Reconceptualizing Sound in Various Forms: The Impact of Recording and Playback Technologies

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Abstract

This paper explores the evolving definitions of music by examining how technological advancements and experimental approaches have influenced sound organization. Beginning with the Pythagorean tuning system and the role of tempered scales, the study critiques the historical constraints imposed by Western music theory. The perspectives of John Cage and Trevor Wishart challenge traditional notions of musicality, advocating for the inclusion of all sounds as potential musical materials. The paper further discusses how electronic and recording technologies have expanded compositional possibilities, shifting the roles of composers and performers. The concept of acousmatic sound, as proposed by Pierre Schaeffer, is analyzed in relation to the separation of sound from its source, redefining listening practices. Through an examination of musical notation, sound reproduction, and contemporary experimental techniques, this study aims to uncover how the act of composing has transcended conventional boundaries, leading to a more inclusive and fluid understanding of music.

Keywords: music definition, experimental sound, tempered scales, electronic music, acousmatic sound, sound recording, composition, musical notation

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Introduction

What defines any possible combination of sounding things as music? In ancient Greece, Pythagoras discovered the relationship between the frequency of objects and their size. The ratio of sizes affects the resulting sound when comparing two sounding objects.[1] The calculation of these ratios reveals musical intervals, which eventually led to the development of tempered scales, adjusted according to a tuning system called “Pythagorean Tuning.” Most eighteenth- and nineteenth-century instruments in Western music were tuned accordingly.

The term "composer" is controversial; however, it generally refers to the organization of various combinations of notes to create a musical composition. In that case, music can be defined as the structured arrangement of sounds according to tempered systems. However, based on this definition, a distinction must exist between musical and non-musical sounds. According to Cage, every possible sound around us is musical and constitutes music (Cage, 1961). His notion that “everything” is music rejects the hierarchical separation between tempered tones and other sounds.

Musical scales, regardless of where or how they developed, typically consist of a finite set of notes. As the name suggests, a scale is structured around specific ratios, meaning that the notes within any given scale inherently fit within the framework of musical composition. As Wishart indicates, conventional music theories rely on finite sets of notes, fixed tempos, and the specific distribution of instruments according to their timbral characteristics (Wishart, 1996).

[1] Oliver Lugg. (2021, April 23). *How Pythagoras Broke Music (and how we kind of fixed it)* [Video]. YouTube. https://www.youtube.com/watch?v=EdYzqLgMmgk

What might have motivated Cage and Wishart to challenge conventional structures and definitions of music? Most sounding instruments are designed based on particular scales and tuning systems. As a result, musical instruments have historically shaped the boundaries of composition and influenced the very definition of music. Conventional composers create music within the limitations of instruments, and compositions are performed by musicians who also have human limitations. However, it should be noted that instruments themselves represent revolutionary developments in musical history.

It can be argued that musical instruments and their limitations have influenced composers and the definition of music throughout history. This may answer the question posed earlier: the technological advancements during Cage's and Wishart's lifetimes expanded sonic possibilities and blurred the rigid role of specific notes within established scales.

Out Forms of the Musical Scales

Understanding the relations among notes and their ratios is one of the conventional ways of approaching the organization of notes. These conventional music theories provide predefined compositional forms according to the harmonic rules based on tuning systems. It might seem that the definitions of music mostly constitute these forms. It should also be noted that note structures not based on a particular tuning system exist as a form of microtonality. It can be said that pushing the limitations of any sounding object also expands the forms, hence the way of composition.

As Holmes (2002) pointed out, at the end of the 19th century, several composers started questioning the equal-temperament scales, which had been used as a standard in 17th-century orchestral music. The discoveries of unconventional combinations of conventional scales, the

usage of microtonal scales, and various rhythmic structures evolved musical forms. When Wishart (1996) pointed out the finite sets of notes, he also suggested the term “lattice sonic,” which means there is no available extra movement outside the forms. Therefore, experimentation with scales and time weakens the limitations of the tempered scales.

One of the first modern composers was Erik Satie, who faced the limitations of conventional forms and understood that these forms were not compatible with creating “Impressionist” compositions(Holmes, 2002, p.30). Structural shifts in tuning systems also changed the way of making music and compositional structures, hence the composer itself. The twelve-tempered scale has a particular fundamental pitch that creates an entire tonal structure on it, which means it has a central point. The point serves as a guideline for the composer to create compositions. It is also not suitable for experimenting with the form itself when following tuning systems.

Stepping out of any central tuning system and interpreting notes differently, such as the twelve-tone technique first suggested by Josef Matthias Hauer—who described the "law of twelve tones" in a 1919 treatise—and Arnold Schoenberg, who developed twelve-tone serialism as we know it (*12 Tone Music: How to Make Music With the 12-Tone Technique*, 2021). The notion of the twelve-tone technique is that there is no central tonal point. The structure of tonality is distributed over all 12 notes. This could be the first step out of the lattice formal forms, as explained above. However, the definitions of musicality were still based on the series of notes and their combinations, not the sound itself.

On the other hand, at the end of the 19th century, the unconventional instrument called the “Telharmonium,” developed by Dr. Thaddeus Cahill, revealed the opportunity to create sounds with almost infinite pitch variations. The instrument creates sound by transforming electrical

current into vibrations(Holmes, 2002, p.33). This mechanical device showed that any possible pitch range could be produced by tweaking the lever of the device. With tempered scales, it is possible to create a set of scales with particular mathematical formulas based on specific tuning systems.

This is the essential point for experimentation with scales and sound, hence forms of music. This is because, for the first time, the instrument itself can push the boundaries of musicality. The hidden structure of the infinite spectra of sound is revealed more than ever before. The scales, which consist of sets of notes, already assign characteristics to the sound for each note and also define their roles, such as mediant, tonic, or dominant. These features also drive the harmonic architecture and create a path for compositional approaches. This is because they provide a convenient way to achieve a pleasant result as much as possible.

The attempt to reach beyond conventional forms of musicality also raises the question: “What is pleasant?” As Cage (1961) indicates, the disagreement between consonance and dissonance evolves through the debate on whether a sound is noise or so-called musical sound. Up to this point, the definitions of music seem to be confined within a particular range of frequencies and their variations according to pitch, duration, and interpretation. Numerous variations have been explored by composers and performers for a long time, ultimately leading to several repetitions that constitute musical forms. This might also serve as proof that there were no tempered scales before. It is also the result of sound experimentation. Repetition and experimentation create a sense of musical form, both in composition and listening.

If the definitions of music, and hence the role of musicians or composers, are based on notes and time organization, does that mean there was no concept of music or musicians before

conventional theories? Answering this question requires another perspective to understand musical notes as an expressive language form. If we take the role of the composer as the central point, their main aim is to combine notes and time to create a composition. Each note has its own decision and duration to be played in notation. As Wishart (1996) describes language, individual "words" have no meaning on their own. Meaning is constituted by the succession of words, forming sentences, paragraphs, etc. The meaning does not belong to the combination of letters or words themselves; rather, words contribute to people's construction of meaning.

If we take meaning as the central point, then meaning is the aim that people constitute via words. In other words, the word itself does not necessarily need to be an essential point in framing the entire structure. Thus, the conventional musical language, which consists of finite sets of notes—whether tempered equally or distributed as microtones—does not necessarily define musicality itself. Therefore, seeking definitions of music solely in sets of notes and their combinations in particular forms is insufficient. The disconnection between the musician's intention and the tools they use is more apparent in conventional music theories. It resembles a puzzle game in which the goal is to complete a final image. In strict conventional music theories, each puzzle piece has a specific shape and only one proper place to fit, making it possible to complete the entire image in only one way. This metaphor represents the inflexibility of finite sets of notes in composing within conventional music theories.

The essential point here is that the roles and meanings assigned to notes in finite scales define the entire compositional structure, as well as the composer and musician. To elaborate on these considerations regarding the role of notes, it is better to approach notes as sound material. However, notes as sound material dominate the compositional structure and meaning, at least within formalized music. The critique I suggest here is that the roles of music and musicality are

restricted by the way these materials are used. Musical ideas are prioritized according to conventional tempered scales and, later on, the instruments designed accordingly. This proves that there is no flexible space for making music beyond these formal structures.

If we examine Eurocentric classical music more deeply, its central approach is the permutational design of finite scales and durations. Essentially, it represents a mathematical approach to arranging notes based on specific harmonic principles and organizing durations according to ornamentation. As Wishart (1996) proposes, music is not solely concerned with finite options and, consequently, is not limited to the application of permutational processes dictated by tuning structures. Sound, as a physical phenomenon, has an infinite spectrum of colors. However, one of the first steps toward breaking away from conventional forms is questioning what makes a sound musical.

As Cage (1961) suggests, all sounds around us are musical. He perceives sound as an infinite palette of possible colors to work with, and the role of the composer is to organize these sounds to create musical structures. The tools used for sound implementation and creation allowed Cage to discover further possibilities and variations in what a sound can do, making its role more flexible. Technological development, and thus the capabilities of musical instruments, has started to change the way sound materials are approached and, consequently, the structure of composition.

Representation of Sound

Musical expression has been conveyed through musical notation for over a hundred years. Broadly speaking, this notation represents tempered pitches and their durations as discrete symbols. However, this notational expression is limited by the technological constraints of instruments.

> Similarly, discrete fixed pitches are idealizations of acoustic reality. In practice, there exist only sounds in their infinite variety of possible frequencies, spectra, timbres, dynamic envelopes, changes (dynamic morphology), and combinations of all these. Consider the irreducible infinitude of tones of voice. However, the infinite is not simply notatable. What notation demands is a finite set of pitch levels that can be permuted and combined. The refinement of instrument technology attempts to impose this discrete permutational rationality upon the very production of sounds, and our ears learn to approximate our acoustic experience to the discrete steps of our imposed logic. (Wishart, 1996, p. 23)

Thus, the definitions of music are not separable from this imposed logic of notational composition. However, attempting to distinguish discrete notes from the idea of sound assigns them as one of the musical gestures. Considering the hieroglyphics developed by ancient Egyptians, the alphabet is the discrete representation of particular moments, things, events, sounds, etc. However, the actual meaning of real-time events is not transmitted exactly as they happened. It is merely an approximation of the actual meaning. On the other hand, the meaning and events recorded historically by the scribes of that time were dominated by them (Wishart, 1996, p. 11).

Understanding the representation of any sound is essential to approximate the roles of sound in a particular context. When reading conventional music scores, we can conceive the roles and placements of each note and its role in compositional structures. Any tempered pitch has its own particular discrete notation. This representation is discrete because it only serves as a trigger for the performer. Sound, and hence any pitch played by any instrument, exists physically in nature. When we look at a photograph, we immediately see momentary visual information, thus making a stronger connection to the meaning itself. This is because it provides actual information from the moment itself. Video technology can be considered in the same context, as it presents a continuum of information over a particular range of time. The strength of visual representation makes the connection between representation and the actual event itself stronger. Musical notation and hieroglyphics are also visual representations of particular sounds. However, they are abstract interpretations of sound events rather than the sounds themselves. This affects the accessibility of the role of sound in musical composition in terms of musicality. Sound has been invisible and transient since the beginning of time. Scott's *phonautograph* recorded it and made it both visible and permanent (*Origins of Sound Recording: Edouard-Léon Scott De Martinville - Thomas Edison National Historical Park (U.S. National Park Service)*, n.d.). This device imitated the mechanism of the human ear, mimicking the ear bones to record sound on synthetic materials. The process itself is literally the transformation of sound events into writing (Sterne, 2003, p. 36). This represents the actual physical structure of sound on paper. This was an essential technological innovation in terms of recording sound as closely as possible to its actual form in nature. It could serve as a bridge for transmitting sonic events, including tempered pitches and voices, to paper as they exist. At this point, the differentiation between sounds in terms of musicality becomes less prominent than before.

> Attempts to visualize sound thus coincided with the construction of sound as an object of knowledge in its own right: where speech, music, and other human sounds were reduced to special categories of noise that could be studied by the sciences of sound (Sterne, 2003, p.43).

It can be said that the resolution of sound representation has reached a higher level, allowing for further investigation of the details hidden within the entire structure of the infinite spectrum of sound itself.

The point of the new appearance of sound in a sense of notation was to evolve the interpretation of any sound material in a sense of compositional structure. Indeed, the role of any tempered pitches in conventional compositional structure is mostly permutational. With the detailed recording of sound itself as one of the early forms of spectrograms[2], it brought a different approach to sound and the relocation of sound in composition because now it also has a real-life connection. When we hear any sound from any traditional instrument, it can be immediately connected with the instrument itself, and hence the connection between sound and musical composition is created. Because the lifelong experience with the imposition of instrument sounds recalls the notion of musicality. However, any sound has an affinity with the noise of daily life; what sort of notion can it recall? As mentioned above, tempered notes are flexible to be present in conventional compositions, having particular roles according to their acoustic features. However, everyday sounds have a strong connection with particular events, so this makes these sounds inflexible to use in a compositional structure because they create anecdotal connections that are challenging to extract from their meaning. Any sound material that implies particular events in daily life can create a conflict among the combinations with other sound materials.

[2] A spectrogram is a visual representation of the frequency content of a sound over time.

Thus, “that anecdotal aspect of sound-material can also be organized coherently and in a complex manner and even enter into our perception of the most supposedly abstract pieces” (Wishart, 1996, p.7). The new representation of sound materials changes the classification of sound materials more according to the phenomenological description of their properties. This foundational point for the new classification of sound materials also affects the role of sound as a real-life object and hence the composer itself.

Hearing the Representations

Brought the idea of the visual representation of sound with the phonautograph, Scott’s intention was to delve into the idea according to the strength of writing culture. However, about two decades later, Edison was working on another machine called the phonograph, which could transmit the visual codes of sound on paper to the actual sounds. This was not the first machine to record and playback audio; however, it was the most reliable one. When the idea first appeared, it gathered the attention of the entrepreneurs of that time to develop this machine with extra layers to make it convenient to use. This is one of the milestones of sound reproduction, which allowed people to listen to monologues, jokes, and songs from that device (Thompson, 2016). This innovation changed the codes of the role of any sound material, which could be used in different forms and variations. If you were a composer or performer living in the 19th century or before that period, when you saw a piece of sheet music, you could hear the sound and make some predictions about what kind of compositional structure you were going to hear when it was played. This mostly required advanced skills in conventional music theory to read any sheet music. However, a performer was able to play sheet music with their skills for their instruments. If we record that sound played by a performer or singer and play it back in another place, what things possibly change in terms of the roles of performer or composer? The answer can be that

there are no significant changes in the context of conventional music architecture. However, the possibility of playing back the sound from recordings drawn on paper might change the roles of sound materials in any composition.

Further Development of the Tools

Broadly speaking, an instrument is a particular tool that can create particular sets of pitches to produce musical sounds. In this definition, we take conventional music as a base. As indicated before, the possible new way of generating sound, such as the Telharmonium, brought a new perspective on sound production. On the other hand, shifts among conventional theories with new permutational approaches, such as twelve-tone methods, evolved the result of the sound outcome and also the way of composing structure. The augmented instruments[3], such as the Theremin, Ondes Martenot, the Trautonium, and Mixturtrautonium, brought a new way of expressing sound in terms of instruments. The difference revealed by these instruments is that the sound material can be interpreted as a wider form of the spectrum itself. They can create pitch-free[4] sound structures. On the other hand, the Gramophone, which is the further development of the Phonograph, provided more options for the reproduction of sound itself. Indeed, sound recording is a milestone for reusing those recordings in various forms. At first, these recordings were mostly used for playing back the recorded sound exactly as it was recorded. Therefore, it might not seem as if sound itself gained a more free form to accomplish itself. Because if we record any sound on paper as a visual form to reproduce sound itself, it eventually has an affinity with conventional music notation because it also drives performers to

[3] An **augmented instrument** is a musical instrument that has been extended or modified to offer new capabilities beyond its traditional function.

[4] **Pitch-free materials** refer to sound elements that do not have a clearly defined pitch, unlike traditional musical notes. These materials are often used in experimental and electroacoustic music to expand the sonic palette beyond conventional tonal structures.

play the notes exactly the same as the notation. However, the next developments in playback devices allowed for transforming recorded sound in various forms.

Tape Era

After postwar Germany, the magnetic tape recorder was revealed as an option to record and manipulate sound. The term "manipulate" means that the inherent nature and features of sound itself could now be transformed into various forms. Also, the linear timing[5] The mechanism of conventional music practice was interpreted with different approaches because tape allowed the composer to set any sound at any time on the tape strips. With the tape recorder, the roles of musical materials shifted or could shift from one form to another. This meant that from now on, composers had more options, allowing them to organize sound materials more freely than before. For instance, “Chords can be sped up to become beats and rhythms. Rhythms can be slowed down to become chords”(Holmes, 2002, p.74). It should be noted that the interchangeable features of the new role of sound material here were going to affect the definitions of music in terms of the way of organizing materials to express musicality. In the context of tape playback, any roles in a sense of musical structure could be assigned to only one sound material. This meant that one sound material could create an entire musical composition by itself. Further developments here allowed us to see the inherent structure of any sound and the shiftable phenomenological meanings assigned to the sound. What I mean by shiftable is that any sound recorded onto tape or any device that allows manipulation could be located in a place isolated from its original context.

[5] Linear timing refers to the idea of starting from the beginning and continuing until the end according to a particular time signature.

Roles of Composer and Performer

A composer who composes a musical composition for sheet music has limitations with harmonic structure and also the limitations of the performers of the composition. As Cage conceived the composer as an organizer of sound, according to him: “It is now possible for composers to make music directly, without the assistance of intermediary performers. Any design repeated often enough on a soundtrack is audible” (Cage, 1961, p.4). It can be said that the sound and time materials that composers had were restricted by several reasons such as harmony and human nature as a performer. After playback technologies, composers could play with sound by themselves and discover other features and contextual meanings of sound materials by manipulating them. Broadly speaking, the roles of composer and performer seemed to merge. This might shake the foundation of the definitions of music and the way of making music. Permutational approaches to music creation could be applied by any composer or performer. The outcome of these applications mostly had similarities to each other. In this context, tape and other devices could change the outcome of musical composition, making it differ from one composition to another.

A composer can be defined as the organizer of a series of notes or, in other terms, sound. However, in this context, the role of sound itself also changes, as it is no longer just a pitch existing in melodic succession or as part of chords. With the advent of recording technologies, sound transforms into a reference that describes both the environment from which it originates and the source that creates it. Indeed, combining tempered pitches in permutational formulas differs from arranging sounds that maintain phenomenological connections with their sources.

For a composer working with recording technologies, the process of organizing sonic entities becomes a more complex task. On one hand, pitches already establish a sense of place through their predefined formulas. On the other hand, sonic entities must be arranged according to the associations they hold with the place of their origin. Therefore, "Music, then, may be defined as an organization of these elementary operations and relations between sonic entities or between functions of sonic entities" (Xenakis & Kanach, 1992, p.4).

Acousmatic Sound

In the early 1950s, tape recorders began reshaping the nature of sound within musical structures. Pierre Schaeffer opposed the traditional approach to music and introduced the concept of musique concrète: recorded electronic music that could incorporate any and all sounds. The term refers to sound objects derived from nature—concrète sounds from the real world (Holmes, 2002, p.86-87). The ability to use any recorded sound in composition marked a radical shift in musical thought during this era. The fact that every sound could be recorded and played back served as proof of how sound could now be interpreted in relation to its source.

Before the advent of recording technology, music could only be experienced in the present moment. With sound recording, however, sound could be heard in a different place or time from where or when it was originally captured. This aspect of the new medium effectively disconnected sound from its source. Schaeffer introduced the term acousmatic to describe sound materials heard without witnessing their source. This term "in fact, emphasizes the perceptual reality of sound, as such, by distinguishing it from its methods of production and transmission" (Schaeffer, 2017, p.64).

This shift in perception expanded the role of sound even further. The recording medium not only transformed the practice of music-making but also altered listening habits. For a long time, the fundamental building blocks of musical construction were tempered notes, forming the basis of an entire architectural framework. As a result, definitions and practices were shaped by these micro-elements. However, with recording technology, the micro-elements of music-making gained greater flexibility and complexity. In conventional music theory, notes held roles based on their acoustic properties and relationships, such as dominant or mediant. The emergence of new sounds introduced more conceptual roles in the organization of compositions and musical structures.

Conclusion

The development of tools for creating, manipulating, and analyzing sound has fundamentally reshaped our understanding of music and its compositional possibilities. Initially bound by tempered scales and instrumental limitations, sound was historically treated as a fixed entity within structured frameworks. However, with the advent of recording and playback technologies, sound was liberated from its immediate source, allowing for new ways of organizing and perceiving it. Innovations such as the phonograph, tape recorders, and digital synthesis have enabled composers to work directly with sound as a material, rather than merely arranging notes within predefined systems. The ability to visualize and manipulate sound through spectrograms and electronic processing further expanded its role, revealing hidden sonic structures beyond human perception. These advancements have challenged conventional definitions of music, allowing for a broader, more fluid approach to composition where sound itself, rather than notation, becomes the central element of artistic expression. As technology continues to evolve,

the role of sound in music will remain dynamic, continuously reshaping how we create, experience, and conceptualize sonic art.

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