

Variables Must be Limited to a Single Feature

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Proposal

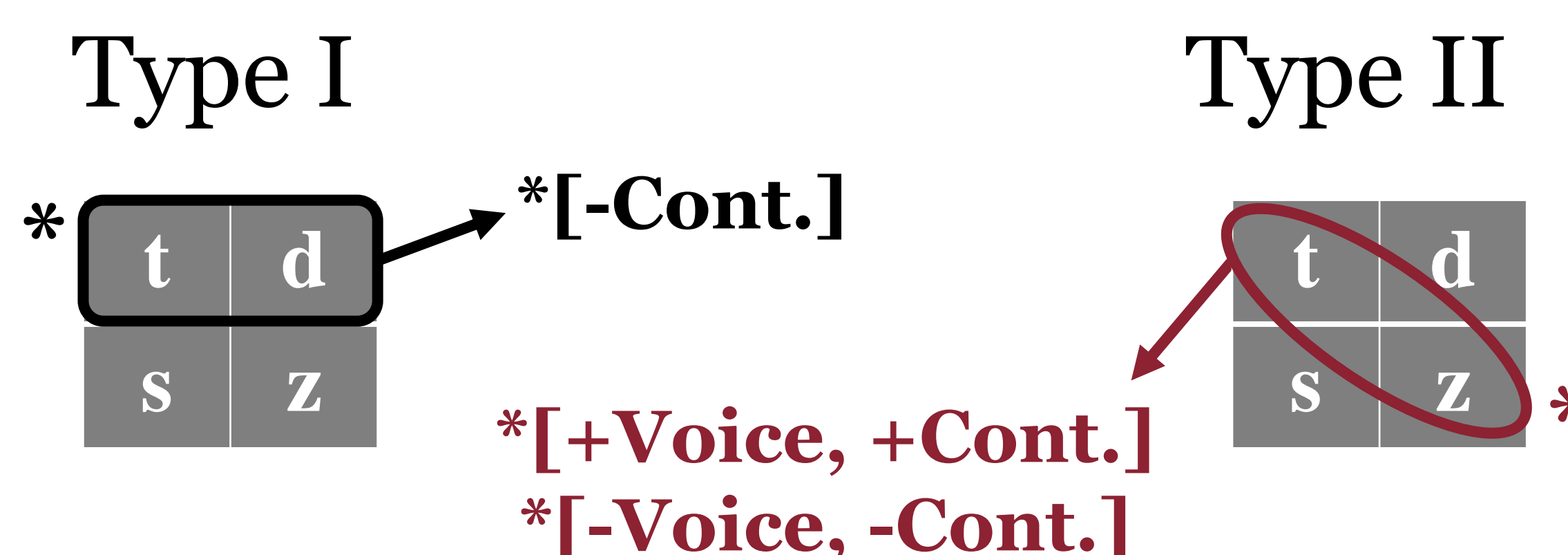
- Since they were first proposed (Halle 1962), algebraic variables (often called *alpha notation*) have primarily been used for assimilation and dissimilation.
- For example, a voicing assimilation process could be represented with two unrelated rules/constraints:
 - [-Syllabic] → [+Voice] / _ [+Voice] *[-Voice][+Voice]
 - [-Syllabic] → [-Voice] / _ [-Voice] *[+Voice][-Voice]
- Or a single rule/constraint that uses variables:
 - [-Syllabic] → [αVoice] / _ [αVoice] *[-αVoice][αVoice]
- Here I'll show that if variables like this are not limited to occurring on a single feature at a time, they:
 - Oversimplify Type II phonotactic patterns
 - Cause the Type I ≫ Type II learning bias normally predicted by MaxEnt models to disappear

Unconstrained Variables

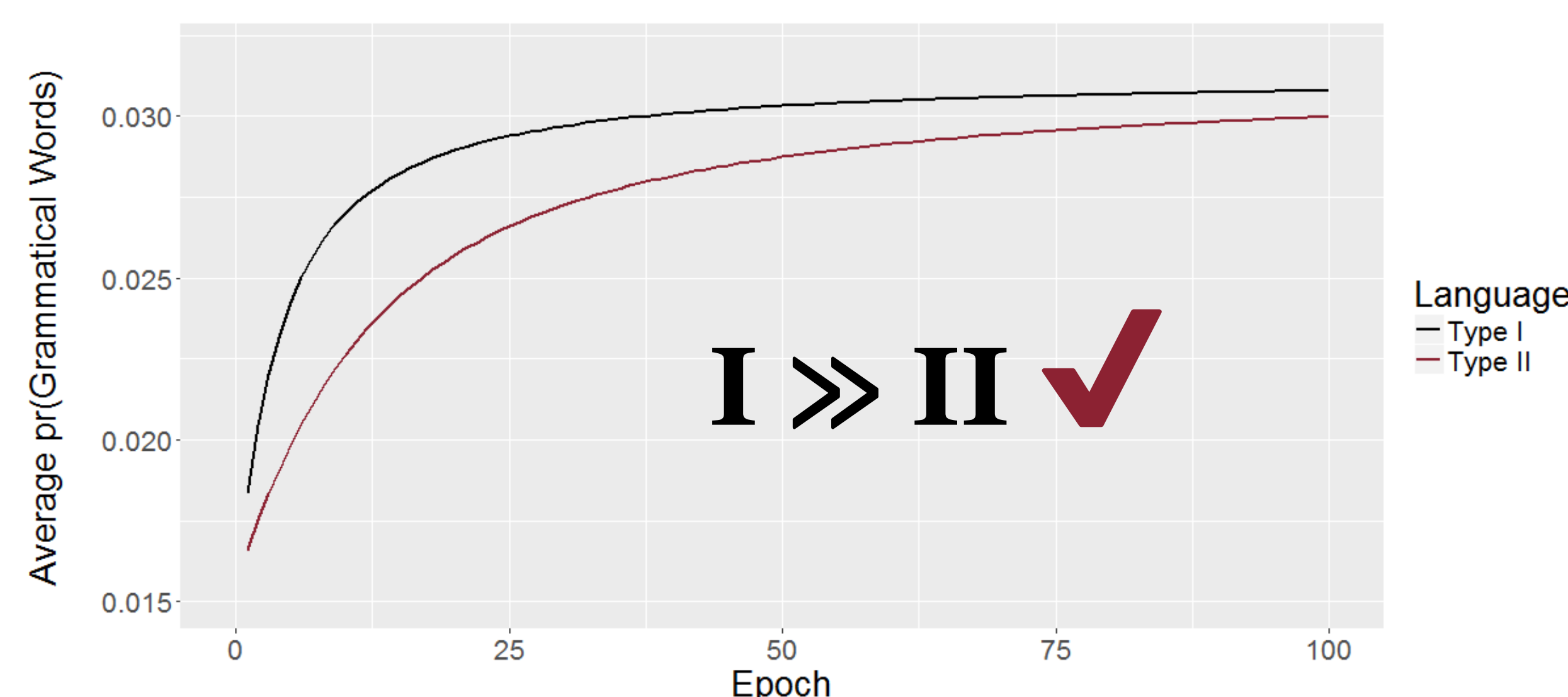
- When Halle (1962) first proposed alpha notation, he didn't just use it for assimilation and dissimilation.
- He also used it to describe a process in Slavic languages that raises /o/ to [u] and lowers /e/ to [æ] before nasals:
 - [-High, -Low, αFront] → [-αHigh, αLow] / _ [+Nasal]
 - For a similar use of variables in tonal processes, see Wang (1967).
- This unconstrained use of variables has previously been critiqued on theoretical grounds (McCawley 1971; Schuh 1978; Odden 2013).
 - But here I'll show that it also makes incorrect empirical predictions.

Representational Complexity and Phonotactic Learning

- Shepard et al. (1961) originally explored and defined six different types of patterns in the domain of visual category learning.
- Across domains, Type I patterns are consistently easier for humans to learn than Type II patterns.
 - This Type I ≫ Type II bias has been demonstrated for phonotactic learning (Moreton et al. 2017)...
 - ...And mirrors trends in phonological typology (Moreton and Pertsova 2014).

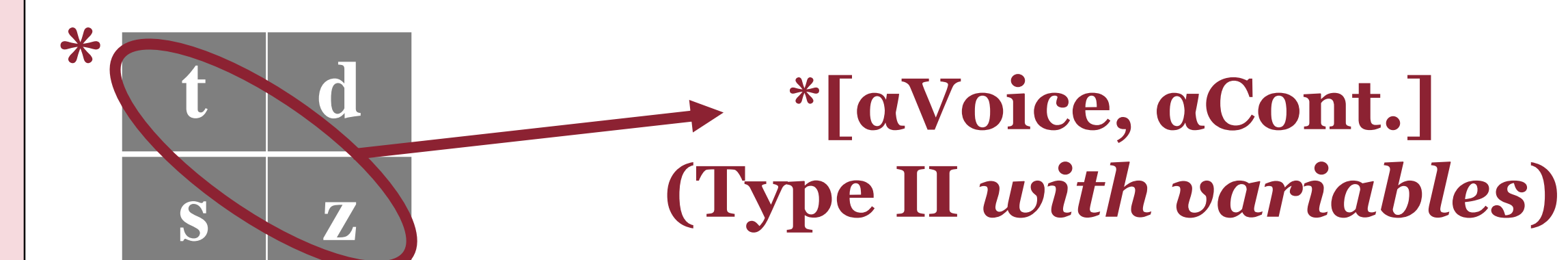


- Pater and Moreton (2014) showed that a MaxEnt learner with a conjunctive constraint set can predict the I ≫ II bias.
 - The reason for this is Type I's simpler representation—since it only requires one constraint to describe, it can be learned more quickly (Moreton et al. 2017).
 - I replicated this finding, using data based on the Type I and II patterns from Moreton et al. (2017):

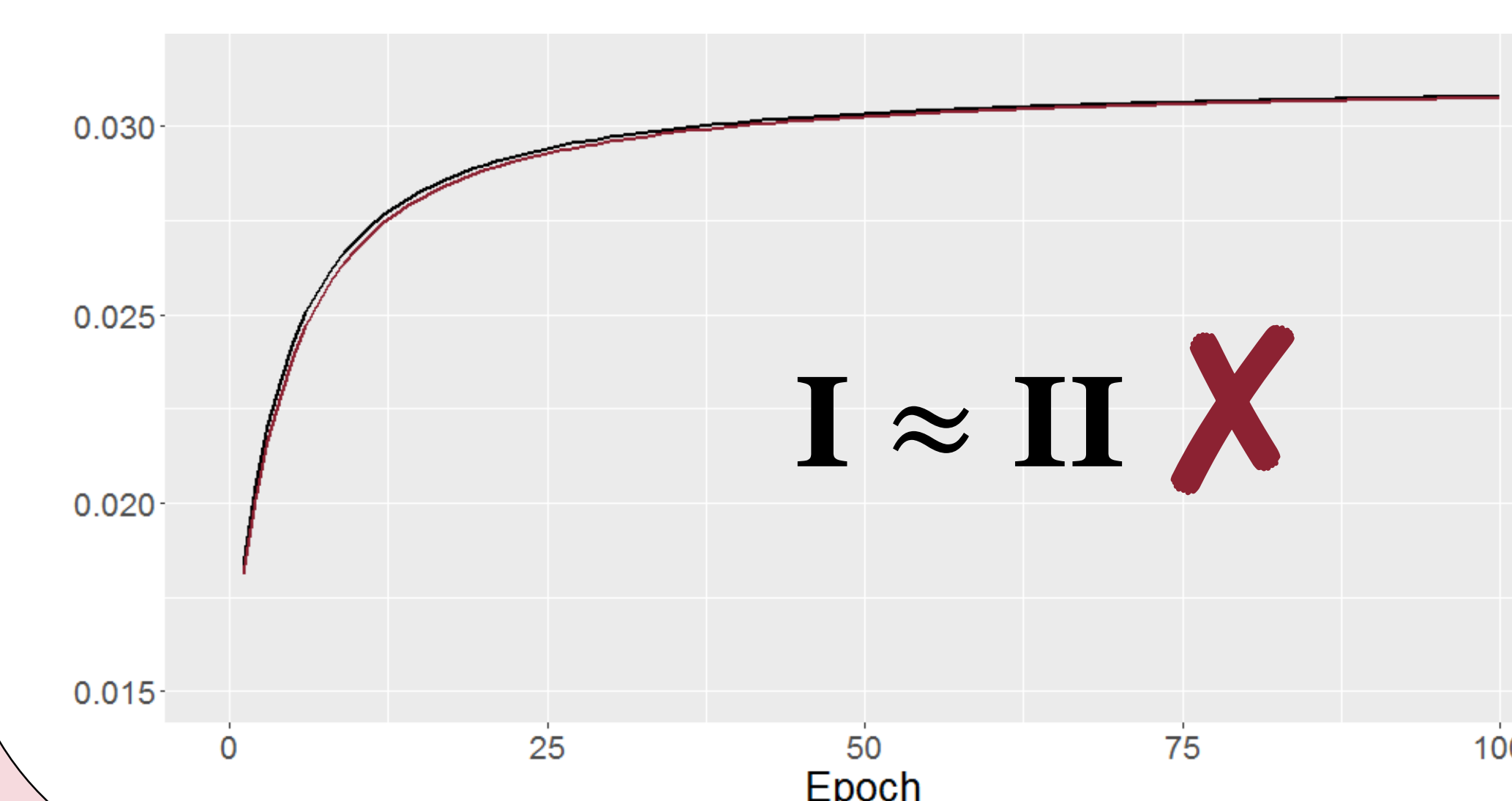


Simplifying Type II

- However, when unconstrained variables are added to the model's constraint set, Type II's representation is simplified...



- ...Which results in the I ≫ II bias disappearing:



Conclusions

- Unconstrained variables oversimplify Type II patterns, which makes incorrect predictions about learnability.
- So how should variables be limited?
 - We *do* want assimilation and dissimilation to be easier to learn (Moreton 2012; Gallagher 2013).
 - Restricting variables so that they only occur on the same feature ensures that they only simplify these patterns.
- This also makes them resemble theories like autosegmental spreading (Goldsmith 1976) and surface correspondence constraints (Rose & Walker 2004).