Quantifying tonal hierarchies and key distances
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Tonal Music
- Tonal music is centered around a reference pitch called the tonic
- The tonic is usually emphasized in both melody and rhythm
- The tonic is sounded with relative frequency

Why tonal?
- There are parallels between musical structure and psychological principles of organization
- Tonal music reflects a general cognitive principle called psychological status

Psychological status
- The mind tends to categorize
- Within categories are reference points
- Reference points are simpler, regular, or more symmetric, and are more stable in memory
Tonal hierarchy

- Concerns the relative stability of tones
- Represents the functional significance of a pitch class relative to other pitch classes

Probe tone study

- Listeners rated which tones best completed the first seven notes of a major scale

C D E F G A B ........

Probe tone study

- Listeners rated which tones best completed the first seven notes of a major scale

C D E F G A B ......C

The tonic was the favored choice

Rankings

- Tonic, perfect 5th, and major 3rd were ranked high
- Tritone and other non-diatonic scale pitches were ranked low
In a minor key, the minor 3rd was ranked higher than the perfect 5th...this could mirror the importance of the minor 3rd as it is the tonic of the relative major key...or is there some other reason we hear the minor third as the most defining characteristic of the minor scale?

In other words, some tones are heard as being more “related” to the tonic, or as better completing a pattern in the tonic key.

Group differences

- Listeners with the least amount of formal musical training emphasized pitch height, not class...but this may just reflect a difference in ranking strategy

Regardless of musical training, elementary school children prefer

- diatonic over non-diatonic tones
- tonic triad tones
- tonic note over other triad notes

...but this may reflect an informal “training” or tonal absorption in everyday life
Keys

- Keys are considered “close” if modulations or transitions are relatively easily executed.

Using the pitch rankings from the probe tone experiment, it is possible to extract a quantitative measure of distance between keys.

Probe tone ratings signify a measure of stability.

Therefore, keys that are close should have similar hierarchies…

Correlations of keys based on pitch hierarchies were computed for each possible pair of major and minor keys.
As expected, the correlations complied with the circle of fifths.

Minor keys also had correlations to both the relative major and the parallel major:
- C minor --- Eb major
- C minor --- C major

**Dimensional representation**

**Multidimensional scaling**
- Places points in a coordinate space, representing 24 keys
- The order of distances between points corresponds to similarity values of the keys

...Two additional dimensions are required to accommodate the relationships between parallel and relative major-minor relationships

This leads us to the *torus* model...