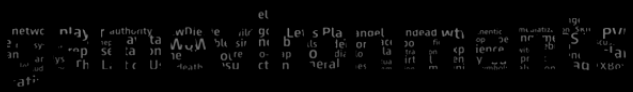

game
narrative

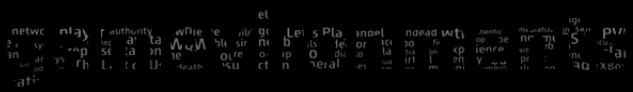


# Issue 14 (2021)

## articles



## research reports



## interviews



## reviews

# Inaudible Systems, Sonic Users. Sound Interfaces and the Design of Audibility Layouts in Digital Games[i]

Eduardo Harry Luersen

**Abstract**
The audible dimension of computer games is revealing of contemporary digital culture and the restructuring of the current media ecology. In this article, I observe some of these rearrangements through a tentative probing of the interfacing conditions of gaming established by their sound design projects. Through a media-archaeological approach, I observe how sonic space is organized, especially in the design of digital games in first and third-person perspective, taking part in the construction of playable audiovisual environments. I begin the article with a brief examination of different concepts of interface, and probe how the sound design of games may relate with previous audiovisual formats. Then, I analyze the particular ways in which computers and humans are interfaced through sound in order to estimate how user interfaces are representative of underlying reorganizations in contemporary sensibility and culture.



**Keywords:** Digital Games, Audiovisual Culture, User Interfaces, Sound Design, Media Archaeology, Media Ecology, Gamification, Industrial Design, gamevironments

**To cite this article:** Luersen, E. H., 2021. Inaudible Systems, Sonic Users. Sound Interfaces and the Design of Audibility Layouts in Digital Games. gamevironments 14, 50-84. Available at http://www.gamevironments.uni-bremen.de.

The sounds heard in digital games have a lot to say about present-day entanglements between technology and society, as material testimonies of the shifts and rearrangements in the media ecology that cut through the fabric of contemporary aesthetics. The strategies for implementation of sound in different stages of digital games' history are in many different forms connected to the material structures and technocultural developments of computer automation, spatial simulation and human-machine interaction. This can be implied by works both in the

fields of game sound history (Collins 2008), ludomusicology (Fritsch 2016, Fernández-Cortés 2017), and media archaeology (Braguinski 2018, Höltgen 2017), albeit marked by the very particular epistemological premises and assumptions that comprise each of them. In this article, I would like to draw from but also contribute to these research fields by analyzing the composites of sound design in digital games as sonic user interfaces.

I begin this article with a brief exploration of the concept of *interface*, observing its possible articulations with previous audiovisual formats in order to henceforth compare it with (and discern it from) the modes of modelling the interface between humans and computers through sound in digital games more specifically. In the setting of the material conditions throughout which players experience computer games, sonic interfaces reveal lingering traces of previous technocultural artifacts with which they share aesthetic predispositions. Such tendencies connect the emergent forms, qualities and usages of user interfaces to previously established media habits. By unraveling the particular role of sound interfaces in instructing the human operation of computer games, I seek to demonstrate how its design relates to a broader context of the management of sensory experiences in audiovisual means of communication.



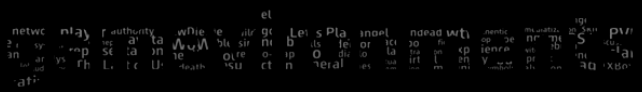
Inquiring sound in games from the perspective of broader cultural and historical tendencies that orient the structuring of their interfaces matters because it allows recognizing the relation between technical media and cultural habits. It helps in accounting for the deeper historical traces of sound interfaces without letting go of their provisional status as design pieces susceptible to further interventions by developers and designers.

Furthermore, the current permeation of cultural forms and social practices with metaphors, methods, values and attributes of games (Fuchs, Russegger and Mañas Carbonell 2013) can be to an important extent attributed to the widespread dissemination of computer-based user interfaces. According to Mathias Fuchs (2012), playfulness does not depend of the voluntary decision of individuals alone, nor is it simply *contained* in objects such as toys or instruments. Playful experiences presuppose the establishment of relational devices to assign the interaction between subjects and objects. Such interfaces also prepare society to imbue a wide array of social activities with game-related rules, behaviors, and paraphernalia, increasingly entangling work, health, politics, war etc. with contemporary gamified processes. This is another significant reason to move forward a research agenda on the interfaces of digital games, even more so in the case of their audible dimension, which has been less extensively studied.



## Relational Effects of Sound Design in Digital Games and Technoculture

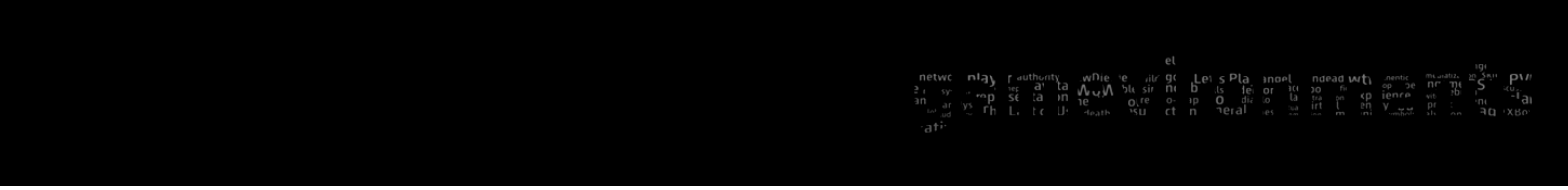
As a way of grasping recursive aspects of the sounds of digital games, I adopt the gesture that Gustavo Fischer (2012, 37) calls "interface retrieval," analyzing the material preconditions that attribute meaning to the experience of playing. This gesture of retrieval is driven by a media-archaeological disposition, which is characterized by rummaging "textual, visual, and auditory archives, as well as collections of artifacts, emphasizing both the discursive and the material manifestations of culture" (Huhtamo and Parikka 2011, 3), while moving fluidly between disciplines. By retrieving the recursive aspects of sound interfaces in games, one can identify genealogical traces in the ways sound interactions are designed, in order to question the recurring *novelty rhetoric* concerning game technology and



aesthetics. Such rhetoric is supported by a chronologically linear historiography that is recurrently voiced about the medium of digital games (Guins 2017, Huhtamo 2005).

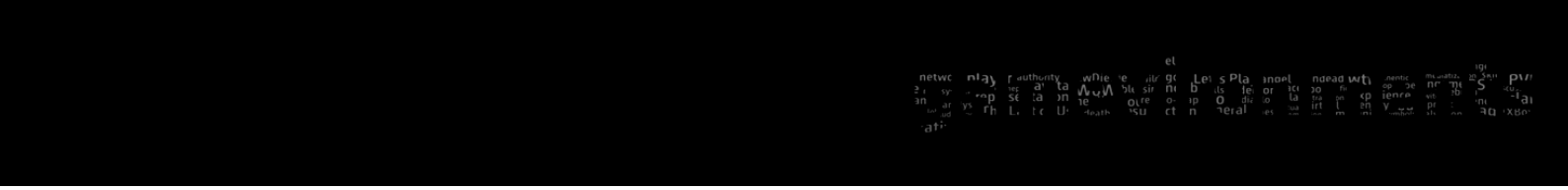
According to Erick Felinto (2011), when combined with a committed attention to the materiality of media, such a media-archaeological disposition allows researchers to grasp the leaps, bounds, and heterochronies that accompany media cultures, which inherently helps in contesting triumphalist, apocalyptic or nostalgic discourses that subsequently occupy the debates on media and technology. Thus, I seek to contribute in unravelling a historical narrative that is too easily calcified in a narrow perspective, usually centered on the inventors, innovation, and in the games themselves (Tobin 2014, 2), in order to re-evaluate such artifacts as part of a wider technocultural fabric.

Lev Manovich (2001, 69) uses the term "cultural interfaces" to frame the graphic user interfaces of websites, hypermedia applications, digital games and other computer-based applications as cultural objects. According to this perspective, computers should be seen as more than just tools, but as universal media machines, through which users manipulate predominantly cultural data: texts, photos, video, songs, documents, 3D environments etc. Manovich suggests that the human-computer interface is "complemented by the human-computer-culture interface, (...) as a cultural interface" (Manovich 2001, 80). For him, the language that is presented in the surface of graphic interfaces is easily understood by users due to its familiarity with previously known formats. Such interfaces perform the connections between very differently operated means of representation, as well as the most particular computational properties that are increasingly pervasive in contemporary culture.



Manovich presents such observations especially through an analysis of computer screens, understanding them as privileged *spaces* to the observation of convergent visual compositions that result from human-computer interaction design. I want to propose herein that the traces of other media in digital games can also be analyzed all the way through the construction of sonic cultural interfaces. This task leads to many particular challenges, though, that result from the peculiar properties of each sensory medium of expression. When I stop the playback of a movie, I can no longer watch its content, but there is still a frame left to analyze. When I stop the playback of sound, though, what is it there left? As an alternative, one can explore the notion of *sound interface*, to compare the different ways of organizing the sonic discourse during gameplay, and especially the conditions of experience they provide to the player/user.

In order to do so, I consider Ian Bogost's (2015) insights about human-computer interfaces. Bogost suggests that the historical development of software as tools for working has made the formal and aesthetic expectations concerning human-computer interfaces, since their conception, subordinate to their functional aspects. A good piece of software, therefore, would be the one that most efficiently presented what is called, in user experience design (UX Design), transparency – it should clearly display its mode of usage and fulfill its more immediate expectations. Bolter and Gromala (2003) suggest that this concept of interface transparency is highly problematic, since it suggests that the software's operational interface should function like a window-like a somewhat *neutral* operator, which disappears while promoting its functional character. Bogost suggests that this conception is especially problematic when designing more expressive cultural forms, after all, a merely functional design feeds back the production of often-familiar interfaces, hindering the potential differentiation that is usually an important attribute of expressive forms.



In fact, interface design encompasses the particular ways of constructing ways of seeing, listening and sensing the audiovisual game worlds, which generate the preconditions of user experience, the models for perceiving the game. According to Rafael Cardoso (2016, 236), design is a discipline that acts on modelling the material conformation of artifacts, and inasmuch as fields like architecture, fine arts, and engineering, it operates at the intersection of material objects and social practices. In particular, I wish to highlight here the way in which design projects carry within themselves traces of both declared desires and silent motivations that lead to the material conformation of interfaces. Here, this means that the way in which the apparatus of digital games is constructed crystallizes very specific imaginaries and worldviews. When analyzing game sound interfaces, I seek to consider such models into this broader perspective.

A complementary, productive addition to bring sound design closer to a notion of interface is what Alexander Galloway proposes in *The Unworkable Interface* (2008, 941). According to this perspective, the interface is, primarily, a *relation effect* that produces coherence between otherwise incompatible domains. Instead of the metaphors that compare interfaces to windows *to* a given place, Galloway defines them as means to communicate *between* spaces, giving them a *threshold* status. In the specific case of digital games, the putting up of an interface is limited by the set of techniques that create information to mediate the relation between player and game. Such a collection of techniques encompasses different ways of managing the audible dimension. This is what I will explore in the following section.

## Sound Interfaces in Digital Games and Beyond Them

Considering the elements that establish relation effects between otherwise uncombinable domains, while still preserving a media-archaeological volition, would recommend contemplating the spectatorship environment of classic cinema, the movie theater (with its set of sensory techniques to communicate with the audience), as such an interface. For José Cláudio Castanheira (2010, 116), even the most radical experiences of videogames, music videos and hybrid manifestations of other media, are indebted to some degree to a language developed for films (he is referring more specifically to the cinematographic apparatus). One can think of the gradual development of an immersive apparatus for movie exhibitions as a sort of interface. Even though immersion is a cliché in game studies, the relation between game sound design and the demand for the player's attention through techniques developed to interface with the player seems to understate the importance of the spatial layout designed for movie exhibitions in especially prepared theaters.



The idea of immersion in games is usually associated with a presumed nature of auditory perception, and this conceptualization of listening as an essentially immersive phenomenon is constantly restated in common sense narratives on the cinematographic sensory experience-an idea that Jonathan Sterne (2012, 9) describes as part of a broader "audiovisual litany." In effect, the cinematographic apparatus *is designed* with stereophonic features, and games feed from the effects of techniques created to build these *involucra*, such as Dolby's *surround*. This is part of the larger project to produce cinematographic audiovisual realism based on spatial distribution. In the 1950s, the development of stereophony stimulated the exploration of – again, not natural but *naturalized* – immersive constructs. Stereo sound allowed the design

of environmental listening models based on a three-dimensional Euclidean notion of space, in a way analogous to how the aerial perspective conceived an optical model for realistic painting.

The Dolby Atmos system enhanced the possibilities of simulating spherical auditory spaces in movie theatres, from the architectural project of the room to the distribution of speakers to support the sound reproduction system. In order to build a space in which the audience was supposed to be immersed, the system projects the virtual listener relatively centralized with respect to the schematics of the built environment.

A similar spatial arrangement is put to work in many audio implementation engines for games. To locate the sound objects in games, dynamic audio systems automatically update auditory instances for the avatar (which is normally positioned in the center of such a spatial construction) according to the performance of the player. In-game sound objects and events in the game environment are also heard with regard to the position of the player. At this point, it is pertinent to mention the *middleware* applications[ii]. Such tools allow the designer to set parameters for the digital signal processing to be performed during gameplay – of course, operating in the game as a background process that manages the audio performance.



With the adoption of the *Dolby* system as a standard in movie theater circuits, still in the 1970's, frequency range, sound compression efficiency and number of soundtracks that could be manipulated in sound design for films were enhanced. According to José Cláudio Castanheira and Vinícius Andrade Pereira (2011, 137), this potentially favored the development of more action-oriented movies like *Star Wars* (1977), among other films that could appeal more immediately to the spectator's

body. Action-oriented movies were also more suitable for experimenting with sub-bass sound frequencies (below 30 Hz) and more complexly designed sounds. It would not be far-fetched to say that such elements have left important marks on the way sound is designed as an interface for the experience of digital games, given that digital game aesthetics are so often dependent of a sense of action that is implied in gaming experiences. This is mostly the case when considering the *tactile* experience involved in certain cinema aesthetics (Shaviro 2015, 66) that are repeatedly remodeled in games, such as sound effects prepared specifically for subwoofers (hyperreal explosions, blows and impacts), or the incremental use of very high frequencies (clinking, wheezing, and the recurrent simulations of *tinnitus*).

As sound interfaces, these models of synchronous audiovisual and tactile forms are actively employed to build an imaginary but also very material bond between the player and the gameworld environment during the gameplay experience.



## The Player/User as a Gravitational Axis in the Audible Experience of Digital Games

In his *Passagenwerk* (1927-1940), Walter Benjamin defined gambling as an immersive experience that converts "time into a narcotic," arguing that "to the phantasmagories of space to which the *flâneur* abandons himself, correspond the phantasmagorias of time indulged by the gambler" (Benjamin 2009, 12). Benjamin emphasizes the gaming competence for exchanging the use value of the player's habitual temporal experience, in particular. There are, of course, important differences in the sense of passing time while gambling and while playing with computers. Whereas, in the Benjaminian description of gambling, the mandatory condition of expectancy plays a fundamental role in what concerns the player's attention, in digital games the

machine's indelibly participates in organizing the operations and engendering synchronous sights and sounds to mediate the player's experience within game worlds. The two cases are marked by different technocultural environments, which entangle the particular conditions for experiencing time in the case of each of these cultural and social practices. The stimuli of pretense immersive techno-aesthetics involves the gamer's perception of playing according to a previous Gestalt of the experience. While gaming, the player's experience of time simultaneously works with a memory of spaces to make sense of the simulated environments.

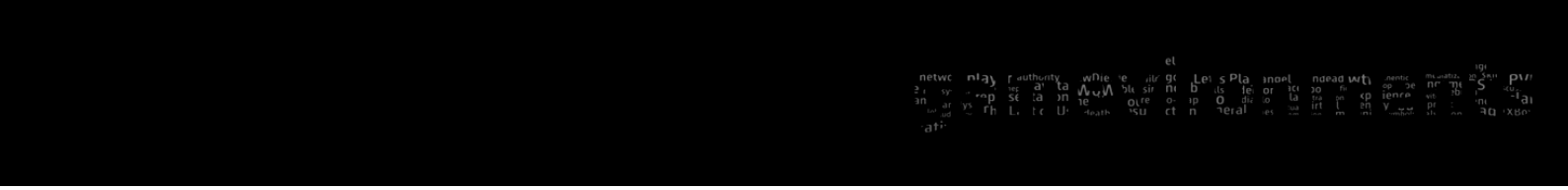
According to Mark Grimshaw (2016, 465), through auditory perception humans are able to experimentally formulate and imagine aural topographies, in a process of adaptive plasticity to perceive spaces. Artificial spaces can be imagined due to previous, experiential auditory conditions, which are evoked as part of simulated environments. The feeling of *being there* in game environments stem from a series of experiential preconditions, with the techniques that create the imagined worlds of games being completed by the player's involuntary recollection of past experiences. Here it is important to develop a bit further about two of these settings.



In the first place, it is pertinent to note that the game engine – the software comprising a series of subroutines to manage the game world's logic and its horizon of possibilities – also operates as a sonification engine. That is, it sets the defining parameters to sonify the player actions and reactions in the game world. The engine sets the player's possibilities of engagement in the playful world through sound from the beginning. Such sonification of the player (user), the conversion of a series of actions into a pre-ordered audio diagram, is partly responsible for the sensation of immersion in the case of digital games. For Grimshaw (2016, 466), these sonified actions should correspond to a realism of form, more than to a realism of content

(that is, sound should remain congruent within the rules and the imagined environment created for the game, constantly responding to its own formal conventions). A variety of sounds derived from the games' designed world, including the player's avatar actions, start to coexist temporarily and, as the game progresses, the different sounds dissolve in the experience of the game worlds. This explains why wandering in the game worlds is an irreplaceable condition for the sensation of immersion.

Secondly – and this is more obvious in the case of games developed in first and third-person perspective – the player is more often than not continuously represented as the center of spherically imagined auditory spaces. Even when the avatar is not visually positioned in a central position, acoustic stimuli seem to come equally from all directions, with the avatar's position understood as a sort of gravitational center for the occurring actions in game worlds: this is a model that turns the imminently spatial character (public, social) of sound into and intimate and individual construct. According to Grimshaw (2017, 292), while the visually stunning landscapes of game worlds may help in making a player feel present in game spaces, the auditory dimension of these worlds is the main responsible for evoking a sense of presence in the player. Due to the nature of human psychoacoustic experience, namely omnidirectional perception of sounds and quick reactive impulses to decipher sonic events, the sense of presence provided by sounds in game worlds shares a common ground with the sense of presence they provide in non-ludic environments. In my perspective, one should proceed cautiously with such an assumption, though. By emphasizing the phenomenological experience of listening while playing, there is a risk of glossing over this sense of presence while experimenting the audiovisual game worlds. Such experience is not something given, and the design of realistic sound



interfaces for contemporary digital games encompass the creation of models that *produce* a commonly mnemonic, yet media-specific sense of presence.

In my view, this sense of presence produces what I would call a *mnemonic gravity*, relating to how players as subjects apprehend and re-enact sounds. Sound is a natural-cultural phenomenon, by which the agencies in the world make themselves noted as modulations and interruptions in vibrations between the moving bodies. The human perception of this phenomenon, per se, our affective appropriation of it, occurs invariably through our body, the interfacing apparatus between the audible dimension of the world and human self-consciousness – which converts this phenomenon into an object of perception. In this sense, it seems important to highlight how sound is perceived not only by the ears, but by the entire body. Our skin, bones, nerves, muscles, as well as our affective and psychological dispositions, conduct and react to vibrations as a whole (Schulze 2019). Memory also acts to evoke and reconstruct past experiences of these stimuli. As I understand it, our bodily experience is therefore remembered and constantly simulated (more often) as simplified gameworld-specific prosthesis for audiovisual and haptic perception. Traditionally, the player's avatar in the game is built-in as the gravitational axis around which the game environment revolves, and the vanishing point where all the actions of non-human agents in the game world would (seem to) converge. This prosthetic body is audiovisually reconstructed inside the game as a sensory interface, the often humanoid figure of the avatar (humanoid less for graphically or sonically *representing* a human character, than for formulating an ideal model almost entirely based on its sensory apparatus). The audible dimension of digital games shows that sound interfaces are recursively feeding back a mnemonic compulsion to design anthropomorphic models of perception.

By identifying our familiar human sensory experience as a primordial model for synthetic interfaces, this anthropocentric bias reveals an inclination to produce effects of immediacy that end up constituting "homophilic" design practices (Reed 2018, 20). Moreover, understood here as an inherent design problem, it should be taken into account that this predisposition becomes inscribed in the technically constructed interfaces themselves. While embodied in anthropomorphic interface models, such a pattern implies an orderly systematic regularization of similarity. In addition to giving vent to a sort of anthropological chauvinism which has been responsible for several regressive types of dehumanization, this indefatigable pursuit to match the most familiar standards ends up mitigating techno-aesthetic alternatives that could nurture more thoughtful potentialities for human-computer interfaces. If the recursive imitation of anthropological behaviors with computers draws on homophilia, in a different direction, heterogeneous interfacing models could provide us with less anthropocentric, yet still anthropogenic, perspectives. As Benjamin Bratton (2015) proposes, this would require designers to be open to speculation, towards project-oriented formulations of interfaces that would explore other forms of machine autonomy and agency, without fearing the displacement of individual subjects from the center of its operational logics.



## Closed-Source Gratification

I observed the willingness to design interfaces aimed at immediacy and immersion, mainly in games of the action and adventure genres, especially by visually modelling the avatar's point of view from three-dimensional perspectives in first or third person, with a central vanishing point. However, there are many other sound interfaces that do not emulate three-dimensional Euclidean geometry.

Games of the platform genre, for example, usually do not point towards realism or verisimilitude. A common trait among these games is that, just as the graphical user interface represents the characters in a flat perspective, corresponding to horizontal movements on the screen, their sound interfaces also express a different aesthetic proposal. Not only are the sound objects no longer represented under a three-dimensional spherical perspective, as there is a much more frequent manifestation of repetitive sounds, background looping tracks and virtually constant sonic iterations throughout the experience, forming a much more uniform, yet very cacophonic sound mix. This model can be traced back to a very different nature than cinema's audiovisuals. The constant production of *defeat* and *victory* exclamations is reminiscent of the sonic utterances commonly heard coming from slot and pinball machines, as well as other coin-operated devices, so-called light entertainment, and further machines of this sort. In this model, sounds seem to logically emulate the stimuli of reflex-oriented games, so that the sound interface is capable of *engaging* consecutive feedback sounds and responses according to each action performed by the player, producing synchronous effects to highlight the mechanical iterations that intermingle the player-user and the machine. Thus, they also seem to resort to constructions that refer to audible traces of previous mechanical machines, deriving some kind of operative intelligibility from these familiar traits. Before the integrated circuits (commonly known as microchips) allowed the electronic triggering of the sounds of a coin falling into a container, it was the sound of the metal coin itself falling into a metal bowl, colliding with other coins, which loudly signaled the outcome of the game to its players.



*Pong* (1972), as the first profitable computer game (it could not be rewritten, only played, contrary to free source hacker ethics), is very representative of this process, especially considering that the machines were designed so that they could be placed

in bars, waiting rooms and departure halls. As Claus Pias (2004) argues, from this point onward it became necessary to invent both a beginning and an end to the game, in order to stimulate the insertion of a first coin, and to request the insertion of further coins into the machines, respectively. Such temporal markers made it possible to establish "an efficient relationship between income, operating costs, and service period" (Pias 2004, 128). Gaming machines can also be considered as part of a broader group of devices that includes previous coin-operated apparatuses, such as Jukeboxes, slot machines, among others. Karen Collins (2016) explains that in the United States, during the Prohibition Era (1920-1933), the initiatives to implement electromechanical sound in the (prohibited) gambling machines happened as a way to mislead the authorities, passing them as (legalized) jukeboxes. At that point, electromechanical gaming devices only played looping background music, while the game sounds were restricted to the mechanical and the operative sounds of the machines. The maturation of a grammatics for indicating the beginning and end of each game, as well as a late game music dramaturgy, was the outcome of a series of cross-pollination between games and other cultural forms. Sonic signs were gradually invented in negotiation with an emerging technocultural environment, in order to elaborate the interfacing conditions that characterize electromechanical games. The metaphysical constructions of gaming, such as scores, bonuses, continuity, and interruption – all that is apprehended between the beginning and the end of gameplay, was invented while taking into account previous audiovisual associations in order to nurture the engagement of users with the machine.



Contemporary games perform a series of synchronous associations between actions performed by the player and sounds triggered in response by the machine. Notably, the bright clinking sounds of scoring in platform games do not refer to anything else than the very contact of coins with the hard metal surface of coin containers in

gambling machines. This metallic sound effect can be very easily found in platform games, but it is not exclusive to them. Even games that invest in more *serious*, realistic aesthetics to interface with the player regularly appeal to these kind of sonic enunciations. This is found especially in setup and configuration menus. Even when exploring more abstract sounds, one can perceive some regularity in such aesthetic expressions: the brightest and most strident sounds normally punctuate affirmative actions. The sound interfaces of these apparently trivial games sound off elements that connect the audible dimension of digital games to widely disseminated meanings of contemporary technoculture.

Digital games connect certain actions to sounds that are historically and culturally associated with meanings of gratification and failure. So, in a way, the countless sounds that resemble coin-operated slot machines, the clinking of metal on metal, or the ringing of a cash register, for example, present themselves as metonymies for some of the most important statements of digital games: the meanings of victory and defeat, success and failure, progress and interruption, gratification and punishment.



Another construct that is common to several different games is the sonic indication of the player's risk of defeat, which warns her of an impending *game over* status. This effect involves audiovisual synchrony, as the sights and sounds complement strict actions in the game to produce the sensation of a looming *risk of death*.

A quick description of this effect in the game *Spec Ops: The Line* (2012) can help in showing how this construct is built with a strong appeal to the audible dimension in first and third-person shooters. As enemies successively attack the player’s character during gameplay, it is noticeable that the more the avatar is hit, the more its listening capabilities in the game are impaired. Some of the sounds that were constantly heard

start to fade out, and suddenly an entire range of frequencies in the audio is suppressed, with all the sounds heard in the game world being muffled from then on. The high and medium-high frequencies are selectively cut, emulating a case of sudden hearing loss. This is an audiovisual effect: the screen gets polluted with red splashes, as the rest of the background landscape loses its color saturation to exhibit a monochromatic aspect while the audio's higher frequencies are filtered. When the player is finally defeated, in addition to the aforementioned fade to black effect, the game sounds slow down, fading out to an expected silence. In other words, the game establishes a correlation between colors and sounds in order to dramatize the player's banal death in the game.

## (Un)audibile Automations: The Sense of Control



These examples suggest that design has, among other functions, the technocultural role of *taming* the environmental noise in order to model them into practical interfacing elements between humans and media. According to Stefan Höltgen (2018), computers have always been noisy, because where there is friction, there is sound. Computer peripherals have always made sounds with their internal motors, rotors, movable heads or relays.

From an operational perspective, the gaming experience implies a playable system, in which player input and programmed computer responses are mediated by hardware peripherals that functions as user interfaces, including input hardware such as mouse, keyboard, joystick, controller, and output peripherals like speakers, headphones and monitors. In addition to granting a very materialistic sense to user interfaces that is

useful for the exploration of sound as an apparatus in digital games, this formulation can also provide an initial clue about the underlying technocultural impulses that push forward the development of such interfacing models.

Consider, for example, the *clicking* of a mouse. A brief archeoacoustic examination of the *click* sound may help in making this movement from the figure to the background. The computer mouse codifies and associates a series of actions to its sounds and gestures. The more basic example: one click – select; two clicks – enter/open; the onomatopoeia itself – *click!*. But beyond these audible codes, there is a second layer: the click of the mouse signals not only semantics to the user. It is also signaling that the button has been pressed enough. On average, both mice and keyboards are designed to, upon pressure, trigger the sound (of clicking and typing) when about 50% of the maximum possible button pressure is exerted. This is due to the vast number of times that buttons and keys are pressed on peripherals like this during the day, so it is a design strategy to minimize repetitive strain injuries and muscle fatigue. In this case, in addition to its semantic function, the clicking sound is a sonic signal related to labor, on which ergonomics play an effective role in the mitigation of potential physical conditions related to the prolonged use of these artifacts.



The curious thing is that in digital games worlds the clicking sound is thoroughly repeated for its semantic function. The clicking gesture is recalled through its sound especially when non-diegetic operative actions are performed during the gameplay, such as in game configuration menus. The reenactment of the mouse's clicking sound is triggered as if it was necessary to have a second confirmation of the player's gestures in the game controller to bind diegetic and non-diegetic worlds.[iii]

Nevertheless, this is also revealing of how game sound design is aimed to relate with the users' actual playing environment. By reaffirming the player's clicking action (it is actual button-pushing) during gameplay, games work to somehow obliterate the non-gaming sonic stimuli that connects the player directly to the place where she plays. This is also why console peripherals are often getting less noisy (just compare the sounds that stem from operating a Microsoft X-Box controller to those made while using an Atari 2600 original joystick or a Zipstick microswitched controller, with their inherently creaking and clicking mechanisms). The part of the experience of play that refers to experiencing the environment in which games are played, including hardware noises, side conversations, and smashing of buttons, tends to become more silent. While digital games are definitely different media than cinema, as far as user interface design is concerned, such an effort to develop more game-oriented playing conditions through hardware sound suppression certainly work in order to favor experiences of immersion (at least as a primary standard, as long as game sound levels are customizable). It is worth noticing, though, that in order to meet a demand from retrogaming enthusiasts, it is also very common for the industry to recreate the design of remarkably noisy devices. Players of earlier Amiga and Atari machines, for instance, sometimes refer to the sound made by the disk drive as an integral part of the playing experience.[iv] Therefore, as media archeologists would properly point out, sketching these overly linear histories concerning game technology and aesthetics may prove to be misleading, and the case of retrogaming indeed shows that controllers are not always getting quieter. The inclination to produce less noisy peripherals can be more accurately described as a strong trend in contemporary design, as well as part of an enduring drive towards immersive experiences that permeates audiovisual media history, even though it is not reasonable to think of it as an unrivaled tendency.

Other important sound interfaces to consider are the systems developed to allow the internal, dynamic control of audio performance in gameplay. With the invention of such applications, sound designers were able write a kind of a musical feedback script to underscore the performance of players. These systems are important here because they also reveal another important aesthetic tendency in contemporary interface design, not only the ones developed for gaming.

An exemplary application in this regard is *iMUSE* (Interactive Music Streaming Engine) system. Developed by LucasArts in the early 1990s, it can be understood as a prototypical model for some of the complex audio systems used in contemporary game sound design. While being used in the first LucasArts *point-and-click* adventure games[v], this system enabled the composer to create specific transitions and state changes in the music as a reaction to game events, situations and transitory changes. It was possible to make changes in tempo, instrumentation, intensity, tone, among others, in addition to programming jumps and loops for specific sections of the tracks.



The iMUSE system is a good example of the particular way in which digital games update the audiovisual tendency of synchronizing actions with emotional cues – a tendency that is not exclusive to them, however. [vi] It shows how the separation between the audio control protocols and sound itself occurs in computer sound design processing. This is why the data about cadence, volume, duration, among other parameters, can be so easily mixed, interchanged, and transposed. The iMUSE system makes the infrastructural asynchronism of digital communication evident. Due to the conceptual and material separation between software and hardware, the computer gives the opportunity to operate in a properly asynchronous, yet automated scheme. Nonetheless, most of game sound design projects are based on

producing associative, synchronic haptic and audiovisual models. The strict synchronic experience of playing digital games is, therefore, utterly paradoxical. To be more accurate, systems like these allow associating music and sounds to the sense of control, a characteristic that in turn is essential to the effect of direct manipulation that is promoted by graphical and sonic user interfaces. The design of iMUSE highlights some of the desires associated with game design, which are incorporated into the system.

The drive towards providing an experience of control that is essential to digital gaming is evident in several parts of the system's registered patent:

> "(I)t is easy to see why the musical flow suffers in existing computer entertainment systems when the music is required to change from one sequence to another. For example, suppose that there is a high-energy fight scene occurring in the game which, at any time, may end in either victory or defeat. In existing systems there would likely be three music sequences: fight music (looped), victory music, and defeat music. When, the fight ends, the fight music would be stopped, and either victory or defeat music would be started. The switch from the fight music to the victory or defeat music occurs without taking into account what is happening in the fight music leading up to the moment of transition. Any musical momentum and flow which had been established is lost, and the switch sounds abrupt and unnatural. (...) Thus, existing music systems do not provide the ability for the computer entertainment system to tell the music system how to intelligently and artistically respond to the events and action of the game. There is needed a music and sound effects system which can be included in a computer-controlled sound system including a computer entertainment system, and which creates natural and appropriate music composition that changes dynamically with the events and action of the game in response to commands from the sound system." (Land and McConnell 1991, 22)



From this, I can infer what is said to be the most *natural* interfacing experience provided to the player. The sound design method that corresponds to this artificially naturalistic model is the one that is more effectively capable of producing an ever

more up-to-date sense of control within the game, while at the same time keeping the mechanic agency of the game system as opaque as possible. The efficiency of this model is very much dependent of the capacity of fragmenting musical states to be associated with the player's actions in the audiovisual world. In other words, the feeling of synchronism between actions and responses increases accordingly with the sound design project's capacity to pre-emptively set a highly quantified program for each of the players' actions. In the long run, the patent's text features a clearer notion of what the system programmer understands as an intelligent system: one that is capable to promote a more accurate rationale for the player's gestures, adapting the state of the score to her presumed preference. In all this process, it is important to note that the system's agency – and, together with it, human-computer interfacing – is also expected to be as invisible as possible.



## Human-Computer Interfacing and Perceptive Labor

According to Manovich (2001), the basic operations of computers apply to the most distinct cultural forms (sounds, but also texts, videos, graphics etc.), which today are subject to a series of shared editing processes: copying, cutting, pasting; sorting, searching, filtering; transcoding, ripping, mixing etc. Like in this example, the iMUSE characteristics can also show some elementary qualities that extend beyond game music: the *real time* perception of live performances, the operative manipulation of selective objects on a screen, and also the strong attempt to hide the loops, sudden breaks, lags and asynchronisms in human-machine interaction as well as other mechanical operations that are endemic to this form of communication. In order to take Manovich's proposal seriously, one should consider that these forms extend

beyond the more personal operation of computers (also surpassing their use in gaming contexts), dispersing in everyday life as ways of working, thinking and existing (Manovich 2001) in contemporary societies.

The ways of designing sound interfaces for digital games correspond to a *gestalt* of other contemporary responsive devices, which range from art performance supporting software, through statistical visualization coupled with scenario planning for dealing with pandemics, to the most elementary voice assisting systems for home applications. The appropriation of sound systems towards immersive forms responds more widely to a culture willing to connect and orient itself through personal (and personalized) devices. As the computer (in different dimensions and formats) propels itself to a wide variety of activities in social life, the development of familiar and *adaptable* graphic and sonic interfaces becomes essential for the prosaic relationship of humans with machines of many different sorts. Therefore, although they are not necessarily the best way to deal with new technologies, recollecting past audiovisual forms and apprehending collectively learnt media habits are the most common way to engage users with emergent media through interface design.



Thus, user interfaces seem quite prominent applications for examining the permeation of digital games operative aesthetics in non-ludic situations of contemporary life. Due to the conditions of experience they offer in games, such interfaces act as a way to immediately accomodate players to the logics, structures, regimes, physical skills and motor habits of routinely laboring with contemporary machines. According to David Parisi:

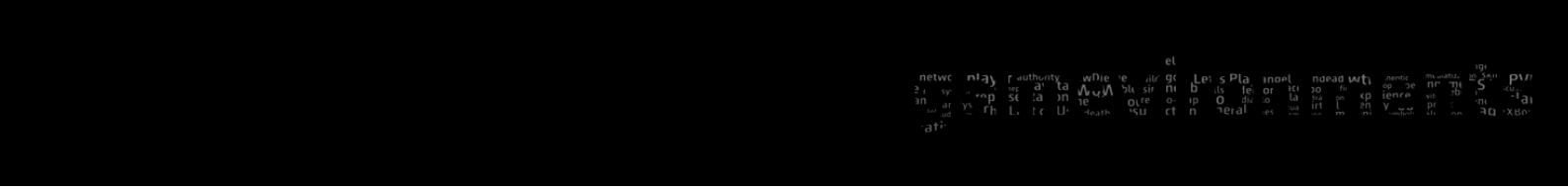
> "(G)ame interfaces — as sites where humans rub up against machines — fill a biopolitical function, allowing for the capture of data about player bodies, quantifying at a micro scale the temporalities of human sensory and motor

> processes, and harnessing the rhythms of machinic interaction. Game interfaces help make player bodies and bodily processes productive in a neoliberal, late capitalist order that depends on the circulation of data through information-processing subjects. (…) Moreover, videogames exist within a longer tradition in industrial design that produces and articulates normative models of bodily functioning through the intense study of the way bodies interact with objects — a Taylorist process of attempting to generate an efficient feeding of human energy into machines. The positivist programs of study in this tradition (ergonomics, human factors, and user-centered design, for example) emerged in the context of industrial and postindustrial capitalism, and depend on the solicitation and aggregation of information about the bodies of technology users, so that the design of objects may be refined to operate more harmoniously with humans". (Parisi 2017, n.p.)

In this sense, game sound interfaces also emerge as inventions of a technoculture in which the two seemingly remote poles of customization and automation converge. They correspond to the immersive and responsive environments of digital games, which also feed different realms of human activity back with new infrastructural means of entangling subjects and machines. In this ways, digital games are allegorical of the transitions from industrial to post-industrial modes of production in contemporary society. In this transition stage, game interfaces highlight the individual demand for processing visual and sonic information, on which subjects depend to relate to the broader context of laboring with black-boxed computational devices.



The sonic and graphical constructions of interfaces define the way machines challenge users in the contemporary condition of technoculture, in which humans fulfill mainly a role of "monitoring and regulating" (Manovich 1996, 7) the information flows. By accessing displayed information, analyzing data, operating controllers, making decisions in tasks that correspond to the cognitive functions of perception, attention, association and problem solving. Thus, the automation of audiovisualities

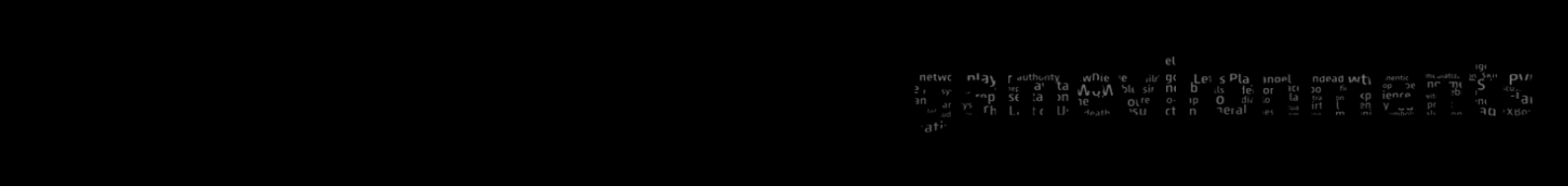


and its use to produce customized, operative forms, show the hybrid character of contemporary labor, which mixes mechanical and semiotic work in activities primarily occupied with the operation of a set of graphical and sonic signs.

Therefore, there is a technocultural background that connects the design of digital games to ergonomics, as far as the history of producing the technical conditions for interfacing with machines is concerned. The scientific study of movements enabled designing suitable interfaces to nurture more efficient labor conditions. For what it concerns the machine operators in the age of portable computers, the apparatus would have to consider them as discreet processors of information, the individual user. The role of the user is more clearly delineated in digital games, where the player is attributed with a series of very specific tasks and responsibilities within the game world. Claus Pias (2011, 180) states that games are a "test of compatibility," through which a kind of *suturing* is promoted to weave together machine logic and human bodies. The computer have to be *humanized* through symbolic language, while humans adapt to the often very limited shapes of machines, by conforming bodily actions to the operable mechanics of the apparatus. In order to operate machines, it is necessary that humans apprehend their structures, logics and gestures, in a process of symbolic and corporeal proto-interaction. Not being able to apprehend the structure or the rules of skillfulness of the game (not passing its compatibility test), the player is prevented from continuing playing, being punished with a symbolic (often audiovisually dramatized) death for not completing her duty.



This ergonomic logic underlies established user interfaces. By providing supposedly universally applicable usability layouts, which can desirably integrate with commercial computers, gaming machines help to uphold the stability of interfaces. This basic principle is what guarantees that actual human-computer interfaces can be employed



to perform tasks as antagonistic as playing or working. Mathias Fuchs, Georg Russegger and Moisés Mañas Carbonell (2013, 31-32) state that this more usual design approach bestows us with "straight interfaces," which are oriented towards some very specific values: effectiveness, universalness, predictability, global availability, and an unawareness for regional or historical contexts.

Initially I did not intend to suggest practical usages or recommend further design models for interfaces, due to the limited scope of this article. Nevertheless, I believe that such discussion on the sound interfaces of digital games, which model how players experience game worlds and help to organize the sense of gaming per se, can indeed make a practical contribution when developing interface projects. It may not be always the case of emulating the more established tendencies of sound design that I traced in this article, which point towards immersive aesthetics, individual control, efficiency management, and more immediate responsiveness. Designers could think on the playfulness that different interfacing conditions would encompass when interfaces are designed considering different sets of values. If this was the case, designers and artists could opt for developing what Fuchs, Russegger and Mañas Carbonell (2013) call ludic interfaces, decidedly oriented towards playfulness, connotative power, surprise, context awareness, critical prowess, and co-creativity, for instance.



I wish to speculate on what this means for the experimental designing of sound interfaces. As a more general note, user-oriented interfaces have been implement at large, and digital games show how sound at large have been used to provide stability, favoring the most established layouts. To raise critical prowess, and especially to provide experiences of co-creativity, which seem to be the most underdeveloped aspects of sound interfaces in digital games, designers would

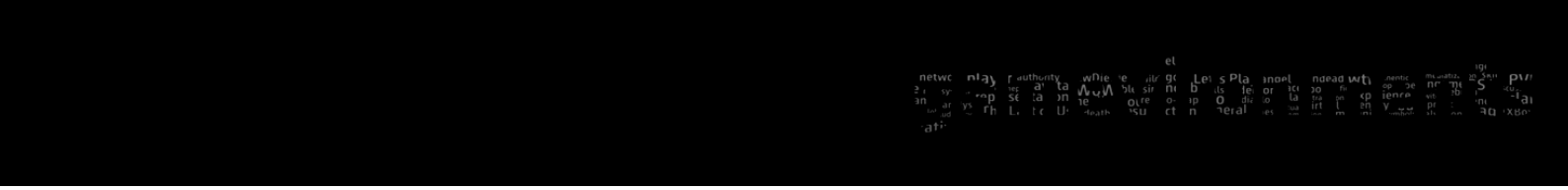
nurture from engaging more playfully with the notion of the *user*. Experimentations with usability and collaboration already have a room when it comes to game mechanics and physics. The game *Octodad: Dadliest Catch* (2014), for instance (there are plenty of other examples), can be played by up to four players who all control the same character, demanding them to coordinate their actions carefully to proceed in the game. When developing sound interfaces, designers would be deemed to consider the potential applications of sound to collaborative experiences that could not only require a multiplicity of coordinated users, but (perhaps more radically) also consider non-user-centered interfacing possibilities. By creatively playing with the quotidian experiences that users have while operating straight interfaces, the development of experimental interfaces would in fact not only help in evaluating potential alternative devices, but also in denaturalizing the habituated practice of constantly re-designing their more conventional models.



## Final Considerations

I want to conclude by reaffirming that, while sound interfaces endemically combine traces of previous audiovisual media languages, their formal composition also stems from clashes between deeply-rooted historical tendencies and the struggles of designers to handle the material properties and contingencies of present-day technologies.

As technocultural anthropological artifacts, human-computer interfaces are also indicative of how humans develop habitual anthropotechnical sensibilities by means of aesthetic practices, in this case, our very adaptation to the escalating processes of working, planning, talking, reading, writing, and playing with computers. By developing further the material apparatus that gives shape to their audible



dimension, digital game interfaces are also probing ways of sensing the computer-built environments, which are meant to be experienced by users whose actions are cleaved by the relational effects of interfacing artifacts.

Bearing in mind their actual operational logics, one can assess, for instance, how the more established human-computer interfaces intermingle with the economies of attention that nurture the media habits of networked corporate media platforms and applications, whose operation strongly functions according to logics of commercial gamification that pervade non-ludic environments (Tiessen 2014). It is one of the aspects that help explaining how the experience of digital games have much to do with the sensorial aspects of other artifacts of audiovisual culture, perhaps much more than with the experiences of playing cards or board games, at least when it comes to matters of usability.



With this, I can conclude by describing computer *usability* as a general infrastructure, a shared precondition for the different forms of communication in the digital milieu. In the case of digital media, this should encompass an understanding of how the operative-driven user interface properties of digital games relate to other control-oriented interfacing possibilities of computer media such as "radar operation, flight simulation, word processing, Web surfing" (Krapp 2011, 107-108). Due to their historical development, digital games have for long now been associated with developing reactive motor skills, hand-eye coordination, and attentive listening, but one should also be observant of how many other kinds of computer-mediated systems increasingly infuse our daily experience with comparable, if not effectively shared, interfacing conditions. Software such as *Wwise*, which had been primarily created to manage audio dynamics in digital games, has been appropriated by artists in audiovisual installations and in theater plays, and also incorporated to automobile

industry in the production of personalized, functional audio experiences for drivers (Audiokinetic 2018). As it had happened with preceding media, the language of digital games is projected, absorbed, reproduced, and reassessed in other contexts, as a source of technocultural breeding. Therein lies yet another particular reason for further studying the aesthetics of gaming in a media ecology that demands a 24/7 attention of its individual users and that multiplies, through graphical and sonic user interfaces, not only audiovisual information, but also our habitual gestures.

With the study I expect to have shed some light on the sonic user interfaces of digital games, emphasizing them as contemporary anthropogenic constructs built in relation to historically developed technocultural tendencies. Having mapped some prevailing models of human-computer interfaces, it is worth mentioning that further studies are still necessary to advance the exploration of alternative sound interfacing models, based on different values, priorities and design approaches.



## References

Audiokinetic, 2018. *From gaming to automotive: leading provider of interactive audio sets new standards for in-car audio.* Available at: https://www.audiokinetic.com/about/news/leading-provider-of-interactive-audio-sets-new-standards-for-in-car-audio/, accessed 20 December 2020.

Benjamin, W., 2009. *Passagens.* Translated from German by I. Aron and C. Mourão. Belo Horizonte: UFMG.

Bogost, I., 2015. *How to talk about videogames.* Minneapolis: University of Minnesota.

Bolter, J. D. and Gromala, D., 2003. *Windows and mirrors: interaction design, digital art and the myth of transparency*. Cambridge: MIT Press.

Braguinski, N., 2018. *RANDOM*: *Die Archäologie elektronischer Spielzeugklänge*. Bochum: Projekt.

Bratton, B. H., 2015. *The Stack*: *on software and sovereignty*. Cambridge: MIT Press.

Cardoso, R. 2016. *Design para um mundo complexo*. São Paulo: Cosac Naify.

Castanheira, J. C., 2010. O som eletrônico no cinema: uma abordagem fenomenológica. *Contemporânea* 8(2), 108-119.

Castanheira, J. C. and Pereira, V. A., 2011. Mais grave! Como as tecnologias midiáticas afetam as sensorialidades auditivas e os códigos sonoros contemporâneos. *Contracampo* 23(2), 130-143.



Collins, K., 2008. *Game sound: an introduction to the history, theory and practice of video game music and sound*. Cambridge: MIT Press.

Collins, K., 2016. Game sound in the mechanical arcades: an audio archaeology. *Game studies*: *The International Journal of Computer Game Research* 16(1), n.p. Available at http://gamestudies.org/1601/articles/collins, accessed 20 December 2020.

Davies, R., 1999. *Complete guide to film scoring.* Boston: Berklee.

Felinto, E., 2011. Em busca do tempo perdido: o sequestro da história na cibercultura e os desafios da teoria da mídia. *MATRIZes* 4(2), 43-55.

Fernández-Cortés, J. P., 2017. Por las sendas de la ludomusicología: tecnología y estética en la música de videojuegos durante el siglo XX. *Anales de la Real Academia Canaria de Bellas Artes de San Miguel Arcángel* 10[1], 195-210.

Fischer, G., 2012. Desencavando interfaces: reflexões sobre arqueologia da mídia e procedimentos de resgate de páginas web. In: Stefen, C. and Benvenuto, eds. *Tecnologia pra quê? As reconfigurações no campo da Comunicação Social*. Porto Alegre: Armazém Digital, 37-52.

Fritsch, M., 2016. 'It's a-me, Mario!' — Playing with video game music'. In: Kamp, M., Summers, T. and Sweeney, M., eds. *Ludomusicology*: *approaches to video game music*. Oxford: Equinox, 92–115.



Fuchs, M., 2012. Ludic interfaces: Driver and product of gamification. *GAME: the Italian journal of game studies* 2012(1), n.p. Available at https://www.gamejournal.it/ludic-interfaces-driver-and-product-of-gamification/, accessed 20 December 2020.

Fuchs, M., Russegger, G. and Mañas Carbonell, M., 2013. Ludic interfaces. In: Webber, N. and Riha, D., eds. *Exploring videogames: culture, design and identity*. Oxford: Interdisciplinary Press, 31–40.

Galloway, A., 2008. The unworkable interface. *New Literary History* 39(4), 931-955.

Grimshaw, M., 2017. Presence through sound. In: Wöllner, C., ed. *Body, sound and space in music and beyond: multimodal explorations*. New York: Routledge, 2017.

Grimshaw, M., 2016. The privatization of sound space. In: Cobussen, M., Meelbert, V. and Truax, B., eds. *The Routledge companion to sounding art*. New York: Taylor & Francis, 463-472.

Guins, R., 2017. New...now? Or why a design history of coin-op video game. *American Journal of Play*, 10(1), 20-51.

Höltgen, S., 2018. Play that pokey music: computer archeological gaming with vintage sound chips. *The Computer Games Journal* 7(4), 213–230.

Höltgen, S., 2017. Códigos & Circuitos its: obstáculos, desvios e atalhos no ensino e pesquisa (através) de softwares e hardwares vintage. *Teccogs: Revista Digital de Tecnologias Cognitivas* 15(1), 75-90.



Huhtamo, E. and Parikka, J., 2011. *Media archaeology*: *approaches, applications, and implications.* Berkeley: University of California.

Huhtamo, E., 2005. Slots of fun, slots of trouble: toward an archaeology of electronic gaming. In: Raessens, J. and Goldstein, J., eds. *Handbook of computer games studies*. Cambridge: MIT, 3-21.

Krapp, P., 2011. *Noise channels: glitch and error in digital culture*. Minneapolis: Minnesota University.

Land, M. Z. and McConnell, P. N., 1991. *Method and apparatus for dynamically composing music and sound effects using a computer entertainment system*. Google Patents, LucasArts Entertainment.

Luersen, E. H., 2020. *Ressonância tecnocultural: rastros da ambiência contemporânea nas sonoridades dos jogos digitais*. Ph. D. Universidade do Vale do Rio dos Sinos. Available at http://www.repositorio.jesuita.org.br/handle/UNISINOS/9316, accessed 26 June 2021.

Manovich, L., 2001. *Language of new media*. Cambridge: MIT.

Manovich, L., 1996. The labor of perception. In: Hershman Leeson, L., ed. *Clicking in*: *hot links to a digital culture*. Seattle: Bay, 183-193.



*Monkey Island 2: Le Chuck's Revenge*, 1991. [video game] (Microsoft Windows, FM Towns, AmigaOS, DOS, Mac OS Classic). LucasArts, LucasArts.

*Octodad: Dadliest Catch*, 2014. [video game] (Android, iOS, Linux, Microsoft Windows, Nintendo Switch, OS X, PlayStation 4, PlayStation Vita, tvOS, Wii U, Xbox One). Young Horses, Young Horses.

Parisi, D., 2017. Game interfaces as disabling infrastructures. *Analog game studies* 4(3), n.p. Available at https://analoggamestudies.org/2017/05/compatibility-test-videogames-as-disabling-infrastructures/, accessed 20 December 2020.

Pias, C., 2004. Action, adventure, desire. In: Hagebölling, H., ed. *Interactive dramaturgies: new approaches in multimedia content and design*. Berlin: Springer, 133-148.

Pias, C., 2011. The game player's duty: the user as the gestalt of ports. In: Huhtamo, E. and Parikka, J., eds. *Media archaeology: approaches, applications and implications*. Berkeley: University of California, 164-183.

*Pong*, 1972. [video game] (Arcade). Atari, Atari.

Reed, P., 2018. *Xenofilia e desnaturalização computacional*. São Paulo: Zazie Edições.

Schulze, H., 2019. *Sound works: a cultural theory of sound design*. New York: Bloomsbury.



Shaviro, S., 2015. *O corpo cinemático*. São Paulo: Paulus.

*Spec Ops: The Line*, 2012. [video game] (PlayStation 3, Microsoft Windows, Linux, Xbox 360, macOS). Yager Development, 2K.

Sterne, J., 2012. *The sound studies reader*. New York: Routledge.

Tiessen, M., 2014. Gamed agencies: affectively modulating our screen-based digital futures. In: Fuchs, M., Fizek, S., Ruffino, P. and Schrape, N., eds. *Rethinking Gamification*. Lüneburg: Meson Press, 251-269.

Tobin, S., 2014. After life history: an interview with Raiford Guins on his Game After: a cultural study of video game afterlife. *Reconstruction* 14(1), n.p. Available at http://reconstruction.digitalodu.com/Issues/141/Tobin.shtml, accessed 25 June 2021.

[i] This article is a translated and updated version of a previous publication, to which some modifications and improvements have been made. The previous version is available in Portuguese: Luersen, E. H., 2020. O corpo suturado: interfaces sonoras e a construção das condições de audibilidade dos jogos digitais. *Revista ECO-Pós* 23(3), 308-338.

[ii] *Middlewares* are software and tools libraries and applications for game development. In the case of game audio, they are mostly used in sound design implementation processes, allowing the sound designer to work with pre-developed manageable behaviors and parameters for audio performance in order to establish the instructions for in-game audio, arranging the operational logics that define the audio system's responses to the player's actions.

[iii] It is interesting to note how this persistence of the clicking sound shows itself as part of a broader, widespread tendency that can be associated with different software and hardware. Think of the clicking sound in amateur digital camera models and smartphone camera software, which frequently imitates the sound made by the shutter of an analog camera, as some sort of a *kitsch* ritualistic sound design that appeals to a common sense roughly imagined gesture of professionally photographing.

[iv] I would like to thank the journal's reviewer for her/his valuable contributions concerning this issue.

[v] Developed for the game *Monkey Island 2: Le Chuck's Revenge* (1991), iMUSE was used in similar genre's computer games developed by the company by then.

[vi] One can situate the composer cue sheets of early cinema (Davies 1999, 17), which contained performance instructions for the musicians employed by the movie theaters at the time, as one of their most well-known historical predecessors (Luersen 2020).