Perception of Musical Sounds

Timbre, Music & Speech
Vocal Tract
Source & Filter

Larynx
Vocal tract
Output sound

Note: SCALE USED BY TUVAN THROAT SINGERS
Pitch and Formants

1. Harmonics (giving pitch) produced by vocal cord vibration
2. Formant frequencies: resonances of the vocal tract
3. Formant frequencies change as you change the shape of your vocal tract

![Graph showing formants](image)
FIG. 8.1 Illustration of how three different vowel sounds are produced. Part (a) shows the spectrum of the sound produced by vibration of the vocal folds. It consists of a series of harmonics whose levels decline with increasing frequency. Part (b) shows schematic cross-sections of the vocal tract in the positions appropriate for the three vowels. Part (c) shows the filter functions or transfer functions associated with those positions of the vocal tract. Part (d) shows the spectra of the vowels resulting from passing the glottal source in panel (a) through the filter functions in panel (c). Adapted from Bailey (1983) by permission of the author.
Tuvan throat music
Tuvan throat music - 2

Alexei Saryglar
of Tuva

Recorded at the Celtic Cultural Centre
1-29-99
Twin Cities, MN USA
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Orchestra in your throat
Sex change

Me (m)

Higher pitch

Shorter vocal-tract (higher formants)

Both (-> f)
narrow-band spectrogram

sine-wave speech
Speech

music
Speech
music
Adding harmonics to make an instrument’s timbre

Different notes on clarinet and oboe

Amadeus
What determines an instrument’s timbre

1. “formant” frequencies
2. Amplitude envelope
3. Onset / offset transients
Instrument timbre does not scale - it is more like speech formants

Timbre does NOT stay constant when sounds are simply scaled up in frequency

Timbre stays more constant when the formants stay constant

Cheap synthesisers do this to generate different notes

Natural instruments and good synthesisers do this
Bassoon & violin notes

Track 57
Forwards & backwards temporal envelopes
Onset transients
Why are some intervals consonant and others dissonant?

Consonant musical intervals form simple ratios

- Consonant:
  - octave: 2/1
  - fifth: 3/2
  - fourth: 4/3
  - major third: 5/4
  - minor sixth: 8/5
  - minor third: 6/5
  - major sixth: 5/3
  - major second: 9/8

- Dissonant
Two complex tones separated by a perfect fifth (3:2)

Consonant intervals have maximally separated component frequencies