

PITCH PERCEPTION OF TIME-VARYING SONG TONES

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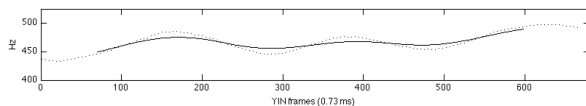


Task: To study the influence of sloped F_0 trajectories in sung tones on pitch perception

Goal: To develop a pitch perception model that accounts for the variation that occurs in sung tones

MOTIVATION

- The trajectory of fundamental frequencies (F_0 s) in sung notes often exhibit a degree of sloping
- For example, in the image below the moving average (solid line) of the F_0 trajectory (dotted line) shows the trend over the duration of the note is an upwards slope



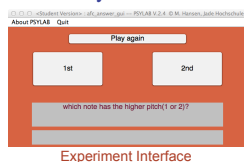
- This study helps to assess whether perceived pitch models based on tones with stable F_0 trajectories are appropriate to use for tones with sloping F_0 trajectories
- This project builds on earlier work that described the use of discrete cosine coefficients to describe F_0 trajectories in sung tones (Devaney, Mandel, and Fujinaga 2011)

RELATED WORK

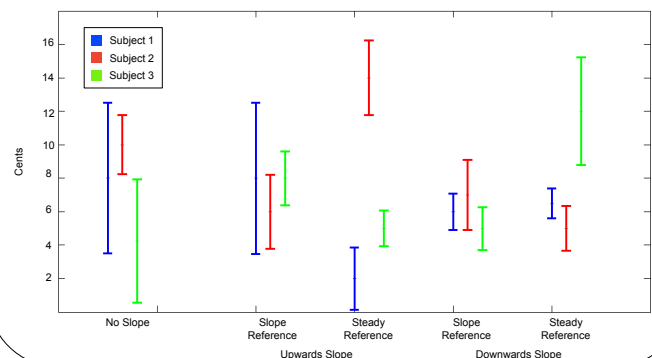
- d'Alessandro and Castellengo (1994, 1995)
 - used short synthesized sung tones with vibrato
 - found that the end of the note was more influential on the pitch perception than the beginning of the note
- d'Alessandro, Rosset, and Piot (1995)
 - used synthesized tones with F_0 glides of various extents and durations
 - findings were the opposite of D'Alessandro and Castellengo's finding that the end of the note was more influential on pitch perception than the beginning
- Gockel, Moore, and Carlyon (2001)
 - used sinusoids
 - modeled perceived pitch as a weighted average favoring the more slowly moving portions of a note

METHOD

- **Paradigm:** Adaptive transformed up-down two-alternative forced-choice (Levitt 1971)
- Versus the method-of-adjustment paradigm used in earlier studies
- Following from Levitt (1971), six reversals were required before the measurement phase began
- **Implementation:** In MATLAB with psylab (Hansen 2006)
- **Stimuli:** 750 ms synthesized tones with either no slope or an upward or downward slope of 0.5 semitones/second
- Vibrato and noise were added to F_0 trajectory
- **Initializations:** The starting mean pitch of the stimuli was 33 cents higher than mean pitch of reference and the starting step size for the stimuli adjustment was 8 cents, with a minimum step size of 1 cent
- **Trials:** Five trials were run simultaneously and interleaved
 - Flat tone versus flat tone
 - Slope up versus flat tone
 - Flat tone versus slope up
 - Slope down versus flat tone
 - Flat tone versus slope down
- **Subjects:** 3 subjects
 - Ages: [29, 31, 36]
 - Years of musical training: [20, 16, 16]



RESULTS



REFERENCES

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- Hansen, M. 2006. psylab MATLAB toolkit. <http://www.hoerntechnik-audiologie.de/psylab/>
- Levitt, H. 1971. Transformed up-down procedures in psychoacoustics. *Journal of the Acoustical Society of America* 49:467–77.



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