

# Basic Concepts of Musical Rhythm

# Musical Rhythm

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beat bin

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# rhythm

*from the ancient Greek “ῥέω” (= to flow)*

Rhythm is a particular way of flowing (Fraise, 1982). It is an ordered succession.

- Order according to whom?

The order is subjective and perceived.

The order implies that we predict and anticipate what will come next. As opposed to arrhythmia which lacks the perception of an order and anticipation.

- Succession of what?

In musical rhythm: Sounds! But how do we segment the continuum of time into discrete sounds and durations?

# perceived vs conceived

Musical rhythms are perceived as opposed to conceived (Fraise, 1982).

Examples of conceived rhythms can be found in very rapid or very slow successions, as for instance in the succession of seasons. In such successions, the order is not “felt” directly.

Our rhythm perception is limited by our short term memory. Discrete events form a unity only when they fall in the brief duration of the psychological present (~3sec).

# categorical hearing

Exact integer ratios of durations should be easier to process as their organization is simpler. Yet they cannot be performed by humans (Clarke, 1999). In most music, the durations have small variations and deviations from such simple ratios.

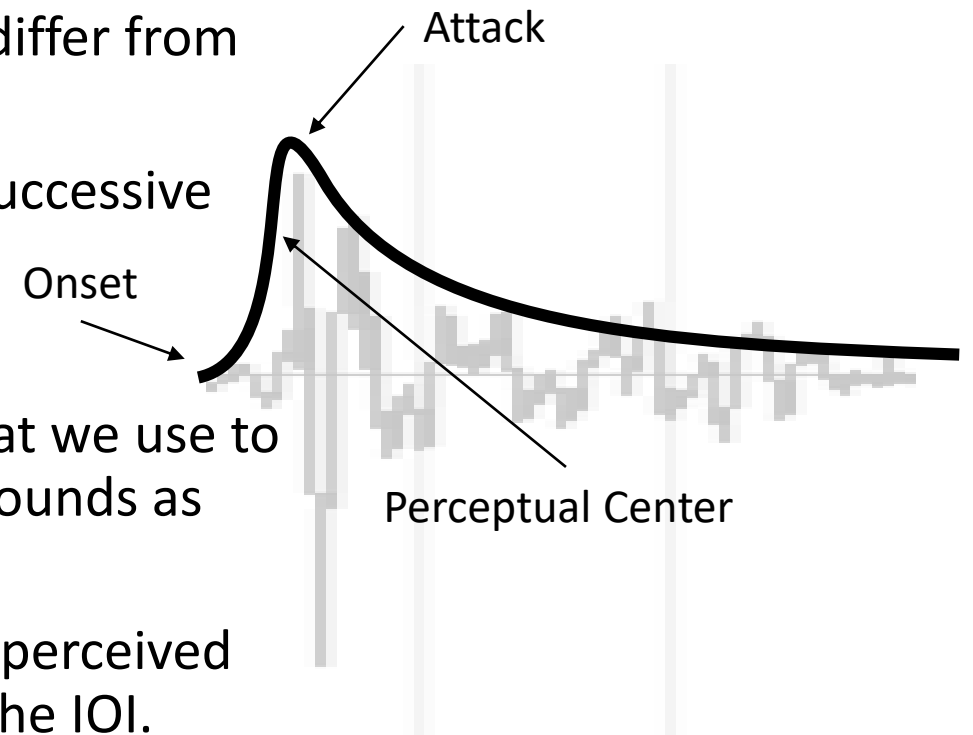
How does order then emerge in our mind? How do we make sense of the varying and noisy durations that make up a musical rhythm?

Rhythm perception is categorical and confined to simple ratios (Parncutt, 1994). A rhythmic pattern is essentially coded as a series of symbolic durations of simple ratios such as “long” and “short”, or 2:1, 3:1 etc., or nominal durations such as the ones found in a music score.

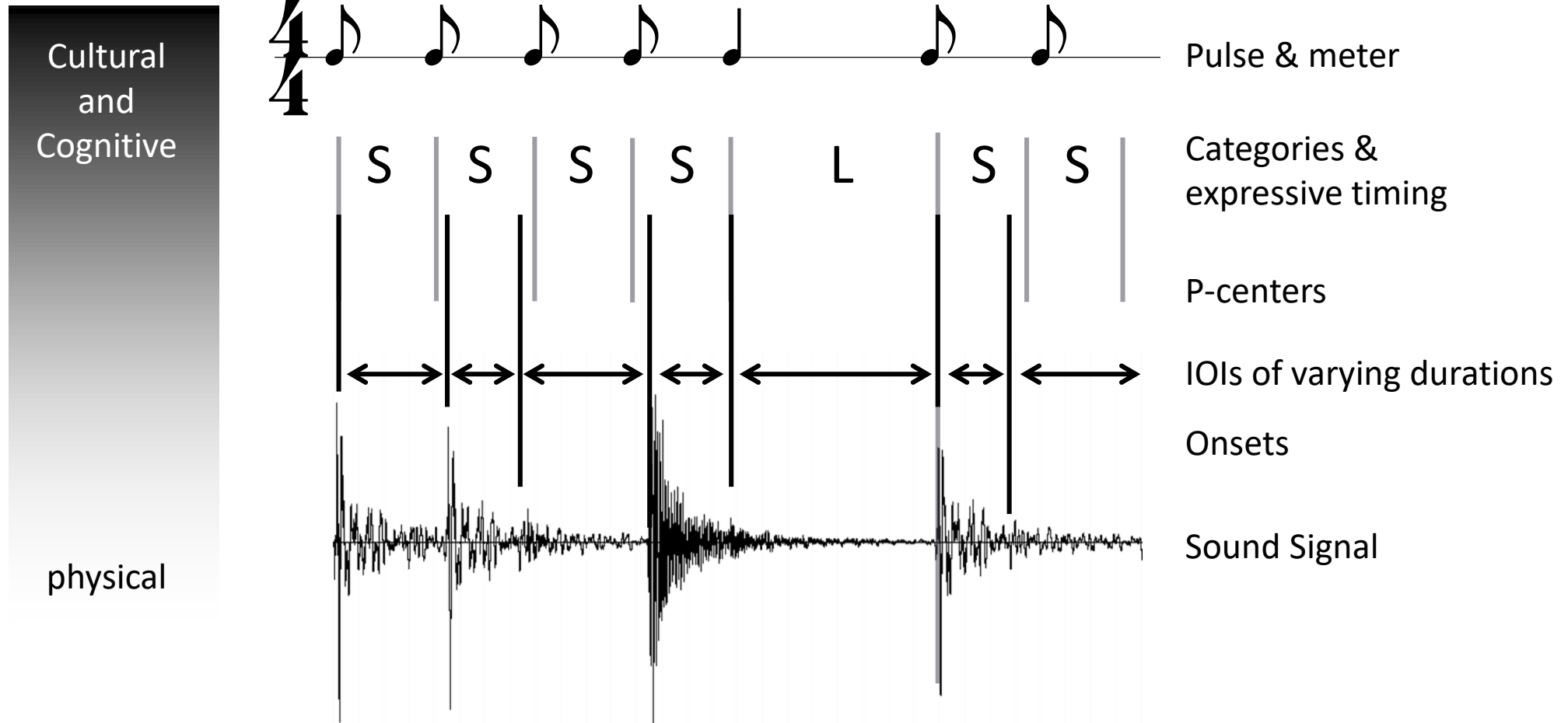
Continuous time changes and deviations from the canonical version of those categories are understood at a different structural level as tempo changes and expressive timing (Clarke, 1987b).

# sound event

- We often attribute sound events to human motor actions.
- Onset: the moment a sound begins, e.g. the moment of the impact of a stick to a drum. The physical onset might differ from the perceptual one.
- Inter Onset Interval (IOI): the duration between two successive onsets.
- Attack: the highest peak of energy or intensity.
- Perceptual center (p-center): the part of the sound that we use to synchronize it with another sound. We perceive two sounds as simultaneous when their p-centers are aligned.
- The duration between two successive sounds is often perceived as the duration between their p-centers, rather than the IOI.



# from sound to categories



# meter

Musical rhythms elicit a sense of periodicity and regularity in listeners (Parncutt, 1987, 1994). Simple or complex music, even when it is not repetitive, it often evokes the sensation of a regular pulse evident when we tap in synchrony with the music.

We perceive some pulses stronger than others, and those alternating strong and weak pulses form a metrical feel in our mind (Honing, 2012).

This metrical feel is subjective; although it depends on the regularity of the durational patterns, it is inferred in our mind through a cognitive process.



# entrainment

Internal oscillators in our brain can synchronize with external rhythms and give rise to the feeling of a steady meter and pulse, a process called entrainment.

According to the Dynamic Attending Theory (DAT), these internal oscillations embody expectations that focus our attention on the moments where we anticipate important events to happen (Jones, 2008).

The internal oscillations are adaptive, but they are also stable. After an oscillation is established, it persists for a period of time even if the rhythm pauses or changes, until it eventually adapts again to the new rhythm.

The metrical feel and the sensation of pulse are related to activity in the motor areas of the brain. Our movement is directly connected to rhythm perception; the natural and spontaneous sway of our body and tap of our foot to the music both reflects and shapes the way we listen to rhythms.

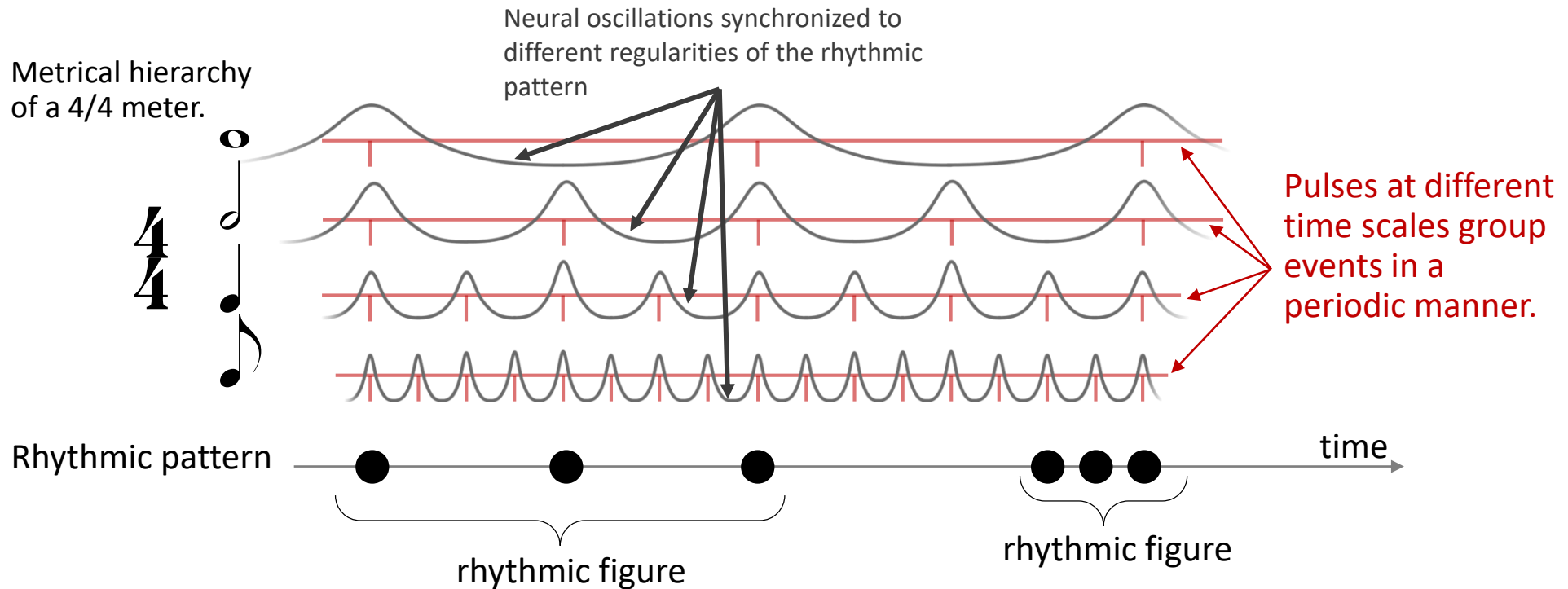
# grouping, periodic vs serial or figural

Serial grouping, referred to also as figural coding, groups a series of durations or events based on their proximity in time. In this way, rhythmic figures and schemes of nominal durations like short-long-long (S-L-L figure) are formed by adjacent events.

The pulses of the meter, on the other hand, group non adjacent events that occur on the same pulse in a periodic way, e.g. all events that occur every 4 ticks of the metronome (Parncutt, 1994). Periodic grouping, forms a structure of embedded or overlapping time spans that groups events at different time scales.

# metrical hierarchy, entrainment, grouping

The pulses and neural oscillations form hierarchical structures, in which all pulses of slower levels coincide with pulses in the faster levels. These structures coincide with the music theoretical definition of meter. The moments when more pulse levels coincide are felt stronger.



# accents

Physical accents occur due to a change in some property of the sound, like the loudness, pitch or IOIs changes. Therefore, they can be traced back to the physical signal.

Other, perceptual accents are created in our mind; they reflect the perceived temporal organization and they cannot be traced back to the physical signal.

Our sensation of pulse and meter emphasizes the moments that we expect events to happen creating perceptual accents, called metrical accents.

Perceptual and physical accents are often undisguisable in our mind.

# beat

Pulses in certain time scales are more prominent than others.

The most salient pulse felt in a rhythm is called the tactus or beat and is the pulse on which most people will tap their foot when listening to that rhythm.

The duration of the beat is restricted between 0.25 sec - 2 sec and is most often felt around 0.6 sec.

However, fastest pulse can be felt, down to ~0.1 sec.

# groove

Groove is generally defined as the pleasant feeling of wanting to move to the music, to swing our head and tap our feet (Janata, 2012).

Not all music urges us to move, but the feeling is found among most cultures and traditions.

Which raises the question: Are there universal aspects of groove? What makes certain music groovier than other?

Generally, groove requires the sensation of a steady pulse and a strong metrical feel.

At the same time, groove is correlated to the feeling of syncopation that arises when the sensation of the regular beat or pulse in the music is momentarily disrupted; when a note occurs earlier than expected, before the beat that we felt we wanted to tap our foot on, surprising us in a pleasant way and making us more aware of that beat.

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