Experimental and typological approaches to nasal vowel sonority

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Markedness relations are a useful tool in explaining and predicting sound patterns, as well as potentially providing important insight into sound structure. However, the discovery, justification and application of non-binary relations are much less straightforward than those of binary relations. The general hierarchy of vowels, an example of the former, is traditionally based in sonority (Kenstowicz 1996) and in practice may predict vowel inventories in prosodically weak positions, as well as outputs of neutralization, undergoers of processes and implicational relationships (de Lacy 2006). Yet despite the wealth of empirical information on the behaviour and typology of nasal vowels, not to mention the extensive attention to these vowels in the phonetic literature, markedness relations among nasal vowels remain unclear. This paper aims to probe this subject by examining both phonological and phonetic evidence for a potential hierarchy.

The phonetic literature would suggest a nasal vowel hierarchy may not be simply identical to the oral vowel hierarchy with the addition of nasality. Numerous acoustic modelling studies show that nasal vowels are much more than a simple "sum of their parts" (e.g., Maeda 1993, Feng & Castelli 1999, Shosted 2015) and are, in practice, quite different from their oral counterparts in both their articulation and resulting acoustic correlates of vocalic features (e.g., Rong & Kuehn 2010, Carignan 2014). As such, we cannot expect as neat a monotonic relationship between the acoustic correlates of sonority and vowel quality as within oral vowels.

To address this issue, the phonetic portion of this study investigates the potential stratification of traditional vowel categories of the sonority hierarchy (i.e., high central, mid central, high peripheral, mid-high peripheral, mid-low peripheral, and low vowels) and the major phonetic correlates of sonority, namely intensity in decibels (Parker 2002 and references), within nasal vowels. A trained phonetician was recorded pronouncing oral and nasal variants of vowels [ɨ; ə; i, y, u; e, ø, o; ɛ, œ, ɔ; æ, a, ɑ] in the following contexts, in both natural and slow speech: in isolation, following and surrounded by [s] and following and surrounded by [n]. Each was repeated twice, yielding 560 tokens. Stimuli were recorded with a Glottal Enterprises NAS-1 SEP Clinic Nasometer in order to quantify nasality as well as to separate the oral and nasal signals. Intensity was extracted at 5 ms intervals (with the initial and final 50 ms of each vowel excluded) from the combined signal and from each signal (nasal and oral) separately. F1 and F2 were also extracted.

Phonological concepts, though, are not necessarily beholden to phonetic concerns, and as such a two-pronged approach is taken here. In this portion of the study, gaps in nasal vowel inventories (Ruhlen 1975, Hajek 2013) were investigated, and processes involving nasal(ized) vowels were catalogued from Schourup (1972) and Beddor (1983) and their original references (along with any newer studies or descriptions, especially instrumental) for any tendencies involving vowel quality.

Preliminary phonetic results show that among nasal vowels, negligible difference obtains for combined signal intensity measurements. However, SSANOVA results show that oral intensity increases proportionally to vowel opening (high < … < low) and nasal intensity in low vowels is greatly diminished, meaning the disparity between oral and nasal energy is inversely proportionate to vowel opening. Additional measurements are being investigated along the lines of Gordon et al. (2012). Meanwhile, preliminary phonological results suggest that only low nasal vowels are typologically implied in inventories. No clear patterns emerge in nasalization processes, and no prosodically-conditioned nasal vowel alternations have yet been found. All in all, low nasal vowels appear to be relatively unmarked, though other relationships are still unclear. In the future, additional phonetic correlates of sonority should be investigated, as well as factors which are unique to and hierarchize nasal vowels. More speakers and natural data must also be investigated.

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