Empirical evidence showing that speakers generalize better over certain sets of segments than over others has been used to argue for the psychological reality of features for representing manner, voicing, and place (e.g. Phillips et al., 2000; Cristiá & Peperkamp, 2012; Fruehwald et al., 2013; Linzen and Gallagher, under review). However, these studies all focus on classes of sound classes that are supported by both phonological patterning (top-down) and phonetic similarity (bottom-up), leaving some questions open: Is this behavior a result of top-down or bottom-up information? Are both needed to support a featural representation?

In this study, I present the case of English u-fronting in the Northeast US, which is ideal for determining the contribution of bottom-up information in establishing featural representations. I claim that the backness distinction in pre-change English was phonetically natural but phonologically inactive, and u-fronting makes the class-level distinction phonetically unnatural as well. I present experimental evidence showing that the cues for contrasts between /u/ and other segments have been restructured, but this restructuring does not extend to the full class of [+back][-back] contrasts. This indicates that without phonological patterns supporting a class, contrasts need not be represented on a featural level—contrasts are defined on a sound pair-by-sound pair basis. Ultimately, this means that speakers might not divide the inventory up exhaustively into sound classes based on phonetic properties.

**Background:** Features have two functions in languages: they characterize contrasts (bottom-up function, forming phonetically natural classes), and capture patterns (top-down function, forming phonologically active classes)—cf. Jakobson et al. (1951). Since the set of phonetically natural classes does not match the set of phonologically active classes (Mielke, 2008), giving priority to bottom-up or top-down information makes contradictory predictions about which features will be induced from any given language.

I propose a dual theory of features where, instead of top-down and bottom-up information competing for determining the set of acquired features, both a set of bottom-up and a set of top-down features can be induced from the data independently via different learning mechanisms. In order to assess the importance of top-down and bottom-up information in feature learning, classes that are either phonologically active or phonetically natural should be in focus. I’ll focus on the latter. If phonetically natural phonologically inactive classes exhibit class behavior (perceptually, neurologically, or in artificial grammar tasks), then bottom-up information is sufficient for feature learning.

**Backness is English:** To my knowledge, there are no descriptions of synchronic phenomena in English that distinguish based on [+/-back]. Simulations with the UCLA Phonotactic Learner (Hayes & Wilson, 2008) on the CMU corpus (Weide, 1995) reveal no relevant phonotactic pattern either, indicating that [back] is phonologically inactive in English.

In terms of phonetic properties, while in the Nationwide Speech Corpus (NSC, Clopper & Pisoni, 2006) all front–back vowel pairs, including non-minimal ones, are distinguished by F2, Lang & Davidson’s (2016) speakers from the Northeast have u-fronting. /u/ is so far fronted that its F2 overlaps with that of /i/, and /u/ and /i/ are distinguished by F1, F3, and duration. Other front–back pairs use other cues: /i–u/ is based on F2, while the /e–o/ distinction is maintained along all four dimensions (a superset of the /i–u/ cues). This shows
that in dialects with u-fronting, F2 is no longer a consistent cue distinguishing the classes of back and front vowels.

An experiment was designed to determine which of the four cues (F1, F2, F3 and duration) speakers use to distinguish /i/ from /u/ post-change, and whether the same cues carry over to the featurally equivalent /ɛ–o/ contrast. We know that /ɛ/ and /o/ are acoustically different along F1, F2, F3, and duration; the question is which dimension(s) speakers actually use in perception and whether they match those used for /i–u/.

**Identification experiment:** A forced-choice identification experiment was conducted with synthesized vowels in isolation. The set of choices varied by height (/i, i, u, u, / or /ɛ, ɛ, o, o/). Tokens were only synthesized for /i, u, ɛ, o/, while /i, o, ɛ, o/ were always “wrong” answers. A total of 256 tokens were created for 16 conditions. The conditions differed in which cue was unchanged (prototypical) or merged (in-between front and back)—e.g. all 4 unchanged (control); only F1 merged; F1 and F2 merged, etc. All 27 subjects saw every token once. Responses were evaluated categorically: whether the subject identified backness correctly.

The experiment showed that the cues differ between mid and high vowels. While backness accuracy for mid vowels worsened when the F2 or duration cue was taken away, high vowels were identified worse without F1 cues. This shows that “backness” is encoded with different cues for mid and for high vowels.

**Discussion:** This experiment showed no evidence of class behavior for a phonetically natural but phonologically inactive sound class over the course of sound change. The cue restructuring of /i–u/ did not affect other front–back contrasts; the cues of backness are restructured in English only on the level of the individual contrasts. This makes the motivation for representing phonemic contrasts with features questionable. Low overall accuracy, however, warrants follow-up experiments. Parallel experiments for phonetically unnatural but phonologically active classes should also be conducted.

**References:**