

Affordant Harmony in Popular Music: Do Physical Attributes of the Guitar Influence Chord Sequences?

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ABSTRACT

Background

In a 2011 study (and a post-publication extension), de Clerq and Temperley analyzed aggregate chords and chord transitions of popular music, constructing a 200-song corpus from Rolling Stone magazine's "500 Greatest Songs of All Time." They observed that chord transitions appear to be mostly symmetrical: for example, a I chord is immediately followed by a IV chord with a probability of approximately 0.4, while a IV chord is followed by a I chord with that same probability. This chord transition symmetry found in the harmony of popular music ("pop harmony") is not found in common-practice harmony, where chord transitions are typically asymmetrical. For example, while ii chords are immediately followed by V chords with a high probability in common-practice harmony, V chords are immediately followed by ii chords with a much lower probability.

One may hypothesize that this chord transition symmetry arises because pop harmony is not governed by *functional harmony* based on tonic-directed motion relative to a key. As an alternative, it is proposed that *affordant chord transitions*, based on minimizing technical difficulty of playing different chords or chord transitions, may account for this symmetry.

In design, *affordance* is the concept that an object's attributes and its perception constrain and suggest the use of that object (Gibson 1997). For example, a horizontal bar on a door suggests that it should be pushed, whereas a loop suggests that it should be pulled. In the same way, the construction of an instrument can make it more or less suitable for playing in certain ways. In a study involving trumpet music written by trumpet players and by non-trumpet players, Huron and Berc (2009) found that the minimization of technical difficulty in musical passages may reflect an instrument-specific conception, or an awareness of that instrument's affordances. To suggest that pop harmony is governed by affordant harmony, then, is to suggest that the construction of the guitar relates to the difficulty of playing certain chords or chord transitions, which in turn affects the chord sequences used in popular music.

Aims

Two factors are considered as governing systems for pop harmony: *affordant harmony* and *functional harmony*. Affordant chord transitions favor chords and chord transitions that minimize technical difficulty when performed on the guitar, while functional chord transitions favor those based on traditional harmonic functions. Although there are certainly other important factors (melodic constraints, stylistic context, chord sonority, etc.), the aim of this study addresses the question concerning the relationship between affordant and functional factors for chord transitions in popular music.

Four studies were conducted to this end. In Study 1, the hypothesis that affordant factors contributed more to chord transitions than functional factors was tested, and the results were not consistent with the hypothesis. Because of the negative result obtained in Study 1, the aims of Studies 2, 3, and 4 were to determine whether affordant harmony influences chord sequences in popular music at all.

Method

Entropy can be used as a measure of unexpectedness of chord sequences in the corpus. In order to compare the influence of affordant factors versus functional factors, it is proposed that both systems will characterize the entropy of chord transitions in the song corpus differently. The entropy value can be calculated in two ways: with each chord encoded as a letter-name, or with each chord encoded as a Roman numeral. The letter-name encoding (LNE) operationalizes the chord's physical position on the guitar, representing the affordant chord transitions. The Roman-numeral encoding (RNE) operationalizes the chord's relation to the tonic, representing the functional chord transitions. The total entropy (a measure of "unexpectedness") within the chord transitions of the corpus for both encodings is then calculated. Arguably, the encoding with the lower entropy value (that is, "less unexpectedness") corresponds with the harmonic system that more greatly influences the chord transitions.

In Study 1, the LNE entropy was compared to the RNE entropy using the entire 200-song corpus. To study the unexpectedness of chord transitions, first-order entropy was used. That is, each pair of consecutive chords was used to calculate the entropy value.

In Study 2, the ratio of LNE entropy and RNE entropy in the corpus was compared to the same ratio in a corpus where each song was transposed to a random key. This was done in order to establish a baseline ratio of LNE versus RNE. Random transposition of songs results in a corpus where affordant harmony is not likely to play a role. Thus, each song in the corpus was transposed to different random keys. This was repeated twenty times, in order to provide a baseline for evaluating Study 1.

In Study 3, the ratio of LNE entropy and RNE entropy for each song is plotted against the year of its release. This was done to test the hypothesis that the use of affordant harmony increased over time; thus, the ratio of LNE to RNE entropy should decrease over time.

In Study 4, a replication of Study 1 was carried out by filtering out songs not likely to be composed using a guitar. This was operationalized by excluding songs in the corpus that a) were not performed by at least one of its composers and b) did not include a composer known for playing guitar. This second criteria was evaluated by using Google Image Search: composers were excluded if they had fewer than six

guitar-related images within the first ten musical-context images, based on an image search with their names. The resultant 98-song corpus was assumed to contain the songs that were most likely composed on a guitar.

Results

In Study 1, the entropy for the letter-name and Roman-numeral encodings was calculated for the 200-song corpus as a whole. The mean normalized transition entropy was found to be 13,122 bits for the letter-name encoding, and 9,401 bits for the Roman numeral encoding. Contrary to the main hypothesis, the LNE entropy was not lower than the RNE entropy.

The negative results of Study 1 led to Study 2, which was conducted to determine whether affordant chord transitions play a role at all. It was found that the RNE entropy from Study 1 was significantly lower than that of the baseline, randomized key corpus in Study 2 ($p < 0.0001$, $t = 8.1120$, d.f. = 19), even when controlling for the overall distributions of keys.

In Study 3, each song's ratio of LNE entropy to RNE entropy was plotted against that song's release date. It was found that this ratio is negatively correlated with a song's release date ($p = 0.0142$, $t = -2.209$, $df = 193$).

In Study 4, the entropy calculations for Study 1 were recalculated for a reduced corpus, where songs were only included if they were: a) likely to be composed in the same key as its performance, and also b) if they were likely to be composed on the guitar. The use of this guitar corpus reduced the mean entropy (per transition) for both LNE and RNE. Notably, the LNE entropy was reduced more than the RNE entropy when non-guitar works were excluded.

Conclusions

The results of Study 1 are not consistent with the original hypothesis; instead, the results are consistent with the claim that functional factors account for chord sequences in popular music better than affordant factors. However, the results of Study 2 are consistent with the claim that affordant factors do have some influence on the chord sequences in popular music.

The results of Study 3 are consistent with the claim that the influence of affordant factors increase relative to functional factors over time in years. It may be suggested that this is due to the increasing use of chords other than I, IV, and V after the 1960s, and that the use of these chords was driven by affordant factors of the guitar. However, other interpretations for the sources of these new chord transitions are certainly possible.

The results of Study 4 are consistent with the tentative conclusion that chord transitions in guitar-driven popular music are different than the chord transitions in non-guitar-driven popular music, and that affordant factors, rather than functional factors, may best account for these differences.

(A more complete discussion can be found online at: http://etd.ohiolink.edu/view.cgi?acc_num=osu1308075022)

Keywords

Popular music, guitar, harmony, chords, affordance, idiomacity

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