



Modeling the Inflectional/Derivational Dissociation in Agrammatic Aphasia with a RNN

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Two Categories of Morphology

Inflectional

"walked"	walk <u>ed</u>
"chairs"	chair <u>s</u>

Meaning Preserved

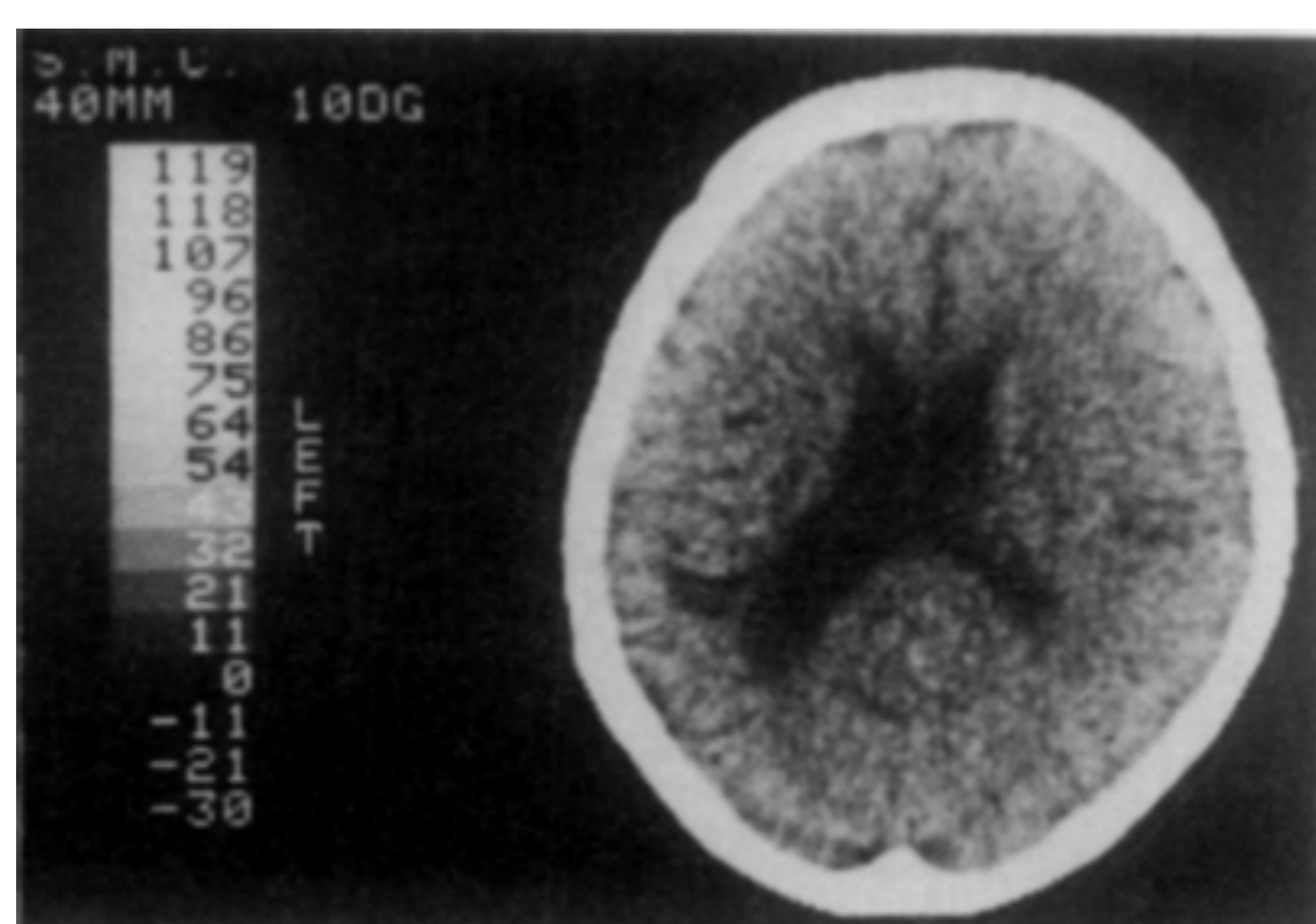
Derivational

"painter"	paint <u>er</u>
"redo"	re <u>do</u>

Meaning Changed

The Inflectional Deficit

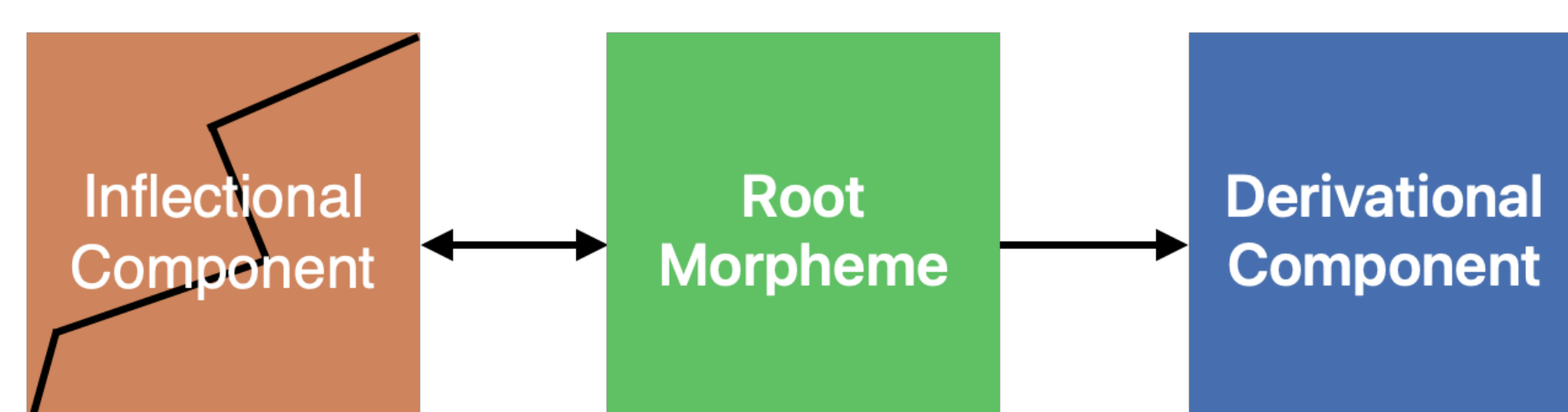
People with aphasia regularly make more errors while producing inflectional morphemes [1]. This has been observed cross-linguistically in cases of agrammatic aphasia [2].



Large lesions visible in the left hemisphere.

Traditional Explanation

Miceli & Caramazza theorized two components that each controlled one type of morphology. F.S. would have a problem with one of these components.



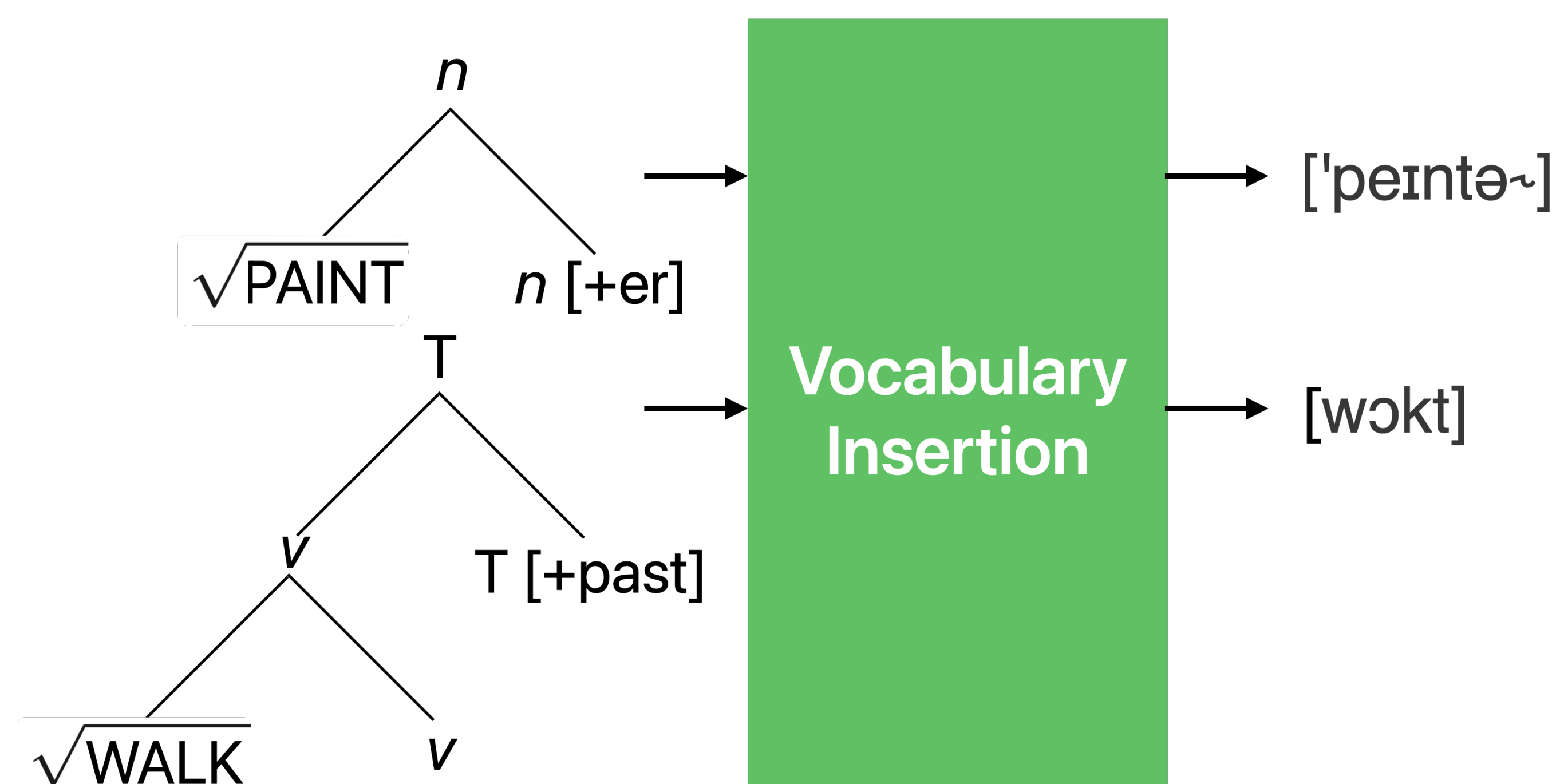
Code used:



References: [1] Miceli, G., & Caramazza, A. (1988). Dissociation of Inflectional and Derivational Morphology: Brain and Language, 35, 24–65. [2] Gheitury, A., Dianat, L., & Rezaei, S. T. (2017). Dissociation of Inflectional and Derivational Morphology in Persian: Evidence from Aphasic Patients. Journal of Modern Rehabilitation, 11(1), 37–44. [3] Embick, D. (2021). The Motivation for Roots in Distributed Morphology. Annual Review of Linguistics, 2021(7), 69–88. [4] Coleman Haley, Edoardo M. Ponti, and Sharon Goldwater. 2023. Language-Agnostic Measures Discriminate Inflection and Derivation. In Proceedings of the 5th Workshop on Research in Computational Linguistic Typology and Multilingual NLP, pages 150–152, Dubrovnik, Croatia. Association for Computational Linguistics. [5] Goslin, J., Galluzzi, C., & Romani, C. PhonItalia: a phonological lexicon for Italian. Behav Res 46, 872–886 (2014). <https://doi.org/10.3758/s13428-013-0400-8> [6] Kirov, C., & Cotterell, R. (2018). Recurrent neural networks in linguistic theory: Revisiting pinker and prince (1988) and the past tense debate. Transactions of the Association for Computational Linguistics, 6, 651–665. [7] Wu, S., Cotterell, R., & Halden, M. (2021). Applying the Transformer to Character-level Transduction. European Chapter of the Association for Computational Linguistics. <https://doi.org/10.48550/arXiv.2005.10213>

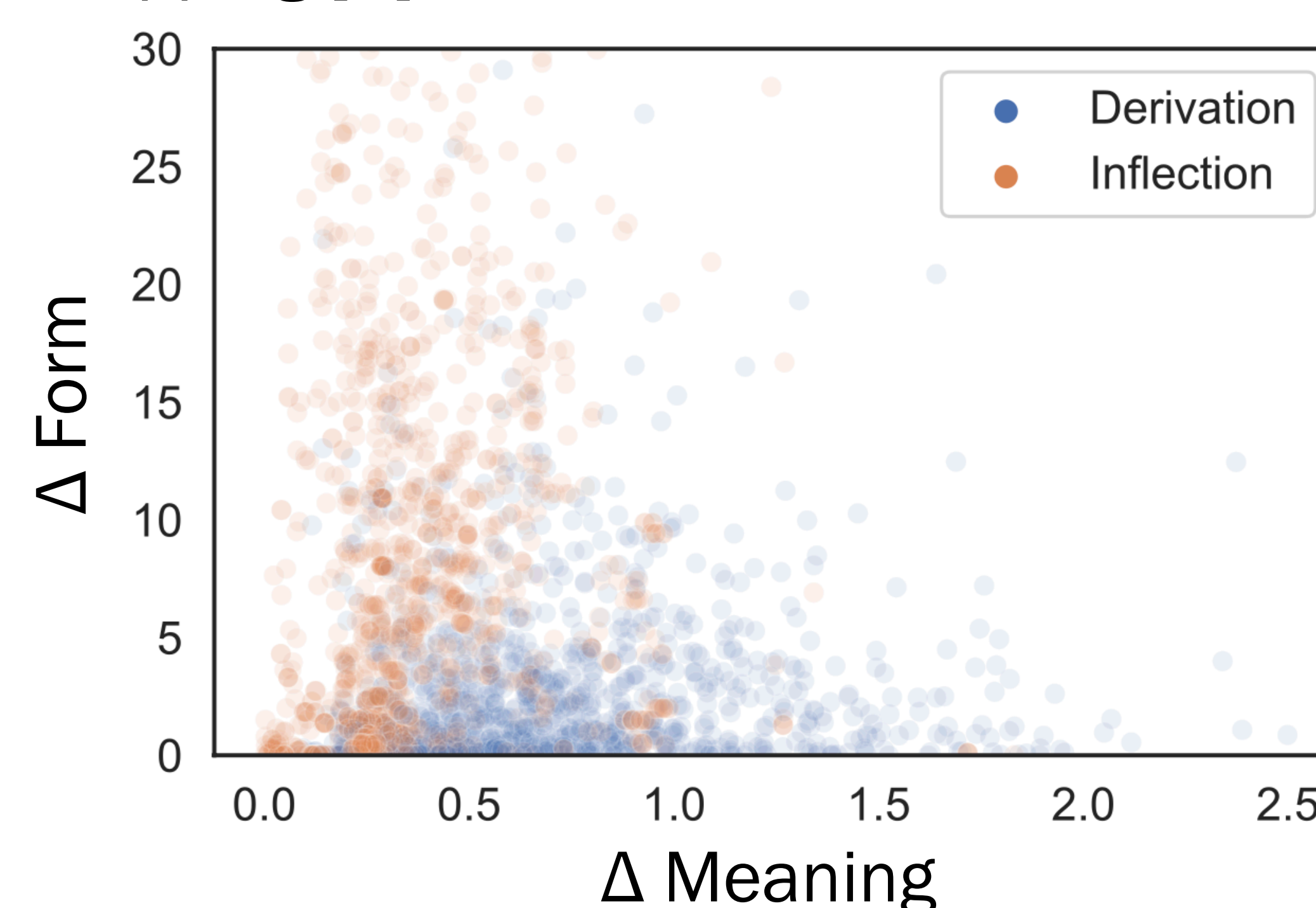
Modern syntax

One process to give phonological form to an abstract syntactic object [3].



Motivation: Dichotomy vs Continuum

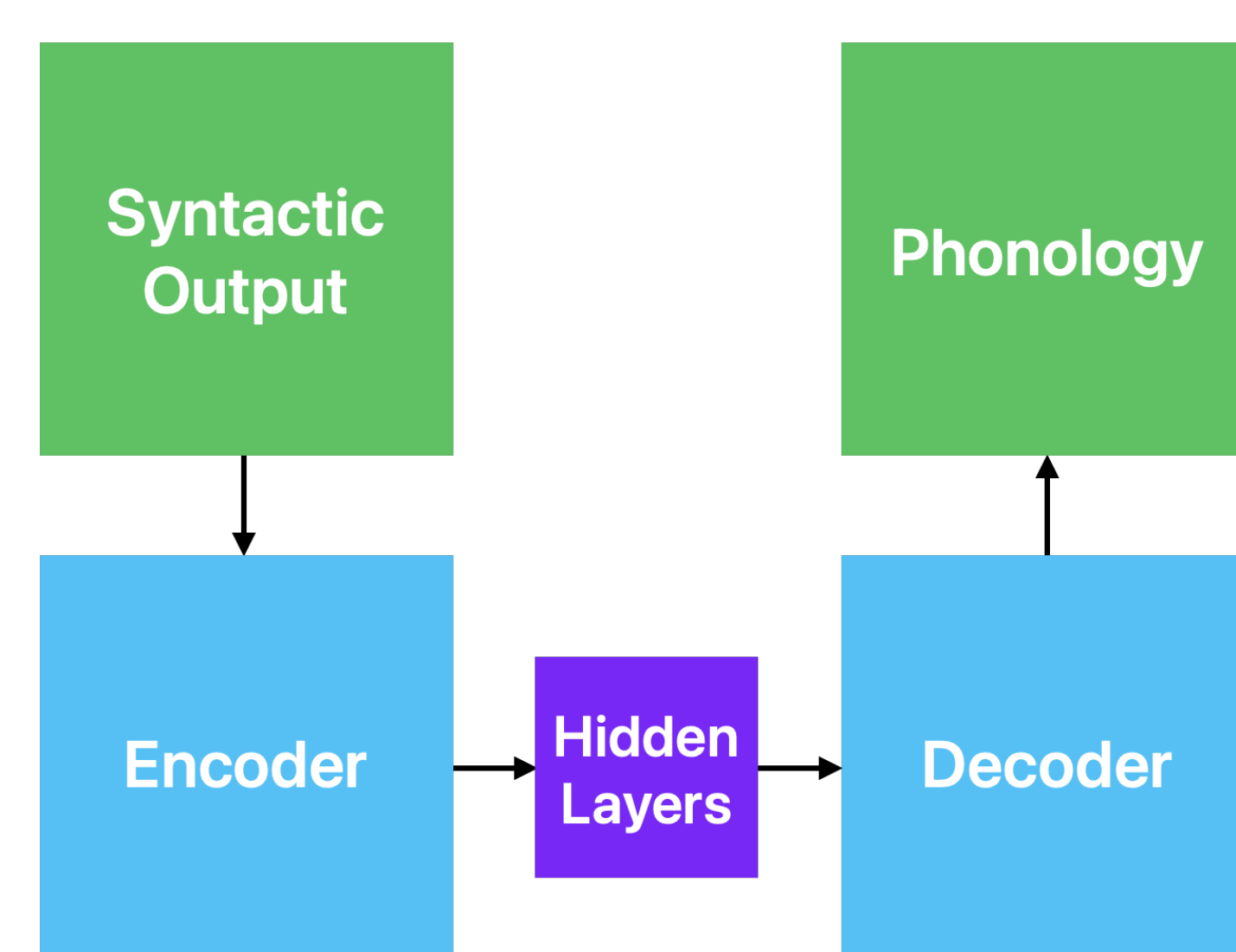
A cross-language study showed that these categories may be overlapping [4].



The Encoder-Decoder

The data: Italian phonology data from PhonItalia [5], morpheme data from spaCy and nltk

The model: Encoder-Decoder architecture, originally designed for translation [6]

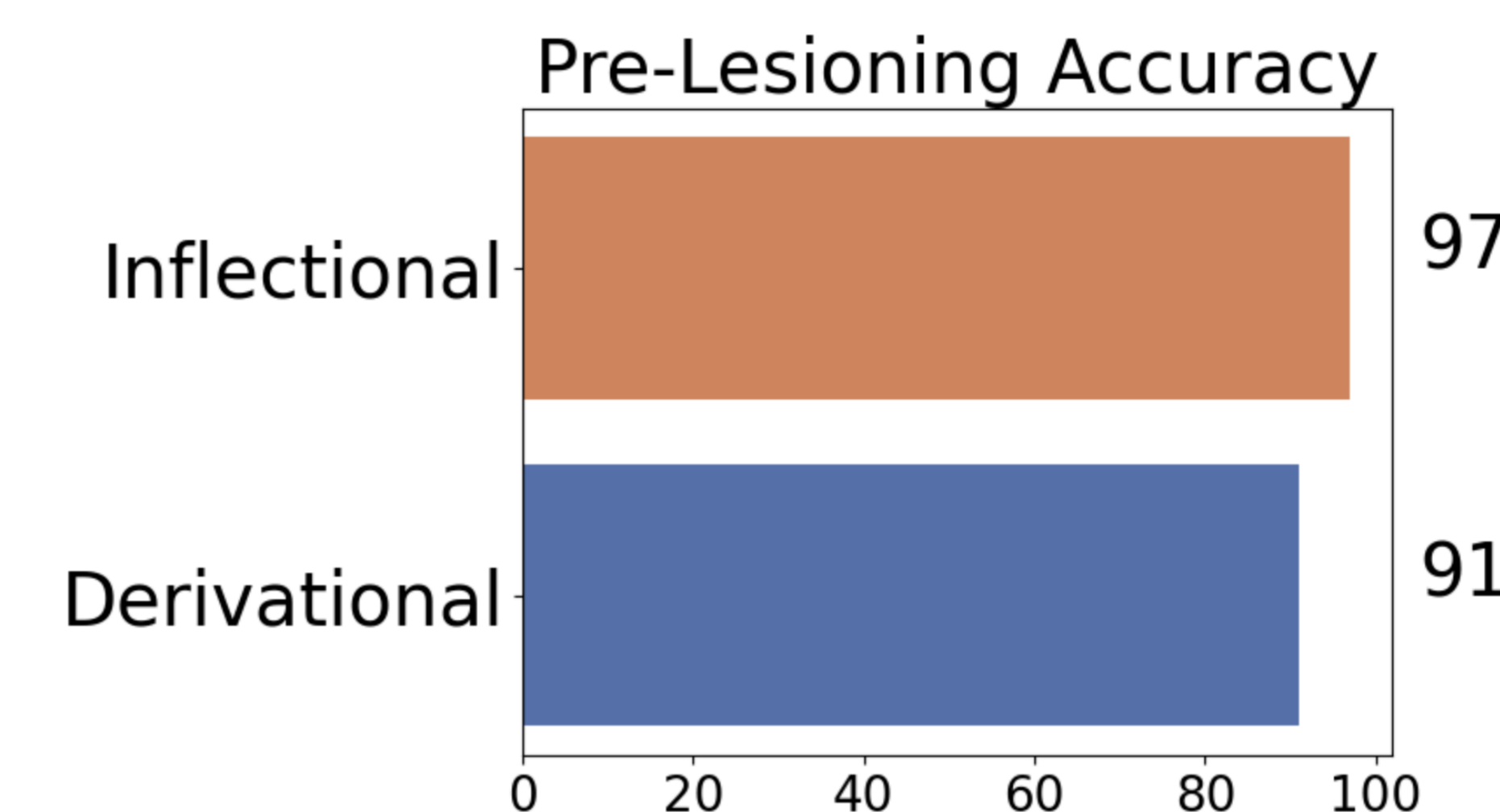


The training: Use perplexity sampling to focus on least-confident inputs

The testing: Lesion the model at 5% increments, test on a balanced subset of the training verbs

Preliminary Training

The training goal is to replicate the skill level of a native Italian speaker.

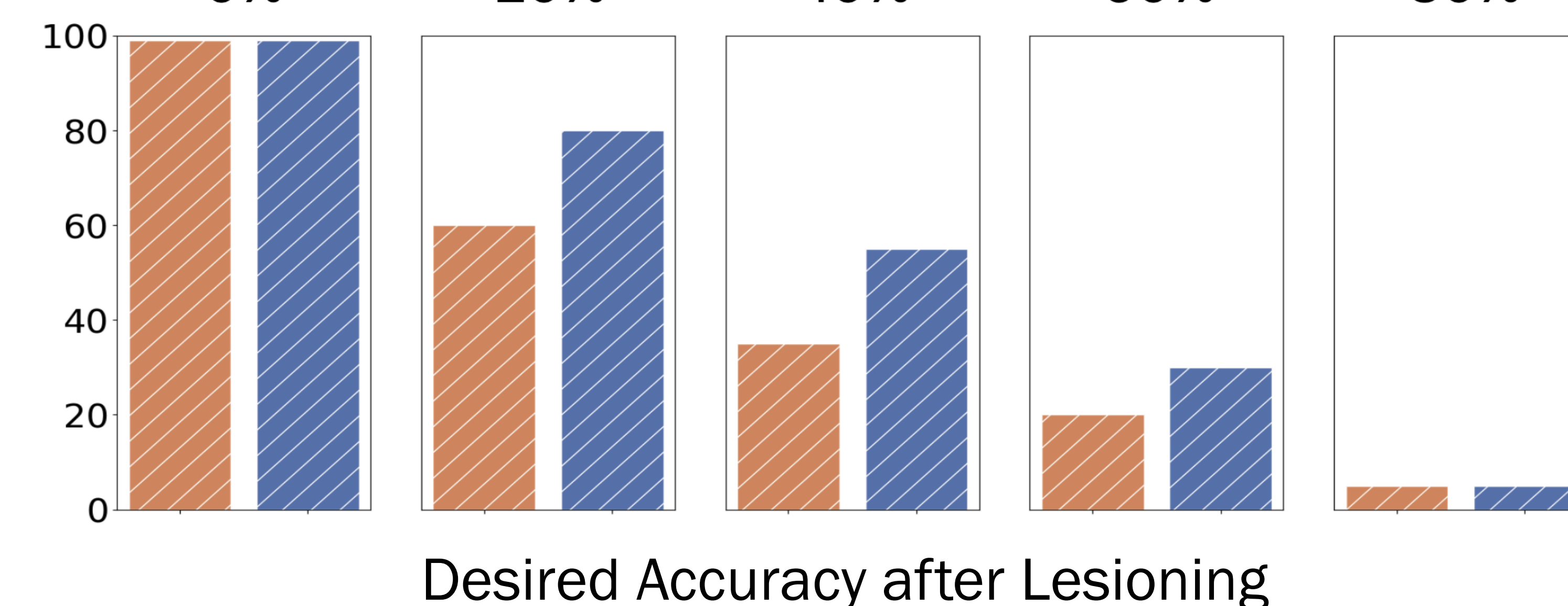
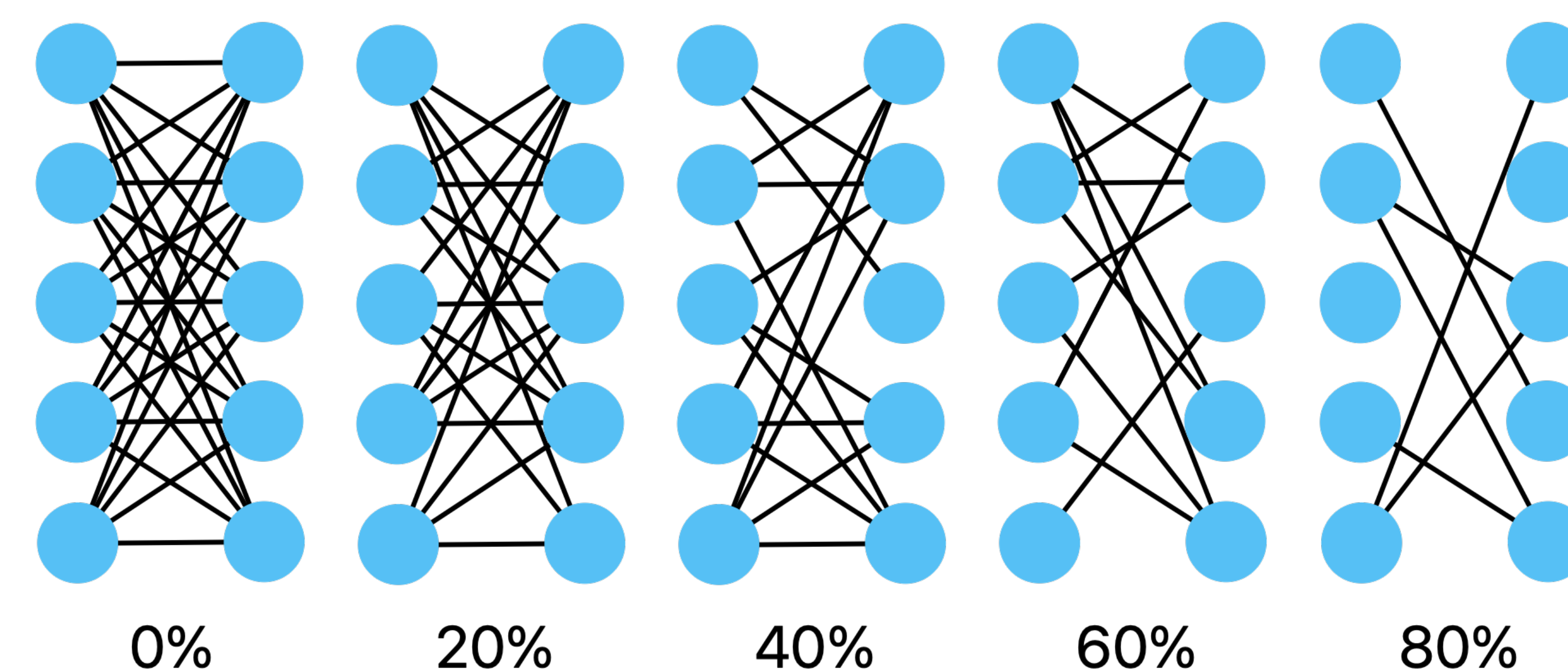


Used large batch size and increased dropout as according to [7].

Can lesioning a model with a single component explain the dissociation in the data of people with aphasia?

Lesioning

To model agrammatic aphasia, we will randomly set some proportion of the model's weights to 0.



If lesioning the single-route model can replicate the clinical data, we argue that there is no neural distinction between these classes of morphemes.