Processing of Dynamic Signals Independent of Presbycusic Hearing Loss.

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Processing of dynamic signals as a function of: age, frequency region, background noise; transition direction, and endpoint frequency was examined among individuals free of presbycusic hearing loss.

Participants

Individuals ranging from 20 to 75 years divided into 5 decades : (20-34 years, n = 25; 35-44 years, n = 20; 45-54 years, n = 20; 55-64 years, n= 15; 65-75 years, n = 18) with normal bilateral air-conducted thresholds (no > than 25 dB HL from .5 kHz to 8 kHz); type A tympanograms, and no history of otological disorders participated in this study .

Stimuli and Procedure

Signals (50 ms duration) were synthesized at 2 frequency regions: 1) at a center frequency of 1030 Hz of the maximal transition excursion ; 2) at a center frequency of 2685 Hz of the maximal transition excursion. Two different patterns of: transition trajectory: (upward or downward); and, end frequency conditions: (varying onset frequencies common offset frequency; common onset frequency varying offset frequencies) created 4 series at each frequency region: converging up (CU); converging down (CD); diverging up (DU) and diverging down (DD). Thresholds were determined in 1) quiet and 2) continuous speech spectrum noise for : converging upward signals (CU-N); and, diverging downward signals (DD-N) in a 2AFC paradigm with individually randomized trials.

Results and Conclusions

There were discontinuities in the effect of age; i.e., advancing age did not produce a concomitant worsening of performance. For converging signals the eldest group performed significantly worse than the youngest listeners but the pattern of responses for the 45-54 year olds was not as predictable. For CD signals 45-54 year olds showed lower thresholds than the 55- 75 year olds, but for CU signals the 45-54 year olds were not significantly better than the 65-75 year olds but the 55-64 year olds were better than both of these groups. For diverging signals 45-54 year olds performed better than the 65-75 year olds for DU signals but *not* for DD signals. Transition direction was not a significant factor

At the higher frequency region again the performance of the mid-age range group of listeners was the most enlightening. 65-75 year olds performed significantly worse than all other age groups for signals with a common offset frequency, but for signals which diverged to varying offset frequencies not only the 65-75 year olds but also the 45-54 year olds demonstrated higher thresholds than all other age groups i.e., the 55-64 year olds performed better than the 45-54 year olds for these series. Though downward transitions were easier to discriminate than were upward transitions this effect was significant only for the 45-75 year olds. Moreover, diverging signals were significantly easier than converging signals to discriminate only for 55-75 year olds.

In the low frequency region, among 45-54 year olds, the presence of noise negatively impacted CU signals but *decreased* the average threshold for DD signals. Eldest listeners did not show adverse effects for noise for diverging signals but did demonstrate increased thresholds for converging signals. At the higher frequency region, the effect of noise was most noted for the impact on endpoint frequency. Converging signals were more difficult to discriminate in noise than were diverging signals, relative to the same signals presented in quiet, principally for listeners 55 years and older.

Certainty of response as assessed by the slopes of the psychometric functions was not a linear function of age (Fig. 1) with neither a requisite shift to the right nor a flattening of the slopes with age. At the low frequency region, in quiet there was no effect on the slopes for direction of the transition. There was an effect for endpoint frequency with 65-75 year olds showing shallower slopes for converging signals while 20-34 year olds showed steeper slopes. In noise, there was no difference in the slopes for diverging signals however for converging signals, 55-75 year olds showed steeper slopes; 20-34 year olds shallower slopes. At the higher frequency region, in quiet all age groups except for the 55-64 year olds showed shallower slopes for converging signals than for diverging ones. Only listeners aged 20-44 years showed steeper slopes for downward transitions versus upward transitions. In noise, the only effect was for diverging signals where 45-54 year olds and 65-75 year olds showed shallower slopes; 20-44 year olds showed steeper slopes, while 55-64 year olds showed no difference for quiet versus noise conditions. Slopes obtained in quiet for diverging signals had greater *intragroup* variability relative to those obtained in the presence of background noise for both high and low frequency regions. In contrast, slopes obtained in noise for converging signals showed *less* variability within groups than slopes obtained in quiet at both frequency regions.

Evidence indicates that: 1) age effects are not a monotonic function of signal difficulty; 2) deterioration in processing occurs early in mid-life with a potential recovery due to 'compensatory mechanisms'; and, 3) noise may enhance the processing of certain signals. These effects comprise an interactive consequence on perception involving combinative aspects of: stationary (external) and nonstationary (internal) noise; temporal-spectral resolution; and compensatory processes.

Figure 1. Age effects of Psychometric Slopes