Chapter 3
Light-to-sound translations

"Anything said is said **to** an observer"
Heinz von Foerster. [1]

The previous chapters surveyed a selection of the enormous variety of photosensitive elements and their uses in media history and media art. Here the discussion is expanded to the subject of attaching light sensitive matter to more complex technical ensembles within media devices and artworks, with particular attention devoted to the many ways of converting light into sound.

The lowest common denominator of the organic and man-made elements in contemporary media devices and artworks is electric current. The zero-dimensionality of electronic and digital media and their software[2] permits the manipulation of matter at the atomic level. This, in turn, enables the creation of new materials, the enhancement of existing ones, and boosts the possibilities of combination and recombination among technical ensembles.[3]

Adressing more concretely how Flusser's idea of the 'zero-dimensionality' of electricity and its modulations enable what is here called the translation of materialities, this chapter discusses examples of media devices and artworks based on translations from light to sound. In the previous chapter nano technology was briefly described as a sort of scale translation, with the operations of machines and devices developed in the twentieth century now being transposed to the molecular scale. Considering the rational and abstractive human action upon the concrete material world (objects, environment, other living entities), one can approach nano technology as a further enhancement of human translating possibilities. In this

1 von Foerster, Heinz. At each and every moment, I can decide who I am. In: Poerksen, Bernhard. *The certainty of uncertainty.* Charlottesville, VA USA: Imprint Academic, 2004. p. 12.

2 Flusser 2008: 16-19.

3 Technically, these technical ensembles may be embedded with an immense variety of sensors and actuators. As observed in the previous chapter dedicated to the discussion of hybrid systems, when organic matter comes into play, such as in wetware, the input quality of sensors and output quality of actuators tend to merge, just as they do on our skin: one touches and is touched, simultaneously.

sense, the making of art and the narratives with which it is associated is also a process of translation involving the translation of sensations, ideas, needs, and other abstract issues into specially organised concrete materials – projected, designed, *gestaltet* and so forth.

A more direct concept used by Flusser to support how human translating activity is manifested within media development is his concept of *Mediumsprünge*: the act of jumping from one medium to another, from the logic of one system to another.[4] He expressed and implemented this concept in at least four different contexts within his media theory: changes of media; comparisons between media; media as an instance of translation; and media development.[5] The present focus on different translation processes from light to sound involves a combination of the two latter instances.

In this chapter, selected historical and contemporary media devices and aesthetic experiments are highlighted. The media devices here discussed use inventions based on applications of photocells in the early history of sound-film and telecommunication, such as the *Photophone* (1880), the *Fotoliptófono* (1930) and even assistive technologies like the *Optophone* (1912). The media artworks, in turn, range from Dada to contemporary aesthetic experiments, including a device and performance developed by the author during the research process as a methodological tool – *Self-portrait of an absence* (2016). Besides representing an instance of cybernetic second-order observation[6], the inclusion of my own work in the analysis challenges the opposition between theory and practice traditionally found in the academic context. Comparable examples are additionally incorporated to enrich the discussion. The study cases were selected based on their historical and technical relevance in relation to the development and applications of photosensitive materials and devices, with the aim of establishing an analytical approach that can assist media artists, researchers and critics to reflect upon the process of meaning attribution through the organization and recombination of materials and techniques in their specific contexts.

The analysis of the examples shows that, although Flusser's perspective is a good starting point for this discussion, it does not encompass the intertwoven aspects between the abstractions and the materialities handled in media art production. To avoid priviledging either the abstract or the material aspects of media art to focus on the complexity of the in-between space where media art's cultural relevance lies, the discussion aims to balance Flusser with authors with more technical

4 Guldin 2010: 165.

5 Guldin 2010: 166.

6 Among other differences, Heinz von Forster distinguishes second-order cybernetics from Wiener's first-order cybernetics, essentially by considering the role of the observer in the observing process. (von Foerster 1995: 2-4)

and material analytical viewpoints, such as Gilbert Simondon, Friedrich Kittler, and others.

Through a sort of "trancedental empiricism"[7], media art is here envisioned as an open field for the invention and re-signification of technical ensembles (with machines and organisms) that are potentially able to generate meaningful situations and experiences. The analysis in the following sections unpacks the cultural relevance of media objects by delineating the knowledge embedded within them and inquiring into symbolic aspects embedded in both how they are built and how they operate in their specific *milieux*.

3.1 On the search for correspondences

3.1.1 Bell and Tainter's Photophone: In-between continuous and intermittent signals

"*– Mr. Bell, if you hear what I say, come to the window and wave your hat.*"[8] These were the words uttered by the engineer and inventor Charles Sumner Tainter (1854-1940) to his boss, the scientist and inventor Alexander Graham Bell (1847-1922), while testing a successful version of the photophone – an apparatus for the production, transmission and reproduction of sound by means of light.

A summary of the series of experiments they developed[9] was published in a paper by Bell in Science Journal in 1880, in which the author also acknowledged the importance of previous researches into the photosensitive properties of the chemical element selenium, discovered in 1817 by scientist Jöns Jakob Berzelius (1779-1848). Bell and Tainter were not the only ones experimenting with the new possibilities opened by the discovery of the new material. In the same paper Bell mentioned a considerable number of researchers whose experiments had informed his research process. In 1907, for instance, the scientist Arthur Korn (1891-1978) built a pioneering and ambitious machine to transmit images likewise based on the light-sensitive properties of selenium in association with a telegraph, which is nowadays recognized as a crucial step in the development of telefax. Another precursor of the telefax was developed by inventor Claude Joseph Édouard Belin (1876-1963), who between 1907 and 1921 coupled a photocell with a telephone and, later, radio technology in order to transmit images. Around 1920, Bell too was occupied with

7 Hui, Yuk. Induction, deduction and transduction: On the aesthetics and logic of digital objects. In: *Networking Knowldege.* Vol. 8 Issue 3. Standard Issue June 2015.

8 Bell, Alexander Graham. *The Photophone.* In: *Science* os-1 (12), September 11, 1880. p. 133.

9 Concerning other experiments with selenium in combination with other metals, e.g. brass, the scientists have devised 50 different apparatuses to study the possibilities of controlling sunlight beams (Bell 1880).

the transmission of images and developed a similar invention, the wirephoto system[10].

Bell's observations of a series of experiments led him to hypothesize that there might be a "*class of substances sensitive to light-vibrations*"[11]. Selenium, Bell reported, was additionally responsive to invisible energy radiation[12] (today's ultraviolet and infrared spectra), emphasizing, however, that the "*ordinary beam of light* (that) *contains the rays which are operative*"[13]. Adding to the previously existent knowledge on selenium, Bell noticed that "*when a vibratory beam of light falls upon these substances they emit sounds*", and "*the pitch depends upon the frequency of the vibratory change in the light*"[14]. Tainter's and Bell's research showed that every material contains a sonority that can be revealed by hitting it with a strong beam of light, thereby consolidating the preliminary empirical documentation of the so-called photoacoustic effect – the phenomena through which a strong light source can be converted into sound due to absorption and thermal excitation. Today it is known that when pulses of light are rapidly projected onto a sample of matter, they are often absorbed and irradiated as heat, whose pressure variations generate sound waves.

Following these observations, further experiments were carried out to find ways to directly influence the sound by better controlling the form and character of the light source. The project also embraced Bell's discoveries pertaining to telephone technology and merged the technique for converting light into sound with voice transmission technology. The photophone, as shown in the illustration below, functioned on the basis of a transmitter and a receiver.

The transmitting apparatus consisted of

> a plain mirror of flexible material – such as silvered mica or microscopic glass. Against the back of this mirror the speaker's voice is directed. The light reflected from this mirror is thus thrown into vibration corresponding to those of the diaphragm itself (…) the curve produced that would graphically represent the

10 Cubitt, Sean. *The practice of light: a genealogy of visual technologies from Prints to Pixels.* Cambridge, Massachussetts/London, England: MIT Press 2014. p. 90.

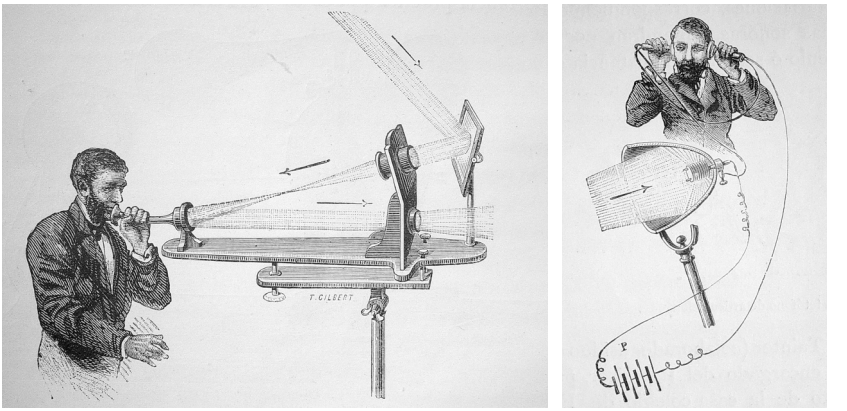
11 Bell wrote: "*We have found this property in gold, silver, platinum, iron, steel, brass, cooper, zinc, lead, antimony, German silver, Jenkin's metal, Babbit's metal, ivory, celluloid, gutta percha, hard rubber, soft vulcanized rubber, paper, parchment, wood, mica and silvered glass; and the only substances from which we have not obtained results are carbon and thin microscopic glass*". (Bell 1880: 130)

12 Mr. May (assistant of Mr. Willoughby Smith) realized that sensitiveness of Selenium was rather upon light, not upon temperature. According to Bell, this fact has been later also verified by Sale, Draper and Moss. Lord Rosse conducted experiments with non-visible radiation. Werner Siemens did further experiments investigating the resistance by analyzing the combination between temperature and light (Bell 1880: 132).

13 Ibid: 133.

14 Ibid: 130.

changes of light would be similar in shape to that representing the movement of the air.[15]



3.1: Photophone transmitter (left) and receiver (right); Source: Guillemin, Amédée 1882.[16]

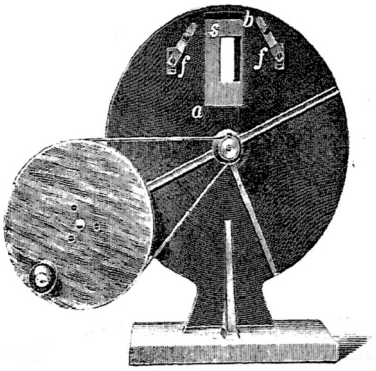
The sound waves of the voices were therefore modulated through the light beam and materially transported to the other side through the air. The modulation of the light source in the photophone was inspired by the application of Morse code[17] in telegraphy and was physically enabled by a disc placed at the bottom of the transmitter, as shown in figure 3.2.

The receiver, in turn, consisted of a parabolic mirror with a light-sensitive selenium cell placed at its focal point, which was connected to a local circuit, which, accompanied by a battery and a telephone, reconverted the modulated light beam

15 Bell 1880: 133.

16 Guillemin, Amédée. *El mundo físico: gravedad, gravitación, luz, calor, electricidad, magnetismo, etc.* Barcelona: Montaner y Simón, 1882.

17 Morse code as it is known today was developed collaboratively in the mid-1830s and standardized in 1865 at the International Telegraph Conference in Paris. Its name refers to Samuel Finley Breese Morse (1791-1872), who first built a working electronmagnetic telegraph using a primitive version of the code in 1833. (Finley, D. Morse Code: Breaking the Barrier. Starkville, MS: MFJ Publishing Company, 1997) Morse code is comprised of a signal set for the transmission of letters, numbers and other characters. It consists basically of three symbols: short signal, long signal and pause. It can be transmitted through different material means, most commonly as sound signals, radio signals, electrical pulses, as well as mechanically or optically (such as through blinking light). Now considered obsolete in scientific, technological and military contexts, it is still used in specific cases ranging from amateur radio to assistive technologies to media artworks.



3.2: Sample of intermittent light disc from the mid-1920's; Source: Fournier D'Albe 1924: 67.

into sound. Enthusiastic about wireless possibilities, Bell envisioned the photophone as a substitute for the telephone, and, indeed, media historians consider the photophone as a precursor of both fiberoptic and wireless technologies.[18]

In Bell's own description of the photophone's working principle, the transmitted speech was produced by means of "*an undulatory beam of light, in contradistinction to a merely intermittent one*"[19]. What is intriguing in this statement is the apparent contradiction to how they previously described the procedure of modulating the light beam using an intermittent light disc. It is possible that Bell was referring to a specific part of the working system. Nevertheless, if one consideres the whole, it seems that the photophone is a media-archaeological artefact that challenges the current opposition between analog (continuos, undulatory) and digital (limited, discrete) signals.

What is essential to notice here is that Bell's and Tainter's experiments led to the conclusion that "*sounds can be produced by the action of a variable light from substances of all kinds, when in the form of thin diaphragms*"[20]. Following this work, the photoacoustic effect was largely ignored for more than a century, until Rosenwaig and Gersho[21] investigated and systematized its theoretical basis. What they found was that the photoacoustic effect is the result of an "*intermittent thermal heating of*

18 The experiments around the photophone happened 19 years before the first known voice radio transmission. Carson, Mary Kay. *Alexander Graham Bell: Giving Voice To The World*. New York: Sterling Publishing, 2007. p. 77.

19 Bell 1880: 132.

20 Ibid: 133.

21 Rosenwaig, A.; Gersho, A. Theory of photoacoustic effect with solids. In: *Journal of applied Physics*. Vol. 47 Issue 1, 1976. pp. 64-69.

a medium that absorbes the energy of intensity modulated light. This causes an intermittent expansion of the absorbing medium. As a result, the medium launches an acoustic wave into its surroundings".[22]

The manner in which Bell and Tainter were able to manipulate this phenomenon is, again, evidence of the efficacy of the fragmentation and discretization of materialities by means of abstract models and rational knowledge. This trend was also observed in scientific investigations related to organic matter, as in the fragmentation and discretization of the human body's sensorial mechanisms and the emergence of physiology as a field of study in the same period.[23] Curiously, in a further development of physiology and attempts to understand the still mysterious and unknown aspects of human nature, contemporary neuroscientific studies, although recognizing brain modules for each of the senses, are also continuously searching for correspondences and associations between the brain's visual and auditory components. According to Gregory, neurology can now even identify regions of the brain for processing different visual dimensions, for instance "*separate 'channels' for the fine detail and broadbrush strokes of a scene. Visual scientists speak of 'spatial frequencies' by analogy with temporal frequencies of sound*".[24] However it is still unknown how the abundance of information comes together to form perception.

This analogy can also be considered the basis for understanding how audiovisual perception works as a key element in human space-time perception, providing an idea of reality as a continuous entity. However, as already discussed in the context of the physiology of vision in the previous chapter, the space-time continuity of the world constructed by human perception and cognitive systems is also based on discretising surrounding stimuli, which are filtered on the molecular level through the physic-chemical activity of sensing cells. Biological strategies found in movement perception through vision, for instance, are similar to those to used to distinguish musical tones[25], as musicologist Victor Zuckerkandl[26] and subsequent studies in psychoacoustics[27] on the stroboscopic effect behind movement perception demonstrated. Fournier D'Albe already speculated in the 1920's that the discrete

22 Roozen, N. Bert; Glorieux, Christ; Liu, Liwang; Rychtáriková, Monika; Van der Donck, Tom; Jacobs, Aernoudt. Converting sunlight into audible sound by means of the photoacoustic effect: The Heliophone. In: *Journal of the Acoustical Society of America*. Vol. 140 Issue 3, 2016. p. 1697.

23 Crary 1990.

24 Gregory 1998: 71.

25 Arnheim 2004: 384.

26 Zuckerkland, Victor. *Sound and Symbol – Music and the external world*. New York: Princeton University Press, 1956.

27 Similarly to the visual system, auditory perception is based on significant signal processing in both the inner ear and brain, by means of the conversion from sound waveforms into neural stimuli. The material constraint of the cells' activities entails that certain differences between waveforms may be imperceptible. More introductory information on the topic can be found

quality of human audio-visual perception could resemble the biological adaptation to the minimum portions of energy (quantum/photons).[28]

3.1.2 Hausmann's optophone

In Bell's article on the photophone, he expressed his amazement at the richness of the scientific knowledge groundind the experiment and the variety of disciplines it involved – optics, electromagnetism, spectrophotometry, etc. – and wondered why selenium had not been used in the arts until that moment, instead remaining merely a "*chemical curiosity*".[29] Nevertheless, some decades later, at the beginning of the 1920s, dadaist Raoul Hausmann (1886- 1971) became enchanted with the technical and aesthetic possibilities of selenium cells and envisioned developing and patenting an *Optophone,*[30] or general electrotechnical apparatus intended to combine the vibrations of light and sound in a synaesthetic manner. By migrating from poster-poetry to so-called optophonetics, Hausmann centered his aesthetic statement around the motif of destruction and creation[31], fragmenting the initial language (verbal or visual) and liberating its elements to be configured in new arragements. In his sound-based artworks, speech and words were suspended, with individual letters freed from any meaning standing side by side as raw elements to become a new statement or even a new language. This method was similar to that of his photomontages, which served to communicate non-trivial associations in contrast to pre-established correspondences, in order to query the status quo of certain realities. His idea of building an optophone followed the same logic, by means of executing translations from light into sound.

On the one hand, Hausmann's artworks were in consonance with Dadasophy, as defended by the major dadaist figure Johannes Baader (1875-1955), which asserted that "*the use of nonsense is to develop the sense that is in the world*".[32] This perspective draws attention to the role of human nature in meaning attribution (*Sinngebung*)

in Plack, Christopher J. *The Sense of Hearing*. London/New York: Psychology Press, Lawrence Erlbaum Associates, 2014.

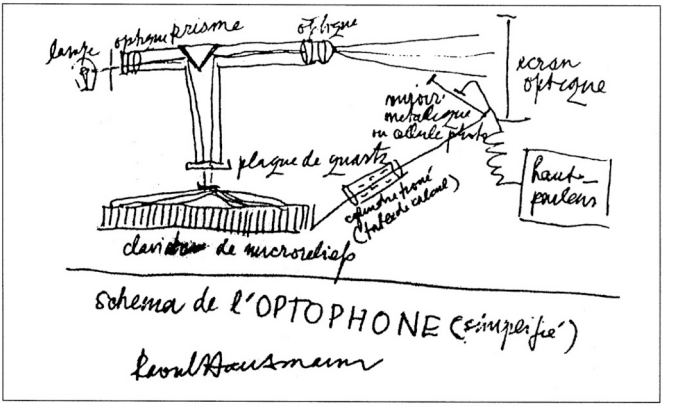
28 Fournier D'Albe 1924: 90.

29 Bell 1880: 132.

30 Donguy, Jacques. Machine Head: Raoul Hausmann and the Optophone. In: *Leonardo – Synesthesia and intersenses.* Vol.34 (3), 2001.p. 217

31 Essentially inspired by the psychoanalytical and philosophical concept of *Selbstzerstörung als Schöpfungsakt* (Self-destruction as creative act), possibly developed by philospher and writer Salomo Friedländer (1871-1946).

32 From the original excerpt in German *"die Benutzung des Unsinns sei, um den Sinn, der in der Welt steckt, zu entwickeln*" Züchner, Eva (Ed.) *Scharfrichter der bürgerlicher Seele: Raoul Hausmann in Berlin 1900-1933*. München/Berlin: Berlinische Galerie/Verlag Gerd Hatje, 1998. pp. 15-16.



3.3: Illustration by Raoul Hausmann with his idea for an optophone. Elements translated by Jacques Donguy: "lamp, lens, prism, sheet of quartz, set of micro-reliefs, slitted cylinder (calculating table), metal mirror or photo cell, speakers, optical screen."; Source: Donguy 2001: 218.

processes, which play out differently relative to the profile of the individual.[33] On the other hand, Hausmann constantly tried to align his artistic production with the scientific discourses of his epoch.[34] He used a similar strategy to substantiate his *optophonetische Weltanschauung* (literally 'optophonetic worldview'). He was convinced that light, electricity and sound vibrate in a basic shared substance called ether, and therefore able to be translated into one another. Less known for his attempts to legitimate his ideas scientifically than for his photomontages and phonetic- and poster poetry,[35] Hausmann's curious multifaceted scientific-artistic legacy encompasses a collection of old-fashioned scientific theories that he articulated to confirm or justify his assumptions. Inspired also by Ernst Marcus's theory on ëccentric

33 Flusser, Vilém. 5….CxB? In: *O Estado de São Paulo.* Published on May 23rd 1964. Available at Vilém Flusser Archive.

34 According to Arndt Niebisch, the ground for Hausmann's physiology, aesthetic, scientific and technological thinking was supported mainly by Hanns Hörbiger's (1860-1931) Welteislehre (literally "world ice theory", also known as glacial cosmogony); Ernst Marcus' (1856-1928) Theorie der exzentrischen Empfindung (theory of the eccentric sensation); Karl Kölsch's Wellentheorie (waves theory); Johannes Zacharias and Arthur Patschke's Ätherdrucklehre (literally "ether pressure theory"); as well as technical media of his time (film, x-ray, radio, etc.). Niebisch, Arndt. Einleitung. In: Hausmann, Raoul. *Dada-Wissenschaft: Wissenschaftliche und technische Schriften*. Hamburg: Philo Fine Arts/Berlinische Galerie, 2013. p. 21.

35 Ibid.

sensations"[36] as a special way to achieve synaesthesia[37], Hausmann's proposals[38] for an optophonetic aesthetics were also related to his belief that the visual arts were already saturated.[39] Moreover, among his aims was harmonising the cosmologic processes, modern media technologies and human life[40] in an attempt to push the boundaries of scientific and technological discourses to a symbolic, aesthetic and existential level. Besides deepening his knowledge of optics and acoustics[41], he worked through the idea that the mergence of the senses and technology was a sort of "spiritual formation of matter" towards a "creative fluid".[42] In his *PRÉ-sentismus Manifest* (1921), Hausmann pleaded for the conquest of all human senses, affirming that "*sensory perceptions are not bound to the limits of the body, but can expand into the outside world, indeed into space*"[43] and that "*every sensation, be it hearing, sight, taste, smell, is added to the sense of touch*"[44]. He invented the "law of universal functionality", reflecting "*that all human organ abilities are unfinished states that carry the germ of self-creative expansion*"[45].

Despite his lack of success at scientifically explaining his aesthetic research, as revealed in his imprecise scientific writings and his attempts to patent inventions, Hausmann's artistic experiments with the concepts, materials and techniques of his time were very fruitful. Still, the objectivism of the scientific community remained sceptical of his ideas and, indeed, rejected his patent applications.[46] Professor of aesthetics Peter Bexte, in a letter addressed to Ralf Burmeister, director of

36 Marcus, Ernst. *Das Problem der exzentrischen Empfindung und seine Lösung*. Verlag der Sturm, 1917.

37 A special Leonardo issue on Synesthesia defines it as "*the phenomenon in which the stimulation of one sense modality gives rise to a sensation in another sense modality, for example some synesthetes see colors when they hear music*". (Donguy 2001: 217)

38 From the original excerpt in German "*Jeder Sinnesempfindung, sei es Hören, Sehen, Schmecken, Riechen, ist der Tastsinn beigegeben*". (Züchner 1998 : 17)

39 Lhot, Patrick. *L'indifférence créatice de Raoul Hausmann – aux source du dadaïsme.* Aix-en-provance : Presses Univ. de Provence, 2013 and Donguy 2001 : 217.

40 Niebsch 2013 : 19.

41 Donguy 2001: 2017.

42 From the original excerpt in German: "*geistigen Formation der Materie*" and "*schöpferischen Fluidum*" respectively. (Züchner 1998: 18, translated by the author, the same for the next excerpts)

43 From the except in German "*die Eroberung aller unserer Sinne*" "*Sinneswahrnehmungen nicht an die Grenzen des Körpers gebunden sind, sondern sich in die Außenwelt, ja bis ins All ausdehnen können*" (Züchner 1998: 17)

44 "*Jeder Sinnesempfindung, sei es Hören, Sehen, Schmecken, Riechen, ist der Tastsinn beigegeben*". (Züchner 1998: 17. Translated by the author)

45 From the original excerpt in German: "*Gesetz der Universalen Funktionalität*" "*…dass alle menschlichen Organfähigkeiten unfertig Zustände seien, die den Keim einer eigenschöpferischen Erweiterung in sich tragen*". (Züchner 1998:18, translated by the author)

46 The Berlin patents office refused his application, stating that his invention was technically feasible but presented no useful application. Hausmann indeed never built a prototype, claiming that he never had the money to afford it. (Donguy 2001: 217)

the *Berlinische Galerie*'s artist archive, states that much of Hausmann's texts on the 'optophonetic worldview' were also "*composed with scissors*", alleging that *"a scientist would be unmasked with such an observation - Hausmann, on the other hand, turns out to be what he is: Dadaist"*[47].

3.1.3 Derivations: the photo-acoustic principle as creative matter

As contemporary media artworks frequently enter into substantial dialogues with media history, it was not difficult to find contemporary artists who are aesthetically appropriating the photo-acoustic principle as seen in Bell's photophone, Hausmann's optophone and similar devices. Produced in radically different contexts and formats, through distinct technical and aesthetic choices, one may also call these expressions, which range from sound installations (with and without participation) to performative artworks, 'optical synthesis'. Some of the countless examples that have been selected for discussion here are: Peter Keene's (1953-) series of optophones (1999-2004); Aernoudt Jacobs' (1968-) *Photophon* (2013) and *Heliophone* (2016); Klaus Filip (1963-) and Arnold Haberl's (noid) (1970-) *Photophon* (2010); Kathrin Stumreich's (1976-) *Stofftonband* (2013); and Arcángel Constantini's (1970-) *Phonotube* (2013).

The artist Peter Keene attempted to reconstruct an *Optophone* consulting the remaining documentation of Hausmann's sketches and writings, completing an initial version in 1999, a second in 2000 and a third in 2004.[48]

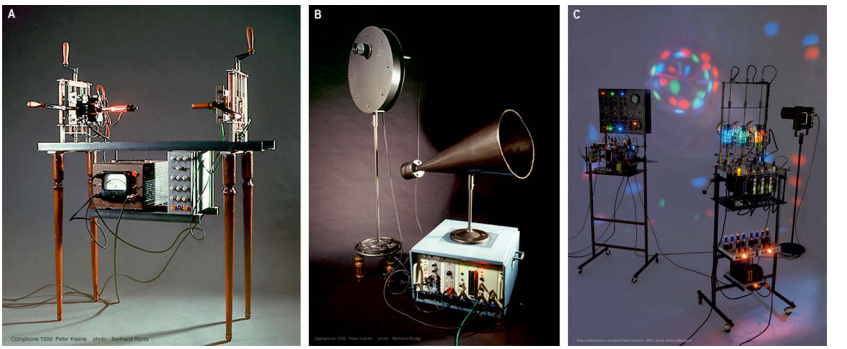
Since the specifications in Hausmann's documents about his idea of an optophone were relatively open and dependent on the materials and techniques of his time, the series developed by Peter Keene constitutes free transpositions, resulting in different actualizations from a common conceptual ground. The main challenge consisted of putting light and sound in correspondence, as well as painting and music, starting with the premise of an existing continuum between the electromagnetic waves of light and the vibrational waves of the air that generate sound.

According to the artist, the *Optophone* built in January 1999 was based on the documents from Raoul Hausmann's patent application for an optical calculating machine, a second version of an optophone that Hausmann submitted in collaboration with engineer Daniel Broid after his patent application for the first idea of an optophone had been refused.[49] Following its logic, Keene's apparatus consisted

47 From the original excerpt in German: *"Ein Wissenschaftler würde mit solcherart Beobachtung zwar entlarvt – Hausmann hingegen entpuppt sich darin eben als das, was er ist: Dadaist"*. (Burmeister 2013:14, translated by the author)

48 Keene, Peter. *Optophones*. 1999, 2000 and 2004. Available at <http://www.peter-keene.com/Optophones.html> Accessed March 23rd, 2017.

49 Donguy 2001.



3.4: Versions of the *Optophones* created by Peter Keene: 1999(A), 2000(B), 2004(C). Mixed media. Photos: Bertrand Runtz (A and B) and Roaln Ménégon (C). Courtesy of the artist.

of a sound matrix activated during the coincidental encounter between a photosensitive sensor and a laser beam on two axes x and y by means of the crank's movements (Fig. 3.4a). For the version exhibited at *Donjon de Vez* in 2000 (fig. 3.4b), in turn, Keene was inspired by John Logie Baird's (1888-1946) mechanical television, associating the previous simple light-to-sound with a more complex technical ensamble based on image-to-sound conversion, a process carried out through a Baird's camera coupled to a Theremin. Keene's machine also could make the inverse correspondence, sound-to-image conversion, by means of a microphone and a television from the same time period.[50]

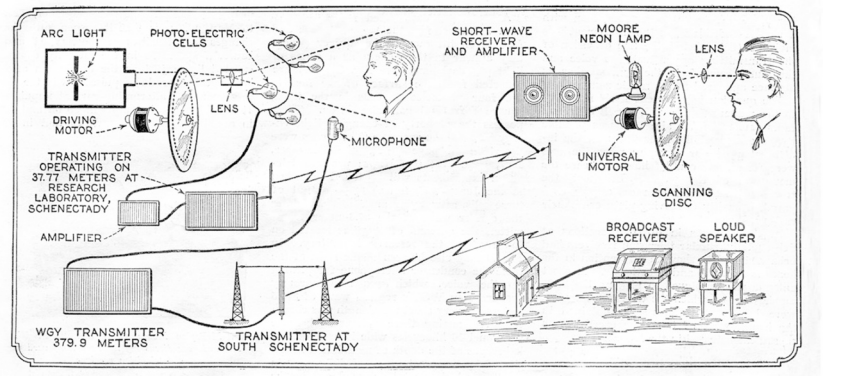
Keene's initiative reveals an interest in technology that bridges the early experiments with selenium cells and its applications in image formation and transmission, a path also suggested by Fournier D'Albe in his book *The Moon Element: an introduction to the wonders of selenium* (1924). The early mechanical television system,[51] on the capture side, was equipped with a mechanical scanning device embedded with a selenium cell and a spinning disk with holes[52] to scan the scene and gene-

50 According to the artist, the second version of his optophone was driven by the idea to use technologies available in the early to mid-1920s, the period in which Raoul Hausmann was elaborating the concept of the optophone. Images formed on a 30-lines television are synthetised from the sounds picked up by the microphone, and the sounds produced by the theremin were controlled by images from a 30-lines camera.

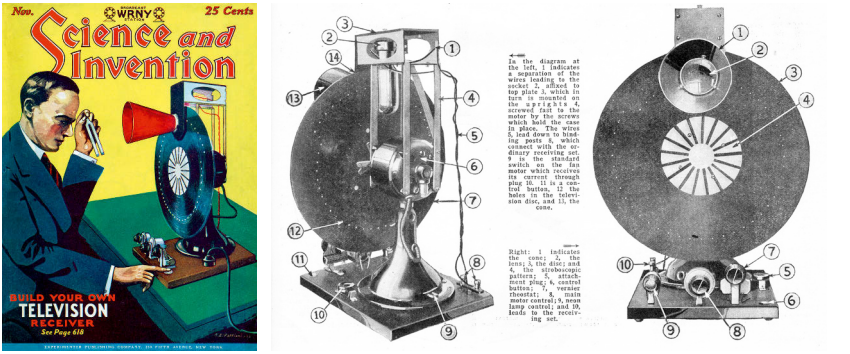
51 In contrast to the television technologies that followed, in which the creation and display of the picture are based on electronic scanning methods, for example the electron beams in cathode ray tube (CRT) televisions or liquid-crystal displays (LCD).

52 The Nipkow disc, invented by the young inventor Paul Julius Gottlieb Nipkow (1860-1940), was fundamental for the development of the early experimental mechanical televisions. Media archaeologist and artist Gebhard Sengmüller has been working on *Big Paul*, an enlar-

rate the image signal; on the receiver side, a similar mechanical device displayed the picture. Figures 3.5 and 3.6 below clairify:



3.5: Early mechanical-scan television system: Image transmission principle using Nipkow's disc and selenium cells; Source: Rowe, C. G. B. 1928.[53]



3.6: US-American magazine presenting a DIY mechanical television receiver in late 1920's; Source: Science and Invention 1928: Cover page and schematics cropped from p. 619.[54]

ged version of Nipkow's disk. More information available at the website of the artist: <http://www.gebseng.com/11_big_paul/> Accessed March 5th 2018.

53 Article titled "Television Comes to the Home" at *Radio News* Magazine, published by Experimenter Publishing, New York, NY, Vol. 9, n. 10, April 1928, p. 1098.

54 Gernsback, Hugo (Ed.) How to build the S&I Television Receiver In: *Science and Invention*, Vol. 16 n. 7, New York, NY. Experimenter Publishing. November 1928. pp. 618-20.

In the version Peter Keene developed in 2004, titled *Raoul Hausmann revisited*, the artist implemented a more complex technical ensemble based on the feedback principle, using a sound source, analog synthesizers, a projection apparatus, photomultiplier sensors, and loudspeakers. According to information available on the artist's own webpage, the initial input sound is transformed by the action of the cylinders into spatialized colored light animation, i.e. a constantly moving image, which is in turn captured and retransmitted to become synthesized sounds. The sequence of feedbacks results in a floating image constantly moved by sound enriched by spontaneously emerging overlays. The colours arising from these overlays themselves generate new frequencies, new sounds. The system is continuosly reinformed with new input sources to create a self-regulating situation.

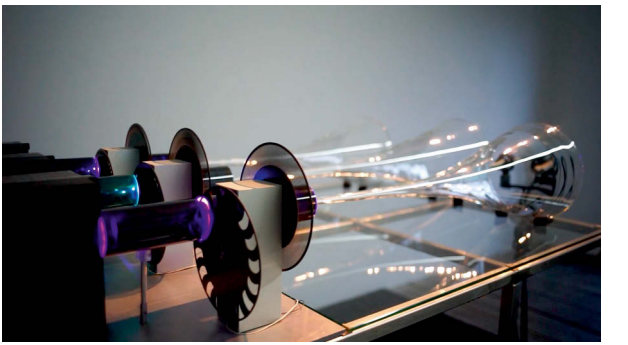
The *Photophon* (2013) by Aernoudt Jacobs, likewise built in a variety of versions, is an installation in direct dialogue with the thermo and photoacoustic principle of Bell's homonimous experimental device. Produced in collaboration with the Laboratory of Acoustics and Thermal Physics from the *Katholieke Universiteit Leuven* in Belgium, the artwork premiered in Maastricht as part of *Resonance*, the European Sound Art Network.

Technically, Jacob's *Photophon* consists of three almost identical photophonic objects, each of them playing a variable tone. Independent strong laser beams generate the sounds simultaneously, each of them coupled with a rotating disc, which chops the light beam into small fragments. The general tonality of the installation constantly shifts over time and provides a changing vibrating micro-tonal structure. The technical ensemble is organised to provide a certain kind of musicality, produced by the form of an installation rather than that of a musical instrument.

Jacobs had direct contact with Bell and Tainter's patent documentation and, contrary to the original device, the artist did not aim to establish remote communication. Jacob's installation reanimates a technical principle of a historical media device in a new version built with contemporary materials and technology, without the pretense of reconstructing an exact copy of the original. In this case, the value of the creative process lies less in the applied technical principle than in the discoveries and knowledge gained during the process of constructing the installation. In an interview with the artist,[55] he pointed out that laser colour intensity was associated with sound amplitude, whereas the amount (frequency) and shape of the perforations on the paper disc influenced the speed and pitch of the sound waves.

Keene's and Jacobs' cases demonstrate how arbitrary and intuitive relationships stand behind every aesthetic choice made concerning the elements used, both in terms of objective and subjective parameters. In fact, the aesthetic handling of technical objects dissolves the objective-subjective polarity normally emphasized in scientific contexts.

55 Conversation with the artist was held via skype on July 9th 2017.



3.7: *Photophon* (2013), by Aernoudt Jacobs. Details of the photoacoustic cell and the intermittent light disc of the installation assembled at the exhibition 'Cause and Nature of Sound' at Le Bon Acceuil in Rennes, France. © Aernoudt Jacobs. Courtesy of the artist.

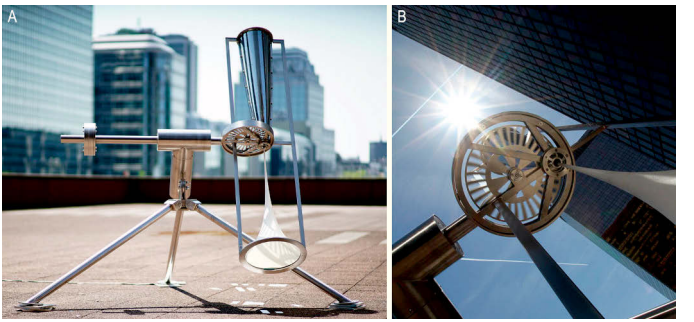
On the one hand, Jacobs' poetics can be better grasped by considering the underlying motivations for his artworks. According to the artist, he was interested in "*achieving a sonic event from pure ephemeral phenomena*" (...) "*I am mesmerized by the idea that sounds around us can be created with light.*"[56]. As a 'sound hunter'[57], he has been producing a series of machines and installations to access new sorts of sonorities, from amplifying ice formation (*SIKUVALLIAJUQ – ice is forming*, 2012 and *Permafrost*, 2015) to experiments with electroactive polymers and other metamaterials, as is the case on *Color of noise* (ongoing research since 2014). On the other hand, Jacobs' experiments with audible non-trivial sounds that emerge from simultaneously simple and complex interactions of matter are inseparable from the strong visual appeal found in his artworks. They are highly conducive to the perception of audiovisual stimulus as a space-time continuum despite the fact that one cannot immediately grasp what exactly is happening on the physical stratum, which may account for why the sculptures and installations attract such attention.

In a further development of his research on light-to-sound translations, Jacobs also created the *Heliophone* (2015), a sort of kinetic sculpture that turns sunlight into sound. The device acts autonomously by following, absorbing, focusing and fragmenting the sunlight. The artist's intention was to create a sound sculpture

56 Jacobs 2013. *Photophon*. Available at <http://www.aernoudtjacobs.info/photophon.html> Accessed February 15th 2018.

57 Exploring different techniques and materials, Jacobs' poetics is strongly based on discovering sound in, and generating sound from, unusual sources, as well as the potentialities for the reception of these sounds in spatialized and visually attractive forms.

for the sun whose tonality changes constantly according to the intensity of light available, which also varies widely according to geographical position.



3.8: A: Setup of the *Heliophone* (2015), by Aernoudt Jacobs, at the roof of WTC Tower I, Brussels, Belgium; B: Detail of sunlight and the optical chopper. © Aernoudt Jacobs. Courtesy of the artist.

By making the atomical changes within the material that constitutes the light-to-sound transducing membrane perceivable, Jacobs' piece involves aesthetic research on the origin of sound and 'environmental sounds'. On his amazement about the physical photoacoustic principle, Jacobs states:

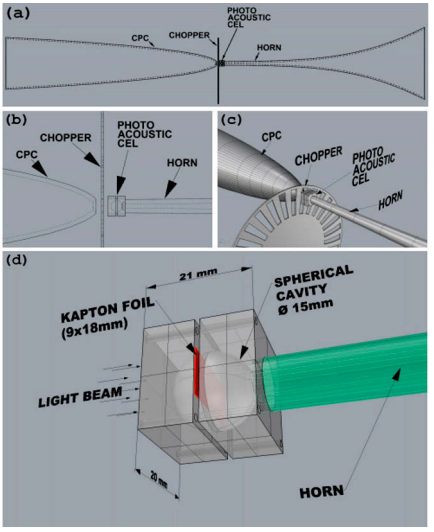
> We know that every material has a resonant frequency but also every material can be 'activated' with light to 'sound' and this sound has a direct correlation to its resonant frequencies. Of course, the shape of materials will also have a big impact, but this remains a side effect. For me this is quite an important revelation because it touches the world of sounds in its very essence. The sun radiates enough energy to produce sounds. You don't need to create a sound with a direct or physical contact. Sound can happen by itself without any direct physical contact. The utmost ephemeral aspects of sounds around us can be revealed with light. Also, the fact that one can build a photo-acoustic cell from basic materials like copper and glass is a fascinating aspect for me. [58]

From a more exacting scientific perspective, the assertion that that sound can be created with "no physical contact" may lead to a misconception of the light-matter interaction.[59] To unveil the very physical "magic" behind the technical apparatuses being used in light-to-sound translations, it is necessary to look more carefully at the mechanisms enabling it.

58 Jacobs 2013.

59 This is a similar misunderstanding to Edmond Couchot's aforementioned statement reducing electronic images to their immaterial nature.

Similarly to his *Photophon*, the technical ensemble responsible for the translation of light into sound consists of a CPC (Compound Parabolic Collimator), a piece through which the light is focused on a photoacoustic cell; a chopper, a sequencially perfurated disc placed in between these two pieces; and a horn, through which amplifies the sound. The material basis of the photoacoustic cell is a patented Kapton®foil (see Fig. 3.10, session d), which is "*coated with copper and blackened with carbon soot from a candle flame*"[60] in order to enhance both light and heat absorption. The rotating disk (chopper) is responsible for the fragmentation and modulation of the light beam before its absorption. The distance between every overture on the disc in combination with its rotational speed forms the intermittent signal, whose audible frequencies are immediately amplified by the parametrically designed horn. The sequence of pictures below shows how the technical elements are organized in the *Heliophone*:



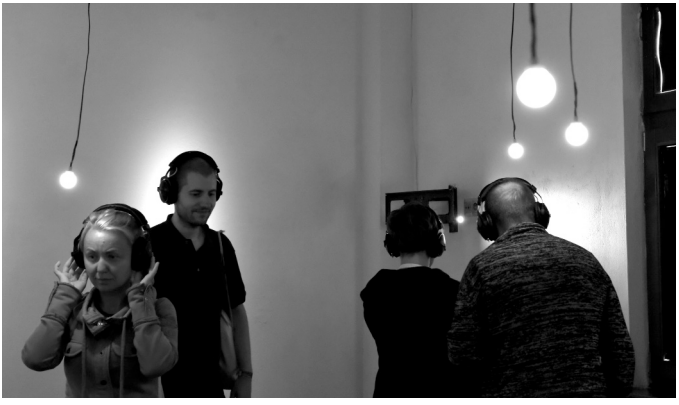
3.9: Detail of photo-acoustic cell used by Aernoudt Jacobs at *Photophone* and *Heliophone;* Source: Roozen et. al 2016: 1697.

Unboxing the technical and aesthetic layers of *Heliophone* reveals the epochal differences between scientific papers addressing similar issues. While in the late 19th century Bell and Tainter needed to test more than fifty different shapes for

60 Tests on how to optimize the relationship between the light intensity and the increase of temperature have also been made in order to find the Kapton Foil's maximum level of efficiency. For more technical details consult Roozen et. al 2016: 1697-8.

their device,[61] the scientists working with Jacobs on the *Heliophone* adopted computer-assisted simulations to develop an optimized and effective design model, which greatly facilitated finding the functional material specifications of both the photoacoustic cell and horn.

Another version of a contemporary art installation departing technically and aesthetically from the photoacoustic principle is the *Photophon* (2010), developed by Klaus Filip and Arnold Haberl (noid). According to Filip[62], the project emerged in an informal conversation with his collaborator and was influenced by an exhibition organised and curated by the Institute of Media Archaeology (IMA) called *Magical Sound Machines*. [63] Reporting that the creative process was intertwined with his experience teaching a media studies course, Filip directly refers to Bell and Tainter's *Photophone*, and the homonious sound installation features "*a direct translation from sound into light and vice versa*"[64]. The artists provided modified headphones able to transform the light signals into sound, and since every light bulb in the room transmits a different frequency to the earphones, the audience can both see what they hear and hear what they see.



3.10: *Photophon* (2010), by Klaus Filip and Noid. © Klaus Filip and Noid. Courtesy of the artists.

Technically, Filip's and noid's artwork is based on a very simple circuit that uses LEDs as the source light and a self-made light-to-sound converter that uses

61 Bell 1880:133.

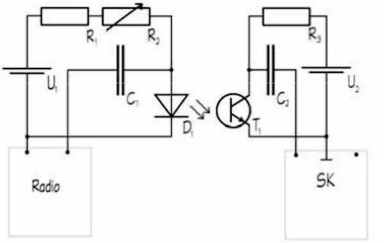
62 Interview with Klaus Filip was conducted by Skype in March 28th 2018.

63 Brief documentation of the exihbition available at <https://ima.or.at/en/sound-machines/> Accessed March 13th 2018.

64 Website of the artist available at <http://filipino.klingt.org/photophon/> Accessed March 13th 2018.

phototransistors. LEDs were chosen due to the ease with which their brightness can be modulated, resulting in the generation of a variety of sound frequencies.

- 2 Batterien (9V): U_1, U_2
- 2 Kondensatoren (2200 F): C_1, C_2
- helle LED (grün, glasklar): D_1
- Fototransistor BPX 25: T_1
- Widerstand (100 Ω): R_1
- Potentiometer (10 kΩ): R_2
- Widerstand (10 kΩ): R_3
- Sinusgenerator (Soundkarte, verstärkt durch Stereoanlage)/ Radio mit Kopfhöreraus-gang



3.11: Radio transmitter circuit that served as the basis for the customization of headphones in the Filip and Noid's Photophon; Source: Klaus Filip's personal archive.[65] Courtesy of the artist.

In addition to its explicit reference to the work of Bell and Tainter, envisioning a synaesthesic experience for the audience by means of artificially merging the senses of hearing and sight brings Filip and Noid's installation conceptually close to Raoul Hausmann's *optophonetische Weltanschauung*. Nonetheless, the artists overcome the merely technical aspects of the device, enticing the audience to participate and to create a very personal soundtrack by moving around the room and potentially playing with the light sources. Beyond the "participatory hells"[66] critized by Claire Bishop (1971-), this set up provides an open listening experience and enables the visitor to take an exploratory approach to easily and intuitively engage with the composition and shape a sonorous narrative that gives sense to their own sensorial experience.

It is curious that in the case of each of these derivative contemporary photophones the artists retained the name given to their forerunner even though they did not aim to rebuild a replica of it. In this sense, the conceptual-material link emphasises the historical and technical aspects of the technical ensemble as a guideline for the artistic research process, without however explicitly commenting on

65 File exchanged during interview with the artist.

66 Bishop, Claire. *Artificial hells: Participatory art and the politics of spectatorship.* London/New York: Verso, 2012.

the nature of the reinvention. This is not the case with the already mentioned *Heliophone*, by Aernoudt Jacobs, or with the *Stofftonband* (2013) by Katrin Stumreich, which will be introduced in the following pages. Are artists who focus more on the material level of their propositions more prone to undervalue the conceptual side of their artworks? Each conceptual-material relationship must be considered within its context.

Aernoudt Jacobs' version of the *Optophone* based on three optophonetic pieces forms a luminous sound sculpture, with a simple minimalist sound composition triggererd by preset machinery, that explores the overlap of changing frequencies. Jacobs' sound poetics is not based on the final artistic product but, rather, on the investigative path the artist chose for finding sounds from non-trivial sources. Nevertheless, when facing non-trivial machines such as Jacobs' *Photopone,* one way that interested audiences frequently query how they work is by investigating if they themselves can somehow influence what is happening. If the machine reacts to any sort of bodily movement around the piece, the next step might be to observe the connections among the given elements, trying to notice any kind of difference and/or repetition in its audio-visual effects. These very first steps can be decisive for grabbing the audience's attention since the human capacity for learning is activated by comparison and pattern recognition operations. It seems that the more one is able to learn with such systems the more attractive and engaging the artwork is, as suggested by Mihaly Csikszentmihalyi's (1934-) remarks on the state of flow.[67] Unlike a musical composition designed simply to be played, the acoustic appreciation of this kind of installation cannot be considered the main aesthetic element of the artwork since the orchestration is concentrated on the articulation of all the constructive elements of the piece.

Both *Photophon* and *Heliophone* are organized technical ensembles that reveal the activity of matter to the human senses. In this sense, such aesthetic experiments recall what Peter Weibel (1944-) called "the world as interface"[68], a term defining a media art creation and its interfaces as a sort of management of the dynamics of the world, by means of addressing endophysics, which, like second-order cybernetics, highlights the role of the observer in the observing act.[69] In this sense, and in a subtler way than real-time reactive installations, the sound machines are

67 Csikszentmihalyi, Mihaly. *Flow: The psychology of optimal experience.* New York: Harper and Row Publisher, 1990. p. 74.

68 Weibel, Peter. The world as interface: Towards the contruction of context-controlled-events-worlds. In: Druckrey, Timothy (Ed.) *Electronic Culture.* New York: Aperture, 1996. pp. 338-343.

69 According to Weibel: "*The description of the world in terms of interface and the acknowledgement of the non-objective, observer-objective nature of objects are corollaries of the endophysical theorem. The world interpreted as observer relative and as interface is the doctrine of electronics interpreted as endophysics. The world changes as our interfaces do. The boundaries of the world are the boundaries of our interface. We do not interact with the world – only with the interface to the world. Electronic*

frames for reality-revealing poetic matter that the human senses in natura cannot perceive. In the case of the autonomous mechanism *Heliophone*, Jacobs framed a piece of physical reality to be perceived beyond the range of the human senses. At the same time as he created another instance of sensing, he set up a situation that stimulates a posthuman perspective. Moreover, the artpiece guides the audience to perceive the given surrounding enviroment as something distinct from the routine nature of everyday life. By creating a sort of poetics of sunlight, this non-trivial machine goes beyond functionality: it expresses the sonorous dimension of an ignored, or less perceived, physical phenomena surrounding humankind by making one aware of the activity of matter, that is constantly at work without our being aware of it.

Filip and Noid's version of the *Photophon* seems to be more structured in terms of the real-time experience it renders. The appearance of the objects used in the assemblage does not play an essential role in comparison to the condition of free spatial mobility that they enable for the audience. Through the earphones and moving light sources that allow the audience to compose their own unpredictable sound experience, Filip and noid's *Photophon* suggests a listening experience similar to that of a labyrinth, to borrow the metaphor used by the composer and music critic Leonardo Androvandi[70] to describe the possible delights of musical appreciation. An uncertain soundscape co-produced by artist and visitor emerges from the programmed set of chances. Like the experience inside a labirynth, the most important aspect of listening fruition is not to solve its riddle but to engage in the game of exertion and wandering.

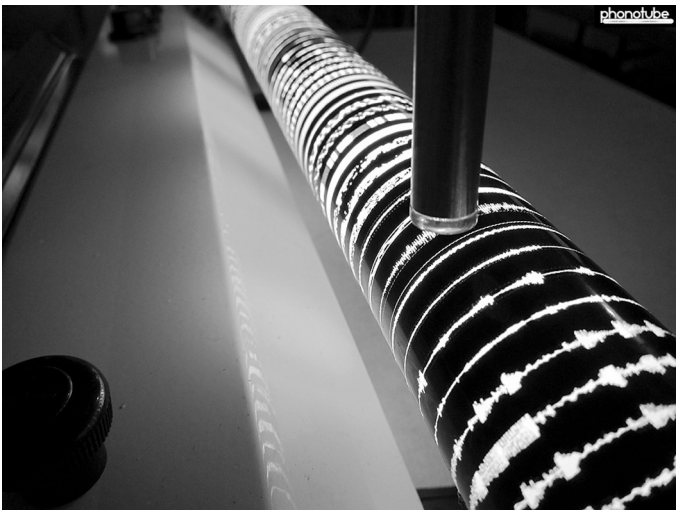
Arcángel Constantini's work has also been inspired by photoacoustic devices, resulting in the development of a series of experimental instruments that he uses for live audio-visual performances. His *Phonotube,* for instance, was constructed with rotating luminous tubes covered with printed sound sequencers. In constrast to the previous examples, Constantini uses the suffix "-tube" to name his instruments, highlighting the subjective nature of his formal choices and his contribution to the aesthetic and cultural understanding of photoacoustic phenomena. The light tubes are capped with offset negative's containing sound waves/patterns that can spin at variable speeds, according to the artist's wishes. In Constantini's own words:

> The oscillation from the light emitted by these patterns is transduced to sound, processed by light excitation, a variety of electronic circuits as pre-amps with photo-cells and phototransitors, voltage control oscillators, relays, filters, 1bit

art should help us to better understand the nature of electronic culture and the foundations of our electronic world". (Weibel 1996: 343)

70 Aldrovandi, Leonardo. Escuta e labirinto. In: *O sonoro e o imaginável: Ensaios sobre escuta, composição e olhar*. São Bernardo do Campo: Lamparina Luminosa, 2014. pp. 11-34.

attiny85 micro controller. The technological principle is based on the photophone, patented by Graham Bell and inspired by audio-visual experimenters as Norman Mclaren, that used the optical sound technology of film.[71]



3.12: *Phonotube* (2011), by Arcángel Constantini. © Arcángel Constantini. Courtesy of the artist.

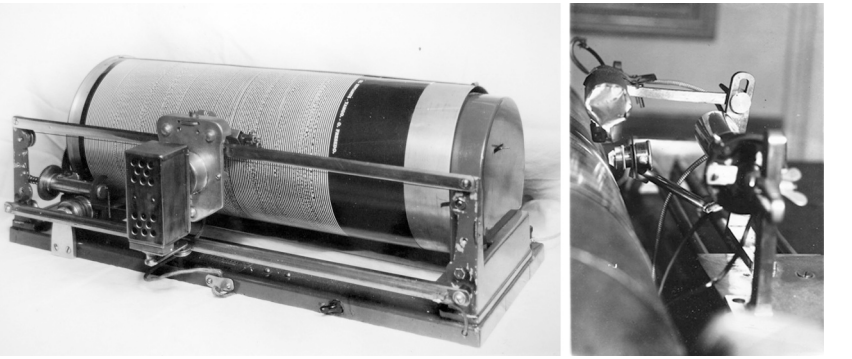
Observing Arcángel Constatini's references more closely, one sees that the artist implemented a remix aesthetic[72] by sampling not only audiovisual contents but also audiovisual machinery. Among his sources was another important and lesser known device called the *Fotoliptófono*, an audio recorder and player invented by Fernando Crudo (1906-1972) in the late 1920s and patented in 1934 in Argentina. Crudo's intention was to create the means for an efficient mass distribution of sound contents using common paper as the medium in which sound waves were printed. Sound reproduction, in turn, required sensors that detected the light level reflected by the printed paper.[73]

According to audio researcher Ianina Canalis, in contrast to the *Phonograph* (1877) invented by Thomas Alva Edison (1847-1931), but analogously to the *Gramopho-*

71 Constantini, Arcangel. *Phonotube.* Available at <http://www.arc-data.net/phonotube/> Accessed September 10th 2017.

72 Navas, Eduardo. *Remix Theory: the aesthetics of sampling*. Wien/New York: Springer, 2012.

73 Canalis, Ianina. El fotoliptófono y sus páginas sonoras. Un reproductor de sonido en la Argentina de los años '30. In : Espinosa, Susana (Ed.) *Escritos sobre Audiovision. Lenguajes, Tecnologías, Producciones.* Remedios de Escalada : EdUNLa, 2010. pp. 151-166.



3.13: Fotoliptófono (left) and detail of the pick-up (right); Source: Canalis 2010.

ne (1887) invented by Emil Belriner (1851-1929), Crudo's *Fotoliptófono* required distinct devices for recording and reproducing audio signals.

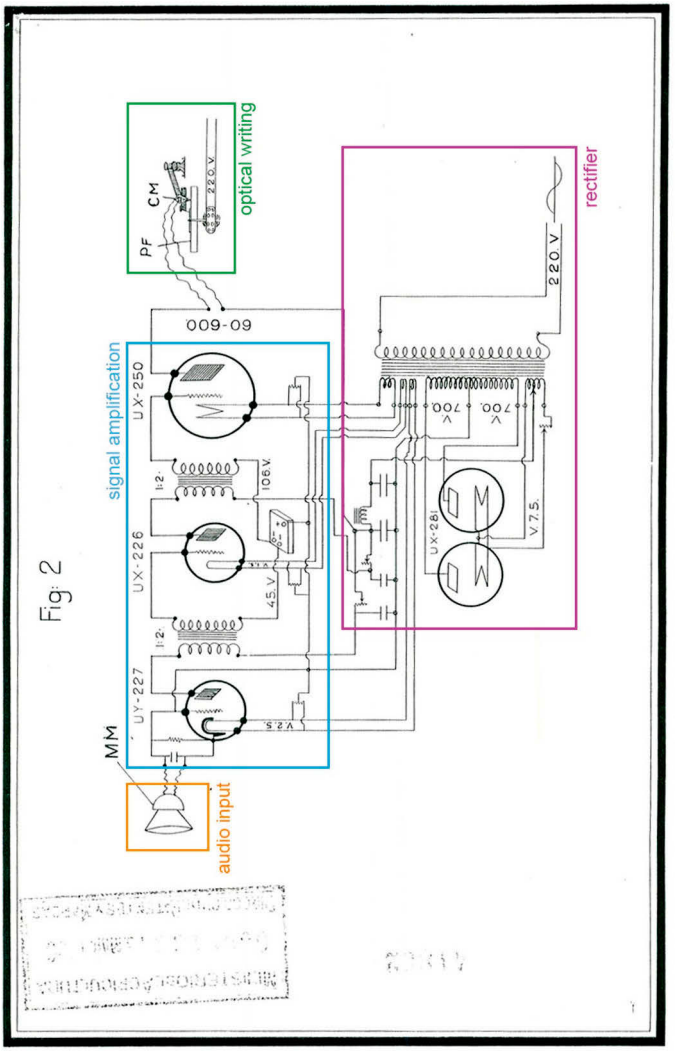
Crudo worked on two different prototypes with distinct techniques for inscribing audio information. One was based on variable grayscale intensity[74], recorded onto a circular disc; the other on the wave inscription through variable width[75], recorded onto a rectangular page. The recording machine needed to be placed in a dark room, since the media in which the signal was written was photosensitive film, similar to that used in still photography and cinema, however, of the format and size required for the posteriorly printed sound pages. Attached to the rotating cylinder was a small lamp that slid along a fixed axis, which emitted the light to mark the film in a helical form.

The audio input was identical in both cases, being captured through a microphone sensitive to variations in the air's pressure and speed, which transduced this mechanical energy into voltage variations. Once the recording process was finished, the 'burned' film was developed, resulting in a sheet full of parallel graphic

74 As reported by Canalis, in order to achieve the grayscale version of the audio information, the microphone signal was amplified to reach a bent glass tube containing rarefied neon gas that, according to the current passing through it, emitted an actinic light proportional to the current that passed through it, which was reflected by a polished metal reflector, which concentrated the light on the target. The emitted light burned the audio information on the light-sensitive film. (Canalis 2010)

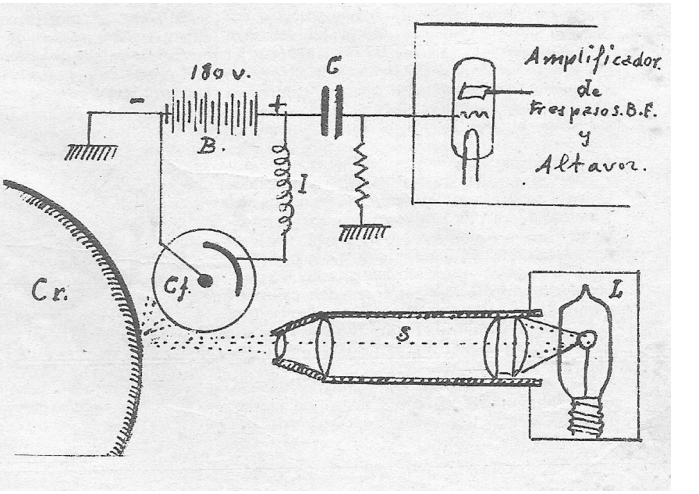
75 In order to record the audio by varying the width of the wave image, Crudo had a fixed beam of light fall on a very thin mirror welded onto a wire involved in a magnetic field and connected to a mechanism immersed in pure paraffin oil, which is capable of oscillating from left to right according to the polarity of the electrical current that reaches its terminals. This current is supplied by the amplifier coupling transformer of the electrical impulses coming from the microphone. (Canalis 2010)

waves: sound pages that could be made of either lithographic or zinc matrices. By observing the device's circuits (Figs. 3.14 and 3.15) it is possible to visualize the various layers of the conversion of the audio input into optical writing on photosensitive film.



3.14: Circuit from the Fotoliptófono for recording circular pages, by Fernando Crudo; Source: Modified from Canalis 2010.

The coloured rectangles drawn over the historic image represent the operating functions of the circuit: the audio input (orange), a microphone in this case; the required sequence of signal amplification (blue) needed to adequately transfer the audio signal to the end point; the mechanical arm with the light source (green); and a part dedicated to voltage rectification that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction.



3.15: Circuit from the Fotoliptófono for reading waves from the rotating cylinder, by Fernando Crudo; Source: Suplemento Blanco y Negro, ABC de Madrid, July 2nd 1933.[76]

The circuit for reading and reproducing the printed sound information, in turn, used reflected light from the paper absorbed by a photosensitive cell, which translated the variation of light into resistance/current/voltage[77] variation that formed a signal variation later amplified and made audible through the vibrations of the loudspeakers' membranes pushing and pulling the air.

A media archaeological approach enables one to realize the rhizomatic character of media genealogy. *Fotoliptófono* represents a summation of the technical principles of photography, phonography and lithography. If one looks back to the

76 Canalis, Ianina; Petrosino, Jorge. ¿Cuánta música cabe en una página de periódico? Sonido impreso en papel a principios del siglo XX. In: *Question*. Vol.1 n.42. Abril-Junio 2014. p. 266. Available at <http://perio.unlp.edu.ar/ojs/index.php/question/article/view/2138> Accessed March 10th 2018.

77 U = r * i (U for Voltage; r for Resistance; i for current).

not-so-distant past, these media archaeological artifacts comprise a combination of techniques that intertwine principles later implemented in Compact Disc (CD) technology – a media already considered obsolete after the popularization of the internet, the compacting .mp3 audio format, and the availability of online storage and streaming solutions under conditions of even faster internet access. In fact, the CD-ROM media, together with the popularization of personal computers, triggered great excitement among artists in the 1990s, many of whom explored the facilitated multimedia aspect of digital technology.[78]

Another example of the implementation of light-to-sound conversion using non-trivial materials in the context of art is *Stofftonband* (2013) by Katrin Stumreich. Her performative sound machine is based on rotative fabric bands, whose different weaving patterns result in different sounds. The fabric tracks play a role similar to that of the rotating chopper, intermittent discs and paper bobbins in the aforementioned projects.

Stumreich provides clear documentation of the piece that explicitly clarifies how she created the correspondences between the fabric design and the sound parameters manipulated during her performance:

> The tone pitch is created by the quality of the fabric, weaving tecnique, basically this is the amount of threads interrupting the light per second. Breaks and rhythm are due to the seam, and the length of each sort of fabric. The arrangement of the fabrics in aspects of length, quality and the connecting seams are additive parameters for composing a rhythm or a flowing change of the tone pitch.[79]

Beyond the photoacoustic principle, Sturmreich's artwork can also be conceptually associated to the first codes written by mathematician and writer Ada Lovelace (1815-1852)[80] at the advent of English textile industry,[81] and thereby be used as a powerful example to make the interweaving of codes and materialities explicit. In fact, one could endlessly enumerate media devices and artworks acting on finding and exploring light-to-sound correspondences.[82] While observing media artworks

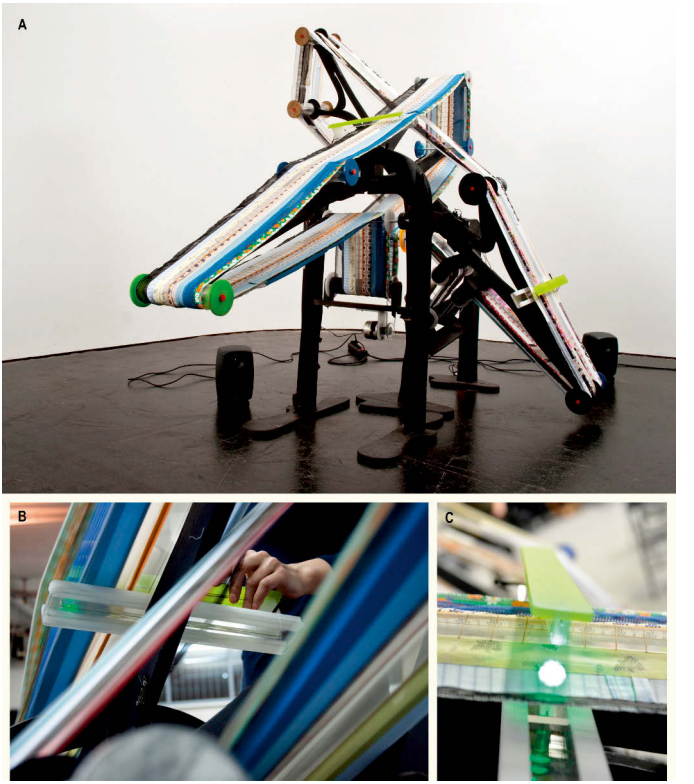
78 The trendy jargon that has always accompained technological media culture adopted the term 'multimedia' in the first half of 1990s, which, in turn, was later replaced by terms like "interactive" due to the advent of the internet and tangible interfaces. Unfruitful choices regarding the characterization and reception of media specificities included prefixes like 'new' or 'post', as seen in "new media" and, more recently, "post-digital" and "post-internet".

79 Artist's website available at <http://www.kathrinstumreich.com/stofftonband/> Accessed February 14th 2018.

80 Fuegi, J.; Francis, A. J. (October–December 2003), "Lovelace & Babbage and the creation of the 1843 'notes'" In: *Annals of the History of Computing*, IEEE, Vol. 25, Issue 4: pp. 16–26.

81 Francis, A.J.; Carr, T.H. Electricity in the wool-textiel industry. In: *Proceedings of the IEEE - Part II: Power Engineering*. Vol. 101, Issue 81, June 1954. pp. 291-307.

82 Just to mention a few examples: the classic *Very Nervous System* (1982-1991), by David Rokeby; more recently the already mentioned Leslie Garcia's *Pulsu(m) Plantae* (2010-2013), Yiannis



3.16: *Stofftonband* (2013), by Kathrin Stumreich. A: Overview of the machine; B and C: Detail of the optical reading system. Photo (C): Ben Keyserling. © Kathrin Stumreich. Courtesy of the artist.

in rhizomatic dialogue with historical devices, one realizes how artists end up using similar techniques, despite working with completely distinct materials, concepts and contexts. The few selected examples demonstrate the diversity of how different aesthetic choices can emerge from the same technical standpoint, and vice versa.

A common element seen in the collection of devices and artworks here presented is that their search for light-to-sound correspondences involves taking advantage of 'techno-magical' conversion in order to spark amazement and the effect of presence. Nevertheless, there is no formula or method certain to be more effective

Kranidiotis' *Pentatono* (2015) and his series of soundscaped based on classic paintings, such as the *Ichographs MdelP* (2015); sound artwork *Vibrant Disturbance III* (2014) by Christian Skødt's and many others.

or successful. Since every artwork emerges from different contexts and has different conditions for coming to fruition, they are in principle incomparable objects. However, the examples have also given precious hints about how aesthetic choices depend on the complex interdependence of several factors, ranging from the artist's subjectivity, background and repertoire, to the material, technical, and other (un)available resources, as well as their possibilities and limitations. The interweaving of technical and aesthetic choices, expressed through the material organization and its subsequent spatial conditions, narratives, metaphors, patterns and/or symbols, is the core issue addressed by the creative processes of media art. The friction and cohesion among these elements are valuable for creating more significant media artworks.

The few aforementioned examples also indicate that when working with photosensitive materials media artists must continually choose one or several of their countless possible operationalites. In this sense, working creatively with light and sound at the atomical level (electrically, electronically, digitally) entrusts media artists with both the freedom and the responsibility of a translator. This role requires being able to articulate different levels of abstraction in order to mobilize, signify and/or resignify matter and materials, be it light, sound, moisture, movement, etc. The abstractive thinking of translational experiments requires the acknowledgment of subjectivity and reveals the limitations of the technological and scientific objectivity necessary for developing media devices. The issue becomes even further intensified when one considers aesthetic experiments. Here, the material-immaterial interplay of light-sound translations addresses another dichotomous dynamic, that between objectivity and subjectivity.

The analysis of the examples gives rise to some difficult questions: Why are artists getting involved with these kinds of translations? Why does one spend time, energy and resources producing such objects and the experiences they render possible? What is at stake? On the one hand, they are based in humankind's urge to express, as can be observed throughout our cultural heritage. On the other hand, in a biological and evolutionary sense, creativity inherently implies the search for novelty and variability, which also emerge from repetition. Both hypotheses refer to an existential level, whose attribution of meaning emerges from and within action itself. The next section examines further examples of the genealogy of photosentive elements and their operationality in light-to-sound translations to explore approaches through which technical features are expanded to symbolic, expressive and existential dimensions.

3.2 Absence as creative matter

A topic that deserves special attention in light-to-sound (and other) conversions is the role played by the notion of absence. The most direct level of absence observed in this machinery is the gap between the energy or signal transfer from one physical system (e.g., light) to another (e.g., sound). Yet, the absence that characterizes this transitional space can be extended to other media contexts and investigated as a promising starting point for creativity. In this sense, this section comments on some of the various dimensions of absence in media history and media art history, ranging from the void found between one system and another, through the birth and development of media in correspondence to the limitations of the human sensory apparatus, to this void's empowering existential and symbolic force.

3.2.1 Selected cases in history of media and media art

To begin with a curios anecdote, it is said that Alexander Graham Bell's interest in hearing, seeing and speech was partially based on the fact that his mother Eliza Bell was hard of hearing (and became, in spite of this, an accomplished pianist), which together with his father's business, encouraged his engagement with the deaf community.[83] Bell's story fits Kittler's argument that "*we knew nothing about our senses until media provided models and metaphors*"[84], elucidating not only how absence triggers investigation, but also how affection plays an important role in knowledge expansion.

A more popular example of the creative potential of absence in media history is connected to the human endeavours towards verisimilitude that culminated in the development of sound-film. Media historians analysing the role of sound in cinema have pointed to an image-ocular centricity in the dominant narrative of cinema history, even though "*as long as cinema has existed, sound has been part of it – both in its presence and in its absence*."[85] The projection of the first so-called silent films were from the beginning accompanied by music performed by solo musicians or orchestras, who also created live sound effects that were later enhanced by the ability to use pre-recorded ones. However, the insertion of sound in the material film itself revolutionized the cinematographic industry and language, due to its economic and aesthetic implications. The absence of diegetic sound in cinema annoyed

83 Benito, Shandra. Alexander Graham Bell and the Deaf community: A troubled history. In *Rooted in Rights*. January 29th 2014. Available at <http://www.rootedinrights.org/alexander-graham-bell-and-the-deaf-community-a-troubled-history/> Accessed February 27th 2017.

84 Kittler 2010: 34.

85 Beck, Jay. The evolution of sound in cinema. In: Guynn, William (Ed.) *The Routledge Companion to Film History*. London/New York: 2011. p. 64.

those who sought to us cinematographic language as a means to achieve complete audience immersion, i.e. a 'real' experience closer to how the human sensorial apparatus perceives and shapes the surrounding physical world. If immersion is undertood as the full capture of the spectator's senses, the film experience was considered as an incomplete media, even if a live musician or orchestra accompanied the film exhibition. Taking theater as its reference, the absence of the human voice was seen as diminishing film's verisimilitude. Hence, sound-film is also called 'speaking-film'. Scientists and technologists all over the globe have worked on the solution to that 'problem', a process that was initiated with investigations around the design of devices based on selenium's photosensitivity.

In the United States of America the development of sound film involved an attempt to attain synchronous reproduction of sound and image, also reflected in inventions such as Thomas Edison's *Kinetophone*, (1895 and 1913); Léon Gaumont's (1864-1946) *Chronophone* (1902), Oskar Messters' (1866-1943) *Kosmograph* (1903), E.E. Norton's *Cameraphone* (1908)[86] and later Lee De Forest's (1873-1961) *Phonofilm* (1922), AT&T Bell Laboratories' *Vitaphone* (1925), Radio Corporation of America's *Photophone* and Radio-Keith-Orpheum *Photofilme* (1927), and so forth.[87]

Apart from the issue of image-sound synchronization, experiments on the optical inscription of sound on film began being conducted at the very beginning of the 20th century when Ernst Walter Rühmer (1878-1931) developed the *Photographophone* around 1900. Rühmer's technique was based on photographing the fluctuating light proceeding from a 'speaking arc', while the reproduction was executed by using the dynamic photosensitivity of selenium to control a telephonic current actuated by variable illumination. This principle is introduced in the explanation of the *Photophone* and clearly visible in the aforementioned *Phonotube* by Arcángel Constantin and *Fotoliptófono* by Fernando Crudo.

In the scientific imaginary and literature of the 1920s a mergence between the *Photophone* and film technique was suggested as a possible solution to the problem of image-sound synchronization in cinema. A brief article published in *Science Journal* titled "Film photophone"[88] described a precursor of what would be a new industrially and commercially successful technical ensemble: sound-film. The author envisioned the 'speaking films' as based on photo-telephony technology and acknowledged the parallel work being done in different countries, without, however, going into the details of how the sychrononization should be executed.

86 Beck 2011: 66. Curiosly, there is little information about the inventor or his device, which coincided with the early versions of smartphones, which overtook the attention of media historians.

87 Ibid: 67-68.

88 The film photophone. In: *Science* 54 (October 21, 1921)Science 54 (1399), p. 373.

A decade later, in a publication responding to the increasing demand for consolidation in the industry, the technical engineers Fischer and Lichte elaborated all the details of sound-film.[89] Observing illustration b in the figure 3.18 below, one notices the miniaturization of the mechanical principle present in Bell and Tainter's *Photophone.* Since the light variation incident onto the selenium cell produced a variable resistence, which was drained off through the anode to the amplifier, the inscription of intermittent light was in this case implemented by means of electric current.

The sequence of illustrations above demonstrates that the elements operate in a similar way to the optical writing process of the *Fotoliptófono*, an invention that was indeed partially inspired by the emerging sound-film technology. Focusing on the technical working systems of the series of examples discussed above, enables one to see the photocell[90] as a leading element in both writing and reading the soundwaves on and from the film surface. Like the *Fotoliptófono*, the signal of the waves inscribed or read from the medium needed to be amplified (*Verstärker* = amplifier).

Selenium cells also played an important role in the development of optophones, prior to Hausmann's awe at his optophonetic perception and failed patent applications. As an enthusiast of the wonders of selenium and fascinated by the possibilities for converting light into sound and vice versa, the engineer Edmund Edward Fournier D'Albe (1868-1933) developed a version of an *Optophone* in 1912 as a means to facilitate the lives of visually impaired people by helping them to orient themselves in their surroundings and be able to read.[91] Therefore, the device belongs today to the technological heritage of visual impairement, which encompasses a variety of attempts to assist people whose bodies are not aligned to the standard media of the epoch, which constantly and emphatically promoted the supremacy of vision.[92]

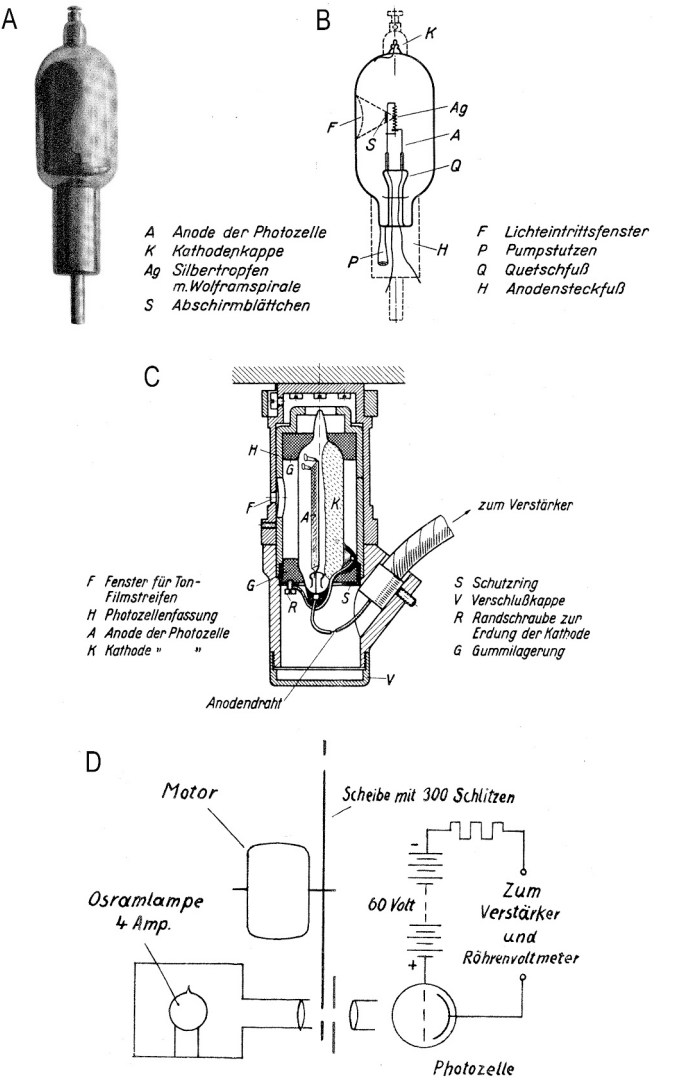
Indeed, the development of media devices is simultaneously based on the limits of the human sensory apparatus and endeavours to extend, assist, enhance, and/or adjust them. Despite the predominance of normative perspectives, there

89 Fischer, F.; Lichte, H. *Tonfilm: Aufnahmen und Wiedergabe nach dem Klangfilm-Verfahren.* (System Klangfilm-Tobis). Leipzig, Verlag von S.Hirzel, 1931.

90 At that time made of the element selenium (indicated by letter S in illustration B).

91 Fournier D'Albe 1924: 32 and Niebsch, Arndt. Einleintug/Optophonethik und die Photozelle In: *Raoul Hausmann. Dada-Wissenschaft. Wissenschaftliche und technische Schrifften.* Hamburg: Philo Fine Arts, 2013. p. 57.

92 In *Techniques of the observer* (1990) Jonathan Crary deeply analysed how optical media since the 19th century have contributed to the abstraction of vision and the formation of visual-based consumers. In contrast, the *Eyewriter* project discussed in chapter two (the optical device that assisted the graffitti artist, despite his absential body movements, to make graffitti again) is a case in which one observes a technological effort that takes advantage of the power and supremacy of vision. It was precisely the contiguity of human vision and cognitive processes that enabled the developers of the project to minimize the body conflict experienced by artist.



3.17: Photocell implemented in recording and reproducing sound-film. A: Photography of a photocell; B: Schematic lateral view with details of each composing element; C: Photocell attached to the structure where the optical inscription is made; D: Circuit of a technical ensemble in which the photocell reproduces audio information. *Source:* Fischer and Lichte, 1931. pp. 58 (A and B) and 66 (C and D).

3.18: Miss Jameson at the optophone; Source: Fournier D'Albe 1924: 132.

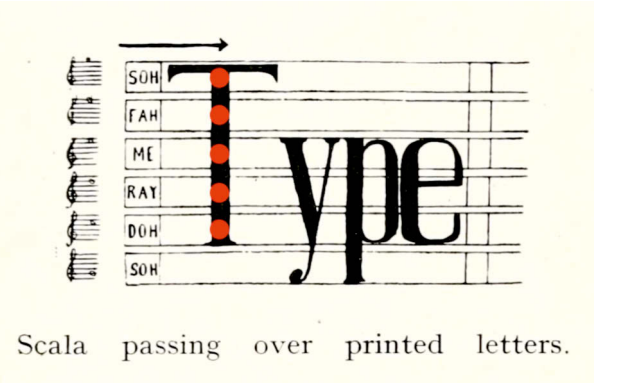
are also appropriations of assistive technologies that regard deviation as a means toward innovation. The idea behind optophones still remains today an inspiring source for creative media technologists and touches upon other levels of absence beyond physiological disability. The aforemetioned case of Peter Keene's apparatuses based on Hausmann's *Optophone*, for instance, also depended on the absence of detailed technical information about the original apparatus leading the artist to create his own relationships between light and sound. The innumerable possibilities for light-to-sound conversion have led to dialogues with media history, especially Keene's endeavour to use devices available on the market in Hausmann's epoch in the second version of his optophone, which has turned his artistic research into a continual process of knowledge construction.

Media archaeologists have been analysing the functional principles of former optophone models, as depicted in figure 3.20. Fournier D'Albe's reading machine resembles a primitive scanning technology, in which an object, as a framed field, is swept by light against a photosensitive surface, thereby detecting the presence (or absence) of elements shaping the letters through light contrast.[93]

On a Cartesian plane, axis x represents the path of the light source while axis y represents the acoustic notes. For each point detected in the scanned column, the corresponding notes that formed that letter were played. Although Fournier D'Albe claimed that through his invention the "*reading problem of the blind was completely solved by means of selenium*"[94], the resulting combination of musical notes as

93 A media archaeological approach requires recognizing this device as part of the history of computer vision; it also has similarities to the technique later used in the *Numarete,* which is presented briefly in chapter 2 as well.

94 Fournier D'Albe 1924: 94.



3.19: Schema of the sound output of an optophone; Source: Tiffany Chan / Maker Lab. July 4th 2016.

feedback can still make it hard to properly distinguish each character, which probably contributed to the short commercial lifespan of the device. The fragmented acoustic feedback of Fournier D'Albe's optophone also bears a resemblance to Morse code, since both suggest a connection between sounds and alphabetic letters. Interestingly, Morse code, as an even earlier technique for coding messages, has been employed as an assistive technology until today, enabling people with a variety of disabilities to communicate as long as they possess a minimal sensory-motor skill to perceive or express the binary combinations of long and short signs.

Contemporary attempts to use light-to-sound translations to develop assistive technological devices search for useful correspondences between visual and auditory stimuli that are more intuitive for users. Finding and establishing these correspondences is called in the scientific context image-visual to audio-auditory mapping[95], which necessarily presupposes an image encoder and software implementing methods to detect and distinguish objects from the background of the visual scene. In a case of mapping reported by Matta et al.[96], for instance, the images are transformed into a multiplexed auditory representation in which every frame is sampled, digitized and stored as a pixel matrix. Rows and columns of

95 In neuroscience one also speaks about mapping retinal images in the context of the immediate relationships between vision and cognitive process within the brain. (Damasio 2010: 63-70)

96 Matta, Suresh; Rudolph, Heiko; Kumar, Dinesh. Auditory eyes: representing visual information in sound and tactile cues. In *IEEE Xplore*. 13th European Signal Processing Conference. Sept 4-8th 2005. Antalya, Turkey. Available at <https://ieeexplore.ieee.org/document/7078395/> Accessed August 1st 2018.

each matrix are individually averaged, and the mapping translates the vertical position into frequency and the horizontal position into time delay, while brightness is translated into amplitude. The mapping method suggested by Matta et al., however, also uses image depth, and therefore becomes slightly more complex: Motion is translated into frequency shift (simulating the doppler effect); brightness into pitch; space into amplitude, reverberation, azimuth and elevation; and edge into duration. Although scientific efforts have aimed to find solutions that users could effortlessly adopt, scientists have been forthright in acknowledging the arbitrariness behind their inventions and have made it clear that the systems they develop require extensive training by the users, who have their own perceptual and learning idiosyncrasies.

Recalling Hausmann's ideal of an *optophonetiche Weltanschauung* and corresponding idea for the construction of an optophone leads to another dimension of absence that is both mirrored in his creative method and observable in his photomontages: destruction is the artificial construction of an absence. Hausmann's theory aimed to harmonise cosmologic processes, modern media technologies and human life,[97] and his propositions were clearly attempts to push the limits of the scientific and technological discourses to a symbolic and aesthetic level beyond the former utilitarian uses imagined, for instance, for the *Optophone*. Convinced that the visual arts were saturated, Hausmann adopted destruction and recreation as his artistic method, artificially creating the absence of meaning and form that opened a terrain for him to let novelty emerge.

The method also implied the absence of meaning aimed at in the Dadaist Manifesto against bourgeois values, a strong statement in the political context of the time. Considering himself a pioneer and martyr for the birth of the new man,[98] Hausmann saw in psychoanalysis the foundations for working towards this ideal: the revolution should begin with one's own 'self'. As a result of these ideas, he appropriated the principle of self-destruction as an act of creation to an aesthetic level, turning it into one of the main tenets of his dadasophy and Dada Berlin.[99] This polar creative impulse between destruction and creation is presumably also the origin of, and therefore the guideline to contextualize the closeness between, his poster poems and his optophonetics.

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97 Niebsch 2013: 19.

98 Züchner 1998: 15

99 Hausmann was also influenced by Salomo Friedlaender's (1871-1946) "creative indifference". For Friedlaender one can only perceive what is different. The difference that makes something a perceptible phenomenon is the "difference." The difference gives rise to a polar structure, and the opposites are related to each other. Friedlaender was interested in the middle between the differentiated poles. Friedlander, Salomo (Mynona). Schöpferische Indifferenz. In: Thiel, Detlef; Geerken, Hartmut (Ed.) *Gesammelte Schriften*. Band 10. Herrsching: Waitawhile, 2009 (1918).

Moreover, in light of the process of fragmentation in his photomontages and the suggestion of synaesthesia (a topic of interest to him following World War II), Hausmann's artworks make the operationalities of the human perceptual apparatus explicit, similarly to the foundations of Op and Kinectic Art. In the Dadaist movement, however, the interrelationship between human sensory and cognitive apparatuses is far more provocative, taking place precisely in the space between sensing and making sense.

A similar contemporary approach to that of Hausmann's *optophonetische Weltanschauung* and the enhancement of the human senses can be found in the artistic statement of eyeborg Neil Harbisson briefely introduced at chapter two in the context of hybrid vision. Inspired by his congenital disease achromatopsia[100], Harbisson has worked on the embodiment of a device that creates sounds according to the colours captured by a photosensitive sensor placed in front of his head.[101] He reports that since the last update of the device his perception of sound occurs through a direct connection with his skull, which has given him the new sense of 'hearing colours', a synthetic synesthetic experience.

As already depicted in the previous chapters, the existence of colours in human vision is the result of light-matter interaction conditioned by the triadic material composition of the cones, which are photoreceptors that form the retina together with the rods.[102] This basic physiological principle of human vision harks back to Isaac Newton's experiments in the 17th century showing that white sunlight is not a single entity but a spectrum of infinite colours. Hausmann's ideas, expressed in his texts on the *optophonetische Weltansachuung*, also address different theories of colours[103] and reveal an attempt to merge the objective and the subjective aspects present in the dominant discourses of his period. "*The eye connects space and brain through a subjective-optical creation toward the temporal world-view, to an intuition of light, called optics. We do not see any light, we see colours*" [104]. Today, considered in terms of

100 Achromatopsia is a medical syndrome also known as total colour blindness, causing people to see only black, white and shades of gray.

101 In collaboration with Adam Montadon, Peter Kese and Matias Lazano. Harbisson, Neil. Human Antenna, March 2014. Manuscripts shared by Harbisson's producer Mariana Viada per email via hiperlink: <https://docs.wixstatic.com/ugd/bbd83c_6e51180105-65401094005275d17b62ad.pdf> Accessed August 8th 2017.

102 Guyton and Hall 1996: 577-589.

103 The predominant influences were Newton's, Helmholz's and Goethe's theories of colours.

104 From the original in German: "*Raum und Gehirn verbidet das Auge durch eine subjektiv-optische Schöpfung zum Zeitlichen Weltbild, zu einer Anschauung vom Licht, Optik gennant. Wir sehen kein Licht, wir sehen Farben.*" (Translated by the author) (Hausmann, Raoul. Versuch einer komischen Ontographie/Optophonetische Weltanschauung. I. Teil. Notizbuch VIII, 1922-1923. In: Hausmann, Raoul. *Dada-Wissenschaft: Wissenschaftliche und technische Schriften*. FUNDUS Band 193. Hamburg: Philo Fine Arts/Berlinische Galerie - Landesmuseum für Moderne Kunt, Fotografie und Architektur, 2013. p. 76.

an electromagnetic radiation with wave-particle properties, the light-colour relationship is the basis of the measuring parameters commonly used both in scientific and aesthetic investigations. When isolated, the energy of a monochromatic beam of radiation is related to its wavelength and frequency. The subjective perception of colour, however, is not evidence of its supposed immaterial condition[105], as some theorists contend. Looking closely at sensitivity to light and the molecular structure of pigments, one finds a material condition enabling colours to be seen or not seen.[106] The absence of specific material conditions within Harbisson's retina is the reason for his achromatopsia.

According to the artist, he was used to ignoring or avoiding colours in his everyday life until the moment he discovered studies relating colour frequencies to sound frequencies and felt motivated to investigate how he could perceive them. Ever since, his previous neglect of this absence has been transformed into a series of creative projects.

Although Harbisson does not provide information on how he developed his own 'sonochromatic scale', it basically consists of correspondences between a colour hue and a musical note, ranging from invisible ultraviolet to infrared spectra. General methods for the sonochromatic music scale consist of microtonal and logarithmic scales with 360 notes in an octave and each note corresponding to a specific degree of a colour wheel ranging from the pure colour to white, the maximum brightness. In contrast, Harbisson's sonochromatic scale is a non-logarithmic scale that includes infrared and ultraviolet, discards colour as being part of a colour wheel and ignores conventions on musical perception in order to overstep the limits of human perception.[107]

The search for correspondences between colour and sound has been an inspiring field of exploration for artists, as exemplified by such works as the *Projet de clavier ultrachromatique* (1943) by the composer Ivan Wyschnegradsky[108] and the

105 Pedrosa 1977.

106 Guyton and Hall 1997: 577-589.

107 To exemplifiy the correspondences that Harbisson is using some of the hues and notes are: Red (to a 363.797Hz) frequency is attributed the note F; Orange (440.195 Hz) is F#, Yellow (462.023Hz) is G; Chartreuse (unspecified frequency) is G#; Green (478.394Hz) is A; Spring (unspecified frequency) is A#; Cyan (551.154Hz) is B; Azure (unspecified frequency) is C; Blue (573.891Hz) is C#; Violet (607.542Hz) is D; Magenta (unspecified frequency) is D#, Rose (unspecified frequency) is E. An audiovisual reference on Harbisson's sonochromatic scale is available at the Youtube channel of the artist at <https://www.youtube.com/watch?v=UawXwCpwDjo> Accessed January 6th 2018.

108 Images and brief description available at <http://www.documenta14.de/en/artists/22761/ivan-wyschnegradsky> Accessed January 5th 2018.

cybernetic *Musicolour* machine (1953-1957) by Gordon Pask (1928-1996) and Robin McKinnon-Wood (1931-1995).[109]

A casual look at the way artists and scientists create their light-to-sound translations induces one to perceive them as natural transpositions, as if the correspondences have always been there, and to ignore the human agency required to bridge the gap between one system and another. The arbitrariness of the established correspondences is necessarily bound to the subjectivities of those who have created them. As philosopher Ludwig Josef Johann Wittgenstein (1889-1951) noticed about Goethe's colour theory[110], such colour-to-sound associations are due more to the psychological traits than physiological ones. Fournier D'Albe addressed a similar issue by calling light-to-sound conversions symbolic rather than actual in the context of revealing the problem of the great physical disproportion between the range of frequencies of light and sound waves:

> Light-waves are from forty thousand to seventy thousand to the inch, according to their colour. In duration they are even further apart. If we could slow down an average light-wave until it took one second to pass us, and could slow down an average sound-wave in the same ratio, it would take no less than two hundred million years to pass by! [111]

In a pragmatic sense, light- or colour-to-sound translations are the product of a mathematical method for scaling and establishing proportions. From an epistemological and biological perspective, one can also remark that the considerable difference between light and sound waves the physical parameter in evolution that has shaped the different types of cells to compose visual and auditory perceptual systems. Moreover, within Fournier D'Albe's attempt to objectively consider the problem one must also notice that his idea of an 'average wave' can only be stated in relation to a specific frequency range, namely, the spectrum that humans can perceive. Such pseudo-objective positions reflect the constant attempt to define a 'standard human being' and the notion of normality, which is frequently not compatible with the specificity of each being.

Since light-to-sound translations have been technically and aesthetically explored in a variety of forms, what is the novelty or potency of Harbisson's work? On the one hand, it lies in the technical audacity to implement with/in his own body a hybrid version of what the classic references have proposed. The automatic

109 *Musicolour* was in fact based on the translation from sound into light projection and movement (Rosen 2008: 131).

110 Wittgenstein, Ludwig. Anscombe, Gertrude Elizabeth Margaret (Ed.) *Remarks on Colour*. University of California Press, 1977. (Original as *Bemerkungen über die Farben* written in Vienna in 1950).

111 Fournier D'Albe 1924: 90.

response of the machinic system embedded in Harbisson's body to translate luminous stimuli into vibrations has led to a self-organizing situation. Self-organizing principles were already very present in almost all Pask's artworks, but according to Harbisson's statements, in his case, biological and machinic systems are merged in the artist's own flesh[112], enabling the mergence of sensorial and cognitive abilities as well. Harbisson has been advancing the idea that he is technology, since a cultural object and its abstractions (encoded knowledge) were symbiotically attached to his body, forcing it on to a new stage of organization. On the other hand, what has substantially empowered his narrative about his corporeal experiment and its derivative artistic propositions is his drive to deal with the absence creatively. He approached his colour blindness in an innovative manner, opening a space for disability aesthetics[113] to flourish.

3.2.2 Self-portrait of an absence

Conceptualization: An artistic experiment as a research tool

The performance *Self-portrait of an absence* (2016)[114] has been created as methodological tool for investigating what is at stake when implementing photosensitive elements in the artistic context and analysing the relevant issues for an academic audience. The project started by considering the materiality and behaviour of photosensors, evolved to encompass the confrontation of eye and camera – organic and machinic samples of photosensitivity, and ended by incorporating and taking advantage of the author's monocularity.[115]

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112 The author did not have access to any technical details of the implanted hardware nor to how the implant has been conducted. According to essays written by Harbisson and provided by his secretary producer Mariana Viada, the implant surgery has been done illegally by an anonimized doctor.

113 Siebers, Tobin. Disability aesthetics. In: *Journal for Cultural and Religious Theory.* Vol. 7 n. 2, 2006. p. 63-73.

114 A video-documentation of the performance recorded at the Gleisdreieck Park in Berlin is available at <http://grazielelautenschlaeger.com/portfolio/self-portrait-of-an-absence/> Accessed August 7th 2018. A more detailed information about the project can be consulted at paper "Self-portraying of an absence" published Candy, Linda; Fabrizio Poltronieri, Ernest Edmonds (Eds). *Explorations in art and technology*. London: Springer Verlag, 2018.

115 The experience of being monocular implies having a more limited sight field (25% shorter), perhaps a slower reflect to some circumstances of spatial perception, and the impossibility of using stereoscopic optical devices. According to Crary sudies on stereoscopy remounts to the first half of the 19th century, unfolded from researches on subjective vision, physiology of the eyes, and debates about the perception of space. Charles Wheatstone (1802-1866) and David Brewster (1781-1868), who worked on optical illusions, colour theory, afterimages and other visual phenomena, were among the main characters behind the first sprouts of stereoscopic optical devices. They are the result of investigations started around the 1820's, when physiologists were looking for anatomical evidences in the optical chiasma, where the ner-

Appealing to an imaginative 'what if question', the artistic research was driven by the curiosity to know more about an unknown part of my own body, my right blind eye. As I already know what it is like to see and have no interest in implanting an artificial retina or anything to 'correct' my partial blindness, I was intrigued by the possibility to aesthetically explore this particular absence. What can an eye that cannot form images do? By reducing the eye and camera's photosensitivity to its operationality in the zero-dimension of electric changes, I was able to address the partial absence of vision by means of challenging the historical dichotomy between the form and function of an eye. Following this logic, on a technical level the project consisted of an eye-tracking system programmed to generate and process sounds according to data generated from the asynchronous eye movements.[116] Wearing a costume in which the necessary electronic devices[117] were embedded I have been performing in public and semi-public spaces, inviting people to share in an observing-listening exercise under a huge umbrella.[118]

Alterations of the material's resistance resulting from the light-matter interaction[119] in the camera's image sensor are the zero-dimensional matter (or data, as some might prefer to call it) that enables light input to be directed and transformed into another physicochemical stimulus, sound in this case. It could have been any other kind of conceptual-material translation. Nevertheless, inevitably the context shaped the choices made during the creative process.

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ve fibers leading from the retina to the brain cross each other, transferring electrochemical pulses from each retina to each side of the brain. (Crary 1990:118-19)

116 Due to its blindness, my right eye behaves differently than the left one, sometimes synchronizing sometimes floating – assuming a resting position when not focused on something relatively close. The regularity of this behaviour was realized only over time, when using and testing the eye-tracking system I developed.

117 Raspberry pi 3 board with camera module, push-buttons, cables, rechargeable usb power bank, software in Python and SuperCollider, costume made of cotton fabric, accessories of brass, steel and rubber.

118 By visually evoking strangeness through the unusual costume and technical accessories, a sort of character framing is established: The audience understands that the character is an invitation to engage in interaction. Moreover, visual contact with passers-by is used as strategy, and if they demonstrate any interest, they are englobed under the umbrella, followed by the introductory pre-recorded voice.

119 In Peter Sloterdijk's essay on light and resistance one can find similitudes between his and Flusser's perspective in relation to the interplay between material and immaterial layers of cultural objects, especially in their shared use of the metaphor of a knife: "*Der Mensch ist ein Tier, das schneiden kann*" / "*The human being is an animal that can cut*." (Sloterdijk 2015: 40, translated by the author)

3.20: Performing *Self-portrait of an absence* at Praça Mauá/MAR - Museu de Arte do Rio, in the context of Soma Rumor - Encontro Latino-americano de Arte Sonora. June, 29th 2019. Photo: Rafael Wallace; Source: Author's personal archive.

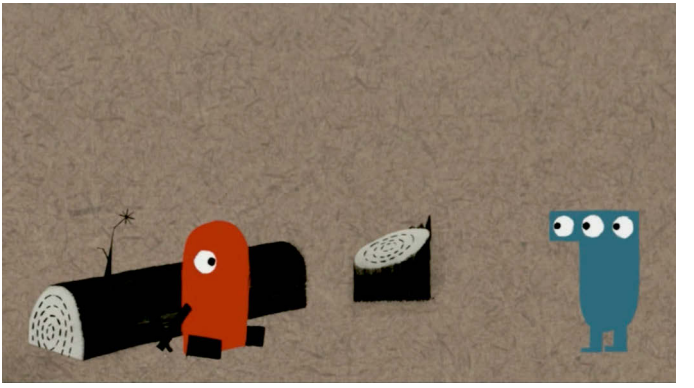
Implementing: A light-to-sound translation for presencing the absence

The choice to translate light into sound was, however, mainly made due to two factors: First, human auditory perception is also structured in terms of spatial qualities like the sense of sight, and therefore an analogy between seeing and listening was envisioned in relation to the reduced field of vision. Second, it was feasible in terms of the knowledge, resources and time available.

Nonetheless, as the artwork developed I realized that what is called translation is a deliberate and creatively arbitrary process. For the light entering the eye and the camera to be translated into sound in the vibrating membranes of the loudspeakers in the specific context of the performance, a sequence of meaning attributions was required for running the technical ensemble and shaping the aesthetic experience.

Unfolding the various suggested metaphors for the experience, absence is on the very first level expressed by the empty space offered to prospective participants under the performer's umbrella. The blind spot in my reduced visual field is turned into available space for the participant to join the performer-umbrella unit, which besides functioning as an acoustic shell suggests complementarity and the possibility of sharing an intimate space. This technical-aesthetical choice is a direct reference to the animation *An eye for Annai* (2005) by Jonathan Klassen and Dani-

el Rodrigues, in which the character Annai is also monocular and is looking for a suitable eye in the world, which is finally found in a partner who has three.



3.21: Frame of the video *An eye for Annai* (2005), by Jonathan Klassen and Daniel Rodrigues. Courtesy of the artists.

The option of building or purchasing eye-tracking glasses was consciously rejected due to its strong symbolic association to corrections of what is considered "imperfect" vision. The solution was to build a simple metallic structure that rests on the head and holds the camera module that tracks the eyes' movements.[120] In this way *Self-portrait of an absence* was spontaneously joined to disability aesthetics, which entails a refusal of "*harmony, integrity, and beauty – as the sole determination of the aesthetic*"[121]. The endeavour thus became an exploration of the absence by stretching the notions of normality and deviation. How can an absence be communicated and shared?

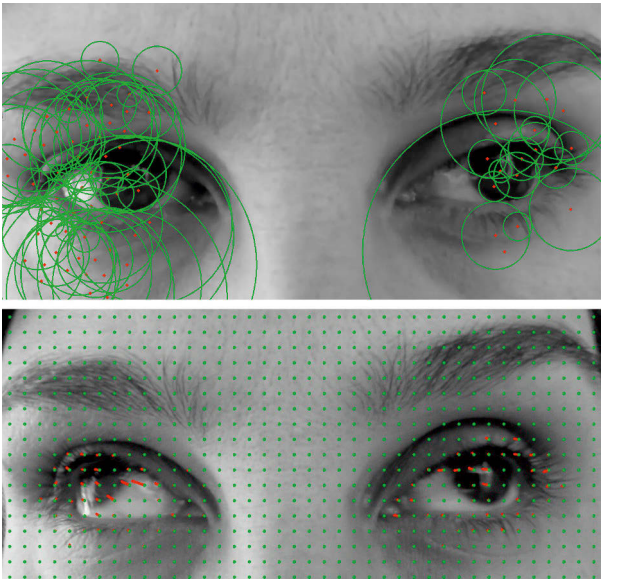
This question was more strongly addressed in the composition of the different sound modes activated during the promenade, which also guide the observing-listening exercise. The more desynchronized or deviated (D) the eyes behaved, the stronger the effects applied to the sounds being rendered were.[122] Absence has been translated into the notion of deviation. Absence has been given presence.

120 The confrontation is set: The eye, as organic photosensitive element, meets the camera, the man-made photosensitive element. This confrontation is the starting point for the theoretical questions that formed chapter two of this work.

121 Siebers 2006: 64.

122 In summary, the sound modes are: (1) Pre-recorded voice greeting the participant and introducing the project's idea; (2) percussive sound whose rhythm loses its periodicity according to D; (3) over pre-recorded audio samples are applied bit-crushing and downsampling effects, more or less intense according to D; (4) tones synthesis, including vibrato and panning effects according to D; and (5) pre-recorded voice thanking the participant and concluding

To put these ideas into practice and bridge the absent space between light input and sound output, software in Python and SuperCollider have been developed.[123] The eye tracking system was built using the library Open CV (Open Source Computer Vision) with a specific technique called optical flow, which is based on the recognition of the apparent motion of objects, surfaces, and edges in a given image, calculated by the relative changes within the frames over time. Another tested technique was blobs detection. However, it proved to be unnecessarily demanding and complicated given the required purpose. Getting absolute values from the blobs positions would require much more power from the hardware and provide unnecessarily more precise data. With the optical flow technique one can extract relational data obtained from the comparison between both matrices of pixels (left and right eyes), and the values are generated only when and where there is movement in the captured image. Further calculations to obtain information on the angle of the difference was obtained by the cosine of the vectors generated.

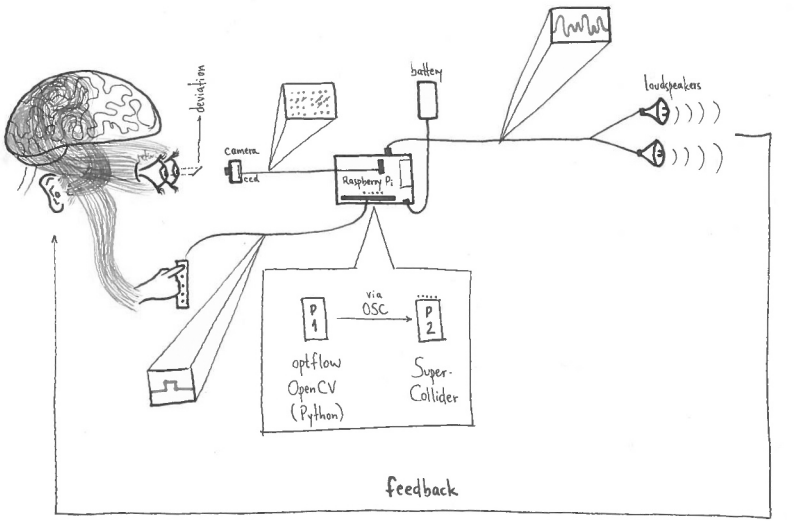


3.22: Frames extracted using the computer vision techniques of blob detection and optical flow; Source: Author's personal archive.

the intervention. They emerged from a soundscape simulating an intervention in an urban space, using the surrounding sounds as inspiration.

123 Special thanks are due to Edgar Zanella Alvarenga, Radamés Ajna da Silva and Dominik Hildebrand Marques Lopes, who asssited in formalizing the ideas in codes.

In addition to movement detection and angle calculation, the software written in Python (P1 at fig. 3.23) also sends the processed data via OSC protocol to SuperCollider (P2 at fig. 3.23), a programming language for real-time audio synthesis and algorithmic composition, where the five sound modes of the performance were written.[124] The illustration below shows the signal flow of the performance system that makes all the connections clearer:



3.23: Signal flow in abstract and concrete levels of *Self-portrait of an absence;* Source: Author's personal archive.

Opening the technical black-boxes of *Self-portrait of an absence*, one can observe the several layers of fragmentation and abstraction between light input and sound output. The technical and aesthetic solutions for executing the light-to-sound translation were much closer to the notion of invention than to finding pre-exisiting correspondences. In contrast to the majority of the other media devices and artworks based on light-to-sound translations presented throughout the chapter, *Self-portrait of an absence* required digital devices and programming for its technical implementation. This decision made the translation process simultaneously freer and more complex. Although technically less complex in relation to what computer scientists and engineers have been developing in the field of computer

124 All codes and audio files developed in the course of the project are documented at Github platform on the link <https://github.com/aivuk/self_portrait_of_an_absence> Accessed August 1st 2017.

vision, unboxing part of the technical details of this artwork is a way to demonstrate how data coding multiplies the possibilities engendered by the abstract in-between layers of translations from light into sound.

The coincidence that Vilém Flusser was also monocular has encouraged me to creatively explore my partial absence of vision regarding issues present in his work, particularly the notions of self-translation and *Mediumsprünge*[125]. As an exercise in playing between the abstract and concrete worlds of codes and materialities, *Self-portrait of an absence* became an unpretensious poetic experiment on the search for possible paths between sensing an making sense of an absence, by means of organic and machinic light-sensitive elements.

Facing the abyss between one system (light input) and another (sound output), Harbisson's case and *Self-portrait of an absence* were free to create completely novel correlations. The interstitial zone of the absence is, in this sense, a fertile field of indeterminacy in which artists can attribute and manage meanings created out of a void. Experiments like these challenge the classic form-function-content relationships that are characterized by friction between meanings and materialities, and they are greatly facilitated by the zero-dimensionality of electronic and digital media.

Translating and hybridizing

Although the creative process has been split here into conceptualizing and implementing, one notices that each aspect is hardly discussed in isolation. Concepts have directly material implications and the use of materials demands conceptualizations. Conceptualizing, building and performing *Self-portrait of an absence* has been an intense learning experience that recursively involved moments of asking, networking, constructing, understanding and reflecting on manifold levels. Nevertheless, regarding the thesis' frame, in addition to the light-to-sound translation itself, it is relevant here to share and comment upon some findings in relation to the biofeedback process established between my body and the constructed technical ensemble. Biofeedbacking has been the core principle enabling the hybrid character of the project.

125 Due to his immigration background, Flusser's philosophical method was strongly based on translations and retranslations. It is possible to draw relations between Flusser's translation theory of the 1960s and his media theory from the 1980s, as suggested by Rainer Guldin in *Pensar entre línguas: a teoria da tradução de Vilém Flusser* (2010). His reflections on media philosophy were intimately related to the concept of *Mediumsprünge*, the act of jumping from one medium to another, from the logic of one system another. This concept was articulated by Flusser in at least four different situations: discussions on the change of media, on the comparison between media, on media as circumstance of translation and on media-historical development. (Guldin 2010: 166)

The audio information produced by my eyes' movements taught me that their synchronization is related to the ability of my seeing-eye to focus, testifying to traces of a symmetry-based body. Based on this understanding, while training and performing with the apparatus I learned the muscular patterns of movement to control my blind eye's position, in a simpler, but similar, procedure to that which led Harbisson to be able to listen to colours. In this way, the aesthetic system was conceptually enriched as the circular interaction between being and machine also revealed a previously unconscious absence of bodily awareness.

The learned muscular control associated with research on optical devices and visual perception has driven me back to the issue of monocularity and its relations to spatial perception – which was set aside in the image-to-sound translation. The findings on the practice date back to studies on stereoscopy in the 19th century, when Wheatstone measured the binocular parallax,[126] contributing to the understanding of the correspondences between eyes' movements and how the physical proximity of objects *"brings binocular vision into play as an operation of reconciling disparity, of making two distinct views appear as one"*[127].

> When an object is viewed at so great distance that the optic axes of both eyes are sensibly parallel when directed towards it, the perspective projections of it, seen by each eye separately, and the appearance to the two eyes is precisely the same as when the object is seen by one eye only (...) When the object is placed so near the eyes that to view it the optic axes must converge... a different perspective projection of it is seen by each eye, and these perspectives are more dissimilar as the convergence of the optic axes becomes greater.[128]

This point recalls that the absence addressed was in the end not one of vision as such, but rather the absence of the stereoscopic nature of human visual perception as well as its related spatial qualities. Using this experiment to escape from the concrete limitations that transform this specific absence into an abnormal condition is an element that demands critical self-reflection. Being monocular gives me a bodily awareness that is skewed to one side of the body, a sort of a 'weight sensation', for lack of a better term, and a clearer perception of the dominant role vision plays in the way one perceives the world. The technical and aesthetic choices made during the experiment did not include sharing this specific way of seeing and perceiving the environment and the body itself. And perhaps that would only be possible to achieve if one could hack the participants' sensory and cognitive apparatuses – a proposition that is still fictional. Therefore, I cannot say that the sensation and the

126 Parallax corresponds to the degree to which the angle of the axis of each eye differ when focused on the same point.

127 Crary 1990:120.

128 Brewster and Wheatstone 1983: 65 apud Crary 1990: 120.

feeling of the absence were, as intended, entirely shared. However, the proposition at least enabled an aesthetic experience that has driven the participants' attention towards a broad and relativized concept of absence.

Furthermore, using biofeedback in an aesthetic proposiotion and one's own body and disability to inquire into the notion of normality is a second-order cybernetic approach that allows the coincidence of both types of absences: one physiological and another existential. Absence can become a presence that provokes reinvention. At stake is the fact that the body organizes the world in order to organize itself. The continuous stimulus exchange between physical entities may lead to new relevant information. In this process, absence becomes the engine for the creation and recreation of meanings, which evolve from empirical situations. Artworks, as well as lives, are experiences in which meanings are produced during the experience itself with its inherent material and spatio-temporal qualities.

The translation of materialities can be an explicit means of betrayal and loss of information[129], but it is also a precious way to visualize the gaps and create the open space for the emergence of novelty. Minding the gap is the first step towards the invention of interesting new bridges.

3.3 Translation of materialities

The media devices and artworks featured in this chapter showed different possibilities for manipulating physical elements to execute light-to-sound translations. The samples discussed were purposefully related to antecedents of digital media in order to elucidate how the process of fragmentation has been continuously enhanced in media history and has also served as the basis of scientific, historical and cultural developments more generally.

Digital media is associated with the possibility of gathering all materialities together in terms of an abstract lowest common denominator of voltage changes or digits, and, in a second step, transforming them into other possible materialities. This locates the current practice of media art literally in the interplay between abstraction and concreteness. In other words, this aspect of digital media leads to translation issues, since it theoretically allows the translation from any material phenomenon into another. In this sense, processes of the translation of materialities refer to this special possibility of programming and editing matter by transforming one type of physical or chemical stimulus into another, and therefore creating situations in which meaning emerges from the experiences that the combined technical ensembles can render.

129 Simondon 1958:143.

Since it is theoretically possible to establish correspondences between any physical or chemical phenomena, How have these correspondences been made in media artworks? And, How are they related to the meanings they potentially convey? Regarding the field of contemporary art, What is so necessary to express that it justifies the current investments of time, energy and resources in translating matter A to matter B?

Considering that any translation, regardless of how literal or free it is, always constitutes an interpretative act executed by a subject, the question remains if artists are aware of their arbitrary choices and the multiple nature – technical, aesthetic, symbolic, etc. – of the materials and methods they have been using. In shedding light on the notion of the "translation of materialities" this section has offered conceptual strategies to deal with the paradoxical material-immaterial challenges arising in the creative processes of media artworks.

3.3.1 Merging conceptual and material approaches to media creativity

Light-to-sound translation is just one example of countless forms of translation that have been accomplished during the current material turn, in part due to an exponentially increasing diversity of materials.[130] Already in the 1980s, a substantial number of issues relevant to the notion of the translation of materialities in artwork was discussed under the concept of intersemiotic translations.[131] Based on Roman Ossipowitsch Jakobson's (1896-1982) writings, artist and art critic Julio Plaza (1938-2003) defined intersemiotic translations,[132] which he also called transmutations, as "*consisting in the interpretation of verbal signs through non-verbal sign systems*"[133]. Despite acknowledging the material basis of any semiotic element[134], however, the necessary crossing over through verbal systems seems to be unsuitable for the increasingly hybrid kinds of media artworks, and other theoretical and practical paradigms have developed since Plaza published his book. This shortcoming is especially notable concerning the siginificant changes brought about by electronic and digital media. Plaza does not grasp electronic and digital media specificities,

130 Yeo, Jingjie; Jung, Gang Seob; Martín-Martínez, Francisco J.; Ling, Shengjie; Gu, Grace X; Qin, Zhao; Buehler, Markus J. Materials-by-design: computation, synthesis, and characterization from atoms to structures. In: *Physica Scripta*, Vol. 93, n. 5, April 2018.

131 Plaza, Julio. *Tradução intersemiótica*. São Paulo: Perspectiva, 2003.

132 The term is contrasted with intrasemiotic translation, in which a text is translated into another text using purely verbal means. The mutual transformative influence from one system to another remains in the verbal domain. Deeper discussion of the difference can be found at Dusi, Nicola. Intersemiotic translation: Theories, problems, analysis. In: *Semiotica*.Vol. 2015, Issue 206. pp. 181-205.

133 Plaza 2003: III.

134 Plaza 2003: 67.

largely due to the lack of attention given to programmability and the creation of potentially self-organizing systems. Mainly emphazising media transpositions from originally concrete poetry printed on paper to video, Plaza theorized about, and put into practice, the Flusserian notion of *Mediumsprünge*. He was thus aware of both the integrated role of sensorial and cognitive process in meaning attribution[135] and the increasing hibridization possibilities of translations.[136] However, in his artistic practice of intersemiotic translation he did not explore either the plasticity of the zero-dimensionality of electronic images, or absent space as creative matter, instead remaining attached to the concept-driven creative paradigms of literary and visual art.[137]

Since favouring the supremacy of meaning has never been the intention of this thesis, a semiotic approach has been seen from the beginning as an incompatible framework to work with regarding the translation of materialities, even in its more contemporary formulations.[138] An additional difficulty is that semiotic approaches disregard (even if inadvertently) the very material basis and implications of the creative use of media, and thus the hermetic terminology and conceptual tools of semiology seem to lack bridiging elements to the current new materialist and media-archaeological approaches of cultural studies. In the translation of materialities a creative process emerges through the activation and embodiment of different media by the artist/translator. Rather than consider meaning as a preexisiting entity, the investigative impetus may be a priori free of meaning(s), which is/are only later attached when framed and experienced in a specific context. This inversion in relation to of a semiotic perspective is a sort of acknowledgement of an initial meaninglessness, the core absence through which creative power emerges. This paradigm enables associations between different cultures and media to be created through movement across systems, in which the artist as translator mediates experiential processes that allow both artist and audience to make the sense(s) for themselves through the translational process. As demonstrated in the examples provided, this approach emcompasses the role of (photo)sensitive materialities as

135 Plaza 2003: 62-63.

136 Plaza 2003: 64-66.

137 In order to clarify how Plaza's video animations do not explore the specificities of electronic media, one can point out that the essence of his intersemiotic translations would remain if they were substituted or reacreated by photographic stop motion, for instance. This criticism does not disregard the historical and aethetic relevance of his experiments. However, they do not explore the technical specificity of the medium. To draw an analogy to the history of cinema, they would correspond to the very primitive experiments that films were short clips of filmed theater, without the further development of their own expressive language.

138 Brier, Søren. Cybersemiotics: A New Foundation for Transdisciplinary Theory of Information, Cognition, Meaningful Communication and the Interaction Between Nature and Culture. In *Integral Review*. Vol. 9, n. 2 June 2013.

protagonists in enhancing the transitional, relative and contextual quality of meanings among different media.

In the description and analysis of the media devices and artworks a variety of terms, such as conversion, translation, and transduction have emerged. Fournier D'Albe, for instance, in his book about the properties and applications of the element selenium, favoured the word 'conversion' to describe light-to-sound experiments based on selenium cells.[139] In contemporary compendiums from the field of electrical engineering, such as the *Handbook of modern sensors: Physics, designs, and application* (1996), inventor Jacob Fraden is technically and terminologically more accurate, distinguishing sensor from transducer. Considering a sensor as "*a translator of a generally nonelectrical value into an electrical value*", Fraden also emphasises the distinction by pointing out that a sensor may contain several transducers.[140] Following this definition one can deduce that the emergence of the term 'sensor' in the English language in 1947, deriving from the adjective 'sensory'[141], is related to the birth of digital technology and its imperative to transform all physical stimuli into a common denominator – electric current.

An etymological analysis of the term also corresponds with what is observed in media art practice. Since the practice involves the manipulation of material and symbolic elements, drawing comparisons between terms such as 'conversion', 'transduction' and 'translation' is challenging, especially because photosensitive matter involves the role of light as both energy (materiality) and signal (symbolic) source. Hence, a careful reflection on the light-matter interaction in the context of art, reinforced by an etymological examination, has led to the acknowledgement of the greater importance of the prefix 'trans-' as a metonymic option that encompasses the countless transferring and transgressing possibilities on which media artworks are based. It is essential to note that each of the terms being used (conversion, transposition, translation, etc.) refers to a passage from one physical state to another, which necessarily involves the overcoming of previously established borders. The decision to use the expression "translation of materialities"was made in consideration of the analysis of the role of translation in cultural development in a broader sense, going beyond the linguistic domain into ontological and philosophical territory.[142]

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139 Fournier D'Albe 1924: 89-93.

140 "*The term sensor should be distinguished from transducer. The later is a converter of one type of energy into another, whereas the former converts any type of energy into electrical*". (Fraden 2004: 3)

141 "*pertaining to sense or sensation*" form latin sensorius, past participle of sentire (to perceive, feel). Etymonline. <https://www.etymonline.com/word/sensor> and <https://www.etymonline.com/word/sensory?ref=etymonline_crossreference> Accessed February 24th2018.

142 This understanding is also reflected in the Berlin Media School and the name chosen for the Transmediale Festival – as a reaction to the obsolescence of the term 'multimedia', extensively used in the 1990s.

On the one hand, the theory of translation has been most established and developed in the realm of linguistics,[143] which is inherently occupied with the notion of language and meaning.[144] On the other hand, it is not by chance that the concept is also often used in other disciplines like molecular biology and genetics, in which the term transduction/translation is used to explain, for instance, the process in which cellular ribosomes create proteins within DNA.[145]

Observing such a broad spectrum of uses leads to a general understanding of translation as occupying and occurring within the space between distinct systems. Looking at the transitional characteristics of media artworks brings translation theories into closer relation with media creation. The challenge of bridging this gap can be attempted by unfolding Flusser's term '*Mediumsprünge*' and the intersections found between his theory of translations, developed in the 1960's, and his media theory of the 1980's. Flusser himself also stated: "*Perhaps, everything I am working towards is a theory of translation*"[146]. According Rainer Guldin, Flusser intersects discourses from linguistic theory, information theory and arithmetic[147], a cross-disciplinary approach that seems to be more adequate to deal with the notion of translation of materialities.

In what follows, only perspectives that address the material relationships permeating translation theories and media art production will be emphasized, and translational operations will be considered as encompassing a broader notion of language, as suggested by Klaus Krippendorff in *Discourse and the materiality of its artifacts* (2011).[148] For instance, in *Understanding Media* (1964)[149] Marshall McLuhan suggests that media are translators, without, however, elaborating the details or the complexity of the subject: "*Translation is thus a 'spelling-out' of forms of knowledge*"[150]

143 Stolze, Radegundis. *Übersetzungstheorien: Eine Einführung*. Tübingen: Gunter Narr Verlag, 2011.

144 Interestingly, the increasing proliferation of new sorts of materials in the twentieth century is accompanied by a significant increase in the attention given to the subject of translation, a topic systematically elaborated by Stolze Radegundis in his aforementioned book.

145 Guyton & Hall 1997: 28-32.

146 Flusser, Vilém. Quote at Rainer Guldin's website. Available at <http://rainer-guldin.ch/vilem-flusser/> Accessed June 1st, 2017.

147 Guldin 2010: 168.

148 Krippendorf proposes five constituent components of discourse: (1) discourses manifest themselves in the artifacts they produce, inclusive of their textual matter; (2) discourses are kept alive within communities of their practioners; (3) discourses institute their recurrent practices; (4) discourses draw their own boundaries; (5) discourses must be able to justify their practices to materially relevant outsiders. Krippendorff, Klaus. Discourse and the materiality of its artifacts. In: Khun, T.R. (Ed.) *Matters of communication: Political, cultural and technological challenges to communication theorizing*. New York, NY: Hampton Press. pp. 23-46.

149 McLuhan, Marshall. Media as translators. In: *Understanding media: the extensions of man*. London/New York: Routledge Classics, 2001[1964].

150 McLuhan 1964: 62.

and "*all media are active metaphors in their powers to translate experience into new forms*"[151]. In his typical prophetic manner, McLuhan envisioned the wonders of electronics and automation ushering in a "*golden age as one of complete metamorphoses or translations of nature into human art.*"[152] Such pronouncements, however, served mainly as seductive generic statements for the artists of his epoch searching for liberation of traditional art forms.

More intriguing and useful for the translation of materialities approach and the current dichotomies hovering around media and cultural studies, is the contribution of computer engineer and philosopher Yuk Hui. Hui has elaborated the idea of transduction as a simondonian third alternative for media philosophies and practices based on apparently opposed poles: those that nurture an understanding of media as an artificial and purely empirical realm versus those that propose a "media-technological a priori" perspective, such as the Berliner New materialist media school.[153] According to Hui, the first is based on inductive logic, where one begins with a series of facts and induces a rule that governs all of them ("*from facts to truth*"). The latter, based on deduction, when one departs from a general rule and deduces facts that accord with it ("*from true to facts*").[154] Hui's alternative way of reflecting on media aesthetics is through the logic of transduction, which enables one to think about the transformative and ruptural effects of digital media, rather than the inferential ones mentioned above. As "*effects of induction and deduction*", Hui adopts the term 'transduction' from Simondon's theory of individuation, referring to it as "*a process or actions that leads to the transformation across different domains*"[155]. This harkens back to Decartes' description of the pineal gland as the transductive corporeal element responsible for connecting soul and body, translating stimuli and language; as well as the definition used in engineering, which defines a transducer, similarly to Fraden, as "*a device for converting energy from one form to another for the purpose of measurement of a physical quantity or for information transfer*".[156] In simondonian terms, the technical meaning is kept as a means of communication and transmission across all scales and organizations of matter activity, addressing physical, biological, mental and social operations.[157]

The light-to-sound translations here exemplified in media artworks and devices were intended to provide a glimpse of some of the methods that creative agents use to connect materials and meanings while creating their media devices and artworks. They represent artists' commitment to meaning attribution by responding

151 Ibid: 63.
152 Ibid: 65.
153 Hui 2015: 3.
154 Ibid: 6.
155 Hui 2015: 11.
156 Ibid: 12.
157 Hui 2015: 11-12.

to and manipulating the cultural objects of their time. Within these circular exchange processes, material and semantic connections are organized in the form of artworks that aim to engage in dialogue with audience's sensorial and cognitive apparatuses.[158]

Investigating the immaterial-material relationships between media artworks and audience has constituted the core of queries by modern and contemporary media and aesthetic philosophers. Jean-François Lyotard (1924-1998), e.g., at the time he curated the media art exhibition *Les Immatériaux* (Paris, 1984) had just finished writing *Le Différént* (1983), a book in which the author also addressed translation issues and discussed the unsolved problem of the "*lack of rules or metanarratives which are common to two different systems of discurses*"[159]. Aiming to review the history of the so-called 'linguistic turn' by analysing the philosophy of Kant and Wittgenstein, Lyotard reflected on the interconnection of terms and their origins, revealing the common origin of 'matter' and 'matrix'.[160] Considering that language was what changed most after the conquering of the ïmmateriaux"[161], Lyotard's diagram is also a platform to approach a broader comprehension of what language is, beyond the representational tradition of linguistics and semiotics, as has been asserted by Klaus Krippendorff, among others.[162] According to Krippendorff, although the linguistic turn has demolished the Cartesian binary of objectivity and subjectitvity[163], its analytical tools have not provided solutions to post-modern issues.

Concomitantly to the reorganization of the technological environment, the postmodern concern with the material-conceptual dichotomy has led to the emergence of new materialist perspectives, such as that of Hans Ulrich Gumbrecht (1948-), which call for a return to the material aspects of communication. In a critique of the Western development of knowledge construction based on the abstract instance of meaning attribution, Gumbrecht defines materialities of communication as "*all those phenomena and conditions that contribute to the production of meaning, without being meaning themselves*"[164]. Developing the concept of "presence"

158 Sensorial and nerve cell interconnections and their biochemical processes have been studied by neuroscience with great effort, as was examined in the previous chapter in the context of explanations on the material basis of and intimate relationship between human sight sense and cognitive processes. They constitute the material level of mental representations and meta-representations that underlie any perception of the world, including that of artistic practices.

159 Hui, Yuk; Broeckmann, Andreas. *30 years after les immateriaux*. Germany/Milton Keynes, UK: Meson Press, 2015.

160 Hui and Broeckmann 2015: 11.

161 Ibid: 14

162 Krippendorff 2011: 9.

163 Regarding "*the claim of a knowable world (an ontology) existing outside of us, which we are supposed to represent as accurately as possible inside of us or in writing*". (Krippendorff 2011: 9)

164 Gumbrecht 2004: 8.

as a spatial rather than a temporal notion, Gumbrecht connects the history of media and body culture, contending that meanings, as abstractions, cannot be analysed separately from their mediality[165] and, therefore, from their materiality. Although originally from the field of literary criticism, Gumbrecht's viewpoint has special significance for producing and analysing media artworks, which can be understood as mediated aesthetic experiences that arise precisely from the tension and oscillation between "presence effects" (concrete) and "meaning effects" (abstractions).

This collection of references and the examples of light-to-sound translations permit one to grasp how the construction of material-based translations reveals human beings as generators of cultural objects in a way that cannot be understood from a platonic perspective that separates the world of ideas from the physical world. To look at the interplay between materiality and immateriality demands a post-humanist endeavor like the agential realism proposed by Karen Barad, who deals with matter (such as meaning) not as a static entity but as a doing, with an on-going historicity and as part of the constant stabilizing-destabilizing activities of all forms of agency in the world. A post-humanist approach, however, does not extinguish human activity and responsibility in those translational processes. On the contrary, within the artistic context of programming matter and meaning, the inherent immaterial and material contiguity of cultural and artistic artifacts also becomes a human existential issue:

> The abstract, objective, problematic circumstance, can be 'informed', and result in Venus of [W]illendorf (sic), in flint knife, in 'culture'. Manipulation is the primordial gesture; thanks to which the human being abstracts the time of the concrete world and transforms oneself into an abstracting being, that is, into man as such".[166]

By observing the complex interplay between the material/technical and conceptual/aesthetical layers in the case studies of light-to-sound translations, and in light of selected translation theories, four main topics deserve to be further developed as a conceptual toolbox to orient the creation of translation-based media artworks. They are: (1) the paradox of (un)translatability; (2) the abstract instantiations (represented by Walter Benjamin's (1892-1940) "pure language" in *The task of the translator* (1923)[167] and Vilém Flusser's notions of metalanguage or zero-dimensionality); (3) the inventive dimension of translation (represented by Ezra Pound's (1885-1972)

165 Gumbrecht 2004: II.

166 From the original excerpt in Portuguese: *"A circunstância abstrata, objectiva, problemática, pode ser 'informada' e resultará em Vênus de Nillendorf (sic), em faca de sílex, em 'cultura'. A manipulação é o gesto primordial; graças a ele o homem abstrai o tempo do mundo concreto e transforma a si próprio em ente abstraidor, isto é, em homem propriamente dito."* (Flusser 2008: 16, Translated by the author)

167 First published in English in Arendt, Hannah (Ed.) Walter Benjamin, Illuminations. Harcourt Brace Jovanovich, 1968.

Make it new! and Haroldo de Campos'(1929-2003) term 'transcriação'); and (4) self-translations, touching on existential sources and implications.

3.3.2 (Un)translatability

The devices and artworks here described assist in perceiving how subjectivity and choices are the foundations of translation practices. As long as each system has its own structure, it seems impossible to always find exact correspondences in translations. The same applies to the difficulties in translating poetry. Nevertheless, translations of all kinds have been made and translators struggle to find the most convenient correspondences, according to their understanding of the "soul" of the matter being translated. From written poetry to media artworks the paradox of translatability/unstranslatability becomes especially complex when aesthetic factors are involved.

Walter Benjamin, in *The task of the translator,*[168] analysed literary and written language-based translations in terms of a series of oppositions: between good and bad translations, content and form (translation is a form), original and translation[169] (probably biased by the experience of the auratic work of art and its reproductibility[170]) etc. However, the development of his argumentation points to a more complex situation and is sustained by a sort of paradoxical and ironic style[171]. Since Benjamin wrote this text in a radically different technological environment, it is interesting to notice, through the terms and metaphors that he uses, how the perspectives on translation mirror their contemporary philosophy of technology. Rereading Benjamin today requires setting aside dated issues – such as the hierarchical and servient relationship of a translation and its original – and retaining those that remain current: translatability is one of the topics that has been most discussed by subsequent theorists, who indeed have frequently established direct and indirect dialogues with his thought.

Poet, essayist and translator Haroldo de Campos has, in connection with Benjamin's theory of translation, also addressed the dogma of unstranslatability. Benja-

168 The extensive intellectual production bridging Benjamins's work and the changes triggered by electronic, digital and networked technologies is well known. A direct reference is Nichols, Bill. The work of art in the age of cybernetic systems. In: Wardrip-Fruin; Montfort, Nick (Ed.) *The New Media Reader*. Cambridge, MA/London, England: The MIT Press, 2003.

169 "*If translation is a form, translatability must be an essential feature of certain works.*" Benjamin, Walter. The task of the translator. In: Bullock, Marcus; Jennings, Michael W. (Eds.) *Walter Benjamin - Selected Writings* Vol.1 1913-1926. London/Cambridge, MA: The Belknap Press of Harvard University Press. 2002. [1968] p. 254.

170 Benjamin, Walter. A obra de arte na era de sua reprodutibilidade técnica. In: *Obras escolhidas I.* São Paulo : Brasiliense, 2012 (1935/1936) pp. 179-212.

171 In agreement with Haroldo de Campos' perspective in: *Da transcriação : poética e semiótica da operação tradutora*.

min, using the rethorical tools of his *Zeitgeist,* approached translation as a unilateral process, completely excluding the reception of the text (or artwork), making the development of his arguments easier. In dialogue with Benjamin, Haroldo de Campos suggests as alternative approach based on the communication model developed by Roman Jakobson in *Linguistics and Poetics* (1960). Supported by the contributions of the physicist Niels Bohr, Jakobson states that "*every cognitive experience can be translated (is conveyable) and classified in any existent language*"[172], assuming the referential and cognitive functions of language, as the metalinguistic operation embedded in the expressive faculty of any given language.[173]

Although Jakobson expands the notion of language by focusing on the operationality of language and envisionsing a metalinguistic level of communication based on the material activity of neurological processes, he still sets aside translation processes that occur among organisms that do not depend on developed neurologic systems. These organisms, although not communicating on the human semantic level, are also constantly transducing and translating physical information and the resulting resistence variation of their molecular activity can certainly serve as relevant information to engage and communicate with other entities pertaining to the same *millieu*. From a second-order cybernetic perspective, analysing the transference of elements from one system of logic to another cannot be separated from the circular processes of information exchange among the involved actants, which have their specific organization and means of signaling.

For Haroldo de Campos, the notion of translatability in Benjamin's theory refers to the conventional idea of textual translations: translatability is evaluated according to the "way of formingßuggested by the original text, according to its density and not according to the simple meaning to be communicated. In Benjamin's view, the translatability factor is conditioned by the quality of the text to be translated. Campos, in turn, understands translatability through proportional relationships: the lower the value of the language of the original, the higher its potential for communication is, and the less it has to offer and be enriched by the act of translation. In contrast, the more sophisticated a work is, the more it will remain translatable (in its historical relevance), though only having the most ephemereal contact with its meaning.[174] In the search for analogies to cases of the translation of materialities, Campos' perspective is partly useful, especially if one considers the attention given to the issue of the proportional relationships and to the historical relevance of media devices of various eras and the many translations and versions they have

172 Jakobson, Roman. *Linguística e Comunicação.* São Paulo : Cultrix, 1971, p. 70. (Campos 2011:19).

173 Jakobson asserts that language, as a cognitive function, depends less on its grammatical patterns than on the complementary dynamics of metalinguistic operations, which constanly demand recoding and interpretating, that is, translation. (Jakobson 1971: 70)

174 Campos 2011: 29.

inspired as a source for contemporary artists. However, Benjamin's perpective on translation as a "way of forming" makes more sense when one considers the fact that media artworks themselves (including all the media devices and artworks discussed along this chapter) can constitute a process of translation. Unfolding this idea requires another mindset, able to consider recursivity and meta-structures, translations within translations.

Furthermore, one can find correspondences between Benjamin's general notion of a 'highly developed' (sophisticated structure) work and the notion of 'aesthetic information' theorized by the cybernetician Max Bense. Regarding the elements to be translated, Bense distinguishes three different informational layers: documental, semantic and aesthetic.[175] Although closer to the current technological environment than Benjamin, Bense's perspective fails to acknowledge the material layer of information[176], which is the very first element in his general theoretical framework for aesthetic analysis. Not addressing the material aspect of translation processes makes Bense's conception, in principle, invalid for posthumanist approaches that consider the agency of non-human entities and information exchange among living organisms without developed cognitive systems, such as the activity of matter. Nevertheless, Bense's concerns with materialities become evident when one regards his notion of the fragility of aesthetic information.[177] For Bense, aesthetic information is inseparable from its concretization, *"its essence, its function are bound to the tools, to its singular execution,"*[178] and its fragility in aesthetic contexts lies in the ephemerality of both the performative act and its reception. By emphasising the real-time and material aspects of aesthetic information, Bense's cybernetic perspective offers the most suitable path to deal with media artworks based on translations of materialities, whose significance is mostly found in the act of translating itself. In this sense, translating is feasible as long as one commits to doing it. Returning to the examples of light-to-sound translations in terms of Bense's classification, reproducing the principles of classical media devices relates the artworks to the documental layer of the "originals"; whereas translating itself refers to the aesthetical information layer per se.

Regarding the translational operationality of media, one can venture to say that electronic and digital technology and their zero-dimensionality have become the sort of meta-metalanguage through which one manipulates matter in the form of

175 Information is defined by Bense as "*every process of signs that presents a level of order*" (From the excerpt in Portuguese: "*é todo processo de signos que exibe um grau de ordem*". (Campos 2011: 32)

176 Ranging from energy and electric signals to any other space-time configuration and/or modulation.

177 Plaza 2003: 28.

178 "*sua essência, sua função estão vinculadas a seu instrumento, a sua realização singular*". Bense, Max. Das Existenzproblem der Kunst. In: *Augenblick*, n.1, Stuttgart/Darmstadt, März, 1958. apud Campos 2011: 33.

energy in order to bridge and communicate between elements that do not operate according to a similar logic. In this sense, a set of new techniques that emerged with digital technology has compelled us to review the parameters being established through the translations of our media and cultural heritage. For Flusser, who was acquainted with both the materiality of electronic media and the issues of translation, translatability is also defined by the potency of articulations in the realm of metalaguages.

3.3.3 Metalanguage

On the one hand, when Benjamin discusses the kinship of languages in terms of the dichotomous relationship between content and language, he envisions the existence of a 'pure language' as the source of a supposed 'truth': *"A real translation is transparent; it does not cover the original, does not block its light, but allows the pure language, as though reinforced by its own medium, to shine upon the original all the more fully."*[179] Benjamin's notion of 'pure language' entails a univocal and absolute view of knowledge, making his position incomparable to the multiple levels of abstractions that are technically possible today, and therefore outdated to the contemporary mindset.

On the other hand, one might immediately associate Benjamin's notion of 'pure language' to the abstract instantiation that his successors call 'metalanguage': an in-between space where the paradox of translatability takes place, addressing both the illusory fidelity to the original material and the translator's freedom. For Benjamin, fidelity[180] and freedom seem to constitute conflicting values – the classic object-subject clash. Acquainted with the practice of self-translation, Flusser's writings do not contain evidence of this conflict, in fact they demonstrate his appreciation for freedom in relation to the act of translation. Although recognizing the translatability paradox, he assumes freedom to be the utopian engine triggering translation processes. According to him:

> The admission of the diversity and equivalence of languages occurs, in a certain way, beyond all languages. It is given in that terrain between languages and beyond the languages that the term translation conveys. The problem of translation is therefore the problem of transcendence, abandonment of prison, being beyond all models. In other words: it is the problem of freedom.[181]

179 Benjamin 2002: 260.

180 In the translation of materialities it becomes non-sense to discuss the issue of fidelity, which I would venture to relate, in the media context, to verisimiltude.

181 From the excerpt in Portuguese: "*A admissão da diversidade e equivalência das línguas se dá, de certa maneira, no além de todas as línguas. Dá-se naquele terreno entre as línguas e no além das línguas que o termo tradução significa. O problema da tradução é pois o problema da transcendência, do aban-*

The terms used by Flusser allow one to easily transpose his ideas from spoken and written language to electronic and digital media. Regarding the aporetic condition of translatability, Flusser states that *"translation is possible (says our theory) insofar as there is a metalanguage for the language of which and to which we are translating, common to both"*.[182] Are not electronics, coding and programming the metalanguage that humanity has been longing for since the tower of Babel?

To a certain extent, the collection of devices and artworks brought into this discussion constitute the basis for an historical perspective on the emergence of coding through audiovisual media, and the increase in complexity found in the passage from analog to digital media – ranging from the very material fragmentation of light beams using choppers, through the signal discretization of Morse code to more sophisticated programming languages like as Python in Computer Vision applications. The variety of ways to handle materials reveals both the freedom one has to transit between different physical dimensions and how this process led to media convergence: an occurrence boosted and technically enhanced by the digital technology and the cultural movement towards ever increasing levels of abstraction. In this sense, Flusser's concepts of zero-dimensionality and *Mediumsprünge* correspond, respectively, to metalanguage and translation processes.

There is much for media artists to explore through the zero-dimensionality of electronic and digital media embedded within contemporary cultural objects. Operating with the common denominator of electric or/and electrochemical changes in materials, media artists are simultaneously, and paradoxically, empowered with freedom and arbitrariness. The initial absence of meaning located in the gap between two systems, as found in the translation of materialities, gives artists an extreme range of possibilities to arbitrarily invent all possible correspondences. The question to pose is, What are the implications of this condition regarding the creation of translation-based media artworks? Flusser radically contended that if there could be a metalanguage as a class for all other languages, it would only be possible through an excessively violent effort to communicate.[183] He continues: *"this universal class will be destitute in such a way until it loses all its meaning. In other words: maximal freedom makes every choice absurd, because it lacks meaning."* [184] The question can thus be reframed as follows: While attributing meaning to the zone of absence

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dono da prisão, do estar além de todos os modelos. Em outras palavras : é o problema da liberdade". Flusser, Vilém. Da tradução. In : *Cadernos Brasileiros* n.49 Set/Out 1968. p. 77.

182 From the excerpt in Potuguese : "*A tradução é possível, (diz esta nossa teoria), na medida em que há uma metalíngua para a língua da qual e para a qual estejamos traduzindo, comum a ambas*". (Flusser 1968 : 78)

183 Ibid : 80.

184 From the excerpt in Portuguese : "*Mas essa classe universal será de tal maneira pobre a ponto de perder todo significado. Em outras palavras : a máxima liberdade torna toda escolha absurda, porque isenta de significado.*" (Flusser 1968: 80)

between systems in translations, are media artists able to establish and maintain coherence and consistency?

Philosophically speaking, if there is a universal language, or a metalanguage to use Flusser's terms, to which all languages are related, it could well be the laws of physics, and out of it the emergence of human feelings and mental activities.[185] In the arts, designing the interactions between materials and meanings on a metalevel seems to be the central challenge facing artists. Nevertheless, accepting these general statements leads back to absolute values of conceptions such as pure language, truth, or even the notion of god, i.e. it refers us back to a universal entitity existing above all else. Against any sort of absolute perspective, Flusser's analysis pleads for the use of metalanguages that emerge in relativized and specific situations.[186] The diversity of light-to-sound translations in media artworks and devices discussed in this chapter illustrates how specificity is shaped by context and context by specificity.

This perspective has been highlighted in both the context of translation and art by a variety of authors using different conceptual frameworks: For Bense, the aesthetic and semantic layers of art are initially separate and are only defined through the practice[187] within the specific contexts of the artworks. Bejamin's conception of translation as a form contends that the reproduction of meaning regarding its poetic significance *"is not limited to what is meant but rather (...) to the way of meaning"*.[188] For Simondon, specificity and the transformative processes are merged in what he calls individuation processes, which according to him happen through transductive activities.[189]

From a technical perspective, the artificial intelligence research conducted on the neural networks behind Google Translator that invented their own language[190] is a very instructive example that seems to confirm both Flusser's prediction of the meaninglessness of maximal freedom and the importance of context and specificities. The machine language that emerged is completely incomprehensible to the

185 Deacon, Terrence William. *Unconplete Nature: How mind emerged to matter.* New York/London: W.W. Norton & Company, 2012.

186 Flusser 1968.

187 Bense, Max. Einführung in die Informationsästhetik. In: Ronge, Hans von. (Ed.) *Kunst und Kybernetik: ein Bericht über drei Kunsterziehertagungen Recklinghausen 1965, 1966, 1967.* Köln : DuMont Schauberg, 1968. p. 28-41.

188 Benjamin 2002: 259-160.

189 Simondon 1958: 95; "*Transductive operation is an individuation in progress*" (Simondon 2005: 32-33 apud Hui 2015: 12).

190 Coldewey, Devin. Google's AI translation tool seems to have invented its own secret internal language. In: *Techcrunch.* Nov, 23rd 2016. Available at <https://techcrunch.com/2016/11/22/googles-ai-translation-tool-seems-to-have-invented-its-own-secret-internal-language/> Accessed April 5th 2018.

machine's creators. The in-between language itself is not interesting to an external observer, but what is relevant is its ability to bridge between languages. This bridging operation has proven to be a convenient strategy for specific purposes in specific contexts.[191] This is an excellent example of the cybernetic model of the black box and an illustration of the the impossibility of making it transparent, as Ranulph Glanville has shown. The envisioned metalanguage is likewise a black box as an epistemological object.[192]

A complementary perspective that takes the work of philosopher Jacques Ellul (1912-1994) and technological society as its points of departure is provided in Yuk Hui's discussion of the desymbolization process that occurs in the growth of technological systems, which necessarily implies the creation and attribution of new symbols. Hui suggests that the desymbolization-resymbolization process he depicts *"may sound similar to Ernst Cassirer's well-known proposal that culture is a constant movement between forma formata (structured structure) and forma formans (structuring structure)"*[193]. If the essence of digital media is the programmability that it entails, software and coding, as metalanguages, can be regarded as *"the technique of providing a dynamic background to control the automatic evolution of meaning."* [194] Such a perspective pushes the understanding of the translation of materialities as a form of transcedental empiricism, a practice that moves towards meaning attribution processes.

Attaining the ability to manipulate matter and language on a deep abstract level has obliged mankind to find a common term for it. The term systems has filled this need and served to enable interdisciplinary research and communication possibilities. The openess of the notion of systems enables, for instance, the present cultural study to identify and analyse biological and engineering approaches in relation to photosensitive elements through their similarities and analogies, such as stimulus uptake, transformation, stimulus transduction and encoding processes.[195] In the space between nature and culture, human beings work hard in decoding other

191 Viégas, Fernanda; Wattenberg, Martin; Corrado, Greg; Hughes, Macduff; Dean, Jeffrey. *Google's Multilingual Neural Machine Translation System: Enabling Zero-Shot Translation.* November 14th 2016. Available at <https://arxiv.org/pdf/1611.04558v1.pdf> Accessed April 5th 2018.

192 Glanville writes: "*The Black Box does not exist and you can't get inside it. The Black Box is a thought experiment. (...) The point of the Black Box is precisely that it allows that you don't know. The Black Box is something which almost institutionalized ignorance. So at least in that respect if I use the Black Box as a model then I can talk about it because the Black Box is about starting in spite of not knowing*". Glanville, Ranulph. Grounding difference. In: Müller, Albert; Müller, Karl H. (Eds.) *An Unfinished Revolution? Heinz von Foerster and the Biological Computer Laboratory | BCL 1958-1976.* Wien: Echoraum, 2007. p. 369.

193 Hui, Yuk. Technological system and the problem of desymbolization. In: Jéronimo M. Helene (Org.). *Jacques Ellul and the technological Society in the 21st Centrury*, 2013, p. 74.

194 Goldsteine and von Neumann 1947 apud Chun 2011: 25.

195 Barth et al 2003.

beings and encoding and recoding what they have learned in cultural objects. This constitutes a limited transcendence, since one necessarily faces the physical limits of materials. However, through experiencing these processes one comes closer to comprehending the universal dynamics of matter activity.

Benjamin also adopted a pertinent physical metaphor to refer to translations when he stated that "*Fragments of a vessel that are to be glued together must match one another in the smallest details, although they need not be like one another*"[196]. Despite referring to a sort of "reproduction of sense" and implicitly opposing an auratic original to a less valued translation, Benjamin's metaphor offers a powerful way to consider the translation of materialities in media art. It recognizes the two types of gaps: the gap between two vessels and the gaps between every piece that is glued together to form a structured unity. The vessel is only one model[197] of countless possible vessels, the rules and materials structuring the pieces are also chosen from a variety of other possibilities, and the most attractive aspect of Benjamin's metaphor is its own limitation as metaphor. It does not consider the temptations that artists face to explore other unknown existing possibilities to shape a vessel, or even, to shape other interesting objects that are not a vessel. Media artists dealing with translation of materialities should neither be concerned about betrayal and loss of information nor about verissimulitude. Translating materialities might be the most valuable exercise for becoming aware of gaps as creative sources, as open spaces for the emergence of novelty. The translation of materialiaties is a means of invention. Translation of materialities is transcreation.

3.3.4 Transcreation

"Transcreation"[198] is a term coined by Haroldo de Campos[199], who was very influenced by Benjamin's writings[200] and Ezra Pound's (1885-1972) "*Make it new!*" (an influential work within the US-American modernist literary movement).

196 Benjamin 2002 [1923]: 260.

197 Flusser also comprehends the language as equivalent to a 'model of reality' opposing his theory to those that consider the act of translation as referring to reality, as Benjamin tended to. (Flusser 1968 : 79)

198 Campos, Haroldo de. *Da transcriação poética e semiótica da operação tradutora*. Belo Horizonte: FALE/UFMG, 2011.

199 Flusser, who was involved with Brazilian concrete art and poetry, translated Haroldo de Campos' series Galáxias (1963-1976), together with Anatol Rosenfeld, for the edition rot 25, implementing a transcreative method. See Jürgen, Claus. Brasilianische Intelligenz: Zwei Charismatiker der cartesianischen Welt: Max Bense und Vilém Flusser. In: Zielinski, Siegfried; Irrgang, Daniel. *Bodenlos - Vilém Flusser und die Künste.* Berlin: Akademie der Künste, 2015. pp. 37-45.

200 Campos 2011.

Pound's practice and theory of poetry translation[201] rejected the former Victorian tradition in the English language and experimented with an array of methods for the developement of his own poetic style based on free-verse translations of classical works. For Pound, each translation was a sort of criticism of the original, revealing both its strengths and limits. In this sense, Pound believed that translators must not necessarily reproduce all aspects of the original, pleading for the freedom to rearrange the material according to one's intentions. By addressing the aporetic possibility and impossibility of translations in practice, Pound created a modernist scandal. His translations of ancient Chinese poetry are emblematic.[202] Since Pound could not properly speak or read Chinese, he invented his own way to translate the very imagetic language, which caused him to be severely criticized as a translator but praised as a poet.[203] Pound's proto-multicultural practice points towards the asymmetries in translating, planting the seeds for a decolonial perspective.[204] An astute comment by T.S. Elliot regarding Pound's practice is relevant to the current translation of materialities being done by media artists: "*Pound is the inventor of Chinese poetry for our time. I suspect that every age has had, and will have, the same illusion concerning translations. (...) Each generation must translate for itself.*"[205]

It is impossible not to notice the suitability of the US-American modernist movement to the anthropophagic and neo-baroque characteristics of Brazilian art and culture in the 1960s. These expressions show that the emphasis of avant-garde movements is not the exclusion of tradition; but rather its renewal, provoking the dissolution of absulute truths, which are purely historically created human constructs. De Campos, ignoring the referential and merely functional sorts of translation, contended that the more difficult the author, the more translatable s/he is. In his view, only the possibility of recreation and reinvention is interesting for the artist as translator.

Transcreating from the original texts using modernist attributes implied the use of free verse, spatial disposition of the words, decomposition and exploration of their phonetic aspects, and the use of neologisms. Light-to-sound translations

201 Alexander, Michael. Ezra Pound as translator. In: *JSTOR*. Edinburgh University Press: Vol.6 N.1 1997. pp. 23-30.

202 Influenced by the work of the orientalist Ernest Fenollosa, Pound, in the essay The Chinese Written Character as Medium for Poetry (1919, provides) the foundations of his poetically fruitful method of creative translation which was considered a scandalous misunderstanding of Chinese language by critics. (Williams 2009:146)

203 Williams, R. John. Modernist scandals: Ezra Pound's translations of 'the' Chinese poem. In: Sielke, Sabine; Kloeckner, Christian (Eds.) *Orient and Orientalisms in US-American Poetry and Poetics.* Frankfurt/M: Peter Lang, 2009. pp. 145-165.

204 Language is considered *"a collective force, an assemblage of forms that constitutes a semiotic regime"*, as *"site of power relationships"* susceptible to minoritizations and domestifications of languages. (Venutti, Lawrence 1998:9 apud Williams 2009:148)

205 Eliot, T.S. 1928:15-16 apud Williams 2009:147.

operate similarly, adding materials and devices, becoming a tiny fragment of the history and archaelogy of media convergence. Material translations have been increasingly prevalent with the development and dissemination of a sort of universal metalanguage (calculating and programming). The sources of inspiration are much broader than a single material or technical source, and meaning is created by artworks in the process of being constructed and/or performed. In this sense, despite the aesthetic values of the sound compositions that have been generated, the exhilaration experienced by those creating and enjoying light-to-sound translations slips to the 'making it happen' moment, and, like Pound, to the act of making it anew. In the context of art history, one can identify this sort of media art practice as a branch of concrete art and poetry, where the weight of words' meanings often loses its singular importance in space- and time-based contexts, as demonstrated by the Brazilian Noigandres group[206] and Raoul Hausmann in his phonetic poems. The zero-dimensionality of metalanguage requires embodiment in order to communicate. However, although transcreativity permits media artists to reset and recombine elements in a metalanguage, their works are not released from the dimensions of space and time, where relational and dynamic characteristics need to be managed to frame possible channels of communication.

Translation-based media-archaeological artworks merge past and future in the immediate present. Translating is the most ambitious form of reading history, since it is a productive type of consumption, as Julio Plaza puts it in his reflections on intersemiotic translations.[207] Translations encourage reinvention both by re-reading and estabilishing continuity to the way of imagining of past media inventors. In this sense, too, Pound's practice remains pertinent. Hugh Kenner, in the introduction to Pound's *Tranlations* observes: "*Translating does not, for him, differ in essence from any other poetic job; as the poet begins by seeing, so the translator by reading; but his reading must be a kind of seeing*"[208]. Analogously to poetry translation, the translation of materialities in media artworks is essentially sustained by the role of imagination. Especially because they aim to animate matter, translation-based media artworks become alive like new poems. Active matter, active poetry.

Nevertheless, due to the several layers of abstraction between the input and output of media artworks[209], one cannot immediately perceive the metalanguage operating. In most cases, understanding (if possible) which elements of the translations are generated, emphasized or omitted, requires posterior analysis of circuitry, software and the other rationalization models that enabled the installation or performance. Returning to the light-to-sound conversions mentioned, one

206 Plaza 2003: 12.

207 Plaza 2003: 2.

208 Kenner, Hugh. In: Pound, Ezra. *Translations.* New York: ND Paperbook, 1963. p. 10.

209 Except in cases of live coding performances. The aforementioned *Stofftonband* is also partially such an expression.

sees that part of the challenge of analog translations (*Photophone*, *Fotoliptófono*, *Optophone*, etc.) was matching the necessary material conditions to extract desirable sounds out of light; whereas in the digital-based translations (*Phonotube,* Neil Harbisson, and *Self-portrait of an absence*) the programmability increased the potential for arbitrarity and imagination almost infinitely.[210] In the latter cases, additional elements of specific context were required, aggregating recognizable information (meaning attributed via pattern recognition) to enable the handling of absence and the execution of the translation process itself. In *Self-portrait of an absence*, e.g., light variation entering the camera is turned into data as the eyes' movements and the difference between them is turned into relevant information to be later transformed into sound. In Harbisson's case, light variations are decomposed into luminance and chrominance to form a color system to be codified as sound, which then emerges as relevant information in Harbisson's skull and auditory system.

Although described here in a very summary way, these processes elucidate the arbitrary steps taken while programming matter and meanings. From input to output, without neglecting the circularity between them, stimuli become information as they are fragmented in several layers of abstractions (holes in the chopper, variables, functions, protocols, etc.) able to be recognized through constancies and variations, and all the derivative parameters and categories one can articulate from them. It becomes clear that in the case of the translation of materialities one is dealing with many more in-between layers of abstraction (models, software, etc.), which provokes an increase in the level of complexity. This is one of the main issues facing translatability in relation to physicochemical phenomena.

The technical ensembles based on light-to-sound translations discussed above thus identify photosensitive matter as one of the ways in the history of media to approach the programmable and dynamic quality of matter and the margin of indeterminacy existing in the absence between two logical systems. Exploring the void between two systems, the notion of transcreation with materialities emphasizes the inventive aspect of translation. Within the terrain of the gap and its uncertainties, Flusser's view of translation as play, in addition to pointing out its motivating joyful aspect, frees the creative translating act (transcreation) from the objective-subjective dichotomous relationship. Rainer Guldin summarizes this aspect of Flusser's theory as follows:

> Translating is a practical philosophy that can best be explained by the concept of playing. The translator is a player who installs himself in a regulated playful totality that, although it surpasses his subjectivity, does not exclude it. The player follows rules that he has to accept if he wants to play.[211]

210 "Almost" because one cannot simply get rid of the material limitations.

211 From the excerpt in Portuguese : "*Traduzir é uma filosofia prática que pode ser mais bem explicada pelos conceitos de jogar. O tradutor é um jogador que se instala em uma totalidade lúdica regrada que,*

Flusser's viewpoint addresses the substantive aspects of the translation of materialities more directly, especially how the 'regulated rules' of grammatic and semantic webs can be expanded to the physical and chemical rules that structure and shape the material world. Morever, the dynamic processes entailed by creative action give the notion of "playä special siginificance for the arts, and within the aesthetic realm this notion is able to transcend the dichotomous relationships of absolute values such as right or wrong, good or bad, etc. to point towards always changing hypotheses of translating.[212]

3.3.5 Self-translation

As a polyglot with an immigrant background, Flusser's philosophical method evolved naturally through the practice of self-translations and retranslations. He considered the metalinguistic in-between space confronted during the translation process as a sort of abyss – a metaphor that he stressed in his media theory in the context of the concept of *Mediumsprünge* but also applied on an existential level.[213] In contrast to what he considered the naïve reality-based theories of the past, Flusser understood language as a model of reality[214] – expressed in the form of dictionaries and comparative grammars – and hence for him the act of translation deals with structures that transcend both the source and target languages. Following this logic, Flusser concluded that "*translation is the transcendence of models of reality*".[215] This statement is especially strong if one takes into account his biography: he was forced to immigrate in order to escape the nazi regime, and this experience influenced several aspects of his philosophy.

If the creative act of translation through its direct relation with a metalevel is a transcendent act, one may use this suspension of space-time to creative purposes. Similar to Haroldo de Campos' position that the target language should be subjected to the wild wind of the foreign language as a means to enlarge its own borders[216], Flusser metaphorically calls one's native language a 'prision' suggesting

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embora supere sua subjetividade, nem por isso a exclui. O jogador segue regras que ele tem de aceitar se quiser jogar" (Guldin 2010: 98, translated by the author).

212 Guldin 2010: 98.

213 Guldin 2010: 31.

214 Several other theorists have resisted the objectivity of translation, such as Robert Kern, who stated: "*successful translation, or what passes for it […] is always a matter of temporal and linguistic localization, a perception of the foreign limited by an inescapably provincial or ethnocentric perspective*" (Kern 1996: 4 apud Williams 2009: 148).

215 From the original in Portuguese: "*tradução é a transcendência dos modelos de realidade*". (Flusser 1968:79)

216 In dialogue with Benjamins's example of Pannwitz's statement in *The task of the translator*, that: "*The basic errors of the translator is that he preserves the state in which his own language hap-*

that the possibility to think in another language is an opportunity for self-expansion. If the possibility of translation is a mark of one's freedom, its impossibility is a mark of one's conditioning; and since the return to the actual language is unavoidable, Flusser deemed the act of translation as a form of limited transcendence.

Other media theorists, each in their own specific terms, have addressed the transgressive power of media. McLuhan did so by generally considering media (as well as language) as a human extension, albeit with the recognition that extensions also imply also amputations.[217] As part of a more specific and complex line of argumentation Simondon addressed the transgression of technical objects through explanations of their individuation processes and their ihnerent interactions with other associated objects, ensembles or *millieux*. He deemed that the material limit of a technical individuum is not a functional limit and pointed out the existence of relative levels of individuation, which are a necessary condition for the technical object to mantain its independence within a self-regulated system.[218] Simondon also comprehended that a "*transductive operation is an individuation in progress*"[219]. Hui, interpreting Simondon's thinking, proposes that "*transduction demands a system that is already energetic and ready to undergo a structural transformation. Such a system is neither fully open nor closed, since it depends on the compatibilities between the incoming elements and the system itself.*"[220]

Analogously, as discussed by Paul Ricoeur,the desire to translate[221] might correspond to the pre-existing tension that triggers an individuating and transductive movement, as a material activity in search of a more stable status.[222] In this sense, creating media artworks based on translations of materialities is a transformative act, and the continuity of the practice can be a method for self-cultivation. Flusser, who adopted translation as his philosophical method, contended that, through the translation practice, as in a spiralic evolution, upon returning to the language of departure one comes back to a more maleable, plastic and extended prision.[223]

Regarding the potential energy between systems in translation, whether in the artistic urge to express or in the desire to translate, Flusser poses a crucial question:

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pens to be instead of allowing his language to be powerfully affected by the foreign tongue". (Pannwitz apud Benjamin 2002 : 262)

217 McLuhan : 1964.

218 Simondon 1958 : 77-80.

219 Simondon, Gilbert. *L'individuation à la lumière des notions de forme et d'information.* Grenoble: Millon 2005. pp. 32-33.

220 Hui 2015: 12-13.

221 Ricouer, Paul. *On translation*. London/New York: Routledge Taylor & Francis Group, 2006. p. 21

222 Hui 2015:12.

223 Flusser 1968: 81.

"How can I transform the limited freedom offered by translation into significant action?"[224] This question applies equally well to the contemporary translations of materialities being executed by media artists.

The role of absence as creative matter and potential was not discussed above by accident. The in-between space achieved in translation processes is very close to the vacuum of one's own meaningless existence. Translations are therefore an existential reaction aimed at making the life of mankind, which is in principle meaningless, less painful. When Benjamin suggests looking at life beyond our biological limits, extending it to the scale of history[225], he approaches the biological impetous behind the human cultural practice of knowledge production and transmission through the attribution of meaning and the emergence of significance – a mysterious and multifaceted survival strategy.[226] In this sense, Neil Harbisson's work and *Self-portrait of an absence* present multiple levels of self-referentiality: they refer primarily to absent elements of idealized standard human vision, but also to the absence of meaning initially present in the gap between the input and output sides of the artwork's systems, as well as to the artists own effort to make sense of their individual existence.

At first glance self-referentiality might sound pretentious. However, this initial impression dissolves once one overcomes the Renaissance myth of the artist as genius and beholds them as social catalysts working hard in the continuos evolutionary process of translating sensations and materials into significant experiences. Concerning the self-critique that was begun above in relation to the ineffectiveness of *Self-portrait of an absence* at sharing the real feeling of absence, one means to handle this material aporia can be found in the elementary subject-object dichotomy of human existence, which is elegantly expressed in the cybernetic dialogue between Heinz von Foerster and Humberto Maturana. Humberto Maturana, explaining the foundations of his epistemological biology, stated, "*Anything said is said **by** an observer*"; and Heinz von Foerster added, "*Anything said is said **to** an observer*".[227]

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224 Original excerpt in Portuguese: *"Como posso transformar a liberdade limitada oferecida pela tradução em ação significativa?"* (Flusser 1968: 80).

225 Benjamin wrote: "*the range of life must be determined by the standpoint of history rather than that of nature*". (Benajmin 2002: 255)

226 Gotschall, Jonathan. *The storytelling animal*. New York: Mariner Books, 2013.

227 "*whereas I am fascinated by images of duality, by binary metaphors like dance and dialogue where only a duality creates a unity. Therefore, the statement that opened our conversation – 'Anything said is said by an observer' - is floating freely, in a sense. It exists in a vacuum as long as it is not embedded in a social structure because speaking is meaningless, and dialogue is impossible, if no one is listening*". Foerster, Heinz von. At each and every moment, I can decide who I am. In: Poerksen, Bernhard. *The certainty of uncertainty.* Charlottesville,VA USA: Imprint Academic, 2004. p. 12.

This conversation shows the inherent flux and inseparability between individual and social layers[228] in the creative process of translations, and it also resembles Paul Ricoeur's praise of the role of otherness and the coexistence of otherness in the depth of the self. Richard Kearney, in the introduction to Paul Ricouer's *On Translation*, synthetizes this view as follows:

> For Ricoeur, the task of outer translation finds echoes in the work of inner translation. Indeed the very problem of human identity, as he shows in *Oneself as another*, involves a discovery of an other within the very depth of the self. This other within is itself plural, signifying by turns the unconscious, the body, the call of conscience, the traces of our relations with other human beings, or the sign of transcendence inscribed in the deepest interiority of the human heart.[229]

Self-translations create the potential for the coincidence of subject and object. The translation of materialities in media art is a very concrete example of a transcendental empiricist exercise. This theoretical framework led to understanding the work and challenges of (media) artists as that of finding material solutions to address local-universal relationships through the interplay between metalanguage (the realm of potentiality) and language (the realm of actualization) in its most expansive sense.

Media artists often ignore their activity as translators, which implies being responsible for recognizing otherness.[230] The urge to translate comes from curiosity about the foreigner, about the alien matter. Interest in otherness concerns both the alien materiality used in artworks and the audience itself.[231] Media artists, while inscribing their modifications on models of reality that they manage to render by recombining materials and devices, can provide significance to their own existence. Just as Flusser used translation and retranslation processes as a philosophical tool to react against the absence of meaning in life, media artists can use these processes to create more meaningful artworks.

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228 At this point it is also relevant to recall the corraboration from the perspective of contemporary neuroscientists: "*there is no real person whose embodiment plays no role in meaning, whose meaning is purely objective and defined by the external world, and whose language can fit the external world with no significant role played by mind, brain or body. Because our conceptual systems grow out of our bodies, meaning is grounded in and through our bodies.*" (Lakoff and Johnson 1999:06)

229 Kearney, Richard. Ricouer's philosophy of translation. In: Ricoeur, Paul. *On translation*. London and New York: Routledge Taylor and Francis Group, 2006 [2004]. p. xix.

230 Ricoeur 2004: 25.

231 Based on Husserl's philosophy, Ricoeur writes: "*There is something foreign in every other. It is as several people that we define, that we reformulate, that we explain, that we try to say the same thing in another way*". (Ricouer 2004: 25)

The fact that media artworks can become the ultimate expression of contemporary art's self-referentiality[232] inevitably makes these artworks more hermetic. The challenges facing (media) artists thus center around the following questions: How can the extraordinary discoveries one experienced through creative translational processes be communicated in a way that enables external observers to join the jam? How can one keep the system open for further conversation, allowing meaning to emerge through experience itself among individual and/or collective bodies? Concepts, like materials, can be understood and treated as abstract machines that demand to be articulated in order to render enriched exchange processes in any aesthetic system.

3.4 Epistemological materialities

Despite technological changes, the search for significance[233] and purpose in life still constantly occupies humans, including, as Benjamin suggested, on the broader scale of history. Rationalization is one of the innate tools that humans have to learn from nature and make sense of the world and life. The body organizes the world to oganize itself, and this continuous circular dynamic consitutes the prevailing exchange mechanism between nature and culture. Framing media art through the lens of the translation of materialities was only one of the possible ways to systematize the constant stimuli and information exchange between things and beings.

Part of this sytematization has been based on the knowledge produced through the objectification and management of the senses and cognitive abilities, especially regarding the transformation of sensory experience from differences in qualities to differences in quantities.[234] Nonetheless, it is not productive either to regret or neglect the rationalization of perception. Through the possibility of *Mediumsprünge* and the notion of the translation of materialities, media artists can envision creating based on the interplay between matter, number and language; this represents an enhancement of the former paradigm of artistic creativity that considered materials as obstacles to be overcome. The complex task is then to find correspondences among the diversity of universes one places conversation with one another. Creating media artworks requires awareness of the confrontation between the metalan-

232 Within discussions on contemporary art theory, although the role of self-reflection is associated with the end of art, the role of innovation is not placed apart. Louise, Schouwenberg. Innovation as a premise of art and design education. In: Schouwenberg, Louise (Ed.) *Material Utopias.* Sandberg Series n.3. Amsterdam: Sternberg Press, 2017. p. 24.

233 *Sinngebung* in the philosophical tradition: From Flusser, through Husserl to Ricoeur.

234 As expressed by Jonathan Crary: "*this new valuation of perception, this obliteration of the qualitative in sensation through its arithmetical homogenization, is a crucial part of modernization*". (Crary 1991: 147)

guages of beings and machines. Although able to communicate, meaning attribution and translation processes tend to be distinct in machinic and living entities. As neuroscientists Lakoff and Johnson contend:

> There is no such a thing as a computational person, whose mind is like computer software, able to work on any suitable computer or neural hardware – whose mind somehow derives meaning from taking meaningless as input, manipulating them by rule, and giving meaningless symbols as output. Real people have embodied minds whose conceptual systems arise from, are shaped by, and are given meaning through living human bodies. The neural structures of our brains produce conceptual systems and linguistic structures that cannot be adequately accounted for by formal systems that only manipulate symbols.[235]

Contemporary art (including media art) is often criticized for being purely conceptual and hermetic, requiring a manual of instructions on how to experience and understand the artworks. Frequently, a media-illiterate person visits a media art exhibition and leaves the space disappointed with what one she experienced simply because she could not grasp anything that had been proposed. The media artworks currently being produced could also be seen as a sort of further stage of the *Neo Dada* movement, insofar as the freedom to articulate alien elements is immense and artists are indeed exploring radical combinations. Common examples today include installations and performances that use plants or other organisms as interfaces to process sounds or disrupt images. However, in many cases one barely notices any connections between the interface materiality, its embedded symbol(s) and the kind of sound or image being produced. Furthermore, most of these expressions lack any kind of political statement and can hardly be grouped together as an artistic movement like Dadaism was. To grasp the significance of contemporary media art, it is necessary to identify what is relevant to translate, why and, above all, how.

On the one hand, it is true that the hermeticism originating from the self-referentiality of media art does make artworks very dependent on the discourses attached to them. This is part of the knowledge construction processes, analogously to how high level programming languages refer to low level languages and so forth.[236] On the other hand, recalling Lakoff and Johnson again, artists must remember that "*there is no Chomskyan person, for whom language is pure syntax, pure form insulated from and independent of all meaning, context, perception, emotion, memory, attention, action, and the dynamic nature of communication.*"[237] Given these circumstances, the key challen-

235 Lakoff and Johnson 1999: 6.

236 Chun explains how the metonymic role of higher-level programming languages emerged, enabling developers to forget the machine. For her, the creation of metaphors in the field of informatics favours the democratization of knowledge, because it permits professionals other than hardware engineers to code. (Chun 2011: 41)

237 Lakoff and Johnson 1999: 6.

ge for artists becomes finding the clearest ways to translate their ideas, concepts and/or sensations into the materialities they are working with. This proposition is not new within art, but the increase in the complexity of the artworks demands proportionally increased attention to steering the translational process. Fernando Pessoa's sensationism theory recapitulates the essence of the aesthetic creation and fruition processes through the following circular set of statements: *"(1) Every object is a sensation of ours; (2) Every art is a conversion of a sensation into an object; (3) Therefore, every art is the conversion of a sensation into another sensation."*[238] Media artists should consider this approach while creating their artworks, posing themselves the challenge of how to create artworks that do not depend on parallel explanations and permit access to the abstract operations that they are mobilizing.

It is possible to consider media art as a sort of material philosophy and media artworks as epistemological materialities, but merging sensorial experience and philosophical questions requires a logic for handling the organizational systems of each.[239]Tackling these issues requires reflecting upon the primary elements of communication, one of the reasons for the existence of artworks. If communication is understood as the exchange between systems in the interest of shared understandings, the role of structuring and structured information, such as spatial configuration, rhythm, metaphors,narratives, leit motives, etc., is crucial. They are key elements to trigger curiosity and empathy in the reception of aesthetic experiments.

Artistic problems become more complex when meaning attribution and the question of a work's reception come into play. Since this is unavoidable, instead of adopting Benjamin's premise that an artwork is not intended for the audience[240], it seems more fruitful to adopt the cybernetic perspective on the interaction between observer and object as well as the efforts required to match the space-time frame of interaction for mutual understanding of a shared reality.[241] The artworks can themselves be invitations for dialogic engagement through meta-structures able to frame and match realities, rendering ephemeral channels of communication during the interaction.

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238 From the excerpt in Portuguese: "*1.Todo objeto é uma sensação nossa./2. Toda arte é a conversão de uma sensação em objeto./ 3.Portanto, toda arte é a conversão duma sensação numa outra sensação*". (Plaza 2003: 11)

239 For Lakoff and Johnson "*the fact that abstract thought is mostly metaphorical means that answers to philosophical questions have always been, and always will be, mostly metaphorical*". (Lakoff and Johnson 1999: 7)

240 Benjamin 2002: 253.

241 Glanville, Ranulph. *Freedom and the machine.* Inaugural professorial lecture at The Bartlett International Lecture Series 2009/2010. Video-documentation available at <https://www.youtube.com/watch?v=Z8g7GA6DEU8> Accessed February 15th 2018.

Creating shared channels of communication relies on the human capacity to categorize, which serves as a "*gateway between perception and cognition*"[242]. Categorization occurs essentially by means of comparison, in which perceived phenomena are grouped into types on the basis of their (mutual) similarity. Over time, previously formed categories enable past perceptions to be used for the interpretation and organization of new events and experiences. [243]

> The primary purpose of perception is to identify objects and places, to classify them, and to attach meaning and significance to them, thus enabling later responses to them to be selected appropriately. As a consequence, perception is concerned with the enduring characteristics of objects so that they can be recognized when they are encountered in different contexts.[244]

In this sense, creating frameworks for conversation and shared action depends on the selection of elements within a network of spatial, temporal and semantic structures, since they suggest the possible operations and narratives. The attributes are created on different levels, ranging from the code and its instructions, through the shape and disposition of objects in space to established relationships with other elements that could be present. This also applies in relation to the axis of time: algorithms and storytelling are made out of temporal elements.[245] The semantic network emerges from those other two primary categorizations, which mutually influence one another and can be expressed, for instance, through the manifold possible figures of speech, such as metaphors[246], metonymies, etc., that are able to merge figurative and literal aspects of language. In the realm of music and sound art, categorization and pattern recognition also play a very significant role, essentially formalized through its mathematic foundations ranging from the regularity of parameters that forms the rhythm and harmony of classical music compositions,

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242 Ziem, Alexander. *Frames of understanding in text and discourse: Theoretical foundations and descriptive applications.* Berlin/Boston: de Gruyter, 2014, p. 214.

243 Konerding 1997: 57 apud Ziem 2014: 215. According to Ziem, "*Every form of categorization encompasses a schematization process, as categories themselves are of a schematic nature: Categories are formed on the basis of past perceptions that are grouped into types with respect to similarity and contiguity. Perception, regardless of its modality, is unimaginable without categorization processes*". (Cohen and Lefebvre 2005 apud Ziem 2014: 219)

244 Milner, David; Goodale, Melvyn 1995:163-4 apud Gregory 1998: 160.

245 Essential reading on the aesthetic function of time, a topic extensively explored in cinema theory are: Deleuze, Gilles. *L'image-temps. Cinéma 2.* Paris : Les éditions de minuit, 1985. and Tarkovsky, Andrey. *Sculpting in time: Reflections on the cinema.* Austin, TX: University of Texas Press, 1989.

246 Essential reading on the role of metaphors in cognitive process, their spatial qualities, partiality and other relevant problems in their use is: Lakoff, George; Johnson, Mark. *Metaphors we live by.* Chicago and London: University of Chicago Press: 1980.

to the game of chances of probabilistic theories, as expressed in the work of Iannis Xenakis[247] and Karlheinz Stockhausen[248].

An explicit concern with merging material and conceptual approaches can also be observed in Marcel Li Antúnez Roca's concept of '*Sistematurgia*', a term he uses to describe a creative method he developed to think of possible dramaturgies with electronic and computational systems.[249] In 2005, Antúnez Roca used this method to enact a series of aesthetic experiments that implemented the technological possibilities of electronic and digital media in a dramaturgical context. The mastery of his pieces is based on his understanding of the specificities of electronics and computing, together with his ability to play simultaneously with concepts and materials by reinventing ways of storytelling. Moreover, his artworks maintain a critical perspective on the technical means he uses, means which he invents while developing a work's own aesthetic language. One notices his investigation of interlacing motor sensory and cognitive challenges that aim to achieve both presence and meaning effects for the works' reception. This mixture also constitutes the core of Gumbrecht's proposal that the materiality of communication can be used as a key parameter to analyse both the maturity and consistency of media artworks.

Gordon Pask once maintained that äesthetically potent environments", like, e.g., interactive media artworks, should provide the conditions needed to attract the audience's attention, allow them to understand the system, and thereby provide the possibility of co-creation within the system.[250] One can add to Pask's argument that this is possible if the artwork – involving its entirety as technical and aesthetic ensemble, as well as the narrative it is rendering – somehow connects to the audience's sensorial and cognitive systems. "*We are, as a species, addicted to story,*"[251] and "*we just can't resist the gravity of alternate worlds*" [252], as the media scholar Jonathan

247 Lammert, Angela; von Amelunxen, Hubertus. (Eds.) *Kontrolle und Zufall - Iannis Xenakis.* Berlin: Akademie der Künste, 2011.

248 Droseltis, Alexandros. *Zufall und Determination in der westeuropäischen Musik um 1960 Dargestellt an Werken von Iannis Xenakis und Karlheinz Stockhausen.* Dissertation von der Fakultät I – Geisteswissenschaften der Technischen Universität Berlin 2011.

249 Roca, Marcel-Li Antúnez. *Sistematurgia*. Vol.1 Abril 2005. Available at <http://marceliantunez.com/texts/sistematurgia/sistematurgia.pdf> Accessed April 23rd 2016.

250 Pask wrote: "*It is clear that an aesthetically potent environment should have the following attributes: (a) It must offer sufficient variety to provide the potentially controllable novelty required by a mon (however, it must not swamp him with variety – if it did, the environment would merely be unintelligible). (b) It must contain forms that a man can interpret or learn to interpret at various levels of abstraction. (c) It must provide cues or tacitly stated instructions to guide the learning and abstractive process. (d) It may, in addition, respond to a man, engage him in conversation and adapt its characteristics to the prevailing mode of discourse.*" Pask, Gordon. A comment, a case history and a plan. In: *Cybernetics, Art and Ideas.* 1968. p. 76.

251 Gottschall, Jonathan. *The storytelling animal. How stories make us human.* Boston, New York: Mariner Books/Houghton Mifflin Harcourt, 2012. p. xiv

252 Ibid: 3

Gottschall (1975-) puts it. By characterizing humans as a sort of *Homo fictus*, Gottschall describes the innate human drive to create and consume stories as an urge to express and, borrowing Pessoa's terms, to communicate by translating sensations into sensations. However, there is no formula to be followed as Hollywood has done in creating a storytelling industry. In media artworks, technical and conceptual ensembles are only significant in their very specific and diverse contexts. As technological artifacts, in contrast to utilitarian ones[253], media artworks *"reside in interdiscursive relations and constitute dialogical reality constructions, which are essentially cultural by involving several discourses."*[254]. This explains the role of media and artists as actants in creating, storing and transmitting knowledge.

What one can learn and grasp from the examples and citations above is that media art is a field of action for breathing new life into and transcreating other space-time based expressions. They establish creative processes in media art as being essentially about systemically imagining, fictionalizing and inventing with materials in specific contexts. The correspondences and exchanges between materials and symbols, between physical laws and languages, as well as the energetic and information flux between communicating systems, are the foundation of the creative process. Since media artists are required to create all the in-between layers that constitute, and permit access to, the artwork, the translation of materialities is the transcreative act sustaining the epistemologic experience that every media artwork has the potential to create. In contrast to general technological devices generated for mere entertainment and commercial purposes, media artworks are pieces of framed realities, which come with their own dynamics and internal rules. The audience is free to engage (or not) in a shared space-time.

The notion of epistemological materialities encompasses a sort of manifesto calling for more critical viewpoints and the creation of more mature relationships between the apparently opposed technical and conceptual approaches in media art. Yet, in addition to the technical knowledge needed to execute the project, when attributing symbolic layers to the work media artists need the sensitivity required to enhance an artwork's potential for communication. The term "mediaïn "media artßhould do justice to the communicative ability and intentions of its technical and historical roots.

The notion of the translation of materialities can be considered as an analytical lens and tool for media art practitioners. Beyond the projects discussed here, this approach can guide other artists to reflect upon the process of meaning attribution through organization and recombination of materials in the specific contexts they

253 *"A computer interface employs icons and metaphors from everyday life to be understandable by many" and that 'the materiality of a computer resides in at least two discourses, the public discourse of its interface and the discourse of those who participated in designing it".* (Krippendorff 2011: 16)

254 Krippendorff 2011: 16.

are working in. The same is valid for critics and audience, who can use the notion of the translation of materialities as an analytical lens to discuss media artworks.