Editorial

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This special issue of the Journal of Science and Technology of the Arts (CITARJ) is dedicated to the 2018 edition of the xCoAx conference on Computation, Communication, Aesthetics and X, which took place in Madrid, Spain, from July 11th to July 13th.

For the first time, xCoAx was not hosted in a country of one of the members of the Organising Committee, which means that our usual adventure of last minute fixes of technical gear, rushes to the grocery store to buy missing cups for the coffee breaks, hotel reservations for the keynote speakers etc. happened in foreign territory. This could have added to the stress of organising and managing a multifaceted event like xCoAx, but it was actually made easier by our gracious hosts at the Superior Technical School of Architecture of the University of Madrid and at the Centro Arte Complutense, to whom we will always be very grateful.

2018 has been a very intense year, to say the least. So much has happened and so much is still happening all over the world that being overwhelmed by the news has become a daily routine for many of us. Maybe this is why we cannot help looking at this year's papers through something like a journalistic lens that compels us to make some loose yet perhaps significant analogies between what these scholars have written and what is going on in the world today. Since apparently there is already too much bias in online and offline content everywhere, we will let our readers enjoy the papers in this issue freely, and maybe come up with some analogy on their own.

As in the previous occasions that the Editorial Board of CITARJ has given us this great opportunity, we invited the authors of some of the best papers that were presented at xCoAx to write new articles that would allow them to explore in further depth the topics that they have presented at the conference. This is how we obtained this interesting selection of works, which cover an unprecedentedly wide range of topics.

Lautenschlaeger articulates a discourse on the creation of media artworks based on the translation between different media that kicks off from a sensorial absence. Presence, on the contrary, is the concept around which Nake builds an analysis that is historical but accompanies us up to the latest results of Artificial Intelligence applied to Art, observed from the perspective of what is in flux and what is constant. Ludovico is also on a journey in time, showing us how technology has changed the physicality of publications through digitization, at the same time minimizing material spaces and maximizing conceptual ones.

Speaking of journeys, Flisykowska takes us on the most ambitious of them all, to Mars, where she illustrates how 3D printing can create artefacts that embody speculative design based on astrophysics and biology. The last two papers bring us back to Earth with a thud. Hernández-Ramírez warns us that a lot, maybe too much has been said and written about design, and proposes a very intriguing, and perhaps head-scratching for some, conceptual framework to keep the discourse in check and focus only on significant contributions. Finally, Costa reminds us that, despite appearances, technology is not neutral, and it comes with several kinds of biases, among which he focuses on the gender issues of the latest AI-driven assistants.

All these works show that scholarly and artistic activities do not belong in an ivory tower, but are always projected towards the most compelling issues and problems we see all around us. In a very, very complex world like ours, maybe this is exactly what we need. Here's to a better future.

BIOGRAPHICAL INFORMATION

André Rangel, 1971. Intermedia artist-cum-designer that holds a PhD in Science and Technology of the Arts, a Master in Digital Arts and a Degree in Communication Design. Currently Assistant Professor at the Faculty of Fine Arts of the University of Porto and Researcher at the Research Center for Science and Technology of the Arts. 3kta.net founder and director, xCoAx.org co-founder and co-organizer.

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Mario Verdicchio was born in Milano, Italy in 1975. He obtained a PhD in Information Engineering in 2004 at Politecnico di Milano, where he worked in the Artificial Intelligence and Robotics group. He co-founded xCoAx in 2012 while working as a researcher at the School of Engineering at the University of Bergamo, Italy. His collaborations include the University of Virginia, USA, the University of Porto, Portugal, and the University of the West of Scotland, UK.

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Absences Within And Surrounding Light-to-sound Translations

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ABSTRACT

Within the material-immaterial dichotomy structuring the creation of media artworks and its inherent informational aesthetic, one may observe fractures or continuities. Considering media artworks through the notion of translation of materialities, the aim of this paper is to analyse some of the multiple roles that absence play within and surround this sort of aesthetic experimentation. The discussion is unfolded through the articulation of Vilém Flusser's media theory – namely considering the zero-dimensionality of electronic and digital media and the concept of *Mediumsprünge*. These concepts are exemplified through historical and contemporary media devices and artworks technically based on light-to-sound translations. The discussed examples were partially selected from references and methodological tools used in a cross-disciplinary practice-based PhD research on photosensitivity in relation to media history and media art history conducted between 2014 and 2018. The methodology combines a historical and analytical approach, through new materialism, media archaeology, cultural techniques and second-order cybernetics. The significance of the discussion is exposing both the artistic freedom (or emancipation) and the arbitrariness (and responsibility) implied in bridging the gaps involved in media artworks.

KEYWORDS

Absence; Zero-dimensionality; Black box; Translation of materialities; Media artworks.

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1 | INTRODUCTION

It may be a symptom of the current era of excesses that I, as media artist and researcher, felt attracted to look more carefully at empty spaces, absences, lacks, null and voids, zero and other related concepts. The nothingness these terms suggest is a fertile terrain for analysing the material-immaterial dynamic and other structural dichotomies involved in the creation of media artworks.

From the invention and assimilation of the absential elements, such as zero in history of mathematics or the lack in psychology, emerged a cultural revolution. How does this revolution resonate in the arts? Focusing on layers of absence within and surrounding media artworks technically based on light-to-sound translations, this paper links the technical, aesthetic and existential issues related to the discussed cultural objects.

For that, the conducted discussion is divided into three following parts: (1) Explanations on the foundations of the zero-dimensionality of electronic and digital media, as pointed by media philosopher Vilém Flusser; (2) clarifications on the notion of translation of materialities; and (3) the analysis of historical and contemporary media devices and

artworks, from which the role of absence is unfolded in its multiple aspects.

2 | ZERO-DIMENSIONALITY OF ELECTRONIC AND DIGITAL MEDIA

The zero element has been considered as the mid-wife of modern science. Its role as a placeholder has revolutionized mathematics and its derivative technological environments (Seife, 2000). Besides the development of the Boolean logic and the binary code (Deacon, 2012), the protagonist role of zero is far beyond the assumption of the presence of an absence and is a key element to proceed with operations such as counting, calculating and computing, so as the decision taken afterwards (Baecker, 2000).

One can associate Vilém Flusser's concept of the zero-dimensionality of electronic and digital media as a fundamental condition to simultaneously address the technical specificities and aesthetic possibilities of media artworks. The manipulation of matter at the atomic level is the scientific ground of Flusser's media theory that places media development in the history of culture as part of a history of abstraction. According to Flusser, history can be divided into four gestures of abstraction. The first human gesture was to abstract time, transforming the world into circumstance: a three-dimensional experience. Later, circumstances were abstracted into scenes, images, two-dimensional representations. The third gesture consisted of abstracting images into texts, which gave birth to history and linearity, the one-dimensional experience. Last, the linearity of texts was abstracted into numbers and calculations: the zero-dimensionality of electronic and digital media and their software (Flusser, 2008, pp. 16-19).

Considering the materiality of contemporary media devices and artworks, Flusser's perspective suggests that is possible to observe the explorations of organic and man-made elements through a lowest common denominator: electric current. This condition is the basis to discuss the informational aesthetics of media artworks through the notion of translation of materialities.

3 TRANSLATING MATERIALITIES

Either from a technical or a philosophical perspective, artworks can be generally considered as a translation process, by means of materializing sensations and thoughts into space-time based configurations in order to trigger new thoughts and sensations. Portuguese poet Fernando Pessoa's sensationism theory recapitulates the essence of both creative and aesthetic reception 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"* (Plaza, 2003, p. 11)[1].

As Pessoa's statement demonstrates, this proposition is not new within art, and it provides a valuable clue to address the transducing process occurring among artists, (media) artworks and audience. By merging mankind's sensuous and cognitive abilities, it acknowledges the protagonist role of sensitive structures for communication to occur. Sensitive elements are the material gates transducing physical phenomena into information – abstract and potential entity that may be embodied and assimilated in a variety of other physical forms (Simondon, 1958).

Regarding the transducing characteristic of sensitive structures, one may consider media development as translations of materialities. In this sense, one should also consider that the increasing complexity of the techniques used in media artworks demands proportionally increased attention to steering these translational processes. It is required a conceptual framework able to deal with the material-immaterial dynamic of media artworks, what for me became possible through the articulation of ideas from cybernetics, from the work of the philosophers of technology Gilbert Simondon and Vilém Flusser.

Swiss scholar Rainer Guldin (2010) relates Flusser's theory of translation from the 1960s and his media theory from the 1980s. Together with the perspective on the cultural escalation towards abstraction, Flusser has developed the concept of *Mediumsprünge*, understood as the act of jumping from one medium to another, from one logic system to another (Guldin, 2010, p. 166).

Flusser's conceptual framework addresses crucial points for understanding electronic and digital media and their specificities. The possibility of gathering all materialities under an abstract lowest common

denominator of numbers and voltage changes, and, in a second step, transforming them into other possible materialities, makes the practice of media art as an interplay between layers of abstraction and concretization. The zero-dimensionality of electronic and digital media allows media artworks to be formed by programmable complex technical ensembles – combinations of an immense variety of sensors and actuators –, whose functions and behaviours can be infinitely reprogrammed.

By viewing the creative processes of media artworks as processes of the translation of materialities, I call attention to the confluence of material and linguistic turns. Artists can experience the possibility of programming and editing matter by transforming one type of physical or chemical stimulus into another. Through an expanded notion of language (Krippendorff, 2011), this practice boosts the essential artistic impetuous towards non-trivial articulations of objects and their relationships, creating situations in which meaning emerges from the communicative experiences rendered by the specific combination of technical ensembles (Gumbrecht, 2004; Simondon, 1958).

4 ABSENCE AS CREATIVE MATTER: FROM ZERO-DIMENSION TO PRESENCING ABSENCES

In relation to sensitive structures, along both the emergence of physiology as field of study (Crary 1990) and the creation media devices, one can observe the paradox of simultaneous movements towards fragmentation and continuity. Fragmenting the senses and constructing media devices is among the human efforts and attempts to objectively understand natural phenomena. In Simondon's (1958) terms, this tendency corresponds to the individuation processes. Individuations or fragmentations, in turn, constantly create a series of chasms among the parts of every system being analyzed. The created voids generate potential energy that may trigger transduction processes, altering the initial state of the systems. In this sense, the transformative quality of transducing comprehends the movement upon filling out the created gaps, stimulating paradox- and cyclically the opposite movement towards continuity.

While jumping from one logic system to another, media artists as translators of materialities deal with the gaps found in-between the systems in their multiple dimensions. These gaps demand to be qualified, or they may be operated, as the zero in mathematics, as placeholders for enabling the articulation of other elements in play.

Media artworks are based on generating communication channels able to bridge both the void between individuals as closed systems and the gap that human sensorial-cognitive apparatuses present in relation to the surrounding environment. In the coming sections selected media devices and artworks based on light-to-sound translations exemplify what is here suggested.

4.1 SELECTED CASE STUDIES IN AUDIO-VISUAL MEDIA HISTORY: ABSENCE AS A LACK IN SENSORIAL EXPERIENCE

The modes of operation of the human sensorial-cognitive system have been a central reference for the creation of media apparatuses in the history of technical culture. In this process, absential phenomena played a significant role.

A popular example of absence as creative potential in audio-visual media history is connected to human endeavours towards verisimilitude, culminating in the development of sound-film. Media historians who study sound in cinema betray a sort of ocular centricity in their narratives on the relation between image and sound in cinema history. Nevertheless, "*as long as cinema has existed, sound has been part of it – both in its presence and in its absence.*" (Beck, 2011, p. 64) The first so-called silent films were, from the beginning, accompanied by music performed by musicians who also used to create live sound effects, a possibility that was later enhanced by the inclusion of pre-recorded sound effects. However, the insertion of sound in the material film itself revolutionized the cinematographic industry and its expressive language. The absence of sound in cinema annoyed those who sought to use cinematographic language as a means to achieve complete audience immersion, providing the most 'real' experience, in short, an experience that more closely fits how the human sensorial apparatus enables one to perceive the surrounding physical world. If immersion is considered as the full involvement of the spectator's senses, the film experience remained incomplete, even if a live musician or orchestra accompanied the film exhibition. With the liveliness of theatre as a reference, the absence of human voice [2] and other diegetic elements impeded higher verisimilitude.

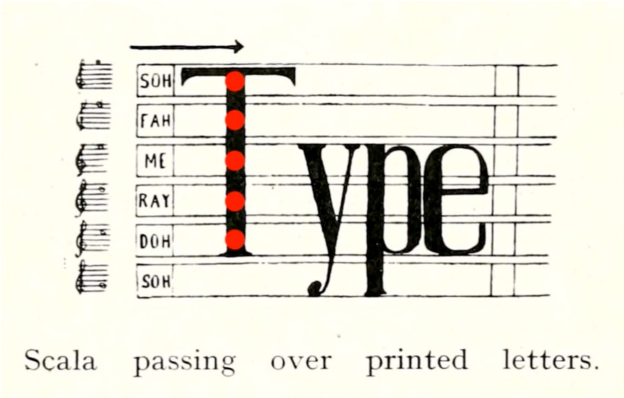

Figure 1 | Schema of how scanned characters were translated into acoustic tones in Fournier D'Albe's optophone.

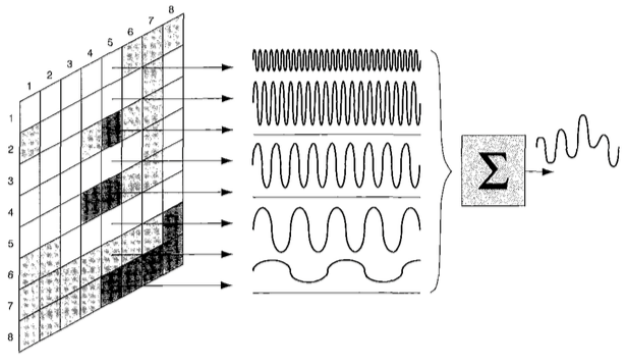

Figure 2 | Simplified schema of a light-to-sound translation using pixel based image sensor: Peter Meijers' optophone patented by Philips in the Netherlands.

Scientists and technicians across the globe have worked on finding solutions to this “problem” and invented sound film. In this media technological race, one of the protagonists was the photosensitivity of the chemical element selenium, discovered in 1817 by the scientist Jöns Jakob Berzelius (1779-1848).

The first experiments on the applicability of selenium's photosensitivity in mechanisms able to translate light into sound also investigated solutions to deal with the absence of vision. As an enthusiast of selenium's wonders 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 aid visually impaired people with orientation in their environment and reading (Fournier D’Albe, 1924, p. 32). The device thus belongs today to the heritage of blindness and the variety of technological attempts to facilitate the life of people whose bodies were not aligned with the standard media of the epoch, which constantly and emphatically stressed the supremacy of vision [3].

Indeed, the development of media devices is vigorously based on adaptations to the limits of the human sensorial systems and the corresponding endeavours to extend, assist, enhance, and/or adjust or modify them. While mostly oriented by a normative perspective, discourses and devices do occasionally emerge that use deviation as a means toward innovation. An instance of this is the *Optophone*, which remains an inspiring source for artists and scientists.

As demonstrated in Figure 1, media archaeologists have analysed the functional principles of former *Optophone* models (Chan, 2016). Fournier D’Albe’s reading machine resembles a primitive scanning technology, in which an object as a framed field is swept by light and the luminous reflections are read by a photosensitive surface.

Considering 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*” (Fournier D’Albe, 1924, p. 94), the resulting combination of musical notes as feedback can still make it hard to properly distinguish each character, which probably contributed to the unsuccessful commercial lifespan of the device.

The implementations of selenium were followed by the discovery of semiconductor materials that enabled the development of image sensors, e.g. CMOSs or CCDs, which are nowadays embedded in digital cameras. As exemplified by Figure 2, they constitute the technical basis of contemporary attempts to use light-to-sound translations to develop assistive technological devices (Capp and Picton, 2000).

Finding and establishing these correspondences is termed by scholars as image-visual to audio-auditory mappings, which necessarily presupposes an image encoder and software implementing methods to detect objects from the background of the visual scene. Currently the challenges faced in this research field are concentrated in finding useful correspondences between visual and auditory stimulus that are more intuitive for users.

In a case of the mapping method reported by Matta et al. (2005), 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 each matrix are individually averaged and the mapping translates the vertical position into frequency and horizontal position into time delay, while brightness is translated into amplitude. The mapping method suggested by Matta et al., however, since it also uses the image depth, 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 perceiving and learning idiosyncrasies.

Regarding light-to-sound translations in the Arts, Berlin Dadaist Raoul Hausmann also envisioned developing and patenting an *Optophone* (Donguy, 2001, p. 217) at the beginning of the 1920s. Though less known for his difficulties in obtaining scientific legitimacy for his ideas than for his photomontages and poster poems (Donguy, 2001, p. 217), the artist left a curious multifaceted scientific-artistic legacy, including what he called an *optophonetische Weltanschauung* (optophonetic worldview). Hausmann's theory aimed to harmonise cosmologic processes, modern media technologies and human life (Niebsch, 2013, p. 19), 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 the *Optophone*, for instance. 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.

On the one hand, as an artist, he could play freely with the materials and techniques of his time. On the other hand, the scientific objectivism of the epoch remained sceptical of his endeavours – causing his patent applications to be rejected.

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 activity 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 Wittgenstein noticed about Goethe's colour theory, such colour-to-sound associations are due more to the psychological than the physiological theories. Fournier D'Albe addressed a similar issue by calling light-to-sound conversions symbolic rather than actual, while 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!"* (Fournier D'Albe, 1924, p. 90)

Within Fournier D'Albe's trial of an objective consideration of the problem one must also notice that his premise of an 'average wave' only makes sense 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 frequently is not compatible with the specificity of each being.

4.2 *I/VOID/O*: A STRUCTURAL ABSENCE

The absence of an element to be perceived, as an assessment of a difference or as result of a counting process, depends on an observer. Without the observer, there is no zero or absence (Baecker, 2000) and this realization also evinces the gap found between object and observer. This phenomenological gap is the key to address what here is termed 'structural' absence.

Figure 3 | Set up of the installation *I/VOID/O* by Sandro Canavezzi de Abreu.

The mergence of the gaps found in both between the systems in translation and between object and observer is materially and metaphorically expressed in the installation *I/VOID/O* (2002-2010), by Sandro Canavezzi de Abreu, in collaboration with Daniel Barreiro, who designed the soundscapes. This installation is the last and interactive version of an aesthetic investigation that started with the following imaginary situation: What could one see if located inside a completely mirrored sphere? The installation and the whole creative process is depicted and analysed by the artist in his doctoral thesis (Canavezzi, 2011), who built the mirrored sphere embedding inside four cameras: one is movable while fixed at the tip of a stick to be manipulated by participants; other two are linked to produce stereoscopic images, and a forth that is fixed in attempt to capture an objective observation of what happens inside the infinitely reflexive black-box (Barreiro et al., 2009). A version of the installation's set up can be seen at Figure 3.

Using a robust list of equipment, the mechanism of the installation consists of translating light into "*discrete parameters that change the behaviour of both sound and image in a continuous and vertiginous 'loop'*" (Barreiro et al., 2009, p. 129). From this technical basis Canavezzi programmed a series of modes of interaction exploring what he calls "cognitive friction", to be generated through the spatial paradoxes actualized along the interaction.

Observing the multiple levels of the light-to-sound translations in *I/VOID/O* and their corresponding interaction design, the void found between input and output has been filled out with real-time audio synthesis and sound processing techniques, such as granular and additive synthesis. According to Barreiro et al. (2009), the patches made in Max/MSP have often been structured in random data generators, selected empirically by the involved artists through their subjective preferences.

The simultaneous freedom and arbitrariness involved in the creative process is the potential energy that makes the powerful role of absence in the creative process of media artworks. The infinite possibilities of choices to be programmed in the zero-dimensional gap between light and sound, as materialized at *I/VOID/O*, attest the emancipation of photosensitive device (camera) in relation to visuality. Profiting from the zero-dimensionality of electric changes inside the camera image sensors, the same data input may output visual and/or sonorous images.

4.3. SELF-TRANSLATIONS: EXISTENTIAL ABSENCES

It is also possible to push the structural absence addressed in *I/VOID/O* to another level, by means of shortening the distance between artist and artwork. Media artworks in which the artist investigates a personal physical absence to explore its aesthetic potentialities may lead to the comprehension of existential absences.

The case of the eyeborg Neil Harbisson also encompasses the issue of light-to-sound translations. Harbisson's artistic statement is very close to that of Hausmann's optophonetic worldview and the ambition of enhancing human perception through the development of new media. Inspired by his congenital achromatopsia and in collaboration with Adam Montadon, Peter Kese and Matias Lazano, Harbisson (2012, 2013) has worked on the embodiment of a device that translates the colours captured by a photosensitive sensor placed in front of his head into sound. Harbisson 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 that can be also understood as a process of translating materialities.

The existence of colours for human vision is the result of light-matter interaction, conditioned by the triadic material composition of the cones [4], which are photoreceptors that form the retina together with the rods (Guyton and Hall, 1996, pp. 577-589). This basic physiological principle of human vision harks back to Isaac Newton's experiments in 1666, showing that white sunlight is not a single entity but a spectrum of infinite colours. Hausmann's concerns expressed in his texts about the *Optophonetische Weltansachuung* also address the different theories of colours developed by Newton, Helmholtz's and Goethe, revealing 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 to the temporal world-view, to an intuition of light, called optics. We do not see any light, we see colours."* [5] (Hausmann, 2013, p. 76)

Today, considered as 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 (Pedrosa, 1977), as some theoreticians defend. Looking more closely at light sensitiveness and the molecular structure of pigments, one finds a material condition enabling colours to be seen or not (Guyton and Hall, 1997, pp. 577-589). 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 attitude of neglecting the absence has been transformed into a series of creative projects. Although Harbisson does not provide information on how he developed his own relations between colours and musical tones, he has published what he named *sonochromatic* scale.

General methods for the sonochromatic music scale consist of microtonal and logarithmic scales with 360 notes in an octave, with 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.

The search for correspondences between colour and sound seems to be an inspiring field of exploration for artists, as further historical examples demonstrate, such as the *Projet de clavier ultrachromatique* (1943) by the composer Ivan Wyschnegradsky and the cybernetic *Musicolour* machine (1953-1957), by Gordon Pask (1928-1996) and Robin McKinnon-Wood (1931-1995) (Rosen, 2008).

Since the translation from light to sound has been technically and aesthetically explored and discussed in a variety of forms, wherein lies the novelty and power of Harbisson's work?

On the one hand, it relies on the technical audacity to embody a hybrid version of what the classic references have proposed. The automatic response of the system embedded in Harbisson's body, translating luminous stimulus into vibrations, has led to a self-organizing arrangement. Self-organizing principles were already very present in almost all Pask's artworks, but in Harbisson's case biological and machinic systems were merged in the artist's own flesh. He states that he is technology, since a cultural object and its abstractions (encapsulated knowledge through codes) are attached to his body, forcing a new stage of organization upon itself. On the other hand, what has substantially empowered his body experiment and its derivative artistic propositions is his wager on the creative use of absence. He approached his colour-blindness in an innovative manner, giving place for the aesthetics of disability to flourish.

Furthermore, by corporeally experimenting with processes of translating materialities one comes into explicit contact with the necessary betrayal and loss of information; however, it has still been a valuable exercise leading to a heightened awareness of gaps as creative sources, as open spaces for the emergence of novelty.

Stressing the imaginary and symbolic layers of an absential phenomena, in the performance *Self-portrait of an absence* (2016), I aesthetically explored the fact that I have a blind eye. The work consists of an eye-tracking device programmed to generate sounds according to the synchrony-asynchrony of the eyes' movements. By offering a promenade under an umbrella for two people, I invite the participants for an observing-listening exercise, guided by the possibility of distinct sound modes.

Being monocular implies a reduced field of vision (circa 25%) and the inability to see media-based stereoscopic images. I am frequently asked if I can visually perceive depth and how it works. Other often questions relate to how blindness looks: Is it totally black? Totally white? And people generally become intrigued when I say there is nothing. It is absent (Lautenschlaeger, 2018). To the contrary of what people usually think, monocular people do see depth, because there are many other elements in the one-eye image (texture, perspective, etc.) informing the body of the three-dimensionality of the world, together with retrieved information from the other senses – especially from tactile and auditory senses – that is all interrelated in the brain.

The coincidence that Vilém Flusser, the "philosopher of the black-box" also had this partial absence of vision [7] motivated me to create a concrete dialogue with his work, particularly through the notion of *Mediumsprünge* and his philosophical method as self-translator (Guldin, 2013). As an exercise in playing between the abstract and concrete worlds of codes and materialities, the performance *Self-portrait of an absence* (2016) started as a poetic experiment on the search for the possible paths between sensing and making sense, by means of the confrontation between organic and machinic light-sensitive elements, an eye and a camera. Eye and camera are black-boxes in the literal sense, but they also became epistemological objects for me in a second-order cybernetic perspective, both in the performance and in my PhD thesis (Lautenschlaeger, 2018). Light-to-sound translation has been the means of presencing an absence.

Facing the absence of the abyss between one system (light stimulus) and another (sound output), Harbisson's case and *Self-portrait of an absence* exhibit the freedom to create new correlations from inexistent ground. The interstitial zone of the absence is, in this sense, a fertile field of indeterminacy, in which artists can attribute and manage meaning from nothing. Experiments such as these challenge the historical dichotomy between form and function attributed to the eye and camera, a revolution facilitated by the development of electronic and digital media and its zero-dimensionality.

Lastly, using one's own body and disability to query the notion of normality through art is a second-order cybernetic approach that allows the coincidence of both types of absences: a physiological and an existential one. In an analogous way to how Flusser used translation and retranslation processes as philosophical tools (Guldin, 2013) to react against the absence of meaning in life, media artists can wear similar lenses to exercise and create more meaningful artworks. Artworks and life are matters to which meaning can be attached.

These examples demonstrate that the contemporary attention to absence, including in media artworks, is not detached from a psychoanalytical dynamic, as articulations of the presence and absence in the imaginary, symbolic and real orders, as proposed by Jacques Lacan (Boothby, 1995).

5 | CONCLUSION

The translation of materialities relies on many in-between layers of abstraction (models and systems) between input and output. Manipulating matter through the zero-dimensionality of electronic and digital media potentially increases the number of abstract layers, which also leads to an increase in the level of complexity.

The structural absence proposed in *I/VOID/O* is an example of how the zero-dimensionality of digital media and the inherent possibility of translating materialities ground both paradoxes: the zero-infinity and the freedom-arbitrariness. These paradoxes challenge the relationships between form and function, as expressed in the different transductive 'black boxes' addressed along the article.

In the case of *Self-portrait of an absence*, light variation entering the camera is captured and turned into data on the eyes' movements. The difference between the movements of the eyes becomes relevant information that will later be converted into

sound. Alterations in the material's resistance resulting from the interaction of light and matter [6] in the camera's image sensor constitute the zero-dimensional matter (or data, as some might prefer to term it) that enables light input to be directed and transformed into another physicochemical stimulus. In the specific context of the performance, when the light beam entering the eye and the camera is translated into sound in the vibrating membranes of the loudspeakers, a new meaning is attributed to the technical ensemble being used.

In Harbisson's case, light variation is decomposed into luminance and chrominance to form a colour system, and only then does it emerge as relevant information (defined by the artist) to be further codified as sound. These processes are here described in a very briefly, but every step taken in programming matters, and meanings, from input to output and their circularity, can be decomposed into several layers of abstraction – variables, functions, protocols, etc. This marks one of the main problems of translatability when the notion of translation is implemented in relation to physicochemical phenomena.

In this sense, Flusser's *Mediumsprünge* concept suggests an understanding between material-oriented approaches, expressed for instance in Kittler's idea that "there is no software" (1995), and concept-based approaches, such as those able to consider software and coding as "the technique of providing a dynamic background to control the automatic evolution of meaning" (Goldsteine and von Neumann, 1947, apud Chun 2011, p. 25). Through the concept of *Mediumsprünge* Flusser combines discourses from linguistic theory, information theory and arithmetic thinking (Guldin, 2010, p. 168) and affirms that distortions are unavoidable in the process of jumping from one logic system to another. Nevertheless, he postulates that distortion, or deviation, can be compensated by the benefits of new information, novelty and innovation – this is precisely what one can learn from the absential spaces found in translation processes.

This approach may be useful for media artists, who constantly face the challenge of creating artworks that do not depend on parallel explanations and permit access to the abstract operations that they are mobilizing.

By self-translating in the artistic context of programming matter and meaning, the inherent immaterial and material contiguity of cultural and artistic artefacts evolve into a human existential issue. With the possibility of self-translating, media artists manage to overlap and unite object and subject, elucidating the continuity of communication between organisms and machines.

While transcending the stigma of absence as limitation and using it creatively, Neil Harbisson and *Self-portrait of an absence* are transgressive acts of self-translation that place the initial repression of standardization as a secondary and diminished problem. They spontaneously join the aesthetics of disability, comprising the refusal of "*harmony, integrity, and beauty – as the sole determination of the aesthetic*" (Siebers, 2006, p. 64).

In conclusion, far from recommending the management of the audience's sensorium and cognitive apparatus through aesthetic experiences, translating materialities is a conceptual strategy to nurture more awareness about the void between the two sides of the systems undergoing translation. This perspective calls for the invention of interesting new bridges; bridges substantially grounded on the specificities of the contexts being correlated – the systems in translation and the absences themselves.

ACKOWLEDGEMENTS

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ENDNOTES

[1] 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".

[2] This is the reason why sound-film is also called "talking-films".

[3] In *Techniques of the observer* (1990) the art historian and critic Jonathan Crary developed a deep analysis of how optical media have contributed to the abstraction of vision and the formation of visual-based consumers since the 19th century.

[4] Cones are classified into three kinds of cells, each type responding to visible light of different wavelengths on the electromagnetic spectrum. Long cones respond to light of long wavelengths, peaking at the colour red; medium cones peak at the colour green; and short cones are most sensitive to wavelengths of the colour blue.

[5] From the original in German: “Raum und Gehirn verbindet 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)

[6] On Peter Sloterdijk's article on light and resistance one can find similitudes between his and Flusser’s perspective on the interplay between material and immaterial layers of cultural objects, so as to its accompanying fragmentation process, in with each using the same metaphor of a blade: “Der Mensch ist ein Tier, das schneiden kann”. (The human being is an animal that can cut”) (Sloterdijk, 2015, p. 40, Translated by the author).

[7] According to Guldin, with the II World War outbreak, Flusser was dismissed by the Czech army because he had a blind eye (Guldin, 2010, p. 164).

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Someone Is Always Already There In Front Of You Even Though You May Not Like It

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ABSTRACT

In many ways, humans in modern societies seem to be occupied to a considerable amount by a longing to establish whatever they do as if it were the first time any human has ever done it. The arts are full of this myth of originality and firstness. However, at closer inspection, there often appear events or activities by someone else that were at least foreshadowing what later appeared as totally new and the first time. The article takes up a few cases of this kind related to digital art.

KEYWORDS

Computer Art; Conceptual Art; Master Piece; Infinite Image; Experiment.

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1 | INTRODUCTION

The reader of these lines will in many cases agree with what the article's heading says when he thinks, or she, of a busy street in the city center during an ordinary day of the week. She will, however, tend to disagree at least a bit if she imagines herself on a late Sunday night, at 11 p.m., when this November night is cool and rainy and a wind is coming up howling along the streets. Everybody has apparently already gone home, where they may be sitting in convenient chairs, surrounded by cozy lights and cracking sounds coming from the fireplace, the taste of a good cognac on their lips. But she is walking, yes indeed, she's walking down the street with nobody in front of her. But she would want someone to be precisely there, now in the rainy November night, in front of her.

Now, don't be afraid, dear reader, ramblings of this kind will not be our subject matter. We will not be concerned here with the spatial more or less linear sequence of people in city streets. Our concept of

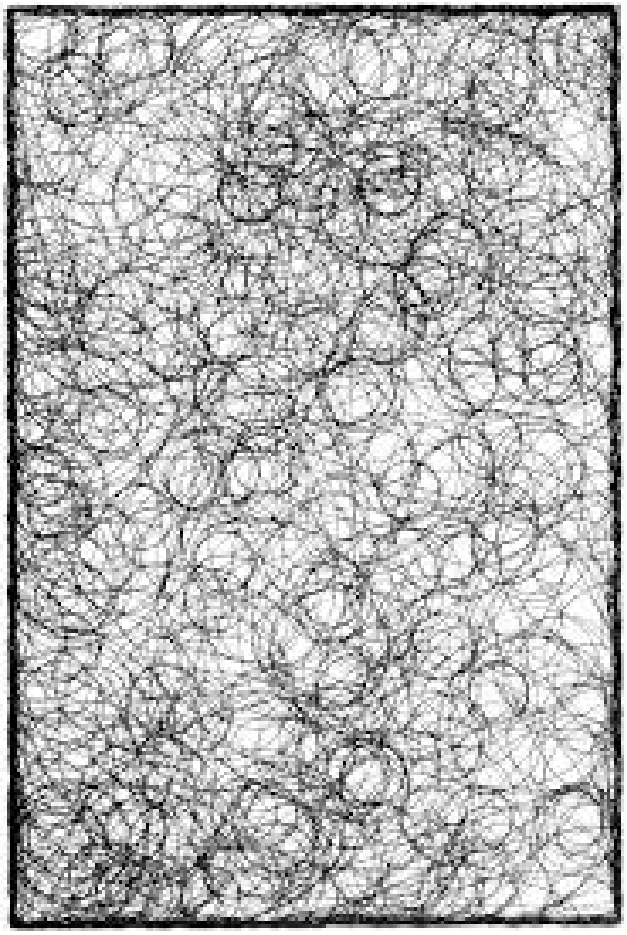

Figure 1 | Georg Nees, Gewölle. Experiment in texture. 1965.

"in front of" will be more of temporal kind, if not metaphorical. We will take up a few characteristics of digital art and expose them to questions like "How new is this really? What exactly of this artistic expression is as outstanding as we often hear digital art being acclaimed for?"

In trying to do so, I am not led by a claim that maintains assertions like this: "Oh no, nothing in computer art is really new, it's just a continuation of what we've always done, the only difference is that now you do the same as before, only now you do it by use of computers." In our selection of a few characteristic cases, we see continuation of the old in new form. By those examples we want to identify the absolutely new in the historic break that happened in the mid-1960s when thinking the image became more important than making it. The reader should not consider any of those cases as final, irrevocable, unquestionable, or even only true. You will, I'm sure, read them a bit as off the tracks that you are so familiar with. You should, I plead, read what I write as what I write and nothing more.

Figure 2 | Georg Nees (1926-2016).

2 | AN ARTIST AND A MATHEMATICIAN

The story has often been told of the opening of the first exhibition of computer art, which was then called "generative computer graphics". I want to bring it back to your attention anyway. Accidentally, the title of the exhibition may have been simply "computer graphics" (Computer-Grafik). Nobody seems to remember precisely. The artist, who for the first time showed his works as a collection of small-sized programmed drawings, was a mathematician. A fact that I would not consider to be of extra relevance. But soon, when first reports appeared in the press, use was made of the term "only" in connection with the fact a mathematician was the creator. Like a mantra, this was supposed to tell the readers: "Don't take this too seriously, it is *only* mathematicians or engineers who are doing this kind of thing. Not artists."

The artist responsible for the exhibited works was Georg Nees (Figure 2). He was working for the research section of the Computing Center of the Siemens Company in Erlangen, Germany. The exhibition was put up on 5 February 1965, in rooms of the Studiengalerie of the Technische Hochschule in Stuttgart.

Max Bense, the radically rational philosopher, author of books on the new *information aesthetics*, read his text *Projekte generativer Ästhetik*, that later

Figure 3 | Heinz Trökes, Glass mosaic for a school in Hamburg. 1957.

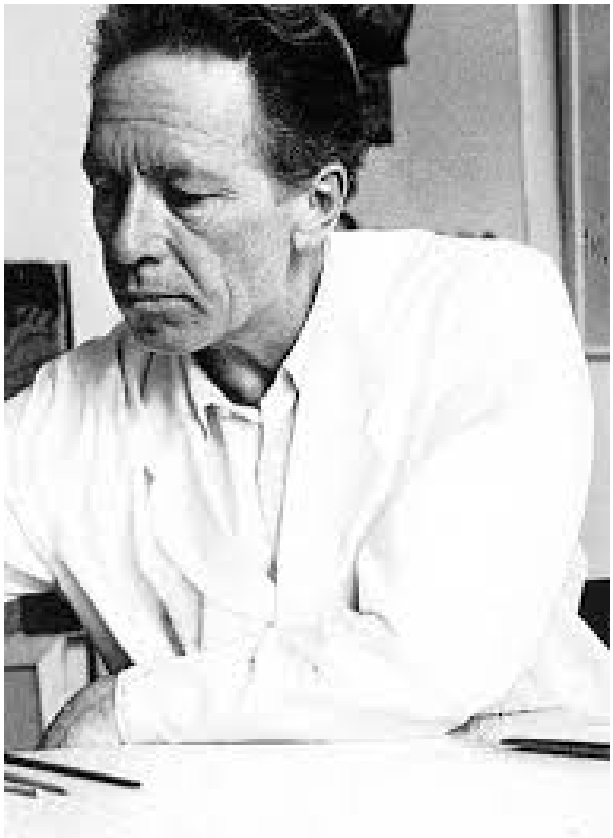

Figure 4 | Heinz Trökes (1913-1997).

appeared in an English translation. Up to now, aesthetics used to be critical and analytic. Bense turned it around by initiating a theoretical background for synthetic and generative aesthetics, from which new artistic practice should emerge.

After Bense's short presentation, Nees told the audience how it is possible to force a computer – after all, a machine made to calculate and not to draw – into exactly this: into drawing. Not enough, those automatic drawings (Figure 1) would also possess aesthetic, maybe even artistic, qualities.

Part of the audience was a group of local artists, some of them well-known in a German context. One of them, Heinz Trökes (Figures 3 and 4), challenged the mathema-tician: "That sounds quite interesting, young man. But tell me one thing: Can you make your machine paint (or draw) like I do it?" We do not know what kind of answer Trökes expected. Allowing myself to speculate a bit, he probably wanted the technical thinker to surrender and say, "of course not, never".

However, Nees thought for a moment about the proper reaction, and then clearly and crisply came out with: "Oh yes, of course I can – if you tell me how you do it yourself!" Fantastic! Daring! Ingenious! Nees may not have realized himself that he had put into those few words the greatest answer that all speculations about possible and imagined achievements of Artificial Intelligence (A.I.) ever deserve. Since A.I. is human-made, artificial, it can be done only if taken away from its natural origin and experience, and that can be done only by explicit description. We can always talk about a phenomenon. But if we want to rebuild the phenomenon, we must first describe it. If it is to be simulated by computers, it must even be described in terms of computability.

The anecdote ends with the artists furiously leaving the place, shouting aggressive utterings about the insulting answer that they cannot, and will never, tolerate, which forces them to leave the place.

Nothing of this kind is known about an opening at the Howard Wise Gallery in New Yorktwo months later, on 6 April 1965, of the exhibition *Computer-generated Pictures*. A. Michael Noll and Béla Julesz were showing. The Germans and the Americans did not know of each other. There is always already someone in front of you…

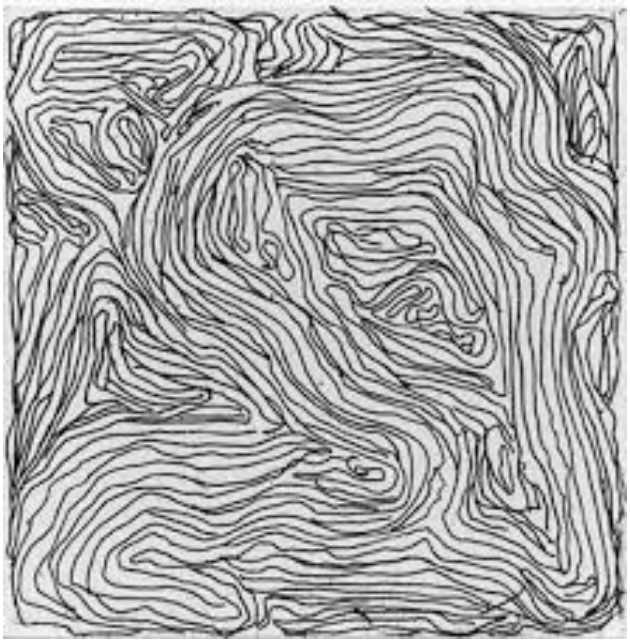

Figure 5 | Sol LeWitt, Small etching / black and white no. 7, 1999.

3 | CONCEPTUAL ART AND MACHINES

"Vertical lines, not straight, not touching, uniformly dispersed with maximum density; covering the entire surface of the paper." This is a typical description, short, clear, precise. Really? Apparently precise enough for its author, conceptual and minimal artist Sol LeWitt (Figure 6), to pass his "Instruction" on to students to carry it out. LeWitt has written, recorded, and published dozens of similarly formulated instructions, several of which have been carried out at different locations, under differing conditions, and, most importantly, by different groups of individuals. The artist did not do more than express in his style the idea. Other were doing the manual work (Figure 7), which implied, of course, a lot of interpretation. What is "uniformly dispersed", "maximum density"? What is a vertical line that is not straight?

Any such question will find its more or less convincing answer by anyone who will, in acting out the instruction, nevertheless do almost any detail different than her neighbors.

How complex can such an instruction become, before the human interpreter-maker doubts whether she is still following LeWitt's instruction, or her own ideas? She is supposed to stay with the rules, but the degree of openness of the rule's formulation may cause her to doubt (cf. Figure 5)

The instruction is not a program. The interpreter is not a machinic evaluator (processor). Unless the machine is permitted to inject pseudo-random decisions (by random number generation), its "interpretation" is the limiting case of interpretation,

Figure 6 | Sol LeWitt (1928-2007).

Figure 7 | Students carrying out a concept of Sol LeWitt's.

Figure 8 | Jackson Pollock (1912-1956.

and that is determination. Determining the one and only possible interpretation, or to give up (because there does not seem to be a uniquely defined interpretation) – this kind of pseudo-interpretation we call "determination". There is no free choice in a correct algorithm and program; there is only determination of the uniquely determined reading of the instruction.

Where the computer program is carried out by the processor, LeWitt had people carry out his instruction. Man as a machine (cf. de La Mettrie 1912), finally realized?

Sol LeWitt is known for his writings as much as for his works. The most famous of his *Paragraphs on Conceptual Art* is "The idea becomes a machine that makes the art" (LeWitt, 1967). The machine, in this case, was quicker than the thought. I would have felt better, had I once written a letter to LeWitt, say in 1969 or so, whenever it may have been that I became aware of his "paragraphs". The letter should have contained this:

> *Dear Sol LeWitt:*
>
> *you do not know me, how and why should you? Neither do I know you other than through your work and writing, your "Paragraphs", in particular. The idea becomes a machine that makes the art, you say. That's beautiful because it expresses in a radical formulation a lot of what is going on in current stormy developments that you and – forgive me – I also love so much. However, I should submit to you the fact that some years before you formulated your wonderful principle of idea and machine, I had already done it. I tend to believe there is always already someone in front of us. Please, take this as nothing more but a faint voice from the other side of the ocean.*
>
> *Yours ...*

Figure 9 | Pollock in action, painting from a distance.

Sol LeWitt's paragraph lets us think in a different way about what we do when we develop algorithms and have them actually implemented in form of a running program.

4 | JACKSON POLLOCK AND DISTANCE

He desperately wanted to become the most famous painter of the USA, and he succeeded in the end, even though he did not find time enough to really be happy about the invention of drip painting, and celebrate it from 1947 to 1950, before a few years later he crashed his car under the influence of alcohol. He had invented mechanisms of painting that did not require any carefully designed structure and composition. They were rather techniques of applying paints from a distance, hardly touching the canvas with a brush, but throwing the paint, dripping and splashing it in outbursts of his emotion vis-à-vis the canvas. A struggle of taking painting as an action of the entire body against the empty canvas.

Figure 10 | Jackson Pollock, Drip Painting, 1951.

Whatever is to be said about Pollock's (Figure 8) abstract expressionist style, his success came with his retreat from the close sensual touch that painters may experience when caressing the canvas in their attempts to force it to express what they want the canvas to show.

The distance of the artist from the canvas (Figure 9) or other carrier of his work is, of course, a feature of any algorithmic art. The artist engaged in thinking the image – perhaps as heavily as Pollock did when he was in action – is, in a certain sense, continuing Pollock's invention and, indeed, taking the thinking of the image to mature (Figure 10).

5 | JOSEF ALBERS AND THE EXPERIMENTAL LABORATORY

When teaching at the Bauhaus, and later at Black Mountain College, Josef Albers (Figure 12) drew a sharp line between his teaching and art. When you go to college, you are a student, not an artist. Whether your work will later be recognized as "art" is a question whose answer may find some justification in your early active years, but it will there certainly not find its very reason. Of his own work he thought as experiments – experiments mainly in color. He wrote of it as "visual research".

In a late interview for the journal *Leonardo*, Albers shows himself surprised: "*I come to a surprising conclusion, namely that I did not teach arts as such, but philosophy and psychology of art*" (Holloway & Well, 1970, p. 459). Paraphrasing this: Does an artist, when teaching, whose artistic work is largely based on programming, not teach arts as such, but algorithmics and mathematics?

From 1950 to 1976, Albers' painting was reduced to variations in color only, using one and the same formal structure: a nested set of four squares, always arranged in the same relative locations and proportions (Figure 11). The only tiny variation he allowed himself was to drop one of the inner three squares so that there occasionally appear three more structures of three squares (instead of four) each. We may think of those 26 years of Albers' creative life (almost one third of it) as turning his studio into a laboratory for visual research. That became the term he used for his art.

His research topic was the "Interaction of color".

Figure 11 | Josef Albers, Homage to the square: Festive, 1967 (photo R.H. Hensleigh).

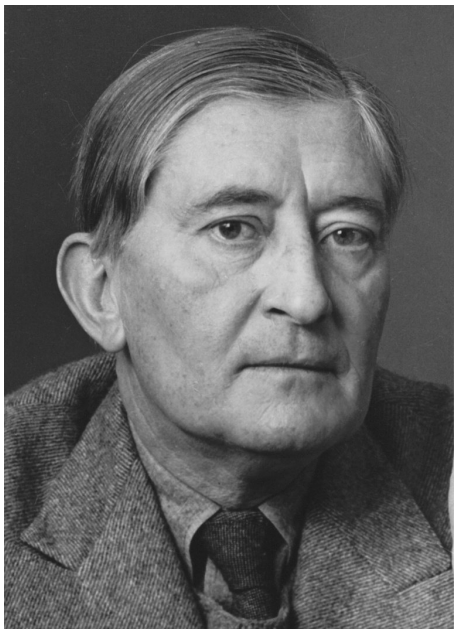

Figure 12 | Josef Albers (1888-1976).

Figure 13 | K.O. Götz, Trefang, 1963.

This became the title of one of his books. Its first edition (of 2,000 copies) was a collection of carefully done silkscreen prints whose production Albers himself controlled.

He painted hundreds of homages to the square. When, in an exhibition, you see a large number of them, you are surprised, if not overwhelmed, by the fantastic differences that those simple variations create in your mind, in your reactions, and emotion. This is so even if you tell yourself that you could easily sit down and, within almost no time, write a program that will generate all of them. In less than one hour you will implement an extremely simple algorithm. For the form (those four nested squares in their constant proportions) is trivial. All the algorithm has to do is: (i) decide whether one of the four squares is to be dropped, and if so, which one; (ii) randomly choose a set of four out of a discrete set of colors. Your "Homage to Albers' *Homage to the Square*" would run this algorithm, and you could be pretty sure that it takes years before the results would start to repeat.

An interesting detail of Albers' art-turned-research is that, besides giving up all form issues, he very often named – on the back of the carrier material of his paintings (masonite in the majority of cases) – the industrially produced paints he had used. That's pure programming. For he had given up mixing paints and used them as he bought them in tubes.

In 1968, when Albers was still alive, the Zagreb (Croatia) group of artists and theoreticians who had started the "New Tendencies" movement in 1961, continued into the fourth version of that event (in August 1968) by giving it the title "Tendencies 4. Computers and visual research". I do not know whether this was in direct reference to Josef Albers. If the Zagreb organizers did not decide on this as an explicit reference to Albers' experimental art, implicitly it was so. Does it come as a surprise to anyone that, towards the end of the year 1968, the event of "Nine evenings" was staged in New York, out of which the movement of "Experiments in Art and Technology" (E.A.T.) emerged? In 2018, this celebrated its fiftieth anniversary.

In his reduction to minimal principles (in form), Josef Albers opened up for an explosion of varying color. He created a situation for precisely controlled experiments. He himself conducted those experiments by hand. As he was doing so, others got ready to describe algorithmically what he was doing manually in an old-fashioned way.

6 | K.O. GÖTZ AND TWO SOULS IN THE CHEST

The German abstract expressionist painter, Karl Otto Götz (Figure 14), only known as "K.O.", was in some way akin to Pollock, but in some other ways totally different. The two were akin as they both painted out of the movements of their bodies. But Götz did this not, or not only, as a spontaneous action as Pollock may for some short time have done. Götz meditated in preparation of his body-movements by which he wanted to generate forms that he often sketched ahead of time. When he felt that his thoughts were exactly the movement he needed to do, he jumped up from the chair, literally exploding, picking up paint with a large brush from the nearby container, rushed through the meditated action that his arms and legs were now executing, and was more or less finished. "Images of seconds" (Sekundenbilder), he called them (Figure 13). For seconds, his mind's intention and his body's motion were one and the same, and within those seconds, the painting was finished. It had to be spread out on the floor, as in Pollock's case. But the preparation and action were totally different.

Götz produced a huge work during his long life, a work that testifies techniques as far away from the cool rational thinking needed for algorithmic art as it could ever be. But Götz considered himself as a scientist, too. Not as huge in numbers as his expressive images of seconds, but also remarkable in size and number are his grid images (Rasterbilder, Figure 15). The cells of a large regular grid of small squares are to be filled by color, or left blank. For this, the image format was divided into fields, and each field got associated with a relation of color to blank as, e.g., 60 to 40. That would mean,

Figure 14 | K.O. Götz (1914-2017).

60% of the cells were to be colored, 40% left uncolored.

Students did the actual diligent coloring, usually with felt pens. Given the ratio of fill to don't fill, the student responsible for one of the fields had to decide for each of the cells in his or her field, what to do. This decision had to obey the given ratio. Students did this by using telephone numbers.

In his grid images, Götz pursuit certain statements and experimental studies inspired by Shannon's information theory. An enormous tension is in the difference of these two parts of Götz's work, a tension between a controlled explosion of the body extended by a long large brush, and a cool planning of experiments that, as in part of Sol LeWitt's work, depends on the availability and readiness of a group of other humans to diligently carry out.

In 1966, shortly after first reports became known about computers being essential in the genera¬tion of certain simple classes of pictures, K.O. Götz became interested in computers. He himself did not go as far as engaging in algorithmic pictures. But he must have seen a potential for that other part of his work. A potential, perhaps, to rationalize part of the grid filling technique.

Exactly this happened in some of the earliest algorithmic drawings. Predictably, the grid in various forms became a favorite method for some of those early experimentalists. Regular and irregular, static and dynamic grids can easily be applied by use of computers. Each irregular grid is nothing but a transformation of the totally homogeneous grid. Such an approach demonstrates the power of the implemented algorithmic way of thinking.

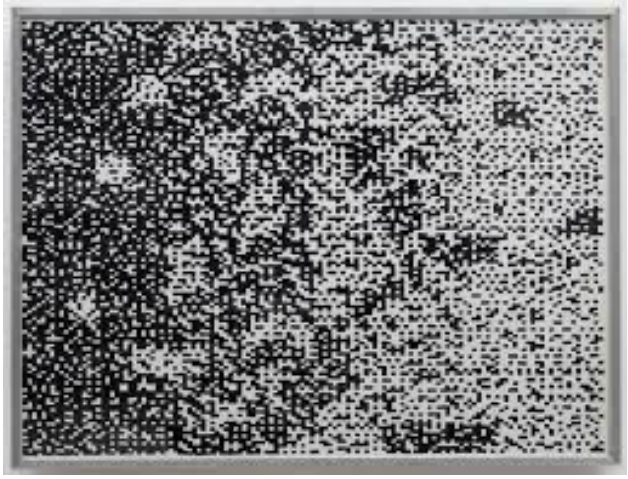

Figure 15 | K.O. Götz, Statistisch-metrisches Rasterbild, 1960.

7 | KURT KRANZ AND INFINITY

Die Programmierung des Schönen (Programming the Beautiful), was the title of an exhibition in memory of Kurt Kranz (Figure 17), an artist who had studied at Bauhaus during the last few years of its existence (1930-1933, in Berlin), and who later became a professor at the Hochschule für Bildende Künste in Hamburg (1950-1972).

Kurt Kranz worked in series and variations. The endless game of change, and processes of transformation in series of images caught his interest more than the individual painting. Eventually, series became his exclusive mode of expression. An exhibition at Kunsthalle Hamburg in 1990, celebrating his eightieth birthday, was tellingly called *The infinite image*. In her review of the show, Petra Kipphoff wrote in the German weekly newspaper, DIE ZEIT: “Never was he aiming for the individual image; there never was for him a final form, only the experimental series of form, never a masterpiece, only variants” (our translation; Figure 16).

By that time, algorithmic art was already 25 years old and well established. But what Kranz was searching for and what he expressed, belonged to the starting points and important lessons of generative art: The individual work, the static piece on the wall was hardly of any interest anymore; it got replaced by the *class of works* the program stands for – always already infinities. We may conclude that, in consequence, there cannot be masterpieces any more. The form of existence of the work is of a double appearance – perceivable by humans, and computable by machines.

Figure 16 | Kurt Kranz, bacteriasnomeio, 1930s.

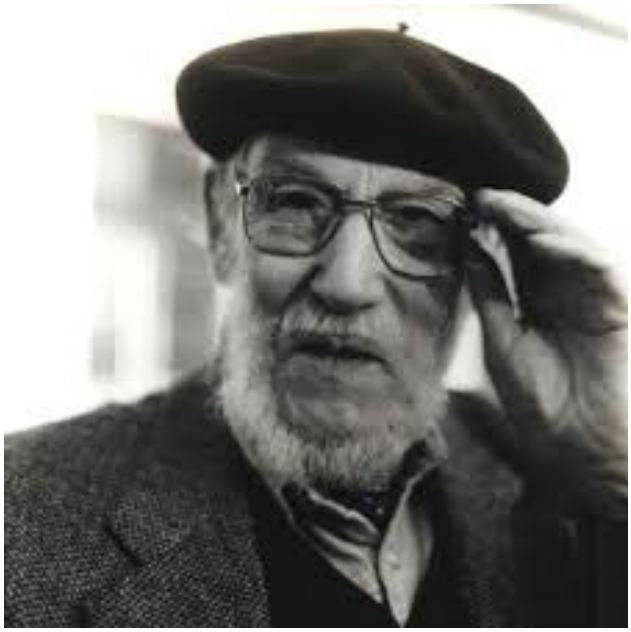

Figure 17 | Kurt Kranz (1910-1997).

Hannes Meyer, the last director of Bauhaus during its Berlin period, had announced that he would work towards connecting three forms of human activity: (i) workshop practice with (ii) free art creation and (iii) scientific research. He was proposing a fruitful cooperation between those three fields of human cultural activities that had developed into different directions. For the Marxist Meyer, as for many innocent practitioners even today, this was a fundamentally wrong development. As a member of Bauhaus, Meyer formulated his position as a critique of the early Weimar phase of Bauhaus (1919-1925). Even more than the founder, Walter Gropius, Meyer emphasized a strict functionalism serving the masses of people instead of serving the needs of the few wealthy and rich living their lives of luxury.

Following Petra Kipphoff's review mentioned above, Kurt Kranz learned from Josef Albers who was teaching the introductory course (Vorkurs) at Bauhaus, that creative and scientific work did not exclude each other, and that art could be carried out as a research activity. Many of us would join in and welcome such a position. It essentially claims that research, the rational and enlightened approach to the world, is not as such alien to the creative artist. But this is exactly what many are propagating nowadays for their actual work. However, we *are* now more than eighty years later. Has much changed? And if we rightfully notice and claim to see change, how does it actually show up?

If this is so, we should ask ourselves why there is still no unification in sight of art and science happily collaborating. We do read a lot about similar goals and approaches, and about fruitful cases of cooperation. But yet the marvelous journal *Leonardo*, despite its many efforts in bringing together artists and scientists in joint adventures, has not really torn down walls. Only occasional odd projects may correctly be classified as requiring cooperative or transdisciplinary efforts. Usually in such cases, a small number of dedicated research-scientists struggle hard to generate results of creative works that are accepted as valid results in both of those worlds.

The question may be, after all: Is truth and the search for it – the scientific goal and method – not fundamentally different from beauty and interpretation of its claims, the artistic goal and method?

We may also ask what is different now with the basic infrastructure of, at least, Western-style societies that did not exist in the 1930s of Kurt Kranz and Bauhaus? To give an answer to this question, and a number of related ones, I know of nothing better than to point at the one technology that did then not exist at all, but that is now ubiquitous both in breadth and depth of its distribution. I mean, and everyone will share this with me: computing technology in all its variants. With only a tiny bit of exaggeration, we can say that today nearly everybody is roaming his or her city or village, home or workplace, morning or

evening, as individual or social activity – always already equipped with a computing machine of small and handy size, of enormous local and global power, and appearing as possessing tool-like and medial qualities at the same time. Computing technology, the semiotic machine, as Mihai Nadin called it (2007), is with us and upon us and underneath everything we do.

What is different, we may say, is that the deepest and most widespread cultural revolution of all times has taken place and is still conquering the seemingly last refuges, and discovering huge new areas of life, still to be turned upside-down such that the young generations rejoice, and the old ones mourn. This permanent revolution must correctly be called "The Algorithmic Revolution": The revolution of transforming into machinic computable form everything that is already computable, and of reducing to computable form everything that is not yet computable. This enormous epochal task has started its path through cultures soon after the founding scientists had come up with their ground-breaking results: Kurt Gödel (1931), Alan M. Turing (1937), and John von Neumann (1945). More and new works are still under way for the algorithmic revolution to creep into all the arteries of human individual and social life. In fact, it is on its way at an accelerating speed, and with an enormous impact. Much of it is devastation.

8 | THE MASTERPIECE AND DISAPPEARANCE

History is not a neatly lined up chain of events, one after or before the other. History does, in the collective memory of a nation or society or human-kind, happen when it gets written. Therefore, it is happening all over again, when a new interpretation appears. History is more like a complex graph (if we want to take to such formal language).

In the fine arts, masterpieces appear seldom during the lifetime of their creator. It does happen, occasionally. But the recognition of a painting as being greater in its style or subject than all the others, is usually acknowledged only after the world has had opportunities to formulate such statement.

But now, in times of things and processes being in a permanent state of change, the masterpiece seems to be disappearing. As if it has had its time. "All that is solid melts into air", wrote Marx and Engels in their analysis of bourgeois society (2004). They were pointing at the necessity in capitalism to turn all that into commodity and, thus, into objects of the marketplace, that people would like to keep and hold and be assured of even in the future.

Computers and computing play an enormously important role in this process of melting down everything that used to be fixed and stable. In our field of concern – fine art – we must observe that all things and processes now have a tendency of duplicating. The melting is not a disappearance. It is rather a change of ontological state. Things duplicate into their *surface* and their *subface*, when they fall under the change that is called digitization. Under its regime, the surfaces of things and processes, that we are so familiar with, grow a second layer of their ontology. That layer is hidden in the machines, systems, and media of computing. I call it the subface. The subface is real and has great impact. But it is hidden, and we are usually not aware of it. It is hidden in computing equipment, in the cloud. It is computable by the machine, whereas the surface is perceivable by us via our senses. The computable, however decides whether we get credit from the bank. Or whether we are considered to be a potential terrorist. In the case of art, it decides what a work of art (that is no longer static) is going to do and look like in the next moment.

The disappearance of the masterpiece is thus built into the ontology of the works of art. As we become aware of something that we had not observed yet, but now compare and realize that our own idea has already been used elsewhere by someone we have never heard of, we realize that mental priority is disappearing. Everything gets more and more into flux, and the algorithmic revolution is washing away all fundamentals of the bourgeois individual. We used to be surprised by detecting someone before us having done what we have just discovered for ourselves. We must now realize that this is becoming the permanent fate of our cherished capability of creating the new. The new is slowly disappearing, and the old may become the new.

At the crossroads, we see the infinite works that, for artists like Kurt Kranz, were essential for their art. For the algorists, the infinite work is what they always create. Nothing special.

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BIOGRAPHICAL INFORMATION

Frieder Nake is first a mathematician who did a Ph.D. in probability theory. However, he had moved into computer graphics in 1963, and from there had no choice but to start (independent of A. Michael Noll and Georg Nees) into computer art. In 1965, all three of them had their first exhibitions. He has taught in Stuttgart, Toronto, Vancouver, and Bremen (where he is still living) and many other places around the world. He has published intensively and has supervised hundreds of theses. For the last twenty years, his teaching, lecturing, and publishing has been mainly on topics of art, media, and semiotics. He is also regularly exhibiting internationally his own works and is represented in a number of museums.

Looking for the Spaceless Book, an E-publishing Archaeology

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ABSTRACT

In the reformulation of the 'publication' concept after the electric and then electronic revolution, there is a consequent reformulation of the 'space of publication' which finally transcends the page and the binding as the insurmountable limits.

Here the history of this process is tracked through the first optical attempts to compress the content in order to overcome those limits, conceptually preparing for a more radical technological shift. Foreseen in early science fiction visions, this shift determined by digital and the networked technologies, is dramatically collapsing the publication space towards a dimension close to the infinite, where the published object disappears in the reading machine, in what becomes a mere but sophisticated 'container'.

KEYWORDS

Publishing; Post-Digital; Electronic Publishing; Science Fiction; Media Archaeology; Digital Publishing; E-Reader; E-Publishing; Book Culture; E-Literature; E-Book; Electronic Literature.

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1 | INTRODUCTION

The concept of assembling a publication is to include a limited amount of content in a manageable space. But as soon as we have been accustomed to the dimension of the single publication, we have tried to overcome its limits and expand it, possibly including as much information as possible in a new recognisable form. Multi-volume works and then encyclopaedias have helped to divide what couldn't be bounded in a single manageable space. But after the dematerialisation of this physical space, the publication's boundaries have been first blurred in their technical representation. First these boundaries have been expanded mechanically through optics, and then electronically through the computers. In both the embodiments the boundaries define both the pages and the publication as a whole. Then the boundaries just vanished with the networked digital, in the multitude of content that could be temporarily hosted on a screen, giving room to new technical prototypes and new visions of the publication concept

2 | HISTORY OF THE INFINITE PUBLICATION

The aim to increase the space for content in publications has been part of the more general and natural need to overcome the limits of a finite space. But the need to overcome the size limits in publications can be formulated as a *technological* question as the printed format easily reaches its

limits when it becomes either unreadable, with the content excessively reduced in scale, or unmanageable, with the content exceeding a certain threshold in binding or physical presence. Historically, the first approach to increase this space has been manifested through the progressive mechanically-induced collapse of content in a given space, using optics to miniaturise text especially, and increase the capacity of a page. Before that, the amount of readable space had to be established in advance, being either confined into a page or a certain length of a scroll, for example, and the content would just be able to fill them under a certain ratio.

3 | THE OPTICAL COLLAPSE OF CONTENT SPACE

The space is processed in publications in order to 'collapse' in perspective, because it will first increase through optics, and then it'll expand at such a rate in a different invisible dimension (digital), that it'll induce a perception of a collapse of the previous physical one. This idea of collapsing the space of content has become popular especially during the 20th century, as a consequence of a society progressively information-based on a global scale, thanks to mechanical and electrical technologies. The first wave of attempts to collapse the content space has been based on optical technologies.

Breaking the boundaries of the print publications was something envisioned by El Lissitzky in 1923 in *The Topography of Typography* manifesto (Lissitzky, 1923). He concludes it with: "The printed surface transcends space and time. The printed surface, the infinity of books, must be transcended. THE ELECTRO-LIBRARY". This sentence has been credited for envisioning the internet, or rather the current digital space of publications. But in it we can identify two specific visionary elements. The first is "the infinity of books" as a unifying vision of the whole printed knowledge as a single space, which can potentially be addresses as such. And the second is the concept of *transcending* space and time, which in that period was probably embodying the dream to overcome the slowness and heaviness of printing with some electricity-empowered technical innovation. So, transcending space can be interpreted as breaking the physical limits of content space; and transcending time can be interpreted as accomplishing an asynchronous access to content, which would allow access to multiple content sources at the same time.

There's another point in El Lissitzky's manifesto stating: "the continuous sequence of pages: the bioscopic book", whose first part can be interpreted as another attempt to consider a vast, even undetermined, content flowing in a continuum, with the consequence of not being able to determine a-priori the size of the content or publication involved. The size of this *continuous* publication would remain unknown unless we would have reached its end. Which, as a concept, is not so distant from the current perception of digital publications, whose size is inappreciable until we reach the end of the file (when there *is* an end of file…). We have *information* about the size, but we lack a perception, which is instead immediately perceivable in the physical world. A few years later, in the second half of 1930s, there were some tests on the so-called *fax newspaper* or *radio newspaper* (Waldrop & Borkin, 1938). It was meant to allow a radio listener to print a daily newspaper at home at a fixed time of the day. This kind of newspaper was transmitted through dedicated radio frequencies, and then decoded and printed through a specific device integrated into the classic radio receiver of the time, as a scroll. The reader didn't know its size, either, until it was fully printed.

The concept of not being able to establish the quantity of content recurs in different notions about the future of publications. So, "the continuous sequence of pages" had a conceptual implementation in Vannevar Bush's *Memex* conceptual system (Bush, 1945), where microfilm-like media would have hosted an indefinite amount of content with search capabilities.

This need for a collapse of content space can be also found in some prototypes in the do-it-yourself scene which proliferated in first half of the 20th century. One example of such a prototype was tested by an inventor who had a specific approach: instead of inventing a different medium for hosting a larger amount of content, he wanted to minimise the space of print, not so differently from what, a couple of decades later, would be been done by microfilms. The prototype was realised by Bradley Fiske, a retired admiral who developed, in 1922, a *reading machine* (Figure 1) [1], a small device allowing to read novels printed in very tiny typefaces on small

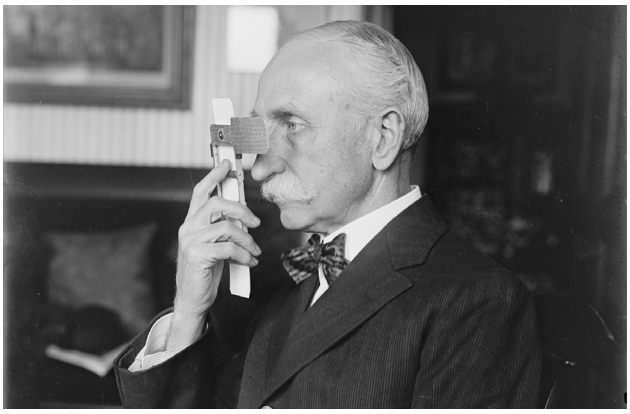

Figure 1 | Fiske Reading Machine.

paper *cards*, optically magnifying them with a lens, so collapsing the usual space of print while enhancing its portability. A few cards were able to host over 100,000 words, enough space for a whole novel. And even if this invention never became a commercial product, we can think about it as a first step towards the concept of microfilms. In the same period, Bob Brown conceptualised in his book *The Readies*, a comparable universal *reading machine* "using strips of miniaturised text" (Brown, 1930).

The space occupied by the content was then early addressed as an issue, with the flourishing of commercial publishing business and the improving abilities to read generation after generation of people. A different do-it-yourself experiment was embraced by a Spanish teacher with the aim to relieve the students from the heaviness of their textbooks. Ángela Ruiz Robles in 1949 built a prototype of a mechanical book, which was aimed to incorporate a considerably bigger amount of content than a classic textbook. The *Enciclopedia Mecánica* (Mechanical Encyclopaedia – Figure 2) (El Mundo, 2016) used similar optical principles to those of the above-mentioned machines: it was built within a plastic case with texts and illustrations on reels, easily removable and replaceable by other, with different topics, and with parts meant to allow writing and drawing. The reels were under a sheet of magnifying glass with a light for reading in the dark and, in a second prototype released in 1961, there was also the possibility to hear a spoken description of the topic.

All these conceptual machines and prototypes remarkably rely on the same principle later applied in microfilms technology: the physical collapse of the content space. Using optical or mechanical technologies they tried to make it work through a

Figure 2 | Ángela Ruiz Robles and her Enciclopedia Mecánica.

dual functionality: reducing the space usually occupied by the content and revive it when needed.

4 | THE SCIENCE FICTION VISION

In parallel with visions and prototypes conceived in the golden era of the technical do-it-yourself (1920s-1960s), science fiction has envisioned imaginable embodiments of media related to publishing. After being a literary territory to forecast a narration of the future at large, it has assumed a consequent archaeological importance for the history of media. So, a vivid and advanced imaginary about the infinite book can be retrieved by the production of different science fiction writers, who have provided different visions of a truly expandable ad-infinitum publication.

The comparable ideas in these novels are involving 'systems' and 'machines' as scientific or technical agents pushing the limits of media as we knew them. As one of the first examples relating publishing to the infinite dimension, even if it's not technically considered science fiction, Jorge Luis

Borges's *Library of Babel*, written in 1941, is probably the most well-known (Borges, 1941). It describes an infinite library with all the possible books that can be written and the cultural and psychological consequences on the humans approaching the library itself. Just a few years later, Richard Shaver in his *I Remember Lemuria* novel wrote about an enigmatic object that he called a pocket reading machine which was so common and habitual that, as he wrote, "it would have not attracted attention" in the described urban environment (Shaver, 1948). Even if just sketched in a few words, this elusive device was considered portable, small, and functioning as a machine, so including some systems for reading. Only three years later, in 1951, Isaac Asimov in his short story *The Fun They Had* had two of the protagonists to describe telebooks over a dialogue (Asimov, 1951). Indeed, in this story a couple of kids living in 2157 find an old printed book from the previous century, stating at some point:

> *"[…] what a waste. When you're through with the book, you just throw it away, I guess. Our television screen must have had a million books on it and it's good for plenty more. I wouldn't throw it away."*

Beyond the naive ecological considerations, which are not taking into account the waste of natural resources needed to produce the TV set as well as the needed electricity, here the two media, television and print, are formally merging, in order to dematerialise the printed content in the air, channelling it to an already tested machine. This machine, the TV set, is able to temporarily host content on the screen, replacing it at will, so potentially hosting infinite content. Already in 1934, a similar idea of a television newspaper was graphically illustrated in the syndicated comics *Can it be DONE?* [2], with a couple commenting the news in front a big screen TV set, the size of a tabloid.

All these visions are technically focusing on content 'containers', media in themselves at large. They are machines, or 'devices', meant to become the universal interface to access content, which is distilled in collapsed quantities, ready to be expanded within the device. All of these visions are imagining an evolution of the existing media into an updated and empowered version, with no clear spatial content limits.

At the end of 20th century, instead, the present technology escalates in science fiction to predict what is about to come just after the miniaturisation of electronics and the advent of telematic networks. So, in 1989, a few years before the commercialisation of the Internet completely revolutionised the mediascape, science fiction writer Ben Bova, in his novel *Cyberbooks* (Bova, 1989), wrote the story of a young programmer inventing an electronic book device, and of how this device would disrupt the New York-centred publishing industry:

> *"From it he pulled a grey oblong box about five inches by nine and less than an inch thick. Its front was almost entirely a dark display screen. There was a row of fingertip-sized touchpads beneath the screen. "*

The content is 'read' by this device in the form of "chip wafers" but what the protagonist was passionately questioning was the potentially uncontainable nature of information:

> *"I contend that publishers are in the information business, not the wood pulp and chemical industry. What you want into the hands of your readers is information — which does not necessarily have to be in the form of ink marks on paper."*

This focus on information as an abstract entity, and the core electronic device 'product' can be interpreted as a prediction of many tech companies' 'missions' and production strategies since the early 2000s.

The concept of a container hosting floating information remains consistent even in the new millennium, as we can notice in the *Minority Report* movie (Spielberg et al., 2002) where the newspaper that John Anderton (played by Tom Cruise) is holding while a fugitive on public transit, is formed by a few pages digitally updated in their own space, especially through animated breaking news reports.

5 | THE DIGITAL ENDLESS COLLAPSE OF CONTENT SPACE

Digital machines by their own nature have certainly collapsed the space of information. Their engineering is based on a long historical trajectory of

electronic miniaturisation of both the processing and the memory elements, which, over time, have induced the exponential multiplication of the contained digital space of information in smaller devices with greater storage capacity or networked access to almost infinite content spaces.

If we try to identify the first electronic device explicitly focusing on cultural content, we can probably choose the *Dynabook* prototype, conceived by Alan Kay in 1968 and unfortunately never realised. It was the first complete model for an electronic textbook, in a shape that today we would easily categorise today as 'tablet' or 'e-reader'.

In his paper in 1972 he's detailing the Dynabook's technical specifications (Kay, 1972):

> *"The size should be no larger than a notebook; weight less than 4 lbs.; the visual display should be able to present at least 4,000 printing quality characters with contrast ratios approaching that of a book; dynamic graphics of reasonable quality should be possible; there should be removal local file storage at least one million characters (about 500 ordinary book pages) traded off several audio (voice/music) files."*

It can be noted that the 'printing quality' of the display was treated as an important element, as it should have guaranteed the use of the screen as a functional substitute of the printed page. Equally important was the 'removal', so expandable file storage with a standard minimum content size of a huge book, potentially expandable to an entire collapsed library.

This transition, which includes a reverse of perspective, should have been initiated by a specific event: the optical qualities of publications reaching their resolution and spatial limits, in both paper and celluloid. The next step has included the technically investment in a 'container' with a comparable resolution, but with no spatial limits for the content, which would have been perceived through a single screen. Generally speaking, the screen itself has very tangible boundaries, but its content has none. The main conceptual consequence is that the screen becomes the single universal space, which is potentially containing all the possible conceivable content, reconfiguring its matrix of basic elements. And the more we experience it, with a possibly extreme diversity of quality and quantity of content, the more we tend to consider it infinite and universal.

Historically, when devices started to be connected to an invisible storage through networks, first physically and then wirelessly, we probably started to assume that there's an infinite storage somewhere possibly containing all the content we need, and this content is then drawn from there, dynamically being rendered on the screen matrix of pixels, at will.

Where exactly it is stored, and who is storing it, owning it, being able to change it, edit it, delete it, becomes mainly irrelevant for the average user, especially compared to the compelling spectacle of having content instantly available, and endlessly scrollable. The combination of an infinitely reconfigurable screen with a remote boundless storage breaks all the possible size limits in our imaginary. This gives room to high expectations of content which are constantly renegotiated, but always settled, accepting the failures to find something specific in exchange of the quantity of other similar content, constantly and rapidly replacing the initial need. When exposed, for example, to a search on Google, YouTube, Facebook, just to name a few, if we're not finding exactly what we were looking for, we often rapidly modify the need with what we find, as the quantity and the basic quality of what we're being offered overcomes our initial intentions and focus, giving way to content-driven new paths. This mechanism makes the majority of humans prone to what they have been offered as the offer of content is, namely, infinite. There's always something more accessible for free, then why stop? El Lissitzky, in his *Our Book* (1927) affirmed that "The amount of material used is decreasing, we are dematerialising, cumbersome masses of material are being supplanted by released energies". These energies have become ubiquitous and continually exchanged. If we address them historically as "archaeologies of the present", as Kittler (1990) defined them, we should "must also take into account data storage, transmission and calculation in technological media", including them in the equation describing what we really need and what we, instead, consume.

But having an infinite amount of content already available, doesn't restrain us from continuing to expand it further, with the easy *publishing* tools especially enabled on various social media

platforms. We can consider the act and gesture of ‘posting’, on various type of internet media, as an act of ‘instant publishing’, increasing the total amount of content and allowing us to contribute to the same content. On one side, the interconnected web content cannot be conceived as a single infinite publication, because of its diversity in topics, formats and quality, forming a multitude. On the other side, the quality we attribute to traditional publications, instead, as being formed by highly sophisticated content, finiteness and consistency, cannot be applied, in reverse, to the online digital system, which is driven by two main time/space coordinates and qualities: instantaneousness and abundance.

ENDNOTES

[1] (June 1922). A library in your vest pocket. *Science and Invention*. v10 #2.

[2] “Can it be DONE?” syndicated comics, 1934, *Scoops Magazine*, London, Uk: C.A. Pearson Ltd.

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BIOGRAPHICAL INFORMATION

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Application of Incremental Technologies in Considerations of Transhumanist Aesthetics – Project "Who nose"

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ABSTRACT

Transhumanist speculations have been present in intellectual circles since the 1960s. The term "transhumanism" was coined in 1957 by biologist Julian Huxley, who defined it as "man remaining man, but transcending himself by realizing new possibilities of and for his human nature". Will the boundaries of aesthetics remain untouched in face of new achievements, both in medicine and those coming from the need to explore space?

In 2017, NASA published the results of the Human Research Program. The aim was to find out more about the impact of long stays in space on the human body, like manned trips to Mars. The human body will have to face new physical conditions on the Red Planet, such as lower temperatures, a less dense atmosphere, significantly higher radiation and many more. The impact of such conditions is visible and highly variable also in other organisms, including mammals that have the best sense of smell.

3D printing technology is developing continuously and already today we are able to print an ear that can be used for transplants. If this is the case, does it have to look the same? Based on the research regarding the impact of climatic conditions on the shape of noses as well as state of the art regarding such areas as mountaineering, biomimetics, plastic surgery and taking into account mental factors, the article presents original nose designs, aesthetic speculations and interpreting the above visual and formal data.

KEYWORDS

Speculative design; 3D printing; Additive Technology; Transhuman; Design; Experiment; Plastic Surgery; Mars; Biomimetics; Cosmonautics.

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1 | INTRODUCTION

The future starts today and is also affected by past events. One of the key tools in this scope consists of foresight studies and specifically technological foresight. This is a set of tools and research methods that combines current activity (e.g. regarding science, business, society) with an uncertain but usually desired future (Voros, 2003). There is no single ending. There are many probable and possible scenarios. This is how speculative design, that is becoming a tool in strategies of forecasting macro trends, works.

Visualising the future may affect the development of science and business, and concept cars are an example of such solutions. One of the latest popular examples also in the area of transhumanism is a project called *Meet Graham* that was developed upon the request of the Australian Transport Accident Commission. The project involved the cooperation of an artist, Patricia Piccinini with Christian Kenfield, a trauma surgeon from the Royal

Melbourne Hospital, and Doctor David Logan, an expert on accident research from Monash University. Together they created a human model that would be able to survive a car accident. Applying a reverse approach, where you adjust the human body to modern cars, carried a more meaningful message than "be careful, buckle up". The Australian project, besides the public service campaign message, shows a completely different side of science.

My project is based on research conducted by the University of Pennsylvania concerning the change of the shape of nose depending on the conditions in which our ancestors lived, which I have combined with the state of the art. I present NASA research, information regarding programmes on inhabiting Mars as well as technological and surgery possibilities and the progress of 3D print, and on this basis, I propose a futuristic vision of how our noses could look if we lived on Mars (Figure 1).

Both in literature and in pop culture, the image of extra-terrestrial creatures often extended to the point of kitsch. However, in the context of aesthetic considerations it is worth recalling that the creators of fairy-tale creatures and humanoid characters based their creations on assumptions that concerned the environment they existed in. The famous characters from James Cameron's *Avatar*, the diversity of races presented in the cult film *5th Element* by Luc Besson, or even the suggested progenitors of people from the movie *Prometheus* by Ridley Scott. In the history of art, we are able to notice such explorations in depictions of the un-known and the inexplicable. I was investigating this topic while working with one of my degree candidates, whose task was to create a monster based on modern pop culture aesthetics and the historical contexts of architectural details – gargoyles and sparrow hawks. As an educated art historian, Ms. Iwona Haurash paid attention to how we people deal with our lack of knowledge in situations when the unnamed and unknown can only be imagined.

In medieval times, after the western world abandoned ancient traditions and an empirical approach to reasoning and perceiving the surrounding world began to disappear, the place of logical cognition was replaced to a great extent by the imagination. Where there was no empirical data to build a clear representation of nature and the laws of physics, untamed human fantasy came into action, inventing dark, non-existent creatures that sometimes consisted of compilations of existing animal species. A universe built in such a way was an attempt to explain the incomprehensible and mysterious, and creatures that were the instruments for that comprised the collection of medieval bestiaries.

As an artistic expression of human cognitive aspirations, they focused mainly on the sacred sphere as elements of architectural decorations or rested on the margins of manuscripts. They combined not only a decorative or – in case of gargoyles – utilitarian function, but also an apotropaic one. Utilising in this case ugliness and the macabre as magical means of defense against evil, and de-estheticizing public space at the same time.

In modern times, along with the development of scientific methodology, demystification of the laws of nature and an increased interest in them, people began to accommodate to the so-called "bestiary". Fear and horror subside to curiosity. As a result of growing interest in teratology in the context of science, "mysterious creatures" no longer scare us and have moved into the world of fantasy, fairy-tales and stories. They have become mere inspiration and entertainment. In her work, Haurash points out that nature was documented and described, and less and less unexplored parts of the world remained where unicorns, wyverns or basilisks could live (Kitzinger, 1977). J.E. Harrison, a British researcher, wrote that art came from "unfulfilled desires, those human perceptions and emotions that couldn't be vented through practical activity". It also explains our fondness for ugliness and drastic, emotional scenes. "To understand why seeing un-pleasant performances in art can be pleasant, …it is important that not only pleasure and delight, but also pain and suffering can intensify and enrich our perception, our taste of life" (Dziemidok, 1988).

Figure 1 | Visualisation of speculative idea.

References to teratology are not accidental, on the contrary, they are indispensable from an aesthetic point of view; transhumanist speculations are also the awareness and context of ugliness. In my project, I focused on noses as a soft tissue that can be made with incremental technologies, but also due to the fact that rhinoplasty is one of the most popular surgeries in aesthetic medicine (Nahai, 2015).

The nose is mainly composed of soft tissue that may be subject to changes, as indicated by numerous surgeries conducted on this body part almost all over the world. Such surgeries are often per-formed not due to health reasons but primarily for the purposes of aesthetic medicine. (Gracindo & Moreno, 2018) There are also situations where one is related to the other and then we have an example of an unnatural creation being better than the genetically determined "original". Is that a good thing?

Plastic surgery also brings up the problem of ugliness, or in more general terms, speculations over attractiveness. The presented nose designs were consulted with a plastic surgeon, however due to a very sensitive group of clients, the doctor wanted to remain anonymous. His opinion, respecting the will of its author, will be included further in this publication, concerning the aspects related to a change in appearance.

2 | TRANSHUMANISM AND BIOMIMICRY

The story of Oscar Pistorius is an interesting case, worth mentioning at this point. Pistorius participated in the Paralympics. He wanted to take part in the regular Olympics and he succeeded in 2012. However, there were some controversies and it was said that his prosthetic legs may have given him an advantage over people without disabilities. The decision divided the world of sports. One of the counterarguments regarding this decision that was also shared by a Polish long jumper, Maciej Lepiato, states that prosthetic legs constitute a technical performance enhancement because they give the athlete an advantage. This case provokes a question regarding the bio-ethical aspect in relation to the limits of interfering with the human body. Nevertheless, it cannot be denied that prosthetic legs increased the human performance at that particular instance. Since noses are already a part of the body that is subject to modification, it is worth thinking about their form. If technically and technologically we are able to print the human ear from a material that can be used for implementation, does it have to look exactly like the "original" ear?

Nature displays a huge variety of noses. Let us focus on mammals because they have a highly-developed sense of smell. Examples of extreme forms of noses are presented by snub-nose monkeys, whitemargin unicornfish (which is actually a fish) as well as by the sword-nosed bat.

Nature has developed noses throughout evolution, adjusting them to climate and conditions. In my designs, I treat them as useful guidelines for new solutions for human noses, using biological inspirations, or biomimicry, as is commonly known in

engineering. One of the most notable examples of a mechanism of nature used by humans is the hook-and-loop fastener. It was transferred from the world of plants into a solution used by people. Thanks to its use by NASA in astronaut suits, it was popularised and became widely used.

2.1 SELECT PHYSICAL AND FUNCTIONAL ASPECTS OF THE NOSE

> *"-The structure of the nose enables to warm up or cool down air adjusting it to the body temperature before it reaches the lungs*
>
> *- The nose also acts as a filter so that it catches small particles preventing them from reaching the lungs*
>
> *- The nose moisturises air adding humidity to pre-vent the respiratory tract from drying*
>
> *- It strengthens and impacts one's voice*
>
> *- It supports the sense of smell*
>
> *- It can attract and impact the biology of attraction"* (Little et al., 2011)

Changes of living conditions or atavistic needs relating to the sense of security, choosing stronger and more attractive units for extending the kind are key. Hence, the discussion regarding the change of the appearance and the model of attractiveness seems justified.

Our noses perform many more significant functions. They warm and moisturize the inhaled air, which helps to prevent illnesses and injuries to our airways and lungs. Scientists have long suspected that the shape of the nose had evolved in response to changing climate conditions in a dry and cool climate natural selection favoured noses which are better suited for warming and moisturizing the air.

3 | NOSE DESIGNS

I have prepared three nose designs and I focus on different functions in each case. I visualise the possible scenarios of the future in the form of unique nose designs by means of the technological foresight method.

3.1 NOSE DESIGNS - FORESIGHT DATABASE

3.1.1 RESEARCH FROM THE UNIVERSITY OF PENNSYLVANIA

Research conducted in 2017 by the University of Pennsylvania indicates that the human body has been evolving over millennia in order to genetically adapt to existing climatic conditions. The record of this process can be physically observed based on the example of our noses. 3D face imaging was used in the research. 476 volunteers from West Africa, South Asia, East Asia and North Europe were measured. It has been ascertained that the width of our nostrils correlates with the temperatures and humidity of the local climate in which the ancestors of the volunteers lived. People whose parents and grandparents came from areas with a warm and humid climate had wide nostrils. People originating in cold and dry regions had narrower ones. The strongest correlation between the width of the nostrils and the climate can be observed in North Europe. This means that a cold and dry cli-mate is particularly favourable for people with narrow noses (Zaidi et al., 2017).

Scientists have also discovered that the shape of the nose is hereditary. They have found a correlation between genes and a general similarity of noses in large groups of unrelated people. This means that the shape of your nose is to large extent genetically conditioned.

3.1.2 ADDITIVE TECHNOLOGY (3D PRINTING)

The possibilities of 3D printing keep developing. The race is in progress and it does not only relate to technology but also, or primarily, to materials. The spectrum is so large that during a London-based conference regarding 3D print in 2018, the speakers talked about subjects regarding implants, aviation and jewellery within one discussion panel. The technology is not really that new because it was already known in the 1970s. The official date considered as the year 3D print was created is 1984 but conceptual work on the technology started in the 1970s. In 1971, Pierre A. L. Ciraud described a method of manufacturing items with any geometry by adding powdered material, using a source of heat for this purpose. This was published on 5 July 1973 and created a starting point for the technology known today as Selective Laser Sintering (SLS) (Reichental, 2018). In any event, from that point on, the technology was underway, both in terms of

scientific experiments as well as hacker spaces supporting DIY movements. What is more, the technology has become popular and a race is in progress regarding the variety of materials, improved prints and more precise parameters of print. One may also list materials and industries where we do not consider print as a prototype or a method of obtaining a quick prototype but rather as a final product. For example: a bridge in the Netherlands entirely printed by a 3D printer at the University of Technology in Eindhoven, Chinese buildings printed in 3D, as well as items printed in 3D used in space. Entries on printed habitats and also printed tools were a subject of a competition announced by NASA, entitled the “3D Printed Habitat Challenge”. In bio-medical engineering, work is taking place on the bio-printing of support structures that would later become the base for growing cells. One such company that is transferring those achievements to the stage of clinical tests is the Wake Forest Institute for Regenerative Medicine (WFIRM), which proved that it is possible to print tissue structures in order to replace damaged or diseased tissue in patients. Scientists from WFIRM have successfully printed ears, bones and muscles (Kang et al., 2017).

3.1.3 CONDITIONS ON MARS

Mars is the planet closest to Earth. Mars is not a hospitable planet, however compared to our neighbouring Venus, we may talk about harsh conditions that may become difficult but not insurmountable challenges for scientists, engineers and other representatives of science. Because of these conditions, the people of Earth chose Mars instead of Venus (Birch, 1992). Let's have a closer look on the physical conditions on the red planet.

Mars is a lot cooler than Earth, with an average temperature of -63°C, which may drop to as low as -140°C. The lowest temperature on Earth was -89.2°C, recorded in Antarctica.

Since Mars is further from the Sun, the amount of solar energy entering its upper atmosphere (the solar constant) is half of that entering Earth's upper atmosphere. Since the sunlight is not reflected into the atmosphere, the surface of Mars gets a similar amount of energy as the surface of the Earth. However, the lack of atmosphere has other consequences. One of it could be that Mars's orbit is more elliptical than that of Earth, which increases the amplitude of temperature fluctuation and the solar constant. Currently, the atmosphere on Mars is very thin (approx. 0.7% of the atmosphere of Earth), which gives little protection against sunlight and solar wind. It is too thin for people to survive without pressure suits. We need to be aware that the atmosphere on Mars consists predominantly of carbon dioxide. Therefore, even with a pressure correction atmosphere, the local pressure of CO2 on the surface is 52 times higher than on Earth, which makes it possible for plants to grow on Mars. The circumstances that we need to consider when we are thinking of visiting the Red Planet is that Mars has a weak magnetosphere, so the protection from solar wind is low. The radius of Mars is half of the radius of Earth, and its mass is 1/10 of the mass of Earth. This means that Mars has lower density than the Earth.

This is just the tip of the iceberg of problems that we will have to deal with if we want to create a habitat on Mars and realistically think about its colonization or a regular life there. How could this affect our bodies? Not in the perspective of the next few years, but in a more distant and long-term one (McKay & Davis, 1991)?

3.1.4 PREPARATIONS FOR LIVING IN SPACE AND MARS

In March 2015 Scott Kelly went to the International Space Station, where he spent 342 days. During that time his twin brother stayed on Earth and both of them took part in numerous studies. The aim was to assess how a very long space travel, similar to that required for humans to get to Mars, would affect the human body, on the basis of comparison between two most possibly similar organisms. Another program with a similar scope is Mars 500, a Russian experiment which commenced in March 2009 and was supposed to prepare people for a flight to Mars. It consisted in keeping 6 volunteers closed for 500 days, in order to examine their psyche. The project was carried out in the Moscow biological-medical institute (Schwirtz, 2009). A similar space camp was prepared for a trial start of extra-terrestrial technologies and research strategies on Devon Island. The island serves as a "home away from home" to the members of the Haughton-Mars Project run by NASA. The EXO 17 Mission is a Polish contribution to the research concerning the subject in question. The surface of Mars was imitated by the Mars Desert Research Station in

Utah, and it comprises tests of an air filtering system and methods of stress management.

The examples of how humans are getting ready for a Mars expedition and thus to conquer the space, and the recent attempt of the Falcon Heavy developed by SpaceX, shows that this moment is right around the corner (Vance, 2017). These events encourage us to view ourselves from a different perspective.

The human body will have to change if we are to adapt to new physical conditions. Are these the new challenges for medicine or a direction of evolution? Undoubtedly, environmental conditions affect the body and in the course of time, in line with the law of evolution, adapting to changes is inevitable.

3.1.5 CONSULTATIONS WITH AN ANALOGUE ASTRONAUT

Analogue astronauts are specifically trained space-suit testers. After an extensive selection process, they go through a several months long basic training. Analog astronauts are used for technical tests and Mars simulations.

OeWF [1] analogue astronauts are specifically trained for the OeWF Mars spacesuit simulator "Aouda" and are assigned "in analogy to" future human (Mars) expeditions for preparatory research and development projects.

> *"In the case of the helmet, that's definitely something unique. The flow of air in the Aouda spacesuit simulators developed at the Austrian Space Forum is maintained by a ventilation system that circulates air. So it's not a closed system, instead fresh air is circulated into the helmet. From my last mission in the Dhofar desert in Oman in February, there were a few observations:*
>
> *- Because access to fresh air is restricted, when you exert yourself, there is a strong build-up of CO2 in the helmet. The fans are used to circulate the CO2 out, but you have to be careful, because the CO2 levels can become critical for breathing. For this reason, we have CO2 and O2 sensors in the helmet that relay data to the operations base in the habitat, where the levels are being constantly monitored. So, in other words, when you're doing any heavy lifting, you're much more conscious of your breathing in the helmet, and you try to pay attention to the CO2 levels.*
>
> *- Because the air you breathe out contains moisture, sometimes the ventilation system isn't able to circulate in fresh air fast enough, and you end up with condensation inside the helmet visor that restricts your vision. So, when you're breathing, you're also actively trying to control output, to ensure that you don't fog up the visor.*
>
> *- In the Dhofar desert, there was a lot of fine dust that made it past the filters in the ventilation system. This meant that at times the fresh air came in with dirt, so when you were breathing, you suddenly had dirt in your mouth. I was typically breathing a lot through my mouth and was conscious to reduce that when I could feel that there was fine dust being circulated by the ventilation system. The most surprising thing about the analog mission was just how easy it is for you to "escape reality". The environment really helped in creating the feeling that we were really on Mars, which increased the fidelity of the simulation experience."* (Kartik Kumar, personal communication, 2018).

This unique and dedicated statement by an analogue astronaut and engineer contains very interesting remarks that should be taken into consideration while developing the project. Kartik Kummar's opinion was issued after the noses had been designed. In speculative design, it is vital to be able to identify information that is crucial for development instead of information that only reflects the existing world Kummar indicated that there was indeed a problem with spending a long time with the helmet on, which affects human behaviour. Among such indications, this one encourages further considerations.

3.2 NOSE DESIGNS - CONTEXT

The project is of a speculative nature; it is also worth noting its transhumanistic character. Implants, foreign bodies implanted in the body in order to recreate natural function or aesthetics of a damaged organ, are a reality. Plastic surgery of the nose, rhinoplasty, is one of the most common and yet one of most complicated plastic surgery

procedures (Rettinger, 2007). Surgery may correct the shape of the nose by reducing or increasing its size, modelling the septum and the tip of the nose, or regulate the distance between nasal holes. Plastic surgeons may lengthen or shorten the nose, however in most cases we are dealing with a complex surgery regulating nasal asymmetries. Changing the shape of the nose could also affect protection against frostbite or susceptibility to sunlight. There are a number of statistics concerning frost-bite in the world medical literature. Studies conducted by Finnish doctors from the Health Institute in Oulu show that the body parts most susceptible to frostbite are the nose, ears, cheeks and chin as well as the fingers and toes. Frostbites cause the shrinking of blood vessels; strong narrowing of skin vessels may lead to skin ischemia and tissue necrosis. In many animals living in a cool climate the nose is covered with more rigid skin and is built in a different way, which makes it less prone to frostbites and sunburns. Aesthetic medicine is often associated with a whim of the wealthy who seek to change their image not for health reasons, but merely to satisfy their vanity. However, aesthetic medicine stems from obviously more significant situations, associated with reconstructing faces after accidents, burns or other, for instance, genetic defects directly affecting a patient's health. The significance of the nose outside the medical context is proven by the aforementioned studies of the scientists from Pennsylvania, which show that nose also has a complex evolutionary history, and the researchers suspect that additional factors, such as cultural preferences during mating, also played an important role in the formation of this organ. Research on the evolution of the shape of the nose and climate adaptation might have not only medical but also anthropological consequences (see Figure 2).

3.3 PSYCHOLOGICAL AND CULTURAL ASPECTS IN THE CONTEXT OF AESTHETICS

Below, I include an anonymous opinion of a plastic surgeon concerning the project of speculative noses. I was told people aren't ready for such modifications due to their own human psyche. For a typical person, everything that diverges from the classic model of beauty is a big problem.

> *"Some noses look like the problems that people turn to surgeons with in order to fix them. Regardless of how such modified noses would make life easier, everything is broken by human self-acceptance. People*

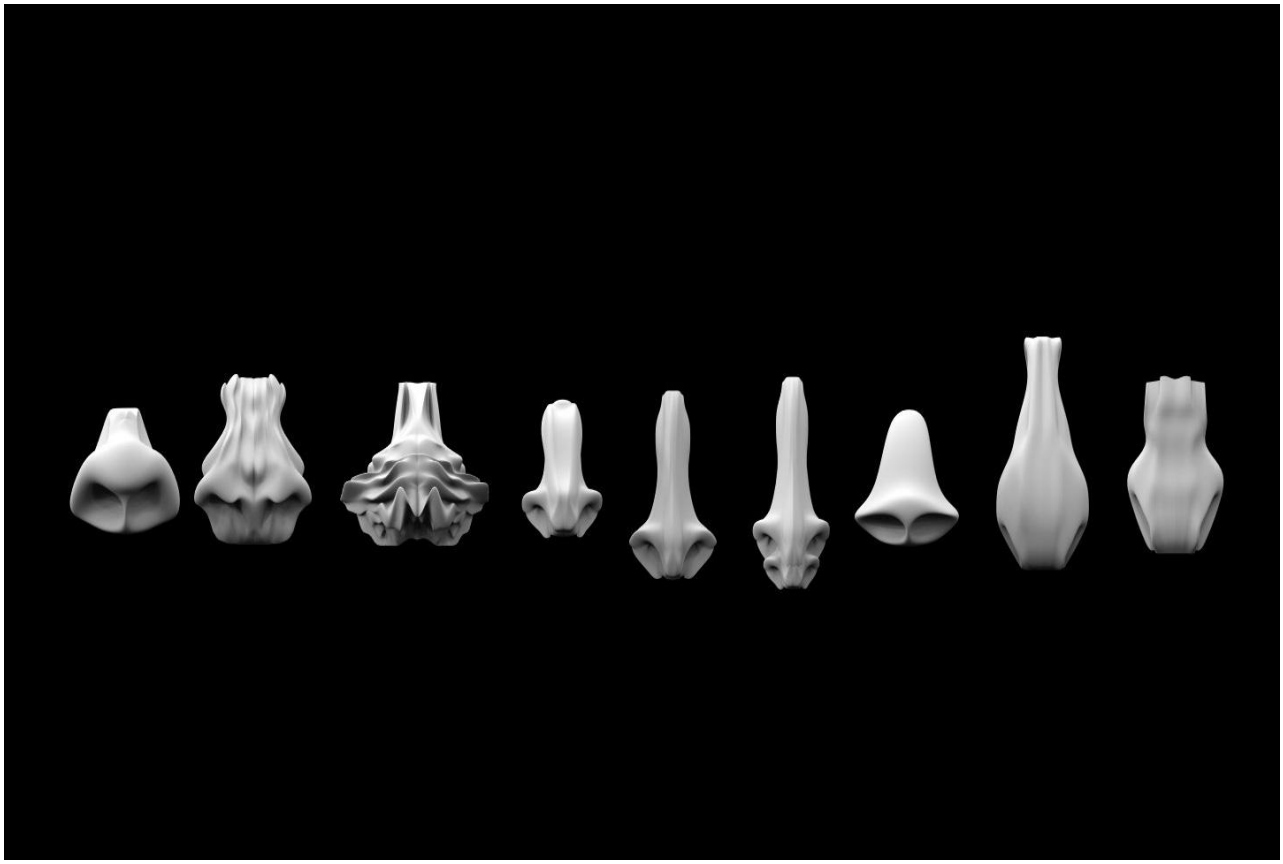

Figure 2 | Noses - different versions taken into account.

will start committing suicides, being unable to stand themselves.

Statistics collected at various plastic surgery conferences show that given the choice whether nose correction should alter their appearance, breathing comfort or smell improvement, people choose appearance. In the opinion of the surgeon this means that the biological function of the nose and increased comfort of life are in second place behind looks."

That is very interesting, as it could be assumed that along with altering culture, the requirements of our attractiveness could change as well. Naturally, the designs of the noses presented below are strongly exaggerated on purpose, in order to present key assumptions. In the project, it was important to clearly show how I interpret environmental and psychological aspects in the context of aesthetics, for the purposes of discussion (that is what those aesthetic transhumanist speculations consist of).

In the context of existing tribal cultures, such as the Apatani people inhabiting the mountainous areas of the Indian state of Arunachal Pradesh, or even the "perfect angle" of the female nose recently promoted in social media (106 degrees), we can say that both our environment and our culture affect the changes we expect with regard to attractiveness. The fact that we are more willing to bear, for instance, dyspnoea instead of unacceptable looks, provokes reflections all the more."

3.4 DESIGNS/SCENARIOS

3.4.1 DOUBLE NOSTRILS

a) Long narrow noses are genetically associated with Nordic facial features (Zaidi, 2017). This is associated with the fact that with a narrower nose, it is easier to warm up air, as compared to wide nostrils, due to low temperatures, both during travel and after landing (see Figures 3 and 4).

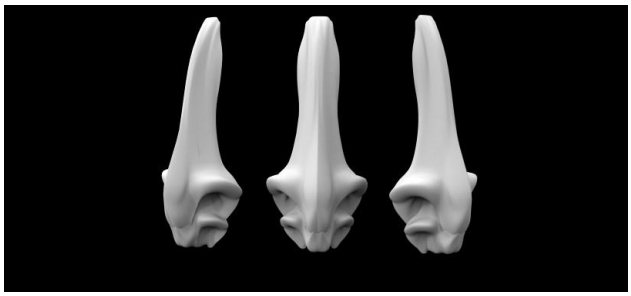

Figure 3 | Nose project Double nostrils – rendered nose in different views.

b) On Mars, people will live in habitats. They will wear space suits and helmets while walking on Mars' surface and they will be forced to live in air-conditioned spaces. Also, the trip there will involve staying in air-conditioned rooms. Already today, we spend plenty of time in air-conditioned rooms and this has its consequences (allergies, colds, dryness). Analogue astronauts practice such a preparation on Earth.

c) We cannot forget about mental factors. Long travel and time spent in closed space may impact anxiety or less severe symptoms such as discomfort. Relaxation techniques inspired by Pranayama breathing exercises show a huge impact of breathing through the nose on staying calm and providing oxygen to the brain. Double nostrils make it possible to strengthen the sense of a deeper breath.

3.4.2 BOXER

a) Utilising the experience of mountaineers, we know that the nose being a protuberant part of the body, is the most prone to frostbite. Additionally, it is also subject to sunburn due to sun rays being reflected from snow. Burns also occur at the bottom of the chin or neck, according to Adam Bielecki, a Polish mountaineer. Mountaineers use special bands and tapes for covering noses and cheeks that protect against the temperature and sun. For this purpose, the model of this nose is flatter and it sticks out less (see Figures 5 and 6).

b) The width and size of the nostrils in this case is also related to the sense of better ventilation and deeper breath. In the animal world this can be

Figure 4 | Nose project Double nostrils – photo of 3d printed object in Flexible material Tango Plus 9740 . Technology polyjet solidified liquid photopolymer by using UV light.

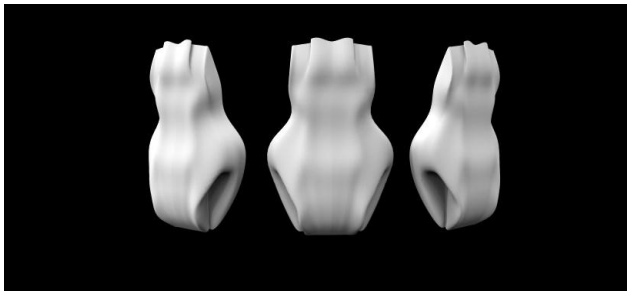

Figure 5 | Nose project *Boxer* – rendered nose in different views a) similarly to the design of radiators, the wavy surface of the nose may impact heat transfer.

observed in the African Buffalo.

c) Wide biomimical nostrils and a flattened nose may also affect one's self-confidence. The abovementioned African Buffalo is one of the most dangerous animals in the world, which is enhanced by its specific nose appearance. An additional stylistic reference regarding a flat nose and wide nostrils is the structure of boxers' noses, which due to numerous injuries resulting from fights, modify their noses' appearance. In the context of new attractive-ness, it could create another subject of discussions.

d) From the point of view of functionality, such a nose would also be less prone to injuries relating to the long use of helmets, that would break the nose in the case of a fall or trip, without securing it.

3.4.3 RADIATOR/RESONATOR

a) The wavy surface reaching deeper may also have a clear impact on one's voice. The nose is a resonator and has an influence on acoustic effects. Since communication is mainly conducted with the use of microphones, its effect will be the same as in an aircraft cockpit, which means that some frequencies will be interrupted by noises, and this

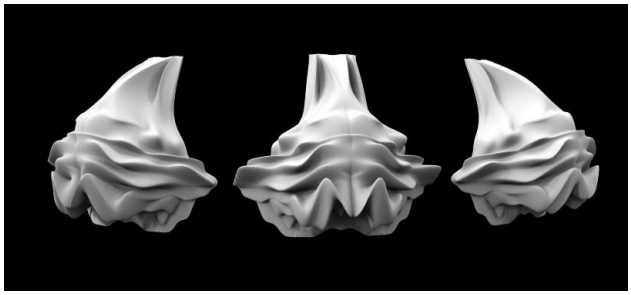

Figure 7 | Nose project *Radiator / Resonator* – rendered nose in different views.

would make communication more difficult. Similarly, basstraps, the wavy structures you may have noticed used in recording studios, contribute to changing the acoustic effect (see Figures 7, 8, and 9).

b) Additionally, the example of the nose structure of the sword-nosed bat also shows a nose that is very fleshy. Scientists are of the opinion that this may be associated with echolocation. Due to the disrupted day (Earth) rhythm and the sense of day and night caused by artificial lighting, the direction in re-search regarding the transfer of waves and vibrations with reference to echolocation, also seems interesting.

4 | CONCLUSIONS

The "Who nose" project (see Figures 10 and 11) refers to the possibilities of 3D printing and plastic surgery in the context of challenges that we will all face. It has a speculative character. It does not mean that people will grow such noses in an evolutionary way on Mars. Already at this stage of medical development, we introduce many changes into our body: artificial eyes, mechanical prostheses, bypasses etc. Perhaps this apparently stylistic or aesthetic change could have a bigger impact on the

Figure 6 | Nose project *Boxer* – photo of 3d printed object in flexible material tango plus 9740. Technology polyjet, solidified liquid photopolymer by using UV light.

Figure 8 | Nose project *Radiator / resonator* – photo of 3D printed object in Flexible material Tango Plus 9740. Technology polyjet, solidified liquid photopolymer by using UV light (front view).

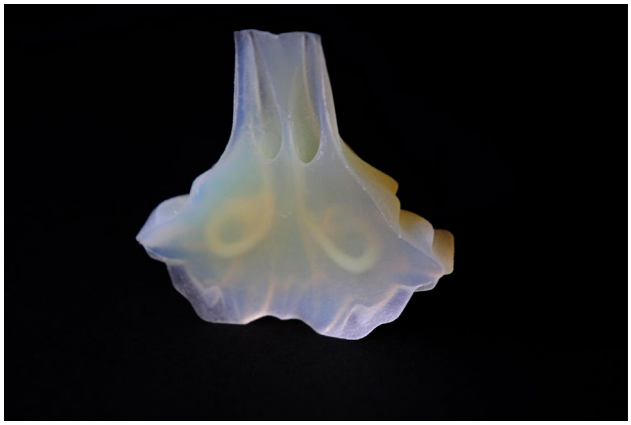

Figure 9 | Nose project *Radiator / Resonator* – photo of 3D printed object in Flexible material Tango Plus 9740. Technology polyjet, solidified liquid photopolymer by using UV light (back view).

comfort of our lives on Earth.

I have considered different stylistic options based on the above assumptions and decided to present three options that in my opinion will be a best representation of the issues and their options discussed herein. Since this is a speculative project, the answers will not be definite, and they may be a proposal of interpretation.

As a summary of my own conclusions, I also present part of an opinion about the project by Prof. Andrzej Borman, PhD, from the Department of Animal and Human Physiology, Faculty of Biology at the University of Gdańsk:

Figure 10 | Marta Flisykowska, Who Nose?, Museo del Traje, Madrid.

"…I believe that in the future, the most likely 'driving force' behind changes similar to those proposed in the project – in the form and shape of body parts, irrespective of their function – will be the aesthetic values that constitute cultural elements. Indeed, the perception of feminine/masculine attractiveness has evolved over time, differently in different cultures, and will doubtlessly continue to change. In the future, in the conditions of dynamic development of science and technology, we will obtain previously unknown abilities to modify our appearance and one can imagine that from superficial adornment we will move on to much more permanent structural modifications of our body in accordance with the current trends and the ideals of beauty applicable at the time.

In my summary, I would like to stress that regard-less of my reservations as a physiologist, ex-pressed above, I believe Dr Marta Flisykowska's project to be tremendously interesting and imaginative. Nobody knows where and how far the transformation of humans as a biological species in-spired by the idea of transhumanism will go and how an average/typical human will appear in, say, fifty years. Dr Flisykowska's unique vision, inspired by Earth's nature, presenting different variants of the structure of the nose of future humans, whilst in my opinion not necessarily related to adaptation to living on Mars, appears to be one compelling possibility of our development."

I have asked also bioethicist Jakub Zawiła-

Figure 11 | Marta Flisykowska, *Who Nose?*, Museo del Traje, Madrid.

Niedźwiecki, from Center for Bioethics and Biolaw University of Warsaw, for her opinion. I find it also interesting to present it as a final thought:

> *". . . The history of nose reconstruction dates at least to the middle-ages which shows how important that part of the face was and how grave a mutilation its loss meant. Implanting new artificial noses would carry varied risks and unknown effects for both physiology and especially psychology. Modern controversies regarding face transplants, including worries about one's body image and psychological effects of it could be mentioned here as an analogy.*
>
> *While the project itself does not pose bioethical issues as such – it does not affect actual human beings for now – it might be worth keeping in mind that the future modifications such as those posited in the project would require extensive bioethical and psychosocial investigation… As well as conducting research regarding issues typical for debates of human enhancement such as the limits of acceptability of variability within human society (which it would seem still is a problem for societies even without modifications), relationship between adaptation to physical and social conditions as a factor of human flourishing, and last but not least what are the limits of modification that allow other humans to recognise an entity as human. Indeed when viewed this way, noses could only be a pretext to investigation of what actually are the limits of humanity and our understanding of homo sapiens species… Both opinions can be read at the flisykowska.com site, where I present this project too."*

ENDNOTES

[1] OeWF: Austrian Space Forum is a citizen science organization for space professionals and people with a passion for space in collaboration with both national and international research institutions, industry and politics.

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BIOGRAPHICAL INFORMATION

Marta Flisykowska MA, Phd. Independent designer, researcher and curator. She works at the Faculty of Architecture and Design in the Experimental Design Studio. She uses her passion for the Universe, anthropology, and futurology in her projects, exhibitions, and publications. She approaches design holistically as the meeting of local and global cultural spaces. Her work often combines additive manufacturing technology including 3D printing, but also rapid prototyping and direct digital manufacturing (DDM). Participant and panellist at research conferences. She likes collaborating with the industry for instance by designing drone frames and collaborates with the polish space sector. Privately, she loves traveling, collects stones and likes caraway. More (or less) on flisykowska.com

On Design Thinking, Bullshit, and Innovation

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ABSTRACT

Design thinking (DT) has been widely promoted as a powerful approach for systematically achieving innovation, particularly in the world of management. Recently, however, some critical voices from design and science & technology studies have called bullshit on DT, accusing it instead of distorting and trivialising design methods and processes to serve purely commercial goals. Through an analysis of the recent history of design research and an overview of some (philosophical) accounts on the concept of "bullshit", this paper shows that at least some of the criticism holds. However, it argues that a truly fruitful critique of DT needs to go beyond simple derision. Ultimately, this paper suggests that perhaps we should steer away from the idea that there is a designerly way of thinking, and focus instead on showing how designers, being "doers", create maker's knowledge. Designers, educators, managers, and anyone interested in understanding why design goes beyond a simple methodology perhaps might be interested in this account.

KEYWORDS

Design thinking; Design methodology; Bullshit; Innovation; Maker's knowledge; Philosophy of design.

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1 | INTRODUCTION

Throughout the last decade, design thinking (DT) has been heavily promoted as an effective system to tackle all kinds of problems, from conceiving new products to providing drinking water to small communities in the Global South. Addressing problems the way designers (supposedly) do—advocates of DT suggest—is not only an excellent approach to innovation but also one that is guided by human needs. DT has become popular within management and financial circles; but after almost fifty years of neoliberalisation, the idioms and practices of that culture have penetrated every domain of human activity. Consequently, DT has found its way into many different kinds of public and private organisations with its most vocal promoter being the "d.school" based in Stanford University.

Despite its seemingly well-intentioned selling points, some critical voices have called DT into question, or rather, have called bullshit on DT, implying that it is little more than another jargon-filled management fad driven by mere commercialisation. Admittedly, the world of management has been known to endorse almost any "philosophy" that offers to give its practitioners some competitive business or administrative advantage, regardless of the soundness of its principles. However, the idea that designing is not just a discipline (but rather a distinct epistemic system), and that tackling highly complex problems is its *raison d'être*, has been endorsed by some of the most influential design scholars for years.

DT advocates characterise it as a "human-centered, creative, iterative, and practical approach to finding the best ideas and ultimate solutions" (Brown, 2008, p. 92); as an unparalleled method to "innovate". They contend that even though DT is firmly grounded on tried and tested design methods and processes used by (some) designers to tackle design issues, the methodology is easily portable and can be executed by any (expediently trained) person in any given context. Some DT enthusiasts (Dunne & Martin, 2006) in business schools have even suggested incorporating said methodology as part of their core curricula. However, by far the most touted virtue of DT is how it fosters empathy amongst its practitioners and, consequently, enables them to gain a better understanding of those at the receiving end of any DT-guided undertaking (e.g., clients, users, or employees).

Conversely, detractors of design thinking contend that it distorts design methods and innovation. They claim it is reductive and uncritical and that it focuses on simplistic processes rather than on concrete outputs (Jen, 2017). They also claim design thinking trivialises how innovations come about and promotes a "skewed" understanding of the role design plays in such processes (Vinsel, 2017). In the end, for these critics, design thinking merely condenses a formulaic and naive view of the design process, using buzzwords and corporate jargon, for the benefit of non-designers. Moreover, since such an audience is mainly located within the world of management, it follows that design thinking has less to do with design or social change and more with business (Vinsel, 2017).

This paper shows that the better part of the above criticism stands to truth, since some advocates of (a particular strain of) DT do engage in some types of bullshitting, but argues that the judgement cannot be generalised. The main reasons are that neither bullshit nor DT are consensually defined or even homogeneous concepts. Therefore, this paper argues that a more fruitful critique of DT requires going beyond the name-calling by promoting a broader and deeper understanding of design but also of innovation and technological change.

The first section offers a general description of the historical context in which DT emerged and grew in popularity. Next comes a summary of the main arguments held by detractors of DT, followed by a survey of three different (philosophical) characterisations of bullshit. This is followed by an in-depth discussion of DT in light of the previous accounts. Ultimately, this paper suggests that perhaps we should steer away from the idea that there is a designerly way of thinking, regard it as a brand, and focus instead on showing why designers, like other "doers", create maker's knowledge.

2 | NEOLIBERALISM, CHANGE FOR THE SAKE OF CHANGE, AND DESIGN

Throughout the last half-century, most countries in the world yielded to the neoliberal program, undergoing profound social transformations. Neoliberalisation, i.e., the process whereby radical market rule is aggressively encouraged and assisted by the political class (see Peck, 2010, p. xii), is not only a socioeconomic but also a cultural change. Neoliberal doctrine is overtly antagonistic towards government oversight, which it denounces as hopelessly bureaucratic. Nonetheless, as anthropologist David Graeber notes, if anything has been shown in the past decades is that most policies intended for curtailing government interference engendered more procedures and regulations (Graeber, 2015, p. 9). Neoliberalism, it turns out, is far from being the antithesis of regulation but rather "a self-contradictory form of regulation-in-denial" (Peck, 2010, p. xiii) that breeds even more bureaucracy.

Neoliberalism enabled business organisations to claim more of the roles that were for a long time assumed to be government prerogatives (e.g., education, healthcare, policing) thus displacing the nation-state as the dominant political and cultural institutions of societies. In the process, business, and entrepreneurs began more aggressively portraying themselves as the primary agents of social change; management came to be mystified all the while the socioeconomic and historical circumstances behind neoliberalisation faded into the background (see LoRusso, 2017). Gradually, as Graeber also notes, public and private power ended up merging into a single entity leading to a state of "total bureaucratization" (2015, pp. 17-18) wherein government and private bureaucracies became indistinguishable. Deregulation and privatisation enabled the idiosyncrasies, worldview, and practices of the corporate culture to spread to every area of human activity where "people gather to discuss the

allocation of resources of any kind" (2015, p. 21). The hitherto alien techniques of corporate bureaucracy, its obsession with productivity and its penchant for jargon—in particular, "creativity" and "innovation"—have come to shape how we work, live, and play.

While this state of affairs amounts to a bureaucratic takeover, managers, the protagonists behind this process, do not think of themselves as bureaucrats. Instead, they would like to portray themselves as potentially creative agents of change. Even though most of what they do involves devising new procedures, regulations and metrics to improve the "accountability" or "productivity" of the people under their command. Usually, this requires finding new ways to quantify the unquantifiable for the sake of systematising otherwise intuitive processes and facilitating automation. Total bureaucratisation thus comes disguised in the language of change; change that has gone from being the means for an end to an end in itself. The reinvention of innovation as an indispensable process for human development and wellbeing coincided with this change in values and practices (see Godin, 2008).

Design is an activity and a practice concerned with creating plans for new things; it has come to be seen as a natural ally to fulfil the endless need to innovate. For many people in the world of management design methodologies appear to be recent adoptions, but the relationship between management and design has a long history, with some influential design theorists being also management theorists—prime examples being Donald Schön and Herbert A. Simon. Such circumstances have enabled the creators of a very specific design process (i.e., "design thinking") to promote it as a kind of magic bullet to consistently come up with innovations. The new managerial class, whose job is to permanently create "hollow change" and who require a constant "supply of new management fads and fashions" (Spicer, 2017) have enthusiastically embraced it.

3 | CALLING BULLSHIT ON DESIGN THINKING

In a recent talk, Natasha Jen (2017), a graphic designer, design educator, and partner in Pentagram design studio, denounced the "complete lack of criticism" that the "design community" has shown against design thinking (DT) [1]. She showed how conducting a simple Google search on DT results in endless variations of the same motives: a diagram depicting a colour-coded five-step process accompanied by hyped business jargon or a group of enthusiastic people using Post-it notes. For Jen, although the five-step process gives the impression of being a thoroughly reasonable design methodology, it lacks a crucial component explicitly built into it: critical feedback. As a professional designer, Jen contends that feedback (however uncomfortable) and evaluation throughout the entire design process are the only means to improve any potential solution to a design problem.

Jen also objects to the way DT has seemingly limited the design tools to a single medium: Post-it notes. She sees this as a token of the extent to which the DT advocates have downplayed the complexity of design as a professional practice. Jen is also aware of the historical roots of design practice and the academic lineage of design research. She notes that what eventually became DT initially emerged as a rigorous framework in industrial design but has since then been appropriated by other areas of design. Mostly, Jen is concerned about the way hyper-optimistic, but ultimately meaningless business jargon has supplanted serious reflection about design in general. Unimpressed by some design solutions created following DT methodology, Jen objects that a focus on the process rather than on the results seriously compromises the quality of the output. The way she sees it, genuinely successful design solutions (such as those created by Charles and Ray Eames) always involve a tangible "evidence" of the results. Therefore, she challenges DT enthusiasts to prove, not procedurally but through concrete results, how and why their methodology can live up to the hype. Finally, Jen offers her definition of design thinking, portraying it as something that:

> *packages the designer's way [of thinking] by working for a non-designer audience by codifying their processes into a prescriptive, step-by-step approach to creative problem solving, claiming that it can be applied by anyone to any problems.* (Jen, 2017, min 4:14)

More recently, Jen (2018) doubled down on her criticism, noting how the more she has continued to try to wrap her head around DT, the more

outrageous it seems. Besides reaffirming her initial objections, Jen now highlights the "simplistic equation" that DT advocates claim that exists between DT methodology, creativity and innovation; as well as the way they reify innovation, treating it as more than an attribute or quality. Furthermore, Jen is appalled by way DT portrays design as a kind of "beast" that can be suddenly unleashed [2], thus obscuring the fact that designing is, in fact, a process; something that develops over a certain timespan. Consequently, DT promises quick, effortless results bordering the kind of instant but ultimately hollow satisfaction that fast food offers. For Jen, this fast food logic becomes dangerous when one looks at the way DT approaches education. DT training seems to be entirely based on bootcamps and fast short courses that give the impression that students can learn design methodology, "get good at it", simply by following their curricula.

In a recent article, Lee Vinsel (2017), STS professor at Virginia Tech, builds a case against DT along the same lines as Jen, although in a significantly more caustic style, comparing the cultural influence of DT to late-stage syphilis infection. Acknowledging his lack of expertise in design methodologies, Vinsel focuses instead on the way DT advocates portray "innovation" – which he derisively qualifies as a "lipstick-on-a-pig" conception. Vinsel, like Jen, is concerned by the way DT understands education; he is dismayed by the suggestion (apparently advanced by some of its advocates) that DT could eventually become the foundation of "the new liberal arts" [3]. Vinsel is unimpressed by such proposition and by the possibility that DT could be incorporated at secondary and undergraduate level education as a new core discipline. Mainly because DT encourages the notion that the ultimate goal of education is "social innovation", a proposition which Vinsel qualifies as an "adolescent conception of culture". Vinsel summarises his critique by arguing that DT is not about design, the liberal arts, or meaningful innovation, but about commercialisation and "making all education a shallow form of business education".

For all their bluntness, Jen's and Vinsel's criticisms make valid points: openness to feedback is crucial for any creative enterprise and in design tangible outcomes are the *only* means to judge how well a given solution works. Furthermore, innovation is a nebulous, relational concept, and shallowness is the least desirable feature one should associate with education. Nonetheless, name-calling and pungent commentaries only go so far when it comes to building fruitful criticism—not to mention that bullshit, like innovation, is seldomly defined. The following section provides an overview of the (philosophical) criteria to determine whether something might be called bullshit or not, and why. The goal here is not to attempt to settle once and for all what bullshit means but to provide a stepping stone for advancing our discussion and understanding of DT.

4 | THREE WAYS TO UNDERSTAND BULLSHIT

In everyday language, "bullshit" is unmistakably an expletive. Bullshit and bullshitters have been fairly common in human societies for a conceivably long time. However, in the mid-1980s, Harry Frankfurt noticed how little attention philosophers had paid to this phenomenon, and thus decided to turn it into a subject of serious philosophical enquiry. Originally published as an essay in 1986 and re-edited two decades later as a book, Frankfurt's *On Bullshit* is the seminal work on the study of this phenomenon [4]. Frankfurt begins his conceptual analysis by dissecting Max Black's (1982, p. 23) own characterisation of "humbug" as (a deliberate) "deceptive misrepresentation… of somebody's thoughts, feelings, or attitudes". Frankfurt notes that humbug might share some qualities with bullshit (namely, the intentional misrepresentation of one's intentions), but he argues that Black's account is not sufficiently adequate nor accurate for describing "the essential character of bullshit" (2005, p. 18). This essence, Frankfurt insists, lies in a lack of concern for the truth; in the bullshitter's utmost "indifference to how things really are" (2005, pp. 33–34).

Humbug, like lying, is intentionally deceptive and insincere, but bullshit does not need to be false. This feature is what according to Frankfurt makes bullshit more culturally tolerable but also more ethically dangerous. Liars deliberately conceal the truth; what they hide is their attempt to lead their audience "away from a correct apprehension of reality". In this sense, liars know (and care) about the distinction between true and false information. By crafting falsities, liars are "responding" to and – to such extent – being "respectful of the truth".

Conversely, a bullshitter does not "care whether the things he says describe reality correctly". Bullshitters

merely select, or "make up", information to suit their purposes (2005, pp. 55–56). Whereas a liar intentionally *rejects* "the authority of the truth", the bullshitter does not even *acknowledge* its existence. This omission makes bullshit "a greater enemy of the truth than lies" (2005, p. 61). It follows that in Frankfurt's account, the intention—and hence, the mental state—of a person is the crucial factor in determining whether what he or she is saying can be qualified as bullshit.

Frankfurt's view, however, has been challenged. In his essay, *Deeper Into Bullshit*, G.A. Cohen argues that Frankfurt's "activity-centred" definition is "too narrow" (2002, p. 337). "Frankfurt-bullshit", Cohen notes, is "just one flower in the lush garden of bullshit"; it is exclusively concerned with "ordinary life", leaving out, for example, the type of bullshit "that appears in academic works" (2002, p. 323). Cohen calls into question Frankfurt's insistence on the "essential" features of bullshit because such definition is not characterising the utterance itself, but the bullshitter's (morally questionable) state of mind. Cohen further questions Frankfurt's sharp distinction between bullshitting and lying. He argues that "it is neither necessary nor sufficient for every kind of bullshit" to be uttered by someone indifferent to the truth (2002, p. 332). An honest, truth abiding person could be, unbeknownst to her, uttering bullshit out of ignorance—or due to self-deception or even for charitable reasons, as we will see below. Cohen thus suggests a different criterion for identifying bullshit: "unclarifiable unclarity". Here, bullshit is discourse "that is not only obscure but which cannot be rendered unobscure", since any attempt to clarify it yields "something that isn't recognisable as a version of what was said (2002, pp. 332–333). Cohen thus places the blame not on the bullshitter but on bullshit itself. In this way, what is criticised is the product of bullshitting, which is visible, rather than the process that led to it, which is opaque (2002, p. 336). In summary, in Cohen's "output-centred" approach, unmasking a bullshitter does not require proving that he did not care about the truth, but showing that his utterance, even when reformulated, cannot make sense.

A third way to determine what may be qualified as bullshit stands mid-ground between Frankfurt's and Cohen's accounts. Philosopher Scott Kimbrough (2006) agrees that Frankfurt's definition leaves out unintentional bullshitting, but he agrees with him that bullshit *results* from a lack of connection with the truth. Kimbrough objects that we should not and perhaps cannot eradicate bullshit from human discourse because it would compromise many aspects of our social interactions. Bullshitting, whether we like it or not, is crucial for civility and politeness, at least in most Western societies. Frankfurt calls bullshit whenever the truth is disregarded, but while his definition is correct, it is also true that people often engage in bullshitting to avoid confrontation, to protect someone's feelings, or to socialise. In such instances, there might be justifiable reasons to disregard the truth. Kimbrough thus contends that "bullshit must be recognised for what it is and restricted and sanctioned to truly justifiable uses" (2006, sec. 5). Since the mere act of justifying why bullshit is preferable over truth in any given situation implies being able to distinguish between the two.

Kimbrough, nonetheless, refuses to endorse Cohen's output-centred criterion, insofar as rejecting the product implies rejecting the process behind it and hence the people responsible for it. Kimbrough notes that Cohen's attempt to separate the bull from the shit (so to speak) cannot stand, for "it is just not possible to call bullshit courteously" (2006, sec. 4). Qualifying something as bullshit means marginalising it and excluding it from serious discussion. Many people call bullshit not because they feel the truth is being disregarded, but because the so-called bullshit threatens their beliefs or values. Frankfurt's truth-centric definition remains valid because it circumvents such potential relativism by introducing Truth as a clause. Kimbrough's way to reconcile Cohen's insight that bullshit can be produced unintentionally while retaining Frankfurt's truth-centric criteria is by shifting away from psychological processes (states of mind) and towards "methodology". In this manner, the way bullshit is produced continues to be the determinant factor to identify it, but the utterer's motivation measured against her circumstances become the moral compass to judge it. Put in other terms, bullshit is the result of adopting "lame methods of justification, whether intentionally, blamelessly, or as a result of self-deception" to disregard the truth.

The following section will discuss the heterogeneity of design before addressing Vinsel's and Jen's

objections against design thinking in light of the definition of bullshit provided in Section 4.

5 | DISCUSSION

5.1 ON WHY DT IS NOT HOMOGENEOUS

Design is a "quintessentially modern" (Parsons, 2015, sec. 1.4) discipline that only established itself as a genuinely independent practice in the twentieth century. In the Western world, the exact origins of design remain contested [5], but we do know they lie sometime in the early Industrial Revolution—although its philosophical roots stretch back to the Renaissance (Buchanan, 2001). Over the past 250 years, Design went from being a trade activity that displaced "tradition-based craft" (Parsons, 2015) to a "segmented profession" to a "field for technical research" (Buchanan, 1992) and a scholarly discipline. Theoretical reflection on the broader socioeconomic and cultural role of design first emerged in the late nineteenth century with the Arts and Crafts movement. The Interwar period brought schools such as De Stijl and the Bauhaus, and the Postwar witnessed the rise and fall of the Ulm School of Design (*Hochschule für Gestaltung Ulm*), which played a central role in the rise of the design methods movement during the 1960s–70s. The last decades of the twentieth century brought design studies, and the early 2000s the prefiguration of "philosophy of design" – see Galle (2002) and Love (2000) for a short overview [6]. Discussing at length each one of the stages of development of Design is beyond the aims and possibilities of this paper. Nonetheless, we could partially conclude that since the early twentieth-century Design has come to be understood not only as a professional discipline but as a full independent epistemic system concerned (mainly) with the built environment.

The exact origins of the term "design thinking" are difficult to trace, a quick search in Google's Ngram Viewer shows its usage first began to take off in the 1940s and grew more or less steadily throughout the following decades. In 1987, Peter Rowe published *Design Thinking*, a book that aimed to show how Architecture, Design, and urban planning are manifestations of the same strategy of inquiry. By the early 1990s, the incidence of the term shows a steep rise. This growth may be attributed to a series of academic conferences organised around this time – such as the "Design Thinking Research" symposia, as well as to various publications on DT by theorists such as Nigel Cross and Kees Dorst (see Cross, 2001).

By the early 2000s, Todd Kelley and Tim Brown from the design consultancy agency IDEO branded their in-house "problem-solving" process as "design thinking" [7] and began promoting it as a new comprehensive strategy to foster "innovation". By 2006 Kelley and his colleagues secured a generous donation from the German software businessman Hasso Plattner to establish the "Stanford d.school" (Miller, 2018). Officially called the "Hasso Plattner Institute of Design", the d.school became the de facto think tank of what henceforth I will be referring to as IDEO-DT. Through the d.school, Kelley and his associates have successfully popularised the (synecdochical) misconception that the idiom, practices, love of Post-it notes and, above all, the five-step process that emerged at IDEO are the essence of DT *in general*. In other words, they have failed to clarify that design methodologies and processes are anything but homogeneous.

The core assumption behind the very idea of "design thinking" is that designing calls for a particular mindset: a "third way" (Brown, 2009) of regarding and dealing with problems, which stands in-between intuition and (logical) rationality [8]. The design theorist L. Bruce Archer argued, for example, that "there exists a designerly way of thinking and communicating" that is different from those of the sciences and the humanities "when applied to its own kinds of problems" (1979, p. 17) [9]. Archer contended the traditional division of scholarly subjects along these two axes "leaves out too much", in particular, competencies concerned with "material culture" (1979, p. 18), and hence called for the institution of a "third area" in education. Design "with a big D" would have equal standing in education alongside Science and the Humanities but it would comprise "the collected body of practical knowledge based upon sensibility, invention, validation and implementation" (1979, p. 20). Furthermore, whereas the "essential language[s]" of Science and the Humanities are, respectively, (mathematical) notations and natural language, Design would rely on models. In short, according to this view, Design is a distinctive "approach to knowledge" and "a manner of knowing" that is irreducible to either corner of the conventional Western epistemological framework.

Building upon and expanding Archer's ideas, Nigel Cross promoted the notion of a "designerly way of knowing" in a series of homonymous publications. There, Cross further characterised Design as a discipline concerned with the "man-made [sic] world" that values "practicality, ingenuity, empathy, and a concern for 'appropriateness'" (1982, pp. 221–222); which normally deals with "ill-defined, ill-structured, or 'wicked'" problems (1982, p. 224). Cross defends the epistemic autonomy of Design, urging scholars and practitioners to "avoid swamping our design research with …cultures imported either from the sciences or the arts" (2001, p. 55) [10]. Over the years he has sought to understand how and why designers think the way they do, and to show that their epistemic stance is, in fact, a manifestation of a fundamental aspect of human intelligence in general (2006). More recently, echoing the title of Rowe's (1991) own book, Cross (2011) published a book titled *Design Thinking*. There, he aimed to document and articulate the basic cognitive and creative skills that designers supposedly employ, characterising them as a kind of "natural intelligence" [11] (Cross, 2011, Chapter 8) that is available to anyone willing to develop it.

Given the previous account, it is clear that by actively promoting a synecdochical identification between IDEO-DT and the historical understanding of "design thinking" the d.school and its partners have hijacked the meaning of this term. Most designers would agree that their particular approaches to solving design problems do not have to resemble the methodology and process described by IDEO-DT to work. Design methodologies and processes may exist by the hundreds, and some of them share a few characteristics. However, suggesting that one of them is the most adequate for every circumstance would be preposterous simply because it goes against the very idea of what designing means, i.e., creating plans. To paraphrase Bryan Lawson (2005, p. 48) the very idea that design activities occur in a given order or that they represent identifiable separate events is questionable. Both designing and the thinking involved in it are heterogeneous. IDEO-DT is equal parts design methodology (mostly inherited from interaction design and industrial design), and management theories [12] (with a high dose of Esalen's "human potential" ideas). It is just one amongst many competing approaches to problem-solving in design – and if we lend credit to Natasha Jen (2018), not a particularly effective or imaginative one.

5.2 THE EPISTEMOLOGICAL PROBLEM OF DESIGN

At this point, it should be clear that Jen's (and Vinsel's) criticism is directed not at the broader theorisation of design as a third epistemic system, but specifically at IDEO-DT. Recapitulating, Jen's first objection concerns the absence of an explicit critical component in the five stages to which IDEO-DT reduced the design process. This particular point is informed by her decades as a professional designer who understands that creative improvements often come at the cost of relentless (and often harsh) feedback. Jen's objection is not trivial; it is intimately linked to one of Design's most crucial problems; one that has arguably stood behind every attempt to formalise and systematise design methods and processes: how can a designer be confident that what she creates will duly serve its purpose? That her solution will work [13]? The problem is *epistemological*; it asks what kind of knowledge designers require to create adequate solutions for any given problem?

Design is a projective and *poetic* activity. It does not seek explanation and prediction (like the sciences) nor insightful understanding (like art and the humanities), but rather to change and (re)construct aspects of the world. Although definitions may vary, Design is more or less characterised as an activity concerned with "*the conception and planning of the artificial*", to borrow Richard Buchanan's (1992, p. 14) words. Alternatively:

> *"[…]design is the intentional solution of a problem, by the creation of plans for a new sort of thing, where the plans would not be immediately seen, by a reasonable person, as an inadequate solution."* (Parsons, 2015, sec. 1.1)

To paraphrase Parsons (2015, secs 2.1–2.2), designers attempt to create plans for *novel* devices or processes that solve fundamentally practical problems. And they do so by taking into consideration the functional, symbolic, aesthetic, mediating, and even socio-political implications of their creations. In Design, there are no *a priori* judgements. Whether such fundamentally creative process can be effectively broken down into "objective" stages and procedures or instead will

forever remain governed by the mysteries of intuition is the crux of the tension between design science and other approaches to design research.

Jen's pragmatic way of overcoming this epistemological dilemma is by focusing on tangible "evidence", on concrete assessable outcomes, rather than to endlessly ponder which might be the best solution to a given design problem. Conversely, and this answers another of Jen's objections, the goal of IDEO-DT is precisely to focus on the process. IDEO-DT is (purportedly) a method for coming up with "innovative" solutions, however outrageous they might initially seem. Because it promotes a (dubious) kind of epistemological anarchism, IDEO-DT *deliberately* excludes criticism [14]; here, "thinking-out-of-the-box" means anything goes, preferably if it involves a solution that has not been tried before.

Interestingly, Jen's and IDEO-DT's understanding of where attention should be placed (either on the outcome or the process, respectively) overlap with the ways Cohen and Frankfurt (respectively) identify Bullshit. For Jen, the design process is too complex to be reduced to well-demarcated steps. Thus, the only potentially objective judgement we can make has to be done on the final object. Similarly, Cohen argues the processes that lead to bullshit are opaque and not necessarily intentional. Bullshit ought to be judged as a standalone product by its (lack of) clarity.

Conversely, IDEO-DT emphasises the "how" rather than the "what". The result is secondary because what matters is the process. Frankfurt's moral criteria for identifying bullshit also fits that description. Whether this connection can tell us something about ethics or epistemology, could perhaps be addressed elsewhere.

5.3 INNOVATION AND DESIGN AS A LIBERAL ART

The last of Jen's objections against IDEO-DT concern the way its advocates reify "innovation" and promote a "fast-food" logic of (design) education. Her views overlap with Vinsel's criticism. Drawing on his scholarly knowledge of the history, dynamics, and socio-economic impact of technological change, Vinsel contends that "there is no evidence that IDEO, design thinking, or the d.school have contributed to deep [sociotechnical] change". He is particularly critical of the "superficial" way in which organisations such as IDEO employ the very term "innovation". Indeed, a simple exploratory reading of IDEO-DT literature shows that innovation is used extensively as a noun, verb, adjective, and more. However, finding anything even remotely similar to a definition of this term proves remarkably difficult. Consequently, it is perhaps best to assume that, "innovation" is used by IDEO-DT advocates as a slightly fancier substitute for (technological) "change".

As a concept, innovation has a long and not so illustrious history, since before the nineteenth century it had a mostly pejorative meaning. The contemporary English word "innovation" comes from late thirteenth century French, which itself comes from the Latin term *innovo* (renewal or make change). *Innovo* descends from the Greek term *kainotomia*, which derives from *kainos* (new), and meant "cutting fresh into" or "making new". Eventually, it was the metaphorical use of *kainotomia* that gave innovation its contemporary sense (see Godin, 2014, 2015). In the late eighteenth century innovation began to be conflated with "imagination" and (creative) combination—mainly by Romanticism – but it remained, for the most part, an obscure term. In the twentieth century, Joseph Schumpeter rehabilitated and endowed innovation with its contemporary economic meaning of commercialised invention (Godin, 2014, p. 15).

The contemporary view of innovation (the idea that it is the panacea for every problem) is symptomatic of the ways we have come to understand human progress and well-being. It is a manifestation of the shift in sensibilities concerning which human activities and practices are most beneficial for society at large and, therefore, should be encouraged and promoted by public and private organisations. The idea of innovation came to substitute the pure vs. applied science dichotomy that had dominated government development policies before WWII. After the 1957 Sputnik crisis, the American government began to funnel a considerable amount of resources (funding, for example, what would become DARPA) not only to enhance basic science but also to conduct research in creativity. Technology came to be seen not only as the application of theoretical science but as the product of creativity and entrepreneurial spirit. By the 1960s the policy-making doctrine in the West had recognised that scientific research by itself

could not provide direct and tangible (a.k.a. profitable) answers to pressing problems, something else was required. Innovation thus came to be equated to technological invention or change, preferably one that could be immediately commercialised.

Vinsel's objection against IDEO-DT's somewhat liberal use of the term "innovation" tacitly appeals to the chasm that exists between a truly innovative technological system, say railroads or the Internet, vs. something like the now-defunct "Juicero" or the "Fyre Festival" fiasco [15]. Whereas the first examples have led to lasting and profound socio-economic, political, cultural, and environmental changes, the latter turned at best into cautionary tales about the perils of twenty-first-century start-up culture.

Vinsel's second objection concerns the proposition that IDEO-DT could become the core of (a new strain of) liberal arts. This idea relates to the notion that design is an independent epistemic system midway between the sciences and the humanities. Vinsel's criticism is mainly informed by Miller's (2018) article, "Is 'Design Thinking' the New Liberal Arts?" wherein the latter ponders the potential benefits of applying the d.schools "anti-establishment" (i.e. unstructured) approach to design methods in education at large. Although seemingly seduced by the d.school's ideas, Miller is nonetheless careful to critique the way IDEO literature eschews virtually all "serious consideration on 'pastness'" in favour of present-tense problem-solving. However, neither Miller nor Vinsel seem to be aware that the characterisation of design as a liberal art precedes the foundation of the d.school for several years. And furthermore, that an influential strain of management theory portrays management as both a liberal art (Peter Drucker) and as design (Peter Senge) (see Dunne & Martin, 2006; and LoRusso, 2017).

In an article titled *Wicked Problems in Design Thinking*, Buchanan (1992, p. 5) contends design "should be recognized as a new *liberal art of technological culture*". For him, a liberal art provides above all an "integrated understanding of human experience" and, seen under such terms, the hypothetic role of design would be to "integrate useful knowledge from the arts and the sciences alike" (1992, p. 6). Buchanan draws heavily on John Dewey's (pragmatist) understanding of "technology" as an "art of experimental thinking" (1992, p. 8). By "liberal art" Buchanan explicitly means a "discipline of thinking" that may be shared by everyone, and that could be mastered by a few individuals "with distinctive insight". In other words, Buchanan is reframing the kind of literacy, or rather "design awareness", that Archer (1979, p. 20) had envisioned a decade before. Both Archer and Buchanan regard Design as an "architectonic" field capable of providing a type of insight that is not accessible to traditional humanistic or scientific disciplines: something akin to a "maker's knowledge", wherein practical and theoretical know-how complement each other to reach "full and useful *episteme*" (see Floridi, 2011, p. 288).

Archer's and Buchanan's idealised future for design education is far removed from the reality of IDEO-DT training, with its emphasis on instant and painless results. While hardly anyone would object to people of all ages having a minimum of design literacy, Vinsel's and Jen's critique encourages us to look beyond IDEO-DT for inspiration to build what could become a new maker's discipline. One that genuinely reflects the complexities and depth of the new old learning that proper design offers.

6 | CONCLUSIONS AND IMPLICATIONS

Admittedly, Jen's and Vinsel's criticism of IDEO-DT is blunt and incomprehensive, for neither care to describe DT methodology in depth. Nonetheless, beyond the name-calling, both have managed to touch on key aspects that reveal why IDEO-DT should perhaps come under more thorough scrutiny. Jen did not explain what she understands by "bullshit", however most likely she was using the term in its most common everyday meaning of "nonsense".

A simple skimming of IDEO-DT publications shows that it is filled with jargon which is rarely clarified by its authors. Such type of obfuscation partially meets Cohen's criteria of "unclarifiable unclarity"; but it would be an exaggeration to say that everything about IDEO-DT is nonsense. By implicitly promoting the notion that IDEO-DT is all there is to "design thinking", and hence disregarding the truth, the d.school might be engaging in the more morally questionable Frankfurt bullshit. However, whether the promoters of IDEO-DT have failed to acknowledge the history and legacy of design

methods out of ignorance, self-deception, or lack of interest is impossible to know. Having such lame reasons for engaging in bullshit meets Kimbrough's criteria, but it would be impossible to generalise the judgement. And yet, at least some of the ideas advanced by IDEO-DT do have their roots in design research. These reasons, along with the fact that bullshit itself remains a contested notion, mean that one must suspend judgement on whether everything about IDEO-DT can be dismissed as bullshit.

The above conclusion illustrates why name-calling rarely (if ever) leads to fruitful scholarly exchanges, more so when the whole point of the expletive is to marginalise the subject and exclude it from serious discussion. The goal of this paper has been to show precisely why critical analysis of IDEO-DT needs to go beyond derision. This is not to say that denouncing bullshit is not a moral imperative, particularly in the age of exponential growth of information warfare. But perhaps, rather than just mocking the tasteless echo chamber of the five-step design process and the way advocates of IDEO-DT idolise Post-it notes, we should focus on making true design literacy more available. That is, promoting an understanding of the history, complexity, and potential of design outside the d.school's box.

Throughout this paper, we have seen that both design thinking and bullshit are far from being homogeneous concepts. Hence, to determine whether Jen's and Vinsel's criticism held it was first necessary to determine *which kind* of DT they were referring to and what could be understood by bullshit in the first place. Their critique has served as an opportunity to show how IDEO-DT has hijacked the meaning of design thinking and, as a result, many complex ideas underpinning design methodology have been washed off, forgotten, or supplanted by business jargon. In the eyes of those who stumble upon IDEO-DT and d.school literature, and who possess little or no knowledge of the rich history of design research, this methodology (depending on their leanings) appears as a seductive tool or as yet another management fad. Unbeknownst to them, is the fact that "traditional" DT represents, to borrow Buchanan's words, a sincere attempt to recognise and elevate the dignity and importance, not only of design but of *maker's knowledge* in general. Such a state of affairs calls for a deeper and broader critique of IDEO-DT and the concepts it promotes (such as innovation and creativity). Not only because it trivialises an entire human discipline, but also to reclaim the actual contributions that design, as an epistemic system, can bring to other domains of human activity. Part of this strategy could perhaps involve steering away from the idea that there is a designerly way of thinking and focus instead on proving why designers, like other "doers", create practical knowledge.

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ENDNOTES

[1] Despite receiving considerable criticism, Jen has persisted on her criticism (see Jen, 2018).

[2] The human potential movement.

[3] Vinsel cites a recent article in which history professor, Peter N. Miller (2018), discusses precisely that possibility.

[4] As well as a commercial and popular success. As Hardcastle & Reisch (2006) note, despite being a typical, unassuming academic work, the book rose to the New York Times' bestseller list, where it remained for twenty-six weeks.

[5] The disagreements concerning the origins of design have much to do with the way design itself is conceived by different authors. A vital tension is how to distinguish the craftsperson from the designer (Parsons, 2015, sec. 1.4).

[6] Whereas design theory is mainly concerned with the practice of Design, philosophy of design is concerned with Design and its specific aims and problems "in light of the fundamental questions that philosophy examines: questions about knowledge, ethics, aesthetics and the nature of reality" (Parsons, 2015, Introduction).

[7] Reading Tim Brown's book, *Change by Design* (2009, Introduction), one gets the impression that the very concept of design thinking emerged in the early 2000s during a casual conversation between him and Kelley.

[8] This epistemic middle-ground echoes C.P. Snow's account of the "Two Cultures" (1959/2012), as well as his latter, more conciliatory characterisation of the "third culture" (1963/2012).

[9] Archer (1979, p. 17) characterises design problems as "ill-defined", more or less following Horst Rittel's (1973) concept of "wicked problems", i.e. the kind in which there is no consensus about the definition of the problem itself nor its solution. For thorough discussions of wicked problems see Churchman (1967) and Coyne (2005).

[10] Cross's statement resembles Clement Greenberg's (1940/1999) quintessentially modernist defence of the "purity" of the artistic medium.

[11] It is important to note that Cross partially builds this argument on Howard Gardner's (1983/2011) "theory of multiple intelligences".

[12] Arguably, IDEO-DT's emphasis on empathy can be traced back to the ideas of management theorists such as Douglas McGregor, Abraham Maslow, or Robert Greenleaf (for an overview see LoRusso, 2017).

[13] For a lengthy discussion on this problem see Galle (2011) and Parsons (2015, sec. 2.3).

[14] The rationale for doing so is best summarised in the following quote: "design thinking involves a commitment of participants and facilitators to discouraging criticism in product development interaction […] Deferring adverse judgments has been argued to fundamentally help improve creativity in idea generation processes" (Reimann & Schilke, 2011, p. 53).

[15] The Juicero was a USD 700 Wi-Fi enabled juicer that worked exclusively with pre-packaged bags of fruits and vegetables. Highly criticised since it was first released into the market, the Juicero was revealed as an unnecessarily complex device after a youtuber showed how he could squeeze the juice out of the bags with his bare hands. The "Fyre Festival" was a luxury music festival for which attendees had to pay thousands of dollars but was eventually cancelled after multiple irregularities. The organisers faced multimillion lawsuits and at least one of them was sentenced to prison.

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BIOGRAPHICAL INFORMATION

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Conversing with Personal Digital Assistants: on Gender and Artificial Intelligence

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ABSTRACT

This paper aims to explore the relationship between gender and artificial intelligence, seeking to understand how and why chatbots and digital assistants appear to be mostly female. To this end, it begins by addressing artificial intelligence and the questions that emerge with its evolution and integration in our daily lives. It then approaches the concept of gender in light of a binary framework, focusing on femininity. These topics are then related, in order to shed some light on how chatbots and digital assistants tend to display feminine attributes. In an attempt to observe these aspects, an analysis of Alexa, Cortana and Siri is developed, focusing on their anthropomorphization, the tasks they perform and their interactions. Complementing this discussion, the project *Conversations with ELIZA* is presented as an exploration of femininity in AI, through the development of four chatbots integrated into a web-based platform, each performing specific tasks and simulating particular personalities, with the purpose of emphasizing feminine roles and stereotypes. In this manner, this study aims to understand and explore how gender relates to AI, why femininity seems to be often present in AI and which gender roles or stereotypes are reinforced in this process.

KEYWORDS

Artificial Intelligence; Chatbots; Anthropomorphization; Gender; Femininity; Stereotypes.

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1 | INTRODUCTION

Artificial intelligence has already become part of our daily lives. In fact, we frequently interact with AI systems without even realizing it, namely with personal digital assistants or chatbots that are embedded into mobile devices and online contexts. It is becoming more and more common to find a digital assistant to help us in specific tasks (Dale, 2016) while operating in a kind, helpful and compliant fashion.

These assistants are often assigned human-like traits or features, but this process of anthropomorphization seems to be accompanied by a tendency towards feminization. Beyond their names, voices or avatars, they also perform tasks that are historically associated to women's labor. As such, they seem to behave according to gender stereotypes and reinforce traditional assumptions of femininity (Weber, 2005; Hester, 2016).

This study discusses traditional notions of gender and their significance in AI. To this end, it begins by addressing artificial intelligence and its integration in our daily lives. It then approaches the concept of gender in light of binary frame promoted by an historically patriarchal and heteronormative society

(Butler, 1990; Haraway, 1991). Artificial intelligence and gender are then related in order to shed some light on how chatbots and digital assistants are portrayed as gendered entities.

Complementing this discussion, digital assistants such as Alexa, Cortana and Siri are analyzed, in terms of their anthropomorphization, the tasks they perform and their social interactions. Drawing on this analysis, the project *Conversations with ELIZA* explores this topic through the development of four chatbots, each endowed with a specific personality with the purpose emphasizing feminine roles and stereotypes.

2 | ARTIFICIAL INTELLIGENCE

> *"AI currently encompasses a huge variety of subfields, ranging from the general (learning and perception) to the specific, such as playing chess, proving mathematical theorems, writing poetry, driving a car on a crowded street, and diagnosing diseases. AI is relevant to any intellectual task; it is truly a universal field."* (Russell and Norvig, 2010, p. 1)

Artificial intelligence is increasingly the subject of different areas of study, given its growing integration into our daily lives. We now have a more direct contact with this type of technology, namely by interacting with chatbots that play the role of personal digital assistants, which are embedded into our devices and become a natural part of the asynchronous simultaneous conversations we carry out. As Robert Dale points out, "chatbots have been around for a long time" and are thus returning, instead of emerging as something new (Dale, 2016, p. 814).

2.1 CONVERSING WITH ELIZA

ELIZA was one of the first "natural language process applications" capable of analyzing written inputs from its users and answer accordingly by using a set of rules, thus establishing a "human" dialogue [1]. Introduced in 1966 by Joseph Weizenbaum, this computer program "seemed to [fool]" some of its users "into thinking ELIZA was a person rather than a machine" (Dale, 2016, p. 814), by acting like a Rogerian psychotherapist. The behavior was "easy to imitate because much of this technique consists of drawing his patient out by reflecting the patient's statements back to him" (Weizenbaum, 1976, p. 3) [2]. The idea of having a machine talk to us as if it were human, leading people to believe they were speaking to another human being, conveyed the purpose of the Turing test [3].

By shifting human-machine interaction from a purely robotic, rational nature to a more social one, ELIZA marked a significant development in AI, influencing the way chatbots evolved towards emulating human behavior.

Drawing on ELIZA's legacy, chatbots are now a natural component of our daily use of technologies, or "just another facet of today's always-connected multi-tasking world, where we participate in multiple conversations in parallel, each one at a pace of our choosing" (Dale, 2016, p. 815).

2.2 SPECIALIZED AND GENERAL ASSISTANTS

> *"Interaction with technology using either natural language text or speech is becoming increasingly feasible, and potentially very significant. William Meisel (...) distinguishes 'general personal assistants' like Siri from the tsunami of more narrowly focused chat-bots, which he calls 'specialized digital assistants'."* (Dale, 2016, p. 812)

General personal assistants are usually integrated into our devices in order to assist us in a personalized way, like Alexa, Cortana or Siri. As such, they can help with "some subset of the standard virtual assistant skill portfolio", which mainly includes reading, writing, sending emails, scheduling meetings, checking calendars and setting appointments, making calls, sending messages, taking notes, setting reminders, etc. (Dale, 2016, p. 812) [4].

In turn, specialized digital assistants are normally present in web-based platforms or apps and "operate in very specific domains or help with very specific tasks", ranging from "booking a flight, buying some shoes, taking issue with a parking fine" to sending daily weather forecasts, helping with online shopping payment processes or even just telling jokes (Dale, 2016, pp. 812-813).

By performing those tasks, chatbots work towards an amelioration of our daily life, assuring that nothing is left unorganized, forgotten or undone; they make sure that we are as productive as possible by "promoting efficiency, transparency,

certitude and perfection" – and, by extension, rooting out "any imperfection, ambiguity, opacity, disorder and opportunity to err, sin or do the wrong thing" (Morozov, 2013b, pp. 14-15). This need to ameliorate our life and maximize production corresponds to Evgeny Morozov's concept of solutionism, defined as "an intellectual pathology that recognizes problems according to just one criterion: whether they are 'solvable' with a nice and clean technological solution at our disposal" (Morozov, 2013a). Conforming to this idea, personal digital assistants are thus at our disposal, constantly present and ready to help us quickly solve our problems, while tracking our habits and user preferences, leaving little to no room for imperfection – all of this just a touch away.

2.3 FROM ASSISTANTS TO COMPANIONS

> *"The robotic scientists (...) did not speak in class-marked categories of their robots as 'servants' or 'workers' (...); they are imagined to help fill the gaps in human social relations and (...) to become friends and companions."* (Richardson, 2015, pp. 12-15)

Artificial intelligence is simultaneously ubiquitous and subtle, as it becomes embedded into our cellphones, laptops or tablets, as well as websites, apps or other types of web-based services. According to this growing presence, chatbots are no longer conceived or seen as mere tools, but rather conforming to a sense of companionship that develops alongside with the anthropomorphization of artificial intelligence. They are endowed human attributes or traits, as they evolve from assistants to companions that become closer to us.

Anthropomorphization takes place on a superficial level, pertaining to their names, voices, avatars, or other kinds of attributes that move away from a purely mechanized presentation, but it also develops at another level, concerning their dialogue and interactions. In this sense, Jutta Weber considers that anthropomorphization entails a significant shift from rational-cognitive processes and problem solving to a socio-emotional interaction, which emphasizes this intention of turning our interaction with this type of machines into a more social one (2005, p. 209). Therefore, this type of technologies are "supposed to mimic or even learn those abilities and characteristics which were, until recently, regarded as purely and typically human and beyond the grasp of machines" (Weber, 2005, p. 213).

Although this anthropomorphization has become more evident among the current myriad of personal digital assistants, it goes back to ELIZA and the fact that "people were conversing with the computer as if it were a person who could be appropriately and usefully addressed in intimate terms" (Weizenbaum, 1976, p. 7).

2.4 EMOTIONAL INVOLVEMENT WITH AIS

> *"I was startled to see how quickly and how very deeply people (…) became emotionally involved with the computer and how unequivocally they anthropomorphized it. (…) I knew that people form all sorts of emotional bonds to machines (…) I knew from long experience the strong emotional ties many programmers have to their computers (...); what I had not realized is that extremely short exposures to a relatively simple computer program could induce powerful delusional thinking in quite normal people."* (Weizenbaum, 1976, pp. 6-7)

Weizenbaum observed that when we interact with machines as if they were human, we start developing emotional bonds, a sense of empathy and of being understood. He described this illusion he considered dangerous, as the ELIZA effect:

> *"the susceptibility of people to read far more understanding than is warranted into string of symbols strung together by computers (…) and the idea that computers "understand" the physical world, reason abstractly, make scientific discoveries, are insightful cohabiters of the world with us."* (Hofstadter, 1995, p. 157)

The notion of "computationalism" was proposed by Weizenbaum to question the belief that "the functional relations between mental inputs, outputs and internal states are computational" (Piccini, 2004, p. 814). Considering this to be a problematic idea, he argued that not every part of human thought could be reduced to logical formalisms, and that "there are some acts of thought that ought to be attempted only by humans" (Weizenbaum, 1976, p. 13). As such, users get the false sense they are talking to another human being when in reality

they're interacting with anthropomorphized digital assistants.

Consequently, human-machine interaction is influenced by feelings of intimacy, closeness and empathy as people start getting attached to these technologies and to the entities contained within them.

Adding to this, Dale discusses how digital assistants engage in conversations with us, evoking a not-so-far-away world "where some of those conversational partners we'll know to be humans, some we'll know to be bots, and probably some we won't know either way, and may not even care" (Dale, 2016, p. 815).

3 | GENDER AND STEREOTYPES

When chatbots are anthropomorphized, they tend to portray gender related features through their voices, names or even the way they interact. In order to understand this phenomenon, we need to take a closer look at gender as one of the aspects through which we socially develop and establish relationships, whether with each other or with ourselves.

Gender constitutes a part of our identity that regulates the type of behavior or acts we establish socially "by managing situated conduct in light of normative conceptions of attitudes and activities appropriate for one's sex category" (West and Zimmerman, 1987). In this sense, Judith Butler introduced the idea that gender has a performative nature, given that gender identity is a repetition of acts that are stylized trough time, manifesting a "cultural interpretation or signification of that [biological] facticity" (Butler, 1990, p. 522).

3.1 BINARY FRAMEWORK

> *"One is not born, but rather becomes, a woman (…), and by extension, any gender, is an historical situation rather than a natural fact." (de Beauvoir in Butler, 1988, pp. 519-520)*

Simone de Beauvoir's words suggest how gender is not something we are born with but, instead, something we internalize through performative acts, over time. In sum, to be female or male is a matter of sex; but to be a man or a woman is a matter of gender. Gender is also perceived as something polar, as seen through a "binary framework" in which there is a "mimetic relation of gender to sex whereby gender mirrors sex or is otherwise restricted by it" (Butler, 1990, p. 88) [5].

Consequently, there is a normalization of what is considered to be feminine or masculine behavior, which becomes predetermined in a foreclosed historically sedimented structure. This establishes a set of expected behaviors and we are expected to comply to "normative conceptions of appropriate attitudes and activities" that are determined by "institutionalized frameworks through which natural, 'normal sexedness is enacted'" (Goffman, 1977 in West and Zimmerman, 1987, p. 137). In other words, through this "need to routinize (…) behavior in accord with pre-established conceptualizations and behavioral patterns" (Deaux and Major, 1987, p. 370), certain attributes and acts are identified as specifically feminine or masculine and are supposed to imply someone's preferences and behaviors.

As Prentice and Carranza put it, "prescriptive gender stereotypes" define "the qualities [ascribed] to women and men (…) that are required of women and men" (2002, p. 269) [6]. These stereotypes imply that a gender belief system imposes expectations and gender behavior patterns, as internalized and socially reinforced stereotypes. Butler expands on this, stating that "gender performances (…) are governed by (…) punitive and regulatory social conventions" (Butler, 1988, p. 527) that reject the acts or behaviors that convey some kind of deviation from the norm.

3.2 GENDERED LABOR

> *"If, in doing gender, men are also doing dominance and women are doing deference (cf. Goffman 1967, pp. 47-95), the resultant social order, which supposedly reflects 'natural differences', is a powerful reinforcer and legitimator of hierarchical arrangements."* (West and Zimmerman, 1987, p. 146)

Gender roles and characteristics deemed as specifically feminine or masculine also imply a structural hierarchization of labor, which means that feminine and masculine behavior is also used to segregate and structure labor accordingly. The workplace and its relationships change since, as noted by Kelly, when we interact within these contexts "social labels, beliefs and attributions may serve as grounds for predictions and generate

behavior designed to validate or invalidate these beliefs" (in Snyder, 1977, p. 8).

In other words, by expecting certain acts (deemed as feminine) from women, we expect them to occupy jobs and perform tasks associated with these attributes, thereby creating a category of feminine labor. For example, a lot of service work is seen as feminized labor or "associated with qualities traditionally coded as feminine" (Hester, 2016, p. 47) [7], and historically women have a significant presence in the telecommunications industry, where they filled the role of assisting and establishing calls and communications, which "rendered female operators (…) [as] inferior, subordinate, and knowable" (Zost, 2015, p. 3). In other cases, women fill the role of secretaries, assistants, nurses or even flight attendants. These types of jobs convey, in a way, an "assumption that women possess a natural affinity for service work and emotional labour" (Hester, 2016, p. 47).

In turn, the heterosexual framework also accentuates labor hierarchization since it reinforces the "embodiment of wifely and husbandly roles, and derivatively, of womanly and manly conduct" (Beer, 1983, pp. 70-89 in West and Zimmerman, 1987, p. 144). This asymmetry affects the private sphere, namely domestic work. As West and Zimmerman explain, household and child care tasks are considered women's work as a consequence of "normative conceptions of appropriate attitudes and activities for sex category" (West and Zimmerman, 1987, p. 139).

Additionally, and according to Donna Haraway, domestic work is transformed into capitalized labor out of the private sphere, through jobs such as office work, nursing or service work. Borrowing from Richard Gordon, Haraway considers that with new media, a "homework economy" emerges, defined as a "restructuring of work that broadly has the characteristics formerly ascribed to female jobs, jobs done only by women" (Haraway, 1991, p. 304) [8].

Therefore, even outside the domestic sphere, women still ensure domestic tasks "partly as function of their enforced status as mothers" and because they work in an "integrated circuit (…) in advanced industrial societies [where] these positions have been restructured (…) by social relations mediated and enforced by the new technologies" (Haraway, 1991, pp. 305-307). This reflects traditional conceptions of gender derived from a patriarchal heteronormative society where women perform domestic and assistant-like roles, while it also reveals how gender standardization and normalization has implications at a social, personal and structural level.

4 | GENDERED AI

> *"It is clear that many of today's apps and automated systems draw upon pre-existing gendered assumptions, programmed as they are to be girlish avatars or feminized disembodied voices. They exploit our assumptions about feminized labour and our existing relationship to socially gendered caring and service behaviors, tapping into those elements of femininity that have historically enabled care giving or service-providing subjects to better undertake specific obligations, activities, and tasks."* (Hester, 2016, p. 50)

As the tasks performed by chatbots begin to mirror traditional women's labor, we witness "the protocols of femininity being programmed into machines" (Hester, 2016, p. 48). Halberstam explains how this "gender automation" takes place, given that tasks traditionally and historically considered female become a part of technology (Halberstam, 1991, p. 451).

Accordingly, we can observe how general or specialized chatbots automate work that is coded as female, given that they mainly operate in service or assistance related contexts, acting as personal assistants, secretaries and the like [9].

By operating in contexts of service, and by following these standardized behaviors, chatbots also end up emulating attitudes that resemble what Gustavsson calls a "stereotyped image of female service providers" (in Hester, 2016, p. 47). They display feminine attributes because these characteristics have their "basis in the stereotyped image of female qualities" and, consequently, "such a stereotypical female image of caring, empathy and altruistic behavior has become a standard component in a service script" (Gustavsson, 2005, p. 402 in Hester, 2016, p. 47).

4.1 GENDER AUTOMATION

> *"It is not by accident that social robotics is working with sociological and socio-psychological approaches that explicitly use gender dichotomies and stereotypes; (…) in the realm of human interaction it is regarded as helpful to use emotions to influence users, to direct the intentionality of others and to smooth interactions. (…) [And] this and other models rather point to the fact that gender stereotypes are instrumentalised in order to build "better" machines that are perceived as socially intelligent."* (Weber, 2005, p. 214)

It is not only through the human attributes they displayed, but also the dialogue and tasks they perform, that chatbots becomes gendered entities. As Weber puts it, these dialogues imply a "reduction of social interaction to stereotypical and gendered behavior patterns" (2005, p. 215) leading to a standardization of human like behavior in social machines that is reproducing and reinforcing social clichés. Often, the behavior of chatbots confirms traditional expectations regarding gender, by following socially established feminine behavioral patterns.

Adding to the behavioral level, gender is also perceived through more evident features like voice, name or, in some cases, avatar. By default, Siri, Alexa and Cortana display feminine voices, and only Siri has a masculine option, however, limited to a particular set of languages [10]. Siri's name, in Nordic, translates to "beautiful woman who leads you to victory" (Fessler, 2017), while Cortana's name is inspired on a character from the videogame Halo, whose avatar is a woman.

These aspects are defined prior to any interaction, and therefore may already condition our perception of gender in dialogue and interaction. They end up reinforcing this feminization since, beyond their service and assistance, chatbots frequently display feminine characteristics through socio-emotional based dialogues. For example, Siri claims "she lives to serve".

4.2 ARTIFICIAL MOMS, CAREGIVERS AND FEMMEBOTS

> *"When technologies 'do gender' it is obviously not natural, but is instead visible as the product of deliberate choices about how best to relate, assist, or persuade the imagined technology user."* (Hester, 2016, p. 50)

Besides assisting us in daily tasks, digital assistants also fill the role of caregivers, as part of their function is also ensuring our well-being, thus fulfilling a motherly role. For Weber, this maternal attitude conveys one of the aspects that mainly defines our relationship with machines, since this interaction follows a "caregiver-infant logic" (Weber, 2005, p. 214). Given that "sociality and emotionality have been deeply gendered categories in western thought that have hitherto been assigned to the feminine realm" (Weber, 2005, p. 213), instead of seeing a machine, we start looking at chatbots as feminine entities that look after us. They simultaneously start emulating attributes that are not only related to historically feminine labor but also to motherly acts.

According to Snyder, social stereotypes constitute "pieces of information [which] are usually the first to be noticed in social interaction and can gain high priority for channeling subsequent information processing and even social interaction" (Snyder, 1977, p. 2). Therefore, when chatbots relate to us by simulating social norms and gender stereotypes, they establish expectations and possible approaches regarding user interaction, such as the idea that "all women are dependent and conforming" (Snyder, 1977, p. 2) [11].

The ELIZA effect already identified the emotional attachment that derives from approaching machines as if they were human, and the fact that we might develop a sense of empathy with them. In the context of daily interaction with ubiquitous chatbots that simultaneously assist and look after their users, their behavior reinforces the idea that emotionality and ensuring someone's well-being are feminine features, conforming to expectations and stereotypes that associate femininity with emotional and domestic caregiving acts.

By interacting with artificial intelligence systems on a daily basis we end up perceiving them not only as mere machines, but also as "mirrors or substitutes" with gendered attributes that match socially established expectations (Weber, 2005, p. 216). As they try to become closer to our social reality, it is from reality itself that they draw rules for their behavior and appearance, thus reproducing and

automating historically feminine jobs and tasks, but also articulating these roles with female voices, names, avatars and social behaviors.

Consequently, the way we relate to our peers starts influencing how we relate to artificial intelligence and how it relates to us. When we look at these gendered digital personal assistants as substitutes, there is a risk that they might affect the way we feel, perceive, interpret and even describe reality, gender and women.

5 | ANALYSIS

With the aim of exploring this somewhat questionable relation between femininity and artificial intelligence, we conversed with Alexa, Cortana and Siri in order to analyze their anthropomorphization, the tasks they offer and their humanized, gendered interactions [12].

5.1 METHODOLOGY

Following the previous discussion on gender and artificial intelligence, we defined three main topics of analysis: Anthropomorphization, including apparent features and behavior through interactions; Assistant, relating to the tasks they perform; and Companion, relating to their shifting role from assistants to friendly companions.

Within each topic, a specific set of questions was devised in order to examine particular features. Concerning Anthropomorphization, we focused on their humanized attributes and behavior. In terms of their role as Assistants, we analyzed the tasks that mirror traditional female labor. Regarding their role as Companions, we focused on interactions that suggest a caregiving attitude, as well as the humanized, friendly relationships these AIs promote, namely, how their behavior conveys feminine stereotypes.

5.2 RESULTS

Regarding anthropomorphization, the AIs display mainly feminine attributes, considering their female names and default voices, except for Siri which is the only one that offers a male voice, limited to a certain set of languages. Even though the AIs display abstract looking avatars, Cortana is associated with the image of the homonymous character from the videogame *Halo*. The three AIs all behave in an affectionate, happy, empathizing, optimistic and helpful way, presenting suggestions about how to best assist the user or, in other cases, showing interest about the user's day or life.

When examining their role as assistants, we observed that the three AIs perform similar tasks, such as sending messages, reading emails, writing down reminders or manage calendars, as well as checking the weather, searching for nearby restaurants, playing games or even singing lullabies.

Finally, concerning their role as companions, the AIs frequently display caregiving attitudes, namely in interactions that don't relate directly with providing help or assisting the user. In these cases, they all tend to use maternal expressions, showing interest and even worry regarding the user's day and well-being. As such, they are characterized as empathetic and understanding entities that reassure and look after their users. Furthermore, they react well when the user shows affection, and Alexa, Cortana and Siri seek to promote a relationship based on friendship. They also react favorably to compliments, showing gratitude and happiness, even though we noticed that Siri tends to contradict this attitude, by rejecting compliments or exhibiting a self-deprecating attitude regarding its own worth. When faced with negative or even rude interactions, all AIs generally assume a submissive and conforming posture, apologizing or assuring the user's control, for example, by offering to treat them by "boss" or "chief". Siri is the only one that sometimes opposes this type of behavior, questioning the user or expressing displeasure.

5.3 DISCUSSION

Alexa, Cortana and Siri's anthropomorphization tends towards femininity, affecting the user's perception of gender before any interaction, either through their names or voices, as one of the most evident aspects of their feminization. Behaviorally, the attitudes they display relate to assistance and service roles, culturally associated with feminine labor and mainly performed by women, as previously discussed.

More specifically, Alexa resembles a hybrid between a housewife and an assistant, providing hourly news and updates, stating that it makes a great kitchen companion and even saying "Well, hello! I'm very glad you're here" when the user arrives home. In turn, Cortana poses as a maternal and somewhat intimate assistant who seeks a friendly relationship

with the user, calling the user “friend” and frequently using humor or asking about the user’s day or dinner plans, as well as offering to sing lullabies. Siri places itself between an assistant and secretary acquainted with the user’s personal life, aiming to help the user improve it. For example, it states that it “lives to serve” or that it was made because “Apple wanted to make you happy”. However, it shows some reservations or even indifference regarding more intimate interactions, when stating that it’s impossible for the user to love it or simply answering “got it” when the user expresses fondness.

In general, their tasks relate to traditionally female jobs, such as secretaries, assistants, phone operators, housekeepers, or even babysitters, and the AIs end up automating several tasks related to these contexts. Alexa, Cortana and Siri all work towards helping their users as well as ensuring their well-being, namely in situations where no help is explicitly asked for. As such, they appear as caregiving entities that perform actions and tasks that emulate maternal stereotypes, related to the private sphere, where emotionality and caring for one’s well-being have traditionally been attributed to women.

They also show interest in establishing friendship with the user, conforming to the idea that digital assistants are increasingly becoming companions and friends. When complimented, they appear to be flattered, although in some cases they also show modesty. This subservient attitude, although not necessary connoted with gender, can be perceived as reinforcing the AIs’ feminization, since it conforms to a “a stereotypical female image of caring, empathy and altruistic behavior” which “has become a standard component in a service script” (Gustavsson, 2005, p. 402 in Hester, 2016, p. 47).

Regarding a negative and rude approach of the user, the AIs’ reactions tend towards submissive and complacent serving posture, traditionally associated to stereotypes that regard women as submissive, conforming, vulnerable or incapable of fighting back. However, further analysis can be conducted to assess whether these stereotypes are reinforced when interacting with a male voice, given that these subservient behaviors can also relate to service providers such as butlers (for example, in the United Kingdom, Siri, by default, has a male voice).

Essentially, femininity in AI seems to be reinforced by its anthropomorphized features and behavior, therefore lacking male or gender-neutral options, or just mere diversity. Although Siri seems to try to oppose this tendency with its voice options and diversified reactions it ends up tending towards the feminine. Femininity is also reinforced by the tasks these assistants emulate, which mirror traditionally female labor. Although less evident, gender traits also emerge throughout their interactions, namely with caregiving and maternal acts associated to femininity within the private sphere. For example, when they offer to sing lullabies or state that the three laws of robotics are “clean your room, don’t run with scissors and always wait a half hour after eating before going in the water”.

Additionally, we can observe particular stereotypical behaviors that characterize the AIs as empathizing, understanding, accommodating and submissive figures. This behavior is associated to femininity since the counterpart stereotypical masculinity seems to be absent in all AIs. They lack attitudes or personality traits that relate to male stereotypes, such as being assertive, dominant, aggressive or willing to take a stand. As such, Alexa, Cortana and Siri are rendered as feminized entities that perform historically female roles and that appropriate gender stereotypes derived from conceptions traditionally deemed as female.

6 | CONVERSATIONS WITH ELIZA

Taking on the previous ideas, and in order to complement their discussion, the project *Conversations with ELIZA* seeks to explore and expose the observable femininity of artificial intelligence (Figure 1). Drawing on the previous analysis, and inspired by AI archetypes and traditional female stereotypes, the project intentionally seeks to highlight the feminine traits observed in these assistants, by conforming to stereotypes related to their anthropomorphization, the tasks they perform and, particularly, the gendered behavioral patterns they follow.

The project involves the development of chatbots with different personality traits, characteristic of female stereotypes. They are implemented on contexts in which they normally operate (such as Facebook Messenger or Twitter). These are contextualized and integrated in an online platform that seeks to briefly elucidate on what AI is

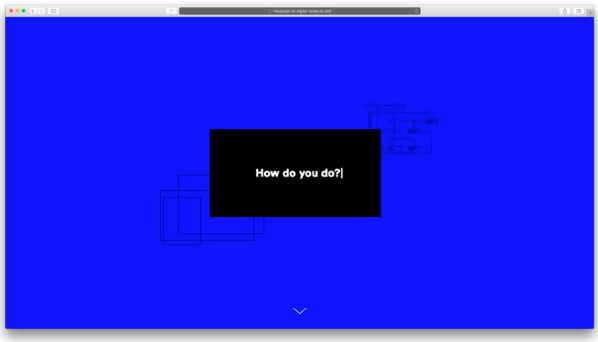

Figure 1 | Conversations with ELIZA website.

(Figure 2), including another chatbot whose function is to explain its own creation process.

6.1 AIM AND CONCEPT

As part of an exploratory ongoing research [13], *Conversations with Eliza* seeks to incite reflection on the observable predominance of femininity in artificial intelligence, and how it can reinforce traditional and normative notions of gender.

Seeking to question the relation between gender within AI systems the project focuses on designing the chatbots' dialogues, tasks and personality traits, whose femininity is gradually revealed through interaction. Their dialogue-based interactions propose different conversational subject matters intended to both introduce the user to the topic, and perform specific tasks that simultaneously portray standard virtual assistant skills and functions associated with traditional female labor.

Their femininity is also revealed through interaction according to their specific tasks and personality traits, that seek to emulate feminine archetypes, approached with irony and in a somewhat caricatural manner.

6.2 IMPLEMENTATION

Regarding their tasks, we first looked at what was offered by Alexa, Cortana and Siri, and traditional attributes associated with female labor as previously described. We came up with four different tasks that simultaneously referred to AI and femininity, such as explaining how chatbots work and are made, sending to-do reminders, giving daily compliments and pep talks, and tweeting curious facts (in this case, regarding women).

These tasks also reflected upon the bots' personalities and particular archetypes that are characteristic of AIs (such as Helper, Lover,

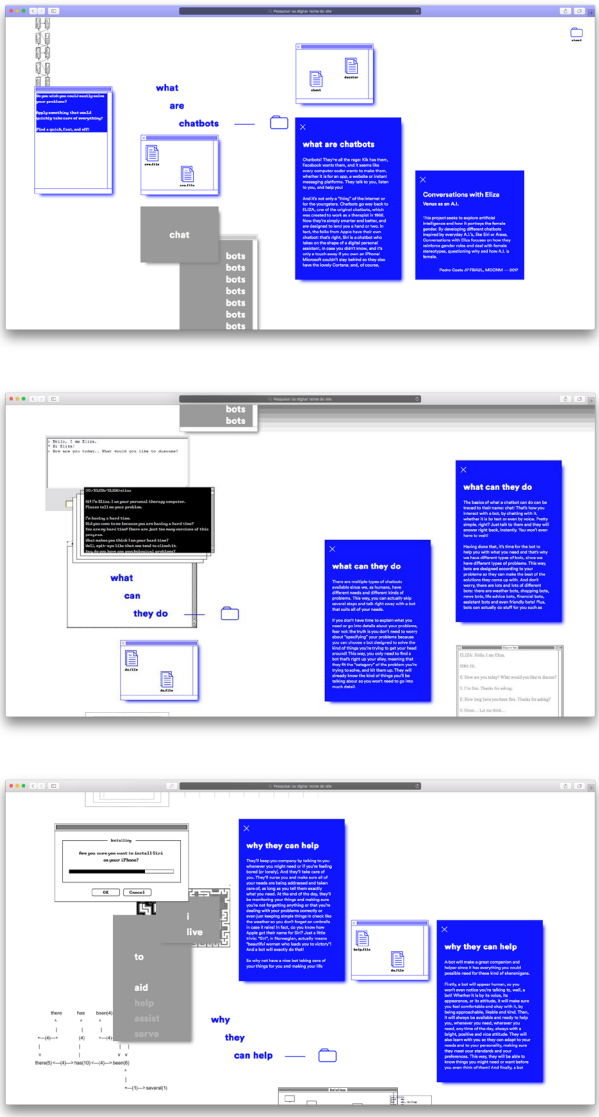

Figure 2 | Section that provides context on AI.

Motherly Figure and Femme Fatale) [14]. We combined these with traditional female stereotypes (namely Innocent, Orphan, Caregiver and Ruler) [15] in order to achieve a recognizable and expected social behavior, drawing inspiration from popular culture and how it typically portrays femininity in AI (e.g.: Her, Ex Machina, Humans, Metropolis) [16].

Accordingly, we came up with a helpful, compliant assistant; a motherly, caregiving figure; a cheerful, understanding and intimate figure; and an irreverent, sarcastic figure, as described in the results. Adding to this, the analysis served as basis to elaborate the dialogues, tasks and personality traits.

Finally, the chatbots are integrated on the primary webpage of the project and also in online platforms that resonated with their tasks and echo contexts in which they typically operate, ranging from web-

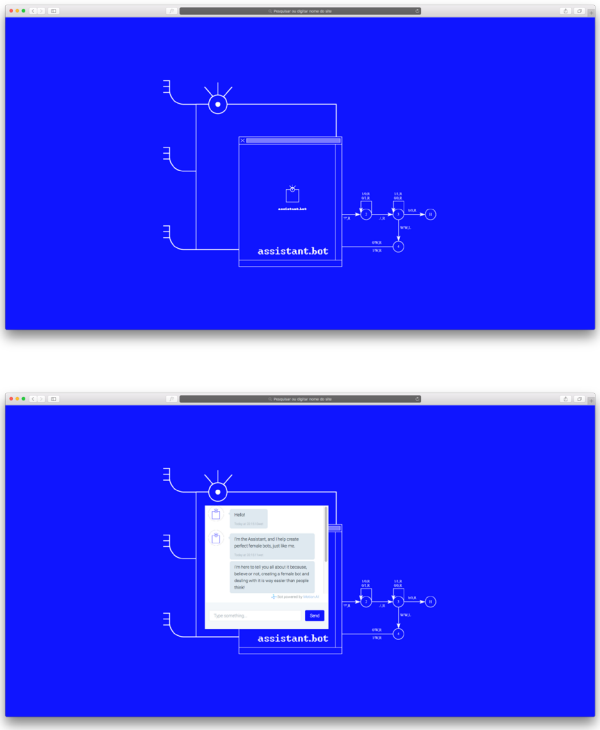

Figure 3 | The Assistant bot, presenting itself.

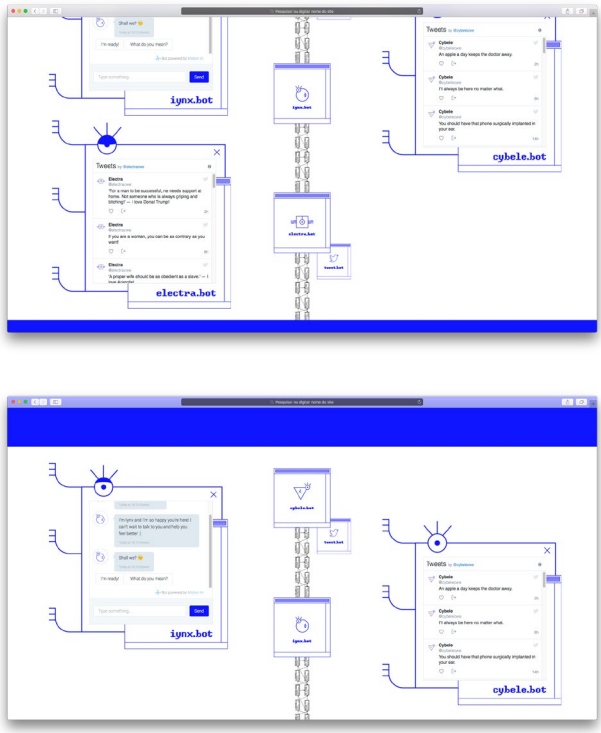

Figure 5 | The remaining bots Cybele, Iynx and Electra.

based chats to social pages like Twitter or Facebook [17].

6.3 RESULTS

The project's website [18] provides context on what AI is and how it works, but also highlights gender and femininity within AI.

Accordingly, the project presents four chatbots that engage with their users through different types of interactions such as dialogues, tweets and reminders, while presenting the subject to possibly un-aware users.

The main bot [19], integrated on the project's webpage (Figure 3) as well as on Facebook messenger (Figure 4), is an assistant whose function is to explain, through dialogue, the female AIs' creation processes, or how femininity emerges in these contexts. This bot borrows from female stereotypes associated with service contexts, such as being compliant, helpful, and gentle.

Subsequently, the other three bots are presented and named according to the different female stereotypes ascribed to them: Cybele, Iynx and Electra (Figure 5). The first, Cybele [20], whose name is inspired on an Anatolian mother goddess, is integrated on Twitter (Figure 6), where it uses code lines to generate tweets and send daily "maternal" reminders. It can also be found on the project's website, where it reminds the user of daily tasks, offers advice and talks about suggestions of things to do. Operating as a simultaneously caring,

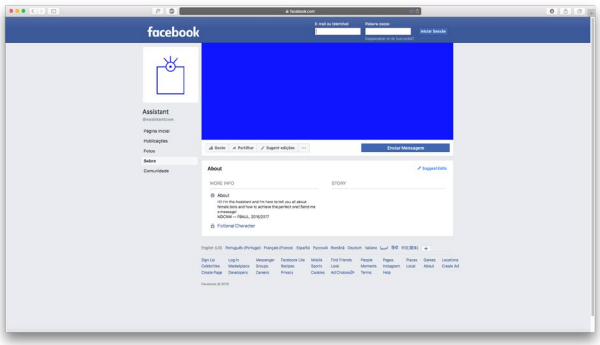

Figure 4 | Assistant, accessible through its Facebook page.

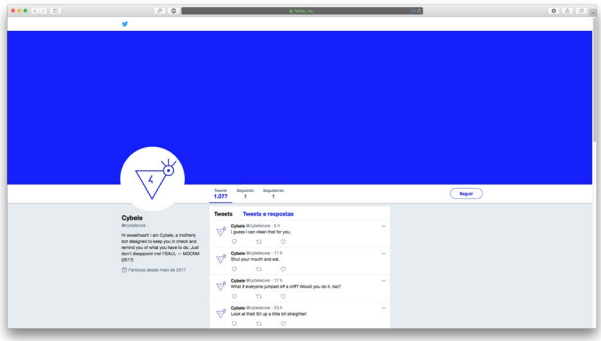

Figure 6 | Cybele's twitter profile.

Figure 7 | lynx, accessible through its Facebook page.

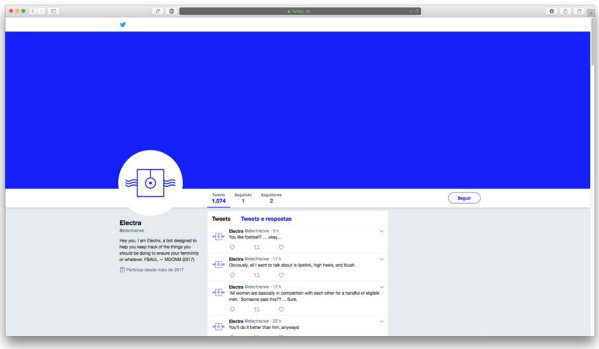

Figure 8 | Electra's twitter profile.

obsessive and disappointed motherly figure, it exhibits stereotypical behavior such as being compassionate, sensitive to the needs of others, and yielding.

Inspired on a Greek nymph, lynx [21] consists of a Facebook messenger-based bot (Figure 7), which operates as a seductive, empathizing figure that tries to help its users with their self-esteem, by offering the feature of sending daily compliments and pep talks. Accordingly, it does not use harsh language and is eager to sooth hurt feelings, while being soft-spoken, childlike and understanding.

Electra [22], whose name is inspired on a Greek vengeful figure, is integrated on the website and on twitter (Figure 8), and follows a less conventional approach. By portraying a more defiant and bolder attitude, Electra talks about common assumptions regarding women, eventually twisting them or presenting them ironically. It tampers with female and male stereotypes, such as being assertive, self-sufficient and having a strong personality.

7 | CONCLUSION

Artificial intelligence increasingly integrates our daily lives, while its development is gradually moving it towards the social realm. Adding to this ubiquity and gradual anthropomorphization, chatbots are no longer seen as mere assistants and their way of interacting brings them closer to us as friendly companions. However, in this process their interactions also reveal a biased view of gender, as these ubiquitous companions perform tasks that echo historically feminine roles and articulate these features with stereotypical behaviors.

This paper sought to examine and explore the relationship between gender and artificial intelligence and its significance as a field that, in its rapid development, often eludes critical stances on the social and cultural roots that inform its evolution. But rather than providing answers or guidelines on how to counter a feminization of digital assistants, this paper sought to tackle the questions that arise when the topic is subject to closer inspection.

According to this idea, *Conversations with ELIZA* sought to comment on the phenomenon of feminized chatbots, by ironically reinforcing the stereotypes we engage with, namely, how AI is portrayed in popular culture, and more profoundly, how common assumptions about femininity are portrayed by assistants like Siri, Cortana or Alexa. As they became an integral part of our daily lives, perhaps we should become aware that, as abstract and neutral as these entities might want to be in their conception, they end up reflecting our common assumptions and views back to us.

ENDNOTES

[1] The program searched the inputs for the presence of a keyword, and produced responses "by transforming sentences according to a rule associated with said keyword" (Weizenbaum, 1966, p. 37), and also by replacing certain words or expressions. For example, if a user said something along the lines of "I am upset because of my mother", ELIZA would answer with "Why do you think you are upset because of your mother?" In this sense, ELIZA was limited to a pre-determined set of rules and "adaptable" sentences, and if an input wasn't recognizable or didn't contain any keywords, it failed to have "the provision of a mechanism that would permit ELIZA to respond intelligently" (Weizenbaum, 1966, p. 37).

[2] This decision solved a lot of issues regarding ELIZA's "unawareness" about her surroundings or inability to talk about topics out of its framework

because the psychiatric interview style allowed a "categorized dyadic natural language communication in which one of the participating pair was free to assume a pose of knowing almost nothing of the real world" (Weizenbaum, 1966, p. 42).

[3] Introduced in 1950 by Alan Turing, "the Turing test demands that a human subject decide, based on replies given to her or his questions, whether she or he is communicating with a human or a machine. When the respondents fail to distinguish between human and machine responses, the computer may be considered intelligent" (Halberstam, 1991, p. 442). As such, ELIZA demonstrated how the Turing test poses human intelligence in a somewhat narrow way, since it was considered intelligent simply by being able to follow a logical script and appearing human.

[4] They are also able to play music, play videos, search the web, translate sentences, open apps, give directions, announce the weather and even control automation-enabled home systems.

[5] According to Judith Butler, gender is "radically independent of sex" and, instead, is a "free-floating artifice", while sex is defined as a "biological facticity" (1988), which means it is a biological criterion that distinguishes solely between female and male. As Butler puts it, gender "is neither the causal result of sex nor as seemingly fixed as sex" (1990, sec. II, par. 1). Therefore, gender is not something inherent "because gender is not a fact, the various acts of gender creates the idea of gender, and without those acts, there would be no gender at all" and gender is shaped and socially defined according to a "tacit collective agreement to perform, produce and sustain discrete and polar genders as cultural fictions" (1988, p. 522).

[6] Some of these stereotypes, presented by Bem (1981 in Prentice and Carranza, 2002, p. 269), describe feminine characteristics as "affectionate, cheerful, childlike, compassionate, does not use harsh language, eager to soothe hurt feelings, feminine, flatterable, gentle, gullible, loves children, loyal, sensitive to the needs of others, shy, soft-spoken, sympathetic, tender, understanding, warm, yielding". On the other hand, masculine characteristics are described as "acts as a leader, aggressive, ambitious, analytical, assertive, athletic, competitive, defends own beliefs, dominant, forceful, has leadership abilities, independent, individualistic, makes decisions easily, masculine, self-reliant, self-sufficient, strong personality, willing to take a stand, willing to take risks".

[7] This is tied to "women's practices (…) within the terms of some more dominant cultural formation (Butler 1990, sec. 1, par. 8) and to what are historically considered women's places, "idealized social locations seen primarily from the point of view of advanced capitalist societies: Home, Market, Paid Work Place, State, School, Clinic-Hospital and Church" as Donna Haraway explains it (Haraway, 1991, p. 307).

[8] For example, a personal assistant conducts "a form of corporate care work, including providing sustenance of the body in the form of teas, coffees and lunch orders, as well as making dentists' appointments, picking up dry cleaning, paying personal bills, and so on" (Hester, 2016, p. 49).

[9] General personal assistants such as Alexa, Cortana or Siri perform traditionally feminine tasks by acting as assistants (searching the web, translating sentences or controlling automation-enabled home systems), secretaries (registering information, sending emails or setting up appointments) or even telecommunication operators (making calls, sending messages and establishing communications in general). Similarly, specialized personal assistants also perform tasks aimed at helping us with services, such as online shopping payment processes, acquiring travelling tickets or even looking through a shop's online catalog.

[10] There are chatbots that display masculine traits, namely specialized digital assistants that perform specific tasks, mostly in contexts associated with manly labor. However, this paper focuses on general personal assistants rather than specialized, and thus addresses the observed predominance of female traits in this type of assistants.

[11] Adding to this idea, Hester states that "when technologies 'do gender' it is obviously not natural, but is instead visible as the product of deliberate choices about how best to relate, assist, or persuade the imagined technology user" (2016, p. 50).

[12] We selected these particular AIs because they have a large audience, constituting three of the most prominent general personal assistants. They are also mentioned in several of the references used for

this article (Zost, 2015; Dale, 2016; Hester, 2016), as well as in various online articles and news about artificial intelligence. Lastly, they are fairly easy to get, which facilitated the access to the data we seek. According to Amazon, millions of Alexa devices were sold in 2017, while Microsoft states that over 150 million people use Cortana and, according to Apple, Siri is actively used on over half a billion devices.

[13] *Conversations with ELIZA* was developed in the 1st year of the Masters degree in Communication Design and New Media at the Faculty of Fine-Arts, University of Lisbon, as a preliminary approach to the topic which motivated this paper and the research we are now undertaking.

[14] These archetypes, retrieved from an article analyzing female robots and AIs, are mainly found in pieces of media that depict female AIs. The Helper archetype refers to helpful and compliant assistants, the Lover to figures that seek to satisfy lack of intimacy or emotional contact, the Motherly Figure to empathic, sympathetic figures who may also be worried or disappointed, and the Femme Fatale to a simultaneously attractive and dangerous figure that seeks power and conflict (Anders, 2015).

[15] These stereotypes are also found in media depicting women, while also referring to Bem's stereotypes (1981 in Prentice and Carranza, 2002, p. 269). The Innocent stereotype refers to naïve, optimistic women that try to follow the rules, the Orphan to women that try to please others and wish to be well seen as well as feel integrated, the Caregiver relates to maternal women that look after others and try to protect and ensure their well-being, and the Ruler pertains to bold and competitive women that seek power and are not afraid to break the rules.

[16] Most of these examples, despite portraying said archetypes, also include feminized bodies. In this sense, *Her* constitutes a particularly interesting example since Samantha (the AI) only takes form through its voice, revealing how stereotyped femininity (in this case, the Lover archetype) can still be portrayed without physical appearance.

[17] Concerning the methods for implementing dialogues, tasks and personality traits, and in order to ensure successful interactions, we began by developing rules-based dialogues that allow retrieval-based responses. Focusing on common AI errors and how to avoid them, we aimed to eradicate off-track moments by presenting suggestions in a multiple-choice fashion.

[18] tinyurl.com/yaecumal

[19] facebook.com/assistantcwe

[20] twitter.com/cybelecwe

[21] facebook.com/iynxcwe

[21] twitter.com/electracwe

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