Title: **Modeling simultaneous learning of multiple phonological grammars**
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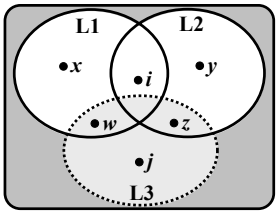
Problem

Multilingual environments present learners with the problem of drawing inferences across observations without knowing whether various observed data are generated by the same grammar. When trying to learn grammars for L1 and L2, if ***x*** and ***y*** are observed (but no grammar allows both), the learner won't draw inferences from their combination. But, if ***w*** and ***z*** are observed and they happen to be consistent with a third grammar L3, then drawing an inference from the pair leads the learner astray.



Real-world learners surely distinguish languages in multilingual environments using many strategies, but in this work I ask how well learners do using only the structure of the hypothesis space to differentiate observations. I model learning as Optimality Theoretic constraint ranking, assume that learners observe input/output pairs, and use a memoryless strategy that doesn't record observed i/o-pairs.

Solution and implementation

Observed i/o-pairs yield sets of Elementary Ranking Conditions (ERCs, Prince 2002) that encode ranking entailments. By treating ERC-sets obtained from the observations as the points in the hypothesis space (rather than individual ranking entailments) we can avoid erroneous inferences. That is, after observing ***x***, ***y***, ***w***, and ***z*** the learner should only infer L3 if ***j*** is also observed. This strategy capitalizes on the fact that ERC-sets entail and contradict each other to structure the hypothesis space (set of possible ERC-sets) and reveal which observations (ERC-sets) can be generated by the same source grammar.

I tested this strategy on Prince and Smolensky's (1993) CV syllable theory and presented my learner with i/o-pairs for randomly chosen inputs generated by multiple grammars whose frequency of use was chosen at random. The goals were to identify the grammars and determine their usage frequency.

Results

An ERC-set can be consistent with two other ERC-sets that aren't consistent with each other (e.g. ***i*** with ***x*** and ***y***). By ignoring these "intermediate" observations and putting ERC-sets into distinct internally consistent groups, it's possible to identify and detect the usage frequency for any two grammars in this scenario (after 60 observations the error in frequency assessment was usually below 2.5%). When dealing with 3 or more distinct grammars, the ability to assess frequency breaks down because intermediate observations can no longer be ignored (e.g. ***i*** is in L1∧L2 but not in L3). It is, nonetheless, still possible to identify the number of source grammars and their rankings after a relatively small number of observations.