

## The role of formant-frequency contours in the perceptual grouping of speech formants

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The perceptual organization of speech remains poorly understood. Recent research using sine-wave speech suggests that the ability of an extraneous formant to impair intelligibility depends on the modulation of its frequency contour (Roberts et al, 2010). This study examined the effect on intelligibility of manipulating the depth of this frequency variation whilst preserving the formant amplitude contours (cf. Remez, 1996). Three-formant (F1+F2+F3) analogues of natural sentences were synthesized using a monotonous glottal source (F0=140 Hz; cf. Summers et al, 2010). In experiment 1, all three formants were presented diotically and each formant-frequency contour was scaled to one of a range of depths about its geometric mean (100%-0%, 10% steps). The psychometric function obtained indicated that scaling these contours to 50% depth had relatively little impact on intelligibility. In experiment 2, perceptual organization was probed by presenting stimuli dichotically (F1+F2C; F2+F3), where F2C is a competitor for F2 that listeners must resist to optimize recognition (Remez et al, 1994). Different competitors were created by inverting the frequency contour of F2 about its geometric mean and varying its depth (100%-0%, 25% steps). Adding F2C typically reduced intelligibility; this reduction was greatest for 100%-depth, intermediate for 50%-depth, and least for 0%-depth (constant) F2Cs. This result indicates that competitor efficacy depends on the overall depth of frequency variation, not depth relative to that of the other formants, and that frequency-contour modulation influences across-formant grouping not only in sine-wave analogues but also in more speech-like simulations. In experiment 3, the importance of speech-like variation for across-formant grouping was explored by using an F2C with a regular and arbitrary frequency contour (triangle wave, not plausibly speech-like) matched to the average rate and depth of modulation for the inverted F2C derived from F2. Contrary to the argument that across-formant grouping depends on speech-specific constraints (Remez et al, 1994; Remez, 1996), the triangle-wave competitors were as effective as their more speech-like counterparts.

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### **References**

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