enable reception by either submerged swimmers or divers. A series of in-water tests was carried out as an intrinsic part of the design evolution of the device. Once the design was finalized, intelligibility of the communicator was measured by underwater audiological testing using tones, phonetically balanced word lists, and sentence lists. Results indicate average word list intelligibility of 82% correct responses and sentence list intelligibility of nearly 100% (both at 5-m range). Open-water range tests showed comfortable communication range between divers using the device to be greater than 140 ft (43 m) in calm seas. [Work was performed as part of a Master of Science thesis in Ocean Engineering at the University of Rhode Island.]

FRIDAY MORNING, 3 MAY 1991 PRATT A & B, 9:00 TO 11:30 A.M.

Session 8MU

Musical Acoustics and Psychological and Physiological Acoustics: Pitch, Timbre, Time, and Melody

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Contributed Papers

9:00

8MU1. Perception of vocal pitch vibrato in short tones. Christophe d'Alessandro (LIMSI-CNRS, BP133, 91403 Orsay Cedex, France) and Michele Castellengo (LAM, Univ. Paris IV, 4 Place Jussieu, 75005 Paris, France)

Two different experiments were carried out to examine the perception of short vibrated tones, using synthetic stimuli. A preliminary experiment on long tones showed results identical to those obtained by Shonle and Horan [J. Acoust. Soc. Am. **67**, 246–252 (1980)]. The first experiment used a method of adjustment to find the pitch of the vibrated tones, according to their durations (or equivalently, to the number of vibrato cycles). Durations from 80 ms (half-cycle for a vibrato rate of about 6 Hz) to 320 ms (two cycles) where studied. The results indicate that an averaging of $F0$ excursion is performed, and that perception may be ambiguous above a threshold of duration, called herein "threshold of fusion." The second experiment used a constant method to estimate the threshold of fusion, defined as the fractional number of cycles where a stimulus is integrated into one tone. Above this threshold, a glissando or two consecutive tones are perceived. The threshold was estimated to be at about the second third of a vibrato cycle beginning at zero phase. It was noticeable that in the first experiment, the subjects were still able to assign a unique pitch to the stimuli above the threshold when the tone is long enough. A concluding discussion points out how these psychoacoustic results may contribute to our understanding of pitch perception for vibrato tones in actual musical performance and explain some aesthetic values governing the production of vibrato by singers.

9:15

8MU2. On the origin of the stretched melodic octave. William Morris Hartmann (Physics Dept., Michigan State Univ., East Lansing, MI 48824)

It is well known that the psychological octave is stretched with respect to the physical octave, i.e., when listeners choose or adjust a melodic octave, the frequency ratio turns out to be greater than 2 to 1. Two explanations have been advanced to explain this effect. Terhardt [J. Acoust. Soc. Am. **55**, 1061–1069 (1974)] suggested that the stretched melodic octave is learned from a harmonic octave that is stretched by partial masking of excitation patterns. The origin of the stretched melodic octave is therefore in the central nervous system. However, Ohgushi [J. Acoust. Soc. Am. **73**, 1694–1700 (1983)] argued that the stretched melodic octave may be caused by the refractory delay in primary auditory neurons, as observed in electrophysiological single unit recordings. In his model, pitch is determined by the first several peaks in the interspike interval histogram, which are increasingly delayed for higher frequencies. The origin of the stretched melodic octave is therefore in the peripheral nervous system. The present paper shows that one can choose between central and peripheral models by an octave-judgment experiment that does not involve any pitch information in the auditory periphery. This is done by creating central pitch sensations with the Huggins effect. Data obtained from 2AFC constant-stimuli experiments favor the central-origin explanation of the stretched melodic octave. [Work supported by the NIDCD of the National Institutes of Health.]

9:30

8MU3. Perceptual limits of octave harmony. Laurent Demany, Catherine Semal (Lab. de Psychoacoust., Univ. de Bordeaux 2, 146 rue Léo-Saignat, F-33076 Bordeaux, France), and Robert P. Carlyon (Univ. of Sussex, Brighton BN1 9QG, England)

Three subjects were monaurally presented with dyads of frequency-modulated pure tones approximately 1 octave apart. The tones, with carrier frequencies F_L and F_H, were heard in a background of pink noise and at a low sensation level, so that they were completely resolvable by the subjects' peripheral auditory filters. In experiments 1 and 2, subjects judged on each trial which of two dyads was inharmonic ($F_H \neq 2.F_L$); the relative mistuning of the inharmonic dyad $[(F_H - 2.F_L)/2.F_L]$ was varied independently of F_L and could be either positive or negative; F_L was fixed within trials in one experiment, and varied within trials (from about 8%–20%) in the other experiment. In both experiments, performance monotonically worsened when F_L was increased from 300–2000 Hz; in addition, negative mistunings were better identified as inharmonicities than positive mistunings. In a third experiment, a 4I-2AFC procedure was used to assess the detectability of changes in F_H irrespective of their effect on the perception of harmonicity. Performances were not the same function of F_L as in the other two experiments, and were