The effect of phase, fundamental and lowest component on the perception of octave height

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### Experiment

- **How much do we have to attenuate the odd harmonics of a harmonic complex to achieve an octave shift in perception?**

- **How is this cosine attenuation threshold affected by a complimentary phase shift of the odd harmonics?**

### Stimuli

- **F0:** 31.25, 62.5, 125 or 250 Hz
- **Lowest harmonic number:** 2, 4, 8 or 16
- **Phase shift of odd harmonics:** 0, 1/3 π or 1/2 π
- **To mask distortion products, white noise was added to the stimuli**

### Procedure

Thresholds were measured using a two-alternative forced-choice adaptive procedure. On each trial, two complex tones were presented. For the standard stimulus, the odd harmonics were attenuated by 60 dB, and thus this stimulus had essentially a fundamental twice that of the test stimulus. The first tone was either the test or the standard stimulus. The listener had to indicate which of the stimuli had the higher pitch by pressing one of two buttons on a response box. The two stimuli always had the same chroma, so the judgement was one of octave height in all cases. After a correct response the odd harmonics of a complex harmonic tone eventually leads to a shift of one complete octave in the perception (Fig. 1 on the right)

### Results

The threshold attenuation values (negative gain), averaged across listeners, are shown in Fig. 3. The four panels show the results for individual lowest harmonic numbers (2, 4, 8 and 16). Within a panel, threshold is plotted as function of F0 (abscissa). The blue, green and red lines correspond to the three lowest harmonic numbers (2, 4, 8 and 16). Within a panel, the threshold was either the test or the standard stimulus. The listener had to indicate which of the stimuli had the octave height of a note gradually without going through the cycle of notes within the octave.

### References