MISOSTENIDO
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CAVEZANE'S BIOMUSICAL PROPOSAL: CRITICAL ANALYSIS OF HIS SONIC THEORIZATION

La propuesta biomusical de Cazenace: análisis crítico de su teorización sónica

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OPEN ACCESS

Recommended Citation
González-Gomis, J. B. (2025). Cavezane's biomusical proposal: critical analysis of his sonic theorization [La propuesta biomusical de Cazenace: análisis crítico de su teorización sónica]. *Misostenido, 5*(10), 18-28. https://doi.org/10.59028/misostenido.2025.09

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Received: 25 feb 2025
Accepted: 2 mar 2025
Published: 30 jul 2025

Financing
Este artículo no ha contado con financiación institucional ni privada.

Competing interest
The author declares no conflict of interest.

Author contribution
The author declares that he has developed the present proposal.

Ethics approval
This study was carried out without the need for ethical approval.

DOI
https://doi.org/10.59028/misostenido.2025.09

Editorial design
PhD. David Gamella
(Universidad Internacional de La Rioja)

Abstract

Background: Music therapy is firmly grounded in evidence-based clinical practice, yet weak institutional control has allowed unverified theories to flourish, notably Gustavo Cazenave's "biomusic", which blends esotericism with the Western classical canon. **Objectives:** This paper critically examines Cazenave's sonic taxonomy—"characteristics, classes and quantification of sound"—to protect the theoretical underpinnings that legitimise therapeutic music work. **Method:** A systematic, comparative reading of the 2024 revised edition of Biomúsica. Los efectos de la música sobre el cuerpo y la mente was undertaken. Sections dealing with acoustics and music theory were cross-checked against specialised scholarship to assess accuracy and coherence. **Results:** The analysis uncovered multiple terminological mistakes, internal inconsistencies and flawed acoustic data. Misuse of basic parameters (intensity, pitch, timbre), ad-hoc labels such as "open" or "femoral" sounds, and erroneous statements about human auditory limits exemplify these flaws. When presented under the banner of music therapy, such inaccuracies threaten both academic progress and client safety. **Conclusions:** The study calls for rigorous acoustic and musicological knowledge in any intervention claiming therapeutic value. It urges the profession to maintain critical oversight and reject pseudo-scientific appropriations, thereby safeguarding the interdisciplinary dialogue that underpins clinical effectiveness.

Keywords: acoustics, musical instruments, music therapy, sound, music theory.

Resumen

Introducción: La musicoterapia se ha consolidado como disciplina clínica, pero su expansión ha propiciado la difusión de planteamientos poco rigurosos, entre ellos la «biomúsica» de Gustavo Cazenave, que combina elementos esotéricos con el canon clásico occidental. **Objetivos:** El artículo persigue analizar críticamente la taxonomía sónica de Cazenave —características, clases y cuantificación del sonido— a fin de salvaguardar la solidez teórica que sustenta las intervenciones musicoterapéutica. **Método:** Se efectuó una lectura sistemática y comparada de la edición revisada 2024 de Biomúsica. Los efectos de la música sobre el cuerpo y la mente. Los pasajes relativos a acústica y teoría musical se confrontaron con bibliografía especializada para determinar su exactitud y coherencia. **Resultados:** El examen reveló numerosos errores terminológicos, incoherencias internas y cuantificaciones imprecisas que comprometen la validez científica de la propuesta. Al presentarse bajo el prestigio de la musicoterapia, tales inexactitudes amenazan el desarrollo académico de la disciplina y la seguridad de los beneficiarios. Entre los fallos destacan confusiones entre cualidades físicas (intensidad, tono, timbre) y su percepción, definiciones inexistentes de «sonidos abiertos» o «femoral» y datos erróneos sobre el rango auditivo humano y las tesituras instrumentales. **Conclusiones:** El estudio exige un uso riguroso del conocimiento acústico y musicológico en cualquier intervención que se denomine terapéutica. Se insta a la comunidad a ejercer vigilancia crítica frente a narrativas personales y a rechazar apropiaciones pseudocientíficas, preservando así el diálogo interdisciplinar que sustenta la eficacia clínica de la musicoterapia.

Palabras clave: acústica, instrumentos musicales, musicoterapia, sonido, teoría musical.

INTRODUCTION

The Sonic Foundation of Music Therapy

While the use of music therapy has been extensively studied—Edwards (2016) provides a current overview of its evidence-based practice in hospital and educational settings, and with adults facing cognitive challenges; Fernández-Company et al. (2024) assess its efficacy in patients with neurological disorders; García-Rodríguez et al. (2023) measure its effectiveness in relation to facial emotion recognition for alexithymic patients; and, specifically, from the perspective of Biomusic: Blain-Moraes et al. (2013) use this term to refer to real-time music generated based on changes in physiological signals produced by individuals with profound and multiple disabilities, enabling interpretation of changes in the patient's state by their caregivers; Cheung et al. (2016) use the term in reference to a listening interface that detects physiological indicators of anxiety in children—to our knowledge, a critical analysis of Cazenave's (2024) book Biomúsica. Los efectos de la música sobre el cuerpo y la mente has not yet been undertaken.

In addition to intervention methods, the formation of the therapeutic relationship, and the collection and analysis of results, music therapy is founded on sound (Benenzon, 1991). Therefore, a solid and verifiable understanding of music theory is essential, encompassing both the physical vibratory phenomenon that enables sonic communication and the theoretical configuration defining our musical culture.

Music therapy is gaining increasing strength and recognition in Spain, yet its nascent stage and relative institutional weakness have facilitated the emergence of unsubstantiated narratives and proposals, sometimes clearly devoid of academic rigour and lacking a scientific basis. Cazenave's (2024) proposal exemplifies this. Although some aspects of his theory may be interesting, its physico-acoustic and theoretical foundations present serious inaccuracies.

Music therapy relies on musical performance (vocal, instrumental, or electronic) to achieve therapeutic benefit for participants. Benenzon (1991) theorises on it through the ISO concept; Bowling (2023) synthesises the biological principles of the relationship between music and mental health; Bruscia (2012, 2014) defines and provides a comprehensive and updated theoretical framework for its definitions, processes, uses, and modalities; Bunt (1994) narrates the emergence and development of the discipline to its current uses for the healing of children and adults in a therapy that unites art and science; Darnley-Smith and Patey (2004) offer an overview of clinical aspects and case studies; Edwards (2016) and Gallardo (2011) highlight its mental health benefits through prevention, assistance, and rehabilitation; Goodman (2011) focuses on the training and development of clinical competencies in music therapy; Jauset (2011) details its applications in neurological diseases, communication disorders, learning difficulties, depressive disorders, and cases of anxiety, stress, oncology, immune system issues, and motor problems. Storm (2013) emphasises the importance of voice analysis in music therapy practice; and Zimbaldo (2015) reviews the methods of Nordoff-Robbins, Clifford Madsen, Mary Priestley, Bony, and Benenzon. By its very nature, music therapy is entirely dependent on the physico-harmonic phenomenon. Its positioning as an academic discipline, which began to establish itself in the United States during World War II (Davis and Hadley, 2015; Jauset, 2011), must be underpinned by an understanding of its physical nature and its theorisation. When a marked divergence from general and widely accepted knowledge becomes apparent, the validity of music therapeutic practice risks invalidation. Hence the importance of speaking accurately and correctly in the theoretical domain.

A Shared Theory and History of Music

Music therapy is founded not only on the nature of the physico-harmonic phenomenon but also on the musical context in which the patient is encultured, in relation to the ISO principle (Dineen, 2024) developed by Benenzon (1991). In our sociocultural context, music has been extensively theorised, generating a wealth of knowledge and terms that enable communication and rapprochement between researchers. There is no reason to abandon these, as they build bridges, facilitate communication, and foster dynamics of emission and listening.

Cazenave's (2024) biomusic is based on common Western practice, within a corpus of great classical works and composers. Regarding this repertoire, he states: "Perhaps it is, then, the great classics alone who have achieved compositions capable of describing that great oscillation, this great quantum dance of which every living creature is a part" (Cazenave, 2024, p. 18). If this is its musical foundation, we must operate with theoretical concepts derived from the practice and analysis of this music (Amorós-Sánchez et al., 2024).

Biomusic

Cazenave (1955) has been involved in composition, musical performance, and music therapy for decades. This latter discipline has become the umbrella under which he has included other neologisms and personal proposals: "Metamusic, musicoembryology, astrosonia, supraconsciousness, musicosophy, and music therapy presiding over everything" (Salazar, 2024, p. 8). Within the context of this thinking, he has developed his concept of biomusic, which "is related to the art of harmonising individual action" (Cazenave, 2024, p. 12), and has three principles: the establishment or re-establishment of personal and collective interaction; the achievement of self-esteem through self-realisation; and the employment of rhythm, harmony, and melody to imbue or rebalance our own energy (2024, pp. 13-14).

Therefore, biomusic employs melodies, rhythms, and harmonies to improve the participant's psychic and affective health, increasing self-esteem and interpersonal interaction. These three pillars bear significant similarities to music therapy (Edwards, 2016; Thaut and Hoemberg, 2014; Theorell, 2014), leading one to question whether a neologism with the "Bio" label is truly necessary.

Furthermore, the use of this term in the context of Cazenave's work overlooks other more standardised uses of the term "biomusic" already discussed, such as those by Blain-Moraes et al. (2013) or Cheung et al. (2016), as well as the encompassing term "bioart," proposed by Gamella-González (2015), who conducts qualitative research combining avant-garde artistic expression with biomedical monitoring technologies.

Objective and Relevance

Based on these considerations, the fundamental objective of this work is to critically analyse Cazenave's (2024) proposal from the perspective of sound theory, in defence of academic rigour, and to rigorously argue for the therapeutic potential of music therapy.

Given that sound is the basis of music therapy, we believe a critical review is necessary to analyse and rectify these statements. The aim of this article is to defend the rigour of the theoretical and musicological knowledge contained within music therapy practice and to demand the seriousness and scientific respect deserved by both the practitioners involved in sessions and music itself.

As Cazenave's therapeutic intervention proposal relies on works and composers from the Western musical canon (2024, pp. 111-115), a critical analysis from Western music theory is necessary regarding this canonical corpus (Bergeron and Bohlman, 1992; Citron, 1993; Weber, 2011) and its theorisation.

MATERIALS AND METHODS

Materials

The primary source for this study is Cazenave's book, Biomusic: The Effects of Music on Body and Mind(1st edition, 2002). The version consulted is a 2024 revision, which reflects the author's current thinking on the subject. The analysis focused specifically on Chapter Three, "Understanding Sound" (Cazenave, 2024, pp. 27-38), where most of the data pertaining to the physical behaviour of sound are presented. Nevertheless, other passages from the text discussing the physical properties of sound and their theoretical underpinnings were also included in the analysis. Therefore, the inclusion criterion for analysed passages was thematic, aiming to capture the entirety of Cazenave's theorisation related to the physical qualities of sound.

Procedure and Data Analysis

Given the foundational material and Cazenave's own musical narrative, this investigation is heuristic and analytical, eschewing stimuli and measurements, and lacking intervention or variables. A systematic and critical reading (Hernández-Sampieri, Fernández, & Baptista, 2014) of the book was undertaken, and data relating to the physical behaviour of sound and the theorisation and taxonomy of Western music were extracted. These textual data were then compared with principal academic acoustic and theoretical references and subjected to systematic review to determine their accuracy, relevance, and veracity.

RESULTS AND DISCUSSION

Due to the method followed, as explained in the preceding section, we have opted to unify the results and discussion; indeed, the entire section constitutes a discussion. The structure addresses Cazenave's categories, classes, and quantifications that we deem worthy of discussion, inasmuch as they represent central concepts in Cazenave's thought which he subsequently applies in his therapeutic interventions. The results of the systematic and comparative reading of Cazenave's proposal against the academic literature of music theory and acoustics are directly discussed point by point. From this point onwards, the order of presentation of Cazenave's concepts is followed to also illustrate the author's content flow and the lack of congruence between them.

Characteristics of Sound

Although Cazenave refers to 'characteristics', each of the identified parameters is more commonly termed a quality of sound.

Intensity

Sound intensity "derives from the amplitude of vibrations" (Cazenave, 2024, p. 28). While brief, this definition is indeed correct, but it could be clarified. Intensity is the quality that refers to whether a sound is louder or softer. When this quality is translated to the sense of hearing, the term loudness is employed, a perceptual parameter that allows for its ordering from weakest to most intense (Bunt, 1994, pp. 51-54; Florentine, Popper, & Fay, 2011; Hartmann, 2013, pp. 125-136). This quality depends on the "vigour or force that the disturbance produces in the vibrating molecules [...]. This vigour translates into a greater or lesser amplitude of oscillation in the molecular vibration" (Calvo-Manzano, 2001, p. 101). Therefore, yes, intensity depends on the amplitude of the vibratory motion, which is determined by the force of the disturbance.

Pitch

Regarding pitch, Cazenave (2024) explains that it is indicated by the number of vibrations per second (p. 28). Here too, we must distinguish between the quality and its psychoacoustic perception. Height (or pitch in a broader sense) is the quality that expresses whether a sound is higher or lower than another. The perception of this quality is what we would call tone (or pitch in a more specific, perceptual sense) (Bunt, 1994, pp. 54-57; Krumhansl, 2001). Height "depends primarily on the frequency of the vibratory movement that originated it, with low sounds produced by vibratory movements of small frequency and high sounds by high frequencies" (Calvo-Manzano, 2001, p. 86). If we analyse the ASA's definition of pitch, we would see how it has evolved from its origins linked to the musical scale to a much more complex current understanding, including aspects such as sound pressure, spectrum, or waveform (ANSI, 2004, p. 34). It is the height that is indicated by the frequency of vibrations, and pitch is influenced by psychoacoustic factors related to how our auditory system and brain process sound (Plack et al., 2005).

Timbre

For Cazenave (2024), this characteristic allows us to differentiate sounds from one another (p. 28). This explanation is confusing and inaccurate. Sound possesses various qualities, and variations in each of them can help differentiate one sound from another: variations in a sound's frequency will lead us to differentiate them. Therefore, timbre is not the sole characteristic that permits sound discrimination. This quality is usually what we refer to when speaking of the colour of sound (Bunt, 1994, pp. 48-51; Jauset, 2011, p. 40; Siedenburg et al., 2019).

He also states: "If we wished to represent the vibratory movement of sounds, we would find that the components of each of them have different amplitudes, although it may happen that they possess the same frequency and identical phase or intensity" (Cazenave, 2024, pp. 28-29). The components of each sound are the partials of the spectrum that make up each complex sound (Calvo-Manzano, 2001, p. 31; Sethares, 2005; Slawson, 1981). Partials, by definition, cannot have the same frequency (Jauset, 2011, p. 42). If they have the same frequency, they are no longer partials, but rather the fundamental sound itself. Their frequency is distinct and is related to that of this fundamental sound. If it is an integer multiple, it will be a harmonic partial sound; if it is not an integer, the partial will be inharmonic (Calvo-Manzano, 2001, pp. 31-32).

Duration

Regarding duration, Cazenave argues: "[although] it seems arbitrary, abandoned to the whim of the composer or performer [...], it is shown to be subject to certain laws such as those of rhythm" (2024, p. 29). Duration is a matter of time (Bunt, 1994, pp. 57-61; Sachs, 1952). Our musical culture has developed systems for measuring time (metre), patterns of repetition of basic impulses (pulsation), and systems for articulating events that constitute rhythm (DeFord, 2015; Hall, 2005; Hasty, 1997), as well as a philosophy associated with the articulation, sequencing, and repetition of sound durations (Cheyne, Hamilton, & Paddison, 2019).

Classes of Sound

The second block in Cazenave's taxonomy discusses classes of sounds as descriptors distinct from the aforementioned characteristics (qualities). This section is presented following the author's order of exposition. It is worth noting that taxonomies of sound have been common in recent decades, with one of the best known being that of Schaeffer: an investigator and composer, pioneer in concrete electronic music, who generated a morphology and typology of sound objects (Benenzon, 1991, pp. 86-89; Schaeffer, 2003; Schaeffer, 2012). In music therapy, Benenzon's proposal on the types of "elements producing sound stimuli" is particularly interesting (Benenzon, 1991, pp. 16-17).

Open Sounds

For Cazenave, these are sounds generated by the human voice in the chest register and those obtained from the hand horn without needing to insert it into the instrument's bell (2024, p. 29). The horn is a metal aerophone instrument, with a mouthpiece to channel lip vibration inside the instrument (Myers, 1997). This description applies to other instruments in its family, such as the trumpet, trombone, tuba, or euphonium (Adler, 2002, pp. 295-355; Del Mar, 1983, pp. 215-338; Miller, 2015, pp. 107-139; Piston, 1969, pp. 206-295). The horn is the only one of these instruments whose player places their hand inside the bell; the others do not physically interfere with the air exiting the instrument (unless mutes are used). If Cazenave intends to denote sounds played on the horn without the hand in the bell as 'open sounds', he should extend this usage to the other brass wind instruments.

Regarding sounds from the human voice in the chest register, we are unaware of the origin of this assertion. It seems to be deduced that he does so to distinguish them from sounds produced using the falsetto technique, but this term is neither clear nor proven to refer to these sounds (Meyer, 2009, pp. 123-128).

He also explains that the C-E-G perfect chord is called 'open' (Cazenave, 2024, p. 29). Does the author refer exclusively to the C-E-G chord, or does it also apply to chords that maintain the same intervallic relationship between their notes? If he refers only to C-E-G, no, nobody calls them 'open sounds'. If he refers to that intervallic relationship of a major third and a minor third, also no; that type of chord is called a major perfect chord (Gauldin, 2009, pp. 62-71; Grabner, 2001, pp. 94-98; Pedro, 1990, pp. 136-139; Zamacois, 1966, pp. 48-50).

High-Pitched Sounds

Cazenave's classification introduces a category for high-pitched sounds, but not for low-pitched ones, which is illogical. He explains about them: "Those which in equal time produce more vibrations than others which, by comparison, will be low-pitched" (Cazenave, 2024, p. 30). This class of sounds is directly related to the previously mentioned characteristic of pitch; a sound being high-pitched depends on its height. It is not logical to establish a class of relative sounds without indicating the alternative.

Antiphonal Sounds

Defined as those that are consonant with each other, at a distance of one or more octaves (Cazenave, 2024, p. 30). Firstly, sounds at a distance of one or more octaves are precisely that, octave sounds, not antiphonal. An octave sound means that its frequencies are in a mathematical relationship of double or half: a sound of 400 Hz is the upper octave of one of 200 Hz. Secondly, not all consonant sounds are octaves. Consonance is a cultural criterion that has evolved (García, 2004). The octave is an interval usually considered consonant, but others have been incorporated into this category. According to acoustic theory (from Tyndall and Helmholtz), consonance is a degree represented by the relationship between two frequencies: "The simpler the relationship of the frequencies of two sounds, the more consonant the interval they form" (Calvo-Manzano, 2001, p. 198). Octave sounds and consonant sounds are not equivalent.

The term "antiphonal sounds" (in plural) is a neologism, inappropriately borrowed from the word "antiphon," which has a history of more than a millennium in music history. It is used to refer both to a dialogic structure of musical participation in Christian liturgical chant and to a musical genre of chants such as Hispanic or Gregorian chant (Asensio, 2003, pp. 274-283; Hiley, 1993, pp. 88-108; Nowacki, 2017).

Artificial Sounds

Another methodological error in the classification is detected. As with high-pitched sounds, if a category for artificial sounds is established, there should previously exist another for natural sounds, rather than simply including the latter in the explanation of artificial ones: "In ancient music, those produced by an instrument, in contrast to natural sound, which was that of the human voice" (Cazenave, 2024, p. 30). The concept of natural and artificial sounds has also evolved over time, especially with the emergence of electrical and electronic instruments. This historical trajectory should be considered by Cazenave.

Compound Sounds

The brief definition Cazenave provides is: "Resulting from two or more sounds" (2024, p. 30). This class of sounds is vague and poorly defined. An incongruity is perceived in the use of the term 'sounds' both in the given name and in the definition. We might think he is referring to tertian chords, to sound aggregates with other types of intervallic relationships, or to a note played by two or more instruments in unison, as these would already be producing two or more differentiated sounds. Therefore, any sound that is not an isolated sound would be a compound sound, a category that also does not appear in his taxonomy.

Enharmonic Sounds

This term is indeed commonly used in music theory. They are sounds that sound the same but have different names; for example: C sharp and D flat (Cazenave, 2024, p. 30). In this sense, it does not disagree with theories accepted by Western music since antiquity (Boethius, 2009; Barker, 2009). As Cazenave indicates, it is currently used harmonically to effect modulations (Gauldin, 2009, pp. 415, 423, 452, 478, 605; Piston, 1998, p. 226). Therefore, it is worth asking what sense there is in establishing this class of sound while neglecting so many other concepts of harmonic practice that could be included by analogy with this one. There is little internal coherence in including the term without incorporating the modal system, tonality, scales, and other concepts that explain enharmonies in their context into the classification system. This becomes evident when he later explains the class of harmonic sounds. The very nature of both words shows a dependence between harmony and enharmony that should be reflected in the structure of the discourse.

Flute-like Sounds

Defined by Cazenave as "Those originating from the collision of the air column against a bevel or opening with cut edges in a closed tube..." (2024, p. 30), this refers to one of the sound production methods of aerophones. The air column inside a sound tube can be excited in various ways (Calvo-Manzano, 2001, pp. 53-64), such as a bevel (flute), single reed (clarinet and saxophone), double reed (oboe and bassoon), or mouthpiece (brass wind). If he includes one class, he should at least include the other three modes of sound production in aerophones of our musical culture, as well as other forms of sound production, such as chordophones, membranophones, or idiophones (Kartomi, 2001; Montagu & Burton, 1971).

Harmonic Sounds

Something similar occurs with the definition of harmonic sounds: "...obtained, instead of pressing, by gently rubbing on bowed and plucked instruments..." (Cazenave, 2024, p. 30). Indeed, on string instruments, harmonics are obtained through this physical operation (Arditti & Platz, 2013, pp. 57-70), but this class of sounds affects all instruments, because it underlies organological acoustics itself (Chaigne & Kergomard, 2016; Meyer, 2009). It is particularly evident in brass wind instruments, which, with only seven fingering combinations, generate many more harmonic sounds from the fundamental note of each position (Svoboda & Roth, 2017).

Imperfect Sounds

Regarding these sounds, he explains: "Those that are not unisons or have distorted audible signals. Probably, they should be considered 'white noise', as opposed to 'clear sound', which is true musical sound" (Cazenave, 2024, p. 31). The accumulation of inaccuracies and errors in these few lines is considerable. Firstly, we must point out that he introduces the class of "clear sound" as a counterpart, when he has not yet explained it. In fact, in the following paragraph, when discussing physiological symphony, he uses this same term, defining it differently: "That produced by the rhythm of a healthy lung" (Cazenave, 2024, p. 31). Clear sound cannot simultaneously be that produced by a healthy lung and true musical sound. These are two incompatible definitions.

The definition of noise is subjective and depends on cultural and personal factors, although generally its audition will cause displeasure and rejection. Elsewhere in the book, he classifies noises into bothersome (hindering or interfering with other activities or rest) and dangerous (having the potential to damage the auditory system) (Cazenave, 2024, pp. 49-50). Physically, we speak of noise as a sound of great complexity, resulting from the inharmonic superposition of sounds (Calvo-Manzano, 2001, p. 84). Again, the spectral composition of sound intervenes, bringing us closer to a more objective definition of noise. Cazenave (2024), in a poor understanding, argues that "the cause of noise is that the fundamental sound is accompanied by a large number of secondary sounds of such intensity that they almost completely obscure the principal one" (p. 42). It is not about the number of sounds and their intensity, but their ratio to the fundamental sound, in an inharmonic relationship.

White noise is a type that "contains all frequencies of the audible spectrum with the same intensity" (Calvo-Manzano, 2001, p. 85). Between 20 and 20,000 Hz (see "Hearing Limits" below), all frequencies should be present with the same intensity; this would be the exact definition of white noise. Therefore, we cannot speak of "imperfect sounds" and white noise as equivalents.

Having dismissed this equivalence, we can ask ourselves whether imperfect sounds are those that are not unisons. Should we consider as such those that compose a major perfect chord, or the example of C-E-G itself? A little earlier, we were told that these sounds were open, and they were presented as a kind of ideal of purity because they belonged to the chest register of the human voice, but now we find that no, they turn out to be imperfect.

Clear Sound

The difficulties generated by Cazenave's (2024) proposed definition for "clear sound" have already been mentioned, associating it both with true musical sound (p. 30) and with that produced by a healthy lung. Informally, when speaking of "clear sound," reference is often made, sometimes unknowingly, to a behaviour of the sound spectrum. A sound, generally a complex vibratory movement, presents a spectrum that is the sum of the various frequencies that compose it. The energetic relationship between high frequencies and. The following is the British English translation of your text, maintaining an academic tone the reduction within that spectrum is what imparts greater or lesser clarity to the sound. In acoustics, clarity is discussed as another subjective aspect of audition, describing the degree to which every detail of a performance can be perceived, rather than everything being blurred by late-arriving reverberant sound components (Rossing, 2007, p. 308). In room acoustics, sound clarity refers to the relationship between early acoustic energy (within the first fifty or eighty milliseconds) and late energy, subsequent to the chosen time limit (ISO 3382-1:2009, p. 21).

Table 1

Comparison between Cazenave's terms and the accepted definition

Cazenave Term	Accepted definition	Source
Intensity	"The quality intended to be expressed when a sound is described as being louder or softer than another."	Calvo Manzano, 2000, 101
Tone	"Subjective characteristic of pitch."	Calvo Manzano, 2000, 86
Timbre	"The quality that enables the differentiation of two sounds of equal pitch and intensity, but of different origin. (...) It depends on the degree of complexity of the vibratory movement that generates the sound."	Calvo Manzano, 2000, 122
Duration	"Aural sensation [which] depends directly on the duration of the vibratory movement that originates the sound."	Calvo Manzano, 2000, 136
Open sounds	Not applicable.	
High-pitched sounds	Not applicable.	
Antiphonal sounds	Octave sounds	
Artificial	Instrumental sounds	
Compound sounds	Option 1: "a set of sounds that are heard simultaneously" or "a simultaneous sounding of notes/sounds" Option 2: "complex vibratory motion"	Pedro Cursá, 1990, 136 Calvo Manzano, 2000, 31
Enharmonic sounds	"Those of the same sound and different spelling."	Pedro Cursá, 1990, 100
Harmonic sounds	"A sinusoidal quantity with a frequency that is an integral multiple of the fundamental frequency of a periodic quantity with which it is related."	ASA Acoustical Terminology, 1960, 8
Imperfect sounds	Not applicable.	
Well-defined sound	Not applicable.	
Gastric sound	Not applicable.	
Intestinal sound	Not applicable.	
Tympanic sound	Not applicable.	

Note: Own compilation

Gastric, Intestinal, or Tympanic Sound

Cazenave (2024) adopts these terms because, in his opinion, this sound is analogous to that produced by the percussion of a drum, also observable in the distension of the stomach or intestine due to gases (p. 31). Little correlation can be established with this class as defined by the author. While it is true that the comparison with a drum, which produces sound through the percussion of a stretched membrane over a resonance box, might allow for a certain analogy with the proposed parts of our organism, the modes of stimulation and vibration generation differ significantly between the gastric system and the percussion of membranophones (Adler, 2002, pp. 461-467; for their modes of vibration: Garret, 2020, pp. 283-332)."

Femoral Sound

This is the last term Cazenave (2024) employs in his taxonomy; he also refers to it as 'dull sound' (or 'muffled sound'), explaining that it is produced by the percussion of a solid, fluid-filled part, as in the case of the heart (p. 31). It is difficult to understand how something can be both solid and fluid-filled simultaneously. Nor is it comprehensible that a sound produced in the heart should be called 'femoral', when this name typically refers to a blood vessel in the lower half of the body.

Quantification of Sound

This section includes a series of aspects addressed by Cazenave concerning the frequency-based quantification of sound and its audition. Again, his ordering is followed, and his definitions are incorporated, which are then immediately discussed based on academic literature.

Limits of Audition

Human hearing is limited. Its capacity to process sounds generally spans frequencies between 20 and 20,000 Hz (Beament, 2001; Hartmann, 2013, pp. 314; Ingard, 2008, p. 1; Rossing, 2007, pp. 459-461; Schnupp, Nelken, & King, 2011, p. 7). Cazenave, when addressing this topic, makes errors and inconsistencies.

Firstly, he explains: "The human ear has a limit for appreciating sounds of a musical character. The average appreciation of sounds does not extend beyond a minimum of 32 vibrations per second for the lowest sound, such as the organ, and a maximum of 8276 vibrations per second given by the highest note of the flute. Such is the range of purely musical sounds" (p. 32).

In this definition, he conflates the frequencies produced by Western academic instruments with the limits of human hearing. He continues his exposition and a couple of paragraphs later states: "To do this, everything related to the limits of human hearing must be taken into account, as it is considered practically a fact that the smallest number of vibrations per second that our ear can perceive is 16, and the largest 38,000 or 50,000, although these limits are not very precise" (Cazenave, 2024, p. 33). It is one thing for these limits not to be very precise (indeed, they are variable and decrease with age [Calvo-Manzano, 2001, p. 255; Jauset, 2011, p. 38]), and quite another for the author to work with ranges of more than 40,000 Hz difference in barely three paragraphs. In another chapter of the book, he revisits the explanation: "The audible spectrum is always spoken of as limited between 18 and 18,000 Hz" (Cazenave, 2024, p. 46). Although these values are the closest to human hearing, it is not coherent that he refers to

Table 2

Frequency Ranges (Hz) of the Human Voice

Voice Type	Cazenave (normal)	Cazenave (Extraordinary)	Calvo-Manzano
Bass	82-293	61-348	82-396
Barítone	87-370	73-392	110-440
Tenor	109-435	98-544	132-528
Contralto	164-698	110-870	176-840
Mezzosoprano	174-870	164-977	220-900
Soprano	218-1044	196-1035	247-1056

Note: Own compilation

audition three times, providing different and inaccurate values in all instances.

Tones of the Human Voice

The problematic use of the term "tone" in this context has already been mentioned; we would rather speak of pitch or frequency. Table 2 displays three columns with the frequency ranges of the six typical voices, with two types of values offered by Cazenave (2024, p. 34) and by Calvo-Manzano (2001, p. 259). In this case, Cazenave has opted for more common and inclusive ranges, with voices that are less professionally trained. Calvo-Manzano's proposal, especially in the upper register, presents excessively high frequencies for average choral singers' voices.

Instrument Scale

Again, a less academic term is employed. What is actually explained in this section is the highest fundamental frequency an instrument can achieve, as detailed in Table 3.

In the case of the piano, the values are erroneous. A standard 88-key piano has a top note that is C8 (Anglo-Saxon notation), equivalent to 4186.01 Hz. Regarding the organ, the determination of its maximum frequency is not well established due to less standardisation in sizes and registers, but in modern organs, we could venture a fundamental frequency similar to that of the piano.

The asterisk next to some instruments indicates that the lowest note of their range can be fixed, but there are many more difficulties in indicating the highest note, which depends on models, performers, or extended performance techniques.

Standard tessituras have been adopted, within orchestral parameters (Adler, 2002), but especially the tessituras of the viola and saxophone can be higher, employing harmonics (viola) and extended techniques (saxophone) (Weiss & Netti, 2010).

Table 3

Maximum Frequency (Hz) of Various Instruments

Instrument	Note (Cazenave)	Franco-Belgian Notation	Anglo-American notation	Frec. (Hz) (Cazenave)	Frec. (Hz) (estandar)
Organ	Do	Do7	C8	4138	4186,01
Flute	Do	Re6	D7	4138	2349,32
Piano	La	Do7	C8	3480	4186,01
Harp	Fa	Sol#6	G#7	2792	3322,44
Viola	La	La5	A6	1740	1760
Saxo	Sol	Fa5	F6	1550	1396,91
Clarinet	Sol	Sib5	Bb6	1550	1864,66
Mandoline	Mi	La5	A6	1303	1760

Note: Own compilation

The clarinet has a complete family with various sizes and, therefore, registers: bass clarinet, alto, soprano, E-flat clarinet, etc. We understand that Cazenave refers to the most common, the soprano clarinet, which can be constructed in B-flat or A. Here we have adopted Rehfeldt's proposal (2003, p. 2). This same situation occurs with the saxophone, where Weiss and Netti (2010, p. 20) are followed. In both cases, it should be noted that the soprano instrument is not the highest-pitched in the family; therefore, the maximum frequency is higher. For consistency, the same system has been applied to the recorder, which has a large family of instruments and two models above the soprano that add another octave to the register (Lasocki, 2022; Thomson & Rowland-Jones, 1995).

CONCLUSIONS

The objective of this article was to advocate for the necessity of establishing rigour in the theoretical and musicological knowledge employed in music therapy practice. To this end, Cazenave's book, Biomusic, was taken as a case study, and a critical analysis was conducted on the sections addressing the theoretical and physical-acoustic knowledge underpinning the understanding of sound and music therapy. The findings have revealed numerous errors, a lack of comprehension, and scientific unreliability within the author's proposal. The taxonomy developed by Cazenave, which includes characteristics, classes, and quantification of sound, exhibits many internal inconsistencies, and its operational validity is not demonstrated in the text.

These results lead us to highlight the importance, for the academically sound development of the discipline, of undertaking critical scrutiny and oversight of personal narratives. This is crucial to prevent unscientific intrusion by individuals who lack the necessary training and rigour to discuss the physical-musical phenomenon that accompanies all music therapeutic practice. Such scrutiny must be systematic and exercised in environments where the well-being of participants in sessions is prioritised. To achieve this, approaches that adhere to criteria of rigour and scientific validity must be chosen, whilst, conversely, improper appropriations or attributions within the discipline must be rejected. After many decades of clinical practice, the benefits offered by music therapy for health improvement are undeniable. However, it is imperative to safeguard the development of the discipline and its operational dialogue with other scientific branches without breaching the terminological, methodological, and physical barriers encountered in the analysed book.

Cazenave's proposal, largely imbued with esotericism and personalism, is substantially based on the musical canon of Western classical music. Therefore, the shared and solidly established knowledge that has been developed since the origins of musicology and acoustics, and which we currently find so advanced within the fields of music theory and acoustics, must be respected.

Generative AI Statement

The author declares that no Generative AI was used in the creation of this manuscript.

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