

Synchronizing with Metrically Ambiguous Music

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Theoretical background:

Metric Structure: hierarchical – ‘well-formed’

-> binary or ternary subdivisions at different levels

e.g.

x				x
x	x			x
x	x	x	x	x
x	x	x	x	x
x	x	x	x	x

(cf. 12/8 meter)

Tempo: ‘most salient’ level, central layer for synchronization

- > theoretical approach: choose an element that determines the tempo (score, basdrum)
- > perceptual/emodied approach: listeners decide through synchronization

=> do listeners always agree?

Ambiguity of Tempo?



Ambiguity of Tempo



General preference for tempi around 120 bpm

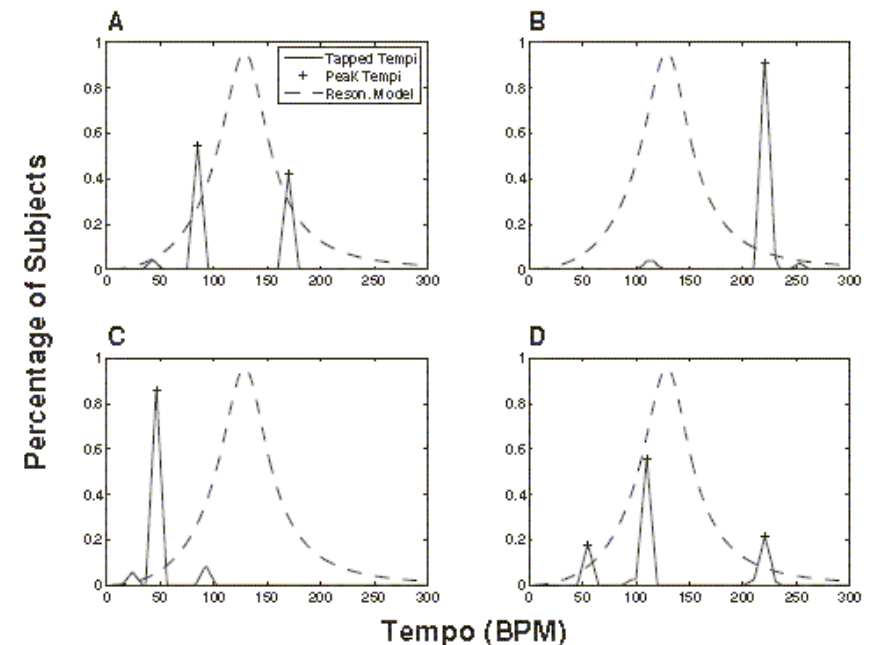
(resonance model, Van Noorden & Moelants, 1999)

(preferred dance tempo 128; Moelants, 2008)

- Music can lead listeners to faster/slower tempi
- Often a choice between two or three metric levels
(ambiguity in tempo perception; McKinney & Moelants, 2004)

-> influenced by musical structure

-> interpersonal differences



Ambiguity of Tempo

Sometimes 3:2-ambiguity is found!

Mainly in pieces that were expected to be ternary

6	x									x	
3	x		x		x			x			x
2	x	x	x	x	x	x	x	x	x	x	x
1	x	x	x	x	x	x	x	x	x	x	x

cf. 3/4 vs. 6/8



Ambiguity of Tempo

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6	x						x			
3	x		x		x				x	
2	x	x	x	x	x	x	x	x	x	x
1	x	x	x	x	x	x	x	x	x	x

cf. 3/4 vs. 6/8



= Metrical Ambiguity



Stimuli

120 excerpts of ‘ternary’ meters, each 30 seconds long

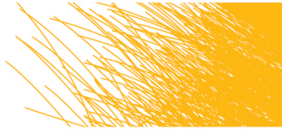
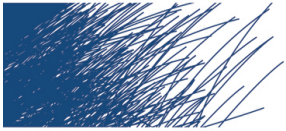
- wide variety of styles
- wide range of tempi (68-495 bpm at the « 1 » level)

Subjects

2 x 50 subjects; age 19-60 (mean 29); 25 musicians – 25 non-musicians;

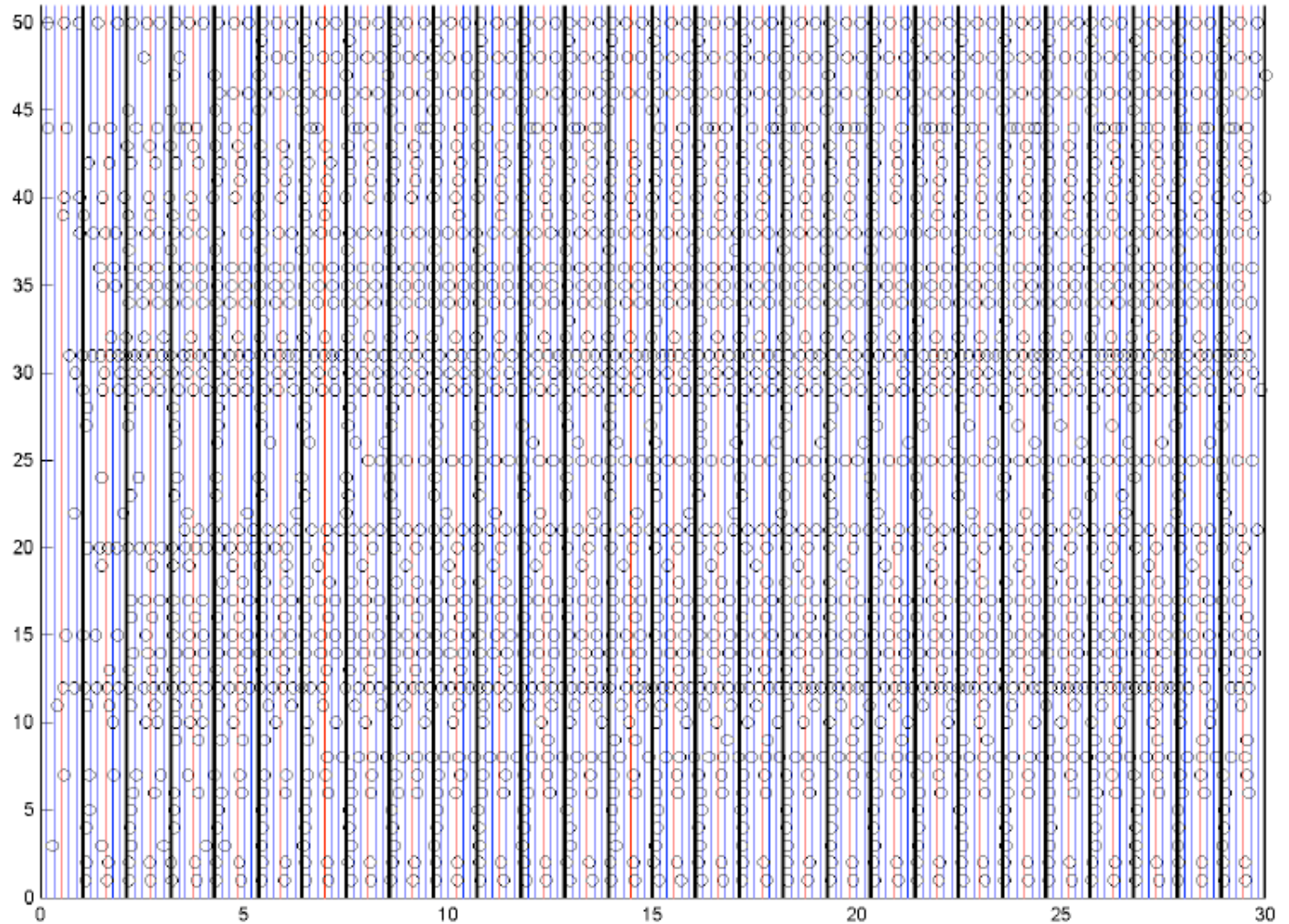
22 male – 28 female

-> let subjects tap along with the perceived beat of the excerpts










Analysis

Visual representation



Results

Distribution of different metrical layers

6	x											6.9%	
4	x		x					x				2.0%	
3	x		x		x				x			44.0%	
2	x	x	x	x	x	x	x	x				13.3%	
1.5	x	x	x	x	x	x	x	x	x			1.4%	
1	x	x	x	x	x	x	x	x	x	x	x	31.3%	
0.5	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx											1.1%	

Results

Huge individual differences

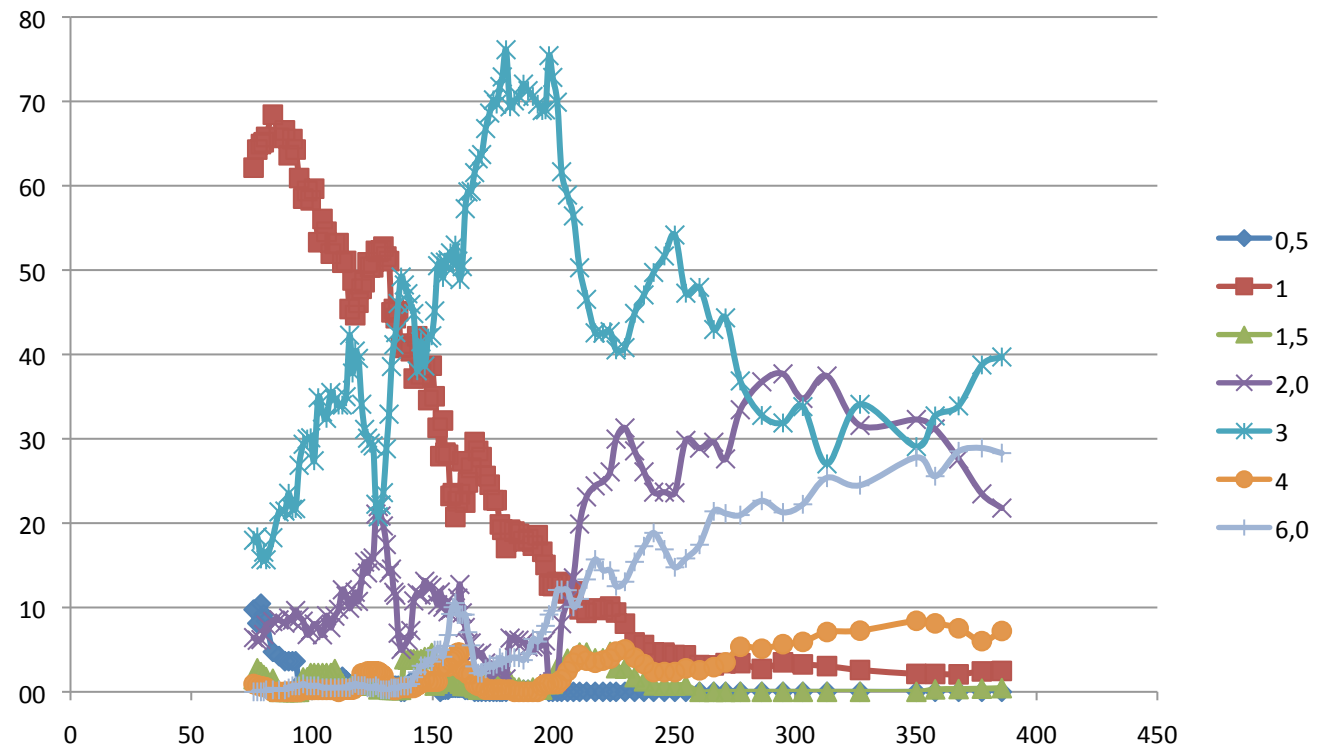
- mean taptempo: 49 – 161 bpm (general average 86)
- ternary/binary ratio: 0.13 – 25.6 (overall 2.89)

No group effects

no significant differences: musicians-non-musicians, male-female, young-old
-> individual image!

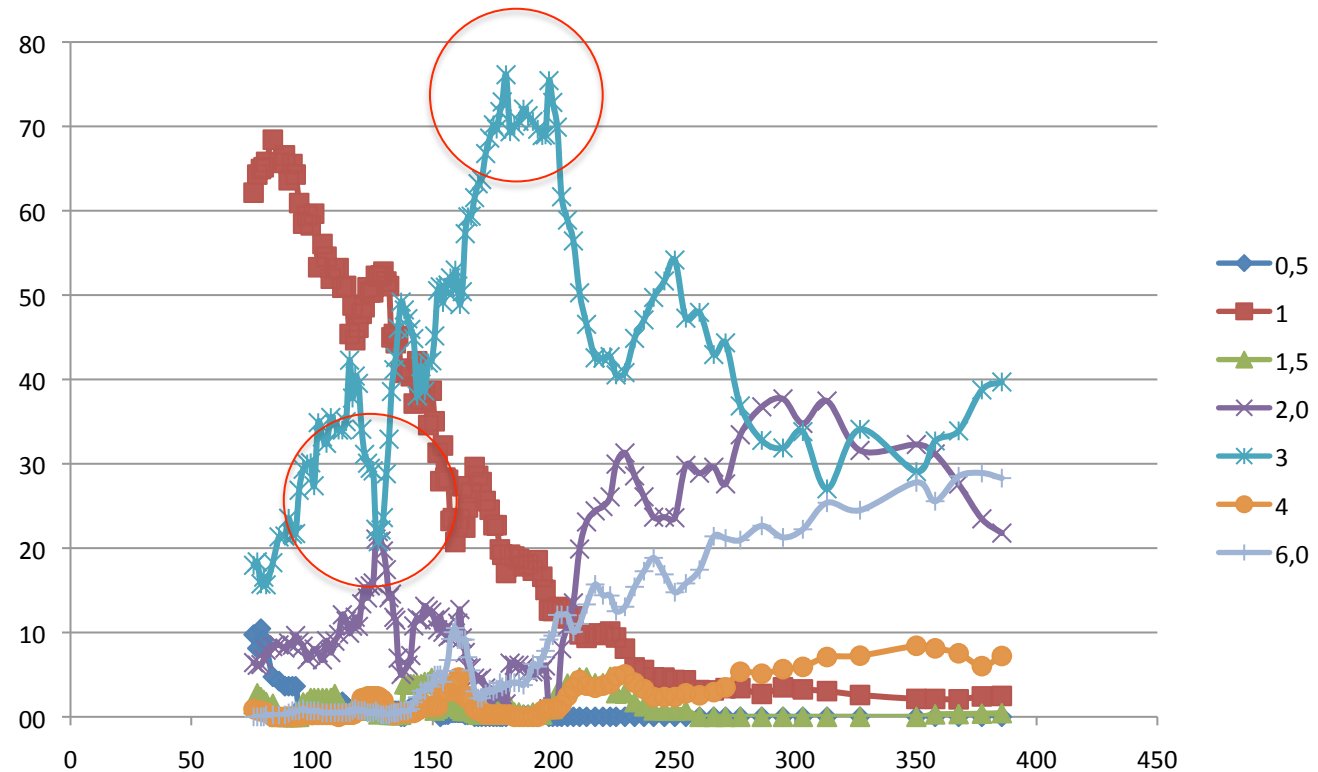
Results

Effect of tempo

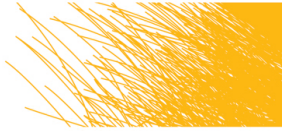
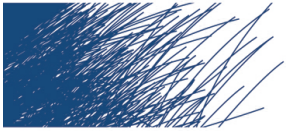


Results

Effect of tempo

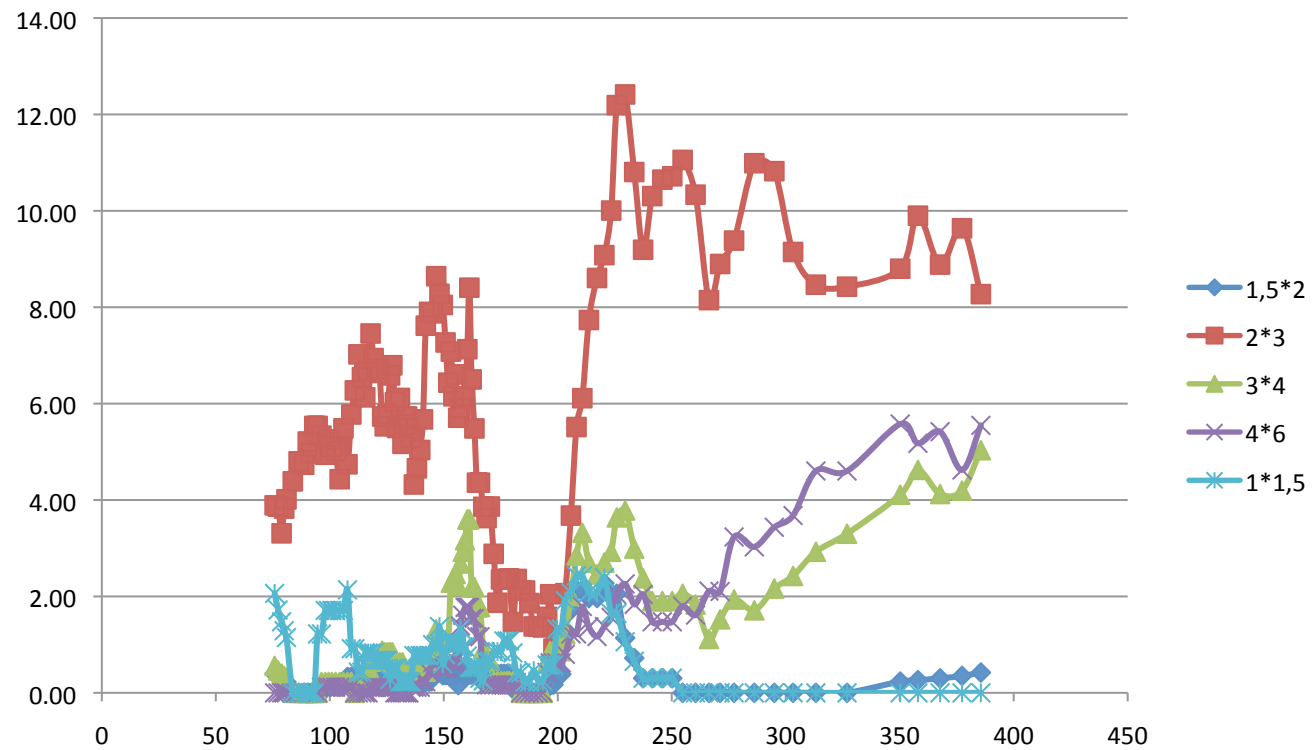


Optimal grouping at 120-130 (binary) and 180-200 (ternary) = 1 second period



Results

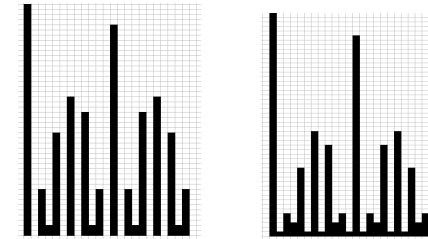
Effect of tempo



Prevalence of ternary interpretation, low ambiguity around 180-200 bpm
-> corresponds to typical Viennese waltz tempo

- Perception of tempo and meter is not unambiguous

-> more complex representation of metric structure?



- Individual interpretation and preferences (speed, binary/ternary)

-> Is there a problem for musical communication?

- Clear relation between absolute tempo and metric grouping

-> choice of tempo important for communication of metric structure

- Can this ambiguity be used in e.g. music theory or music information retrieval?
- Further investigate the relation between musical structure and ambiguity
- Investigate full-body synchronization (different metrical levels?)