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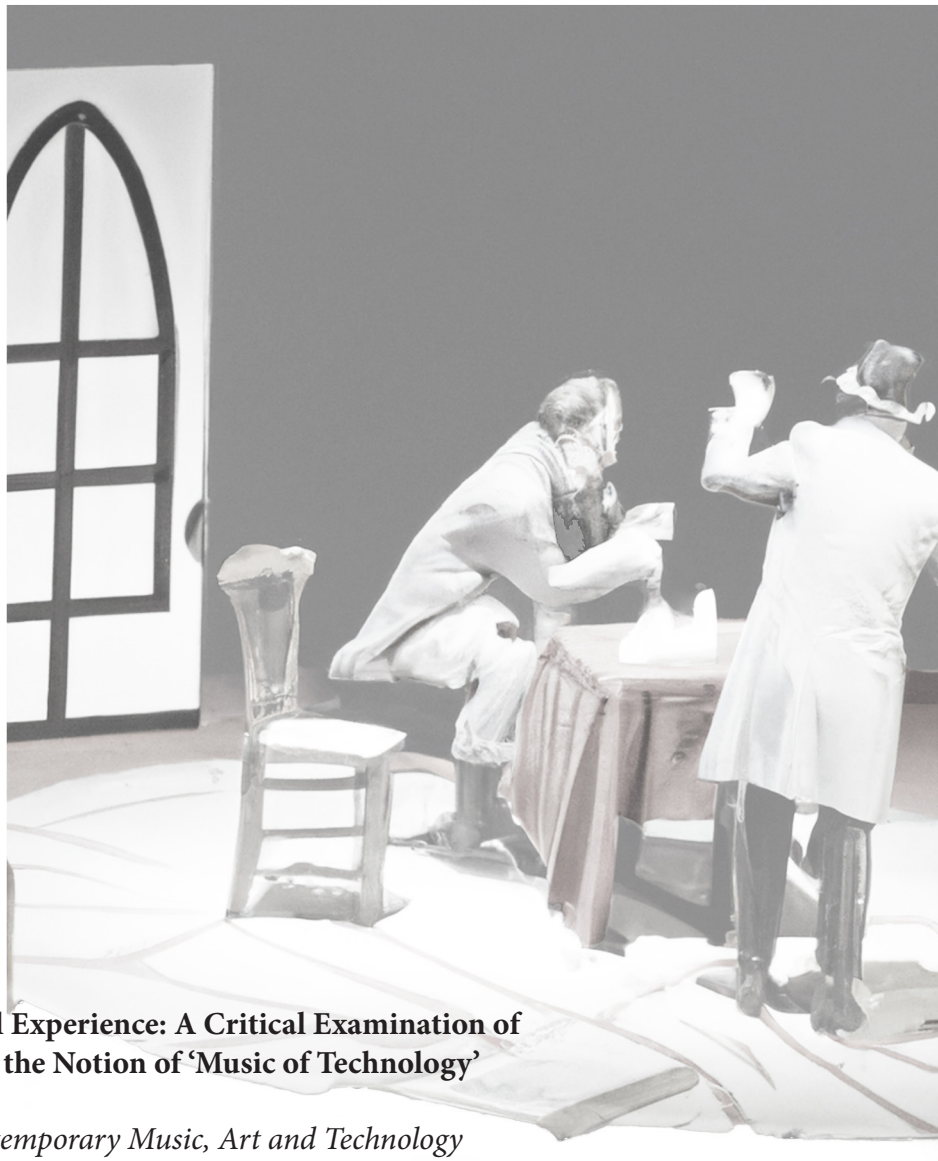

Reshaping the Musical Experience: A Critical Examination of *Musique Concrète* and the Notion of 'Music of Technology'

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RESHAPING THE MUSICAL EXPERIENCE: A CRITICAL EXAMINATION OF *MUSIQUE CONCRÈTE* AND THE NOTION OF 'MUSIC OF TECHNOLOGY'

Abstract: The critical examination in this paper should point to a shift in a perspective in understanding *musique concrète* (concrete music) in relation to its historical evaluation, viewing it as a *music of technology*. The paper is based on the hypothesis that each technology in its materiality and functionality shapes the outcomes that arise from it, which is ultimately aimed at looking for the 'human' in the 'composer-technology' dichotomy. That is where the reshaping of the musical experience takes place. But it should be noted that the technology share will be questioned through only a few aspects of concrete music, which is why there is an open possibility for further research problems.

Keywords: musique concrète, technology, music of technology, electroacoustic music, Pierre Schaeffer, musical experience.

(…) the exploitation of technology is often disguised by claims of authenticity and naturalism – camouflage designed to preserve and protect the myth of artistic inspiration.
- Peter Shapiro, *Modulations*, 2000.

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Introduction

By way of a few introductory words, it may be appropriate to refer to Jonathan Kramer's reflection on the impact of technology on musical experience in a general sense of meaning:

> (…) our conservatories and universities must train their music students to understand and respect technology, not to fear it. A young violinist may still spend countless hours alone in a practice room, improving his/her sound. But how often will that sound be heard without the intervention of recording, broadcasting, or acoustic-reinforcement technology? That violinist need not become a technological expert, but at least must learn what technology is capable of doing and how to communicate with engineers. Any musician who does not know the meaning of words like equalization, digital editing, sampling, reverberation, mixing, etc., is out of touch with his/her art and is, in a real sense, illiterate (Kramer, n.d.).

The research question from which the critical examination of *musique concrète* begins in this essay is essentially related to the intention and effort of framing a specific musicological point of view on electroacoustic music. The very style of writing indicates that the author does not try to offer any kind of answers in this paper, but rather to come up with as many questions and problems as possible that require more detailed and systematic research, and would help to explain in depth the subject of electroacoustics research, that is, *musique concrète* as an instance of type. In other words, this piecemeal research endeavor is not an "attempt to encapsulate the 'state of knowledge' of a subject field at a particular time" (Emmerson 2018, 10). Consequently, the text is woven from a series of apparent digressions that divert scientific writing into deeper-rooted problems of *musique concrète*. However, the following research issues are not self-contained nor mutually exclusive from one another; rather, those issues persistently assert themselves and prompt a critical examination of the assumptions.

The effort to introduce the term *music of technology* was motivated by the insufficient representation and reverence given to *musique concrète* in the sphere of the "official" knowledge about music in the 20th century.[2] The author assumes that this probably arose from the lack of an adequate perspective in the research of music that originates from the 'inside' of technology,[3] or there is an additional

2 This is an obvious omission from the position of authority of the Western institution of art music, especially musicology, despite the importance and impact of *musique concrète* in the 'broadened' field of music.

3 In this paper, the term "technology" primarily pertains to electroacoustic technology as *metaaparatus of communication*, with occasional references to computer technology. Certain

problem that arises in efforts to formalize *musique concrète*, since formal coherence[4] is a very important characteristic of musical composition in a traditional sense.[5] He also believes that it is necessary to offer a specific perspective – a technological one – through which we would actually observe its essence, starting points, intentions, and goals, as well as composing process, analysis, the way of (re)shaping the musical experience, finding a humanizing element in what arises 'from' technology, etc. There is an attempt to say that this is in some way a need for a (historical) re-evaluation of *musique concrète*.

Stepping into the knowledge and findings from the history of 20th-century music means stepping into a handful of paradigmatic streams and boundaries of consciousness, each of which has its own value in the artistic sense. Some of these paradigms have been accepted *cum laude* by the 'official' music history, but some have passed under the radar of the academic milieu, despite their importance and impact.[6] One such phenomenon is *musique concrète* or concrete music (both terms used interchangeably throughout the text), most likely 'disenfranchised' due to apparent naivety, undeveloped semantic system, and non-musicality in the conventional sense attributed to it. An average connoisseur of concrete music will most certainly recognize the superficiality and layman's interpretation here. Be that as it may, concrete music appears in various encyclopedias, catalogs, books, and indeed a few academic papers,[7] where it often receives piety and recognition for its pioneering merits in electroacoustics,

concepts mentioned in the paper can be explicitly understood within the context of 20th-century technologies that played a significant role in the emergence and evolution of *musique concrète* (for further details, refer to Schaeffer 2017). Due to methodological considerations, the author chooses not to provide an exact definition of the specific types of technology (even in the operational sense, be it memory, reproduction, analysis, or any other), as doing so would necessitate a separate discussion. Alternatively, the title itself would serve to guide the research in that particular direction.

4 "(…) [formal] coherence manifests itself as a limitation in the choice of compositional materials and a consistency in the operations applied to those materials. (…) music is not a purely formal system; rather, it is grounded in acoustics, auditory perception, and psychology. Musical coherence seems to be a poorly understood psychological category. (…) [An algorithmic] approach [to music] make for a tidy package, free from anomalies and logical inconsistencies. The compositions it produces can be proven to be formally consistent, even if they are dull or incomprehensible" (Roads 2015, 21; cf. Ibid., 64–5).

5 In this sentence, among others, there is a justification for the research of this kind. Could it be that *musique concrète* lost its historical 'battle' in academic circles based on a forced attempt to formalize it as such?

6 A similar observation can be found in Valiquet 2018, 98.

7 As excellent examples of valuable academic understanding of concrete music, the author of this article recommends other authors' writings on this topic, namely Brian Kane, Michel Chion, Carlos Palombini, Leigh Landy, and Curtis Roads, as well as the authors that can be found in the list of references at the end of the article.

although the explanations and discussions are very modest.[8] Therefore, the critical point of view taken in this paper will serve in part as an attempt to correct this omission of music history, at least to a lesser extent.

How and why does concrete music begin from the 'inside' of technology?

Although technology by itself is perceived as socially neutral, the appearance of each of its subsequent types increasingly determines all kinds of our life actions and ways of living. According to Social Construction of Technology (SCOT) foundations, technology represents some kind of working framework or "frame with respect to technology" (Klein et al. 2002, 31, as cited in Bijker 1995, 126) and implicitly determines limits and possibilities, both in work and in life,[9] which is directly reflected in the reshaping of different cultural matrices and ways of behaving.

The narrative of technology as a kind of ideological force within the field of electroacoustics, and causally *musique concrète*, should begin with the assumption that a technological artwork[10] – visual as well as auditory – can legitimately exist. Such thinking is motivated by the thought that the history of music over the past hundred years and so is mainly the history of technology (Shapiro 2000, 2; Rebelo et al. 2018, 139). In support of that, we could note that technology was and still is a fundament for most of the paradigms in music.[11] The 20th-century artistic music will serve as good proof for that claim. Various aesthetic goals of contemporary music, i.e., electroacoustic and electronic music composition as an artistic activity in a large number of cases appeared, progressed, and died out with the appearance of each new technology (Valiquet 2018, 98); most of the old, entrenched paradigms were replaced by new ones, and the science behind each subsequent technology ensured the survival of those paradigms that were potentially good enough for further artistic (or technological?) research and refinement.

8 For an introduction to the topic, see Schaeffer 1986. For more precise insights and discussion, see Battier 2007.

9 In this kind of question, it is useful to consider the variegated views in the dichotomy of technological determinism and the social construction of technology, set forth in Yousefikhah 2017, 32–34.

10 In this context, the term "technological artwork" refers to a work that exists as an instance of a type in digital art, but also in general to a work inspired by the drive of technology. For a more detailed insight, see Cecchetto 2008.

11 For a more comprehensive examination of the historical portrayal of the evolution of technology and art, refer to Mikić 2004, 39–63. Also see Holmes 2008; Katz 2004; cf. Cunningham et al. 2017.

So, how is it possible that *musique concrète* as an artistic practice rests on technology? This problem is addressed by David Cecchetto's statement (which will serve as a basis for further considerations here), although directed towards the explanation of a technological artwork:

> The technological artwork can be understood as particularly powerful in this respect, then, because a computer [as well as other types of technology] des not [sic!] carry the enormously (and complexly) rooted history that, for example, a violin does. In the absence of this history and its rituals, then, the mode of presentation enacted by this work is emphasized because it is chosen rather than assumed. As such, these choices are made both in terms of content and of context, leaving the technological artwork (perhaps) uniquely positioned to enact the political reality of it's choosing (Cecchetto 2008, 17).

The critical use of technology can be an excellent starting point for research of any kind. This is because, for example, electronic components or computers do not include any kind of prejudice or conventional systems of values and belief (cultural, emotional, aesthetic, political, religious, moral, etc.). As Ian Andrews states, "an investigative starting point free of such prejudices is said to be *presuppositionless*" (Andrews 2013, 69). In other words, again and again, we choose the position from which we observe technology,[12] which clearly alludes to the phenomenological character and such research methodology.

Aside from the common knowledge of the well-worn story about the benefits of using technology (see Rebelo et al. 2018, 140), its technical aspects and the benefits of using it, the epithet of powerful tools and the possibility of ease at work, speaking from a scientific-and-artistic research position – the one that seeks a 'perfect' unprejudiced zero point for research – we will potentially be able to understand why concrete music starts *from the depths* of technology.[13,14] This is quite obvious since concrete music appeared in the mid-20th century, i.e.,

12 In addition, it would be helpful to know that "if we cannot analytically distinguish between context and content (technology), then it is impossible, even in a tentative way, to understand how the social world shapes (the meaning of) artifacts" (Klein et al. 2002, 36).

13 In this regard, we should consider this view: "The first act of 'relaying' by the concrete musician is related to the machine. It suggests, by virtue of its arrangement and its functions, possibilities of actions related to a given real-world sound, such as is its recording. (…) It is here that we interpose the idea of reinvention: throughout the twentieth century the artist has shown how he can transform the machine into a basis for creation. When the gramophone changed its status from being an apparatus for reproduction to an instrument of production, an artist has, by thought or deed, reinvented the apparatus" (Battier 2007, 195).

14 The integration of technology into the process of observations is paramount for the study of concrete music (as well as *elektronische Musik* and computer music). As Chagas discusses, "(…) [in the observing process] technology itself becomes an observer. The observer 'is characterized by being able to make descriptions'" (Chagas 2014, 134, as cited in Foerster 2003, 283).

in the midst of the expansion of analog technology for recording and manipulating audio signals. To cut a long story short, without technology as a research and operating platform, concrete music cannot exist[15] (the statement includes electroacoustics and electronic music in a broader sense as well).

Semantic and aesthetic aspects of using technology in concrete music

In concrete music, there is not a single sound event or a sound object that exists by 'itself', i.e., nothing happens without symbolic thinking. Every element in a concrete piece should be there for a reason. This is also the case with various instances of *call-it-so* abstract contemporary music, e.g., (post)spectralism, (post)serialism, (post)minimalism, new complexity, etc. However, each of the aforementioned practices is set up at some level of compositional calculation or determination which is superior to a material for the purpose of planning and building the process of encrypting musical thought, that is, for the establishment of some kind of form.

The aggravating circumstance for this type of musical thought characteristic of concrete music is not so much contained in symbolic thinking itself, but rather it is actually the problem of applying symbolic thinking in the phase of analysis (just listening or subsequent theoretical conclusions) which, according to high-brow artistic customs, should respect the existence and legitimacy of a musical work that has no conventional type of score. Difficulties in the analytical approach to electroacoustic music arise due to the untranslatability of meanings, processes, and strategies into another context (Caesar 1992, 32), which is very often scaled with culturally accepted meanings.

Despite sporadic instances of divided academic opinion on the increasingly complicated issue of (limited) usage of technology in music,[16] as well as the conventional perspective that *tool*, also known as *technology*, should not have a significant function in musical composition, and that 'what a composer brings to a tool' is important,[17] electroacoustic music actually indicates that technology leaves a noticeable mark on artistic strategies. But what is really causing the problem here? Conventional opinion most likely originates from attempts to

15 For a more detailed insight, see Schaeffer 2017, 69, 321–339.

16 It could be assumed that this is a historical problem that probably originates from the 1950s, i.e., from the aesthetic 'gap' between the *elektronische Musik* and *musique concrète* (Chagas 2014, 108-9; cf. Rebelo et al. 2018, 139–40).

17 "(…) the history of artificial music is more deeply rooted in composer's opinion and aesthetic ideals than in technological data – even in the field of electronic music (…)" (Danuser 1984).

'translate' and (re)contextualize the system of relations and meanings of electroacoustics (see next section) to the principles of acoustic music. Such endeavors are simply pointless since the history of music, as well as aesthetics, lead to the thinking perspective that these two 'poles' of music have very little in common. To an average, but also classically trained listener, intentions of acoustic music are much clearer than intentions of electroacoustics; we receive and understand instrumental sound sources in combination with technical aspects of a particular work as data or information, since the instrumentation is very limited in relation to the totality of all possible existing sounds, and, on the other hand, different composing techniques and strategies have been codified within the centuries-old tradition of classical abstract music.[18]

In contrast to acoustic music, the compositional strategy of 'listening' with acousmatic intention (see Chagas 2014, 128; cf. Schaeffer 2017, 69) – which is imposed by the nature of concrete music – fundamentally deals with the problem of recontextualizing the sound object in the musical sense (Bayle 1997, 17). A trained listener will potentially be clear about a sound source, although one will not expect it in a given listening context. Defining a meaning of a compositional process for a listener is presented as an intimate process, since a listener himself is expected to reconstruct any explanation for the 'sequences' of sound/musical objects he listens to in real-time, even immediately afterward. The very idea of the possibility of composing electroacoustic music as such already transcends conventional musical ideas. A very idea and an extensive set of possible composing actions in electroacoustics dismiss the view of music as an architectural entity with different measurable quanta in traditional parameters.[19] In fact, a certain idea in concrete music is based on the principle of organic development and the continuous flow of sound material in time. Therefore, "it is a discourse at the level of perception, not a concept" (Brümmer et al. 2001, 8) in which we find ourselves in the acousmatic problem of continuous 'rationing' acoustic/musical elements, attempts to distinguish sound sources, interpretations of mimesis, references, meaning, and semantic allusion (Roads 2015, 85, as cited in Barret 1997 and Bodin 2004). So, a listener has a very specific task: to clarify and explain to himself what he hears and what it means for him; there is no unified system of meaning, at least not yet.[20]

18 About the 'fashion' of individual and historical styles, this story deserves a different form of discussion, but that kind of detailing is not necessarily needed here.

19 "In traditional Western music, the note is like a brick – a basic building block of musical structure" (Roads 2015, 72).

20 The author finds a motive for such a point of view in the typological and morphological systematization, that is, the classification of sound objects, which he found in the writings of Pierre Schaeffer (see Schaeffer 2017, Books Five and Six).

Although it seems that electroacoustics, especially *musique concrète*, lacks inventiveness,[21] it is essentially no less inventive than instrumental music composed *in a score*. A concrete piece finds impetus in a composer's skills and experience with studio equipment and certain suggestive characteristics of 'raw' sound as a material.[22] A layered process of composing results in an electroacoustic piece that could offer a listener a more precise compositional intention, especially if one takes into account the advantage of direct intervention on a musical 'text', as well as feedback received through multiple listens to a piece during a composing process.[23] From the technical aspect, the above should convey to us the extent to which (equally or even more) a concrete music composer is involved in the *symbolic explanation* of work in the same way as a composer of any other musical genre, whether it is historical or not.

The fact is that concrete music and electroacoustics in general leave a listener indifferent if he tries to translate the experience into one of the other musical languages, systems, or aesthetics. This is because technology-born music requires its own 'grammatical' determinants – syntax, vocabulary content, methods, and outcomes that match its materiality and functionality. Consequently, in concrete music there is no systematic, unified, or prescribed approach for the analysis of such works;[24] each work is *new*, it is a language for itself and contains universal characteristics and parameters, so the analytical approach should be entirely

21 Interpreting this statement from a historical perspective, very likely one of the interpretations would be that this was usually the case in certain academic 'turmoils', often originated by composers or advocates of various genre trends in electroacoustic music of the 20th century. Among others, those are examples like Jean-Claude Risset's criticism of concrete music as compared to early computer music (Chagas 2014, 133-4, as cited in Risset 1990, 108), the allegation by Pierre Boulez about condemning concrete music and acousmaticians to failure due to his own unsuccessful 'concrete' etudes (Roads 2015, 71; Ross 2007, 279-80), or Boulez's determination to prevent (by what means?) the use of personal computer technologies for generative purposes in compositional processes (Taruskin 2010, 495, as cited in Jameux 1984, 18-20). The latter is quite a paradoxical point of view, especially bearing in mind the 'technological legacy' of IRCAM, whose founder was Boulez himself.

22 "Schaeffer also meant the term 'concrete' to refer to a studio-oriented manner of composition based on interaction with specific tools. (…) Since concrete sound depends on recording [that is – technology!], it follows that the audio quality depends greatly on the resolution of the recording chain (microphones, preamplifiers, and the recording medium). Equally important is the technique of the sound engineer" (Roads 2015, 80).

23 This indicates that the *trial-and-error* method is one of the main methodologies in composing *musique concrète*.

24 For example, François Delalande addressed these questions relating to listener responses and differentiated them as "taxonomic (distinction of key morphological units to acquire a synoptic sense of the work), empathic (attention to individually felt sensations and experience of sound dynamic), and figurativist (interpretation of the sound work as a narrative) and/or as mixes of these elements." Sally Jane Norman adds the ability of human organs to be answerable to unruly amalgams of habits, expectations, and aspirations (Norman 2018, 210).

analogous to that. Analytical procedures still do not represent a tool with which one could approach the systematization of electroacoustics in the narrower and broader sense; even the very description of the work depends on its character and fails to 'extract' and apply earlier levels of knowledge.

In general, what holds value for individuals is often deeply interconnected with meaning. But our understanding of 'meanings' is not just a projection of our values. This can be explained using the example of a sound object in concrete music. The 'feeling' evoked in a person who listens actually already exists as part of a sound object, thanks to its shape, i.e., its morphology (Bayle 1997, 17). It is about taking a purely phenomenological perspective in practice. On the other hand, the 'attractiveness' of the visual in relation to the auditory is psychologically imposed as dominant; certain visual cues are archetypes naturally appealing to our eye. Although in the sense of sound as a unique, (un)repeatable energy and time-space event, the *contour* of a sound is in a psychological sense (sometimes also psychoacoustically) positioned as a 'support' for meaning, which will ultimately determine its potential function.[25] Concrete music, among other things, deals with the research of morphological characteristics of sound in the context of musical composition, and with the assistance of computers, the research process is somewhat easier; according to a more precise visual representation of audio signals through various software tools, we will be able to explain things more easily and more precisely. Perhaps it would be wise to perceive concrete music in a general semantic sense as a chain process of *research – modification – composition – (auditory) re-research* applied to the morphology of sound events or objects that have a specific aesthetic purpose.

Works of concrete music, just like those organized according to the aesthetics of relative silence, are particularly operative in such a way that they leave enough interpretive sonic space in which a listener, as a listening *self*, can confront himself as a listener (Philips 2006, 233). With this, we step on a path of a humanizing element in the *music of technology* (see next section). The search for each unique subjectivity of listeners and composers is consciously encouraged. With that in mind, can we perceive music as a language? Probably not. Music, both in the most conventional and the most modern sense, is essentially a *game of relations* (see Minsky et al. 1992 32–33) in which everything depends on a chronology of cause and effect(s). Thereby, it is not possible to establish or systematize the objective spectrum of meaning of musical elements nor parameters, and then the possibility of defining an 'agreed' system of meaning in the communication chain between a composer, a listener-individual, and concrete works certainly suffers.

25 The stated point of view can only be considered through the use of technology for recording, reproduction, and analysis of audio signals, since in *laboratory* conditions sound as such becomes the object of study.

A perfect fourth interval, a dissonant orchestral chord, pizzicato passages, or a piano pedal tone, just like a raw or modified sound object in electroacoustics, simply do not have the potential to 'say' something accurately (see Huron 2006), concretely, and objectively comprehensible in the chain of communication. This is their artistic significance and usability at the level of materials. In contrast, language operates with signs and meaning in all its aspects. Also, it is extremely functional in terms of realizing meaning in communication; there is a basis, an 'agreed' spectrum of meaning that facilitates the understanding of each piece of information. Practically speaking, if communication is successful and a message is received, a language will be a semantically functional system. In most cases, various aspects of a concrete or abstract piece of music fail to reach this.

According to the pioneering concrete works, as well as post-Schaefferian trends in electroacoustics, we see that composers of concrete music are/were fully aware of this endlessly entangled semantic problem, just like the fact that communication cannot be one-sided. However, we will notice another solution; the only functional solution at the semantic level is brought into the process of evolution from the *art of composing music* to the inspiring *art of listening to sounds* initiated from a composer-insider to a listener-outsider. In conclusion, we pretend to say that in concrete works it is absolutely impossible that the levels of understanding of a 'message' are not uncertain.

Why *Music of Technology* and does technology even matter?

The origin of the term *music of technology* follows the path of defining the object of music as "music that exists because of the use of electronics rather than music that simply uses electronics" (Valiquet 2018, 98, as cited in Holmes 2008). In order to avoid doubts about why the author takes a one-sided attitude towards *musique concrète*, omitting or not specifying other (sub)genres of electroacoustics, it is necessary to emphasize that the principles explained in this paper are very applicable to the entire field of electroacoustics as such.

The term *music of technology* does not solely encompass "music made with technology" (see Emmerson 2018, 10), as it extends beyond the production aspect. By refining the definition, we could include that the genuine essence of thought in *musique concrète* (and hence electroacoustic music) becomes discernible through technology. It is worth noting that there are several key areas where technology proves to be valuable as "access points" (as issued in the following sections); it is crucial to recognize that the compositional process is not the sole aspect to consider.

Musique concrète starts from what a sound itself has to 'say' (see Chagas 2014, 122–3), which becomes an associative instruction for research. That means that

the 'concrete' method is empirical; in a processual sense, the empiricism starts from *found sounds* and "moves toward a musical macrostructure using available tools" (Roads 2015, 80). A detailed insight into the properties of a sound (object) can only be obtained with the technology, and for the kind of research required by concrete music, we really need an in-depth, *probe-like* approach to sound properties at the micro level.[26] Only electroacoustic technologies, as well as computer ones, will enable us to do this, and there is no different way.[27] In relation to the variety of compositional material (more or less everything musical or non-musical we hear in our surroundings), a composer of concrete music *discovered* something that we could presumably find or hear elsewhere – but in a much 'rawer' and 'rougher' form, i.e., in the form of a sound object as it *is*[28] – and then using adequate technological procedures recontextualized it from its 'natural habitat' into a musical object that becomes an integral part of a musical work.[29]

In an effort to begin from a zero point of research which, as stated, should be presuppositionless, concrete music places all its objective power and potential usability on machines. Since it was driven by the power of technology, we can discuss some kind of *symbiotic* relationship between music and machines. A process of planning, recording, listening, inspecting sonological properties, multidimensional analytical examination of the suggestiveness of sound as material and its characteristics, and on the other hand manipulation, modulation, mixing, and organizing processes, all the way to reproduction and spatialization – everything is being supported by technology in one form or another.[30] Causally, the question arises, what is happening at the edges of technology, i.e., in

26 Concrete music, as described by Curtis Roads, is distinguished by its emphasis on "hyperrealism and magnification" of sounds, which is often perceived as a process of "sound zooming". Roads defines *hyperreal magnification* as "the exaggeration of feeble sounds for expressive effect. This is analogous to the blowup technique in photography, which greatly magnifies a detail of an image" (Roads 2015, 86).

27 A related issue from an ontological perspective of 'authentic sound' is addressed in Bohlman 2000, 32.

28 Many useful insights on this subject, as well as insights into the philosophical and aesthetic foundation that underlies acousmatic music, can be derived from Kane 2014 (cf. Roads 2015, 85).

29 This can be observed in an early example of concrete music in Pierre Henry's *Variations pour une porte et un soupir* (1963).

30 The fact that each of the mentioned composition–engineering steps (and there are many more!) in working with sound has become a separate field of study with a distinct stage of scientific and practical discipline speaks volumes about the potential of using concrete music as an artistic practice in the sphere of applied music and industry.

the instance that exceeds the boundaries of user experience?[31,32] The answer to that apparently simple question is what concrete music deals with, among other things.

In the realm of aesthetics of *musique concrète* (see previous section), the research of different sound properties by various techniques of isolating sounds is just one of many aspects and broader solutions. By developing notions such as sound objects or sound events as analytical and synthetic categories resulting from the interaction between sound material and technical apparatuses (Chagas 2014, 107), *music of technology* presents a comprehensive approach that allows for diverse possibilities in sound exploration, manipulation, analysis, listening, musicalizing (very often something non-musical, such as different types of noise), composing music, (re)contextualization of sound objects/events and (re) shaping the musical experience[33] for the purpose of establishing meaning(s) for each listener, and the like.

In light of the previous discussion, defining concrete (electroacoustic) music as *music of technology* at its core would signify that it emerges from the utilization of machines (see ibid, 124). The significance of technological mediation cannot be overstated, as it plays a crucial role in shaping an environment where specific tools give rise to a wide range of possibilities and foster exploration that goes beyond traditional boundaries. The pros and cons of technology depend strictly on the user's intention, experience, and way of dealing with it. However, in the domain of electroacoustic music, technology is just as important as the artistic or research thread of music itself.

31 For more on user experience, tacit knowledge, and participatory design, see Tanaka et al. 2018, 173.

32 At the time of writing, the author does not know the precise definition of "edges of technology" from a scientific point of view. One possible interpretation could be that "edges of technology" are everything that in one way or another exceed the stated norms, and by its nature (mostly intimate and very difficult to explain) belongs to tacit knowledge in electroacoustics. Also, one should bear in mind that the "edges of technologies" could be examined from semantic complexities intertwined with technological advancements. In the interpretation of "edges of technology", one should pay attention to "(…) three domains of technological frames: 1) Nature of technology, that implies on the image of technology and its capabilities and functions in the minds of users, 2) Technology strategy, that is the motivation or vision behind implementation of that technology, 3) Technology in use, that refers to understanding of how to use the technology on day to day basis" (Yousefikhah 2017, 37, as cited in Bartis 2007, 129).

33 Various terms, such as acousmatics, different types of listening modes (see Schaeffer 2017) or ways of dealing with mimesis (could be connected with expanded sonic imagination), reproduction technology, immersive and spatial experience (multidimensional sonic environments), etc., are included here.

Is there a 'humanizing element' when working with technology?

> Electronic machines and computer science guarantee hitherto unimaginable power, precision, and opportunities. But all sensory relationship between man and instrument has disappeared. From musical conception to musical production there is now nothing but causal relationships, which we must *understand* to control. (…) the workings of a machine are always comprehensible. Is this true of the workings of music? (Schaeffer 2017, 546).

If we operate with digital or digitized data, the computer will serve us as a tool for editing data and adding effects that are in no way possible with analog technology.[34,35] But the fact that both analog and digital technology are not linear means that material can be edited or reproduced from any point in (virtual) time-space, regardless of the beginning or end of the *tape*. In other words, the phenomenon of non-linearity is the most important humanizing factor. However, it should be noted that the sequential mode of operation of digital technology is essentially linear in most cases during the execution process, while the 'humanizing' element in the sense of non-linearity belongs to the user's work process.

Facing the reality of technology is the fact that, at least for now, it is constantly evolving. Accordingly, composers and scholars should be aware of the limitations and possibilities of the technology[36] they work with or own. Within the operating technological 'corpuses' or their own framework, user-composers give meaning to the product that they are using (Yousefikhah 2017, 36).[37] Awareness of these issues and problems will define the specifics of music composed with a specific technology, so each "piece of equipment" will leave a unique mark on the piece of music. We cannot really talk about this if we question classical

34 For more precise information about the principles and techniques of composing music with an analog tape, see Russell-Hallowell 2019. The same principles and techniques are very easy to achieve using digital technology.

35 The sudden transition of the author's thoughts to digital technology should not be seen as an intention to specify or determine technology but as an attempt to explain the studied (musical) phenomena that originate from the 'inside' of technology. Based on this, the author tries to set as many questions or problems as possible for more focused research. The story of the type of technology being studied, just like what was gained/lost by the transition from analog to digital or something else, deserves a different kind of discussion.

36 François Bayle shares a similar sentiment: "We should not be afraid of imperfect technology. It is often the confrontation with limitations and "faults" that stimulate one in making a piece. I am not alone in this view" (Bayle 1997, 18).

37 This can be observed and determined on various domains and meanings, considering elements such as "goals, key problems, problem-solving strategies, theories in hand, tacit knowledge, design methods, etc." (Yousefikhah 2017, 36, as cited in Bijker 1995).

(or abstract) acoustic music. The aesthetic vision derives directly from practice, leaving idealistic philosophy aside. A true understanding of the technology used will enable the composer to assess the 'correct' evolutionary steps in the processes of electroacoustic music. Theodor Adorno also warned about the problem of senseless, i.e., uncritical use of technology in modes in which it becomes objectively powerful. The question of its (un)usefulness in art is still a burning question today, primarily because of its distribution in all aspects of life. However, the mannerisms of a machine devoid of any kind of utility only emphasize its uselessness in the midst of universal utility (Adorno 1988, 109). In other words, from the unconscious and biased interpretation of the role of machines in the composition of contemporary artistic music, composers will get a 'useless' result, precisely the kind for which numerous later artistic discourses attributed the blame to romanticism, and triumphed on the basis of that. A special aesthetic task when composing in most cases is the "humanization of a piece of music", that is, the task of a composer of electroacoustic music is to control the machine to the level of achieving the highest *human* result. In the golden age of analog and early digital machines, Daphne Oram (1925) had these perspectives:

> By 'human' in this context I do not mean that the sound must ape a human voice, or ape an instrument played by a human being. I mean that there are certain human qualities which are difficult to convey by electronic machines. Machines, at their present stage of evolution, do not appear to be designed for conveying this humanizing element. It is this humanizing element which (…) enables individuality to become apparent and express itself (…) (Oram 1972, 93).

Applied to the modern world, looking at digital machines as tools that need to be (pre)programmed over and over again in order to get a result, it is noticeable that even modern machines lack a humanizing element.[38] At this point, one should slow down and change the way of seeing things, while taking into account the historical immediacy of Oram's words. However, there is another side of the story – the digital natives' one.[39] Observing the current situation through the prism of democratization,[40] and consequently individualization in accessing technology, artistic and research thinking supported by in-depth knowledge of hardware and software can bypass this situation and *shift* the humanizing element to the foreground through unconventional and *not-quite-machine* proce-

38 A related issue is addressed in Chagas 2014, 110–11, focusing on the relationship between creativity and technology as an important research field of electroacoustic music. Also see Emmerson 2018, 9.

39 A well-described and vivid example of how digital natives relate to technology can be found in Milojković 2020, 284–334.

40 For a more detailed examination of technological changes, progress, democratization, innovation, and adding political values to technology, see Valiquet 2018, 108.

dures and operations. Nothing can be perfect; it is a human artifact (see Norman 2018, 210, as cited in Vaccari and Barnet 2009, 10) because it is in man's nature to be imperfect. In this way, we will be drawn into the discussion about whether man can really progress with technology and, if so, whether progress is guaranteed. But nothing is black or white; it is all about layers and nuances.[41,42] In relation to the pioneers of electroacoustic music from the 1940s and 1950s, and the knowledge, very limited recording and studio equipment, and *primitive* skills they had at their disposal at the time, we could probably determine that contemporary composers already by default possess a certain set of advanced or expert skills that enable the use of technology that exceeds the boundaries of user experience. Most of them are already digital natives according to their own environment in which they develop and operate. Therefore, for successful realization of an artistic vision, machines must be explicitly viewed as a very limited synthesis of means, media, and tools. Otherwise, the means, tools, and medium will be the ones dictating the way of composing. By avoiding unenviable situations, the composer shows his individuality. The process of composing becomes challenging due to the fact that each machine, piece of equipment, hardware, or software requires a new research approach with the aim of finding enough space to identify the humanizing element in a technological artwork. Ultimately, the question arises: what can we do with a certain technology? A professional composer who programs a machine knows exactly what result he can expect based on the input; therefore, he can use technology to express his idea as clearly as possible, which further depends on one's character and intention.

This is where the digression should begin. It is necessary to refer to some kind of non-linearity of sound objects, on the basis of which the technological *design* of concrete music will be explained, and at the same time to see how all the above works in practice. Namely, the non-linearity of objects as compositional material and *fragments of perception* does not refer to the position of an object and its 'accessibility' in technological time-space, but to the change in

41 The modest history and index of composers of concrete music actually prove that man can progress if *fused* with technology – progress as a unique 'symbiotic organism'. This does not necessarily imply transhumanist ideals, but rather refers to a natural progression of a man-technologist-composer. However, accepting the imperfections and surprisingly narrow frameworks of machines is the right path to a piece of concrete music. In that sense, François Bayle expresses thoughts of exceptional importance for the scientific interpretation of the *music of technology*. Quote: "Most composers of *musique concrète* are stimulated by what happens at the frayed edges of the technology. This is important. If we adopted a Boulezian attitude, we would say that defects are inadmissible. Upon their discovery, we would call the management and throw out the technician. If your attitude toward defects is punitive, then you cannot continue" (Bayle 1997, 18).

42 "Technology not only allows and encourages extension – it becomes a manifestation of that extension" (Emmerson 2018, 11). This statement by Simon Emmerson – although from a different perspective – supports Bayle's view quoted in footnote 21.

psychological perception of sound in the context of a complete piece of music with each new listening. Relying on his theory about sound and musical objects, natural/innate perception of sound qualities, and 'learned' cultural criteria for the process of listening to music, Pierre Schaeffer (1942–1990), after many years of interdisciplinary research,[43] considered:

> Another misunderstanding would be to expect typology [of sound objects] to provide fool-proof boxes in which sounds could be classified once and for all. It must be stated emphatically that a sound-object may very well jump from one box to another according to the degree of attention with which we listen to it, and the degree of complexity conferred upon it by its context. This remark will avoid many useless discussions and time-wasting (Caesar 1992, 12–13 after Schaeffer 1967, Face VI, section 88).

On the other hand, the manipulation of sound objects will often give a non-linear result that needs to be contextualized within the musical composition. With digital technology in his work environment, the composer is able to multiply processes that take place simultaneously, that is, to layer effects or sound events. In software, this most often looks like a series of vertical layers applied to a horizontal structure of sound events. The multiplication of simultaneous processes within one sound object will ultimately give a unique sound event. Expressed in the language of mathematics and its derivates, non-linearity is defined by the fact that the change in the output is not proportional to the changes in the input, but is directed towards the aesthetic goal and raising the usability potential of a sound object as a *fragment of perception* in an artistic sense.

The digression ends. Based on the above, we see that the logic of music composition based on recorded material leads a composer to the inevitable situation of 'outsmarting the machine' because the technology by itself does not exist as a 'generator' of (musical) language. At whatever stage of development it is – now critically speaking – a machine should always be perceived as an assistant, not a leader. A composer's role is to manage the process, and that can often be very demanding since compositional processes (as well as composing processes) in electroacoustics often require an interdisciplinary approach[44] due to their complexity, whether the outcome is tape or live music interpretation.

43 The outcomes of Schaeffer's research can be found in his Treatise, see Schaeffer 2017 for more.

44 The term 'interdisciplinary' means that a composer will very often simultaneously use skills and knowledge from completely separate disciplines, such as music composition (often as a primary discipline), music production and industry, sound design, computing and programming (not necessarily music only), sonology and (psycho)acoustics, audio engineering, physics, knowledge of video technologies and the like, but also disciplines that do not necessarily have limitations in professional qualifications (e.g., DIY and similar 'adaptive' concepts).

The following statement by Pierre Schaeffer points to the 'composer-technology' dichotomy: "Electroacoustic systems are powerful, but they are not musical instruments; they are sound machines. And before putting questions to the computer, we must know what we ourselves think" (Schaeffer 2017, 555). We will take the first quoted sentence with a certain historical distance and worldview since the expansion of PCs as very powerful technologies in line with postmodernist ideas will only begin about 30 years later. But this is the point; prejudices that identify studio equipment with an instrumental corps can become an enormous obstacle for music composition. In this sense, a composer's most common problems are technological ignorance and failure to recognize the non-linear response of technology. And why would that even be a problem, at least in a practical sense? Well, in this case, a composer relies on the 'machine as an instrument' and misses out on what could be used as a tool for unique artwork. There is an example of this already in the pioneering days of electronic music in the narrow sense (so-called *Elektronische Musik*). Here, one appeals to one-sidedness in understanding music composition, melting from concept to concept on the basis of material and structure, and ignoring the basic principles that technology 'imposed' on music as art – invention, and discovery.[45] Ultimately, the intention to act between invention and discovery – both in the technical and musical sense – is essentially a consequence of critical understanding that a composer's work in the domain of electroacoustics can only develop as long as the keyword 'experiment' is focused, and with the aim of finding what is primordially human, not technological. The condition for invention is the art of finding the 'new', and in the context of electroacoustic music, this depends entirely on the composer's ability to use technology as a means, tool, or medium to cohere invention and discovery with changing concepts such as material and structure.

45 In particular, the aesthetics of Karlheinz Stockhausen and the team gathered under the WDR Electronic studio label is questioned here. The reason why Stockhausen took serialist principles and *mapped* them to electronic 'experiments' (in the partial sense of the word) is potentially debatable. Just listen to what happens in his *Studies* (1953 and 1954) – is that music really *electronic* or can we still discuss the *acousticity* of that music on the basis of the compositional strategies and processes taken over from serialist legacies? And why is it even important? Perhaps it can be a problem that remained unsolved at the very beginning, so it is often considered that electronic music is going through a crisis even today – this could also be discussed. It's a matter of genesis.

Concluding remarks

Considering the assumption that there exists a domain *beyond the sound*, which represents the fundamental investigative problem of *musique concrète*, any approach to that domain necessitates the intervention of technology. This recognition led to the coinage of the term *music of technology*, aligning with the underlying justification for *musique concrète* as an artistic practice that originates *from the depths* of technology. The notion of *music of technology* addresses more than just music produced with technology; it signifies a deeper connection between thought, sound, and technology, i.e., it broadens the scope of sound exploration and it could help provide meanings for individual listeners. Ultimately, the term reflects the inherent functionality and essence of concrete music, highlighting its symbiotic relationship with technology.

In conclusion, it is almost imperative to adopt a specific technological perspective in order to gain insights into the essence, origins, intentions, and objectives of concrete music. This perspective, among others, allows us to examine the composition process, analyze the (re)shaping of musical experiences, and identify the humanizing elements that emerge from the utilization of technology. By embracing this technological 'lens', there arises a need for a historical reassessment of *musique concrète* and electroacoustic music in general, which can provide a deeper understanding of its musicality, significance, and the profound impact which passed 'under the radar' of the authorities of art music. This reevaluation only superficially delves into the early stages of the notion of *music of technology* and provides a nuanced perspective on the artistic and cultural value of *musique concrète*.

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RESHAPING THE MUSICAL EXPERIENCE: A CRITICAL EXAMINATION OF *MUSIQUE CONCRÈTE* AND THE NOTION OF 'MUSIC OF TECHNOLOGY' (summary)

This paper critically examines *musique concrète* and proposes the notion of *music of technology* as a means to address the existing limitations in understanding and representing *musique concrète* within the 'official' knowledge of music.

Concrete music, as well as electroacoustics and electronic music in a broader sense, places its objective power and potential usability on machines, leading to a symbiotic relationship between man and technology. Therefore, the author explores the compositional process, aesthetic and technological aspects of *musique concrète*, emphasizing the interplay between music and machines.

Concrete music explores what happens at the 'edges' of technology, delving into the semantic complexities intertwined with technological advancements. Composers of such music are aware of the intricate nature of communication and the inherent uncertainties in conveying a message. As technology continues to evolve, composers and scholars must be conscious of its limitations and possibilities. The specifics of music composed with a particular technology are defined by understanding and addressing these issues.

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