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A Peircean approach to musicality

ABSTRACT: Musicality is central to musical processes and music research. Yet, there is no consensus of what is understood by the term. It can be assumed that in large populations musicality is distributed according to a bell curve — just as any trait of personality. It is also clear that musical skills can be improved, regardless of a possible stigma of unmusicality. Depending on the conception of musicality, musicality research confronts issues and trade-offs relating to ecological validity of the concept (how musicality connects to actual music), methodology (which methods of study yield valid and reliable results), epistemology (how the gain knowledge of musicality), and ontology of music (what processes pertain to music, what not, and what is possible shared). These issues are reflected in the primarily psychological theories and tests of musicality.
This article makes an attempt at a Peircean analysis of musicality. It has been suggested that the traditional psychometric approach to musicality is followed by a semiotic approach, and assuming musicality has to do with how subjects make sense in musical processes, the semiotic analysis of musicality is critical. This analysis applies Peirce's notion of thought-sign and his tenfold classification of the sign (suggesting a three-dimensional exemplification of Peirce's trichotomous, three-dimensional model). The ten classes are differentiated by six transitions, that seem to have their correlates in the psychological understanding of cognition: manifestation, definition, filtering, binding, associating and understanding of the sign.
The six transitions appear useful in analyzing the concept of musicality. Correspondingly, the conditions for musical signification extend from ability of auditory sensation to those of dynamical memory, auditory filtering, auditory structuring, association sound objects and ability to understand and manage communicational situations in music. In order to understand musicality, all these aspects should be studied with good ecological and methodological validity in mind.

KEYWORDS: musicality, musical ability, musical semiotics, Peirce, sign, thought-sign, music psychology

She is quite young: 17, and pretty; really it was a joy to guide her little fingers. But joking apart, she has a lot of real musical feeling; one did not have to say: crescendo here, piano there; now quicker, now slower, and so on. I could not refuse to send them my polonaise in F minor, which captivated Princess Eliza; so please send it to me by the first post...

1. Introduction

Chopin's description of princess Eliza Radziwiłł illustrates salient features of musicality:[1] it is a quality that a person more or less possesses, it can be felt (without reasoning), it is communicated in action (without verbal language), it tends to commit, even compel those around — it is at the core of professional and amateur music-making. The concept of musicality is ubiquitous in musician's thinking, conscious or not, as well in thinking of those teaching, researching or simply listening to music.

Yet now, after about one hundred years of research in the field, there still is no clear consensus of what is understood by the term "musicality". Consequently, we tend to be stranded with dictionary-like definitions unable to truly illuminate the concept, or with avoidance of the concept altogether. Adding notions such as musical talent, musical intelligence, musical competence, aptitude, ability and achievement, or those of artistry, creativity and musicianship, we end up with quite a hodgepodge for a conceptual apparatus.[2]

Typically in lay theory, imprinted by a Kantian–Goethean–Beethovenian genius cult, a person either is innately musical (preferably a child prodigy), or not, and there is not much that can be done about it. This would be a good excuse for not making an effort for musical growth, paralleling the same in mathematics, foreign languages, sports, etc. Yet, it can be assumed that in large populations musicality is distributed according to a bell curve — just as any personality trait or feature: length, intelligence, ability to concentrate, or what not. There are many people who are moderately musical, and less of those who are extremely musical or extremely unmusical. It is also clear, that through rehearsing and studying, musical skills can be improved to the point that the stigma of unmusicality, often considered absolute and immutable, is shaken off, especially if motivated, guided by a proficient instructor, and supported socially.[3]

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[1] Fr. Chopin's letter to Tytus Wojciechowski, 14 Nov. 1829, Frédéric Chopin, *Chopin's letters*, with the assistance of Henryk Opieński, and E. L. Voynich (New York: Dover, 1988), 74.

[2] Please note, that I am here referring to musicality as a form of predisposition, mental capacity, prospective or manifested cognitive skills relating to music, rather than as an identity, part of self, particularly the professional self or profile (cf. "musicianship" in English).

[3] See e.g. Adrian C. North and David J. Hargreaves, *The Social and Applied Psychology of Music* (New York: Oxford University Press, 2008), 51–60 for the impact of environment and motivation on development of musical skills, and Ava Numminen, *Laulutaidottomasta kehittyväksi laulajaksi: Tutkimus aikuisen laulutaidon lukoista ja niiden avaamisesta*, Studia musica 25 (Helsinki: Sibelius Academy, 2005), [Helping adult poor pitch singers learn to sing in tune: A study of stumbling blocks confronting developing singers and means of surmounting them], whose "results show that a disability to sing is not a fixed trait of an individual but a skill which can be developed in adult years from any initial level" — the study found no correlation between the developing ability to sing with good pitch and a musicality test (ibid., 6). See also Isabelle Peretz, "Brain specialization for music: New evidence from congenital amusia," in *The Cognitive*

Hence, from the viewpoint of music education, the easier a person adjusts existing or acquires new habits of perception, thinking and action pertaining to listening, performing, composing or other ways of being involved with music, the more musical he or she is. When musicians talk of a highly musical musician, they refer holistically to the quality of music-making, music-related communication skills, sense of situation and shape, innovativeness, and, yes, creativity (whatever that entails), freshness, richness and keenness of expression, even charisma. This understanding of musicality reflects the artistic practices, experiencing and the related emotions. Consequently, musicality in this sense may be difficult to observe by an outsider, and is therefore difficult or even impossible to describe qualitatively, let alone to measure quantitatively.

2. Musicality research in music psychology

Musicality being an issue of mental capacity, it has been studied particularly in the field of music psychology. The empirical research tradition has stressed the need to be able to measure what is measurable, and to make measurable what is not. Consequently, the fact, that it is easier to measure readily observable abilities rather than emotions or needs, creativity or expression, has had an impact on the ruling conception of musicality in psychological research of musicality. Furthermore, ontology going hand in hand with epistemology and methodology, the different currents of psychology have each left a mark on how musicality is understood and how it is studied. Hence the scientific notions of musicality have varied e.g. from Carl Seashore's structuralist to James L. Mursell's Gestalt-psychological notion, and from Robert Lundin's behavioristic notion to John Blacking's anthropological and Kai Karma's cognitivist notions of musicality.[4] Within this complex of conceptions of musicality Kai Karma[5] identified three, closely related aspects: 1) the sensory versus holistic character of musicality; 2) the explanatory power of the concept versus its homogeneity and 3) musicality as pertaining exclusively to music vs. as a more general ability.

Neuroscience of Music, ed. Isabelle Peretz and Robert J. Zatorre (Oxford, New York: Oxford University Press, 2003), 192–203., for a lead-in to the still on-going discussion on amusia versus acquisition of musical skills.

[4] Kai Karma, "Musikaalisuus" in *Musiikkipsykologia*, ed. Jukka Louhivuori and Suvi Saarikallio (Jyväskylä: Atena Kustannus Oy, 2010), 355–68; Musicality, 355–356; see also Jere T. Humphreys, "Precursors of Musical Aptitude Testing: From the Greeks through the Work of Francis Galton," *Journal of Research in Music Education* 41, no. 4 (1993), doi:10.2307/3345507., Jere T. Humphreys, "Musical Aptitude Testing: From James McKeen Cattell to Carl Emil Seashore", *Research Studies in Music Education* 10, no. 1 (1998), doi:10.1177/1321103X9801000104.; Heiner Gembris, "Historical phases in the definition of musicality," *Psychomusicology: A Journal of Research in Music Cognition*, no. 16 (1997).

[5] Karma, "Musikaalisuus," 355–68.

Some conceptions hold that musicality is determined by or structured on the sensory abilities, such as those of pitch or timbre discrimination. This kind of sensory abilities are relatively easy to measure, and tests based on this view, such as the atomistic musicality tests by Carl Seashore of musicality, are sometimes still used — for just that: for measuring the abilities to discriminate e.g. pitch or rhythm. However, the sensory abilities are no longer regarded as a guarantee for musical abilities and their development, and the tests of musicality that rely on sensory discrimination tasks are usually considered more or less alienated or detached from the actual music: they are not considered "ecologically valid".[6] In other words, the sensory abilities do not seem to have sufficient explanatory power over musical skills.

In contrast to the sensory conceptions of musicality, the conceptions of musicality in the tradition of Gestalt psychology opted for examining musicality in terms of phenomena present in actual music: melodies, chords, keys, rhythms, etc., even their esthetic values. The abilities to discriminate, perceive or operate with these may, again, be measurable to a degree. Nevertheless, also this approach is problematic, since the musical features operated upon are specific to certain music culture of a certain era (in this case usually classical Western tonal music).[7]

Consequently, we face a two-fold question. First, is it possible to reach a conception (or even a theory) of musicality that would explain the actual skills involved in musical processes across music cultures, and yet would be accessible to scientific and empirical research? The ensuing problem is that, according to Karma (2010, 362), "[I]f musicality is, what is required for musical thinking, listening, and making, it consists of almost the whole person. Music-making involves motivation, motor abilities, intelligence, personality etc." As a result, we end up with a heterogeneous collection of abilities, that are again difficult to measure, and that pertain to many aspects of life, also much beyond music.

Second, this leads to the question of whether musicality is something that pertains exclusively to music or whether it shares some cognitive processes with other aspects of our lives. Some correlations have been found between musicality and, e.g., general, verbal and spatial intelligence. At the same time, neuropsychological studies suggest, supported by "compelling" evidence (such as case studies with subjects with amusia without language deficits and vice versa) that "music might

[6] Steven M. Demorest, "Issues of ecological validity for perceptual research in music," *Psychomusicology: A Journal of Research in Music Cognition*, no. 14 (1995)., Kai Karma, "Musical aptitude definition and measure validation: Ecological validity can endanger the construct validity of musical aptitude tests," *Psychomusicology: A Journal of Research in Music Cognition* 19, no. 2 (2007), doi:10.1037/h0094033.

[7] Karma, "Musikaalisuus," 355–68; at 358–60.

well be distinct from other cognitive functions, in being subserved by specialized neural networks".[8]

If musicality is understood broadly as extending to all aspects of musical processes, examining and measuring it would require examining and measuring much of the whole personality, which may be much too big a task. Should musicality then be limited to those aspects of personality specific and exclusive to music, further problems arise: which aspects are indeed specific and exclusive to music, and what ramifications would exclusion of aspects non-specific to music have on the conception and research of musicality?

A compromise to this has been advocated by Kai Karma who has defined musical aptitude or musical ability (sic! *versus* musicality) as the ability to structure acoustic material, the ability to 'conceive auditory patterns, i.e. sets of relations between tones".[9] This way musical ability becomes analogous to spatial ability in that it exists as a general ability, which may develop into various specific forms or expressions, pending on the music culture, resembling the development of technical and mechanical abilities based on spatial ability. In this approach, the limitations of the atomistic sensory approach and the problems of transcultural differences between subjects are avoided, while maintaining the possibility for rigorous music-psychological study of the phenomenon, and enabling objective measurement of the untrained potential, as developed by Karma.[10]

The study of musicality has emphasized the cognitive measurements in musical processes, and rightly so, assuming we want to adhere to the psychometric principles of being able to measure subject's musicality in purely psychological terms. However, since musicality appears to be a property of both music and the subject involved in music, it might also be advisable to examine the interplay between the subject and music, and to study how music is experienced and how it is made to be experienced, i.e. the process of musical signification.

In fact, Heiner Gembris[11] has advocated an essentially semiotic approach to musicality as the third historical phase, following what he has considered the initial

[8] Isabelle Peretz, "Brain specialization for music: New evidence from congenital amusia," in *The Cognitive Neuroscience of Music*, ed. Isabelle Peretz and Robert J. Zatorre (Oxford, New York: Oxford University Press, 2003), 192–203. See also Aniruddh D. Patel, "Why would Musical Training Benefit the Neural Encoding of Speech? The OPERA Hypothesis," *Frontiers in Psychology* 2 (2011), doi:10.3389/fpsyg.2011.00142. for a suggested hypothesis for a neurophysiological consolidation of distinct versus shared processing.

[9] Kai Karma, "Musical Aptitude as the Ability to Structure Acoustic Material," *International Journal of Music Education* 3, no. 1 (1984), doi:10.1177/025576148400300104., 28.

[10] Ibid., Kai Karma, "Components of Auditive Structuring — Towards a Theory of Musical Aptitude," *Bulletin of the Council for Research in Music Education*, no. 82 (1985)., Karma, "Musical aptitude definition and measure validation: Ecological validity can endanger the construct validity of musical aptitude tests", Karma, "Musikaalisuus,", 355–68.

[11] Heiner Gembris, "Historical phases in the definition of musicality," *Psychomusicology: A Journal of Research in Music Cognition*, no. 16 (1997).

phenomenological approach, and the second psychometric approach to musicality (extending from Seashore 1919 to Gordon 1989). Objecting to the relatively poor validity of the psychometric tests of musicality, among other issues, Gembris has emphasized that "generation of meaning is at the core of musicality",[12] and found support to this from John Sloboda's definition of musical ability as "the ability to make sense of music", John Blacking's definition of musical intelligence as the "cognitive and affective equipment of the brain with which people make musical sense of the world", and Gino Stefani's definition of musical competence as "the ability to produce sense through music".

Gembris has defined musicality as "the ability to generate musical meaning",[13] and called for a line of research that would map the plethora of the manifestations of musical abilities across the differentiated musical styles, whether in listening, composing, or producing, in order to derive a descriptive inventory for those abilities, i.e. for musicality.

This, of course, brings musicality research again in closer contact with actual musical processes, and with all likelihood improves the ecological validity of the research. Also, it again brings up the problem of homogeneity of the concept and the problem of generality versus specificity of the processes involved in music. Hence it seems that a synthesis between what e.g. Gembris is after and the vast amount of psychological research pursued in the issues relating to musicality might benefit from a semiotic analysis of the notion of musicality.

3. The Peircean framework: the thought-sign and the tenfold classification of the sign

Peirce's pragmatic maxim

> Consider what effects that might *conceivably* have practical bearings you *conceive* the objects of your *conception* to have. Then, your *conception* of those effects is the whole of your *conception* of the object.[14]

provides a method or conceptual analysis as "[t]he method prescribed in the maxim is to trace out in the imagination the conceivable practical consequences, -- that is,

[12] Ibid., 20.

[13] Ibid.

[14] Charles S. Peirce, *Collected papers of Charles Sanders Peirce*, editor Arthur W. Burks, Collected papers of Charles Sanders Peirce VII-VIII (Cambridge, Mass.: Harvard University Press), 1931–1958; Charles S. Peirce, *Collected papers of Charles Sanders Peirce*, editors Charles Hartshorne, and Paul Weiss I-VI (Cambridge, Mass.: Harvard University Press), 1931–1958. References to the *Collected Papers* (abbreviated CP) are conventionally designated by volume number and paragraph number. CP 5.438, italics original.

the consequences for deliberate, self-controlled conduct".[15] The pragmatic maxim is the third grade of clarity, according to Peirce,[16] the first being mere "familiarity with a notion" and the second "the defining of it".[17] Some aspects of the conceivable practical consequences of the concept of musicality to the research on it have already become apparent above. If the conception is too narrow, it leaves out important parts of musical processes, whether crosscultural diversity of musical abilities or issues of sensory psychophysiology. In contrast, a broad conception has an inherent trade-off: the broader the concept, the better ecological validity can be assumed, but at the cost of losing the homogeneity of the concept resulting in a conglomeration of the objects of study, which would require a) exceptional conceptional and methodological clarity, and b) joined efforts across disciplines of research. Regarding the depth of the concept, the concept of musicality is clearly inseparable from that of music, but that discussion is beyond the scope of this article.[18]

Let us now briefly go through how thought-signs develop, based on Peirce's notion of thought-signs and his tenfold classification of the sign, for the benefit of then matching the concept of musicality with the model of the sign.

According to Peirce, "thought is the chief, if not the only, mode of representation",[19] and in Peirce's days representamens with "a cognition of a mind" as Interpretant were "the only representamens that have been much studied,[20] in contrast to contemporary achievements of, say, biosemiotics or artificial intelligence. Consequently, Peirce's semiotics is largely about thought-signs, although these form a special case of signs. Peirce described thought-signs as follows:

> Whenever we think, we have present to the consciousness some feeling, image, conception, or other representation, which serves as a sign. But it follows from our own existence (which is proved by the occurrence of ignorance and error) that everything which is present to us is a phenomenal manifestation of ourselves. This does not prevent its being a phenomenon of something without us, just as a rainbow is at once a manifestation both of the sun and of the rain. When we think, then, we ourselves, as we are at that moment, appear as a sign. Now a sign has, as such, three references: first, it is a sign to some thought which interprets it; second, it is a sign for some object to which in that thought it is equivalent; third, it is a sign, in some respect or quality, which brings it into connection with its object.[21]

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[15] Ibid.

[16] CP 5.402.

[17] CP 5.392.

[18] Also see Juha Ojala, *Space in Musical Semiosis: An Abductive Theory of the Musical Composition Process,* Acta semiotica fennica 33 (Imatra: International Semiotics Institute at Imatra; Semiotic Society of Finland; Dept. of Musicology, University of Helsinki, 2009), 79–156.

[19] CP 2.274.

[20] CP 2.242.

[21] CP 5.283.

Applying the phaneroscopic categories of Firstness, Secondness, and Thirdness to the concept of sign and its three references yield the tenfold tripartition of the sign, here treated as a thought-sign. Peirce illustrated the ten classes of Signs in the traditional triangles as shown in figures 1 and 2.[22] The problem with these illustrations is that they lack in bringing forth how each of the three references of the sign makes up a distinct dimension in this inherently three-dimensional model. Unfortunately, any illustration of a three-dimensional model suffers if portrayed in two dimensions. A better solution might be if the ten classes were illustrated as a three-dimensional model. A sample projection of the three-dimensional model, with the ten classes and the six transitions therebetween labeled is given in figure 3.

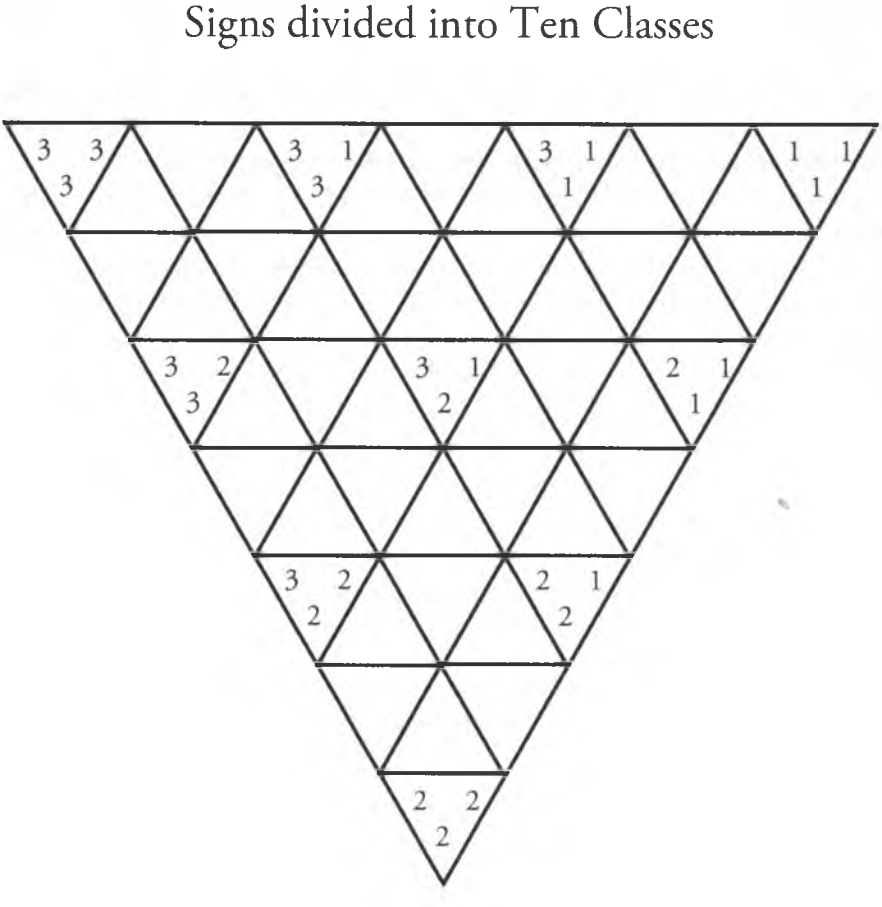

Figure 1

[22] CP 8.376.

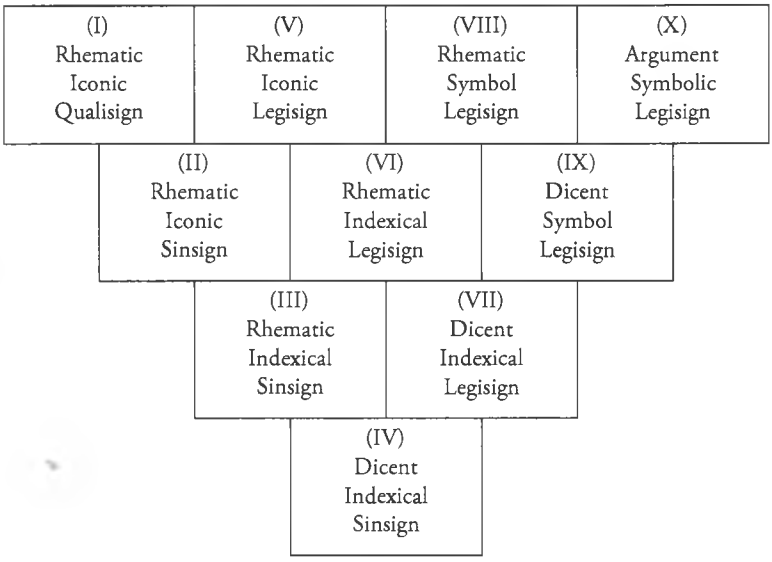

Figure 2

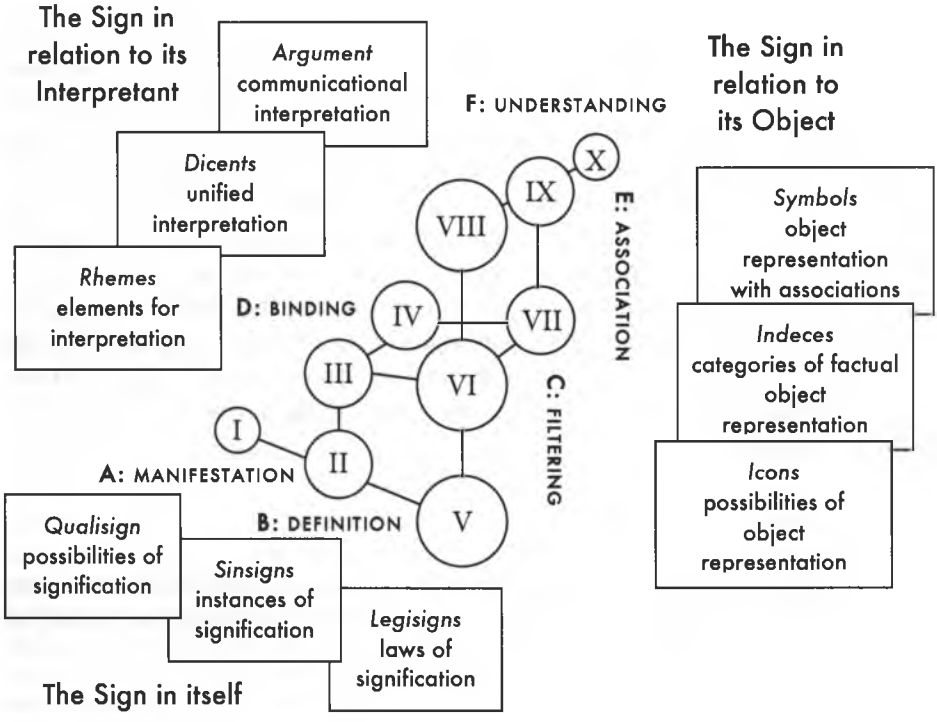

Figure 3

The ten classes can be approached in terms of the six transitions that distinguish A) the three sinsigns from the qualisign; B) the six legisigns from the three sinsigns; C) the four indices from the three icons; D) the three dicents from the six rhemes; E) the three symbols from the four indices; and finally F) the argument from the three dicents, as follows.

To begin, transition A is the manifestation of the qualisign (class I) in the rhematic iconic sinsign (class II). A qualisign is a quality, a First in all respects, a mere possibility for representation (from the viewpoint of the semiotic subject), but the rhematic iconic sinsign is "an actual existent thing or event which is a sign".[23] Second, transition B is that of defining: Sinsigns exist as particular instances, but the particular stands in relation to nothing, except for the qualities it embodies. To become significant, it needs to be compared with a relevant accumulation of sinsigns, a corresponding legisign, which reciprocally needs its sinsign (its replica) in order to signify.[24] Hence, the instance of the rhematic iconic sinsign (class II) is paralleled by the accumulative rhematic iconic legisign (class V), and other sinsigns hold a similar relation to their corresponding legisigns. The law-like character of the legisign is pivotal, because it expands the *hic et nunc* of the sinsign into the temporally less volatile accumulation of the past and expectancy of the future, which is the basis of memory and learning.[25]

The transitions from icons to rhematic and dicent indices is a transition from mere possibilities present in the iconic qualities to representing the object of the sign as an object, endowing the thought-sign with "a real connection" between the index and its object.[26] The filtering transition C from iconic sin- and legisign to indexical sin- and legisign is the semiotic counterpart of the perceptual feature selection process in which features useful for the represention are filtered out of the chaotic noise of the sensory level. Next, the binding transition D from indexical rhemes to indexical dicents combines the distinct, selected qualities of the rhemes, each carrying clues as to the object of the sign into a unified experience. At this point, then, the thought-sign is capable of representing the object of the sign as an object. But this is not enough for the object of the sign to be significant for the subject, since there is no "some thought which interprets" the sign: it is not more than a representation of the object as an object. Fully-developed signification requires symbols.

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[23] CP 2.245.

[24] CP 2.246.

[25] As becomes apparent, there are close parallels between the tenfold classification of the thought-sign and the psychological understanding of human (or other mammalian) cognition, but these are only hinted at in this context. See Ojala, *Space in Musical Semiosis*, Juha Ojala, "Before and after the emergence of musical thought-signs," in *Proceedings of the 10th International Congress on Musical Signification*, ed. Lina Navickaite-Martinelli (Vilnius: Lithuanian Academy of Music and Theatre, 2010).

[26] See CP 5.75, CP 2.286–287.

Transition E, that of association, moves us from the Secondness of indexical signs (and dicents) to the Thirdness of symbols. Peirce defined symbol as "a sign which refers to the Object that it denotes by virtue of law, usually an association of general ideas, which operates to cause the Symbol to be interpreted as referring to that Object".[27] The indexical legisigns are combined with other, associated legisigns of other interpreted signs (which in turn have or have had their own sinsigns as their instances). Thus Symbols form a mutually interconnected cluster of legisigns and are no longer in need of corresponding sinsigns of their own. No wonder Peirce stressed that the term symbol derives from the Greek "sumballein", "thrown together".[28] The reason why this transition is so significant, is that through symbols the subject can associate any developing thought-sign with what is most meaningful for the subject: the signs of herself, i.e. through symbols our subjective experience is formed as objects of the signs are put in relation with ourselves as objects of other signs.

This takes two routes, which could be called qualitative and factual. On the one hand, rhematic indexical legisigns (class VI) and their unincorporated accumulations of filtered features are associated with rhematic indexical legisigns into rhematic symbols (class VIII). These have significance even without the binding into dicents by accounting for such qualitative aspects of the subjective experience, that are hard to reach in terms of factual representation. I.e., the rhematic symbols account for the association of "feelings" in the sense that they are still Firsts in the relation of the sign to its interpretant. Rhematic symbols can then again be unified with other associated features following the principle of binding (dicent symbol, class IX). On the other hand, the factual aspect is established in the indexical dicents, representing factual objects or situations and their categories (classes IV and VII). Once these are associated with other representations of objects or situations, including those of the subject herself, the representation of the particular object in the indexical dicent turns into a dicent symbol (class IX), a representation of the object or situation for the subject as the associations are attached to the accumulation of experienced, factual situations. At this point, something stands for something, *for someone*.

Finally, transition F, that of understanding, reveals the operation of the sign as a sign.[29] The argument (class X) does not only convey the factual issues of being and acting in the world, or the associations with all pertinent past and present experiences. It becomes a domain of reflection and of the exploration of the semiotic process itself. This last transition takes the sign into a semio-cognitive metalevel. It allows for an understanding of the semiotic process, and provides the basis for deliberate, purposeful communication.

[27] CP 2.249.
[28] CP 2.297.
[29] CP 2.252.

This concludes the brief outline of how thought-signs are developed from the ten classes of the sign. Note, that Peirce's examples of the ten classes in the 1903 Syllabus, perhaps with the exception of "a feeling of red" as the example of qualisign, they can all be considered examples of fully developed Signs, rather than different stages of developing thought-signs.[30] Now, let us consider how musicality could be understood in terms of this model.

4. Musicality as understood in the Peircean framework

If ability to "make sense of music", that is, if musical signification accounts for musicality, the six transitions between the ten classes of sign may provide a means for breaking down the conditions for musicality. This might help managing both the concept and research. To begin, (see transition A above), the qualisign must be manifested as sinsign. In terms of musical signification this simply means — for confirmation — that sensory abilities for sound perception are needed. First, musical notation is not music, but ink on paper or dark pixels on screen. Second, while perception in other sensory modalities does affect (or interfere) auditory perception, music is mediated by sound (either exclusively or primarily, depending on the definition). Deficiencies in hearing make it difficult to participate in any musical process, whether reception, performance or creation.[31] Hence, the understanding and making sense of music does require the elementary, "atomistic" abilities of auditory sensation, since they indeed are the building blocks for musically meaningful sound objects, regardless of musical style, genre or culture. These elementary abilities are a necessary but by far not a sufficient condition for musicality.[32]

For the sensory processes to be operative and well-tuned for music, there needs to be exposure to musical sound. Despite of his later sensory deficiency, even Ludwig van Beethoven had an operative auditory sense for a sufficient period

[30] CP 2.254–261, 271, 253, 266–270.

[31] Karma (Kai Karma, "Auditory and Visual Temporal Structuring: How Important is Sound to Musical Thinking?," *Psychology of Music* 22, no. 1 (1994), doi:10.1177/0305735694221002.) raised a question of whether musical thought processes "exist outside music". A temporal structuring test was administered to both hearing and congenitally deaf subjects. The study showed that a about half of the score variance could be explained by a component common to auditory and visual temporal structuring, while the remaining half seemed to be modality-dependent. The results of the deaf subjects were quite similar to the controls, although their mean score was somewhat lower. Karma interpreted the results as "showing that sound is not a necessary condition for musical thought processes, although it is the most effective means of communicating them". Is visual temporal structuring musical thinking?

[32] Hence the critique towards the atomistic theories or models of musicality seems deserved.

of time during right developmental periods to generate habits of feeling, thinking and action essential for music. Once these habits are formed well enough, the qualisign needs not necessarily originate in actual sound, but an imaginary one will suffice — the sinsign can be instigated through musical imagery, as is shown right in e.g. Beethoven's case.

Yet, the development of the habits is not possible without the relative permanence of legisigns (cf. transition B). Musical signification requires that the perceived sounds (sinsigns) are put in relation with the relatively stable models or categories (legisigns) which organize them (and which can reciprocally be updated by individual sinsigns). Hence another requirement for musical abilities is a good short-term and long-term memory.[33] It seems to be essential for musicality (and creativity) that legisigns either are constantly dynamical and updatable by sinsigns (cf. lifelong learning), or had the chance to develop sufficiently when possible (cf. neural plasticity in sensitive periods[34]). This again emphasizes the importance of exposure to a variety of musical sounds, particularly early on in life. Once the habits are set, it may be difficult to change them, and in music this means that it may be difficult or impossible to relate musical phenomena new to the subject (whether new in own culture, or old or new from another music culture) to accumulated experience. Hence Zoltán Kodály's coinage that music education should preferably begin nine months before the birth of the parent, rather than in childhood.[35] In all likelihood, "negative learning" takes its toll here: potential ability deteriorates unless used and trained.

The features necessary for signification are extracted from the chaotic sensory stream (transition C from icons to indices above). All messages have noise, more or less. In music, the subject ought to be able to discern those features that are relevant for the musical communication and to neglect the irrelevant ones. Controlling this prioritizing by means other than exposure and statistical learning may be difficult, since what is relevant may be highly dependent on the context, in addition to often being largely or completely preattentive. For instance, if a slight fluctuation of pitch is irrelevant, it may be enough to merely categorize the pitch to, say, a^1. However, if the fluctuation is a means of expressions by juxtaposing shades of vibrato, the subject should be able to pick it up, and when necessary, also to produce or use

[33] Musicians have an enhanced auditory working memory, but whether the enhanced memory has been the reason they have become musicians or whether music enhances the memory, is not yet certain. See e.g. Karen J. Pallesen et al., "Cognitive Control in Auditory Working Memory Is Enhanced in Musicians," *PLoS ONE* 5, no. 6 (2010), doi:10.1371/journal.pone.0011120., Stefan Koelsch, Erich Schroger, and Mari Tervaniemi, "Superior pre-attentive auditory processing in musicians," *Neuroreport* 10, no. 6 (1999).

[34] E.g. Josef Rauschecker, "Functional organization and plasticity of auditory cortex," in *The cognitive neuroscience of music*, ed. Isabelle Peretz and Robert J. Zatorre (Oxford, New York: Oxford University Press, 2003), 357–65.

[35] Mihály Ittzes, "Zoltan Kodaly 1882–1967: Honorary President of ISME 1964–1967," *International Journal of Music Education* 22, no. 2 (2004), doi:10.1177/0255761404044015., 137.

in own music-making. This kind of training is what enculturation and acquisition of styles, and hence learning musics are largely about. Hence the third aspect of musicality is this kind of auditory filtering system, which needs to be maintained and developed in interaction with the environment.[36]

This extraction process is a part of auditory structuring: selection and preparation of the building blocks for sound objects. The fourth aspect of musicality is the transition from rhemes to dicents (transition D), the core of the psychometric approach to musicality, the actual auditory structuring or integration of the selected acoustic features into a musically meaningful, (temporally and spatially) coherent sound image or sound object, which can be a part of the musical message or narration. This entails phenomena such as motifs or themes that operate either as backgrounding reference or narratively more foregrounding characters that may encounter other characters or backgrounds.[37] Without putting sound objects together and relating them with one another, it may be impossible for the subject to understand the logic of musical events and situations. Hence, the core of the psychometric approach to musicality, that of auditory structuring is an important condition for musicality.

Going beyond the traditional psychological core of musicality, a further requirement for musical signification comes from the transition from indices of sound objects to musical symbols (transition E). Note the emergence of the word musical at this point: musical symbols are here understood as the relations between the sound objects and their references, associations in the experience of the subject. The sound objects are not interpreted as emanating from their actual sources as with sounds of everyday life, but are freely thrown together with other experiences, other legisigns, as is befitting for the subject (the mechanisms for which is another issue). Particularly important in terms of musicality is the ability to connect the habits of perceiving characteristics of sound and unified sound objects with perceived features and the totality of the subject's self, i.e. how the sound and its features relate to subjective experience, yielding the emotional effects that music has. Hence music constructs and reconstructs imaginary or real experiences and thereby has an effect on us, our emotions and experiences, and the ability of this associative construction is an important aspect of musicality, albeit apparently very difficult to study.

Last but not least, the sixth aspect of musicality is connected with the transition F from dicents to the argument, and is essentially the ability to understand the communicational situations in music. In music, virtual situations are communicated from subject to another (or to subject herself, in autocommunication).

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[36] Cf. Mari Tervaniemi et al., "Pitch discrimination accuracy in musicians vs nonmusicians: an event-related potential and behavioral study," *Experimental Brain Research* 161, no. 1 (2005), doi:10.1007/s00221–004–2044–5.

[37] Cf. Eero Tarasti, "Signs as acts and events: An essay on musical situations," in *Musical Signification, Between Rhetoric and Pragmatics: Proceedings of the 5th International Congress on Musical Signification*, ed. Gino Stefani, Eero Tarasti and Luca Marconi (Bologna: International Semiotics Institute & CLUEB, 1998), 39–62.

When listening to music, we expose ourselves to the musical situations in order to create changes in or reinforce existing habits of feeling, thinking, and action. This may suffice for reception, but as far as musicality of performance or creation is concerned, the ability to control the musical praxis and poiesis is also required: the ability to do and make it right in order to create the wanted experience in the listener. Apparently this is at least partly an empathetic ability, in the sense that ability to predict and assess the effects music might have on others requires understanding of how people other than self might experience the communication. No wonder it has been shown that creative musical abilities are associated even with genes known to modulate social cognition and behavior.[38]

5. Conclusions

Based on the above, the core of the psychometric approach to musicality, that of auditory structuring is but a part of the aspects of musicality. This article delineated six aspects, based on the six transitions between Peirce's tenfold classification of the sign: a) ability of auditory sensation; b) dynamical memory; c) auditory filtering; d) auditory structuring a.k.a. integration of auditory features into sound objects; e) ability to associate sound objects and features thereof with other objects and features, particularly those of oneself; and f) ability to understand and manage communicational situations in music. It seems that delimiting research of musicality only to one aspect is not warranted, even if it has made sense in terms of efficient methodology and clear conceptual apparatus. Musicality should be approached on its own terms, and each of the aspects should be studied with good validity as a goal.

The trade-off is indeed in that with this kind of holistic approach, musicality cannot be studied within one discipline and its methods. Efforts needs to be made towards improving and expanding the methods used, based on a valid ontology and epistemology of musicality. This calls for and interdisciplinary approach between semiotics and psychology of music, music analysis, sociocultural research on music, and even genetics. It seems musicality should be approached on terms of music, rather than having researchers decide as to the ecological validity of the research, regardless of the musical practices.

This signifying nature of music and holistic notion of musicality is not only a challenge. In fact, this is potentially what makes studying musicality and musical signification very interesting and rewarding: since musical signification involves the mind in its entirety, through studying musical signification one learns a great deal of not only of music, but of signification, our mind and lives.

[38] The AVPR1A haplotype, see Liisa T. Ukkola et al., "Musical Aptitude Is Associated with AVPR1A-Haplotypes," *PLoS ONE* 4, no. 5 (2009), doi:10.1371/journal.pone.0005534.

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