

Tone and Voice: A Derivation of the Rules of Voice-leading from Perceptual Principles

David Huron
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Part I: Ching-Hua Chuan

Abstract

- The traditional rules of voice-leading in Western music are explained using experimentally established perceptual principles.
- In Part I, six core principles are shown to account for the majority of voice-leading rules given in historical and contemporary music theory tracts.

Voice-Leading

<http://www.tonalityguide.com/tkvoiceleading.php>

- Voice-leading describes the way in which individual parts or 'voices' interact, creating and embellishing the progression from one chord to another.
- Example: Voice-leading characteristics of Bach's style

Case 1. Write the chord progress with no knowledge of voice-leading

ii₅ V I

Voice-leading (case 2)

- Case 2. Two **general characteristics** of the Bach's voice-leading style :
 - it is usual for at least one part to move in a different direction but in case 1 all the parts move in the same direction
 - it is characteristic for the individual voices in a Bach chorale to move predominantly by step but all the voices move in large leaps in case 1.

ii₅ V I

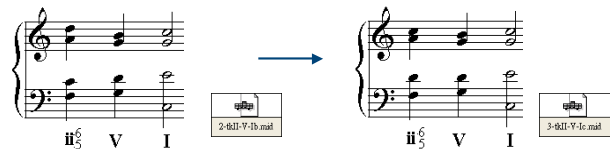
Voice-leading (case 3)

- **succession of intervals**

- the Bach chorale style very rarely contains **parallel fifths** (two voices moving in parallel a fifth apart)

- **dissonance**

- there is a general prescription in the style of Bach's time that sevenths should resolve downwards by step



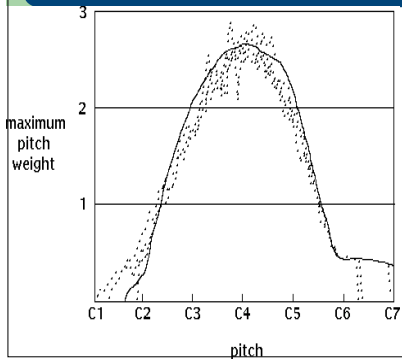
Rules of Voice-leading Reviewed

1. *Registral Compass Rule.*
2. *Textural Density Rule.*
3. *Chord Spacing Rule.*
4. *Avoid Unisons Rule.*
5. *Common Tone Rule.*
6. *Nearest Chordal Tone Rule.*
7. *Conjunct Motion Rule.*
8. *Avoid Leaps Rule.*
9. *Part-Crossing Rule.*
10. *Part Overlap Rule.*
11. *Parallel Unisons, Fifths and Octaves Rule.*
12. *Consecutive Unisons, Fifths and Octaves Rule.*
13. *Exposed (or Hidden or Direct) Octaves (and Fifths) Rule.*

1. Toneness Principle

- Toneness: the clarity of pitch perceptions. (Parncutt 1989)
- Terhardt-Stoll-Seewann model (1982) – pitch weight
- Huron and parncutt (1992) – average notated pitch v.s. virtual pitch weight

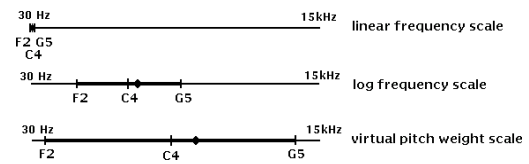
Terhardt-Stoll-Seewann model, 1982



- Pitch weight: an index of the pitch clarity, a measure of toneness
- A stable region of maximum pitch weight, F2 – G5, coinciding very well with the range spanned by the bass and treble staves in Western music.

Huron and Parncutt (1992)

- Experiment and Results: Calculated the average notated pitch in a large sample of notes drawn from various musical works. The average pitch in this sample was found to lie near D#4.
- This coincidence is especially evident in the following figure where the average notated pitch is plotted with respect to three scales: frequency, log frequency, and virtual pitch weight.



Huron's Conclusion and Principle 1

- Conclusions
 - "Middle C" truly is near the middle of something
 - The typical range for voice-leading (F2-G5) spans the greater part of the range where virtual pitch weight is high.
- Toneness Principle

Strong auditory images are evoked when tones exhibit a high degree of toneness. A useful measure of toneness is provided by virtual pitch weight. Tones having the highest virtual pitch weights are harmonic complex tones centered in the region between F2 and G5. Tones having inharmonic partials produce competing virtual pitch perceptions, and so evoke more diffuse auditory images.

2. Principle of Temporal Continuity

- Continuity is another factor influencing the vividness of auditory images.
- Auditory images may be evoked by either real (sensory) or imagined (purely mental) processes. Two examples of purely mental auditory images can be found in echoic memory and auditory induction.

Auditory Induction Warren, Obusek & Ackroff Experiment, 1972

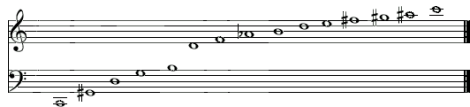
- Experiments: Intermittent faint sounds were alternated with louder sounds, the faint and loud sounds were contiguous, but not overlapping.
- Explanations: the frequency/intensity thresholds for auditory induction coincide closely with the thresholds for auditory masking.
- Conclusions:
 - Although imagined sounds may be quite striking, in general, imagined sounds are significantly less vivid than actual sound stimuli.
 - In general, the longer a sound stimulus is absent, the less vivid is its evoked image.

Principle 2

- **Principle of Temporal Continuity.** *In order to evoke strong auditory streams, use continuous or recurring rather than brief or intermittent sound sources. Intermittent sounds should be separated by no more than roughly 800 milliseconds of silence in order to assure the perception of continuity.*

3. Minimum Masking Principle

- Tonal mapping / cochlear map (Békésy, 1943/1949, 1960)
- Critical band (Fletcher, 1953)
- A linear relationship between critical band and cochlear map (Greenwood, 1961)
- Critical band spacing (Huron)



Sensory Dissonance v.s. Critical Band

- Plomp and Levelt hypothesized that in the writing of chords, composers would typically endeavor to maintain roughly equivalent amounts of sensory dissonance throughout the span of the chord.
- Figure shows the average spacing of notated (complex) tones for sonorities having various bass pitches from C4 to C2. (Huron)

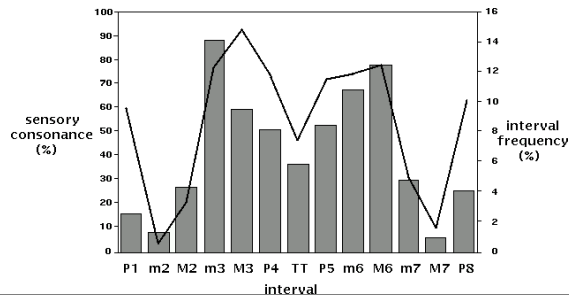


Principle 3

- **Minimum Masking Principle.** *In order to minimize auditory masking within some vertical sonority, approximately equivalent amounts of spectral energy should fall in each critical band. For typical complex harmonic tones, this generally means that simultaneously sounding notes should be more widely spaced as the register descends.*

4. Tonal Fusion Principle

- Kaestner (1909), the relationship between sensory dissonance and tonal fusion.



Musical Terminology: Types of Harmonic Intervals

- The experimental results pertaining to sensory dissonance and tonal fusion may be used to illuminate traditional musical terminology.

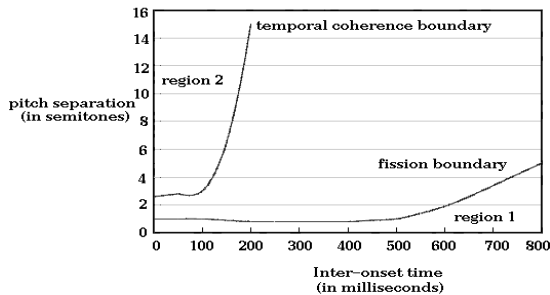
	Intervals	Sensory Dissonance	Tonal Fusion
<i>perfect consonances</i>	P1, P8, P4, P5	Low	High
<i>imperfect consonances</i>	M3, m3, M6, m6	Low	Comparatively low
<i>dissonances</i>	M2, m2, M7, m7	High	Low

Principle 4

- **Tonal Fusion Principle.** *The perceptual independence of concurrent tones is weakened when their pitch relations promote tonal fusion. Intervals that promote tonal fusion include (in decreasing order): unisons, octaves, perfect fifths, ... Where the goal is the perceptual independence of concurrent sounds, intervals ought to be shunned in direct proportion to the degree to which they promote tonal fusion.*

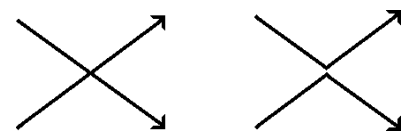
5. Pitch Proximity Principle

- In 1975 van Noorden mapped the relationship between tempo and pitch separation on stream integration and segregation.



Pitch Proximity (cont'd)

- Bregman (1981) and his colleagues have assembled strong evidence showing the pre-eminence of pitch proximity over pitch trajectory in the continuation of auditory streams.
- Deutsch and van Noorden (1975) found that, for tones having identical timbres, concurrent ascending and descending tone sequences are perceived to switch direction at the point where their trajectories cross.



Principle 5

- **Pitch Proximity Principle.** *The coherence of an auditory stream is maintained by close pitch proximity in successive tones within the stream. Pitch-based streaming is assured when pitch movement is within van Noorden's "fission boundary" (normally 2 semitones or less for tones less than 700 ms in duration). When pitch distances are large, it may be possible to maintain the perception of a single stream by reducing the tempo.*

6. Pitch Co-Modulation Principle

- McAdams (1982, 1984) demonstrated that co-modulations of frequency that preserve the frequency ratios of partials promote tonal fusion, and also showed that positively-correlated pitch motions that are not precise with respect to log-frequency also tend to contribute to tonal fusion.
- In other words, tonal fusion is most salient when co-modulation is precise with respect to log-frequency and the frequencies of the two tones are harmonically related. Tonal fusion is next most salient when co-modulation is precise with respect to log-frequency and the frequencies of the two tones are not harmonically related. Finally, tonal fusion is next most salient when co-modulation is positively correlated, but not precise with respect to log-frequency.

Co-modulation principle in musical practice

- In Huron (1989a), it was shown that polyphonic composers (not surprisingly) avoid semblant pitch motions -- both parallel and similar contrapuntal motions. Moreover, it was shown that parallel pitch motions are avoided more than similar motions. Finally, it was shown that parallel motions are most avoided in the case of intervals that tend most to promote tonal fusion: unisons, octaves, and perfect fifths in particular.

Principle 6

- **Pitch Co-modulation Principle.** *The perceptual union of concurrent tones is encouraged when pitch motions are positively correlated. Perceptual fusion is most enhanced when the correlation is precise with respect to log frequency.*

That's all for the REVIEW!
Here comes the KEY part...