Chris Salter

Experiencing Data – Discovering Space: Immersive Arts for Learning

Abstract

The interest in immersion as a model for aesthetic experiences that involve "walking into artworks" rather than observing them at a distance has gained interest from creators, curators, students and audiences over the last decade. Yet, the issues brought up by the immersion understood as digital-technologically mediated experiences, have remained unresolved. In particular, questions of absorption/saturation versus reflection/critical distance and how immersive environments produce knowledge and experience based on the role and presence of audiences'/participants' bodies, continue to shape discussions among art historians, anthropologists, sociologists of science in addition to practitioners. In particular, the question of what kind of experience might be anticipated from audiences encountering immersive experiences versus what is anticipated from artists and students interested in building such work, is a focal point of this essay.

Keywords: immersion, critical technical practice, STS, attention economy, computing

Introduction to immersive arts

The question of anticipators in the arts and in particular, the context of pedagogy today cannot be discussed without reference to the radical social-cultural changes brought about by digitization and the emergence of new technologies such as machine "intelligence," extended reality (XR) and the metaverse as well as forthcoming fields such as quantum computing. This essay focuses less on a specific technology that may impact arts pedagogy than on a broader paradigm of experience: that of "immersive technologies" in the arts. From the perspective of the Zurich University of the Arts, the term immersive arts has a particular significance: it is the name of a cross-departmental, interdisciplinary lab for research, teaching and production called the Immersive Arts Space which is directed by the author of this essay. Immersive Arts is a catch-all descriptor for a genre of contemporary arts practices which utilize technological apparatuses and setups in order to "immerse" visitors and thus, merge the physical and digital world; a genre that art critic Rosalind Krauss in her study of the late

capitalist museum similarly described as artworks that "forego history in the name of a kind of intensity of experience."[1]

But what does immersion as an aesthetic, cultural or affective concept signify? How does it operate? How does it span different genres of practice, different contexts and different disciplines, from the fine arts to critical design or the sociology of science? What kind of pedagogical models might be suggested by a focus on immersion? My aim here is thus to understand the context of the emerging field of immersive studies in the arts and the sciences and to critically examine what such contexts hold for contemporary pedagogy involving these paradigms.

To address these questions, I want to principally examine several *epistemes*, that is as Foucault described them, the "frameworks that define the conditions of possibility of knowledge, whether expressed in a theory or silently invested in a practice,"[2] where the concept of immersion arose in different social-technical contexts. While there has already been a lineage of art historians who have tried to genealogize immersion through the Western art historical canon, a predominantly visual and spatial set of trajectories (cave painting and the Renaissance invention of perspective; tromp d'œil and the proto cinema of the magic lantern' the 19th century device of the panorama; "future cinema"-like systems such as IMAX, Sensorama; commercial virtual reality systems that started in the 1960s but reached their height first in the 1990s and then later in the late 2000s), my aim is to show that the concept of immersion, particularly from a techno-scientific perspective, is far more contradictory and pluralistic; a concept which is contested and continually being revised based on historical, economic, political and aesthetic circumstance.[3]

Indeed, as I will show, there are multiple trajectories encompassing the concept of immersion that, while partly art historical, can also be argued to be situated in certain understandings of the role of subjects within technologically augmented environments. The development of performative events that spatially and temporally unfold before the viewer or in which the viewer becomes an integral part of more complex technological surround, the role of human agency and autonomy and how it is constrained by such environments and finally, as Walter Benjamin stated, "The manner in which human sense perception is

[1] Wiener, 2002.
[2] Foucault, 1970, p. xxii.
[3] Grau, 2004.

organized, the medium in which it is accomplished is determined not only by nature but by historical circumstances as well,"[4] constitute these different epistemes of immersion.

Immersion as Dematerialization of the Object

In the 1960s, as postwar visual and performing artists were interested in what the American art historian Lucy Lippard and the Argentinian writer Oscar Masotta once called "the dematerialization of the art object," the American visual artist Allan Kaprow proposed what he labeled "happenings" – temporally situated, "pan-artistic phenomena" in which the borders between art forms "would cross each other's paths at various and unexpected places."[5] At one point in an unspecified interview, Kaprow was asked to define (and most likely defend) what he meant by happenings. He quickly sought to distinguish between the all-encompassing experience of the happening from the distanced observation and the self-sufficiency of the artistic object (most strongly embodied by abstract expressionism), announcing simply the sentence "go IN instead of LOOK AT."[6]

Kaprow's interest was not the experience that Michael Fried, another influential 1960s art historian would soon label "absorption" – a mode of perception in which the viewer or "beholder" of a work of art is specifically distanced from the work itself. According to Fried, the artwork consciously and deliberately is designed to ignore the beholder, in order to produce what he called a "perfect trance of involvement;"[7] an experience that draws the beholder in, allowing them to experience the artwork with prolonged concentration. Although focused on painting (in the case, painting of 18th century France), Fried's distinction between absorption in the work of art and what he calls "theatricality," describes two core opposites in the dematerialization of art objects that begin in the 1960s and now reach their zenith in our contemporary discourses on immersion.

If absorption is a strategy to remove the viewer from the artwork, theatricality (as particularly represented in the 1960s by the figure of John Cage) describes a situation in which the artwork can only exist because of the viewer or experiencer; a situation which Fried

[4] Benjamin, 2007, p. 217.
[5] Salter, 2010, p. 155.
[6] Kaprow, cited in Reiss, 1999, p. 24.
[7] Fried, 1980, p. 103.

argues will lead to "the negation of art."[8] Such "literalist" art would both endanger the purity of the art object (its ability to seal itself off from other artistic media) *and* more importantly, its privileged status as object exterior to the perception and interaction of the viewer. Art that wanted to escape from both painting and sculpture aimed not just to be an autonomous object but part of a *situation* that included the *beholder*. The object *within* the situation, particularly as it shifts to a larger scale and distances the viewer, however, should be the focus of the artwork and not the beholder him or herself.

Instead, theatricality involves the hybridization of art forms that began to take place in the 1960s with the emergence of mixed media; what the art and technology-based curator Jack Burnham would begin to label "systems aesthetics"[9] and what might now go by the term "immersive" experience. As Fried notoriously stated, "the success, even the survival of the arts, has become increasingly to depend on their ability to defeat theater."[10] "Theater" not only signifies hybridization and the loosening of boundaries between painting, sculpture and other art forms – *it also includes artworks whose status is subjected to change in and over time*.

Such a mode of distanced perception from not only art but daily life clearly was not in Kaprow's interest. Yet, at the same time, Kaprow's notion of immersion was also not the experience of being surrounded by mediated images that would aim to construct another kind of reality. Instead, the artist was perhaps more interested in what we might broadly call "interaction" – establishing relationships between the inhabitants of an environment and the actions of that environment itself. In fact, as he argued in one particular manifesto, the notion of "audience" should be eliminated as "all the elements – people, space, the particular materials and character of the environment, time – can in this way be integrated."[11]

Immersion as the producer of technological futures

Fast forward now to 2023. In the midst of the dry bone desert landscape dotted with Astroturf and 16 lanes of traffic that constitutes the modern urban phenomena called Las Vegas, the largest LED screen in the world opened in Summer 2023. The "Sphere" is the brainchild of a

[8] Fried, 1998, p. 153.
[9] Burnham, 1968.
[10] Fried, 1998, p. 163.
[11] Kaprow, cited in Stiles and Selz, 2012, p. 833.

New York billionaire who owns Madison Square Garden (one of the largest sports and live entertainment arenas in the US) and who is known to use artificial intelligence-based facial recognition technology to identity and eject people whose law firms are tied up in litigation with the billionaire's business interests.[12]

As a modern technological marvel, the Sphere is unparalleled in its technical scale (Fig. 1) : a massive architectural structure measuring some 110 meters in height; a 16K x 16K interior LED screen measuring some 160,000 square feet; a 53,000 square meter exterior LED screen covered in some 1,000,000 LEDs that functions as the world's largest and brightest billboard; an inside behemoth sound system featuring some 1,586 loudspeaker modules; 167,000 speaker drivers, amplifiers and processing channels; and 300 mobile loudspeaker modules.[13]

Yet, if the concept of technologized absorption is not new (although the Sphere's technological sophistication is), then what was such media immersion before the age of the wraparound LED screen? Already in the 1950s and especially 1960s, World Expositions in far flung places like Brussels, New York, Montreal, and Osaka were seen as the premiere international sites to get a glimpse of the future. As art historian Caroline Jones describes in her work on *The Global Work of Art*, such "infrastructures of spectacle" aimed to detach "the citizen from her locale and inscribed her in a stirring narrative of "man's universal progress"[14] World's Fairs were sites in which "subjective experience" and art were thrown into relief, against the "objective" displays of technoscientific wonders and the industrial sublime.[15] Such universal progress was not only political in the name of the triumph of democratic nation building capitalism in the post war era. It was also aesthetic-technological.

Take the example of the 1967 World Exposition, held in Montreal and anointed with the theme "Man and his World." (Fig. 2). The exposition was widely seen as a moment in which Canada itself became part of the international stage as behind the scenes political controversy raged. While Indigenous Canadians were given their own controversial pavilion which aimed to paint a picture of settler colonialism, political tensions between Francophone

[12] Cf. Vorkunov, 2023.
[13] Cf. Las Vegas Review Journal, 2023.
[14] Cf. Jones, 2016, p. 64.
[15] Ibid., p. 197.

and Anglophone Canadians were on the rise, culminating with Charles de Gaulle's visit to Quebec and his controversial declaration of *Vive le Quebec libre*.

What was also more evident against this political turmoil was the role that technological utopia also played in the presentation of "Man and his World." From Roman Kroitor (one of the founders of the technology that would become IMAX) and Colin Low's multi-room, multi-screen environmental pavilion *Labyrinth* to the Greek-French composer Iannis Xenakis' 3D virtual architecture of sound and light named the *Polytope de Montreal* or Czech scenographer Josef Svoboda's Communist era multi-screen technological marvels in the Czech pavilion, "Man and his World" was marked by displays of technological power and prowess. Ironically then, as an actual shape, the Las Vegas' Sphere (albeit different in technological size, scale and equipment) was preceded as well by a plethora of experience environment spheres as well at the World Expos, from American design polymath R. Buckminster Fuller's geodesic dome in Montreal to German composer Karlheinz Stockhausen's Osaka 1970 Spherical Concert Hall featuring a fifty-loudspeaker setup across multiple ringed levels in the space.

It was not only that the technological future was exhibited for general publics to experience in these world expositions. It was also that the future would be brought to you by the corporations actively invested in producing it. Indeed, in a universe beyond Kaprow's almost now seemingly quaint anarchic happenings, the Sphere is closer in spirit to the corporate visions of immersion delivered by Disney, IBM or General Motors in the World Expos of the past (Fig. 1). Given the fact that seats in the Sphere for the opening concert spectacle of the rock band U2 were sold based on "a dynamic pricing algorithm" for a startling range between 200 – 1500 USD (Fig. 3), it wouldn't be a stretch to claim that contemporary notions of immersion are less about nation building than they are about lining corporate pockets (Fig. 2).

Immersion in the Attention Economy

In fact, in recent years, immersion has shifted its playing field away from nation building and instead, towards a new politics of experience dependent on corporatized visions of such an expression; a new take on the 1990s Harvard Business School vision of the "experience

economy."[16] Yayoi Kusama's artworks focused on the obliteration of the self now give way to her therapeutic polka dots adoring Louis Vuitton wallets and suitcases (Fig. 4) while the "AI Data paintings" of the Turkish media artist Refik Anadol grace installations set up by Dior and Bulgari. In a 2022 New Yorker article, author Anna Wiener described this new "rise of immersive art" as one in which art works constructed for museums built by starchitects are "seen as financial assets."[17] Such works, in the words of the blue-chip gallery PACE's director Marc Glimcher, not only act as commodities but as almost a new form of spiritual awakening. The "churches are emptying," and "these artists are trying to fill that gap."[18]

That such immersion is problematic to art historians and critics who see its aim at self-obliteration through the machinery of digital technology can be clearly seen in the response of the art critic Hal Foster who claimed that in works of artists like James Turrell or the American video artist Bill Viola, "you are lost in relation to your body, and you stumble not only into the work but through it as well. It's an effect, beyond distraction, of disorientation, of being lost in space, and one has to wonder about its ideological effects."[19]

But is there something else beneath the glossy surface of such immersive technologically augmented experiences which feature cheap hand waving interaction and rooms filled with gigapixel projections of Van Gogh (Fig. 5) or the Mona Lisa? The answer might lie in the argument of the French cultural critic Jacques Rancière, who argues in his work on the politics of aesthetics that aesthetic experience is intimately bound up with political framing and context. According to Rancière, the very notion of the aesthetic is connected with what he calls "the sensible" where "politics revolves around what is seen and what can be said about it, around who has the ability to see and the talent to speak, around the properties of spaces and the possibilities of time."[20] In other words, politics through statements and positions, produces "regimes of sensible intensity" – "relationships between modes of being, modes of saying, and modes of doing and making."[21]

The political tension established between immersion as capitalist saturation in the attention economy and immersion as a mode of shifting the borders of what is sayable and

[16] Pine & Gilmore, 1988.
[17] Wiener, 2002.
[18] Ibid.
[19] Foster, 2004, p. 329.
[20] Rancière, 2013, p. 13.
[21] Ibid, p. 39.

sensible, has, albeit in different forms, long existed. In the European-styled 20th century, there was long a battle between two modes of perception and experience in art: that of critical distance versus saturation, both achieved through technological means. In the 1920s, for example, playwright and theater director Bertolt Brecht already sought to utilize mass media in the form of radio, film, slides, projections and other technical machinery in order to "put modern processes on the stage."[22] The imagined but never built theaters of the Bauhaus also sought to get at the transformation of the human through a theater that Laszlo Moholy-Nagy described as a "theater of totality" involving "great dynamic–rhythmic processes constructed from "great clashing masses of media," that would disintegrate the line between spectator, performer and environment, now so sought after in the development of immersive experiences.[23]

At the same time, the French theater director and writer Antonin Artaud represented the other extreme. If Brecht aimed to use new technologies of the time to create a "theater of instruction" in which the audience would take political decisions as a framework for action, Artaud sought nothing less than a total spiritual transformation; art as a metaphysical purification of the soul by means of a media phantasmagoria "of pile-driven sounds, wildly stamped out rhythms, vibrations and resonances," "flowing and surrounding the organs" of the spectator.[24]

These battles between distance and immersion, what Ranciere in his work on the emancipated spectator would sum up as the tension between "distant inquiry and vital embodiment"/"Artaud/Brecht" – one where "the spectator has to become more distant," and the other where must "lose any distance" – continued on into the 1960s with a different social-technical backgrounding.[25] These movements were marked by two seemingly incommensurable paradigms. On the one hand, Cold War military research involved a relentless drive for computer-based systems. On the other hand, a vital counterculture emerged in which artists sought to fulfill an almost spiritual quest to liberate psyche and libido, sometimes by way of these very same machines.

[22] Brecht, 1964, p. 66.
[23] Cf. Salter, 2010, p. 39.
[24] Ibid., p. 47.
[25] Cf. Rancière, 2007.

Immersion as Information Overload

Simultaneously, new technical concepts that had been primarily the territory of mathematicians and engineers—information, feedback, communication, control, behavior, and interaction—also entered artists' practices. Within the context of the dematerialization of the art object and artistic movements such as happenings, installation, land and performance art, new ways of conceptualizing the relationship between aesthetics, perception and politics in relationship to the viewer's position within the artistic experience emerged. Thus, immersion as a post war concept increasingly would come to be seen to "remove the boundaries and psychological distance between observer and image space."[26]

In the contemporary context of our data-rich societies, immersion is again being rethought through what the British art historian Claire Bishop has called "information overload" – a mode of contemporary spectatorship that is fundamentally shaped by our current saturation in media images and texts made possible in the "post internet" age. In this case, immersion denotes bombarding the viewer in a flurry of information. Bishop's notion of information overload is shaped by her focus on the increasing disorderliness and distractedness of spectatorship (scanning/skimming/surfing) which is apparent in the techniques of exhibition display that she refers to as "research-based art" "Research-based installation art—its techniques of display, its accumulation and spatialization of information, its model of research, its construction of a viewing subject, and its relationship to knowledge and truth—cannot be understood in isolation from contemporaneous developments in digital technology."[27]

Immersion as big data-driven culture

Bishop's notion of immersion is not focused on technical machinery that produces media effects on perception but instead, the practices of contemporary artists who concentrate on archiving and information display/saturation, whether from images, texts or other forms of visual representation, that are primarily driven by research (that is, knowledge creation-based) oriented processes. In her comments, for example, about the UK-based collective Forensic Architecture, Bishop argues that while the collective's aesthetic strategy is "informational and high tech," its content strategy is political to the core –

[26] Grau, 2004, p. 6.
[27] Bishop, 2023.

"counterhegemonic." In this case, an overwhelming flood of data (in the form of video, maps, visualizations) not only produces information; it also produces knowledge, truth and "ethical claims."[28]

That immersion is not only about exploding, expanding, distancing or transforming the viewer's spectatorship and agency through data (much of it computationally generated and displayed) appears at first to be a symptom of a big data-driven culture. But such strategies of putting the spectator inside a bath of information (i.e., overload) are really not that new. In the 1960s, the studio of designers Ray and Charles Eames was already focused on the question of how to distill coherent patterns and hence, meaning, from a seemingly random barrage of data. In one pedagogical strategy that aligned with the Eames' interest in information immersion, seminars with students consisted of "methodological experiments" where "students would be exposed to a vast amount of data and asked to distill this data into a single, coherent visual presentation."[29] Similarly, the Eames' studios design for the multimedia presentation entitled "Think" for IBM pavilion at the 1964 World's Fair in New York, concentrated less on conveying specific ideas than on presenting what historian of science Orit Halpern has called "a perceptual field"– an attempt to bring the spectators "a lot of information in a short time" that might resemble the process of how not only computers but also thinking patterns in the human brain function (Fig. 6).[30]

Such information/data-based forms of immersion are not just restricted to the arts or design. In 1973, the computer scientist Thomas DeFanti together with the artist Dan Sandin founded what was known as EVL, or Electronic Visualization Laboratory at the University of Illinois in Chicago. Throughout the 1970s and 1980s, EVL's work centered on computer graphics-based visualization, large scale display design, emerging interfaces for human-computer interaction and even special effects for Hollywood (the computer visualization of the Death Star in the film *Star Wars*).

But in the late 1980s, the team moved into a different territory with the development of a (at the time) virtual reality-based (i.e., 3D stereoscopic) immersion visualization system for scientific research named the CAVE (Cave Automatic Virtual Environment) which consisted of a multiscreen, high resolution, stereoscopic surround visual display system (Fig. 7).

[28] Ibid.
[29] Halpern, 2014, p. 105.
[30] Ibid., p. 125.

According to Caroline Cruz-Neira, one of the core researchers on the project, the CAVE (Fig. 5) would create a new kind of shared information space by redefining the concept of immersion in the context of computer science as "the degree of visual simulation a virtual reality interface provides for the viewer – the degree of the suspension of disbelief."[31]

While immersion was also framed as the ability of a display to surround the viewer, from the earlier applications of the technology there is a clear understanding that such a surround system was meant as a system to make information viewer centric, with the body of the user becoming part of the information field. Given its technological complexity and infrastructural costs, the CAVE was primarily used for high resolution scientific visualization. For example, early deployment included applications such as the modeling of fractals and chaotic attractors in non-linear dynamical systems, graphic planning for brain surgery and 3D displays of weather data. At the same time, the system was replicated at research institutions around the world - not only in scientific infrastructures but also art-technology centers such as the NTT-ICC in Japan and the Ars Electronica Center in Linz, Austria.

Immersion and the politics of scientific knowledge

The informatic immersion of the CAVE is not to be overlooked. A far cry from the wraparound Van Gogh or Monet exhibitions which have earned the name immersive, such scientific visualization environments like the CAVE make an important contribution towards the idea of immersion as not simply about AI-driven eye candy but about the instantiation of new kinds of knowledge by way of our bodies being embedded, surrounded and immersed in high resolution images and audio; media that attempts to communicate scientific knowledge. In this sense, the CAVE as a paradigm of data immersion focuses the genealogy of the term not only on such systems as technological instrumentaria but also describes media environments that feature the human body as a key component.

Conducting ethnographic work among geologists working inside a CAVE environment, anthropologists Natasha Myers and Joseph Dumit argue that the key to understanding how scientific data is experienced in situ lies in how such an immersive environment re/configures the scientist's bodies. Immersive media spaces "increase the degrees of freedom for researchers to scale and rescale data in real time. This is not just a practice of placing objects

[31] Cruz-Neira et al., 1992, p. 67.

in direct relation to human durations and dimensions; it is one that allows researchers to transform their bodily capacities and refigure what they can see, say, feel, and know."[32] In other words, what such an immersive knowledge environment like the CAVE accomplishes is to draw researchers into interacting with data directly affectively and kinesthetically – bringing them into physical tactile actions and movements that are not known in advance (what the anthropologists call "haptic creativity"). Myers and Dumit thus identify a key idea in the arena of information-data immersion: the manner in which human bodies are intertwined with and reconfigured in real time by instruments, machines and data such that new kinds of knowing and experience can emerge. In other words, the human body in its socio-cultural specificity is placed at the center of an immersive experience.

Towards Critical Technical Practices in Immersive practices and pedagogies

If immersion therefore has these varied and perhaps, contradictory histories, from glorified entertainment and spiritual transcendence to the process of reorganizing perception or creating new conditions for tacit, embodied experience as key to the process of scientific knowledge making, then what pedagogically can we actually "teach" about these immersive arts? Or to put this another way, what skills and knowledge will students need to navigate these social-political-cultural-aesthetic histories as preparation for an ever increasingly media saturated ecology that they already inhabit but perhaps are not responsible for actually constructing? To answer these questions, I want to briefly focus on three concepts that we at the Immersive Arts Space at the ZHdK are currently working with as we develop a new so-called T-Minor in the Immersive Arts: a transversal minor program that will allow students across the entire ZHdK to take a one-year concentration in another area of focus that is not their major concentration as the majority of universities already offer. These three concepts go by the names of

- *technological thinking*,
- *critical technical practice* and
- *complexity literacy*.

In contrast to the culture of the spectacular as we have seen from the various examples in this essay, the Immersive Arts Space's aims are more modest. The IASpace functions in two

[32] Myers & Dumit, 2011, p. 258.

ways. In a well cited report commissioned for the Rockefeller Foundation, professor and new media policy maker Michael Century defined a new class of innovative institution called a *studio-lab*, "where new media technologies are designed and developed in co-evolution with their creative application."[33] In following with this definition, the IASpace is a physical site; a large black box space outfitted with motion capture, multi-channel Ambisonic audio, high lumen digital video projectors, theater/film lighting and networked computers together with a theatre-based technical infrastructure (trusses on winches, screens, large black curtains on tracks) (Fig. 8). Key creative applications areas thus align with these technologies including projection mapping, volumetric capture, spatial audio, Extended Reality and tools for "virtual production," an amalgamation that comes from the Space's founding out of the Department of Film at the ZHdK.

At the same time, the IASpace is also a *conceptual* site to critically reflect upon such emerging technologies and applications by way of experimentation. Such experimentation is materialized through a range of activities, ranging from workshops and intra-departmental projects (namely student-driven) to internal research projects and recently, projects outside of the ZHdK (for example, participation in external exhibitions). It is then that the concept of the IASpace takes on a double function through what Lucy Suchman calls "configuration" – how "technologies materialize cultural imaginaries, just as imaginaries narrate the significance of cultural artefacts."[34]

Thus, the IASpace not only aims to instill technical skills which, in this case cover the mastery and integration of software and hardware, ranging from programming languages, physical (i.e., sensor and electronic) based computing to Game Engines (Fig. 9), real time audio and video systems and the fundamentals of machine learning and deep learning-based processes but also how such tools can be brought into artistic processes. We also seek to develop something that we might call *technological thinking* – understanding how specific situated contexts, histories, methods and practices underpin a certain technology and how those concepts establish distinct modes of perception and action for those who build or engage with these technologies. In other words, this covers not only technical learning but an aesthetic and social-cultural-political approach to such technologies in their design and use.

[33] Century, 1999.
[34] Suchman, 2012.

Usually, such technological thinking is taught to social scientists interested in studying what are called "social-technical systems" – large scale systems where humans shape technology rather than the other way around – in order to address questions associated with such systems such as "What is technology? Is it and if so, how is it socially shaped? Do technological artefacts like software and hardware or the shape and schematic of complex interactive have politics? What are the common mistakes in thinking about technology?" These are questions which have traditionally involved discursive means of knowledge making: writing and talking. But within an artistic context, we can get at these concepts also through direct material engagement with these technologies: programming them, hacking them and putting them to use. In other words, the concept of technological thinking involves understanding what is at stake in conceiving, designing and integrating multiple technologies that audiences then come to interact with in aesthetic ways – aesthetic in the Rancière sense of transforming what is sayable, sensible, knowable and doable.

The second concept is similarly attuned to the first and is named by the American computer scientist turned sociologist turned technology critic Philip Agre who describes something called a *critical technical practice*. For Agre and his students and interpreters, the concept of a critical technical practice is where "one foot is in design and the other is in critique."[35] While such thinking can be found at work in design and social software contexts, it is less known or applied in such emerging areas like extended reality (XR), the integration of media systems (like motion capture or sensing technologies) into the performing arts and even (despite its origins in Agre's critiques of artificial intelligence) AI techniques aligned with creative practice. Most of these fields are celebrated by weird combinations of idolatry and, at the same time, a form of scepticism. Thus, the core value proposition of a critical technical practice is to provide critical reflection that can question the core metaphors of a technical field. To do this, CTP involves identifying core metaphors that operate within a field, observing what remains unspoken of and marginalized and then moving the margin to the center and finally, embodying the alternative as a new technology. What is key throughout such a practice is the ability to question and shift the specific values embodied in the field itself.[36]

The third concept is an invented idea which for better or worse we term *complexity literacy*. Normally, the term technological or media literacy is used to signify "a framework to

[35] Boehmer et al., 2005a.
[36] Boehmer et al., 2005b.

access, analyze, evaluate, create and participate with messages in a variety of forms — from print to video to the Internet."[37] By complexity we don't mean complicated. Rather, we use the term complexity as it is denoted in natural sciences which describes the "behaviour of a system or model whose components interact in multiple ways and follow local rules, leading to non-linearity, randomness, collective dynamics, and emergence."[38] Complex systems are potentially unpredictable, their behavior depends on interaction among the different components of the system and, perhaps most importantly, they have scale dependent behaviors temporally and spatially.

Conclusion

Based on these histories and practices, where does all of this lead? How could these concepts impact the teaching/learning practices not only of immersive experience in the arts/ design but also larger issues around the use and critical reflection upon digital technologies that operate on us cognitively, affectively and culturally. First of all, these different examples and contexts demonstrate that technology is not only *not* neural but that every technology carries with it specific histories, assumptions and practices. In other words, one cannot take for granted that technologies are only forms of applied knowledge to solve problems. Rather, the kinds of technologies that we are increasingly confronted with such as generative AI or "XR"/"Extended Reality" (an umbrella term denoting for computer-generated environments accessed and experienced through worn headsets and body interfaces) are more akin to what could be called cultural technologies – part of the "tools by which culture is formed, reproduced or changed."[39] This position aims to remove the severe sense of a-historicism which accompanies newly emerging technologies and to frame them as socio-material, signifying that all technologies are socially produced and shaped.

Second, the concepts laid out previously suggest that we have to understand media not as objects (like a video or a snippet of audio) but as part of interacting system in which human perception is a key part of. This idea connects us in an interesting way to the earlier ecological work of the anthropologist Gregory Bateson who argued that interactions within parts or circuits within any system will specify that no part of such an internally interactive

[37] Cf. Media Literacy, https://medialiteracynow.org/challenge/what-is-media-literacy/ [23.10.2023].
[38] Complexity Wikipedia definition n.d.
[39] Bolin, 2012, p. 2.

system can have unilateral control over the remainder or over any other part. The "mental characteristics are inherent or immanent in the ensemble as a whole."[40] This suggests that we cannot understand media in isolation but rather as part of an entire system: a network of interacting parts in which such interactions cannot be known in advance.

Third, and perhaps most importantly in the context of anticipation, artists, and designers, those individuals tasked with creating new imaginaries, should be aware that they operate within what Michael Century has called an alternative technological ethos – that is, a common way of apprehending technology as a malleable material, open to revision by artists in (and through) its use and subject to both conceptual and functional re-imaginings.[41] Century's argument reminds us of Marshall McLuhan's statement that artists represent a distant early warning system since they are able to sense the societal changes that can emerge from new media technologies. In this context, artists are indeed anticipators, or harbingers of things to come. Yet, Century goes further than McLuhan's techno-determinism, suggesting that artists not only anticipate new technologies – they can also *reimagine and reappropriate* them and create counter-environments in response to the standardized imaginaries envisioned by the manufacturers of such systems. In this sense, we can thus see that pedagogy within the multiple contexts suggested by immersion signifies not only technological tools and processes but also specific modes of critical thinking and reflecting around these systems. It is these modes of thinking that should guide us as we anticipate the conception and design of futures experiences that have at their core an interest in perceivers being inside what they perceive.

[40] Bateson, 1972, p. 315.
[41] Cf. Century, 2022, p. 1.

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