

Differences in Pitch Perception of Tense-Lax vowel pairs for German and Catalan listeners

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It is widely agreed that there are perceptual differences between high and low vowels concerning pitch perception (i.e. Fowler 1984): The more open a vowel the higher it is perceived when compared to a closed vowel with the same fundamental frequency. This phenomenon is called Intrinsic Pitch (IP). Explanations of IP are still controversial: Fowler stated that it could be due to a mechanism that compensates for Intrinsic Fundamental Frequency (IF₀) differences. Stoll (1981) found that IP is at least partly a psychoacoustic phenomenon: The different spectra of the relevant vowels introduce a psychoacoustic change of the perceived pitch (psychoacoustic pitch shift).

Previous work on acoustic showed no significant differences in fundamental frequency comparing comparing tense and lax vowels in German. In contrast, articulatory data on tongue height (which after a biomechanic theory is responsible for the IF₀ differences) differed significantly for the complete F₀ contour of the vowel (Mooshammer 2002, Pape and Mooshammer 2004). However, following the biomechanic model the fundamental frequency should be lower for lax vowels due to their lower tongue height compared to tense vowels. These discrepancies between the acoustics and the articulatory results could be explained by Hoole et al. (2004) who found higher CT (cricothyroid) activity in lax vowels compared to tense vowels. These results would suggest an active F₀ control for lax vowels.

The following question arises whether there is a difference in pitch perception of German tense and lax vowel pairs, i.e. is the underlying articulatory structure or the acoustical information the crucial factor for the pitch perception of tense/lax pairs.

In order to investigate this issue a pitch perception experiment was carried out with (1) German listeners and (2) Catalan listeners (who do not have a tense/lax distinction in their phoneme inventory). Stimuli consisted of pairs of tense /i:/ and lax /I/ which had identical F₀ contours. The complete F₀ contours for both stimuli were then shifted 10Hz up and 10Hz down in 2.5Hz steps and were paired randomly. The listener were asked to detect pitch differences for each pair.

Results suggest that there is no significant difference in pitch perception between tense and lax vowels for the German listeners. Musical training of the listeners does not influence the tense/lax pitch perception.

For the Catalan listeners there is a significant preference to perceive the lax /I/ higher than the tense /i:/, independent of the pitch (in the given range +10Hz to -10Hz). Surprisingly musical education of the listeners did not improve the pitch sensitivity. It is not clear what causes this insensitiveness to the given task, since in Catalan like in English and German F₀ is prosodically used and should therefore be perceptually identifiable.