Vowel nasalisation in Scottish Gaelic: The search for paradigm uniformity effects in fine-grained phonetic detail

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According to the modular feedforward architecture of grammar, the phonetic component is sensitive only to the output of the phonology and is thus blind to morphological or lexical conditioning (Pierrehumbert 2002). However, this prediction is challenged by claims that fine-grained phonetic detail may display e.g. paradigm uniformity effects (Steriade 2000) or lexical frequency effects (Bybee 2001). In the present study I search for potential paradigm uniformity effects on vowel nasalisation in Scottish Gaelic by investigating alternating items in which a nasalising environment is removed by a morpho(phonologica)logical process. A clear distinction is found between categorical phonological nasalisation, which is "carried over" into derived forms, and gradient phonetic nasalisation, which is eliminated completely when the triggering environment is removed. This is consistent with the predictions of the modular architecture.

Studies claiming to find evidence of morphologically conditioned phonetics often overlook the fact that a modular architecture may allow prosody to mediate between morphology and phonetics, thus granting the phonetics indirect access to morphological structure. For instance, the subtly differing degrees of /l/-darkening and GOOSE-(non-)fronting found by Strycharczuk & Scobbie (2016; 2017) between morphologically simplex *hula* and morphologically complex *fooling* are compatible with an analysis in which -*ing* is joined directly to the prosodic word, as in Bermúdez-Otero (2011: 2028), resulting in distinct prosodic structures in *fooling* vs. *hula*. Ideally, the search for morphologically conditioned phonetics must therefore focus on processes which do not involve overt segmental affixation, thus ruling out prosody as a confounding factor.

In the Lewis dialect of Scottish Gaelic, vowels are usually nasalised after initial [m], e.g. *madainn* [matitude] 'morning', but this appears to be blocked in some exceptional items such as *marag* [marak] 'pudding'. Using a nasal airflow mask, I carry out a preliminary investigation of patterns of nasal airflow in one 62-year-old native speaker from Ness in the north of Lewis. Stimuli were presented in a word list and the speaker read each aloud within a carrier sentence three times in succession. This procedure was repeated twelve times overall, using a different randomisation of the word list each time, resulting in 36 tokens of each target word. By averaging across all tokens of each stimulus I obtain highly detailed dynamic nasality profiles of a number of items (see Fig. 1). It is found that all items in initial [m] display a high level of nasal airflow early in the vowel; however, in items such as *madainn* a moderately high level is sustained throughout the remainder of the vowel, while in items such as *marag* it rapidly decreases to zero. This suggests two scattered (Bermúdez-Otero 2007) nasalisation processes: one categorical phonological process which may be subject to lexically conditioned blocking, and, superimposed upon this, another more subtle gradient phonetic process which applies without exception.

Scottish Gaelic, like all living Celtic languages, displays morphosyntactically conditioned alternations in initial consonants known as *initial mutations*. Under the *lenition* mutation, *radical* [m] alternates with *lenited* [v]. It is a matter of debate whether Celtic initial mutations involve autosegmental affixation in the phonology (Lieber 1987; Wolf 2007; Iosad 2014) or are pure morphology (Green 2006; Hannahs 2013), but it is clear that the radical and lenited grades of a given lexical item are paradigmatically related. In this study it is found (see Fig. 1) that items with categorical phonological nasalisation after radical [m] (*madainn*) also display categorical phonological nasalisation after [v] in the lenited grade (note that some nasalisation is also present on the consonant itself); crucially, however, those items with only gradient
phonetic nasalisation after radical [m] (marag) display no nasalisation in the lenited grade. Thus while categorical phonological properties of the radical grade can be "carried over" into the lenited grade, the fine-grained phonetic detail of lenited forms is seen to display no sensitivity to the fine-grained phonetic detail of their radical counterparts.

These results are consistent with a modular architecture in which the phonetic component has no direct access to morphological information. I take this as evidence that dismissal of the modular architecture is premature and I claim that the search for paradigm uniformity effects in fine-grained phonetic detail should be restricted to cases where prosodic structure cannot play any mediating role, as exemplified here by the lenition mutation in Scottish Gaelic.

**Fig. 1:** A comparative plot of the dynamic nasality profiles of the underlined portions of madainn [m̃ətɪn] 'morning', marag [maɾak] 'pudding', a' mhadainn [əṽətɪñ] 'the morning' and a' mharag [əṽəɾak] 'the pudding'. The x-axis represents normalised time, where 0-1 is the duration of the consonant [m ~ v], 1-2 is the duration of the vowel [ã ~ a], and 2-3 is the duration of the consonant [t ~ r]; measurements were taken at one-eighth intervals throughout the duration of each segment. The y-axis represents an analogue of nasal airflow rate. Error bars represent 95% confidence intervals.