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Targeting the Three Dimensions of Auditory Imagery in the Creative Process of Composing: Models of Rhythmic Expression

Abstract. This article centres on auditory imagery from two perspectives. From the first one, imagery as an experience is analyzed. Drawing on the theories of music psychology and experimental evidence the analytical principle was derived linking perceptual dimension of audiation to cognition of physical movement and its reflection in musical gestuality. This leads to the second perspective of analysis – representations of three-dimensional imagery's experience in music composition based on conceptual models of periodicity perception – *regularity*, *differentiation* and *cyclicity*.

Drawing upon general humanistic and specific creativity researches the multisystemic framework of parametrical contexts in music was formulated, defining the grammar of *compositional gestures* – the means for modelling of 3D changes in sonic expression of music. The capability of the framework is exemplified by diagrams of so-called (gestural) acts of rhythmical expression – *rhythm*, *metro-rhythm* and *meter*, which are considered morphological constituents of *rhythmical contour*. The audiation of the latter is made possible to envisage by qualifying *implicit grammar* of listening. An example of the practical application of the analytical framework is given (analysis of a composition), showing auditory possibilities of explicit (compositional) grammar thus disclosing the personal attitude to music writing of the composer in question.

Keywords: auditory imagery, perpetual dimensions, conceptual models of perception, implicit grammar of auditory perception, explicit grammar of composition.

Introduction

As can be discovered from the sources at Stanford University (Thomas 2014), "in the philosophical and scientific literature (as well as in everyday discourse), the expression of 'mental imagery' (or 'mental images') may be used in **any** or **all of** at least three different senses:

1. Quasi-perceptual conscious experience *per se*;
2. Hypothetical picture-like representations in the mind and/or brain that give rise to 1;
3. Hypothetical inner representations of any sort (picture-like or otherwise) that directly give rise to 1."

Consequently, auditory imagery is a quasi-perceptual experience of sound or its mental representation. As Nigel J.T. Thomas emphasized (ibid.), the distinction of whether mental imagery is an experience or a representation is one of the crucial ones in both theoretical and practical discourses. We can hypothesize that the answer depends on the inquiry which is being sought. However, when speaking about the phenomenon of mental imagery in the context of audiation (which, according to the premises of this conference, is "an aptitude to hear and comprehend music even when the real sound is not present") – the experience part should be emphasized. Nonetheless, it could prove to be very helpful to analyze the implications (i.e. representations) of audiation on the process of composing; however, due to the extent of this paper, we will primarily focus on the side of the musical experience.

Composing in the academic field very often, though not necessary, refers to "writing notes on the staves". Considerations of audiation in this scoring environment can rely, among other aspects, on a phenomenon called "notational audiation", which is a "sense of an auditory image that is being created in the process of reading musical scores". In this paper, we are going to take a closer look at how the imagery as a quasi-perceptual experience can take place in the process of "hearing while reading".

1. Auditory imagery

1.1. Cognitive foundations of audiative dimensionality

Our auditory apparatus is apt to process the information of a three-dimensional kind – we can easily distinguish whether the sound comes from above or below, from the left or right, as well as to whether the sound object is in front of us or far in the background. However, that is not the case when it comes to reading the scores, which are almost exclusively a two-dimensional medium. Thus, our imagination makes an attempt to invent the missing third dimension, creating a consciously perceived quasi-perceptual experience. The word "consciously" in the latter statement means that the "reading listener" must understand the described process. Let us take a deeper look into cognitive theories (explaining human understanding) that can help us to expand on our concept of "notational audiation" in a 3D style.

William F. Thompson (Thompson 2008: 227–228) has summarized the evidence supporting the existence of a phenomenon called *perceptual dimensions*. According to Thompson, research on humans with neurological lesions suggests that **separate** features of the auditory stream are being processed independently and are

later reintegrated into the sensory system. Isabelle Peretz and her associates (Peretz 1989) cite a double dissociation between the pitch pattern and rhythm as evidence for a neural dissociation between these dimensions. One patient with a lesion in the left temporal lobe could not discriminate different rhythmic patterns but could discriminate sequences differing in the patterns of pitch. Another patient with damage to the right hemisphere showed the opposite effect: discrimination based on patterns of the pitch was impaired, whereas discrimination on the basis of rhythm was normal. Such research illustrates that temporal and pitch information is being separated at some stages of mental processing.

Research with musicians provides us with additional evidence of perceptual analysis of music being separated into different dimensions or features. Peretz and Myriam Babai (Peretz & Babaï 1992) found the advantage of the left ear for contour discrimination and the advantage of the right ear for pitch-interval discrimination. This asymmetry implies that the contour is being processed in the right hemisphere and pitch interval is being processed in the left hemisphere. "**Overall, it appears that melodies are neurally separated into components such as rhythm, intervallic pattern and con**tour" (Thompson 2008: 228).

The aforementioned evidence gives us an idea about the mechanism of a three-dimensional experience and orients the search for its representations within the categories of rhythm, intervals and contour. For our research to be properly grounded and trusted we need to deconstruct these well-known definitions in the light of contemporary cognitive research. For the complex contour definition let us consider for a moment it can be perceived (as one of the possibilities) as harmony. Later in the article, we will widen this quite narrow explanation.

Rhythm, pitches and harmony are the only **primary parameters** in music perception (according to Bob Snyder; Snyder 2001: 195). Primary parameters are categorized as particular scalar values, thus consciously remembered and compared. Categories for such memorability are **time-intervals** (IOI) for rhythm, **pitch-intervals** for pitches and **scale** for harmony. All these categories have one aspect in common, which could be considered the main feature of musical perception – that is **periodicity**. That way the metro-rhythmic pulsation can be distinguished from the periodical one (which in some instances could be perceived as being close to "noise"), a pitched tone from a percussive one (i.e. a short blast of noise), as well as tonal music from atonal, a glissando from a passage etc. Lawrence Zbikowski has a beautiful idea about how the aforementioned facts of perception can be beneficial in conceptualizing and re-thinking what counts as knowledge about music (Zbikowski 2004: 273). Zbikowski relies on anthropological assumptions rather than on music theory. He delivers the notion of so-called *conceptual models*, which are derived from proprioception, i.e. knowledge about how parts of our body move. *Periodicity* in that sense is perceived as three related concepts of *regularity*, *differentiation* and *cyclicity*. As Zbikowski explains (Zbikowski 2004: 278), "**regularity** is the periodic recurrence of some event; … our knowledge of such regularity comes first from proprioception during the first months of life and is only subsequently applied to the musical experience. **Differentiation** involves simultaneous non-identical regularities, such as what occurs when different limbs are engaged in regular but independent motions. **Cyclicity** involves composite regularities made up of coordinated differentiated regularities; most forms of human locomotion (including infants' creeping and crawling) involve cyclicity."

One may ask how it all is related to audiation. Basically, this conceptual modelling shows the way how experiences of perceptual dimensions can be represented during the processes of cognition. These are like certain kinds of spatial movements linked to certain features of perceptions. Lawrence Barsalou (Barsalou 1999) provides an elegant solution for such linking with the notion of *perceptual symbol systems*. He claims that "the neural basis of perceptual symbols is a 'simulation' of the brain processes that would be involved in the actual perception of whatever it is that is being symbolized" (Thomas 2014). "The neural states associated with perceptions are recorded in the brain" (Zbikowski 2004: 277) and can operate either in a conscious or unconscious (intuitive) way. According to him, brain maps of such neural activations can operate even in the absence of auditory sensory stimulation (as when we read score; Zbikowski ibid.). Thus, three conceptual models of periodicity come into power every time, when we are exposed either to an actual movement of the body, or a movement of music (when there is no physical movement, our brain tends to simulate it). Cognitive musicologists refer to the latter as musical *gestures*.

With the presented theoretical knowledge in mind, we can assert that the composer has an ability to shape the expression of rhythm, tone or timbre by applying regularity, differentiation or cyclicity to the structure of these parameters. In order for this process to become more explicit, we need to establish connections between the perceptual dimensions and models of perceptual conceptions by explaining the principles according to which the aforementioned dimensions can be represented by individual conceptions of periodicity.

1.2. Linking conceptual gestures to the dimensions of auditory imagery

In the previous chapter, we discussed the phenomenon of quasi-perception of auditory streams that could allow us to link these theoretical conceptions to the mechanics of perceptual dimensions of sensory input. This raises a series of questions. First of all, "what kind of periodicity is it, when we refer to it as 'rhythm'"? Snyder (Snyder 2001: 196) defines rhythm "as the perception of accents and proportional intervals of time between sounds". As we mentioned previously, these time-intervals should be of multiple duration in order to be perceived "musical" in a pure acousmatic sense (i.e. without any influence of the context of perception). So "the rhythm" is a kind of an implied **regularity** that is perceived in the horizontal axis of time and of auditory imagery.

Next, we can ask the same question regarding "pitch". Once again relying on Snyder, "we can proportionally categorize pitches into tuning systems and scales and construct many different melodic patterns that can be recognized when repeated. The parameter of pitch can be further divided into pitch interval and direction of pitch motion" (Snyder 2001: 196). From this, we can conclude that all these aspects can be generalized by the notion of "differentiation". We can see another vital question emerge here: Which dimension of auditory imagery these parametrical gestures (sound changes) could be attached to?

One may recall that the perception of periodicity's conceptions happens in a consistent way. That means differentiation can be accepted only when regularity in the horizontal axis of auditory imagery is already realized. Without any occurring changes (e.g. pulse of *tactus* events) horizontality starts being imagined as a one-dimensional line, which only has the quality of *length*. If there is a change in duration between sound events (be it a change in rhythmic values or pitch), it forces changes in the dimensionality of perception. The two dimensions are commonly perceived as "length and height" (as a non-perspective drawing on paper), thus from now on let us consider pitch differentiation to be attached by imagery to the vertical dimension.

The last category – "contour" – is a little bit complicated. For the sake of simplicity, we can think of it as "the contour of melody", which is a kind of derivation from the simultaneous exposition of rhythm and pitch in the sensory input. Intuitively such perception can be represented in the auditory imagery as *spacious*. But the notion of *cyclicity* remains undisclosed with that explanation. As we discussed earlier, cyclicity is formed of "coordinated differentiation of regularities". With that in mind, let us rely on the beautiful notion presented by Karlheinz Stockhausen – the *formant-rhythm*.

To begin, we have to refer to the idea that rhythmic expression is a simultaneous application of meter and rhythm (London 2001: chapter 1). This assumption serves as a starting point to explain Stockhausen's ideas (Stockhausen 1959: 19): "The difference between *meter* and *rhythm* is exactly that which we discern between the 'fundamental tone' and the 'tone-colour' of sound-spectra. The fundamental phase (metric fundamental) is defined by the periodic main intensity-maxima (the heaviest accents), and these results shape the formant-structure. The relationships of the subsidiary to the main maxima (subsidiary to main accents) define the 'tone-colour', i.e. the rhythm. 'Tone-color' is a confusing idea that could well be replaced by 'sound-rhythm', and one should use the general term 'formant-rhythm'".

One may ask how this described analogy can help to relate melody contour and cyclicity. Snyder defines melody "as any sequence of acoustical events that contains recognizable patterns of *contour* (its "highness" or "lowness") in the time dimension…" (Snyder 2001: 135). Recognizability depends on *salience* (as defined by Richard Parncutt; Parncutt 1994). Salience is implied for rhythmic contour by the metric events, while space between is "filled" with occasional rhythmic gestures. In the next chapter, we will more deeply inspect this interaction between different gestures of rhythmical expression. Now let us conclude with an implication of spaciousness within such perception.

In the domain of aural perception, "space" is just a way to name the cognition of simultaneous differences. Slower "salient fundamentals" of the contour tend to be referred to as being "below" in the vertical axis of differences and thus "closer" in the space of auditory imagery. At the same time, quicker fillings tend to be interpreted as being "higher", thus "further" into the background of auditory imagery. It is also worth noting, that levels of saliency are in no way limited to those two (thus, deeper space of expression can be achieved). Let us examine how such space can be audiated while reading a notated rhythm. First, we need to understand how gestural movements in space can be notated, i.e. to define the three composing gestures, which can be linked to the three-dimensional perception of rhythmic expression.

2. Modelling the experience of auditory imagery in music composition

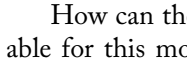
2.1. Conceptualizing 3D expression in rhythm creation

The term of conceptualizing is used to define the devices the composer employs to create rhythm, which can be perceived as a three-dimensional expression. Rhythm, as already mentioned, is defined as a sequence of events' durations, or more technically, as time distances between succeeding sound events (changes of volume), so-called IOI (inter-outer-interval). These chained experiences of changes in volume are perceived in auditory imagery as movements of musical expression or *gestures*. Unlike the perception of physical gestures[1], gestures of the imagery can be recognized in two ways.

The first type of perception is identical to both physical and mental gestures – changes occur one after another (with or without pauses in between). As Snyder pointed out (Snyder 2001: 55) this experience is called **hierarchical** – suggesting that the perceiver can deduce the difference in the action of direct comparing (e.g. "the new sound event is louder"). The second way of gesture processing is unique to mental gestures alone. Here changes can be perceived as related while being detached in time by in-between unrelated events. This experience is defined by Snyder as **associative** (Snyder 2001: 56) that matches through knowledge, experience and memory, not through direct comparison of sensory inputs (as in the case of hierarchical gestures)[2]. Many devices used for composing a musical form are based on this second principle of gesturing – like leitmotivs, themes, rhythmic conventions for certain musical genres (e.g. march, waltz). All such gestures can be composed only through changes of expression in the primary parameters – rhythm, pitches and category of timbre (e.g. flute solo in several places of the piece). These changes of primary parameters are recognized by the mechanism of perceptual dimension (i.e. memorable timbre is perceived as "the contour"). Thus, for now, we have the first important classification factor of a composer's decision-making in the process of creating rhythm – it is possible to act either in a hierarchical (or syntactic) or an associative (or paradigmatic) way.

The second important factor was formulated by David Huron (Huron 2006: 11), who noticed that in psychology any new action, which can be taken in an already present context (as an intention to improve the context in question) can only be of three kinds. Applying this notion to music creation, we can deduce that firstly, the composer has a possibility *to develop the current quality of musical expression* (e.g. to increase the tempo of current rhythmical formula) – i.e. to **process** the gesture of expression. Secondly, in the process of modelling the expression, the composer *can reject an already achieved sonic quality* or make a **reversal**[3] of the gesture (e.g. end current rhythmic formula). And finally, there is an option to *"freeze" current expression* – put it into the background and begin to work with other primary parameters left, e.g. change melody or harmony while maintaining stable rhythmic repetition. This third type of musical movement can be defined as a **neutral**[4] (or **relief**) gesture.

With the presented knowledge in mind, we can determine whether these three types of *compositional gestures* (*process*, *reversal* and *relief*) are hierarchical or associative. One of the reasons for musical complexity is an enormous number of contexts to which the gestures can be applied. We will deal with the structure and guidelines for mastering contexts of composition in the next chapter. For now let us consider how gestures can be realized in rhythmic expression, i.e. in changing durations in an aural-friendly way. Relying on Narmour's treatise of I-R model we can distinguish that the changes of event length can happen either in a counter-cumulative () or cumulative () manner. As it can clearly be seen both gestures are hierarchical (unbroken). The first one (counter-cumulative) is suitable for the *process* type of gesture to build up the tension of duration changes. Cumulative rhythm can model the *reversal* type releasing expressional strength up to the stop on a very long duration.

How can the *relief* type of gesture in this context be composed? Because no other possibilities are available for this modelling (next duration should be either shorter or longer if a *change* is desired), the third gesture can be achieved through an associative combination of the first two types in a periodical rhythm –  . As can be seen in the example the *process* and *reversal* types of gestures happen in pairs and thus a sonic association between those pairs can be perceived. These associations are periodical ones, thus Zbikowski's *cyclicity* conception can be directly created with a *relief* gesture. Such cyclic gestural neutrality, according to the definition, "freezes" the current state of rhythmic expression and reveals composing pos-

[1] A gesture in the physical context is defined as a movement with certain intention, e.g. handshaking, toasting etc.

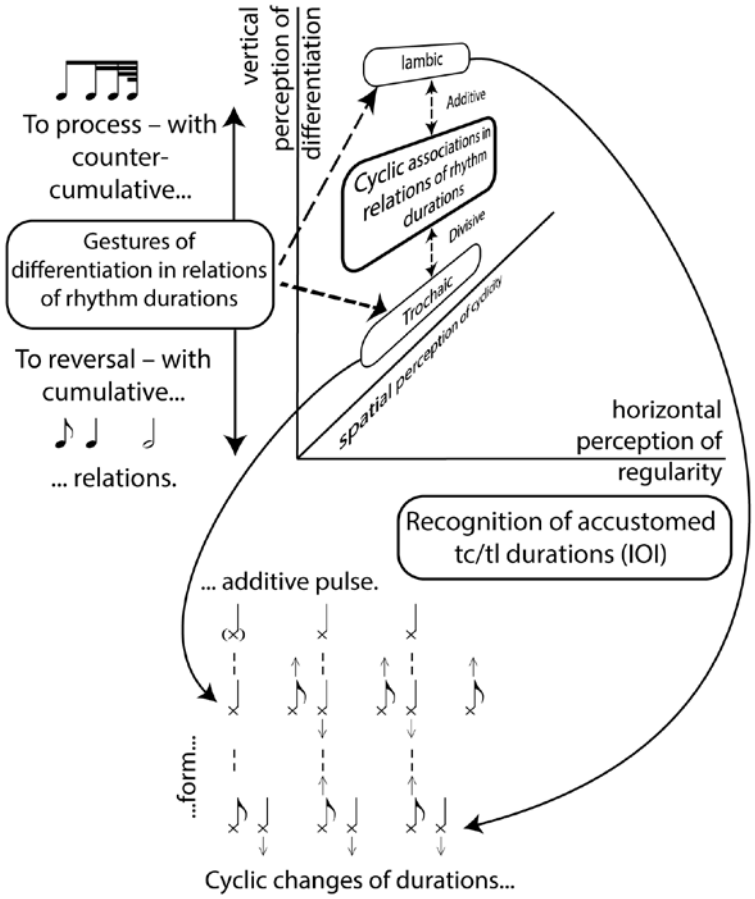
[2] Associative experience can be recognized in many well know metal phenomena, e.g. *déjà vu*.

[3] This term is borrowed from Eugene Narmour (Narmour 1990).

[4] Neutral movement of expression is a part of Narmour's I-R analysis model.

sibilities for other parameters (i.e. there is a change of *expressional dominance* in musical movement). What otherness could start to dominate in the expression of durational changes?

Let us look at the generalized diagram of all gestural possibilities in the rhythmic domain:



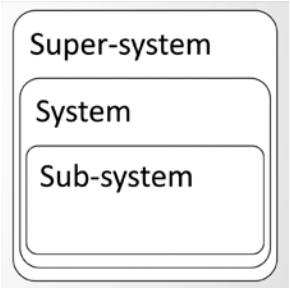
Picture 1. Composition gestures of rhythm expression

As shown in Picture 1, the horizontal perceptual dimension of composing rhythm is modelled of relatively ordinary (i.e. recognized "regularly") short/long durations. Paul Fraisse (Fraisse 1992: 167) defines them as *tc* (or *temp court*) about 400 ms; *tl* (*temp long*) about 800 ms. Vertical perceptual dimension can be modelled in auditory imagery by differentiating between the *process* and *reversal* types of gestures in rhythmic structure, multiplying *tc/tl* to both ends of absolute durations (e.g. next value of *process* gesture would be about 200 ms). In order to model a *relief* type of gesture, a periodical rhythm must be applied, which can be realized by either an *additive* or a *divisive* manner (through associations of iambic or trochaic metrical feet). This distinction in composing of rhythmic *relief* creates variations in the quality of expression in the background. **Divisive** quality has a clearly perceived pulse (emerging on "heavier" *tl* events, as shown in the notated example in the lower part of Picture 1), the *relief* type of structure thus is well "divided". **Additive** iamb, on the other hand, gives the *relief* structure a kind of displacement of *tl* suspending the heavier duration in a certain expressive tension. In every cycle of perception (created by *reversal/process* pair), this tension forces anticipation of the next associable aural pair. Such anticipation forms a chain of combined differentiated gestures in periodic rhythm, still expanding by *addition* of yet another similar iambic rhythmical cell.

Either divisive or additive model in relief structure gives rise to the **pulse** (duration of which equals the sum of lengths of hierarchical gestures, as shown in the notated example of Picture 1). Thus, the dominance of expression is being transferred to another parameter – namely, pulsation, its models and tempo – which has nothing to do with the changes of rhythmic durations. Having defined such "change-of-dominance-in-expression" mechanism we come to an even more important concept supporting the usage of compositional gestures – a multileveled contextuality.

2.2. Multileveled contexts of compositional gestures

As it was already mentioned, there is a vast array of contexts in which the knowledge of gestural application in composing can be beneficial. Leonard B. Meyer gives the first hint on how to deal with this broad scope. Meyer (Meyer 1974: 191), advocating a scientific approach to the artistic research, distinguishes "three kinds of hypotheses, used to explain the works of art … : a) **general laws**, which are presumed to be constant over time and space; b) **restricted principles**, derived from and applicable to the norms and procedures of a specific style; and c) **ad hoc reasons** which … are the necessary adjuncts to the first two types…" in artistic research. Meyer's primary concern was the legitimacy of critical inquiry. Concerning the creative action itself (like compositional gestures under discussion) another scholar Genrikh Altshuler, a creator of the famous mathematically driven TRIZ theory for creative problem-solving, defined an analogous multisystemic approach to the definition of creativity contexts by introducing the so-called Nine-screen model of system evolution[5]. Altshuler divided the levels of inquiry for creative action planning into *super-system*, *system* and *sub-system* (as shown in Picture 2) and additionally added *past-presence-future* axis for inspection of problem-solving stages.



Picture 2. A multileveled system of compositional contexts

Now we can fuse this highly technical approach with a more art-friendly conception by Meyer in order to define the multileveled contexts of music writing. The easiest way to do it is by relying on the structure of musical grammar, whereas in this way the compositional gestures could serve as rule-devices for structuring the grammatical items.

Just as in linguistics of spoken language, there are syntactic, morphologic and phonetic levels of contexts (corresponding to systemic levels in Picture 2), for which certain rules can be described. These rules could subordinate a functional unit of musical grammar – a *change of expression* (forced by sound-volume event). It is worth noting that despite the small number of possible compositional gestures, their effect in every level is different. A previously discussed example of rhythmic gesturing (see Picture 1) represents the context of a subsystem, where ad hoc reasons for musicking[6] (in case of a rhythmic act – the production of durational changes) are projected. These acts can be thought as "syllables" in musical grammar, while conceptual models of periodicity (Zbikowski's version) – as "phonetics" of those "syllables".

Because of the three-dimensional nature of our aural perception, there is a need for a fusion of three different acts, in order to fulfil the morphology of a contour (i.e. "word-phrase") on a system level, where restricted norms of styles are considered[7]. Additional support for the combinational "holy trinity" requirement comes from Snyder's explanation about the structure of working memory (Snyder 2001: 48–50). This kind of memory is responsible for the perception of any movement and research has shown that only three concurrently running processes can be distinguished with a high level of confidence. Thus, even in the exploration of rhythmical domain only, two additional acts for expression should be defined[8].

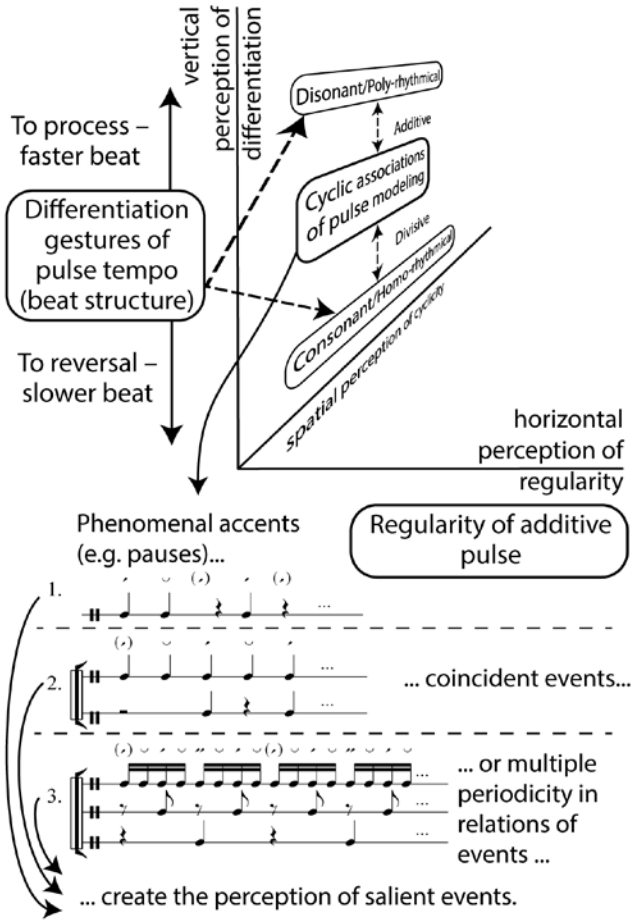
5 English version of this approach is delivered by (Orloff 2017: 221).

6 *Musicking* is the term coined in (Small 1998). It embraces **any** physical act necessary for generation of acoustical sound (e. g., not only instrument playing, but also instrument's logistics etc.).

7 These norms are described through the interaction of implicit and explicit grammars, which are not covered in this article. As well as grammar on the super-system level where general laws of the contours' syntax are considered for creation of a musical form. Exploration of these levels in English is pending in forthcoming publications from the author of this article.

8 The morphology of contour is no way limited to these rhythmical acts (as parts of general musical skills). Non-musical modelling can be applied (*e.g.* serial technique), also acts can be borrowed from other primary parameters (*i. e.* tones and timbre).

The premises for the second act were already distilled – it should encompass the act of tempo and models of the pulse and allow gesturing the vertical dimension of differentiation in an implicit rhythmical grammar. This could be called a **metro-rhythm** and encompass the following possibilities:

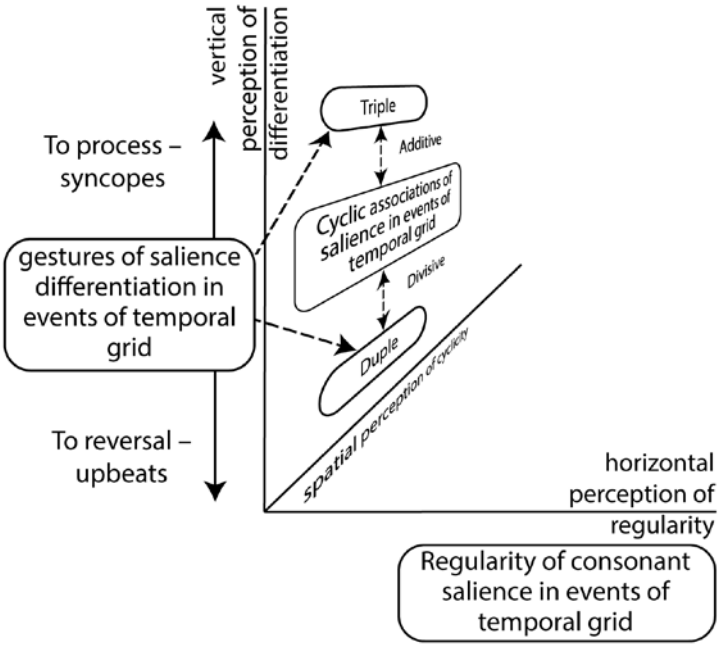


Picture 3. Compositional gestures of a metro-rhythmical act

The cognitive premises for compositional gestures of a metro-rhythmical act are analogous to the act of rhythm (reflected in Picture 1). Definitions here are quite self-explanatory, only a few remarks could be added in order to make the conception even clearer. The regularity of metro-rhythm starts from an additive rhythm (i.e. a row of sound-events that features inter-outer intervals of the same duration), which can be generated by the 3D expression of the act of rhythm (see Picture 1), or simply by adding the same durations one after another (in this case the expression for the act of rhythm is skipped in the morphology of the contour). Vertical hierarchy of metro-rhythm is triggered by manipulating the tempo of the beat – that way the nuances of time-expression in music can be added to an otherwise very strict *tc/tl* ratio of the act of rhythm (e.g. 3 or 5 tuplets can be modelled). Associativity of metro-rhythmical modelling in the *relief* type of gesturing defines its function in the expressional background. If an **additive** structure becomes a dominating one, its functionality then gains poly-rhythmical traits. If a **divisive** consonance is modelled (as shown in notated examples at the bottom of Picture 3), then the events of various saliences of the rhythmic pulse are perceived and implicit power of expression is delegated to the metric act[9] (Picture 4).

[9] This implicit mechanism of dimensional change of expression defines **implicit grammar**, which is based on the ability to recognize conceptual models during perception. But the composer does not have to follow the structure of listening habits. He can create his/her own **explicit grammar** (by fusing acts of different parameters or change the order of parameter's acts in perceptual dimensions). Acoustic interaction between both grammars create *poetic function* of composer's **model of expression** reflected in the latter's parameter of **cognitive strength**. Such functionality is important in form of creativity, as it assists in modelling tension and release processes on a super-system level of expression.

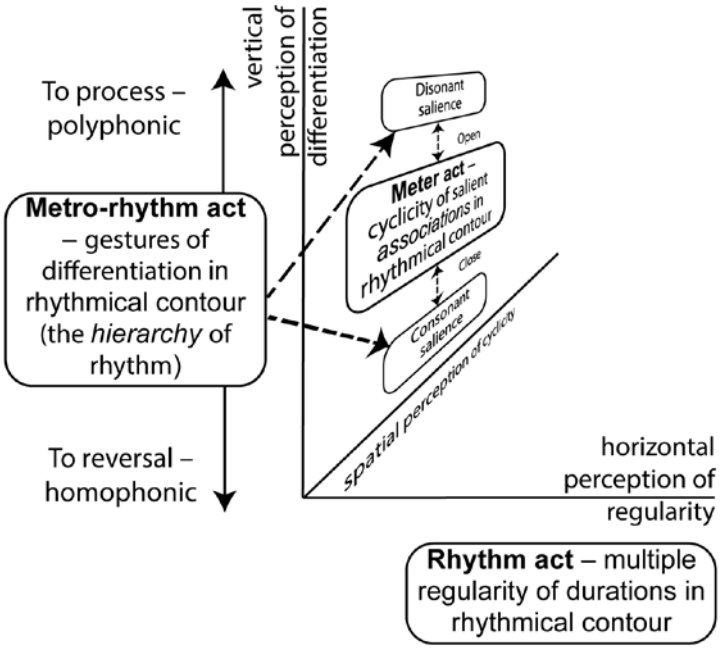
Picture 4. Compositional gestures of the metric act



Compositional gestures of the metric act are based on the models of the temporal grid in the auditory imagery. A 1D regularity starts in a consonant *relief* of the metro-rhythmical act (see Picture 3). A 2D expression is recognized, when there is a categorical shift (i.e. bigger than perceptual tolerance for nuances of performance) from an implied grid position (modelled by the usage of syncopation or upbeat devices). *Relief* type of gesture of the metric act (i.e. a 3D expression) supports very common associations between triple (additive) and duple (divisive) cyclicity, which can further be combined into complex associations (e.g. 5/4 or 6/8 time signatures, the former being of an additive and the latter – of a divisive quality). Compositional gestures of the metric act complete the morphology of **implicit grammar**, which defines how the contour of rhythmic expression is recognized in auditioning (through the mechanism of perceptual dimensions).

2.3. The implicit grammar of contour recognition while audiating *vs* explicit grammar while composing. Case study

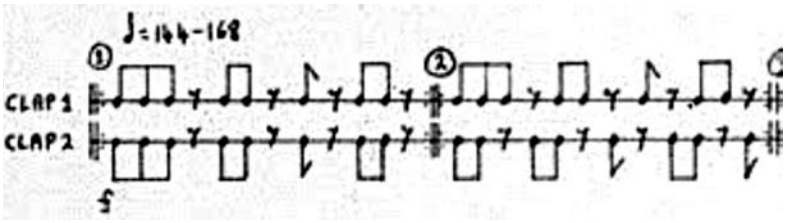
Term **implicit** here refers to being based on our acquired skills and habits of listening, not on thinking or musical practice, while the latter support **explicit** (that is, "explainable") actions. As mentioned earlier, the contour is to be recognized as a functional unit, while listening should trigger all three dimensions of our perception (as Snyder puts it, the change must be of multiparametric nature, in order to form "sectional boundaries"; Snyder 2001: 194). Furthermore, parametrical changes in this multi-array should follow a particular order which conforms to the logic of relations of conceptual models. Differentiation can only be perceived, when two different regularities are discernible, while cyclicity encompasses a new order of interrelations between both differentiation and regularity. Also, for rhythmical contour, the *relief* type of structures of both rhythmic and metro-rhythmic expression acts, points to the dimension of regularity of "the next" act (as explained in pictures 1 and 3). All defined conditions lead to an implicit "inevitability" of contour recognition (Picture 5).



Picture 5. Recognition of rhythmical contour in audiation (implicit grammar)

The perceptual "rhythm" in the dimension of the rhythmical contour is rendered via rhythmic act (i.e. regular changes of durations of time intervals). The fewer multiple durations are recognized, the "noisier" (and less periodical) the contour becomes in our audiative perception. An equivalent of "pitch" for rhythmic contour is created by a change of the tempo of the beat and can be modelled in either polyphonic or homophonic manner (i.e. can have more dissonant or more consonant quality). The salience of metric events defines the points from which either closure or opening (i.e. perception of "the contour" dimension) can be deduced while audiating.

The crucial point here is to remember that rhythmic, metro-rhythmic and metric dimensions in the described context of implicit grammar define morphological elements of audiating and should in no way be confused with the categories of musical parameters used while composing. The composer has the power to combine any acts in new creative ways and thus create his/her own explicit grammar of expression (which nevertheless will be perceived by the listener in an implicit order of audible dimensions). Let us make a short example of how presented knowledge of implicit *versus* explicit grammars can help in the case of notational audiation (i.e. "listening while reading"). Steve Reich's "Clapping music" suits this purpose very well, because there are no changes in either pitch or timbre.



Picture 6. Steve Reich. "Clapping music" (1972). Excerpt of m. 1–2

As can be seen in Picture 6, Reich starts from the pulse (a metro-rhythmical gesture). Two equal time intervals between first three notes form an additive pulse[10], thus the beat is a start of the musical movement and not of the changes of duration (i.e. the rhythmic act). On the other hand, multiple regularity of durations is maintained, so the horizontal dimension of implicit grammar (according to the definition of Picture 5) is recognized securely. By inserting a rest in the position of the 4th eight note, Reich makes an expressional difference (or a vertical gesture of expression) by using a twice longer rhythmic value (because for percussive sound only the onset matters), which perfectly conforms to the horizontal dimension of the rhythmic act (see Picture 1). The positions of the next three eight notes (5-6-7) maintain the pulse, but the change of duration happens a one-eight earlier, so the differentiation of rhythmic durations in a steady beat background occurs with a *process* type of gesture (the rhythm becomes 2D, while metro-rhythm remains one-dimensional). The same is true for the eight notes in the 8th and the 9th positions of the first measure (a change of duration happens only after a one beat-pulse), while the last three positions are affected by the *reversal* type of rhythmic gesture (the 4th change of duration once again occurs after a time interval longer than the 3rd one). When a repetition of the 1st measure comes, the expression of the rhythmic act becomes 3D, because of a clear cyclic appearance of interactions between *process/reversal* types of interactions – it produces a *relief* type of rhythmic expression.

The salience of the pulse occurs exactly at the beginning of the measure, where three onsets are exposed in a rhythmical unison by both parts. Thus, the gesture of the metric act is started, maintaining a regular temporal grid throughout all repetitions of the 1st measure (i.e. expression of the meter is also 1D). The provided analysis shows that Reich has created a model of expression (his explicit grammar) starting from the beat (a metro-rhythmic act) and putting emphasis on the rhythmic expression (as a device for verticalization of the expression), while the unfolding of repetitions brings the regularity of temporal grid to the highest dimension of the three-dimensional experience. Because all three perceptual dimensions are modelled, the contour of the 1st bar is clearly audible on the systemic level.

The situation in expressional gesturing changes in the second measure where the composer applies the modelling of the pulse (*relief* type of gesture of the metro-rhythmic act). A full scale of the three-dimensional

[10] According to Narmour's I-R theory, the first time interval creates aural anticipation, the second one – fulfilment of that anticipation (realization of implication).

expression of metro-rhythm starts to dominate on a sub-system level of audiation, thus almost covering the other two morphological constituents of the structure of the contour. A 3D *relief* of the rhythmic act partly survives because of the associative memory and prolonged demonstration of the formula at the beginning and continuation in Clap 1 part throughout Bar 2. On the other hand, there are no conditions for the salience of pulse to emerge (which are exemplified at the bottom of Picture 3) and the dimension of the contour of the metric act is dropped completely so the boundaries of the contour are blurred in Bar 2. The expression on the systemic level becomes two-dimensional and is kept that way for the next 11 measures, eliminating the possibility to audiate the changes of the contour. Thus, only the hierarchical syntax is being expressed on a super-system level (i.e. the creation of musical form). Only when the 1st measure reappears at the end of the piece, associations and full-scale dimensionality come back, thus ending the piece with proper contouring on the level of musical form. At this point, the gestural expression of the metro-rhythmical act conforms (on the contour-level) to the direction of the *reversal* (from the modelled poly-rhythm of bars 2–12 to homo-rhythm of the 1st bar; see Picture 5 for the differentiation gesture of implicit grammar), while from Bar 2 to Bar 12 we find the polyphonic differentiation, i.e. the *process* type of gesture is retained, thus pushing forward the expression of musical form.

As we see, the gestural analysis is capable of explaining the perception of expression in a 3D domain of the auditory imagery. It as well possesses the ability to explain the quality of creativity in the composition. Creative action (according to Oxford/Cambridge version; Kaufman & Sternberg 2007) is defined as a *novel*, *structural* and *contextual*. In the case of Steve Reich's *Clapping music*, the **novelty** lies in "jumping" between 2D and 3D expressions at the systemic (contour) level as a result of recombination of expressional acts. Identifying gestural decisions on every level of expression of the composition helps to maintain the **structural** unity of grammatical endeavour, while the 3D metaphor of auditory imagery allows us to **contextualize** our audiative experience, qualifying the effect of changes into changes of musical expression. Etymologically words "create" and "creativity" are pretty close to each other and so are the results from both gestural and creativity analysis.

Conclusion

Cognitive foundations for the three-dimensional experience being backed by the phenomenon of auditory imagery it is just the beginning of the audiative story. By searching for compositional devices, which can represent every perceptual dimension in an enormous number of musical contexts, the composer can unleash his/her creative and expressive power. Gestural analysis offers sophisticated guidelines in the explication of such acknowledgement by introducing a method for linking conceptual models of regularity, differentiation and cyclicity with the multisystemic properties of expressive parameters. Due to the fact that the structure of those parameters is directly derived from the structure of the perceptual dimension, compositional gestures (devices intended for modelling the changes of parameters within musical movement) are likely enough to conform to the possibilities of our perceptual nature for capturing those modelled changes. Acoustical interaction between composer's intentions (expressed as an explicit grammar) and listener's abilities (defined as an implicit grammar) thus are unified in one convenient framework, which is open to include every possible context of expression – be it a variety of parameters or any level of compositional stages (from sub-motive to form scale). By defining the clear relations between both grammars, the suggested gestural method of analysis offers psychologically backed guidelines for improving the ability to audiate while writing music.

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Trijų klausos vaizduotės dimensijų vaidmuo kūrybiniame komponavimo procese: ritminiai išraiškos modeliai

Santrauka

Klausos vaizduotė straipsnyje apibrėžiama kaip gebėjimas audijuojant „simuliuoti“ trūkstamas garsines dimensijas. Tai gali nutikti esant restriktyviam muzikiniam dimensiškumui, pavyzdžiui, bandant užrašyti muziką ant dvi dimensijas reprezentuojančio popieriaus lapo arba klausant geometriškai apibrėžto (pvz., akustinių sistemų) garsinio lauko. Garso suvokimas yra kognityvinis mechanizmas, susidedantis iš trijų dimensijų, todėl komponavimo praktikoje mums dažniausiai prireikia vaizduotėje sumodeliuoti bent vieną trūkstamą garso dimensiją.

Ritmo komponavimas – daugialygmenis procesas, priklausantis nuo ritminio kontūro gramatikos. Tokios gramatikos sintaksė (ryšiai tarp kelių kontūrų) gali paskatinti inovatyvius kūrybinius formos sprendimus, o jos morfologija (kontūro formavimas) gali būti suprantama kaip sintaksinė *muzikavimo aktų* kombinacija. Išskirti trys ritminės ekspresijos aktai – ritmas, metroritmas (pulso modeliavimo aktą) ir metras. Remiantis kognityviniu percepcinių dimensijų modeliu (apibendrintu Williamo Forde'o Thompsono), straipsnyje atskleista, kaip ritminės išraiškos *muzikavimo aktai* gali būti panaudojami *horizontalios*, *vertikalios* ir *erdvinės* garsinės vaizduotės dimensijų modeliavimui.

Trijų dimensijų išraiškos modeliavimo kompozicijoje principas pagrįstas Lawerence'o Zibkowskio pristatytais nuo propriocepsijos (t. y. savo kūno padėties, jėgos ir judėjimo suvokimo) priklausomais koncepciniais modeliais. Šie modeliai yra projektuojami kaip tam tikri muzikinės ekspresijos gestai (garsinio judėjimo pokyčiai). Taigi *horizontalioji* dimensija gali būti audijuojama kaip muzikinės išraiškos pokyčių *reguliarumas, vertikalioji* dimensija – kaip *skirtumai* tarp įvairių reguliarių percepcijos pokyčių versijų, o *erdvinė* dimensija – kaip pasikartojančių modelių *cikliškumas* skirtingose muzikinės išraiškos plotmėse.

Percepcinių dimensijų potencialas kartu su koncepcinių modelių percepcija sukuria *implicitinę* (nulemtą natūralių klausymo proceso ypatybių) *ritminio kontūro gramatiką*. *Horizontalus reguliarumas* šioje gramatikoje (suprantamas kaip „*ritmas*“) yra atpažįstamas kaip *ritmo aktas*, kurį galima įgyvendinti naudojant kartotines (reguliarias) ritmines vertes. *Vertikalūs skirtumai* (atpažįstami kaip implicitinės gramatikos *tonai*) sukuriami *metroritminio akto* metu, kuris gali būti įgyvendintas pasitelkiant tiek imitacines, tiek ne imitacines poliritmines figūras. *Erdvinis cikliškumas* (atpažįstamas kaip *kontūras*, *frazė*) implicitinėje gramatikoje yra suvokiamas kaip *metro* aktas, utilizuojantis *reljefo* (pagal Richardą Parncuttą) pokyčius ritminiame audinyje. Straipsnyje atskleidžiama, kaip, pasitelkęs skirtingų percepcinių dimensijų modeliavimo strategijų audijavimą, kompozitorius gali sukurti eksplicitinę (t. y. sąmoningo pasirinkimo būdu atsiradusią) gramatiką, apibūdinančią jo muzikinės ekspresijos individualias ypatybes.