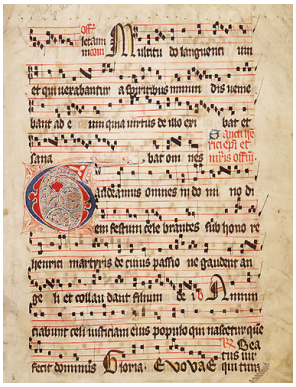

The relative prevalence of Medieval modes and the origin of the leading tone

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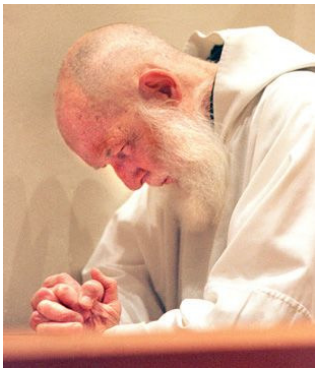


Main questions

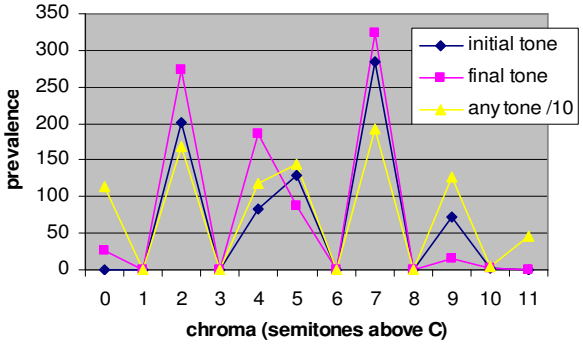
- How often is each scale step used in Gregorian chant?
- Is mode prevalence (finalis) different from tone prevalence?

Method

Source: Bryden, J. R., & Hughes, D. G. (1969). *An index of Gregorian chant.* Cambridge, MA: Harvard University Press.

Selection: All chants on first 20 pages of vol. 1 (order of title) and pages 20, 40, 60 … 340 of Volume 2 (order of pitch intervals).

Results



C (chroma 0) and A (9) rare as initials or finals because the 8-mode system recognizes only four finals D, E, F, G. Possible explanation:

- Most prevalent tones are the final and its upper/lower neighbors (more so than initial and neighbors → Is final a *melodic tonic*?)
- None of these 3 tones should be B (since no fifth)

Unanswered questions and possible answers

Q: Why does correlation initial-any (r=.92) exceed final-any (.80)?
A: Is initial tone a *harmonic tonic*?

Q: Why is E (chroma 4) more prevalent as final, F (5) as initial?
A: A rising tone interval is preferred both at start and end.

Possible psychoacoustic origins of profiles

- roughness of successive partials in resonant rooms
- audibility of partials as spectral pitches

Hypothesis

Chant sounds better (coherent, consonant, preferred…) when

- pitch commonality among successive tones is high
- successive partials produce minimum roughness

Prediction

- Scale steps are preferred whose (spectral or virtual) pitch commonality with other scale steps is high

Predictor 1: no. of harmonics above each scale step

How many harmonics of a scale step correspond to other steps?

C		D		E	F		G		A		B
4	2	4	2	3	4	1	5	1	4	3	2

Octave-generalized harmonics are P8, P5, M3, m7, M2
E.g.: harmonics of C are C, G, E, Bb, D → 4 are diatonic

Predictor 2: weight the harmonics before adding

Weights of octave-generalized harmonics

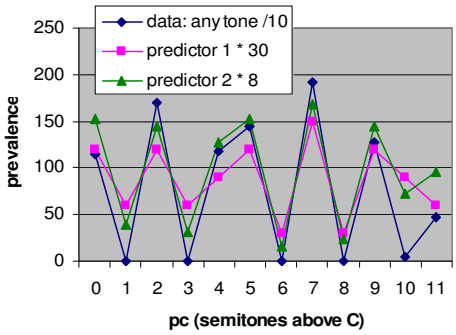
P8	P5	M3	m7	M9
10	5	3	2	1

These are *root-support weights*, cf. Parncutt, R. (1988). Revision of Terhardt's psychoacoustical model of the root(s) of a musical chord. *Music Perception*, *6*, 65-94. → Revised predictions:

C		D		E	F		G		A		B
19	5	18	4	16	19	2	21	3	18	9	12

This is the output of Parncutt (1988) for input = diatonic scale.
The 2 predictors correlate with each other, r = 0.94.

Comparison of data with predictors



correl-ations	initial tone	final tone	any tone
Pred. 1	.86	.66	.90
Pred. 2	.83	.65	.95

Predictor 2 is closer to "all tones" profile (most robust data)

Possible origin of the leading tone

- The tone C is more prevalent and stable than the tone B.
- The tone F is more prevalent and stable than the tone E.

=> A rising semitone corresponds to an increase in stability.

International Conference of Music Perception and Cognition (ICMPC10), Sapporo, Japan, 25-29 August 2008