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# 2.4 Rhythmus und Zeitgestaltung bei nicht-isochronen Metren (Rhythm and timing in non-isochronous meter)

The contributions collected in this section originate from a thematic session held at the Berlin 2015 conference, convened by Rainer Polak under the title *Rhythm and timing in non-isochronous meter*. Non-isochronous meter represents a historically neglected topic in metric theory; recently, however, it has increasingly attracted attention and specifically motivated interdisciplinary, empirically informed, and cross-culturally comparative approaches. The session aimed to productively integrate perspectives from music theory, ethnomusicology, music psychology, empirical/systematic musicology, and music pedagogy. It opened with an introductory review talk (Polak), followed by original research contributions on music from southeast Europe (Daniel Goldberg), Turkey (Andre Holzapfel), and Brazil (Gérald Guillot). The session ended with an invited response to the research papers (Justin London).

Rainer Polak

## Non-Isochronous Meter Is Not Irregular

### A Review of Theory and Evidence

In this brief survey paper, I argue that in most theories of musical rhythm and meter, the quality of regularity constitutes the referential framework; moreover, in such theories, regularity is normally equated with isochrony. However, in certain musical styles rhythm is structurally non-isochronous, and yet conceived of and perceived as being metrically regular. Therefore, the assumption that metric regularity depends on isochrony is inconsistent with this evidence, which provides grounds for metric theory to scrutinize some of its most fundamental assumptions. In the paper, I discuss works related to the disciplines of music theory, ethnomusicology, and music psychology/cognition. The discourses on meter in these disciplines traditionally have been disconnected from each other, which may help explain why non-isochronous meter has been under-theorized until today. The paper's interdisciplinary perspective is reflected in a quite diverse and extensive list of references.

## Meter requires regularity

The proposition that regularity is at the core of musical meter underlies a broad range of metric theories. I here focus on listener-oriented theories, which have emerged as particularly influential since the 1980s. Such theories conceive of meter as a perceptual activity. They propose that meter is functional in allowing listeners to anticipate the timing of rhythmic events, to estimate and evaluate the actual timing of present events with reference to preceding metric anticipations, and to entrain to the perceived rhythms. Some of these approaches highlight subjective flexibility and conceive of a projective process that is typically fluctuating and inherently open-ended, while others emphasize the reliability that may emerge from attending and entraining to stable periodicities in the perceived rhythms.[1]

The aspect of regularity typically is foregrounded in pulse/beat-based approaches to metric theory.[2] Speaking of a pulse-stream implies that its con-

1 Hasty 1997 is the main exponent of the former, while Lerdahl/Jackendoff 1983 and London 2012 represent the latter; for a contextualization of these approaches in the history of metrical theory, see Johansson 2010.

2 Africanist musicologists have first developed the concept of a perceptual metric beat or pulse as derived from, yet being partially independent from, rhythmic figurations, beginning with Richard Waterman's seminal discussion of »metronome sense« (1952); see also Nketia 1963; Kolinski 1973; Blacking 1967; Chernoff 1979; Locke 1982, 2010; Dauer 1983; Arom 1984; Kubik 1988; Burns 2010; London et al. 2016. Some two decades later, Western music theory independently (re)invented the rhythm-meter distinction and the concept of meter as nested pulse streams (Yeston 1976; Lerdahl and Jackendoff 1983; Krebs 1999; London 2001, 2012; Temperley 2001). Mirka 2009, chapter 1 discusses late 18th century German theorists as conceptual forerunners.

stituents, the single pulsations, recur at regular intervals and are categorically equivalent; it is their regular reoccurrence, one after the other, which makes the individual pulsations appear as a stream of same-order elements. The psychological theory of dynamic attending suggests that the perceptual system itself tends to entrain, that is, to attune itself to periodicities tracked in the rhythms of one's environment.[3] This theory has been influential in conceptualizations of beat induction, musical meter, interpersonal entrainment, and their eventual biological underpinnings in neural oscillation.[4]

By contrast, other approaches such as Christopher Hasty's theory of metric projection argue that much of the musical interest and aesthetic appeal of metric experience is that it can flexibly fluctuate from moment to moment, inseparably tied to the ever-changing flow of rhythm itself. This approach conspicuously does *not* emphasize regularity at musical and theoretical surface levels. Rather, it highlights and values options for metric ambiguity and/or change through articulated durational spans that question or deny the currently active metric projective potentials. However, this does not mean that Hastian metric projection does not involve regularity. The mechanism of projection entails the ›throwing forward‹ of a durational span that is equivalent to a just-completed durational span,[5] thus setting up an expectation of local periodicity.

In short, listener-oriented, psychologically-minded metric theory assumes meter to build on the universal tendency for recognizing and anticipating periodicity. Even in the case of metrically ambiguous music that may cause the listener to frequently reorient him/herself in the course of the listening process, the act of metric perception compares an actual event-timing with a forecast that has emerged from the latent expectation of a repetition of the same (that is, metrically equivalent) timing. Meter thus is seen as a perceptual referencing of latent virtual isochrony, a view which prevails also in research in music psychology, musical neuroscience, and biomusicology.[6]

3 Jones/Boltz 1989; Large/Jones 1999. In a seminal article, Mari Riess Jones (1976) situated this approach in the context of James Gibson's ecological psychology of perception (Gibson 1966), which emphasizes that humans actively and dynamically scan their environment for perceptual ›invariants‹, within the framework of which we meaningfully perceive change. In the temporal dimension, Jones conceives of periodicity as a perceptual invariant in the Gibsonian sense.

4 See London 2012; Clayton et al. 2005; Clayton 2013; Large/Kolen 1994; Snyder/Large 2005; Large 2008.

5 Hasty 1997, p. 84.

6 Among many others, see Longuet-Higgins/Lee 1982; Lee 1991; Essens/Povel 1985; Large/Jones 1999; Snyder/Large 2005; Desain/Honing 1999; Grahn/Brett 2007; Merchant et al. 2015; Fitch 2013; Madison/Merker 2002; Merker et al. 2009.

## Non-isochronous meter exists

Descriptions of rhythmic structures that resist being directly mapped to isochronous pulses abound in musicology, particularly in comparative musicology/ethnomusicology. Specific types of systematically non-isochronous rhythm appear to be typical of certain culture-geographic areas. Let me first describe some aspects of such non-isochronous durational structures and their (hypothetical) metric implications and then discuss whether these metric implications indeed appear plausible.

Manifold particularities and combinations aside, we may basically distinguish between non-isochronous durational patterns at the *beat* versus the beat *subdivision* level. Different durations at the beat level can periodically alternate within a metric cycle (or, measure, if you will). For instance, after two beats of equal duration there may follow a beat that is longer by about one half of the previous (short) beat durations. If this timing pattern repeats, the measure as a whole would be periodic, but the pulse at the beat level would not be. Rhythmic structures that suggest non-isochronous beat cycles of this sort are prominent in musical styles from Scandinavia, the Balkans, Turkey, the Near East, southern Asia, as well as in Euro-American art music of the 20$^{th}$ century, to name a few prominent cases.[7]

Uneven, ›swung‹ rhythms at the level of the metric-beat subdivisions in the framework of isochronous beats occur in parts of Africa and its diverse American diasporas.[8] Both the cycle and the beat levels are iso-periodic here, while the rhythmic texture at the surface level is non-isochronous. The theoretical issue to be discussed below is whether these textures in the listeners' perception represent deviations from a categorically isochronous subdivision, or rather constitute a type of non-isochronous metric subdivision.

These two basic types (non-isochronous beat and non-isochronous subdivision cycles) engender a plurality of particular forms. For instance, some music from North Africa shows systematic metric transformations from non-isochronous to isochronous subdivision anchored to structural tempo accelera-

7 See, among others, Blom/Kvifte 1986; Kvifte 2007; Johansson 2009; Haugen 2014; Brăiloiu 1984; Goldberg 2015, 2017; Cler 1994; Bates 2011; Holzapfel 2015; Clayton 2000, 1997; Marcus 2007.

8 On *samba* from Brazil, see Gerischer 2003; Gerischer 2006; Lindsay/Nordquist 2007; Guillot 2011; and Haugen/Godøy 2014; on jazz, see Benadon 2006; Friberg/Sundström 2002; Honing/Haas 2008; Dittmar et al. 2015; on dance-drumming from Mali, see Polak 2010; Polak/London 2014; Polak et al. 2016.

tion.[9] Also, there exist drastically non-isochronous or ›ovoid‹ forms of rhythm, to borrow a term from Jean During, for instance in Scandinavia and Central Asia, which may have to do with double non-isochrony at the beat *and* the subdivisions levels, both at the same time.[10]

Can we safely assume that the non-isochronous durational structures in performed music, as just surveyed, do indeed suggest and afford the perception of (non-isochronous) meter? An alternative understanding views non-isochronous timings as either local/expressive or constant/systematic variations of some underlying isochronous structure.[11] For example, the unequal beat durations of the Viennese waltz, patterned short – long – medium,[12] may be theorized as representing a performance timing deviation from a structurally isochronous triple meter. One indication typically put forth in support of such a view is the inconsistency of the performed timings. In historical recordings of urban popular Viennese waltz from the early 20th century, one can indeed hear that the contra-guitar dedicated to accenting the second and third quarter notes in each measure (the so-called ›Wiener Nachschlag‹ or Viennese afterbeat) effects a strikingly non-isochronous, short – long – medium or short – long – long timing of the three quarter notes in each measure. By contrast, the melodies played by the accordion and violins do not systematically follow this non-isochronous timing pattern.[13] Similarly, there is a considerable degree of flexibility in the timing of non-isochronous rhythmic surfaces in swung jazz music, and this, too, has been usually theorized as a performance/performer-dependent deviation from some underlying isochronous pulse.

Importantly, however, such flexibility does not characterize all of the non-isochronous rhythmic practices surveyed above. For instance, in Malian drumming, uneven beat subdivision timings can be extremely stable.[14] Furthermore, the performance timings of non-isochronous beat patterns, for instance in Balkan percussion, are clearly structural; no underlying isochronous beat is remotely feasible here. Recent work has empirically shown that in some styles of folk dance from Norway, non-isochronous beat patterns that had been found

9 Jankowsky 2010 and 2013.

10 During 1997; Kvifte 2007; Johansson 2009.

11 See Clarke 1985 and 1987.

12 Bengtsson 1975; Bengtsson/Gabrielsson 1983 and 1977; cf. also Stockmann 1977.

13 Listen to tracks #15, #16, and #19, recorded 1908–1910, of the CD *The Best of Schrammelmusik Instrumentals – Soul Music of Old Vienna* (München: Trikont, US-0223).

14 Polak et al. 2016.

in the respective fiddle music also pertain in both the fiddlers' foot-tapping and the dance-couples' vertical oscillation of their bodies' center of gravity.[15] In sum, while it is plausible to assume that some non-isochronous timing structures can be understood as performance deviations from some metric isochrony, such a view does not hold in these particular cases. Earlier efforts to marginalize non-isochronous meters as exotic derivatives of ›actually‹ or ›originally‹ isochronous meters represent a speculative, Euro-centric type of explanation that is no longer tenable today.[16]

In addition to the lack of sufficient alternative explanations for the cases of consistently and structurally non-isochronous rhythmic patterns discussed above, there are three other factors pointing to the plausibility of the idea of non-isochronous meter. First, we can adduce the existence of indigenous theoretical concepts of rhythmic mode, which clearly conceive of literal non-isochronous durational structures as expressions of (what I here refer to as) non-isochronous meter. The most prominent among these concepts are Balkan *aksak*, Turkish *usul*, Arabic *iqa*, and Indian *tala*.[17] Second, there is a small yet growing body of research that tries to experimentally operationalize and empirically measure metricality in musical and quasi-musical behaviors, such as tapping along to simple rhythms, perceiving manipulations (differences and changes/errors) in listening to simple rhythms, and ensemble synchronization in live performance of real music. These studies suggest that metric performance in non-isochronous meters is as precise and fluent as is analogous task performance in isochronous meters.[18] Finally, ethnographic observations indicate that non-isochronous meters are experienced by encultured listeners as perfectly normal, easily accessible, and simply natural. For instance, sequences consisting of non-isochronous beats or non-isochronous subdivisions are regularly embodied, without particular complication, in vernacular folk dance in Bulgaria, Scandinavia, Mali, and Brazil.[19]

15 Haugen 2014 and 2015, forthcoming.

16 For the case of ›irregular‹ meter in Bulgarian folk-dance music, see Rice 2000b.

17 See Brăiloiu 1984; Bates 2011; Clayton 2000; Marcus 2007.

18 Repp/London/Keller 2008; Hannon et al. 2012; Polak et al. 2016. This phenomenon of »familiarity overriding complexity« (Hannon et al. 2012) in meter perception is plausible from probabilistic accounts of meter perception based on implicit learning and predictive coding (van der Weij et al. 2017).

19 Rice 2000a, 1994, pp. 98–103; Polak 2010; Polak/London 2014; Haugen 2014; Haugen/Godøy 2014. The term *aksak*, which means ›limping‹, and thus may suggest some emic concept of irregularity at work (etymologically, at least), in fact was introduced to musicological discourse

## Implications for metric theory

To summarize the above, ample evidence suggests that non-isochronous meter is widespread and appears as a normal and everyday (not exotic) occurrence in many musical styles and practices. In view of this evidence, the theoretical assumption of meter fundamentally building on virtual isochrony is hardly tenable. Moreover, it appears to misleadingly regard non-isochronous meter as irregular. While one can certainly understand the mathematical aspect of such qualification (since non-isochronous meter lacks perfect evenness and symmetry), it is misleading to conceive of such meter as irregular from perceptual, cognitive and experiential viewpoints. Non-isochronous meter does not lack a conventional set of principles and procedures and thus does not lack continuity and predictability (not to speak of being flawed or damaged). If one is familiar with non-isochronous meter, it does not involve any particular difficulty. In sum, non-isochronous meter is as perfectly metric – i.e., reliably functional in providing stable reference for predictive rhythm perception and entrainment – as is isochronous meter.

Let me finally consider three of the many theoretical issues that the evidence on non-isochronous meter raises.

## Metric pulse-streams constituted of non-equivalent elements

As described in the first section, the concept of metric pulse implies that its individual constituents (single pulsations) all are perceived as functionally equivalent; besides the fact that they follow one after the other, it is their being of the same class that makes pulsations pulse. If we assume two different pulse classes to form part of the same metric cycle, however, these pulse classes are categorically distinct. Theory needs to engage with this apparent contradiction: At the level of both metric beat and subdivision, one can have more than one pulse-class while nonetheless perceiving a ›stream‹ of pulsations.

from a Western-European perspective. Yet it was not originally used as a generic term for non-isochronous (odd) meters in the Balkan region (Rice 2000b, p. 922); it rather was the name for one specific non-isochronous (9-beat) Turkish *usul* (rhythmic mode; see Holzapfel in this volume), but nothing else. To my best knowledge, there is *no* indigenous term, neither in Bulgaria nor in Turkey, that would allow us to typologically distinguish non-isochronous (odd) from isochronous (even) meters at a conceptual level.

Justin London has proposed that, to be ›regular enough‹ for metric functionality, the degree of unevenness among the metric beats in a cycle must be constrained by some upper limit: specifically, the long-to-short ratio of beat classes must be smaller than 2:1.[20] On the other hand, there must also be some lower limit of unevenness among the metric beats for a listener to perceive those beats as forming a non-isochronous meter. Considering the upper and lower limits for unevenness helps explain why the long and short beat classes in non-isochronous meters are often coordinated by ratios in the range of 3:2 (1.5) or 4:3 (1.33).[21] London's mathematical formulation of these proportional relations refers to the principle of maximal evenness, which requires the cardinal relation of the two pulse classes in a non-isochronous pulse-stream to be based on a common fast denominator; for instance, 3:2=(1+1+1):(1+1). This is applicable for non-isochronous pulses at the beat level if the related subdivisions are categorically isochronous (which they not always are, however; more on that later), but not for non-isochronous pulses on the subdivision level itself. The latter tend to be too fast and too proportionally irrational to be based on a faster common denominator. However, London's consideration of upper and lower limits for unevenness is relevant for non-isochronous subdivisions, too, which would make it worthwhile to rephrase their description in more inclusive terms.

## Layers of pulse and their hierarchical coordination in non-isochronous meter

The conventionally assumed isochrony of pulse streams logically entails metric hierarchies of symmetrical structure. Symmetry therefore is at least implicitly assumed in most metric theory. By contrast, non-isochronous beat cycles, say a measure of one long and two shorter beats subdivided by three and two fast pulses, respectively (3+2+2), clearly generate an asymmetric hierarchy. Polak and London propose that the coexistence of swung binary and ternary subdivisions in some African and African-diasporic forms of music, too, constitutes asymmetric metric hierarchies.[22] Taken together, this and the previous point suggest that a realistic concept of metric regularity would need to allow for

20 London 2012, p. 128.

21 Ibid., chapter 8.

22 Polak 2010; Polak/London 2014.

a certain degree of structural (not ›deviant‹) asymmetry in both horizontal (sequential) and vertical (hierarchical nesting) dimensions.

London 2012 suggests that the complexity of non-isochrony on one metric level needs to be balanced by isochrony on some neighboring level.[23] In the case of non-isochronous beat cycles, the subdivision level suggests itself as a referential anchor, and while perhaps true when the subdivision is isochronous, this is not always the case.[24] Moreover, the assumption of a fast subdivision as an elementary reference level is inconsistent with the fact that a pulse at some intermediate level (the beat or tactus) of the metric hierarchy typically provides the core metric reference.[25] Finally, some performances based on non-isochronous beat cycles and most performances of non-isochronous subdivision cycles are too fast to be advantageously framed by reference to some still faster layer of periodicity.

Tellef Kvifte 2007 argues for the impossibility of understanding non-isochronous meter in Scandinavian folk dance music in the framework of a model of meter that requires all levels to be derived, from bottom upwards in the metric hierarchy, as multiples of a common fastest denominator. Building on this, he offers the alternative model of a common slow pulse. He supports this idea by suggesting that it may be physical gestures, such as dance moves in the case of music for dance, that make up the structural contents of such a common slow pulse.[26] This is an intriguing idea, yet it would require us to rethink and/or go beyond the concept of pulse/beat. If metric experience consists of feeling durational structures in terms of corresponding dance moves that we anticipate to continue and periodically recur, what we ›throw forward‹ in time is not a discrete periodicity (as suggested by the conventional concept of pulse), but a complex pattern of continuous motional gestures and related durational shapes.

23 London 2012, chapter 8.

24 Kvifte 2007; Goldberg 2015; Polak 2015.

25 This point is claimed both by general theories of meter (see London 2012, pp. 30–32) and by repertoire-specific ones. Among the latter are Western theories of isochronous meter (see Lerdahl/Jackendoff 1983, p. 21) as well as treatises of non-isochronous meter in music from Scandinavia (Kvifte 2007) and the Balkan region (Goldberg 2015 and 2017).

26 Kvifte 2007.

## Pulse and pattern

In experiencing a non-isochronous metric pulse, a listener generally cannot predict an upcoming event by relying only on the projection of periodicity; information is also required regarding whether the upcoming pulse is of either the long or the short class. In other words, beat induction here must include, or be informed by, knowledge about the periodic pattern of alternating elements, and the listener must continuously feel where exactly he or she is within the metric cycle. It appears that in order to reliably achieve this in the context of non-isochronous meter, what needs to be projected forward in time is not latent periodicities alone (as suggested by the concepts of beat induction, metric projection, and neural oscillation, for instance), but more fully integrated patterns of expectations for temporal intervals or durations.

## Conclusion

To conclude, the study of non-isochronous meter requires us to reconsider issues as basic as pulse, hierarchy, and pattern. This fascinating area of study thus provides a foundation for ongoing and future research in metric theory. It encourages us to continue the increasingly productive trend of transcending compartmentalization in terms of disciplines (music theory, ethnomusicology, music cognition, computational musicology, musical neuroscience, etc.) and area-studies (music theory of Western art music, African music, Balkan music, etc.), and to prioritize cross-cultural and inter-disciplinary perspectives instead.

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