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Masker Profiling Yields Insights Into Mechanisms of Masking

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dips present in steady-state speech-shaped periodic maskers at 65 dB SPL.

484 Interactions of Pitch and Timbre: How Changes in One Dimension Affect Discrimination of the Other

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Background

Variations in spectral shape, perceived as timbre changes, can lead to poorer fundamental frequency (F0) or pitch discrimination. Less is known about the effects of F0 variations on the discrimination of spectral shape. The present study used bandpass-filtered complex tones to examine both the effect of changes in spectral centroid on pitch discrimination, and the effect of F0 changes on timbre discrimination. Variations in the two dimensions were equated for salience by normalizing changes relative to individual subjects' difference limens (DLs). The two aims of the study were 1) to determine whether the interactions between pitch and timbre were symmetric, and 2) to assess the effects of musical training on listeners' ability to ignore variations in irrelevant perceptual dimensions.

Methods

The thirty subjects were divided into two equal groups of musicians and non-musicians. In Experiment 1, the subjects' task was to compare sequentially presented tone pairs that differed in either pitch or timbre and to judge which was higher. The DLs obtained for both tasks were used in subsequent experiments. In Experiment 2, F0DLs were measured as a function of the size of random variations in spectral centroid, and vice versa. In Experiment 3, sensitivity was measured as the target parameter and the interfering parameter varied by the same amount, in terms of individual DLs.

Results

Both pitch and timbre DLs were affected by random variations in the non-target dimension. The amount of interference observed was similar for both pitch and timbre dimensions. Although musicians had lower (better) F0DLs than non-musicians on average, the amount of interference produced by random spectral variations was similar for the two groups. In addition, there was no significant difference in spectral centroid (timbre) DLs between musicians and non-musicians with or without random variations in pitch. Overall, performance was better when the random non-target variation was in the same direction as the target variation (e.g., when an upward movement in timbre was paired with an upward movement in pitch).

Conclusion

Difference limens for both pitch and timbre are strongly, and similarly, affected by random variations in the non-target dimension, and extensive musical training does not seem to reduce this interference. The results confirm that pitch and timbre are not easily separable as perceptual dimensions of hearing, and that directional changes can be confused across the two dimensions.

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485 Masker Profiling Yields Insights Into Mechanisms of Masking

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Background

Signal detection in noise is assumed to be a function of signal-to-noise ratio in the frequency region of the signal, but there is little consensus regarding specific decision strategies.

Methods

Thresholds were determined for eight normally hearing listeners for detection of a signal (2000- Hz sinusoid, 100 ms long, and 20 ms ramps) centered in an 8-ERB wide broadband noise (1219-3200 Hz, 300 ms long, 5 ms ramps) presented at 47, 62, and 77 dB SPL. An independent level rove of +/- 8 dB in 1 dB steps was then applied to individual half-ERB wide bands of the masker while the signal was fixed at either +4 or +8 dB above threshold. In each condition, listeners ran 1000 trials in a Yes-No paradigm. Perceptual weights for masker bands were obtained using a reverse correlation method, separately for signal and no-signal trials, such that a positive weight indicates a tendency to vote "Yes" when the level of the masker band is higher. In a new masker profiling analysis based on the overall framework of signal detection theory, trial-by-trial data were divided into four categories of responses namely, Hits, Misses, False Alarms, and Correct Rejections and the mean level of each masker band within each response category was calculated.

Results

Perceptual weighting patterns reflect auditory filter shapes and indicate that listeners respond "Yes" on signal trials when the level of masker bands near the signal is low, but respond "Yes" on no-signal trials when the level of those bands is high. The four-category masker profiling analysis provides a basis for the interpretation of perceptual weights by showing the average masker levels resulting in the "Yes" and "No" decisions that contribute to each weight.

Conclusion

Lower mean levels of masker bands near the signal in Hits and higher levels for those bands in Misses suggest that detection is based on signal-to-noise ratio. On no-signal trials, however, listeners vote "Yes" when the level of the masker in bands near the signal is higher, consistent with an energy detector. Since signal and no-signal trials are presented randomly and listeners are blind to this information a priori, it is generally assumed that listeners' decision strategies are similar on signal and no-signal trials, but this is clearly not the case. Use of masker profiling may provide significant information to improve models of masking.