JOURNAL OF Music RESEARCH ONLINE

A JOURNAL OF ADELAIDE UNIVERSITY

# UNDERSTANDING THE HARPSICHORD RATTLE:

## A Multi-Disciplinary Inquiry Into The Acoustics of Harpsichord Sound

ASSI KARTTUNEN, HANNA JÄRVELÄINEN & LEENA UNKARI-VIRTANEN

Hanna Järveläinen: Zurich University of the Arts, Pfingstweidstrasse 96, 8005 Zürich, Switzerland.
Leena Unkari-Virtanen & Assi Karttunen: Sibelius Academy, University of the Arts Helsinki, Pohjoinen Rautatiekatu 9, 00100 Helsinki, Finland.
assi.karttunen@gmail.com
https://doi.org10.20851/jgefar25

JMRO

www.jmro.org.au

Adelaide University

www.adelaide.edu.au

## INTRODUCTION

The harpsichord occupies a distinctive place in the history of Western music, renowned for its unique timbral qualities and its central role in the musical life of the eighteenth century. Among its most intriguing sonic features is the characteristic rattle, a phenomenon that has attracted both admiration and curiosity from musicians, audiences and scholars alike. While much has been written about the instrument's repertoire and performance practice, less attention has been paid to the ways in which its material construction and acoustic properties contributed to its expressive potential within its original cultural context.

Recent interdisciplinary research has begun to bridge this gap, drawing on historical documents, musicological analysis and acoustic studies to offer a more nuanced understanding of the harpsichord's sound world. This article builds on such approaches, particularly the material turn in historical research, to illuminate how the interplay of craftsmanship, performance and cultural values shaped both the perception and the significance of the harpsichord's sonic qualities in early music.

The focus of this article is the harpsichord's characteristic rattle sound, the noisy attack transient at the beginning of the sound which is followed by its vocal *cantabile*-like component. Historical accounts reveal that this idiomatic rattle was not merely tolerated but highly valued: eighteenth-century writers described its distinctive quality and suggested techniques for repeating notes or chords to emphasise and shape the *croquante* materiality of the sound. Naturally, this consonant-like beginning of the sound was useful for the clarity of rhythmical textures but it could also be used to intensify the dynamics of the music. The article will not address the issues concerning *cantabile* playing on the harpsichord, since these have been addressed by François Couperin in his *L'Art de toucher le clavecin* (1716) and Jean-Philippe Rameau in his *De la méchanique des doigts sur le clavessin* (1724).

Contemporary perspectives, by contrast, often regard noisy sounds as antithetical to musical tone, especially in traditions that prioritise pitch, rhythm and projection, parameters typically absent from noise. Helmholz described timbre as the quality of

sound that enables the listener to distinguish 'the musical tone of violin from that of flute or that of clarinet or that of human voice, when all these instruments produce the same note at the same pitch' (Helmholz [1885] 1954: 10). In 1780, Jean-Jacques Rousseau described the timbre of different instruments in terms of touch and sight, with tactile and embodied perceptions:

> A sound's timbre describes its harshness or softness, its dullness or brightness. Soft sounds, like those of a flute, ordinarily have little harshness; bright sounds are often harsh, like those of the vielle or the oboe. There are even instruments, such as the harpsichord, which are both dull and harsh at the same time; this is the timbre. The beautiful timbre is that which combines softness with brightness of sound; the violin is an example (Rousseau 1780–1789).

Timbre has been associated with aesthetic values, as in Rousseau's definition. Since at least the nineteenth century, noisy sounds have occupied an ambiguous position in music and there have been efforts to avoid sounds that interfere with the perception of pitch, rhythm, and loudness. These parameters are usually not discernible in noisy sounds. The quality associated with the harpsichord's noisy attack is therefore referred to as timbre, which is often treated as a secondary parameter in music.

This study investigates the expressive and acoustic qualities of the harpsichord's rattle through a multidisciplinary and theoretically grounded approach, drawing on historical, acoustic and experiential perspectives. The research is structured around three central questions:

- How is the harpsichord's rattle (its croquant quality) described in the eighteenth-century French sources, and what do these accounts reveal about the harpsichord's specific, croquant timbre, its musical function, possible aesthetic meanings, and its use in music? What causes the harpsichord rattle?
- What do acoustic and psychoacoustic studies disclose about the material and perceptual characteristics of the harpsichord's croquant timbre, and how is this specific sound shaped by the performer's embodied interaction with the instrument?
- In what ways can integrating historical, acoustic, and experiential perspectives on timbre inform contemporary harpsichord pedagogy, music history education and listening practices?

## Material and Methods

The purpose of this article is to examine the rattling nature of harpsichord sound through two different research traditions. A multidisciplinary approach is necessary because this research is grounded in the material turn in historical studies. As Gerritsen and Riello (2021) highlight, the material turn in historical research shows how focusing on things, whether everyday or extraordinary, rather than on events or people, for example, offers new perspectives on the past. Gerritsen and Riello emphasise the multidisciplinary nature of this research field. We therefore draw, in this research, on methods from acoustics, historically informed performance, and historically oriented timbre research.

Primary historical sources were selected for their relevance to eighteenth-century French harpsichord practice and their detailed treatment of timbre. Key texts include Saint Lambert's *Nouveau Traité de l'accompagnement du claveçin* (1707), Jean-Philippe Rameau's *Traité de l'harmonie* (1722) and *Génération harmonique* (1737), and Claude Perrault's *Essais de physique* (1680). These treatises were analysed using close reading, focusing on descriptions of timbre, performance techniques and metaphorical language used to characterise the harpsichord's sound.

Historically informed performance is oriented, on the one hand, towards the study and interpretation of historical sources and, on the other hand, towards the study of the player's actions and the work's interpretive horizon. The pedagogy and research of historically informed performance have been shaped by discussions of historiography and historicity in early music since the late 1980s (Harnoncourt 1988; Haskell 2001; Butt 2002; Haynes 2007; Munslow 2006; Pryer 1994). The choice of historical sources here has been informed by the study of early acoustics, particularly the work of Claude Perrault (1680) and Joseph Sauveur (1697; 1701). These studies led to the emergence of topics including harmonics, resonance, noise, and timbre in the treatises written by Jean-Philippe Rameau (1722; 1737; 1760). This approach, which Sauveur called *'l'acoustique'*, was also supported by the French Academy of Sciences, which published Sauveur's work (1701) as a part of a larger publication.

During the last twenty years, historically informed performance has been developed in line with the ideas of embodiment (e.g. Le Guin 2006; Wentz 2010; Järviö 2011; Belgrano 2016; Spissky 2017). In this article, the analysis of auditory qualia, the property or quality of tone as perceived or experienced by a person, in this case the player, requires an approach which has sometimes been called 'carnal musicology' (Le Guin 2006) or embodied historically informed performance. We investigate, through embodied and tactile analysis of harpsichord playing, how the player's gesture, the harpsichord's response and its material affordances can shape the quality of the noisy part of the harpsichord sound. As a part of the preparatory discussions concerning harpsichord sound, the authors of this article visited the instrument collections of the Fenton House and the Royal Academy of Music Museum in London during summer 2025, including many kinds of European seventeenth- and eighteenth-century harpsichords and virginals.

The acoustic considerations and historical methods of the study are based on a review of relevant analysis-synthesis literature on string vibration and inharmonicity, body resonances, attack transients and the dynamic range of harpsichord sounds (Fletcher and Beebe 2010; Beurmann and Schneider 2008; Välimäki et al. 2004; MacRitchie and Nuti 2015). These findings were then compared with historical descriptions and performance practices to identify points of convergence and divergence.

This study, in addition to empirical and historical methods, is grounded in the theoretical framework of humanistic timbre research and historical thinking. The analysis is informed by the material turn in musicology, which emphasises that musical phenomena, such as timbre, emerge through the interplay of material, bodily and meaningful interactions rather than being reducible to either physical facts or cultural conventions alone. Drawing on recent scholarship (e.g. Wallmark 2022; Van Elferen 2017), the study approaches timbre as a multidimensional phenomenon, historical, cultural, aesthetic, semiotic and philosophical, while also considering perceptual and embodied aspects.

The interpretation of historical sources is thus not limited to their factual content but also involves a hermeneutic reading that situates descriptions of timbre within their broader cultural and historical contexts. Acoustic data are similarly analysed not only for their measurable properties but also for the ways in which they afford meaningful multisensory experiences for performers and listeners, both past and present. This approach enables the integration of empirical findings with humanistic inquiry and supports a historically conscious interpretation of the harpsichord's rattle as an expressive and culturally embedded phenomenon.

As Gerritsen and Riello (2021) argue, examining material objects helps historians uncover social, economic and cultural relationships and sets the stage for the exploration of how material culture can transform historical narratives. When situated within historical contexts, timbre emerges not merely as an acoustic phenomenon but as a medium, a concrete and culturally embedded expression (Sterne 2003; Delpech 2019; Wallmark 2022). The conclusion of the article considers the sound created by playing the harpsichord from the perspective of historical consciousness (Rüsen 2004; Seixas and Morton 2013). This view offers a perspective on the harpsichord timbre, presenting the harpsichord as an instrument with a rich and expressive dynamic range, versatile playing techniques and performance practices valuing the material qualities of its timbre and aesthetics, even drawing on ideas associated with percussion instruments such as the *tambourin*.

## Abbé, Harpsichordist Saint Lambert and his Description of the Harpsichord Rattle

The idiomatic rattle seems to be greatly appreciated in the above-mentioned French historical descriptions of the harpsichord sound. Moreover, some authors writing about harpsichord technique point out the importance of repeating the sounds or chords to emphasise and manipulate the valued croquant materiality of its sound.

The harpsichordist and *maître de musique* Monsieur de Saint Lambert (1707), in his treatise on basso continuo playing *Nouveau Traité de l'accompagnement du claveçin, de l'orgue et des autres instruments,* points out several specific basso continuo styles or techniques producing maximum amount of rattle. The book is intended to provide general guidelines for playing basso continuo *comme il faut*. The chapter, *Du goût de l'accompagnement*, focuses on the questions of accompaniment's support, the adjustment of the accompaniment's dynamics to the singer's vocal dynamics. The author sums up his guidelines: '... in one word, one must make as much sound as the voice but also take care not to overpower it' (Saint Lambert [1707] 1991: 61).

After certain guidelines for correct and interesting voice leading and doubling of parts, Saint Lambert describes numerous ways of playing *arpeggiando* in a delicate manner. He even encourages players to repeat the chords by arpeggiating them 'in ascending and then in descending' order (Saint Lambert [1707] 1991: 110), or to dwell upon some filled-in chords at length and then to repeat only single, casual notes, here and there 'with such discretion that it seems as though the harpsichord gave them up all by itself, without the initiative of the accompanist' (Saint Lambert [1707] 1991: 111), but restricts this style to recitatives without a steady metre. Saint Lambert ([1707] 1991: 111) maintains that 'at other times' the harpsichordist playing basso continuo and doubling parts might restrike all the notes one after another in a continual repetition 'thereby drawing from the harpsichord a crackling [*petillement*] a bit like a volley of musket fire'.
He continues:

> ... but after having made this agreeable clamor [*agréable charivari*] for three or four measures, one then stops short on some great harmonic chord (that is, one without dissonance) as if to rest on it from the strain of making so much sound (Saint Lambert [1707] 1991: 112).

The term *'Charivari'* [tumult or chahut] is an insightful choice, as it has also referred, since medieval times, to a desired deliberately manufactured noise, a noise that creates a certain buzz, often used to arouse excitement, anticipation and even irritation. *Charivari* or *skimmington* (or *skimmington ride* in England; German *Katzenmusik*) was a folk custom in which a mock parade was staged through a community accompanied by a discordant mock serenade. *Charivari* was an appropriate method to stir up mayhem at carnivals, processions or similar gatherings. A *charivari*-like sound is usually created by a mishmash of rather unorthodox percussion instruments or objects like rattles or ratchets that were used. Illustrations and paintings show that charivari also included some harsh and brutal vocal singing, as in this famous illustration (Fig. 1) from 14th-century medieval poem the *Roman de Fauvel* (Radomme 2017: 344). The image depicts the tambours and many sorts of metal or wooden cutlery as a part of the *charivari* soundscape.

What is interesting in this passage is the description of the timbre and the specific tangible and auditory qualities of the desired sounds. It seems that Saint Lambert, who flourished around 1700 in Paris, like his colleague Jean-Philippe Rameau (1683–1764), agreed on this contrasting dimension of the harpsichord sound, a sort of charming clamour (*bruit*), which is therefore even emphasised by continuous repetition. Intuitively, it's easy to maintain that the clamour, rattling or noise (*bruit*) are much easier to identify and perceive in a repetitive chordal musical texture, since the actual beginning of each chord embeds agreeable *bruit* in its most audible form.

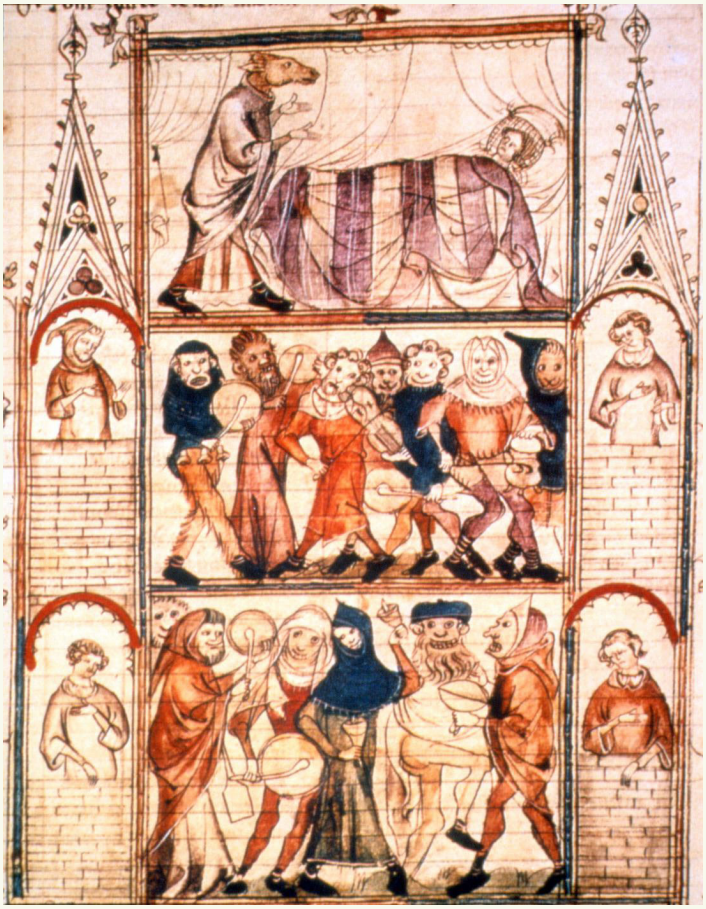
## Rameau's Solo Harpsichord Music and the Register of Deliberate Agreeable Noise

As early as the seventeenth-century, sound philosopher Claude Perrault (1613–1688) gave a clear description of the noisy part of the plucked instrument's sound. Perrault, in his *Essais de physique* (1680), defines the origin of the *cacophonie, le bruit,* and its characteristics. He points out how the noise, *le bruit,* results from several sonorous vibrating instrument parts, each of them accumulating the sound and causing reverberations (Perrault 1680, Part II: 65).

Perrault, in Part II, starts to write on the topic of resonating noise, *le bruit resonnant* (Perrault 1680, Part II: 78). Perrault uses the word 'timbre' and describes a particular case of noise created by metal strings which are stretched over the soundboard (Perrault 1680, Part II: 85–6). This kind of chaotic, tumultuous noise, according to Perrault, is caused by the fact that the first plucked string causes other parts of the instrument to reverberate and resonate as well (Perrault 1680, Part II: 85–6). The early French explorations of acoustics led to ideas about vibrating bodies and air, *le corps sonore,* in Rameau's *Génération harmonique* ([1737]: 2–9).

The composer and harpsichordist Jean-Philippe Rameau's (1683–1764) music may be seen to embody several registers, among which noisy clamour works as a contrast to the lyrical, sweet and melodious textures. Percussive playing is almost completely avoided in French harpsichord technique, since the main challenge is to create a harpsichord touch as effortless, gentle and flowing as possible. The reason is that the beginning of the harpsichord sound is characteristically clear-cut, thus giving a rhythmical impulse as such. The aim also was to technically imitate vocal *cantabile* heard in the ideal French *air,* which was described as sweet, effortless, flowing, engaged, natural, well attended, uniform and even [*douce, facile, coulant, lié, naturel, suivi, uni et égal*] by French music commentator Le Cerf de La Viéville ([1705–1706] 1972, premier dialogue: 22) and 'natural, simple and naïve' by composer Blainville ([1754] 1974: 85). Rameau describes in his *De la méchanique des doigts sur le clavessin* (1724) harpsichord technique as follows:

**Figure 1.** *Le charivari* in the illustrations of the 14th-century *Roman de Fauvel.*



> The fingers must drop on the keys and not hit them: moreover, they must glide [*il faut de plus qu'ils coulent*], so to speak, from one key to another when playing successive notes, which will give some idea of how gently [*la douceur*] one has to start. ....
>
> Never make the touch of your fingers heavy by the effort of your hand. On the contrary, let it be your hand, which, by supporting your fingers, makes their touch lighter; this is of great consequence. Observe a high degree of evenness [*égalité*] of movement among all the fingers and, above all, never precipitate these movements, for lightness [*légèreté*] and speed [*vitesse*] are acquired only through smoothness of movement and it is often the case that hurrying too much we lose what we are seeking. (Rameau [1724] 1958: 17–18.)

Rameau ([1724] 1958: 19) is the only *maître de la musique* (metaphorically) to mention percussive instrument-like mallet technique as a part of the harpsichord playing. In the same treatise, he points out the percussive nature of his rhythmical *arpeggiando* figures called *batteries,* which are played by moving the hands in 'consecutive movements of the batons of a *tambourin*'. These batteries take place in a piece called *Les Cyclopes,* which is a perfect example of this more rattling and clattering register of Rameau's music also found in his orchestral works and *opéra-ballets.*

The repetitive, consecutive (the word Rameau uses is *consecutif*) movement is needed to maximise the noisy component at the beginning of each eighth note (or sixteenth note). The beginning of the harpsichord sound, at the initial pluck, is mostly made up of this *cacophonie* caused by the actual string itself, the plectrum and the sympathetic sound of the other vibrating strings nearby, the soundboard and other sonorous instrument parts. In a way, each beginning of the harpsichord sound includes an element of rattling almost like a *tambourin*.

## Acoustics of the Harpsichord

The harpsichord produces its sound through mechanised plucking of the strings (see Fletcher and Beebe 2010; Fletcher and Rossing 1991; Campbell et al. 2004). When a key is pressed, a jack is raised and the string is plucked by a plectrum. The resulting horizontal and vertical vibrations are coupled to the soundboard and amplified. When the key is released, the string vibrations are damped by a damper felt. Dampers are not always necessary in the highest range of the keyboard where the sound decays fast.

In comparison to gut or nylon strings used in many other plucked string instruments, metal strings can be thinner and strung at higher tension. This allows for a more efficient transfer of energy to the soundboard, and higher resulting loudness. They also absorb less of the higher frequencies internally, which results in a brighter timbre (Fletcher and Beebe 2010).

Harpsichord sounds can be very rich, especially in the low range where the string is typically plucked further from the midpoint than in the treble, which results in a higher number of harmonics. Strings that are plucked near the midpoint will, in contrast, lack energy at every second harmonic and therefore sound hollower (Fletcher and Rossing 1991). A third characteristic of harpsichord string vibration is inharmonicity. Due to string stiffness, the frequencies of the harmonics are systematically stretched from exact multiples of the fundamental frequency (Fletcher, Blackham, and Stratton 1962). Although the effects of this kind of inharmonicity are weaker than in the piano, for instance, it might be audible in the lowest two octaves (Välimäki et al. 2004), giving the tone a sense of naturalness and warmth (Fletcher, Blackham and Stratton 1962).

The resulting sound is also affected by the plectra. When a key is pressed down, the respective jack moves up and the plectrum lifts the string before bending so much that the string slips free. The bending behaviour of the plectrum depends on plectrum geometry and material. Measurements have revealed that the shape of the plectra has an influence on the resulting sound in terms of sound level, spectral centroid and decay time (Paté et al. 2017a).

Finally, the string vibrations are amplified through coupling to the soundboard, and the soundboard vibrations are transmitted to the air. The harpsichord's sound is greatly influenced by the soundboard's resonance characteristics. These are determined by the shape, stiffness and material of the soundboard, as well as the resonance behaviour of the air enclosed in the case (Kottick et al. 1991). The lowest resonance at around 30 Hz is important to the instrument's bass response. The very dense resonance structure across the entire audible range contributes to the harpsichord's rich overall sound quality and varies between instrument types such as Italian and northern harpsichords (Fletcher and Beebe 2010).

Due to the string being plucked, the initial period of the sound is described by several time-varying spectral and temporal phenomena (Beurmann and Schneider 2008). Weyer (1976a, 1976b) describes that, during the first few tens of milliseconds, these variations produce a bright and noise-like sound: this initial brightness is visualised well by Perng (2012, Fig. 5.6). The transient may also contain a short-time initial sharpening of the pitch due to string elongation during plucking. Proportional to the distance of 2–3 mm that the jack and the plectrum travel (Perng 2012), this elongation might have a significant effect. Beurmann and Schneider (2008), however, did not observe this effect. This was due to an impulse-like excitation instead of a triangular initial string shape, as is evident from their measurements of string velocity of a Ruckers 1628 instrument. Another important part of the harpsichord sound comes from the percussive noises caused by the key hitting the key rail or the jack hitting the jack rail. They can be controlled by the performer by varying the key pressing force. Penttinen (2006) observed that these key noises can significantly amplify the body resonances through direct mechanical coupling. Before the main string vibration dominates, a short high frequency pretransient can be observed, corresponding to the vibration of the plectrum as it bounces off the string (Gäumann 2003). Although small in amplitude, this pretransient was found to contribute to the brightness of the sound.

Regardless of how much energy the player puts into the pressing the key, the amount of energy transmitted into string vibration is rather unvaried. The dynamic range of string vibration is therefore very modest. Penttinen (2006) reported that listeners perceived an average increase of +1.68 dB in loudness between high- and low-key pressing forces, due to increased amplitudes in the lowest harmonics. Physical measurements of a historical 1788 Taskin instrument by MacRitchie and Nuti (2015) showed similar results, in accordance

with historical descriptions of differences between the hard and the soft (or struck and pressed) touch. In a perception experiment involving a free-playing task, harpsichordists perceived a difference between two plectra voicings in perceived loudness of the sound and hardness of the plectra (Paté et al, 2017b) which corresponded to differences they measured in sound level and in the minimum force required to trigger the key. Interestingly, the study showed that changes in plectra hardness were experienced in a multisensory way and participants' descriptions of sound and touch perceptions were often entangled.

Dynamic variation during playing, however, is mostly attributed to musical means: controlling the number of onsets (Paté et al. 2017b). Higher loudness can be achieved by playing shorter notes in fast succession or by striking dense chords at once, emphasising the noisiness both through relative prominence of attack transients and through direct mechanical coupling of key noises to the instrument body. Loud material should, consequently, also be composed in a way to accommodate this timbral noisiness.

## Historical Thinking and Sounds from the Past

The material turn helps us to understand that musical phenomena, such as timbre, are not mere physical facts or cultural conventions, but rather emerge through material, bodily and meaningful interactions. Our article combines perspectives from acoustic measurements, historically informed performance and historically oriented listening experience, and provides a concrete example of a material approach to historical topics.

Research into timbre has long viewed sound either as a purely material phenomenon or as a purely perceptual quality. Van Elferen (2017: 626) describes the phenomenon as the 'timbre abyss', as this binary has characterised the definition of the object of study, research methods and the interpretation of the meaning of timbre. Wallmark (2022) describes timbre research as having interdisciplinary origins, but there have been few attempts to combine different research approaches. From a humanistic perspective, timbre has been seen as a historical, cultural, aesthetic, semiotic and philosophical phenomenon, but humanists rarely include the perspectives of perception and cognition. In the field of empirical research, on the other hand, musical and contextual aspects are often left out of consideration (Wallmark 2022: 13).

The study of timbre can unite these different research traditions. The material turn makes it possible to examine sound with physical, objective and measurable parameters, at the same time as considering the interaction of people, for example players, composers, instrument makers, listeners, researchers, critics and philosophers, with material objects. The historical perspective, however, imposes its own requirements for defining the starting points of analysis. The examination of historical phenomena always involves choices and is therefore never neutral or objective.

The starting point of cultural research on sound and soundscape research is to combine the study of physical sounds with a cultural context and examine sounds in relation to how people have responded to them (Feld 2012). Research on the soundscape of 1500 to 1800 has shown how sounds were a central part of everyday life. Church bells, merchants' shouts, music and the noise of cities created a sense of community and built social relationships. Sounds served as information carriers and helped people locate themselves in time and space (Garrioch 2003; Dufourt 2025). For example, the *charivari* nature of the harpsichord's sound (noise, clamour, even annoying sound) is associated with historical communal experiences, such as carnivals and folk traditions, where sound has been part of community celebration and creating atmosphere.

When we examine the choices and changes in historical writing, we speak of historiography. Historiography therefore takes existing writings and research as its subject and adds to our understanding of the changes in interpretations of history (Burrow 2009; Tosh 2015). As our article presents, there are descriptions and reflections on the rattle sound of the harpsichord dating back centuries. Historically informed performance approaches have been used in an effort to reach the sounds and intentions of the past and to apply those perspectives to today's performance practices. Historiography helps, in this way, to understand historical continuities and discontinuities in harpsichord playing.

Eighteenth-century writers cited above appreciated the rattle of the harpsichord's sound for several reasons. The variations in sound create contrasts between bright pure notes and rattling sounds, which can create tension or drama, while the variation of the rattling sound enlivens the dynamics and can be used to emphasise rhythmic precision. Historical descriptions, combined with acoustic mapping of the instrument's acoustic behaviour, may free the player's imagination and sensitivity allowing them to better exploit the kaleidoscopic richness of the harpsichord's sound, which includes the original, croquant sound as an essential part of it.

Our topic leads us to discuss the concepts of historical thinking and historical consciousness (Rüsen 2004; Seixas and Morton 2013). The past is of interest and has many interpretations, as it is the basis for understanding who we are (Seixas and Peck 2004: 110–1). Many different images of the past are created not only through historical research, but also through films, textbooks, fiction and all kinds of stories. Seixas and Peck (2004: 110) emphasise that the past cannot be reached directly, but that six matters need to be considered, some of which we have discussed in this article[1]. We have examined the significance of the noisy part of the harpsichord sound and used reliable contemporary sources. Acoustic studies show a material continuity in the sound of the harpsichord regardless of the century and the instrument. The harpsichordist and listeners experience the delicate sound world created by the harpsichord in music and can thus reach some aspects of the experiences of people in past centuries.

Historical harpsichords and replicas of old harpsichords and notated music make it possible to play, study, listen to and experience old music. But it is easy to see that rooms, salons and performance spaces are different today than they were in the eighteenth century, and it would be an interesting topic for further research to examine social situations related to music from a material perspective of acoustic spaces: (i) who could hear the harpsichord being played, and who had the opportunity to play it themselves? (ii) in what kind of environment did this listening experience, in which hearing involves an unconscious understanding of the material quality of the sound source and space, and is now understood as multisensory, arise?

Instrument making has always utilised the latest technology of its time, and new innovations change the possibilities for musical sonority, and aesthetic expectations change (Dufourt 1991). Although the music of the nineteenth and twentieth centuries utilised new types of sonority in instruments, the harpsichord is still actively played. The nineteenth century also saw significant changes in the way we understand sound and hearing, and in our relationship with the audible present and past. As Jonathan Sterne (2003) noted, from around 1750 onwards, sound and hearing became a subject of study in themselves, whereas previously these have been examined through, for example, the study of music: 'So, too, transformations in sound, hearing, and listening were part of massive shifts in the landscapes of social and cultural life of the last three centuries.' (Sterne 2003: 2). Making this transformation visible or even audible is one of the results of our article. By examining the sounds of the past through a material perspective, we can grasp this transformation, which has remained largely in the background of music studies, hidden from view, at the core of music, sounds and human interaction. The rattle sound of the harpsichord leads us to seek an experiential answer to the question of how historical consciousness can help us understand the difference between human perception in the past and the present.

## Conclusion: The Materiality of the Harpsichord Sound as a Dimension of the Harpsichord Pedagogy, Music History Pedagogy, and Research

The vibrating and rattling harpsichord sound causes all the neighbouring strings to resonate as well, and the whole instrument, along with the instrumentalist, is vibrating too, as if electrified. The eighteenth-century French sources reveal how the musicians, composers and early acousticians were fascinated by these sonic features. What kind of humanistic-hermeneutic meanings this phenomenon creates is a complex question providing each with their own singular experience. For Denis Diderot (1713–1784) the harpsichord was quintessentially the instrument representing the human body, its nervous system and emotions, too (Robichaud 2017: 40). The connotations of the metallic tinkling sonorities of the harpsichord sound may, on the other hand, be associated with valuable objects like jewellery, gold and coins, all of which were associated with wealth and possessions. The *tambourin*-like rattling and tinkling timbre may refer to the origin of the harpsichord as a cousin of a *cimbalom* and *dulcimer.* It may, therefore, be experienced as an archaic part of the harpsichord sound.

What does the listening to sounds tell us about the materiality of our surrounding world? Why do human beings crave this kind of material, even a noisy layer of sound? Because listening is a multisensory experience (O'Callaghan 2012), we gain more information about

sounds, when their beginnings contain information concerning the concrete materials causing the sound. By listening to the materiality of the sound, we get information about the shapes, surfaces, interiors, speed and directions of the heard sounds (Ihde 2007: 61–8). In the primal, sensory experience, the information embedded in the materiality of the first beginning of a sound is rich, since it is connected to our ability to hear specifically, which material is causing another to vibrate. The listening experience is a manifold, bodily event including a vast amount of tactile and kinaesthetic dimensions, and without the informative first beginning of the sound we would know less about our surroundings (Ihde 2007: 61 and 67–8).

How is this rattling noise then shaped by the performer's embodied interaction with the instrument? In speaking about harpsichord pedagogy, it's valuable to recognise the role played by the beginning of the harpsichord sound (the attack) and by its repetition, i.e. 'the number of onsets' (Paté et al. 2017b) in creating a dynamically versatile, vibrant musical way of playing the instrument. This functions like a contrasting timbral register that provides dynamic possibilities. The acoustic knowledge concerning the harpsichord timbre helps us to pay attention to the ways in which harpsichord nuances are created in music and are often notated in the original scores. In the scores, the textures including, for example, dense repetition of singular notes or chords, may refer to enhancing the harpsichord's rattling timbre and thus to boosting the loudness of the sound in case this is needed.

Again, considering the insights of this article related to harpsichord pedagogy, the restriking sometimes performed as a rolling *arpeggiando,* can be done subtly by letting the sound linger and creating dynamic fluctuation without aiming at fierce *crescendos*, for example, as described by Saint Lambert, ([1707]1991: 111). One could think that even ornaments like *tremblements* and *pincés,* essential for harpsichord expression, are vibrant because of the elevated timbral effect caused by their vast amount of attack transients. The ornaments can be heard clearly since the repetitive attack transients make them louder (Paté et al. 2017b). The ornaments sculpt the auditory experience of the played harpsichord music like thick oil paint strokes of lead white *impasto* in an oil painting.

In acoustic research, the harpsichord's dynamic range and timbre should therefore be considered together, in a way that an analysis of isolated sounds cannot achieve. The varied historical and contemporary descriptions of the attack transient, such as sharp, percussive, noisy, distinctive, clear-cut, consonant-like, croquant, rattling, clamouring, crackling, buzzing, cacophonic, tumultuous or biting, motivate further research into the harpsichord's semantic timbre space (Saitis and Weinzierl 2019) to account for the extended dynamic range and the intensification of the rattling characteristics through musical means.

The rattling, consonant kind of part of the harpsichord sound gives us an abundance of auditory information about the material and shapes of the instrument, not to mention the quality of the touch filled with life and presence. During an interview, harpsichord builder Andrea di Maio (2025) talked about the clarity and presence of the very first beginning of the harpsichord sound, which is guaranteed by carefully and professionally cut and shaped plectrums. The well-cut plectrum carves the core for the *cantabile* harpsichord sound. Musician Romeo Ciuffa (2025), the owner of the harpsichord collection in *Palazzo Annibaldeschi,* Colle Mattia mentioned the word, *croquante*, describing so well the feature we often desire in the beginning of the harpsichord sound.

To conclude, in this article we have integrated acoustic empirical findings concerning the harpsichord, with historical descriptions of the actual bodily practices used by writers who cherish the harpsichord's rattling, croquant timbre. We find the interdisciplinary approach valuable for encouraging musicologists, music history pedagogues, performers and acousticians to investigate the rich materiality of the specific instrumental qualities, even those ones that are not readily appreciated in the contemporary music field. The specific timbre reveals itself not merely as an acoustic phenomenon but as an event embedded in living musical culture.

## ENDNOTE

1. (i) Evaluating Historical Significance (ii) Evidence: Reading and interpreting both primary and secondary sources. (iii) Continuity and Change: understanding that history is not just a list of events but a complex flow. (iv) Analysing Cause and Consequence (v) Historical Perspectives: developing historical empathy by looking at events through the social, cultural and emotional viewpoints of the people who lived them, rather than judging the past by modern standards. (vi) The Ethical Dimension: evaluating the moral and ethical responsibilities concerning past injustices, recognising how historical interpretations inform contemporary ethical choices (Seixas 2013).

# REFERENCES


1. Belgrano, Elisabeth. 2016. *The Non-Human and the Inhuman in Performing Arts: Bodies, Organisms and Objects in Conflict*. In *Proceedings of Carpa4 Colloquium on Artistic Research in Performing Arts*. University of the Arts Helsinki, Theatre Academy, The Performing Arts Research Centre.
2. Beurmann, Andreas and A. Schneider. 2008. 'Acoustics and Sound of the Harpsichord: a Case Study'. In *Systematic and Comparative Musicology: Concepts, Methods, Findings*. Albrecht Schneider, ed. Frankfurt, M., Berlin usw.: P. Lang, *Hamburger Jahrbuch für Musikwissenschaft*, Bd 24: 241–63.
3. Blainville, Charles-Henri de. [1754] 1974. *l´Esprit de l´art musical ou reflexions sur la musique et ses differentes parties.* Minkoff.
4. Burrow, John Wyon. 2009. *A History of Histories. Epics, Chronicles, Romances and Inquiries from Herodotus and Thucydides to the Twentieth Century.* Alfred A. Knopf.
5. Butt, John. 2002. *Playing with History: The Historical Approach to Musical Performance*. Cambridge University Press.
6. Campbell, Murray, C. Greated, and A. Myers. 2004. *Musical Instruments: History, Technology, and Performance of Instruments of Western Music*. Oxford University Press.
7. Couperin, François. 1716. *L'Art de toucher le clavecin. Gallica*.
8. Delpech, Louis. 2019. 'Zwischen Akustik, Neuropsychologie und Gedächtnistheorie. Episteme der Resonanz im Paris des Fin de Siècle (1880–1910)'. *Zeitschrift für Ästhetik und Allgemeine Kunstwissenschaft* 64 (2): 235–60.
9. Du Bus, Gervais and R.C. De Pestain. *Le Roman de fauvel.* Gallica.
10. Dufourt, Hugues. 1991. *Musique, pouvoir, écriture*. Christian Bourgois, ed. Early Modern Soundscapes. 2025. <emsoundscapes.co.uk/>
11. Feld, Steven. 2012. *Sound and Sentiment. Birds, Weeping, Poetics and Song in Kaluli Expression*. Duke University Press.
12. Fletcher, Neville H. and C. Beebe. 2010. 'Harpsichord and Clavichord'. In *The Science of String Instruments*. T.D. Rossing, ed. Springer: US.
13. Fletcher, Neville H. and T.D. Rossing. 1991. *The Physics of Musical Instruments.* Springer: Verlag.
14. Fletcher, Harvey, E.D. Blackman and R. Stratton. 1962. 'Quality of Piano Tones'. *Journal of the Acoustical Society of America* 34 (6): 749–61.
15. Garrioch, David. 2003. 'Sounds of the City: the Soundscape of Early Modern European Towns'. *Urban History*, *30* (1): 5–25. Cambridge University Press.
16. Gäumann, T. 2003. 'The Pretransient of the Harpsichord Sound. I. Vertical Movement of the Plectrum'. *Proc. Stockholm Music Acoustics Conf. (SMAC'03)*. Stockholm, Sweden,163–6.
17. Gerritsen, Anne and G. Riello. 2021. *Writing Material Culture History*. Bloomsbury.
18. Harnoncourt, Nicolaus. 1988. *Baroque Music Today: Music as Speech: Ways to a New Understanding of Music.* Amadeus Press. Internet archive.
19. Haskell, Harry. [1988] 2001. *The Early Music Revival. A History.* Oxford University Press. <doi.org/10.1093/gmo/9781561592630.article.46003>.
20. Haynes, Bruce. 2007. *The End of Early Music: A Period Performer's History of Music for the Twenty-First Century*. Oxford University Press. <doi.org/10.1093/acprof:oso/9780195189872.001.0001>.
21. Helmholz, Hermann von. [1885] 1954. *On Sensation of Tone as a Physical Basis for the Theory of Music.* Dover.
22. Ihde, Don. 2007. *Listening and Voice. Phenomenologies of Sound.* State University of New York Press.
23. Järviö, Päivi. 2011. *Laulajan Sprezzatura: Fenomenologinen tutkimus italialaisen varhaisbarokin musiikin laulaen puhumisesta*. Suomen musiikkitieteellinen seura.
24. Kottick, Edward, K. Marshall and T. Hendrickson. 1991. 'The Acoustics of the Harpsichord'. *Scientific American* 264 (2): 110–5.
25. Le Cerf de la Viéville, Jean-Laurent. [1705–1706] 1972. *Comparaison de la musique Italienne et de la Musique Françoise.* Minkoff.
26. Le Guin, Elisabeth. 2006. *Boccherini's Body: An Essay in Carnal Musicology*. University of California Press.
27. MacRitchie, Jennifer and G. Nuti. 2015. 'Using Historical Accounts of Harpsichord Touch to Empirically Investigate the Production and Perception of Dynamics on the 1788 Taskin'. *Frontiers in Psychology* 6. <doi.org/10.3389/fpsyg.2015.00183>
28. Munslow, Alun. 2006. *The Routledge Companion to Historical Studies* (2nd ed.). Routledge.

29. O'Callaghan, Casey. 2012. 'Perception and Multimodality'. In *Oxford Handbook of Philosophy and Cognitive Science*. Margolis, Samuels and Stich eds. Oxford University Press.
30. Paté, Arthur, J.-L. Le Carrou, A. Givois and A. Roy. 2017a. 'Influence of Plectrum Shape and Jack Velocity on the Sound of the Harpsichord: An Experimental Study'. *Journal of the Acoustical Society America* 141 (3).
31. Paté, Arthur, A. Givois, S. Le Conte, J-L. Le Carrou, M. Castellengo et al. 2017b. 'Perception of Harpsichord Plectra Voicing'. *Acta Acustica united with Acustica* 103 (49): 685-704.
32. Penttinen, Henri. 2006. 'On the Dynamics of the Harpsichord and its Synthesis'. *Proceedings of the 9th International Conference on Digital Audio Effects (DAFx-06)*, Montreal, Canada, September 18–20, 2006.
33. Perng, Chao-Yu, Jack. 2012. *Physical Modeling of the Harpsichord Plectrum-String Interaction.* PhD thesis, Stanford University.
34. Perrault, Claude. 1680. *Essais de Physique ou Recueil des plusieurs traités touchant les choses naturelles.* Gallica.
35. Pryer, Anthony. 1994. 'Re-Thinking History. What Is Music "History" and How Is It Written? Anthony Pryer Reflects on the Problems of Music Historians and on Some Recent Histories of Early Music'. *The Musical Times 135* (1821): 682–90.
36. Radomme, Thibaut. 2017. 'L'Optimisme de satiriste'. *Cahiers de recherches médiévales et humanistes* Vol. 34: 239–57. Classiques, Garnier.
37. Rameau, Jean-Philippe. [1722] 1986. *Traité de l'harmonie réduite à ses principes naturels. Facsimile edition.* Slatkine Reprints. Gallica.
38. _____. 1724. *De la méchanique des doigts sur le clavessin.* Bärenreiter.
39. _____. 1737. *Génération harmonique ou Traité de musique théorique et pratique*. Gallica.
40. _____. 1760. *Code de musique pratique.* Gallica.
41. Robichaud, Philippe Sarrasin. 2017. *L'Homme-claveçin, une analogie diderotienne.* Classiques Garnier.
42. Rousseau, Jean-Jacques. [1780–1789] 2025. *Dictionnaire de Musique.* Volume 9 in–4°. In *Collection complète des œuvres de Jean Jacques Rousseau*. <www.rousseauonline.ch>
43. Rüsen, Jörn. 2004. 'Historical Consciousness: Narrative Structure, Moral Function and Ontogenetic Development'. In *Theorizing Historical Consciousness.* Seixas, Peter, ed. University of Toronto Press. 63–85.
44. Saint Lambert, Michel de. [1707] 1991. *A New Treatise on Accompaniment.* John S. Powell, transl. Indiana University Press.
45. Saitis, Charalampos, and S. Weinzierl. 2019. 'The Semantics of Timbre'. In *Timbre: Acoustics, Perception, and Cognition*. Siedenburg, K., Saitis, C., McAdams, S., Popper, A., and Fay, R., eds. 119–49. Springer Handbook of Auditory Research, Vol 69. Springer, Cham. <doi.org/10.1007/978-3-030-14832-4_5>
46. Sauveur, Joseph. 1697. *Traité de la théorie de la musique.* Gallica.
47. _____. 1701. *Principes d'acoustique et musique ou systeme general des intervalles des sons & de son application à tous les systêmes & tous les instrumens.* Académie Royale des Sciences.
48. Seixas, Peter and C. Peck. 2004. 'Teaching Historical Thinking'. In *Challenges and Prospects for Canadian Social Studies*, Sears, Alan and I. Wright, eds. Pacific Educational Press. 109–17.
49. Seixas, Peter and T. Morton. 2013. *The Big Six Historical Thinking Concepts.* Nelson Education.
50. Spissky, Peter. 2017. *Ups and Downs – Violin Bowing as a Gesture.* Malmö: Malmö Faculty of Fine and Performing Arts, Lund University.
51. Sterne, Jonathan. 2003. *The Audible Pas*t. Duke University Press.
52. Tosh, John. 2015. *The Pursuit of History: Aims, Methods and New Directions in the Study of History.* Routledge.
53. Van Elferen, Isabella. 2017. 'Drastic Allure: Timbre between the Sublime and the Grain'. *Contemporary Music Review* 36 (6): 614–32.
54. Välimäki, Vesa, H. Penttinen, M. Laurson, C. Erkut and J. Knif. 2004. 'Model-Based Sound Synthesis of the Harpsichord'. *Proceedings. Joint Baltic-Nordic Acoustics Meeting*.
55. Wallmark, Zachary. 2022. *Nothing but Noise. Timbre and Musical Meaning*. Oxford University Press.
56. Wentz, Jed. 2010. *The Relationship between Gesture, Affect and Rhythmic Freedom in the Performance of French Tragic Opera from Lully to Rameau.* Leiden University.
57. Weyer, R.D. 1976a. 'Time-Frequency-Structures in the Attack Transients of Piano and Harpsichord Sounds'–I. *Acta Acustica united with Acustica*. *35*(4): 232–52.
58. _____. 1976b. 'Time-Varying Amplitude-Frequency-Structures in the Attack Transients of Piano and Harpsichord Sounds'– II. *Acta Acustica united with Acustica 36* (4): 241–58.

## FIGURES

**Figure 1.** Du Bus, Gervais. *Le Roman de Fauvel.* Fol 34r. *Le charivari* in the illustrations of the fourteenth-century *Roman de Fauvel.* Gallica.

## INTERVIEWS

Ciuffa, Romeo. 2025. Interview. 24 February.
Di Maio, Andrea. 2025. Interview. 19 February.

## ABSTRACT

Harpsichord sound is recognised by its characteristic rattle, a noisy brittle sound at the beginning followed by the vocal cantabile part. In historical descriptions, this idiomatic rattle seems to be appreciated as a contrast for more flowing and horizontal playing. Many historical treatises point out the importance of repeating the sounds or chords to emphasise and manipulate the valued *croquant* materiality of its sound.

This article aims to investigate the expressive potential of this sometimes-rattling character of the harpsichord sound's consonant-like beginning by integrating historical, musicological and acoustic perspectives. It seeks to demonstrate how material characteristics and performance practices contributed to the instrument's distinctive sound and cultural significance in eighteenth-century music.

The material turn of historical research has led scholars to move from abstract musical concepts to the tangible artefacts and practices that shaped past musical experiences. Recent advances in measurement techniques and computational modelling have enabled a more detailed spectro-temporal characterisation of harpsichord sound and especially of its attack transient, allowing researchers to correlate specific acoustic features with historical descriptions and performance practices.

Ultimately, the study aspires to enrich both scholarly understanding and practical interpretation of harpsichord repertoire. This article does not discuss the *cantabile* playing on harpsichord, which has been addressed in treatises written by François Couperin and Jean-Philippe Rameau, for example.

**Keywords**. acoustics, timbre, harpsichord, *claveçin,* historically informed performance, historical thinking, instrument pedagogy, embodiment, material turn, multidisciplinary research, *charivari,* rattle, croquant, clamour, noise, *le bruit.*

## ABOUT THE AUTHORS

Leena Unkari-Virtanen (D.Mus) is an Adjunct Professor of Music History Pedagogy at the Sibelius Academy, University of the Arts Helsinki. Possessing a diverse educational background with studies at the Sibelius Academy, the Sorbonne, and IRCAM, she has served as a senior lecturer, researcher, and RDI specialist in Finnish higher music education. In addition to her doctoral degree, she is a certified supervisor and consultant, bringing a systemic perspective to institutional shifts within the arts. Her research operates at the intersection of musicology, sociology, and modern pedagogy, encompassing twentieth-century piano repertoire, cultural timbre analysis, and the implementation of interdisciplinary practices in music. Her current work centers on decolonizing music history curricula and introducing materialist perspectives to historic exploration. By examining how music history learning interacts with a musician's evolving professional identity, her research aims to foster more inclusive, diverse, and transformative educational practices. Her extensive bibliography includes peer-reviewed articles, handbooks, and research monographs.

Hanna Järveläinen received the M.Sc. and D.Sc. degrees in electronic and communications engineering from the Helsinki University of Technology (now Aalto University), Finland, in 1997 and 2003, respectively, and the B.Mus. degree in music theory from the Sibelius

Academy, University of the Arts Helsinki, Finland, in 2006. She also studied baroque and vocal ensemble singing at the Schola Cantorum Basiliensis, Basel, Switzerland. She is currently a Research Associate with the Institute for Computer Music and Sound Technology (ICST), Zurich University of the Arts, Switzerland. Her primary research interests include psychoacoustics and multisensory perception. Parallel to her academic career, she is an active musician specializing in early music.

Assi Karttunen, DMus, is a harpsichordist and Adjunct Professor of Artistic Research at the Sibelius Academy, University of the Arts Helsinki. She specialises in performing and researching Baroque music. She also performs in interdisciplinary groups with experimental and contemporary repertory. Karttunen has recorded four CDs of solo works by Couperin, Rameau, Froberger, Lynch and Frescobaldi. As a soloist she has performed in European countries and Japan and she performed with the Finnish Baroque Orchestra for 11 years. She worked for many years (2006– 2016) in the Elysian Fields-workshop. She currently works in the Superpluck contemporary music trio. Karttunen works as a lecturer in instrument pedagogy and early music at the Early Music faculty and at the DocEdu Doctoral school of Sibelius Academy. She has published research in journals like the peer-reviewed quarterly journal Musiikki, Trio Research Publication, Journal of Comparative Literature and Aesthetics (JCLA), and Ruukku Studies in Artistic Research.

Received by the editors 17 December 2025. Accepted for publication, in revised form, 20 July 2026.

© 2026 Assi Karttunen, Hanna Järveläinen and Leena Unkari-Virtanen