

# Rhythm, meter, and their perception

# Bruno Repp: Tempo and Timing (2002)

<https://doi-org.stanford.idm.oclc.org/10.1525/mp.2002.19.4.565>

Percentage deviation from  
Bar rhythm in 4 tempos.

Musical examples in duple,  
Triple, and compound r.

TABLE 4  
Percentage Deviations of Bar Durations from Metronome Interval

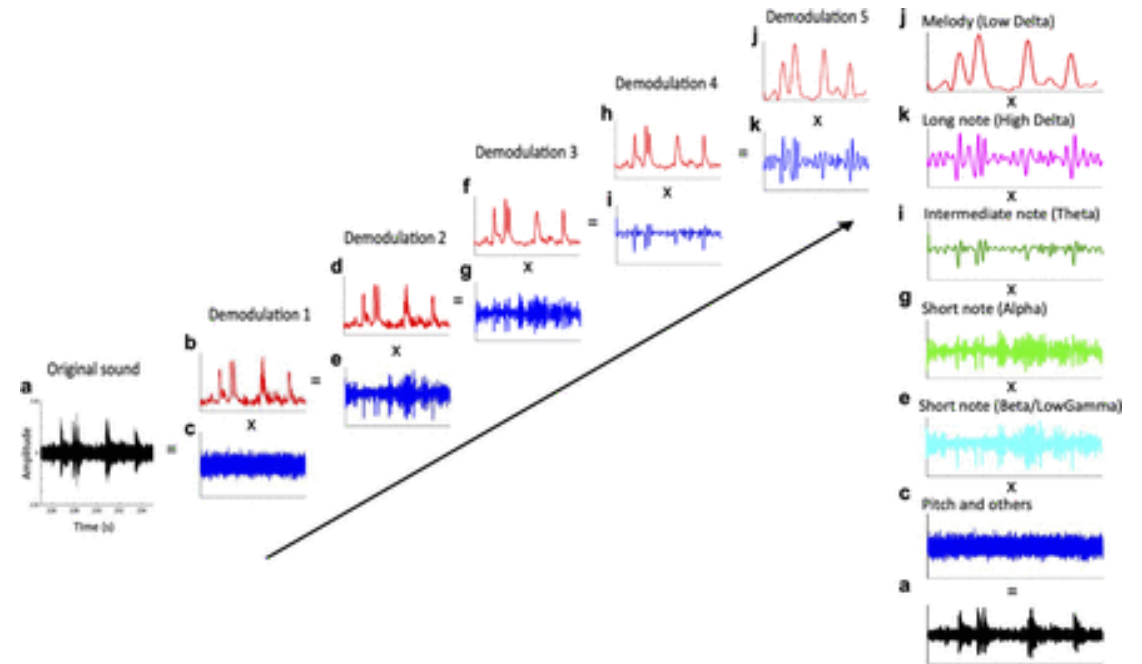
Rhythm	Tempo			
	Slow	Medium	Fast	Very Fast
2:2 (2/4)	1.8 (3.9)	-1.6 (2.8)	-2.1 (2.4)	-0.3 (2.4)
3:1 (2/4)	4.1 (4.9)	1.7 (4.0)	3.5 (3.6)	2.9 (3.0)
1:3 (2/4)	3.3 (4.4)	3.1 (2.8)*	6.7 (4.6)**	6.1 (3.8)**
2:1 (3/8)	5.7 (4.8)*	6.4 (3.5)***	10.0 (6.6)**	13.1 (4.1)***
1:2 (3/8)	9.1 (5.0)***	10.6 (3.3)***	14.6 (5.5)***	16.5 (3.6)***
3:2 (5/8)	-1.5 (3.6)	7.3 (4.9)**	16.6 (6.7)***	17.3 (10.9)*
2:3 (5/8)	-0.6 (3.8)	6.5 (5.0)**	14.0 (6.3)***	15.5 (7.4)***
2:2:2 (3/4)	-10.2 (7.1)**	-4.6 (6.9)	-2.2 (4.5)	0.3 (3.7)
3:1:2 (3/4)	-2.5 (4.5)	6.7 (3.1)***	14.8 (5.1)***	14.9 (6.8)***
3:2:1 (3/4)	-2.0 (2.7)	12.5 (4.6)***	20.4 (7.1)***	19.3 (9.8)***
2:3:1 (3/4)	-2.3 (4.1)	6.9 (4.8)**	10.8 (5.6)***	10.3 (5.7)***
2:1:3 (3/4)	-0.6 (1.7)	8.1 (3.4)***	14.2 (5.4)***	14.8 (6.0)***
1:2:3 (3/4)	-1.1 (3.5)	9.0 (5.3)***	17.0 (6.6)***	20.1 (5.0)***
1:3:2 (3/4)	-2.8 (2.6)	9.0 (3.0)***	16.2 (6.5)***	16.7 (3.9)***
2:2:2 (6/8)	-2.7 (4.9)	6.0 (5.0)*	17.7 (8.0)***	17.3 (10.6)**
3:1:2 (6/8)	0.0 (4.7)	10.2 (3.8)***	11.6 (4.2)***	15.4 (6.3)***
3:2:1 (6/8)	-1.9 (4.7)	5.3 (5.3)*	7.3 (4.6)**	1.0 (8.0)
2:3:1 (6/8)	-0.2 (2.7)	7.6 (5.7)**	12.2 (5.8)***	14.5 (7.9)***
2:1:3 (6/8)	-0.8 (4.2)	3.8 (4.0)	7.3 (3.7)***	11.3 (5.7)***
1:2:3 (6/8)	-1.4 (4.4)	10.0 (6.5)**	15.0 (5.3)***	16.7 (7.6)***
1:3:2 (6/8)	-2.2 (2.9)	10.4 (4.8)***	15.1 (5.1)***	23.9 (8.6)***

Numbers in parentheses are double standard errors. (\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ ).

T. Daikoku, U. Goswami (2020):

# Amplitude Modulation in adults and infants

- The Temporal Statistics of Musical **Rhythm** across Western Genres: An Amplitude Modulation Phase Hierarchy Model
- doi: <https://doi.org/10.1101/2020.08.18.255117> [BioRxchiv]
  - Looking for similarities in IDS, CDS in perception of music and speech
    - Temporal Sampling Theory (TS)
    - Amplitude Modulation (AM)
    - Various genres and instruments



Recursive filtering by various methods (PAD model)

# Japanese shamisen overlapping patterns

- Rhythmic elements of melodic process in nagauta shamisen music (Masato Yako), CM ii (1998), 169-184
- Rhythmic pattern types
  - Flexible
  - Inflexible
  - Reverse
- Beat types (can produce lost or redundant beats)
  - Before-beat
  - On-beat
  - After-beat

# Poudrier and Repp: polyrhythmic perception

- Can musicians track two different beats? (*Music Perception* 30/4, 2013) Download PDF here: [https://online-ucpress-edu.stanford.idm.oclc.org/mp/article/30/4/369/62561/Can-Musicians-Track-Two-Different-Beats](https://online.ucpress-edu.stanford.idm.oclc.org/mp/article/30/4/369/62561/Can-Musicians-Track-Two-Different-Beats)
- Can listeners track two rhythms at the same time?
  - Well defined musical phenomena illustrate this ability in
    - Specific African drumming (Arom)
    - Vocal performance of with Japanese koto (plucked instrument)

# Polyrhythms in Western music?

- Poudrier and Repp ran three tests from which they produced divergent results
- Subjects listened to two examples simultaneously
  - One example in 2/4, one in 6/8
  - Each at a different register
- Asked to state whether a probe tone coincided with beat in one examples, both, or neither
- Results: subjects did well in first phase, less well when beat patterns were more complicated. Composite rhythm valuable for profiling results.

# Shamisen: Elaborate pattern classification system

Example 1. Tokimune (samurai proper name)

Complex system of pattern-combinations

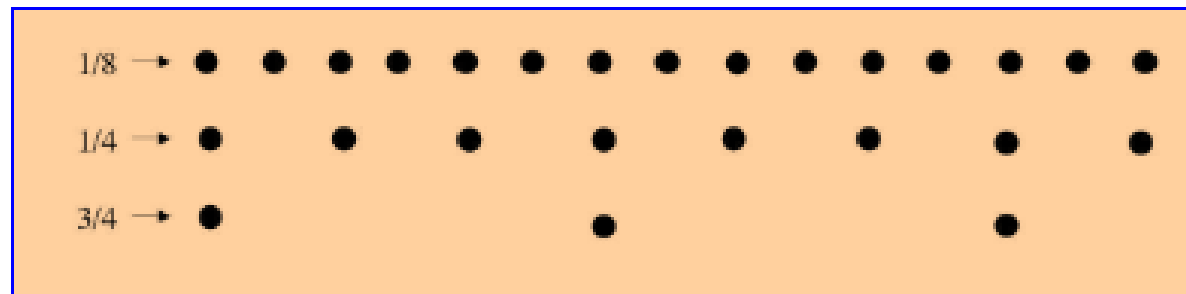
Music typeset with SCORR using Hiragana font.

This system a challenge to hierarchical phrase models.

Example 2. Akenokane ("Bell of the Morning Glow")

# Anja Volk: Inner metric [cumulative] accents

- Explores interplay of pulse and metrical accents
- Orientation: meter is complicated



Full explanation in UI Utrecht lab report:

<http://www.cs.uu.nl/research/techreps/repo/CS-2008/2008-006.pdf>



# Volk example

## Inner metric analysis



- Schumann Op. 124, bars 1-4

