

# Tempo Versus Harmonic and Melodic Pacing in a Corpus of Rock Music

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## Abstract

As the tempo of a song increases, the duration of harmonic and melodic events will decrease proportionally in terms of absolute time. Examining a corpus of 200 rock songs, however, this principle is found to not always hold true when comparing tempo to harmonic and melodic pacing between songs. Specifically, median chord durations and median melodic note lengths per song—as measured in seconds—tend to remain somewhat constant across the entire range of tempos. Relative harmonic and melodic lengths thus tend to increase as tempo increases. Absolute time thus appears to shape not only the perceptual limits for meter and maximal pulse salience (London 2012) but also cognitive preferences for rates of harmonic and melodic motion. Most importantly, these results may help explain why different listeners often entrain to different metric levels in popular music (Moelants & McKinney 2004, Levy 2011), since the speed of the drum pattern may be considered distinct from the rate at which harmonic and melodic content is disbursed.

## Background

Research described in de Clercq (2016) shows that tempo ratings for songs judged to be in quadruple meters (e.g., 4/4 and 12/8) consistently average around 120 BPM across three separate corpora of popular songs (Covach 2009, Burgoyne et al. 2011, Temperley & de Clercq 2013). This average tempo creates an average measure length of 2 seconds.

Tempo ratings for songs in these three corpora judged to be in duple meters (e.g., 6/8) average around 60 BPM. This average tempo also creates an average measure length of 2 seconds.

Based on these findings and other evidence, de Clercq (2016) posits that absolute time shapes the general pacing of harmonic and melodic content in popular music and that this pacing is often rather moderate in terms of absolute time, despite apparent variation in perceived tempos. The current study investigates to what extent this hypothesis may be true.

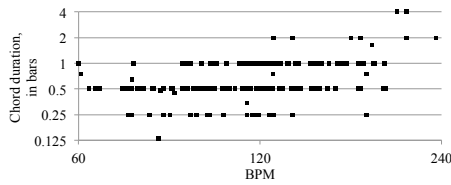
## Methodology

The current study uses the 200-song corpus of “rock” music described in Temperley & de Clercq (2013). This corpus, derived from *Rolling Stone* magazine’s 2004 list of the “500 greatest songs of all time,” generally spans from the 1950s through the ‘90s and encompasses a broad range of popular styles, including heavy metal (“Enter Sandman”), soul/R&B (“Respect”), grunge (“Nirvana”), country (“I Walk the Line”), hip-hop/rap (“California Love”), pop (“Hey Jude”), and classic rock (“Satisfaction”).

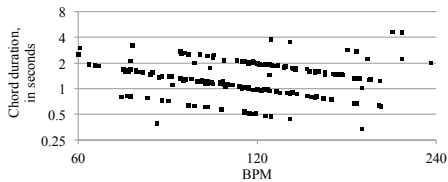
The following figures and tables investigate the shortest harmonic and melodic events, i.e., those in the 10<sup>th</sup> percentile, and median chord durations and note lengths. N.B. Only songs in quadruple meters (i.e., 4/4 and 12/8) were considered, and a handful of songs were excluded because they did not contain any significant harmonic motion or melodic content, engendering a remaining set of 185 for the harmonic study, and 186 for the melodic study.

## Harmonic Pacing: 10th Percentile Chord Durations

**Figure 1.** 10th percentile chord durations in bars vs. tempo. Significant correlation was found, with  $r(183) = .51, p < .001$ . As tempo increases, durations of shortest chords tend to span longer amounts of relative time.

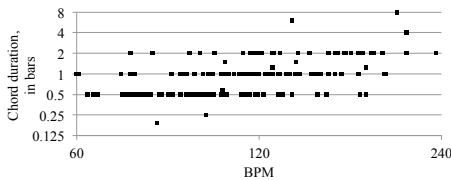


**Figure 2.** 10th percentile chord durations in seconds vs. tempo. No significant correlation was found (BPM vs. 1/seconds), with  $r(183) = .06, p = .39$ . Note that although three distinct descending lines can be seen, these lines tend to center around 1 second.

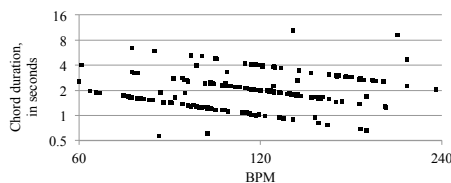


## Harmonic Pacing: Median Chord Durations

**Figure 3.** Median chord durations in bars vs. tempo. Significant correlation was found, with  $r(183) = .47, p < .001$ . As tempo increases, median chord lengths thus tend to span longer amounts of relative time.

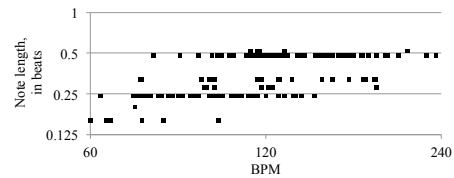


**Figure 4.** Median chord durations in seconds vs. tempo. No significant correlation was found (BPM vs. 1/seconds), with  $r(183) = .01, p = .90$ . Increasing tempo thus does not appear to correlate overall with decreasing chord lengths in terms of absolute time. Note that although three distinct descending lines can be seen, these lines tend to center around 2 seconds.

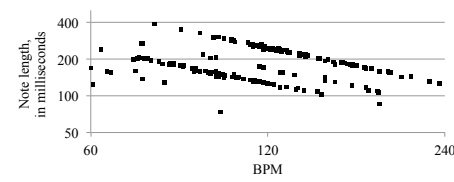


## Melodic Pacing: 10th Percentile Note Lengths

**Figure 5.** 10th percentile note lengths in beats vs. tempo. Significant correlation was found,  $r(184) = .58, p < .001$ . At slower tempos, shortest notes tend to be 16th notes; at faster tempos, 8th notes, with a breakpoint around 120 BPM.

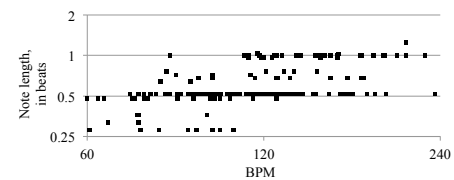


**Figure 6.** 10th percentile note lengths in milliseconds vs. tempo. Significant correlation was found (BPM vs. 1/milliseconds), with  $r(184) = .23, p = .001$ . The correlation is due to the overall descending trend, but note the division of this trend into two distinct lines, which appear to center around 200 milliseconds.

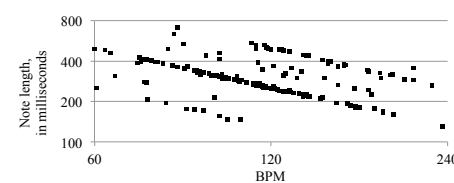


## Melodic Pacing: Median Note Lengths

**Figure 7.** Median note lengths in beats vs. tempo. Significant correlation was found, with  $r(184) = .53, p < .001$ . At slower tempos, given a 4/4 meter, median note lengths tend to be eighth notes; at faster tempos, quarter notes, again with a breakpoint around 120 BPM.



**Figure 8.** Median note lengths in milliseconds vs. tempo. Significant correlation was found (BPM vs. 1/milliseconds), with  $r(184) = .33, p < .001$ . Again, two overall descending patterns are clearly visible, but they tend to operate within the one-octave window between 200 and 400 milliseconds.



## Average Durations and Lengths, in 5 Bins

**Table 1.** Average chord durations, as calculated with BPMs grouped into 5 bins ( $n = 37$ ).

Bin	Average BPM	Average chord duration			
		in bars		in seconds	
		10th %ile	Median	10th %ile	Median
1	76.1	0.54	0.75	1.657	2.336
2	98.8	0.57	0.87	1.379	2.153
3	115.6	0.69	1.04	1.411	2.153
4	132.5	0.82	1.25	1.484	2.265
5	173.8	1.13	1.74	1.497	2.329

**Table 2.** Average note lengths, as calculated with BPMs grouped into 5 bins ( $n = 37$ ).

Bin	Average BPM	Average note length			
		in beats		in milliseconds	
		10th %ile	Median	10th %ile	Median
1	76.0	0.24	0.47	192.2	372.7
2	98.6	0.31	0.50	188.2	297.0
3	115.4	0.39	0.64	207.1	325.3
4	131.2	0.42	0.64	197.0	292.0
5	174.2	0.44	0.80	156.3	277.2

## Similar Forms Despite Different Perceived Tempos

Two songs may display similar melodic and harmonic content distributed at the same rate in absolute time, despite different perceived tempos induced by the drums. Note, for example, the highly similar harmonic plans (I-IV-V-I) and melodic organizations for the songs “Heartbreak Hotel” and “That’s All Right.”

**Example 1.** “Heartbreak Hotel” (Elvis Presley, 1956), with a tempo of about 92 BPM (2.55 second bar lengths); the 8 measures below last about 20.4 seconds.

**Example 2.** “That’s All Right” (Elvis Presley, 1954), with a tempo of about 210 BPM (1.14 second bar lengths); the 18 measures below last about 20.5 seconds.

## Select References

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