

Canadian Raising revisited: Evidence for a gradient, lexicon-based approach

Kathleen Currie Hall
Ohio State University

Canadian Raising (CR) has played a central role as evidence in the development of various phonological theories. In such theories, it is generally assumed both that CR is categorical and that it applies uniformly to all words having the same phonological environment (see, e.g., Chambers 1973, Paradis 1980, Halle and Bromberg 1989, Mielke et al. 2003). The production study presented in this paper, however, shows that CR is in fact a gradient phenomenon that does not apply uniformly across the lexicon.

CR is usually characterized as a phonological process in which the distribution of the vowels [ai] and [ʌi] can be predicted by a rule such as in (1). Phonological rules like these rest on two assumptions: first, that there is a categorical difference between the segment that the rule applies to and the segment that is the outcome of the rule (i.e., that there are in fact two and only two discrete variants of the vowel /ai/); and second, that the rule applies in all words where its phonological environment is met. In practice, it is taken for granted that such rules abstract away from phonetic variation across individual productions. Under such an analysis, however, we would expect that measurements of formant values of actual productions of different words containing /ai/ would resemble the hypothetical graph shown in (2). This graph shows two distinct clusters, representing [ai] (high F1) and [ʌi] (low F1), each of which shows variation across the words within its cluster.

In the experiment reported on here, an intensive production study was carried out with 20 native speakers of Canadian English from Meaford, ON. Each speaker was recorded reading a wordlist containing 299 words with /ai/, controlled for factors such as syllabification, voicing of the following segment, stress, and token frequency. In stark contrast to the expected results given a standard phonological rule, the formants of the recorded vowels are distributed gradiently along a continuum of F1 and F2 values, as shown for one speaker in (3).

Even if we arbitrarily impose some form of categoricity on the data by assigning the datapoints with the highest 25% of the F1 values to an [ai] category and those with the lowest 25% to an [ʌi] category (as indicated by the horizontal lines on the graph in (3)), a further problem emerges. Some words that we would expect, given the rule in (1), to have a low F1 (a high vowel) actually fall in the 25% of words with the highest F1s, and vice versa. This is shown in the graphs in (2) and (3) by the word “hype,” which (1) predicts will have the [ʌi] variant, as shown in (2), but which appears in the lowest quadrant of the actual data in (3).

I suggest that this unexpected distribution can be explained by appealing to factors in addition to the traditional phonological factors of voicing, syllabification, and stress. We must also consider lexical characteristics of particular words, including token frequency, familiarity, and lexical neighbourhood. For example, the word “hype” is relatively transparently related to words such as “hypothesis” and “hypotenuse,” which are not predicted to have the high variant based on phonological factors. I suggest that the vowel of a low-frequency word (like “hype,” which does not occur at all in the CELEX corpus) is influenced by the quality of the vowel in higher frequency words (“hypothesis” occurs 245 times in CELEX), violating the predictions of the straightforward phonological rule.

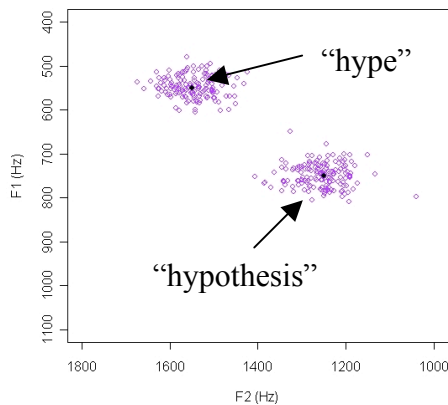
Based on the data analyzed so far, I argue that CR can be better characterized by a “rule” that is gradient rather than categorical and that allows each of a series of factors to contribute to the final outcome. This rule can best be expressed as a multiple regression equation of the form given in (4), in which the phonetic formant value of a particular token is the sum of various weighted factors, which include both traditional phonological attributes as well as other lexical characteristics. Such an account fits in well with recent approaches in phonological theory that model the grammar and the lexicon as a field of finely-grained exemplars, with regularity emerging as abstractions over these exemplars.

(1) Chambers (1973): Canadian Raising Rule

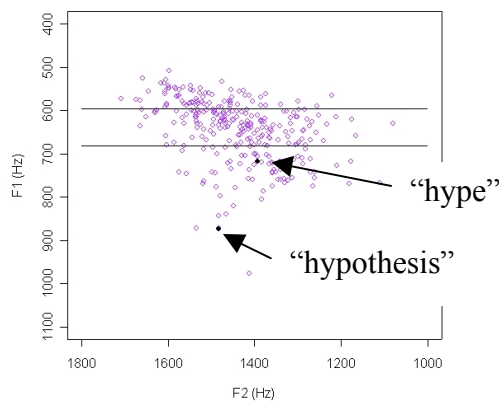
V → [-low] / ___ glide C
[+tense] [-voice]

Conditions: The CR rule can't apply if V is less than [1 stress] AND V' = [+stress] where V' is the following nucleus.

(2) Hypothetical graph showing predicted vowel formants in 300 different words containing /ai/, for one speaker, given the rule in (1):



(3) Actual graph showing vowel formants in 296 different words, for one speaker, with upper and lower F1 quartiles marked:



(4) New proposed "rule" for determining vowel quality:

Formants = A + Phonological Parameters (voicing, syllabification, stress) + Talker Parameters (sex, age, education) + Lexical Parameters (frequency, familiarity, neighbourhood) + . . .

References

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