

## How nasal does a nasal have to be? Insights from the Upper Amazon

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Shiwiar is a Chicham (Jivaroan) language spoken by around 1,200 people in the Ecuadorean and Peruvian Amazon. It has 13 consonants in its phoneme inventory, as well as 12 vowel phonemes. There are four contrastive vowel qualities (/i ĩ u a/) which each have three contrastive variants: voiced oral, voiced nasal, and voiceless.

In addition to being contrastive on a lexical level, nasalisation in Shiwiar is used as a grammatical marker (i.e. certain grammatical operations are conveyed purely by nasalisation). As nasalisation is used for both lexical and grammatical contrasts in Shiwiar, one might expect that it is in the interest of speakers to articulate nasalisation clearly and saliently to avoid misunderstandings. Surprisingly however, some speakers of Shiwiar do not nasalise vowels consistently in canonically nasal environments, and some do not nasalise vowels at all. Nevertheless, listeners have no trouble in understanding these speakers, suggesting that phonetic nasalisation is not the only cue to phonemic nasalisation in Shiwiar vowels. This implies that (some) speakers are exploiting one or a number of secondary cues to nasalisation which can be readily perceived by listeners.

In order to determine how different speakers produce nasalisation in Shiwiar, a production experiment was performed. Speakers were asked to do a picture elicitation task. All vowel qualities were tested in phonemically oral and nasal conditions. Three acoustic measures were taken from each test vowel: degree of nasalisation, vowel duration and formant frequencies.

Preliminary results show that there are indeed two strategies used by Shiwiar speakers to convey nasalisation. Some Shiwiar speakers canonically nasalise phonemically nasal vowels. In this case the velum is raised and the nasal cavity is coupled to the vocal tract, thereby raising the formant frequencies (as found in the previous literature). For these speakers, there is no significant duration difference between nasal and oral vowels. Interestingly, the second strategy involves no velum raising (i.e. no canonical nasalisation). However, for these speakers, phonemically nasal vowels still had raised formants *and* had a longer duration than phonemically oral vowels. These findings confirm that phonemic nasalisation in Shiwiar can be conveyed by cues that do not involve phonetic nasalisation. Secondly, and perhaps more importantly, they show that non-nasalising speakers are exploiting a cue (namely duration) which is *not* found in the signal of nasalising speakers. Previous research has shown that there is a perceptual link between nasalisation and duration. It is therefore possible that the non-nasalising speakers *perceived* nasalised vowels to be longer and consequently started making use of duration in their production of those vowels, even though that cue was absent in the original nasal stimuli.

In addition to these findings, this talk will address methodological issues. With respect to investigating nasality, a new method will be proposed which allows researchers to collect nasality data in the field in a cheap and effective manner by using earphones as microphones placed inside speakers' nostrils.