Four Chords Go a Long Way: Measuring Chord Progression Similarity in Chinese Popular Music

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INTRODUCTION

Popular music is often criticized for "reusing" chord progressions — as famously parodied in Axis of Awesome's "4 Chords" song. Chinese popular music in particular has seen a raft of criticism and controversy in the last decade surrounding the reuse of chord progressions from previous hits (cite or quote article)? But has Chinese pop *really* become more harmonically homogeneous?

We investigated the reuse of identical, and **similar**, chord progressions in Chinese popular music from the last decade. Based on the controversy and criticism, we hypothesized that harmonic similarity would increase in the last five years.

To afford nuanced comparison of similarity, we propose a novel **Chord Progression Similarity Index (CPSI)** based on a Markov Model of pitch content in consecutive chords. The CPSI model can be restricted/weighted to explore various musical interpretations.

CHINESE POP MUSIC DATABASE

o Sampling Method:
- The 20 most popular Chinese pop songs from each year $\in$ {2012, 2013, ..., 2021} were sampled based on a aggregate ratings from *QQ Music*, *Kugou Music*, and *Kuwo Music*, which represent 72.8% of Chinese streaming.

o Chord Progression Notations:
- We accessed existing chord-transcriptions of 200 sampled songs from the *Echangwang* website:
  - We encoded chords from the verses and choruses of each track;
  - We transpose all major pieces to C major and minor pieces to A minor.

CPSI MEASURING ALGORITHM BASED ON MARKOV MODEL

o Each chord is represented as a set of equal tempered pitch **classes (pc)**.
- Complex chords (such as 7ths) may or may not be simplified to triads.

o A **12 × 12** transition matrix represents transitions from pcs in each (antecedent chord) to the next (consequent) chord.

o In the **full model** *every* pc in the antecedent chord is tallied as a transition to *every* pc in the consequent chord.
- This approach effectively ignores voice-leading between chords.

o In **weighted/restricted** versions of the model, transitions can be weighted (or removed based on various criteria; for example, prioritizing the chord roots or transitions that fall on stronger hypermetric positions.

o Root-based Measuring Model:
- For a chord progression K with chords $\{C_i\}$, where i represents its location index in K, we simplify it as a directed Markov chain based on its roots $\{R_i\}$. Denote the transition probability from root R_i to R_j as P_{ij}.

The relationship between notes and numbers
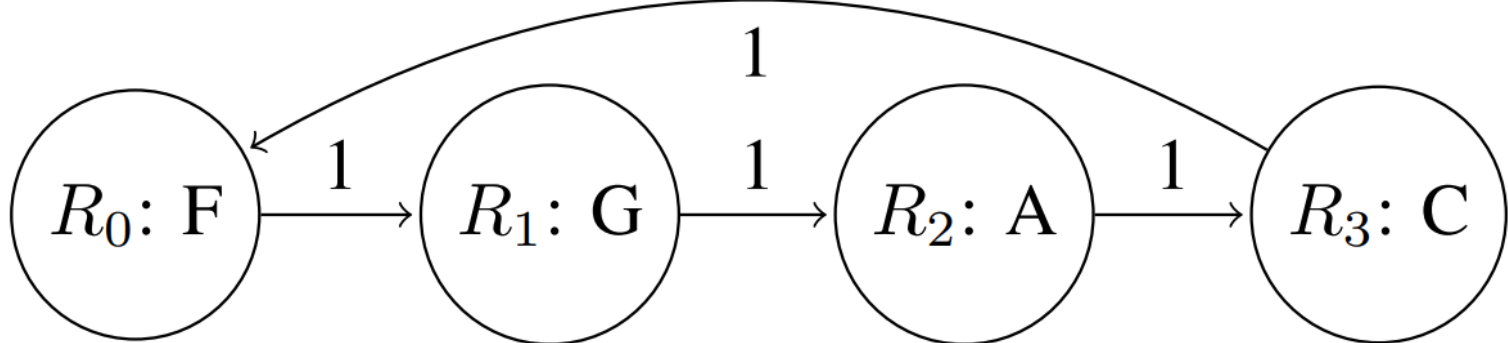
Example of chord progression "F->G->Am->C"
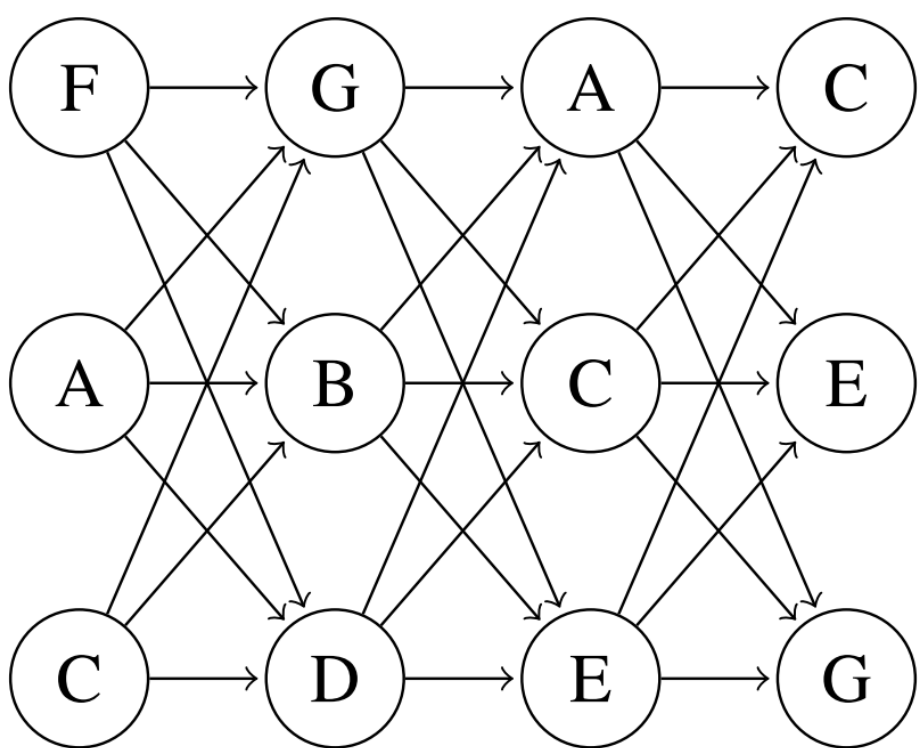
o Construction of Chord Progression Transition Matrix:
- For notes N_{ij} in chord C_i, their transition probabilities to the notes N_{i+1j} in the next chord C_{i+1} are the same;
- The transition probability p_{ij} from note N_{ij} to N_{i+1j} is defined as: $p_{ij} = \dfrac{P_{ij}}{\max j}$

o CPSI: *smaller* CPSI values represents *more similar* chord progressions.
- For chord progression K_1 and chord progression K_2, define their similarity index as the Euclidean distance of their note transition matrix Π_1 and Π_2:

$$\rho_{1,2} = \sqrt{\sum_{i,j}[\Pi_1(i,j) - \Pi_2(i,j)]^2}$$

o Metric Weighting:
- Metric and hypermetric position are extremely important to musical organization and to music perception, especially the first note;

- Assume that the practical human perception weights w_i for chord C_i, the transition matrix P is modified to:

$$P_{ijmodified} = \frac{w_i P_{ij}}{\sum_{i,j} w_i P_{ij}}$$

CPSI EXAMPLES

Example Pair	Chord Progression	weight	CPSI
1	C->Am->F->G	10%	0.0000
	C->Am->F->G	10%	
2	C->Am->F->G	10%	0.0552
	Am->F->G->C	10%	
3	C->Am->F->G	10%	1.6382
	C->Am->F->C	10%	
4	C->Am->F->G	10%	1.8555
	C->G->Am->F	10%	
5	C->Am->F->G	10%	2.1538
	Cmaj7->Em->G->Dm	10%	

Examples of chord progression pairs and corresponding CPSI with first-note-weight

RESULTS

o We first investigate how often any of year's top-20 songs actually use identical chord progressions:

Non-simplified version   Simplified version   Root version

o For a more nuanced analysis, we compare the mean full-model CPSI score in each year, for verses, choruses, and both sections together.

CPSI Data Analysis by Mean   CPSI Data Analysis by Median
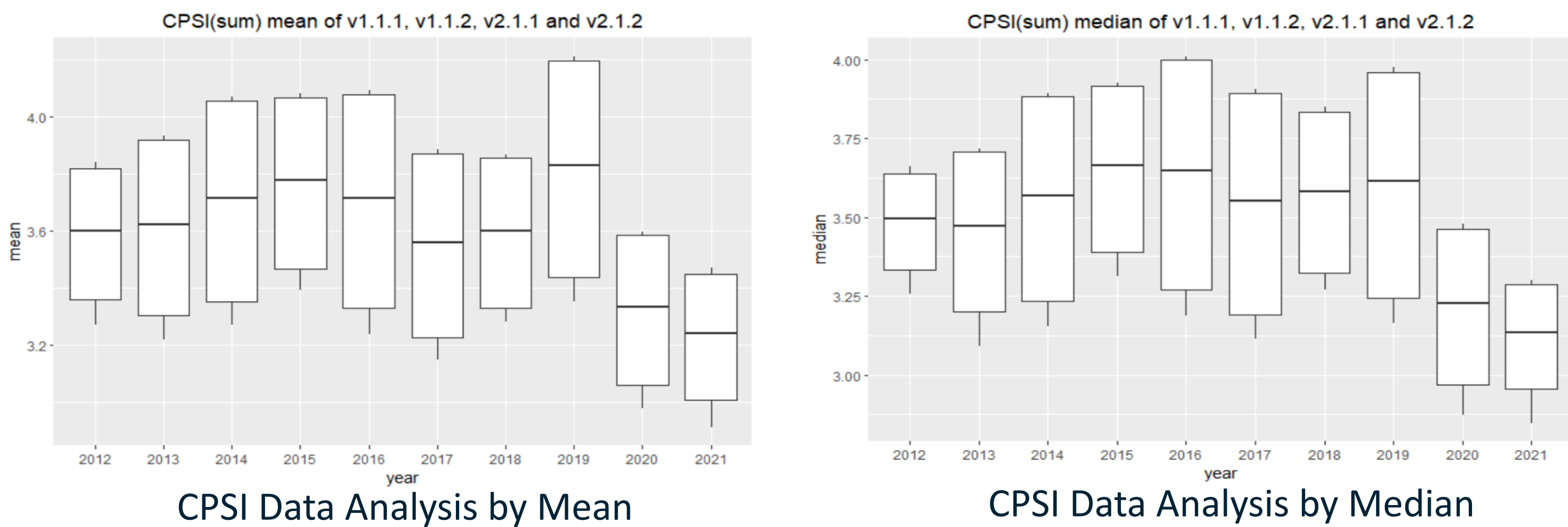
o Mann-Kendall test for monotonic trend analysis shows that the decreasing CPSI is significant in the past five years.
- Comparing to the verse, chorus part more likely appears the same chord progressions.

PERCEPTUAL EXPERIMENT

o We are currently gathering perceptual judgements of chord progression similarity. Please participate in our study if you have 20-30 free minutes! Simply navigate to:
- https://ccml.gtcmt.gatech.edu/ChordSimilarity/interface.html

o Our plan is to compare participants' perceptual judgements to different versions of the CPSI metric, to determine which model assumptions best match perception, and to what degree.

o We will compare twelve versions, representing different weightings (or restrictions) of the transition matrices.
- Version 1.x.x: No weight for chords;
- Version 2.x.x: Add weight to leading chord;
- Version x.1.x: Non-simplified chords;
- Version x.2.x: Simplified chords into triads;
- Version x.3.x: Root-based model;
- Version x.x.1: Progression group as basic analysis unit;
- Version x.x.2: Combining all chord progressions together as basic analysis unit.

CONTACT INFORMATION