Session 4aPP

Psychological and Physiological Acoustics: Frequency Analysis and Timbre

William A. Yost, Cochair
Parmly Hearing Institute, Loyola University of Chicago, 6525 North Sheridan Road, Chicago, Illinois 60626

Toshio Sone, Cochair
Research Institute of Electronic Communication, Tohoku University, 2-1-1 Katahira, Aoba-ku, Sendai, Miyagi, 980-77 Japan

Contributed Papers

10:05

4aPP8. Dynamic properties of pitch perception of sweep tone. Tomonori Shihara (Dept. of Comput. Sci., Kumamoto Univ., 2-39-1 Kurokami Kumamoto, 860 Japan), Hiromitsu Miyazono (Pref. Univ. of Kumamoto, Kumamoto, 862 Japan), Tsuyoshi Usagawa, and Masanao Ebata (Kumamoto Univ., Kumamoto, 860 Japan)

It is important to investigate the auditory dynamics of pitch perception of a sweep tone in order to make auditory processing clear. In recent years, the trajectory of pitch perception of a sweep tone has been estimated within the viewpoint of auditory scene analysis. However, there are few studies to quantify "instantaneous pitch" in a sweep tone. In this study, instantaneous pitch in the sweep tone was measured by comparing the perceived pitch of a sweep tone with that of a pure tone. The sweep tone used in the experiments had a duration of 4250 ms and a frequency range of 1 oct. As a result, the instantaneous pitch almost matched the pitch corresponding to the actual frequency of the sweep tone at the middle of duration. However, it was higher at the position of $\frac{1}{4}$ of the duration, and lower at the position of $\frac{3}{4}$ of the duration than the pitch of actual frequency. It seems that the gradient of the perceptual trajectory is gentler than that of the actual frequency. It was suggested that the dynamic property of pitch perception of the sweep tone was affected by forward and backward pitch in the stream.

10:20

4aPP9. Time discrimination and amplitude modulation (AM) detection. Neil P. McAngus Todd (Dept. of Psych., Univ. of Manchester, Manchester M13 9PL, UK)

The model [N. Todd, "A theory of the principal monaural pathway I. Pitch and time perception," J. Acoust. Soc. Am. **99**, 2491(A) (1996)] proposes also to account for the psychophysics of time by the interaction of a "sensory memory," in the form of the collective response of cortical bandpass cells, and a "long-term memory," which is the result of learning in a cortical neural network. Since the time constants of the cortical cells are relatively long, their response to an inferior collicular (ICC) input lasts long after the ICC input has ceased (and hence the form of the sensory memory above). The cortical amplitude modulation response is roughly a Laplace transform of the ICC response envelope, and so is highly dependent on envelope duration. The cortical response thus captures both the pitch and durational properties of the tone. It is shown how this model is able to provide an account of two fundamental aspects of auditory temporal processing: (1) the psychophysical law for time interval discrimination and (2) the psychophysical law for AM detection. The model is further applied to the problem of the "filled interval illusion," which hitherto has evaded a convincing explanation.

10:35

4aPP10. Integration times for frequency discrimination. Jonathan

10:50

4aPP11. Perceptual segregation by timbre: Streaming by bandwidth but not periodicity. Rhodri Cusack (School of Psych., Univ. of Birmingham, Edgbaston, Birmingham B15 2TT, UK)

Alternating tones and noises are rated as segregating into different perceptual streams [Dannenbring and Bregman, J. Exp. Psychol. **2**, 544–555 (1976)]. The current study examined segregation by timbre using an interleaved melody task [Dowling, Cognit. Psychol. **5**, 322–337 (1973)] in an adaptive, 2IFC procedure. The discrimination threshold for a melody interleaved with distractors was measured. The melodies were five pure tones, randomly chosen from a two-thirds octave range. In experiment 1, the distractors were either: (1) pure tones from the same frequency range; (2) narrow-band noises from the same frequency range; or (3) pure tones from a frequency range 1 oct higher (a comparison condition expected to induce streaming). The timbral difference between the melody and distractors in (2) improved performance, though it was less effective than the frequency difference in (3). In experiment 2, narrow-band noise distractors (aperiodic) were compared with two-component complex tone distractors (periodic), chosen to evoke a similar excitation pattern. Performance improved equally when pure tone distractors were replaced either by narrow-band noises or two-tone complexes. This indicates that differences in bandwidth influence streaming, but provides no evidence for an effect of differences in periodicity. [Work supported by EPSRC, UK.]

11:05

4aPP12. Identifying musical instruments from multiple versus single notes. Gregory J. Sandell and Michael Chronopoulos (Parmly Hearing Inst., Loyola Univ., Chicago, IL 60626)

These experiments investigated to what degree the identification of a musical instrument depends on change of timbre across total pitch range. Subjects were trained to recognize 12 orchestral musical instruments (natural recordings) by name. Each instrument was represented by a variety of pitches sampled regularly from the standard pitch range of that instrument. The sampling was four notes per octave, effectively forming (in musical terms) a diminished seventh chord arpeggio. First listeners identified the instruments from single note presentations taken from the arpeggios. Results showed that an instrument's identity is not equally salient across its range of notes, in ways that differ for each instrument. Next listeners were tested on a variable number of notes ($N=1,2,\ldots,7$) sampled from the arpeggio presented during training in such a way that with increasing N, a greater amount of the arpeggio's total range was included. Results showed that on average, recognition improved as increasingly recognizable notes (experiment 1) were included in the arpeggio. The relationship between the rate of improvement with N and the recognizability of the single notes is explored. An auditory gestalt called "macrotimbre" is proposed to consider the role across-range timbre changes play in the identification of an instrument. [Work supported by NIH.]

Sandell

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Table of Contents on p. A5