Evidence for an effect of attention on the buildup of across-frequency streaming

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In everyday life, we often have to select one source from the mixture of sounds that reach our ears. To assist this selection, the auditory system segregates acoustical energy into different auditory objects or streams based on available acoustical cues. Here we investigate whether an auditory object, formed by grouping energy across frequency, is affected by attention.

The stimuli were an alternation between a pure tone (A) and a harmonic complex (B) in an ABA-ABA-ABA- pattern, with the whole sequence lasting 20 seconds. The harmonic complex was spectrally shaped to create a synthetic vowel, and repeated at half the rate of a separate, ongoing stream of pure tones. The vowel was generated such that its perceived identity depended on whether or not one particular harmonic (the “target”) was perceived in the complex (shifting the vowel from /eh/ when the target was perceived in the complex to /ih/ when the target was not perceived in the complex).

Both the perceived vowel identity and the perceived rhythm of the tone sequence changed over time. To test whether the change in vowel percept was affected by attention, we presented the 20-second-long ABA- sequences to one ear and a 7-second-long series of noise bursts to the contralateral ear (with the two starting simultaneously). In one condition, subjects were asked to judge properties of the contralateral noises for their 7-sec duration, then to switch attention to the ABA- sequence and judge vowel identity. In a second condition, subjects ignored the noise bursts and judged vowel identity throughout the entire 20 secs. Results suggest that there is a pre-attentive adaptation process akin to phonemic transformation, but that, in addition, the extent to which the target component was integrated into the vowel depends not only on the time that the ABA sequence has been presented, but also on the time over which it is attended. These results imply that attention affects auditory scene analysis in ambiguous stimuli containing a “target” that logically can fall into one of two competing auditory objects. [Portions of this work were supported by a grant from ONR N00014-04-1-0131].