Lecture: Plosives and Nasals

Overview

1. **Acoustic Cues:**

   when listeners interpret a speech signal, they look for aspects of the spectrotemporal pattern that indicate which particular phonetic and phonological components were produced by the speaker. In terms of vowels, we have seen that the identity of the vowel is indicated (or **cued**) by the formant frequencies. For fricatives, we have seen that the frequency of the main spectral peak and the bandwidth of that peak increase as the place of constriction moves further forward in the mouth. For diphthongs and approximants, we have seen that their identity is indicated by both the frequencies and the shapes of formant movements. In general the manner of obstruents is indicated by rapid formant transitions in the vowel regions leading up to and following the articulation of the obstruent, particularly the first formant transition. The place of obstruents is also indicated in these formant transitions, particularly the shape of the second and third formant transitions. Since transitions change in shape a great deal according to the identity of the vowel, we introduced the notion of **locus frequency** to independently characterise the transition shape for a given consonant. All of these indicators: formant frequencies, spectral peaks, transitions, locus frequencies are called **acoustic cues** to phonetic identity.

2. **Plosives:**

   the articulation of a plosive requires a closing articulation phase, an obstruction phase (stop gap), a release phase, an optional aspiration phase, and an opening articulation phase, see figure 2-6.1. These phases have characteristic acoustic cues associated with them.

The **manner** cues for plosives include the presence of the silent region in the stop gap, the rapid formant transitions and particularly a low locus frequency for F1, sudden energy change, release burst and aspiration. The **place** cues for plosives include the centre frequency (i.e. main spectral peak) of the turbulence occurring at the release (the **burst**), and the locus frequency for the second and third formant transitions. The burst centre frequency cue turns out to be processed *relative* to the frequency of the vowel F2 (as shown by the **pika- pu** experiment, see figure 2-6.2).

Place Burst Centre Frequency F2 Locus Frequency F3 Locus Frequency

Bilabial Lower than vowel F2 Low Low

Alveolar Higher than vowel F2 Mid High

Velar Close to vowel F2 High Mid

The **voicing** cues for plosives include the voice onset time, the presence of aspiration, the presence of an audible F1 transition, the intensity of the burst and the duration of the preceding vowel. There are notable differences in cues to voicing across languages: some do not use aspiration, others have a three-way contrast, see figure 2-6.3.

3.

Nasals: nasal consonants involve a lowering of the soft-palate (velum) which links in the nasal cavities as additional acoustic resonators. The **manner** cues for nasals include the presence of a low-frequency resonance due to the nasal cavity, and the rapid fall and rise inenergy as the nasal is made and released. The **place** cues to nasals mostly arise from the second and third formant transitions, as for plosives, see figure 2-6.4. In addition, the spectral shape of the nasal itself varies slightly with the place of the obstruction in the vocal