

From Clavilux to Ufabulum

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ABSTRACT

This essay establishes a parallelism between the 'Clavilux', a silent colour-organ from Thomas Wilfred in the —beginning of the 20th century, and 'Ufabulum', an audiovisual live performance from the artist Squarepusher in the year 2012.

It presents an overview of the analogies and synergies between sound and image in the recent history of music and visual arts, and connects both artists with almost one hundred years of audiovisual instruments, techniques and sound-image analogies, that despite the technical and creative evolutions, maintain the same concepts and dreams over time in the quest for high-sensory experiences and synaesthetic states.

Keywords: *Visual Music; Audiovisual; Lumia; Sound-Image Analogies; Colour Organs; Synaesthesia*

1 | INTRODUCTION

The known history of the relations between music and colours goes back to 500 BC in ancient Greece, where Pythagoras whose "intuition of the analogy between vibrations in tone and vibrations in light led him to imagine the Music of the Spheres as the sounds created by the perfect movement of heavenly bodies as they proceed along their inevitable course"

(Snibbe and Levin, 2000, p. 1). These ideas inspired many other thinkers, scientists and artists until today, who have been trying to "create with moving lights a music for the eye comparable to the effects of the sound for the ear" (Moritz, 1986).

It was clear for many scientists and artists that both sound and colour are wave frequencies on a spectrum, and that there must be a relationship between them.

"Most inventors of colour organs were convinced that their instrument constituted a breakthrough"

(Moritz, 1986), but despite centuries of experiments, achievements and amazing visuals, visual music is still an unsolved field with plenty to explore. Every tool or colour-organ instruments remained until today as an "eccentric curiosity and a technology dead end" [idem].

2 | VISUAL MUSIC

The modern history of the visual music/colour music starts in the 18th century, inspired by the ideas of Pythagoras and the recent advances of science in the fields of Physics and Optics, and mainly the work of Isaac Newton who, in his famous publication "Optiks" (1704), for the first time made a comparison between colour and a music scale

(Jewanski, 2009). In his research in the fields of optics, Newton was able to divide “white” light in to seven different colours with the help of a triangular prism. Later he assigned to each one of those colours a corresponding sound note.

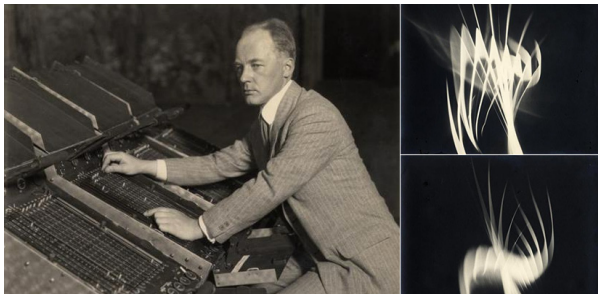


FIGURE 1 | Thomas Wilfred with the Clavilux(left).
Some Lumia images (right).

Inspired by these events, Father Loise-Bertrand Castel built the first known instrument of visual music in 1754, a colour organ called “Ocular Harpsichord” (Snibbe and Levin, 2002). Castel’s harpsichord had candles placed behind coloured glass and was controlled by a keyboard. When a key was pressed, a coloured strip of paper or glass appeared in the panel letting the light from the candles pass by. This way each time a key or a combination of keys was pressed, the corresponding colour was visualized, a kind of expressive performance of light art. Castel’s colour organ was followed over time by a successive number of other colour organs, like Wallace Rimington’s colour organ or Sarabet, the organ developed by Mary Hallock Greenewalt.

In the early 20th century Thomas Wilfred created his colour-organ, the “Clavilux” (Figure 1), an instrument made of lenses, mirrors and coloured lights for projection of light performances. The instrument was operated by a keyboard like a normal organ. Inside it had a triple light chamber with discs. The pressed keys would determine the discs position. There were 100 positions for each key, which made the possibilities almost infinite (Popular Mechanics, 1924).

“He stressed polymorphous, fluid streams of colour slowly metamorphosing” (Moritz, 1997).

Wilfred named this art form as “Lumia”, the art of Light, the eighth art form. “Lumia” was an aesthetic concept, “the use of light as an independent art medium treatment of form, colour and motion in a dark space with the object of conveying an aesthetic experience to a spectator” (Wilfred, 1947, p. 252).



FIGURE 2 | The home version of the Clavilux.

For Wilfred light is the artist’s “sole medium of expression” (Wilfred, 1947, p. 252). In the same way a sculptor models clay, a light artist controls light, its colour and especially its motion. Light art is a sculpture time. Motion gives the piece a third dimension, the time. The light artist must be “a choreographer in space” (Wilfred quotes taken from Rezende, 2012).

Despite the “Clavilux” being regarded as a colour-organ, it was very different from the others. It had no sound, only light and colour. This was a silent art, an art of full stimulation of senses, where the artist suggested abstract aesthetic concepts, and let the audience the freedom to materialize the forms, colours and motions into their personal visions, fusing imagination with reality (Wilfred, 1947). Besides having done several public performances with the “Clavilux”, Wilfred also imagined a personal use of the instrument, and created a home version of it (Figure 2). This was a small box with a screen similar to a TV that could play images for days without repetitions (Moritz, 1997).

“Everyone who saw this colour-play instrument was fascinated and excited, ... I was truly surprised to find that the instrument could be played with the greatest of ease, and I was thrilled to feel the tremendous joy of being able to improvise, to see music take form and colour instantly on the screen, responding to each subtle or strenuous dance-like gesture of the player. What an exciting and fulfilling sensuous exercise” (Fischinger, 1980). Oskar

Fischinger (1900-1967) is considered by many as the father of "visual music". Besides the creation of the "Lumigraph" he played a very important role in the field of animation and abstract films. He was the precursor of the synchrony between sound and moving images. His films were impressive non-narrative sound experiences, without any story line or acting, but with an amazing power to convey emotional experiences and synaesthetic sensations.

Fischinger predicted a future where the music was not written in a musical score but painted in a more free and expressive way (Fischinger, 1932).

Norman McLaren, another pioneer in the abstract and experimental film field, followed and improved Fischinger techniques of painting in the sound strip of the film. This way, they were able to create and control a perfect synthetic and synchrony between sound and image. This technique can be observed in "Pen Point Percussion" (1951), a documentary that describes with detail McLaren's process of painting sound on the film. As an example, by observing his film "Dots" (1940) it is clear the strong influence from the abstract, surrealist and expressionist art movements that brought new ideas to the relationship between sound and image. They used not only the colour-tone analogy, but also the concepts of motion, shape, rhythm and time.

In the 60s, with the explosion of rock concerts and psychedelic culture, light shows became very popular. Analog light effects, illusions and liquid projections were performed at the same time as the music, to provide visual correlation and create an immersive environment, "dissolving the boundaries between audience and performers, between mind and body, between the different senses, and between individual and communal identity" (David E., 2009). Light performers understood that by spontaneously synchronizing layered images with the rhythmic beats of music they could tap into the collective consciousness of the audience (Oppenheimer, 2004). Immersed in a strong psychedelic and counter-culture movement, San Francisco of the 60s was the birth of a strong light show scene. These came to be an inseparable part of music events and acid-test dance happenings (idem).

Also in the 60s/70s, a group of artists and inventors started to create and modify video and TV apparatuses to create video art driven by the appearance of video technology and more affordable equipment (like the Sandin Image processor, the Beck Direct, Rutt-Ettra and Paik-Abe Video Synthesizers) (Cuba, 2002). They explored manipulations of image

signal in real time, treating the video signal as an electronic wave form, manipulating, deforming, changing and merging audio and sound signals (Spielmann, 2009).

Artists like Nam June Paik and Steina and Woody Vasulka were exploring the mix of images, electronic feedback of videos sources and the manipulation of electronic oscillators that generated modulated images and sounds.

"In the video, the wave forms of the pattern-generating oscillators as well as those of his voice can be simultaneously heard and seen. ... In video, one can see what one hears and hear what one sees." (Spielmann, 2009).

In the 70s, Steve Rutt and Bill Ettra created a famous analogue video synthesizer that allowed real time manipulation of the video signal. This synthesizer has been used until today for video manipulation (nowadays more as a software version). In 1974 Steina and Woody Vasulka created the video "Noisefields", a self-reflexive interplay of visual input and exploration across the pure electronic signal. The image is the result of unformed electronic oscillation processes, the video noise (Spielmann, 2004).

The culture of following and merging music with visual performances remains until the present day. Since the 80s and 90s with the explosion of techno and rave culture, audiovisual performances have become an essential component in most music events.

3 | SYNAESTHESIA

In neurology "synaesthesia" is a mental state where different senses are mixed or perceived concomitantly, like seeing sound or smelling colours. The term comes from the ancient Greek "syn" which means "at the same time" and "aesthesia" meaning "perception". So this term relates to simultaneous perceptions (Hinderk, Neufeld and Sinke, 2009). Despite being a topic of interest since ancient times, it only became an object of scientific research in the late 19th century. This phenomenon happens when a sensory inducer activates a perceptual feeling, and can have different forms and levels of complexity (e.g. Colours triggered by numbers, shapes triggered by sounds, etc.) (idem).

Synaesthetic experiences can be divided in three types depending on its source: a) Genuine synaesthesia, when these events are and were always present in the subject since childhood; b) when they are acquired later in life due to a brain

damage or loss of sensory input; c) when they are temporary, induced or suggested by special immersive environment conditions, extreme sensory inputs, or by action of psychoactive substances (Grossenbacher and Lovelace, 2001).

Neuroscience research is focused mainly on *genuine synaesthesia*. However, most people can be induced into temporary synaesthesia states when confronted with hyper-sensory environments.

The human brain uses the information provided by the five senses to perceive reality. This is called "Multimodal Integration" (Daurer, 2010), when the perception of surroundings is dependent from the information collected by several sensors simultaneously. Audiovisual immersive environments can play with our spatial and temporal senses and induce temporary synaesthetic sensations.

4 | SOUND-IMAGE ANALOGIES

"I don't believe in pre-analogies between sound and colours. I believe the sound itself has a visual language.

I am interested in graphic analysers, different ways to analyse frequencies." (Noto, 2009)

Connecting the exact sound frequencies with colour frequencies may have physical and mathematical justifications, but it is a close, absolute and very limited approach. It does not include shapes, rhythm, motion, it does not permit the changing of rules and it does not represent emotional states.

"...An absolute or best correspondence does not exist between music and image" (Ritter, 1992, p. 5)

In fact, sound and image are two physically separated phenomena. Sound is wave vibration in the air, and what we call light is a small part of the spectrum of the electromagnetic radiation. The only place where they appear together and influence each other is in human perception (Daniels, 2004). So there is not a scientific or objective connection between both elements. Apart from some conventions (for warm and cold colours as an example) everything else is subjective, that happens in human perception and cannot be explained or observed except by the ones who experience it (*idem*). Michael Chion describes the relation between sound and image as "added value" (Chion, 2004). Sound manipulates the way the image on screen is perceived, it can enhance image expression and suggest scenarios that are not visible on screen. Sound works as the "audiovisual chain" (Chion, 2004, p. 47), unifying and binding the flow of images and defining the atmosphere.

The abstract, surrealist and expressionist art movements brought new ideas to the relationship between sound and image. They used not only the colour-tone analogy, but also the concepts of motion, shape, rhythm and time. In Kandinsky's paintings we can have a clear perception of rhythm and music through his shapes and colours. He said that he could hear chords and tones when he was painting (Holmes, 2011). Through his paintings, specially the "Compositions" series, one can clearly perceive expressive musical tones and rhythm, and establish a parallelism between spatial relations, structures,

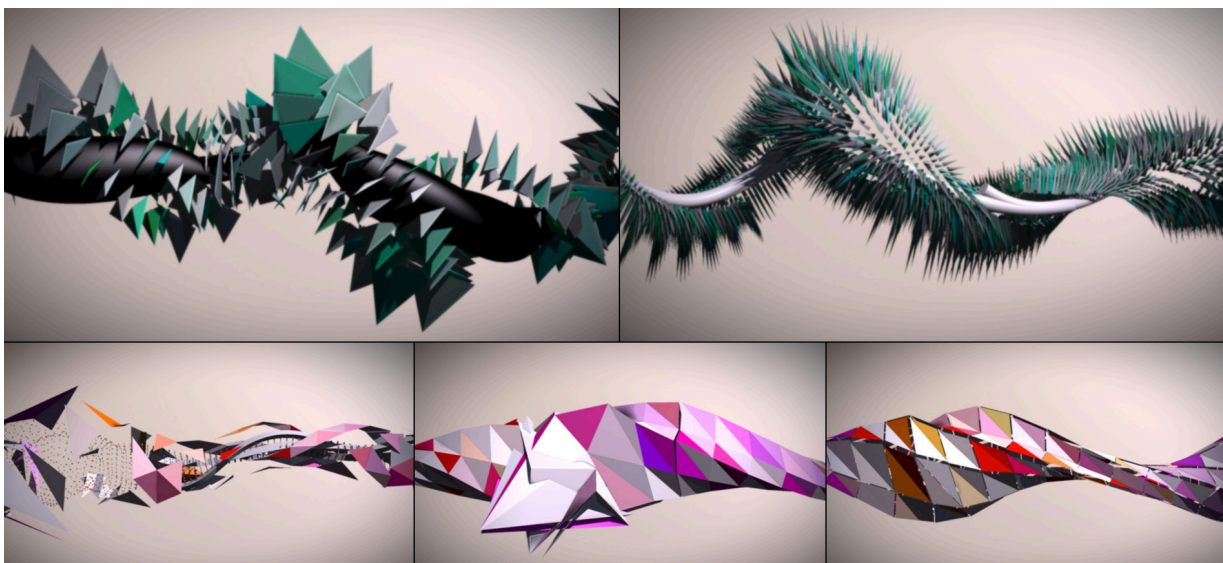


FIGURE 3 | "Partitura" sound visualization.

forms and planes of both image and sound (John, 2004). He translated music into abstract colour patterns that return sound impressions and temporal proportions (Föllme and Gerlach, 2004). Time perception became the center point of his artistic work, it became a new category, taking into balance the importance devoted to space. "I want to animate my painting, I want to give it movement, I want to introduce rhythm into the concrete action of my abstract painting, rhythm that derives from my inner life" (Survage, 1914).

If we make a parallelism between the beginnings of the 20th century and nowadays, and compare these first motion abstractionists with current artists, we see that they all share similar ideas about shapes, and the perception of rhythm and structures of time. In "Partitura 001" a real-time generative sound visualization by Davide Quayola and Natan Sinigaglia, we can see how geometric shapes and colours transmit the oscillation of sound waves over time (Figure 3). It has a horizontal linear structure, like a musical score, where different abstract elements evolve over time. "Partitura creates endless ever-evolving abstract landscapes that can respond to musical structures, audio analysis and manual gestural inputs." (Quayola, 2011a).

If we look to Kandinsky compositions, "Composition 8" (Kandinsky, 1923) as an example, and compare it with the "Partitura 001" we can immediately feel a connection. We see explosions of graphic elements (dots, lines, planes) that flow along an imaginary timeline, and the shapes' features transmit musical expressivity. They do not just react to sound frequencies, like an audio visualizer, but they recreate the tension, motion and expressivity of the musical piece. The horizontal strings in "Partitura", that swing and flow along with the music, are the perfect illustration for Kandinsky thoughts in "Point, line to Plane", where he explains how the sharpness of a line can express the different levels of intensity of music, from pianissimo to fortissimo (Kandinsky, 1947, p. 99).

In an interview for the Creative Projects website, Quayola talks about the importance of Kandinsky in his work and highlights the obvious connection between his paintings and sound, "in fact he started to call his paintings, compositions. A musical term." (Quayola, 2011b). He also refers to the graphical systems and languages that Kandinsky used to develop relationships between forms, shapes and geometry to build his compositions, which are somehow similar to composing music and to the way Quayola works to develop his sound visualizations (idem).

"I tried to define and manipulate arrays of graphic elements, intending to discover their laws of harmonic relationships." (Whitney, 1980, p. 40).

"Time" is an inherent parameter for answers to questions related to sound and image synergies. Time connects and gives a new dimension to both domains. John Whitney, in his book *Digital Harmony* (1980), dedicates a chapter to this issue: "*The Problem: How Shall Motion Pattern Time*" (Whitney, 1980). In his work he dealt constantly with solutions for manipulating visual elements in a way that they contribute to communicate time and to achieve a time-structured design. The relationships between sound and image are much more than the simple translation of sound frequencies to colour and shapes. It is also about expressivity, dynamics, rhythm, motion and time.

Whitney described the factor of motion and time as a dynamic pattern, and the image as patterns in motion. He dealt with this topic by giving motion to patterns of graphics elements with certain rules (velocity, direction) which obeyed to a major pattern and that could be modified and deformed (Whitney, 1980). This way he was successfully able to visually transmit the expressivity of music, as in both music and the visual "emotion derives from force fields of musical structuring in tension and motion" (Whitney, 1980, p. 41).

Alva Noto (Carsten Nicolai's stage name) is an audiovisual artist from Germany who for almost 20 years has been focused on the physical and visual characteristics of sound, exploring the limits of human perception and experimenting with high and low frequencies until the frontiers of audible sounds. Sounds that even if we do not hear them, exist, and our body can feel them (Noto, 2010). He explores sound not necessarily from a musical point of view, but more the graphic features of the waveform itself, shaping and sculpting it like if it was a physical object.

Due to the fact that many frequencies are out of the audible sound spectrum, Noto has the need to make a visual representation of those frequencies, in a way he can see the waveform and perceive what is happening.

He says that he is not interested in merging sound with image, but in making them interact mutually and create a unified hypersensorial experience (Noto, 2009).

"Our hearing can only hear a specific frequency, but our body can hear much more" [idem].



FIGURE 4 | Squarepusher Live Audiovisual performance (2012).

Nowadays, with the advances of technology, computation and interfaces, sound and image can be easily manipulated in real time. Every parameter of each medium can now be converted into data, without being affected by signal loss, and then used as an input in the other medium. Every aspect of sound (pitch, volume, timbre, duration) can be mapped and used as an input into the image generation system. All this data can now be used in generative systems that under certain rules created by the artist, would take the received data, process it, and output infinite and different results.

The digital era allowed the birth of a new kind of real time performance. “The audio or control data from the musicians’ controllers were transferred to the image-generating system and used as actuators for visual impulses” and vice versa (Tina and Lia, 2009). A new concept of artist was also born, an artist that acts at a meta-level (Krueger, 1977). He creates the mechanism, the instrument, and he defines the parameters, the sequences, the possibilities.

5 | UFABULUM

UFABULUM is the name of Squarepusher’s, (Tom Jenkinson, 1975), last album and audiovisual live show. This live performance delivers an extreme and aggressive hyper-sensory, audio and visual synaesthetic immersive experience to the audience. Image and sound go hand in hand, complex data

streams generate images and sounds and flow synchronized between both mediums.

The next sentences are Tom Jenkinson’s detailed descriptions about two tracks of his new album. In these descriptions he tells us where concepts and ideas for each track came from, and he tells us how he connects a bass sound with a certain material texture, or an underwater structure to a polyphony sound wave.

“4001 — I was working on a visual representation of a large underwater structure that you could gradually start seeing bits of, but at no point would the whole thing be revealed. That image gave me the idea of a tidal wave of polyphony smashing over this submarine edifice.” (Jenkinson, 2012c).

“UNREAL SQUARE — I had made the image of a square outline morphing into a kind of circular saw with a vicious shining blade, rotating in two directions at once. At the same time I had been trying to make a bass sound that had the quality of being sharp enough to rip through concrete.” (idem).

When a music journalist confronted Jenkinson with these descriptions, and asked him if he was synaesthetic, he answered:

“Yes. But I don’t think that’s uncommon, is it? This is something that lots of people have.” (Jenkinson, 2012b).

These detailed descriptions give us a hint about Jenkinson's creative process and how he lets the visual images feed back to the music, and the music feed back to the images in order to merge both and create one full experience. Music is able to produce a huge range of imaginary visualization, not only colour but also complex geometric forms.

"I'm not interested in what the machines can contribute. I'm trying to absolutely dominate them. I'm not trying to get their input." (Jenkinson, 2012b).

Jenkinson sees music as a grid of coordinates. For the artist music is like a set of numbers, and composing is the act of combining those numbers in patterns and sequences (Jenkinson, 2012a) and the images are fed with the same raw data. Generating both is all about controlling and manipulating information, patterns of data. In the same way sound synthesizers generate sound, a video synthesizer generates various visual patterns through mathematical functions. Data from the sound waves analysis is inputted into the video synthesizer to generate forms and data from the images that go into the sound sequencer.

This way, Jenkinson has real-time control over sound and image. If the music changes, a parallel change also occurs in the images, and he can "generate a vivid, hallucinogenic and chaotic experience" (Jenkinson, 2012b).

Ufabulum's live setup is composed by a big LED screen on the back of the stage, in front of the equipment table there is also a LED screen covering the entire area under it. Jenkinson performs dressed in black wearing a futuristic helmet with another frontal LED screen connected by a data cable to the system.

The visuals displayed in the LED screens are in black and white, minimalistic, based mostly on dots, lines and grids. The live setup combined with the low-resolution graphics creates a sci-fi atmosphere, involving the audience in an imaginary cyberspace world built on data matrices.

The first single extracted from the album was "Dark Steering" (Squarepusher, 2012). In the video teaser we can get a feeling of the atmosphere of the live performance and how images and sound flow together as one. The audiovisual track starts with a high-pitched sound, similar to an alarm, which drags irregularly and at the same time a random array of dots appear in the displays. After some time a rhythm section starts and in the dark screen a grid of white squares is flickering and zooming in and out following the broken beat. Later the initial

alarm sound comes back and a melody overlaps the beats, at this point the grid is deconstructed. After a while there is a break in the music, the beats vanish and a spatial melody is left, on the screen an array of dots explodes leaving a trail behind them. The track continues then until the end alternating between fast and unstable rhythm sections, with flickering graphic shapes, and more spatial melodies with fluid line trails.

The reactive visuals are used to lock-in the audience and enhance their sonic experience, they work as "added value" to the sound, just like Chion described the relation of sound with the image on screen (Chion, 2004).

It has the function to augment the sound perception and take the audiences deeper in Squarepusher's alternative cyberspace world.

Jenkinson emphasizes the idea that in an audiovisual performance the visuals must be deeply linked with sound, and that they must be created specially for that performance, only this way it makes sense. Displaying random video loops without a physical connection with sound only draws the audiences attention away. (Jenkinson, 2013).

6 | CONCLUSION

Like in "Lumia", the Art of Light from Thomas Wilfred in the beginning of the 20th century, Squarepusher's performance has the objective to stimulate the senses and suggest abstract aesthetic concepts. The audience surrounded by a massive hyper-sensory space materializes those visions of forms, colours and motions into their personal visions, fusing imagination with reality.

When we read Wilfred's article "Light and the Artist" (Wilfred, 1947) and Jenkinson's track descriptions we can immediately feel a link between the two. Despite decades of difference, different technologies, context and formats, the main concepts and ideas persist over time. This strong link is clear between both even though "Lumia" was a silent art form, light art without any sound. They share key concepts that go beyond techniques, formats or media. Forms, shapes, motion, dynamics, rhythm and textures mold a visual aesthetic language that strikes the perception and the subconscious of the audiences in the dark concert halls. Sound and vision domains blend between them into an audiovisual flow inducing the audiences into virtual realities, at same point it is not clear if is the image that is dependent of the sound or vice-versa. In fact Nicolai and Ikeda

in the preface of their book "Cyclo.id" claim: "we abandoned the idea that the image acts only as a functional accompanist to sound and instead subordinated the audio element for our desire of the image" (Nicolai and Ikeda, 2011, p. 3).

Tom Jenkinson, Thomas Wilfred and many others in the time between them share the dream of involving the audiences in hyper-sensory immersive media experiences and generate truly synaesthetic states.

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IMAGE CREDITS

(Figure 1 and 2) Archive of Yale University. [<http://www.library.yale.edu/mssa/>]

Thomas Wilfred Papers (MS 1375). Manuscripts and Archives, Yale University Library. Copyright unknown.

(Figure 3) "Partitura" still images. Authorized by Davide Quayola and Natan Sinigaglia.

(Figure 4) Ufabulum album cover. Authorized by Squarepusher.

REFERENCES

Chion, M. (2004). "Audio-Vision: Sound on Screen". New York: Columbia University Press. ISBN: 978-0-231-07898-6

Cuba, L. (2002). "Media Art in the 60s: The Abstract, The Spiritual and The Psychedelic". KineticATM 4 Catalog [<http://www.iotacenter.org/program/publication/moritz/Absolut/publication/kinetica4/mediaart>]. Accessed 09.01.2013.

Daniels, D. (2004). "Sound & Vision in Avantgarde & Mainstream". Media Art Net. [http://www.medienkunstnetz.de/themes/image-sound_relations/sound_vision/1/]. Accessed 09.01.2013.

David E, J. (2009). "Light Shows / Multimedia Shows". SEE THIS SOUND compendium, Linz. [<http://see-this-sound.at/compendium/abstract/79>]. Accessed 20.07.2012.

Daurer, G. (2010). "Audiovisual Perception". SEE THIS SOUND compendium, Linz. [<http://www.see-this-sound.at/compendium/abstract/33>]. Accessed 16.09.2012

Fischinger, E. (1980). "Writing Light". In "Fischinger: A Retrospective of Paintings and Films exhibition catalog". Denver, CO: Gallery 609. [www.centerforvisualmusic.org/]. Accessed 30.04.2012.

Fischinger, O. (1932) "Sounding Ornaments". [<http://www.oskarfischinger.org/Sounding.htm>]. Accessed 09.01.2013.

Föllme, G. and Gerlach J (2004). "Audiovisions, Music as an Intermedia Art Form". Media Art Net. [http://www.medienkunstnetz.de/themes/image-sound_relations/audiovisions/1/]. Accessed 09.01.2013.

Grossenbacher, P. G. and Lovelace, C. T. (2001). "Mechanisms of synesthesia: cognitive and physiological constraints". In "TRENDS in Cognitive Sciences. Vol.5 No.1". p. 36-41.

Hinderk M, E., Neufeld,J., and Sinke,C. (2009). "Synaesthesia". SEE THIS SOUND compendium, Linz;. [<http://see-this-sound.at/compendium/abstract/36>]. Accessed 20.07.2012.

Holmes, K. (2012)."Original Creator: Computer Animator John Whitney Sr.". The Creators Project. [<http://www.thecreatorsproject.com/pt-br/blog/original-creator-computer-animator-john-whitney-sr>]. Accessed 10.01.2013.

John, B. (2004). "The Sounding Image About the Relationship Between Art and Music – an Art-historical Retrospective View". Media Art Net. [http://www.medienkunstnetz.de/themes/image-sound_relations/sounding_image/]. Accessed 09.01.2013.

Jenkinson, T. (2012a). Interviewed for "Creators Projects". [<http://thecreatorsproject.com/creators/squarepusher>]. Accessed 20.07.2012.

Jenkinson, T. (2012b). Interviewed by David Foster. "Spin" magazine [<http://www.spin.com/blogs/squarepusher-qa-chat-electronic-musics-own-david-foster-wallace>]. Accessed 20.07.2012.

Jenkinson, T. (2012c). SquarePusher - "UFABULUM" Press-Release [<http://warp.net/records/squarepusher/ufabulum-track-by-track/>]. Accessed 20.07.2012.

- Jenkinson, T. (2013). Interviewed by Mad Dax. "Electronic Beats" magazine. [http://www.electronicbeats.net/en/features/interviews/testing-things-to-destruction-is-probably-the-best-way-to-test-things-max-dax-talks-to-squarepusher/]. Accessed 10.09.2013
- Jewanski, J. (2009). "Color-Tone Analogies". SEE THIS SOUND compendium, Linz; [http://see-this-sound.at/compendium/abstract/43]. Accessed 20.07.2012.
- Kandinsky, W. (1923). "Composition 8". Permanent collection. New York: Guggenheim Museum.
- Kandinsky, W. (1947). "Point and Line to Plane". New York: Solomon R. Guggenheim Foundation.
- Krueger, M. (1977). "Responsive Environments". In PACKER, Randall, JORDAN, Ken – "MULTIMEDIA, From Wagner to Virtual Reality". New York: Norton&Company; (2001). ISBN: 0-393-04979-5. p.104-120.
- McLaren, N. (1940). "Dots" [video]. Canada: National Film Board of Canada.
- McLaren, N, Peters, D. and Batchelor, L. (1951). "Pen Point Percussion" [video]. Canada: National film Board of Canada.
- Moritz, W. (1986). "Towards an Aesthetic of Visual Music". ASIFA Canada Bulletin. [http://www.iotacenter.org]. Accessed 30.04.2012.
- Moritz, W. (1997). "The Dream of Color Music, And Machines That Made it Possible". In "Animation World Magazine". [http://www.awn.com/mag/issue2.1/articles/moritz2.1.html]. Accessed on 20.05.2013
- Nicolai, C. and Ikeda, R. (2011). "Cyclo.id". Berlin: Gestalten. ISBN 978-3-89955-383-3.
- Noto, A. (2009). Interview by Juliana Mori, "Tugobot Tech-Doc", Barcelona. [http://tugobot.com/]. Accessed 20.05.2013.
- Noto, A. (2010). Interview for SLICES MAGAZINE. [http://www.youtube.com/watch?v=zi2Xht-EZFG]. Accessed 20.05.2013.
- Oppenheimer, R. (2004) "An International Picture Language: The History and Aesthetics of West Coast Light Shows", in "PAGE 58, Bulletin of the Computer Arts Society Autumn" [http://www.computer-arts-society.org]. Accessed 20.05.2013.
- Popular Mechanics. "Music is Turned Into Glowing Color". In "Popular Mechanics". USA; (April, 1924). [http://blog.modernmechanix.com/2007/03/29/birth-of-music-visualization/2/#mmGal] Accessed 20.05.2013.
- Quayola, D. (2011a). Quoted in Kelvin Homes article "Quayola Sets A New Standard For Visualizing Sound" [http://www.thecreatorsproject.com/blog/quayola-sets-a-new-standard-for-visualizing-sound]. Accessed 20.05.2013.
- Quayola, D. (2011b). Interview for The Creators Project". [http://thecreatorsproject.vice.com/en-uk/creators/quayola]. Accessed 20.05.2013.
- Quayola, D. and Sinigaglia, N. (2011). "Partitura" [video] [www.quayola.com/partitura1/]. Accessed 20.05.2013.
- Rezende, M. (2012). "Original Creators: Thomas Wilfred, The Father Of Multimedia". In Creators Project. [http://thecreatorsproject.com/blog/original-creators-thomas-wilfred-the-father-of-multimedia]. Accessed on 20.05.2013.
- Ritter, D. [1992]. "A Flexible Approach For Synchronizing Video With Live Music". [http://aesthetic-machinery.com.] Accessed 20.05.2013.
- Snibbe, S. and Levin, G. (2000) "Interactive Dynamic Abstraction". In "NPAR 2000". Annect, France.
- Spielmann, Y. (2004). NoiseFields' (Steina and Woody Vasulka) Artwork description for Fondation-Langlois' archive. [http://www.fondation-langlois.org/html/e/page.php?NumPage=483]. Accessed 20.05.2013.
- Spielmann, Y. (2009). "Video, an Audiovisual Medium." SEE THIS SOUND compendium, Linz. [http://see-this-sound.at/compendium/abstract/48]. Accessed 20.05.2013.
- Squarepusher (2012). "Ufabulum" [video]. [http://www.youtube.com/watch?v=XvLAKrVbCBM]. Accessed 20.05.2013.
- Survage, L. (1914). "Document Nr. 8182". Paris: Académic des Sciences. Quoted from (John, 2004).
- Tina, F. and Lia [2009]. "Audiovisual Parameter Mapping in Music Visualizations" .SEE THIS SOUND compendium, Linz. [http://see-this-sound.at/compendium/abstract/72]. Accessed 20.05.2013.

Whitney, J. (1980). "The Problem: How Shall Motion Pattern Time". In "Digital Harmony". U.S: McGraw-Hill Inc. ISBN: 007070015X. p.36-45.

Wilfred, T. (1947). "Light and the Artist." The Journal of Aesthetics & Art Criticism V (4). p. 247-255.

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Graduated in Design (Aveiro-PT.2005) and with a Masters Degree in Digital Arts (Barcelona - ES.2009).

He is nowadays a PhD student in Digital Media at the University of Porto under the UTAustin/Portugal Program.

He is focused in the relations and the synergies between sound, movement and image in audiovisual real time systems and environments.

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Portfolio

[<http://www.visiophone-lab.com>]

Sound+Visual+Movement research blog

[<http://s-v-m.tumblr.com>]