

The effects of interaural time difference on temporal and spectral grouping using synthetic vowels.

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Previous investigations by Darwin and colleagues investigated grouping mechanisms using a synthetic vowel of simultaneously presented harmonic components. The vowel was generated in such a way that its identity depended on whether or not one particular harmonic (the “target” tone) was present or absent (shifting the vowel between /eh/ when the tone was heard as part of the complex and /ih/ when it was not). Experiments showed that preceding tone(s) whose frequency matched the target could “capture” the target and reduce its influence on the perceived vowel identity. Furthermore, the degree to which the target tone influenced the vowel identity depended on the relationship between the ITDs in the target, the other vowel harmonics, and the preceding tones.

The current experiments used a similar paradigm to investigate the influence of ITDs on both the vowel identity (influenced by across-frequency grouping of the target tone) and the perceived rhythm of the repeating tones (influenced by across-time grouping of the target tone). The basic stimulus (a pair of preceding tones followed by a harmonic complex) was repeated ten times, producing a perception of two objects: an ongoing stream of tones and a repeating vowel that occurred at a rate one-third as rapid. Just as the vowel identity depended on whether or not the target tone was heard as part of the vowel complex, the rhythm of the ongoing tone stream depended on whether or not the target was heard in that stream (creating either an even or galloping rhythm). Identical stimuli were presented to the subjects in two different experiments, one in which they identified the perceived vowel and one in which they identified the heard rhythm of the tone sequence. The ITDs in the preceding tones, target tone, and non-target vowel harmonics were manipulated to explore how spatial cues influence across-frequency and across-time grouping. In another pair of experiments, either the vowel complex or the tone stream was presented alone and the target tone level varied to produce psychometric functions showing how the percentage of responses (/eh/-/ih/ in the vowel experiment and “even”- “galloping” in the tone experiment) depended on the relative strength of the target tone.

Results confirm the influence of ITDs on vowel identity. However, the degree to which the target influences the vowel does not predict the degree to which it influences the tone stream rhythm. In some conditions, the tone is heard prominently in the tone stream and not heard in the vowel, as might be expected; however, there are other conditions in which the target tone is not heard strongly in either vowel or tone stream. Results suggest that the influence of ITD cues on grouping depends on what object is being attended. Furthermore, it appears that ITD cues have a stronger influence on grouping over time than across frequency.