

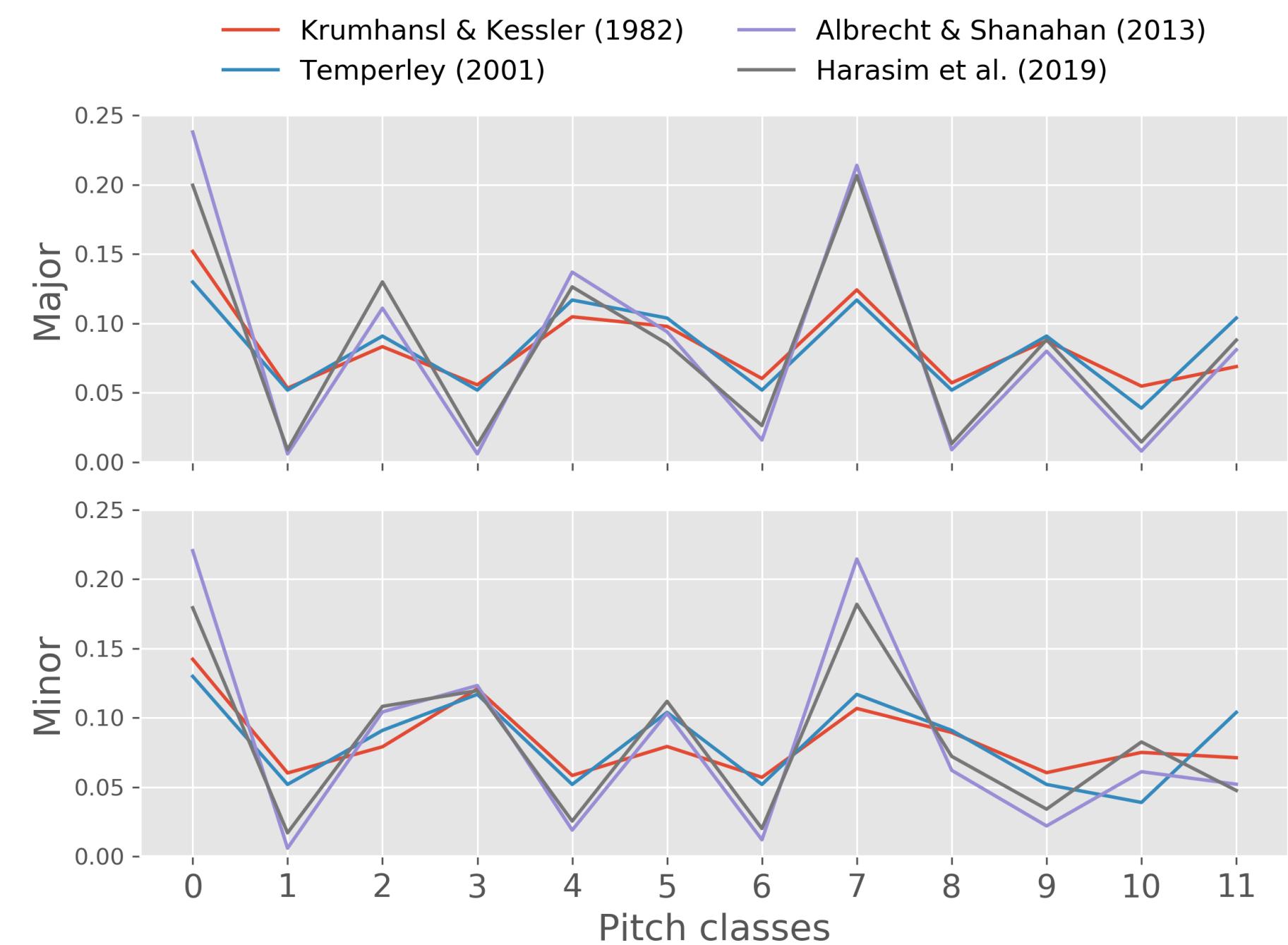
# Inferring Tonality from Note Distributions: Why Models Matter

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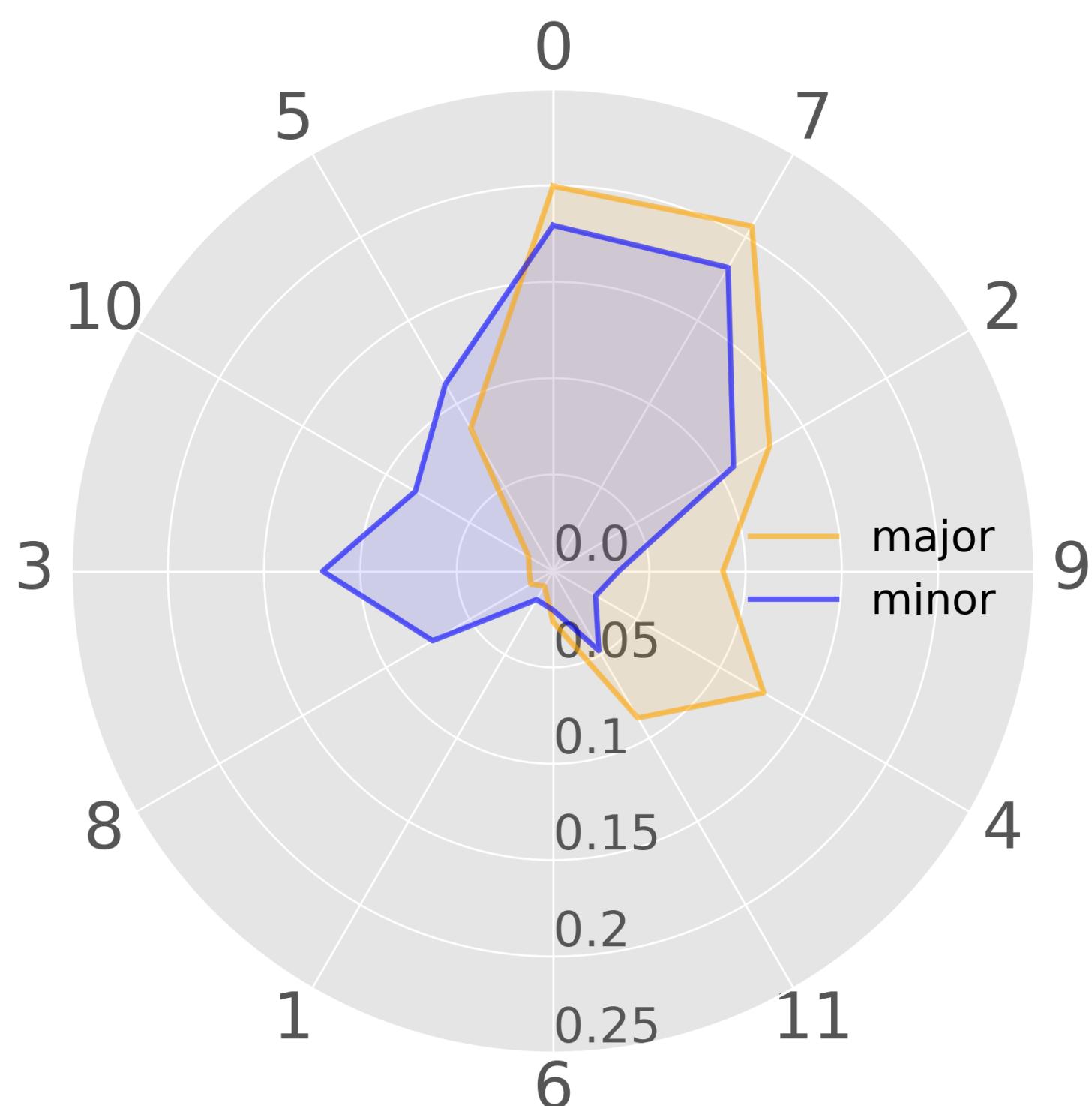
## Background

Statistics of pitch classes (PCs) in musical pieces correspond to cognitive representations of tonality [1, 4, 5, 6] and are assumed to constitute the foundation of statistical learning.



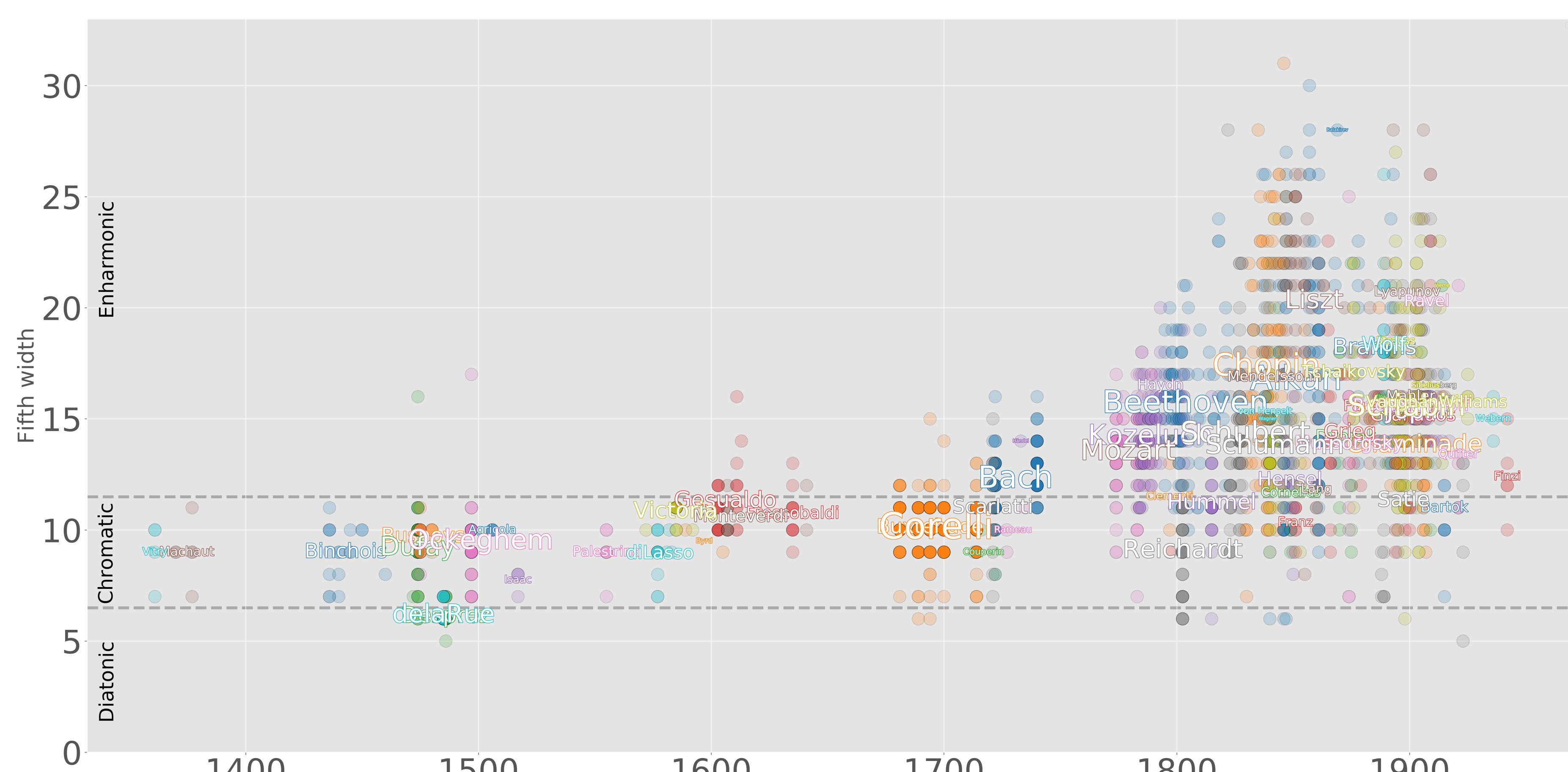
## Model 1: Circle of Fifths

Reordering PCs by  $x \mapsto 7x \bmod 12$  and arranging them on the **circle of fifths** emphasizes differences and similarities of the major and the minor mode [4].



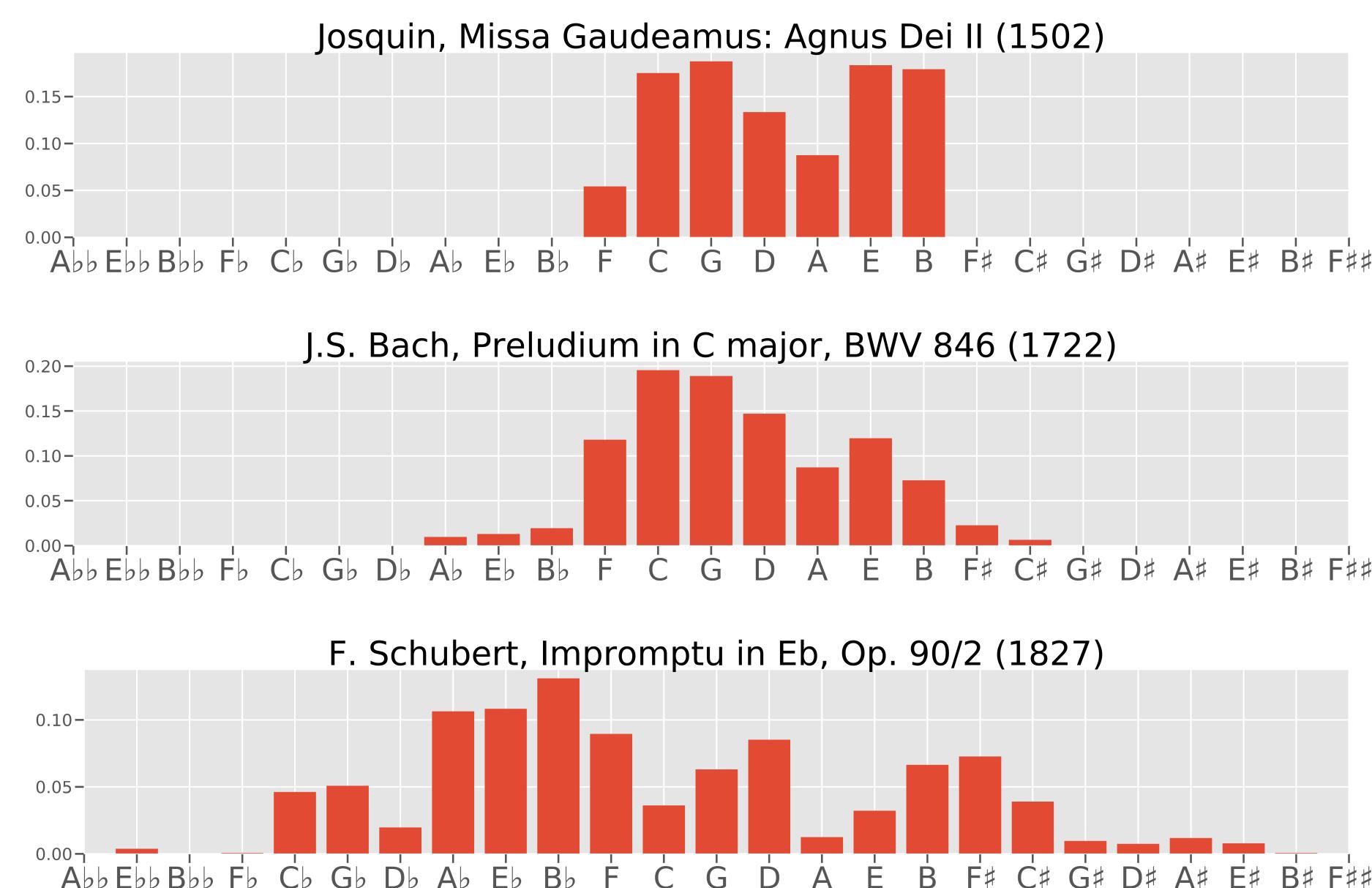
In particular, the relation between in- and out-of-scale notes becomes apparent, as well as the discrepancies between PCs 3 and 10 (minor) vs. PCs 4 and 11 (major).

## Historical Development 1340–1942



## Model 2: Line of Fifths

Using **spelled PCs** enables the distinction between enharmonically equivalent notes that is not possible when using only 12 PCs.



Moreover, comparing pieces across different time periods indicates a trend towards expansion of the tonal material (see "Historical Development") and a transition from diatonicism to chromaticism and enharmonicism [3].

## Conclusion

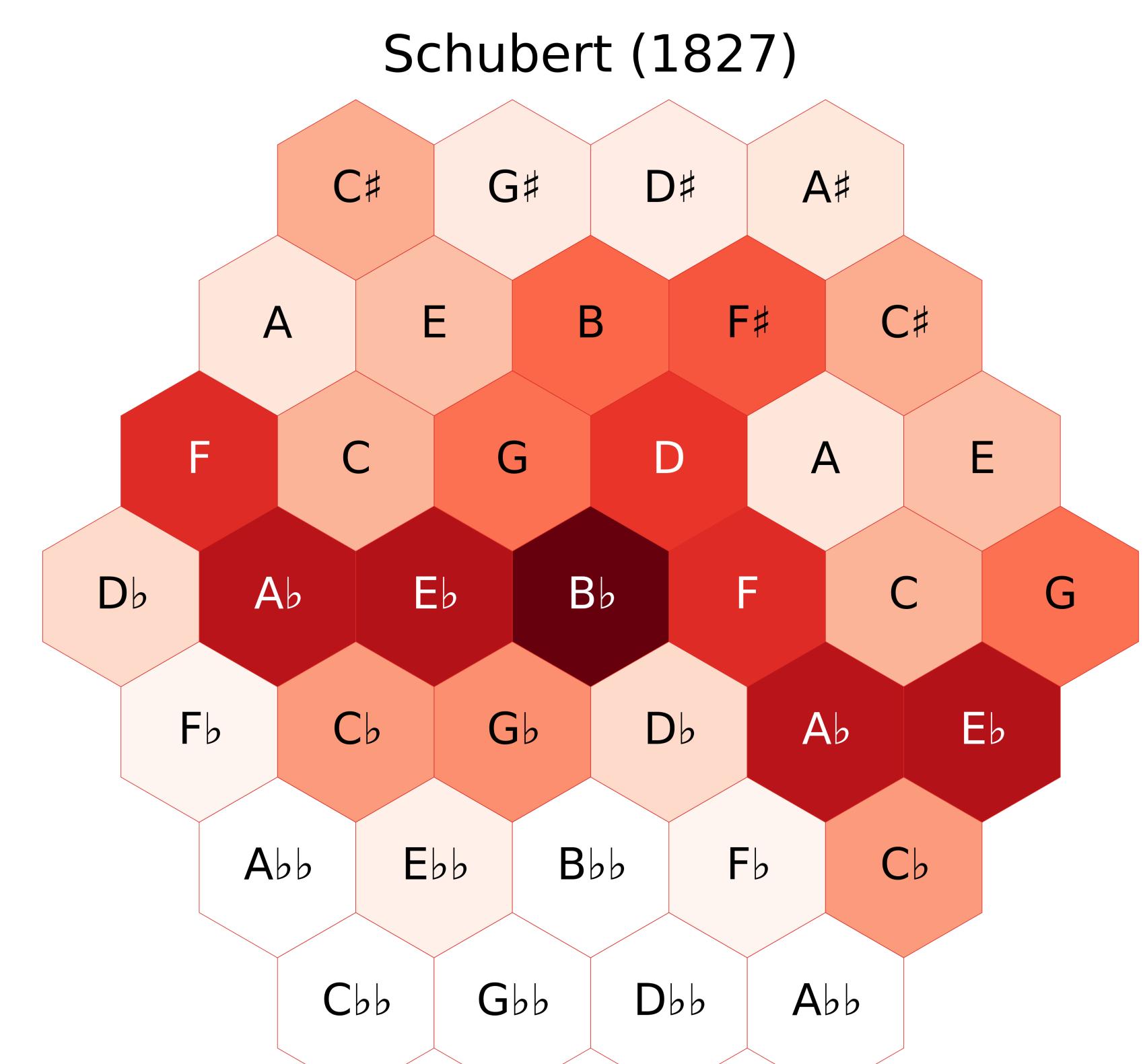
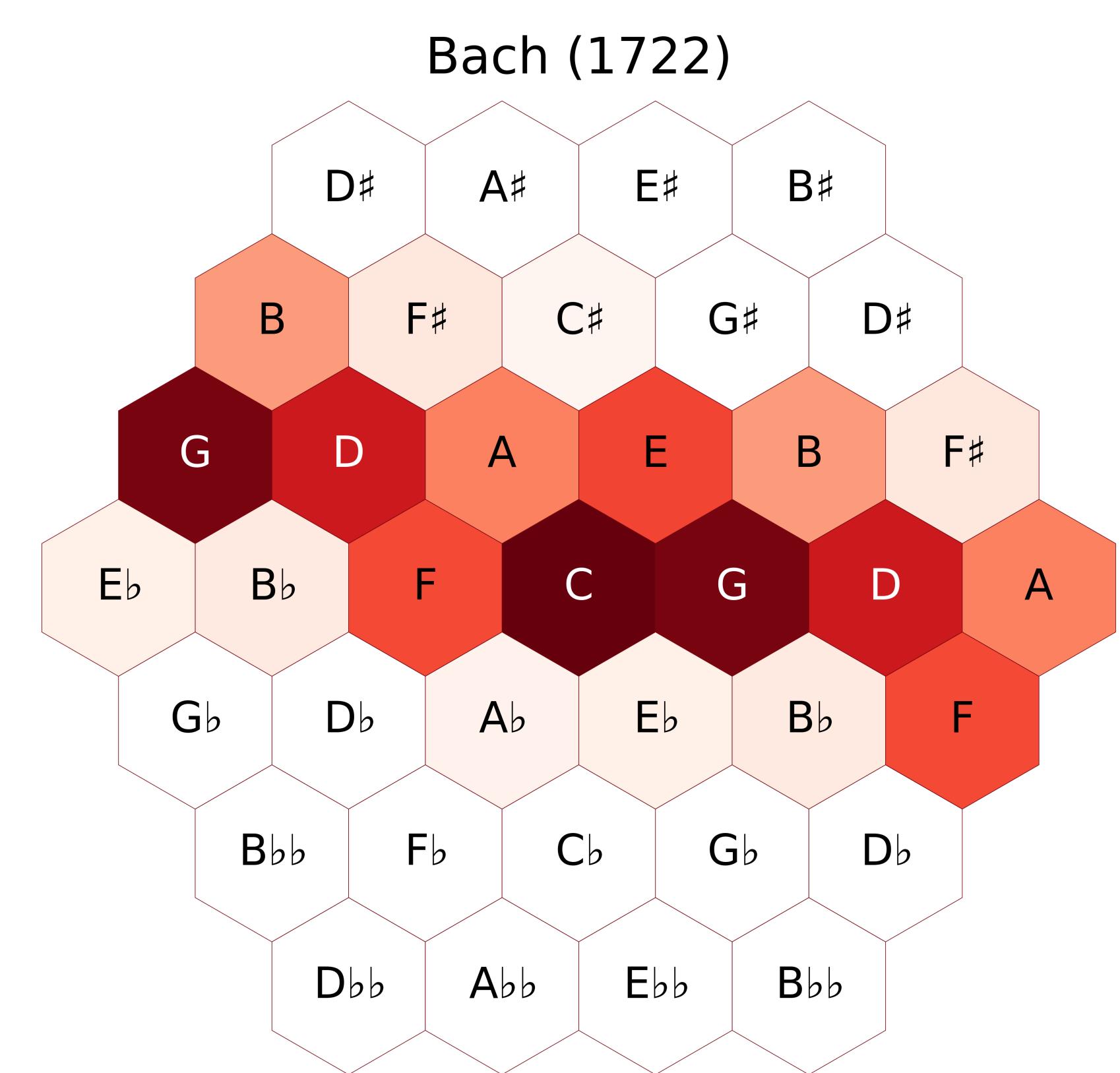
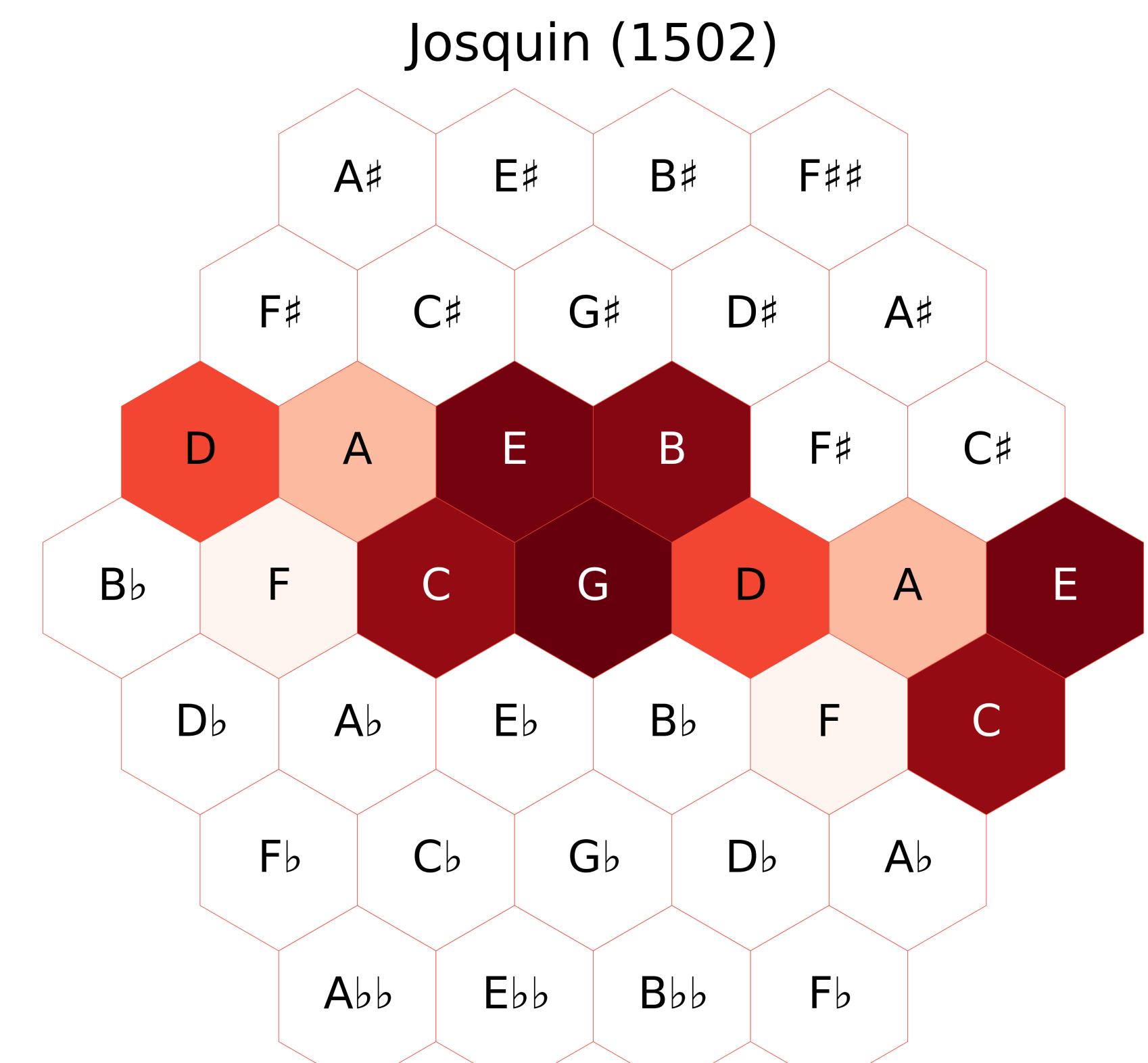
Both psychological as well as theoretical research on tonality is crucially affected by the often implicit or unconscious **assumptions** about underlying tonal spaces. Making these assumptions explicit acknowledges **modeling** as an integral part of study design. Incorporating music-theoretical knowledge about the structure of tonal spaces furthermore allows to apply more apt models for the research on the **history of tonality** as well as its **cognitive representations**.

## References

- [1] J. Albrecht and D. Shanahan. "The Use of Large Corpora to Train a New Type of Key-Finding Algorithm: An Improved Treatment of the Minor Mode". In: *Music Perception: An Interdisciplinary Journal* 31.1 (2013), pp. 59–67.
- [2] R. Cohn. *Audacious Euphony: Chromatic Harmony and the Triad's Second Nature*. Oxford: Oxford University Press, 2012.
- [3] Z. Gárdonyi and H. Nordhoff. *Harmonik*. Wolfenbüttel: Möseler Verlag, 2002.
- [4] D. Harasim, F. C. Moss, M. Ramirez, and M. Rohrmeier. "Cognitive modeling reveals history of major and minor in Western classical music". Submitted.
- [5] C. L. Krumhansl and E. J. Kessler. "Tracing the dynamic changes in perceived tonal organization in a spatial representation of musical keys.". In: *Psychological Review* 89.4 (1982), pp. 334–368.
- [6] D. Temperley. *The Cognition of Basic Musical Structures*. Cambridge, MA: MIT Press, 2001.

## Model 3: Tonnetz

The expansion of tonal material entails also an increase in **mediantic relations**. Consequently, the usage of PCs diachronically spreads out in both the fifth and the third dimensions of the Tonnetz [2].



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