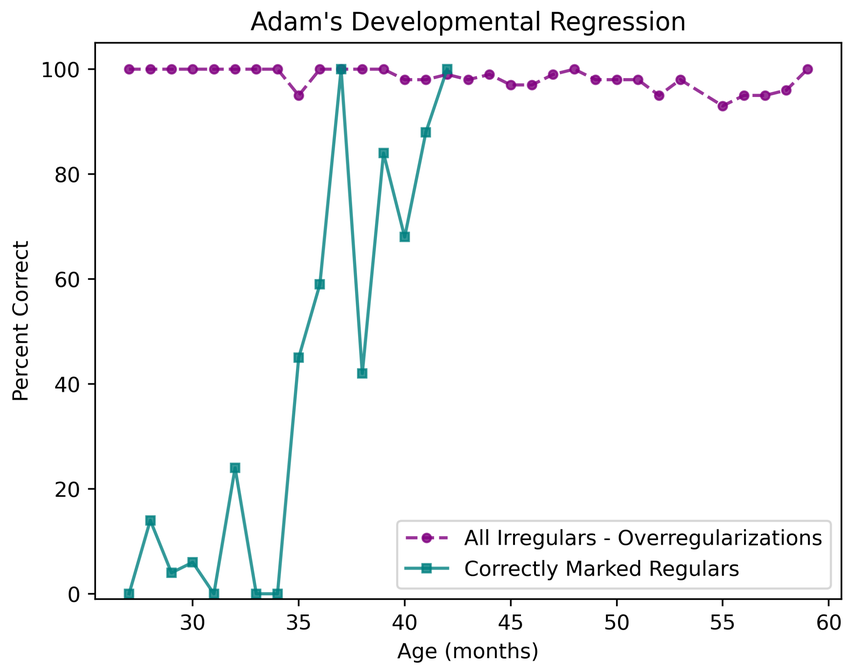
❌ **Bergmanis et al. 2017 RNN** & **Makarov 2017 ED** make a number of "silly" errors ***(mail-membled)*** on 11/12 languages tested

Kodner et al. 2023:

❌ **Wu et al. 2021 transformer** & **Wehrli et al. 2022 transducer** over-irregularize too frequently in English & Arabic

Problem 3: Developmental Regression

Child Developmental Regression



Developmental Regression by NNMIs

Pinker & Prince 1988

❌ **RM1986** forced developmental regression with **artificial input**

Belth et al. 2021

❌ **KC2018** report **oscillations over epochs**, not regression
❌ When trained on incrementally larger data, **no regression**

Kodner et al. 2023:

❌ Neither **Wu et al. 2021** nor **Wehrli et al. 2022** exhibit regression in **Arabic or English**

Conclusions

Despite impressive improvements in **architecture and accuracy**, modern NNMIs still:

- ❌ Don't learn from **realistic input**
- ❌ **Over-irregularize** too much
- ❌ No developmental **regression**

The **persistence of these shortcomings** despite advancements in architecture and performance suggests that they reflect **"innate" characteristics of NNMIs** as a class of learner.

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