EXPLORING AN-ICONS, BETWEEN MEDIA ARCHAEOLOGY, CULTURAL HISTORY, MEMORY STUDIES AND CONTEMPORARY APPLICATIONS

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AN-ICONS
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The ERC Advanced Grant AN-ICON, coordinated by Andrea Pinotti and hosted by the Department of Philosophy Piero Martinetti of the University of Milan, is cross-disciplinary project that brings together aesthetics, media theory, archaeology and various disciplines to address the complexities of contemporary mediascape, particularly in the realm of Extended Reality (XR). Within XR, which encompasses Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR), 'an-icons' emerge as self-negating images that blur iconic boundaries and promote environmental presence. This paper provides an insight into AN-ICON's diverse investigations dedicated to immersive technologies. It explores the cultural lineage of VR, AR and XR, their intersections with design and urban spaces, and the emerging prospects for digital memory studies. It also highlights the therapeutic, educational and prosocial potential of these media, informed by their historical and mediarchaeological backgrounds.

INTRODUCTION

The opportunity to intervene in this issue of the IMG journal represents for me a particularly significant occasion, not least in order to express a sincere feeling of gratitude. It was in 2017 when the notion of 'an-icon' was first introduced (Pinotti, 2017), and precisely in the proceedings of the first conference organized by IMG: the International and Interdisciplinary Conference *IMMAGINI? Image and Imagination between Representation, Communication, Education and Psychology*, hosted in Brixen, 27-28 November.

This programmatic paper, which found its way into that online publication, was the seminal stimulus for the drafting of the proposal for an ERC Advanced project, which was elaborated thanks to the intensive cooperation of Federica Cavaletti, Pietro Conte, Anna Caterina Dalmasso, Giancarlo Grossi and Giacomo Mercuriali. Once approved, the project started in the autumn of 2019 at the Department of Philosophy of the University of Milan with the title: *AN-ICON. An-Iconology: History, Theory, and Practices of Environmental Images*[1].

Since then, the project has grown excitingly, expanding into a team of more than fifteen members that I have the privilege to coordinate: four PhD students, eight post-doc researchers, four professors, all kept in line by Giulia Avanza and Irene Magrì our very efficient and resourceful project managers.

Combining a strong transdisciplinary approach (aesthetics, media theory and archaeology, history of art and cinema, history of science and technology, education and computer science), AN-ICON has being revolving around 'an-iconology' (Pinotti, 2020), which serves as a fresh framework to confront the complexities of our contemporary iconographic landscape, and especially the challenges posed by a variety of technologies which are nowadays often collected under the comprehensive term of XR – Extended Reality: immersive (Virtual Reality), emersive (Augmented Reality), and manifold Mixed-Reality hybridizations[2]. 'An-icons' are precisely self-negating images, i.e. images which tend to dissimulate

their iconic status: by virtue of their being unframed, aiming at transparency and eliciting a strong feeling of presence, they become 'environmental': they inhabit our 360-degree space offering affordances and triggering agencies. The project is structured into three interconnected research clusters, which enlighten several dimensions of an-iconology: 'history', 'theory', and 'practices'. Specifically, we aim to explore how this evolving landscape is fostering a novel interplay between the human body and technology, thereby reshaping human sensibilities in both individual and social contexts.

This paper, co-authored by several members of the team, summarizes some of the various research avenues within the project. While it presents a selection of these areas, it is not to be considered an exhaustive account of the whole *AN-ICON* field of analysis[3]. Rather, these suggestions are intended to provide a glimpse into the diverse topics under investigation: we will intricately weave together archaeological, historical, cultural, architectural, educational, and therapeutic perspectives to suggest intellectual paths into the elaborate nature of immersive and emersive technologies, encompassing both VR and AR and their intersections. As the reader will discover, the media-archaeological analysis of VR ranges from film theory to history of science. Insights into the 'astronomical' genealogy of immersive didactic devices such as the planetarium will help us to introduce some features of the cultural history of VR and its connection to American counterculture and alternative architecture. Then, it is precisely VR's productive interaction with design that enters into a dialogue with practices that augment urban spaces, paving the way for the study of AR in general. The current possibilities of technological telepresence made possible by these new media lay the foundations for new studies of digital memory. Finally, the therapeutic and educational applications of immersive technologies draw on the historical and archaeological background of these devices, opening up new perspectives for their prosocial use.

IMMERSIVE DEVICES AND SCIENCE POPULARISATION: A HISTORICAL PERSPECTIVE

In 1847, Alexander von Humboldt devoted several pages of his masterpiece, *Cosmos*, to 'panoramic buildings', stating that they would be useful and effective tools for disseminating the study of nature. Panoramas, he noted, were mostly applied to "views of cities rather than to scenes in which nature appears in its wild luxuriance and beauty." If, however, they showed "a succession of landscapes belonging to different geographical latitudes and different zones of elevation", and were "freely open to the people" like museums and galleries, they would be "a powerful means of rendering the sublime grandeur of creation" and "the feeling of the unity and harmony of the Cosmos [would] become at once more vivid and more generally diffused" (von Humboldt, 2010/1848, p. 91). Humboldt's words introduce us to a fundamental issue, namely the historical use of immersive devices in the popularisation of scientific knowledge. If it is indeed true that panoramas, cycloramas and dioramas favoured inhabited landscapes or, at most, ancient ruins, it is equally true that the history of immersive devices has at various times intersected with the history of the dissemination of science. This history, which begins long before the 19th century, has yet to be written.

Examples from different times and places reveal that immersion has been addressed by different disciplines, from optics to geology, from biology to astronomy. The latter is a good starting point: if it is easy for us today to relate immersive experiences to astronomical themes, thanks to the extraordinary proliferation of planetariums, in the past all sorts of things had to be invented to immerse the spectator under the celestial vault. Celestial (and terrestrial) globes, for the home or pocket, and mechanical orreries did indeed offer an experience of the celestial bodies that was centred on manipulation. This preamble allows us to fully grasp the significance of the *Gottorp Globe*, a gigantic walk-in globe cre-

ated in the 17th century: on the outside it represented a terrestrial globe, while on the inside one was immersed in the sky, its stars and planets. Holes in the surface, in correspondence with the stars, let in light from the outside and mapped out the constellations. The idea is very similar to another giant walk-in globe built in 1900 for the *Paris World Exhibition* (Hernandez Barbosa, 2021). Fifty years earlier, a "vertical orrery" had been projected by magic lanterns in London theatres in front of large crowds (Golinski, 2017).

But astronomy was not alone. David Brewster (1781-1868), best known as Isaac Newton's principal biographer in the 19th century, was also the inventor of the kaleidoscope and of the portable (and popular) version of the stereoscope. Brewster emphasised that these two immersive devices could be used to illustrate optics and its principles (Brewster, 1856; 1858). This was already happening when Brewster wrote, and would soon develop further, with other optical devices: magic lanterns projected microscopic images, surrounding the viewer with the infinitely small; the *London Cyclorama* staged the Lisbon earthquake (1755), allowing Victorians to feel immersed in a natural disaster, thanks to 360-degree paintings and an apparatus of *ad hoc* sounds (Hibberd, 2015). A century earlier, Martin Engelbrecht had sought the same effect with his portable theatre (or *vues à perspective*), a wonderful example of paper technology. The list could go on. What is most important here is that these case studies, when placed in their historical context and analysed, can tell us a lot about evolving ways of constructing, elaborating and communicating scientific knowledge. They do indeed share the characteristic of immersion, but this immersion has been achieved in very different ways and for different purposes over time. Moreover, if we investigate their uses in depth (in terms of places and audiences), their circulation and reception (for example, through the accounts that can be found in gazettes or in private correspondence), we can understand what it meant for laypeople to be immersed in science. The subject could not be more timely.

VR AND CINEMA: A POSSIBLE ARCHAEOLOGY

Conventionally considered the first virtual reality device in the strict sense, Morton Heilig's 1957 *Sensorama* was presented by its inventor himself as "the cinema of the future" (Heilig, 1992). Indeed, it added wind, haptic feedback and vibration to the purely audiovisual experience of cinema; vision was enhanced by the illusionistic effect of stereoscopy, sound by stereophony. What then remained of cinema, of an experience whose structural characteristics include a state of submotricity, darkness and frontality of vision? And, more generally, can we still think of VR as the cinema of the future, or is it rather a specific media experience to be considered in total autonomy?

There is thus an urgent need to investigate what relationships cinema and immersivity have historically enjoyed; to understand what survives of the largely codified language of cinema in the discursive strategies of a medium yet to be interpreted; to individuate, in the logic of remediation (Bolter & Grusin, 2000), what is the social space in which cinema and VR compete and according to what strategies the identity of one has been absorbed and translated within the other.

From a historical point of view, it is possible to consider how cinema in its origins won the social competition with immersive media in the 19th century. An outstanding example is the failure of the *Cinéorama* (Castro, 2001, pp. 44-95), patented by Raoul Grimoin-Sanson in 1897 to be presented at the 1900 *Paris World Exhibition* and which was supposed to be the natural evolution of cinema in an immersive way. While the success of the cinematograph establishes the end of the era of panoramas, dioramas, and phantasmagorias, cinema's immersive vocation has never ceased to re-emerge, as much in the enhancement of audio and video systems as in the continuous representations of imaginary media close to VR within movies.

A constant reference to cinematic language, at a citationistic and metariflexive level, is indeed often present in

numerous virtual reality narratives. In *Evolution of Verse* (Chris Milk, 2015), the founding myth of the birth of cinema is taken up in a dreamlike version: the train that hits the viewer's gaze, similar to the effect that *L'arrivée d'un train à La Ciotat* by the Lumière brothers would have on fleeing spectators in 1895. Chris Milk's VR experience thus reminds us that even cinema, though it soon lost this status, was perceived in its origins as a medium at once immersive and 'emersive'. Other experiences translate milestones of film history into VR, radically rethinking them: an example of these is ArteTV's immersive audiovisual *Caesar's Dream*: *In the Cabinet of Dr. Caligari* (2020) inspired by Robert Wiene's masterpiece of German expressionism, whose prototypical ambivalence between dream and reality finds new expressive force in the illusion of the head-mounted display.

It is no coincidence that filmmakers such as Alejandro González Iñárritu, Tsai Ming-Liang, and Kathryn Bigelow have resorted to VR to explore new artistic and creative stimuli. Iñárritu, in particular, with *Carne y Arena* (2017) questioned the power of the new medium to convey in a more radical form processes traditionally linked to the spectatorial relationship with the cinematic medium such as identification and empathy[4]. VR also represents fresh territory for the affirmation of new authorial identities related especially to the universe of documentary film. In the context of Italian productions, Rossella Schillaci's *Affiorare* (2022) tells the story of women convicts who live with their children in prisons. Davide Rapp's *Montegelato* (2021), on the other hand, uses the 360 degrees of the virtual image to reconstruct an imaginary archive of all the film sequences set in the waterfalls of Montegelato, near Rome. Through the multiplication and superimposition of virtual screens that appear in every direction of the immersive space, Rapp's VR experience becomes a way to rethink the very space of cinematic spectatorship by radically reinventing it.

VR is becoming increasingly aware of its ability to absorb and repurpose the cultural identities of the media which

preceded it. One of the most radical reflections that VR has offered on its connection to cinema (and immersive theatre) is represented by *The Horrifically Real Virtuality* (Marie Jourdren, 2018), which pays homage to Ed Wood's B movies, inviting the users first to create one of these films together with the legendary director and his favourite actor Bela Lugosi (played by two live performers), and then to enter the film itself (by crossing the boundaries of the film screen). This is done through a process of incorporation into avatars, which allows real-time interaction between users and performers. In fact, with the virtual helmet, we can return to the illusion depicted in an early movie such as *Uncle Josh at The Moving Picture Show* (Edwin S. Porter, 1902), depicting a countryman who, unaccustomed to the cinematic machine, converses and even argues with the characters represented on the screen. With one radical difference: now there is no mistake.

VR WITHOUT HEADSET: A SEEMING CONTRADICTION IN TERMS

Virtual realities should not be solely equated with the use of head-mounted displays. We can therefore speak about 'VR without headset' from several significant points of view. Primarily, from a technical perspective, the immersive experience VR provides can be achieved not only by wearing helmets, both stand-alone or wired, but also by creating a simulation environment which envelops the users entirely, without totally isolating them. One such example of this immersive approach is the *CAVE*, which stands for the *Audio-Visual Experience Automatic Virtual Environment*. In the words of its creators, "the CAVE consists of a room whose walls, ceiling and floor surround a viewer with projected images" (Cruz-Neira et al. 1992, p. 65). The user wears a pair of 'distorting' goggles that allow stereoscopic and 3D vision, without occluding sight, so that "the body appears physically and does not require rendering" (Cruz-Neira et al., 1992, p. 68). This

approach to VR has gained a considerable following, and its main appeal lies in the fact that CAVEs do not require 'proper' headsets, which at the time of their invention were still very heavy and generally uncomfortable. Furthermore, because they do not obscure the user's body, they can facilitate truly collaborative experiences. Among the most recent and innovative applications of this technology, we can mention the museological designs of Sarah Kenderdine, which include, among others, domes, such as the *Cupola* or the *IDome*, and *CAVEs* such as the *0.5CAVE* (Kenderdine, 2015).

The second reason why VR cannot be reduced to the headset is genealogical. This would imply that humans have been creating virtual realities since the beginning of their artistic and intellectual journey. Here, I am referring to the cave paintings of the Upper Palaeolithic: perhaps, these representations are in fact early forms of VR, or at least have been interpreted as such (Pinotti, 2021). This is because of their 'ecological' and 'cosmological' nature, not just their environmental and cinematic aspects (Azéma, 2015). They can be, and have been, seen in this way along what I like to call the 'palaeocybernetic' (Youngblood, 2020/1970) or 'primitivist' trajectory of VR (Fontana & Pinotti, 2022), a trend that envisioned these new devices as a means of reconnecting humans with their 'primitive', thus 'true', nature. In fact, VR in its present form can be traced back to an American cultural milieu which supposed that the near future would have the same impact on human beings as the discovery of fire or the invention of writing: a new language, a new 'man', was preparing. In this respect, it is interesting to note that one of the first examples of a collision between VR and a prehistoric cave dates back to 1995, at the dawn of VR as we know it today. In fact, Benjamin Britton's *LASCAUX* project was intended to be both a reconstruction of the French site and a transformative experience that would give the user a more complete awareness of humanity's journey on planet Earth.

Lastly, there are also physical environments which are not strictly designed to be visualization devices like VR, but

which share with this medium a peculiar aspect of virtuality. I am referring to utopian, or sometimes dystopian architectures, such as the underground bunker and the geodesic dome (Fontana, 2023b). With regard to the latter, as theorised by their inventor, the American visionary Richard Buckminster Fuller (1969), geodesic domes are intended as worlds within worlds, like spaceships on our planet, defined in turn as 'Spaceship Earth'. In fact, they are a sort of virtual environment, designed as escape to the present world's social, ecological and ethical crises. Geodesic domes were seen as a valuable tool for the American counterculture of the 1960s, which discovered precise instructions on how to construct this futuristic housing solution in Stewart Brand's revolutionary periodical, the *Whole Earth Catalog*. Interestingly, the concept of the dome as a way to envision new lifestyles intersected with the life of VR pioneer Jaron Lanier, who built and resided in a dome during his teenage years, immersing himself in the values of the hippie movement which would later shape his ethical approach to technology (Lanier, 2017). A similar hypothesis can be formulated about bunker architecture, whose "aesthetics of disappearance" (Virilio, 2008/1975) make it paradoxically 'virtual'. Designed for defence and attack, solid but without foundations, liminal spaces between outside and inside, life and death, reality and non-reality, bunkers are in fact a paradoxical way of making architecture virtual. A particularly significant case in this direction is the *Underground House* (1978) in Las Vegas. It is a luxurious 1970s mansion with all the amenities, including a garden, an artificial lawn and a swimming pool, only underground. Designed as a shelter in case of nuclear fallout, the *Underground House* is an illusionistic space built to emulate 'real life' by technological means: a curious case of the offline metaverse (Fontana, 2023a). The trajectories briefly outlined here hopefully provide some indications on the cultural history of VR, while proposing alternatives to the mainstream narrative, which would link VR only to big tech companies and to dystopian scenarios of self-isolation and diffused surveillance.

VR AND AR TRANSFORMING ARCHITECTURE, URBAN DESIGN, AND CITIZEN ENGAGEMENT

VR is increasingly being used as a valuable and creative tool in architecture and urban design to simulate the environment of future buildings or the assets of new neighbourhoods (Vilar et al., 2022). The fundamental distinction between VR and other types of visual representation lies in the direct involvement of VR in experiencing space in an immersive manner. This feature stimulates a vivid feeling of presence among users, akin to the phenomenological concept of lived space (Bandi, 2021). Users are required to constantly move and look around the digital space, while changing their perspective on the surrounding image. This process generates a personalized experience which is continuously re-shaped through their gaze and bodily position.

By wearing VR headsets, architects and urban planners can step inside their designs and sketch directly in an artificial space, dynamically adjusting components, dimensions, colours and lighting. This technology also has the potential to facilitate collaborative experiences in a virtual dimension and improve communication between the various stakeholders involved in the projects. These stakeholders include architects, engineers, consultants, clients and the general public. VR is a powerful tool for creating and simulating project realities, enabling the exchange of expertise and opinions in real time, even when participants are in different geographical locations. It is also becoming an innovative and experimental teaching practice in architecture and urban planning faculties (Vegetti, 2022; Sheikh & Crolla, 2023).

This technology is especially useful in projects which emphasize participatory design, where citizens play an active role in the process, frequently in sensitive urban contexts. n situations such as these, non-expert members of the project team may find it difficult to make an effective contribution. Virtual Reality – but also Augmented Reality, and Mixed Reality – could bring about transformative changes, allow-

ing the public to experience the project first-hand, thus increasing their awareness of available input options, potential changes, and projected outcomes.

As discussed at the conference *Real Space-Virtual Space. Aesthetics, architecture and immersive environments* organized by AN-ICON and Milano Triennale, virtual realities have various objectives and types, where architecture serves distinctive purposes and manifests in diverse forms. Recently, there has been an upsurge in discourse surrounding the 'metaverse'. This lineage of cyberspace (Benedikt, 1991) has also emerged as a sphere of experimentation (Shakeri & Ornek, 2023) for renowned architectural firms realising their visionary designs, such as Zaha Hadid Architects' *Liberland* project (Schumacher, 2022). Architecture also finds a place in immersive environments to reinterpret the past, as in the case of Femme Fatale Studio's *Dream Builders VR*. This experience delves into Étienne-Louis Boullée's unrealised 1784 project for the *Cenotaph* of Isaac Newton.

Augmented reality, which will be discussed in more detail in the next section, can also serve an important purpose in smart city implementation strategies, especially in improving points of interest (POIs) such as historical sites, monuments and landmarks (Andolina et al., 2021; Yovcheva et al. 2012; Kounavis et al., 2012). It can enhance accessibility and make these places more navigable. Thus, AR acts as a powerful tool capable of interpreting the cityscape so as to create interfaces that provide quick access to visible and readily available data. In urban environments, specific forms of augmented space deliver innovative and creative functions in addition to practical applications. The integration of novel virtual objects and meanings redefines Manovich's (2006) notion of "new poetics of augmented space". *Happy Stripe* (2020), designed by SomePeople, a New York-based studio, investigates the idea of reclaiming public spaces. This installation, located in a narrow alley in the Downtown area of Frederick, Maryland, consists of a red structure made of steel and nylon ropes, along with an AR application that allows for individual or group play with

spheres of different colours virtually gliding on the structure. The project aims to encourage citizens to re-appropriate certain areas by promoting interaction between public and virtual spaces.

THE EMERSIVE VIRTUAL: AUGMENTED REALITY AND THE CONCRETE WORLD

Virtual Reality is part of a wider family of technologies, also known as Extended Reality, which includes Augmented Reality. As already mentioned, VR is mainly (albeit not exclusively) implemented by means of a headset which totally obscures the user's visual field, often combined with hand controllers, sometimes also with more sophisticated gloves or suits to track the user's entire body. When it comes to AR, things are more diffuse in a variety of tools. All those devices that involve the superimposition of digital entities (such as 3D objects, texts, images, videos, audio tracks) on the concrete environment can be regarded as Augmented Reality (Liberati, 2018). AR can be therefore considered a family within the family: it can be experienced thanks to portables such as smartphones and tablets; using wearables like smart glasses; even with VR headsets when set in the so-called 'see-through modality', which still allows to perceive the physical surroundings. More experimental instruments are on their way, especially those conceived to 'augment' touch and the smart lens. However, at the moment retail still seems very far away for this kind of product: Ultraleap, which used to produce ultrasound tablets simulating the actual texture of concrete objects, is now more concerned about creating tools for a 'no contact' touch; the same goes for Mojo Vision, which at the beginning of 2023 decided to abandon their contact lens project, just a few months after the first successful test of a prototype on a human being.

With regard to headsets and glasses, some researchers prefer to speak of Mixed Reality (MR) to emphasize that they

represent a more complex version of AR, as they permit the interaction with multisensory objects (Arcagni, 2018). However, the first AR device was actually a pair of glasses. The term 'augmented reality' was coined in 1992 by the engineers Thomas Caudell and David Mizell. They were working on a 'see-thru' VR spectacles (Caudell & Mizell, 1992, p. 660) that would let aircraft assembly workers visualize a range of practical information for performing a task alongside their usual field of vision. In this respect, a radical distinction between portable AR and wearable AR fails to reconstruct its history, together with the widespread tendency of those actually designing, marketing, and using the technology to call it AR most of the time.

Despite their differences, all the XRs seem to be moving in the same direction: mixing the concrete and the digital to generate virtual environments. For this reason, the trend today does not seem to make a radical distinction between AR and MR. On the contrary, producers are working on devices they describe with the wider expression 'spatial computing', which, like the Apple Vision Pro, realize both AR and VR, depending on the user's wishes. According to the famous taxonomy proposed by Paul Milgram and Fumio Kishino (1994), VR and AR would in fact occupy the poles of a continuum of virtuality: while the former allows access to a completely synthetic world, which replaces the usual physical world, the latter aims at integrating everyday life with digital objects, mostly responsive and networked. In this sense, some scholars have referred to VR as immersive and AR as emersive XR (e.g. Asselin & Grosselin, 2014, p. 139; Eugeni, 2021, p. 131; Pinotti, 2021, p. 113).

As the title *Back To The Real World* of a seminal paper by Pierre Wellner, Wendy Mackay, and Rich Gold (1993) very clearly suggests, the most important feature specific to AR is the connection to concrete reality, to which it adds new electronic functions. Furthermore, in order to work properly, AR needs to be completed by innervating itself in a given context and at least in the body of one user. The movement and be-

haviour of the individual are among the most relevant components. Some parts of the human body, such as the eyes, the hands, the voice and the skin, literally serve as the technology's surface; by performing simple but specific gestures, the user controls the device. Far from being impalpable, despite its ghostly appearance, AR is capable of very tangible consequences. Thanks to AR, some, like the inventor Steve Mann, pursued the dream of liberation from some human constraints by hacking his own body to enhance perception and cognition and become a cyborg (Mann, 2001). Some others have realized that it has great productive potential, in manufacturing, in architecture and engineering: on the one hand, by keeping the users constantly at work, it absorbs them and prevents them from being distracted (Pirandello, 2023); on the other hand, it speeds up the creative and reasoning process by working with highly modifiable digital models and allowing for collaboration with others (Chandrasekera, 2018). Google, Microsoft, Magic Leap and others are all working on patenting the best enterprise smart glasses, mainly to save time and money in the assembly line and in the inspection process. At the moment, the military (which gave birth to it) and the medical field are the areas where AR is most used: it is not difficult to see why doctors and soldiers can benefit from touching and manipulating objects at a distance, without exposing themselves (or the patients) to risks; communicating remotely with other peers; rehearsing for a mission or a procedure without wasting instruments and materials.

Finally, since the 1980s, artists have become increasingly interested in the digital augmentation of space. Looking at the example of AR videogames, such as the renowned *Pokémon Go*, also intertwining its fates with certain political protest movements and with Street Art, today AR art lends itself particularly well to the production of artworks that populate public spaces and penetrate the walls of our homes, by no means designed to remain sheltered in the rooms of a museum. AR art tries to transform AR constant movement and interaction into engaged mobilization (Pirandello, 2021; 2023).

RAISING THE DEAD THROUGH VR, AR AND (PSEUDO)HOLOGRAMS

Since presence is an essential feature of immersion, AN-ICON also focuses on how XR technology can be used to make the past present again, thus contributing to the scientific field of memory studies. VR experiences such as *The Last Goodbye* (2017), *Witness: Auschwitz* (2017) and *The Journey Back* (2022) plunge users into hyperrealistic digital replicas of concentration camps which can be explored in the company of the few who survived the Holocaust (Modena, 2022, pp. 102-106). The debate is fierce between those who enthusiastically welcome the advent of new tools to preserve memories and help educate new generations by connecting them with past events, people, and facts at a much higher level of empathy, and those who, instead, highlight the dangers of fictionalising or 'Disneyfying' the genocide of European Jews during World War II.

A similar dispute has erupted over so-called 'survivor holograms', that is, hologram-like recordings of living witnesses giving authentic answers by means of artificial intelligence systems selecting the appropriate clips to play in response to questions from people interacting. While some emphasise the crucial role they can play in keeping memory alive in the post-witness era (Soulard et al., 2023; Shandler, 2020), others draw attention to the mere 'allure' of responsiveness they can actually grant (Alexander, 2021), also underlining the real risk that the thrill of a new interactive technology may become a goal in and of itself, thus causing a 'hollow' encounter with the survivors (Frosh, 2016).

The promise of immortality which lies at the core of the increasing spread (and marketing success) of 'survivor holograms' is shared by other holographic projections that make dead singers like Maria Callas, Frank Sinatra, Whitney Houston, Amy Winehouse or Tupac Shakur perform 'live' in concert again (Ng, 2021). The same goes for the digital cloning of deceased movie stars (such as James Dean, Peter Cushing,

or Carrie Fisher) via computer-generated imagery, thanks to which on screen there appear virtual actors who are barely distinguishable from their once-living counterparts.

Seen from this perspective, the new frontiers of picture production and manipulation which AN-ICON deals with seem to be aimed at challenging the traditional interpretation of the image as a paradoxical entanglement of absence and presence: the image tends to conceal its representational nature, exhibiting transparency instead of opacity, immediacy instead of mediation, presence instead of absence. Emblematic examples are the (in)famous case of a South Korean mother 'reunited' with her deceased daughter by means of a VR simulation (Conte, 2020) or the virtual sanctuary dubbed *Project Elysium*, where clients can interact with 3D models of their deceased parents or friends and thus work through their grief. Augmented Reality, too, has provided new strategies for bringing back the dead. There is also a fast growth in the number of smartphone AR apps which allow users to 'capture' pre-recorded video messages from loved ones at their graves or to create AI-powered avatars of the deceased to interact with in a metaverse.

Notwithstanding the hype around these projects, one cannot fail to notice that their promises cannot be kept. Aspects like the lack of credible eye movement on the part of the avatars or the absence of any genuine interaction because of the technical constraints peculiar to all existing versions of virtual metaverses cannot but reveal the true nature of the simulation. Despite all the fanfare, a deathlike stasis still permeates these technologies of animation.

Other strategies for preserving memory and commemorating the dead thus prefer to avoid narratives of absolute immediateness and perfect transparency and make evident from the outset the necessarily mediated nature of all XR experiences. In the domain of public art, a good case in point is *Border Memorial: Frontera de los Muertos* – an app built to celebrate the countless South American migrant workers who have died in the attempt to enter the Unit-

ed States illegally. Aiming the cameras of their devices at the landscape, people see superimposed skeleton effigies floating off into the sky at the precise GPS coordinates of each recorded death (Auchter, 2020). Rather than trying to captivate the user by giving them an illusory sense of presence, *Border Memorial* induces a strong sense of loss and absence, paradoxically eliciting higher empathy precisely when all the rhetoric surrounding the "empathy machine" (Milk, 2015) is eschewed.

Lastly, VR can also be used to make people experience their own death, inducing in them a strong feeling of having an out-of-body experience – something that previous media like cinema and television could barely achieve (Conte, 2021). In this specific case, the first-person perspective provided by the head-mounted display ends up coinciding, paradoxically enough, with a disembodied gaze: the observer finds herself gazing at her own dead (and therefore unable to gaze) body, so that she feels as if she possesses a body that is, and at the same time is not, her own. According to some recent experiments in the field of cognitive science (Bourdin et al., 2017), this can also lead to a mitigation of the fear of death.

INSIDE THE USER'S MIND: VR IN PSYCHIATRY AND PSYCHOTHERAPY

Neglected or hidden away for a long time, mental healthcare is currently receiving increasing attention in public discussion. The World Health Organization has launched initiatives to improve treatment coverage and fight stigmatization, and representations of mental health issues proliferate in the mass media: from 'top-down' productions (TV series like *BoJack Horseman* or *Atypical*) to 'bottom-up' phenomena (memes and reels circulating on Instagram or TikTok).

Such renewed interest is accompanied by a tendency to introduce innovations in mental healthcare 'from within',

with some practitioners becoming interested in new technological resources. Among the latter is virtual reality – VR (Cavaletti & Grossi, 2020; Park et al., 2019).

One of the main properties that make this technology interesting for psychiatrists and psychotherapists is its capacity to produce simulations with a very high degree of realism – defined not necessarily as photorealism, but rather in terms of providing sensorimotor contingencies that are similar to those encountered in the actual environment (O'Regan & Noë, 2001). In this way, VR can elicit what has been named plausibility illusion: i.e., the impression that the events in the virtual world are really happening, and the subsequent propensity to react to them as in real life (Slater et al., 2022).

Highly realistic simulations in the sense specified are very useful for therapeutic approaches inspired by the principle of exposure, i.e. the idea that dysfunctional responses – like phobias – triggered by given stimuli can be improved by presenting to the subject precisely those stimuli (Foa & Kozak, 1986; Craske et al., 2008). VR allows this to be done in a way which, while preserving the substantial traits of a real-life situation, makes it safer and more bearable, as patients know that – as compelling as they may be – the stimuli they are facing cannot actually threaten them. Virtual simulations thus become a testing ground for developing coping skills to be transferred later on into real life. An example in this regard is *Khora Exposure*, an application that offers people with social anxiety a selection of 'triggering' virtual scenarios: taking part in a house party, giving a speech, or causing a delay at a supermarket check-out.

A second relevant property of VR is the fact that it can facilitate the occurrence of another illusion, that of body ownership (Kilteni et al., 2015). Occurring in the presence of a virtual representation of the user, or avatar, this phenomenon implies feeling transported into the avatar's body, to the point that the latter substitutes one's own – an extreme instantiation of embodiment. In therapeutic settings, this il-

lusion becomes fruitful in the treatment of so-called 'body image disorders': in fact, researchers are experimenting with ways to help people restructure distorted perceptions of their appearance by letting them inhabit different bodies (Riva et al., 2021; Turbyne et al., 2021).

Among the available approaches, some combine the embodiment technique with elements of exposure. In the reference frame shifting approach (Riva, 2011), for instance, patients share an episode of their life in which their body image was impacted negatively; a virtual reproduction of the episode is then created, and the patients are assisted as they go through it again while alternating first- and third-person perspectives on their body, a process that helps counter the acquired negative feelings and beliefs.

As promising as it can be in the treatment of different mental health issues, recurring to VR in therapeutic settings does not always appear fully justified.

A problematic case in this regard is the use of VR in autism interventions (Dechsling et al., 2022). VR, when experienced via headset, can be uncomfortable: the device produces a sense of pressure and heat on the user's face, and it can feel heavy. Since people with autism often experience hyperreactivity to external stimuli (American Psychiatric Association, 2022, p. 57), the discomforts just listed are arguably accentuated in this specific population group. For this reason, it has been suggested, VR may be usefully replaced by augmented reality – AR (Liu et al., 2017; Cavaletti, 2022). Potentially as effective as the former, the latter usually proves less perceptually challenging, which could make it more tolerable for particularly sensitive users.

Assessing carefully the concrete advantages and limitations of VR in therapeutic settings, and remaining open to discard it in favour of better alternatives, appears key not only to ensuring the success of particular interventions, but also to preserving the credibility of VR itself as a reliable and effective tool, and to fostering its further growth in mental healthcare.

VR FOR TEACHING AND LEARNING

As we have just seen, VR is not a recent technology, nor is its application to education (Hamilton et al., 2021): the first recorded implementation of a digital VR system appeared in 1966, in the form of a training flight simulator for the United States air force (Page, 2000), and since then the phenomenon has become more and more debated in the scientific community and increasingly used in teaching and training practices. VR technology has emerged as a powerful and transformative tool with profound relevance for both teaching and learning paths. In this context, VR applications address several key challenges facing educators and learners, aligning seamlessly with the changing needs and learning styles of contemporary students.

In the rapidly evolving landscape of modern education, it becomes evident that this technology raises numerous issues and seems to be aligned with the needs of contemporary learners and educators. As Virtual Reality mediated through head-mounted displays (HMD) becomes more affordable, children and young people are beginning to engage with the technology during leisure and school time. For example, it is estimated that after its release in late 2015, Google Expeditions, promoted as 'field trips to anywhere' has been tried by more than two million school children (Charara, 2017).

The use of VR in schools is in its infancy (Southgate et al., 2019), even though the phenomenon of immersive learning has been studied for years. Immersive settings are exploited especially when it is advantageous to generate simulations of scenarios and places in which interactions with other objects are activated, useful for developing skills and abilities that are difficult to achieve in face-to-face settings. Through its visual and interactive representation, VR enables learners to transcend mere theoretical comprehension and actively participate in the practical facets of a learning scenario. Learners can witness correct procedures,

emulate the actions of the virtual model, and acquire a more profound grasp of the sequential steps essential for successful execution.

Contents from medical disciplines, generally designed for universities and some secondary institutions, are particularly widespread (Garavaglia & Petti, 2022). A motivation commonly cited was the potential that VR holds to facilitate personalized learning experiences, aimed at meeting the needs of individual students. Educational Virtual Reality software potentially allows students to explore and learn at their own pace. This characteristic gives rise to a self-paced learning experience: using VR, students can potentially repeat lessons as many times as they want, without the need for an instructor (Tredinnick et al., 2014).

Many studies agree that immersive technologies have broad potential for learning (Kavanagh et al., 2017): simulation and training are the two main scenarios in which VR seems to have a very high impact. On the one hand simulation VR provides the possibility for participating in the exploration of virtual environments that would otherwise be infeasible or too dangerous to undertake in reality; on the other hand, training supports the acquisition of procedural knowledge, relying on the modelling strategy and allowing students to observe particular actions, behaviours or skills that need to be learned. From this perspective, VR offers a unique solution by enabling students to step into virtual worlds and engage with realistic scenarios. This not only enhances their understanding of complex concepts but also allows them to apply theoretical knowledge in practical settings. Fields such as medicine, engineering, and aviation have embraced VR simulations to provide students with invaluable hands-on experiences, enabling them to practice complex procedures and situations before encountering them in real-world contexts.

In terms of learning outcomes, the adoption of VR as a pedagogical tool is certainly challenging but it appears to be useful and effective as well. A recent study (Jensen &

Konradsen, 2018) confirms that learners who used an immersive HMD were more engaged, spent more time on the learning tasks and acquired better cognitive, psychomotor and affective skills.

In 2003, Burdea and colleagues showed that the frequent use of interactive VR can both improve student motivation and retention; other studies described either novelty or the increased interactivity typically provided by educational VR systems as an explanation for why their system would result in increased student enjoyment (Fabola & Miller, 2016). Many studies have also shown that the use of immersive technologies supports the students' sense of presence (Makransky & Mayer, 2022) and the memorisation and execution of procedural knowledge, rather than theoretical knowledge (Makransky, et al., 2021).

Considering the concrete use of immersive technology in schools, it is often hindered by different factors. Students frequently reported issues with the lack of realism provided by the educational VR implementations, and this could potentially detract from the learning experience (Le et al., 2014). Secondly, it is crucial to consider the high costs of these devices, often prohibitive for state schools, and also the preparedness of teachers, who are often inadequate to offer an effective immersive experience. However it is useful to remember that affordable solutions have been available on the market for years, such as the Google *Cardboard* system. Google *Cardboard* is a VR headset made, as the name suggests, of cardboard or other low-cost materials. It was first introduced by Google in 2014 as an open-source VR platform. The design is straightforward: it consists of a cardboard frame which holds a smartphone in front of the user's eyes. The smartphone acts as the display and computing unit for the VR experience. Lenses inside the Cardboard headset help create a 3D stereoscopic effect, making virtual environments appear immersive when viewed through the lenses. Plenty of immersive content is also available for free online: on Google Play Store there are many downloadable experiences, the

Google *Expedition and Sites in VR* offers several 360-degree tours, and YouTube makes available a channel specifically for 360 videos as well. There are also some immersive platforms for schools, where students and teachers are provided with different 3D environments or layouts that are easy to build (*CospaceEdu*, *Spatial* or *Verse*). In all these cases it is essential to remember to design VR experiences thoughtfully, considering the specific learning objectives, target audience, and educational context to maximize the benefits of this technology. Teachers have to consider that the immersive experience should be short (Jensen & Konradsen, 2018), situated (Mei & Sheng, 2011) and interactive, giving students the opportunity to engage with objects and/or classmates and carry out functional tasks (Hamilton et al., 2021).

Thinking about the characteristics of the didactic experience, teachers should consider the importance of both a preparatory (Cavaletti & Terrenghi, 2023) and debriefing phase. In addition to the attention mentioned above, it is important for teachers to monitor motion sickness, a temporary discomfort due to sensory misalignment and which can present in different forms depending on the subjects (Khalid et al., 2023). This phenomenon can be significantly reduced by using devices with high definition and refresh rate; there are also very recent studies showing that certain electrical stimulation goes a long way toward reducing these physical problems (Benelli et al., 2023). In conclusion, we know that research in the educational field is therefore still very intense and constantly being updated, showing rapidly evolving scenarios.

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NOTES

1 https://an-icon.unimi.it/
2 In the following pages we will refer to the latter by the abbreviations XR, MR, VR and AR.
3 The project also includes research on gestures and interfaces in VR by Barbara Grespi (2021), on the phenomenology of the corporeality of the virtual avatar by Anna Caterina Dalmasso (2019; 2022), on contemporary art and immersive storytelling by Elisabetta Modena (2022; 2023), on the new truth paradigms of immersive journalism and forensic photography by Rosa Cinelli, on immersive devices and their relationship with erotic-pornographic material by Roberto Paolo Malaspina (2023; Malaspina, Pinotti & Pirandello 2022), on funeral practices and rituals in digital and virtual environments by Maria Serafini, and a feminist theory of horror cinema that includes contemporary immersive media by Rossana Galimi. Last but not least, within the project Alessandro Costella is working on the design for a prosthetic system for people with disabilities.
4 For the a neuroscientific analysis of the empathic relationship toward movies, see Gallese & Guerra, 2019.

REFERENCES

Alexander, N. (2021). Obsolescence, Forgotten: "Survivor Holograms," Virtual Reality, and the Future of Holocaust Commemoration. *Cinergie. Il cinema e le altre arti*, *10*(19), 57-68. doi:10.6092/ISSN.2280-9481/12205

American Psychiatric Association (2022). *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision*. Washington, DC: American Psychiatric Association.

Andolina, S., Yi-Ta, H., Kalkofen, D., Nurminen, A., Cabral, D., Spagnolli, A., Gamberini, L., Morrison, A., Schmalstieg, D., & Jacucci, G. (2021).

Designing for Mixed Reality urban exploration. *Interaction Design and Architecture(s) Journal*, *48*, 33-49. doi:10.55612/s-5002-048-002

Arcagni, S. (2018). *L'occhio della macchina*. Turin, IT: Einaudi.

Asselin, O., & Grosselin, L.A. (2014). This side of paradise: Immersion and emersion in S3D and AR. *Public*, *47*, 132-141. doi:10.1386/public.24.47.132_1.

Auchter, J. (2020). Augmented Reality: Memorializing deaths of migrants along the US-Mexico border. In S. Marschall (Ed.), *Public Memory in the Context of Transnational Migration and Displacement*. Cham, CH: Palgrave Macmillan. doi:10.1007/978-3-030-41329-3_10

Azéma, M. (2015). *La préhistoire du cinéma: Origines paléolithiques de la narration graphique et du cinématographe*. Arles, FR: Éditions Errance.

Bandi, F. (2021). Cyberspazio e realtà virtuale: L'esperienza della spazialità negli ambienti digitali. *Aesthetica Preprint*, *117*, 9-23. doi: 10.7413/0393-8522063

Benedikt, M. (1991). *Cyberspace: First steps*. Cambridge, MA: MIT Press.

Benelli, A., Neri, F., Cinti, A., Pasqualetti, P., Romanella, S. M., Giannotta, A., De Monte, D., Mandalà, M., Smeralda, C., Prattichizzo, D., Santarnecchi, E., & Rossi, S. (2023). Frequency-Dependent Reduction of Cybersickness in Virtual Reality by Transcranial Oscillatory Stimulation of the Vestibular Cortex. *Neurotherapeutics*, 20, 1796-1807. doi:10.1007/s13311-023-01437-6

Bolter, J.D., & Grusin, R. (2000). *Remediation: Understanding New Media*. Cambridge, MA: MIT Press.

Bourdin, P., Itxaso, B., Ramon, O., & Slater, M. (2017). A Virtual Out-of-Body Experience Reduces Fear of Death. *PLoS ONE*, *12*(1). doi:10.1371/journal.pone.0169343

Brand, S. (Ed.). (1968). *Whole Earth Catalog: Access to Tools*. New York, NY: Random House.

Brewster, D. (1856). *The Stereoscope: Its history, theory and construction with its application to the fine and useful arts and to education*. London, UK: John Murray.

Brewster, D. (1858). *The kaleidoscope, its history, theory and construction with its application to the fine and useful arts*. London, UK: John Murray.

Buckminster Fuller, R. (1969). *Operating Manual for Spaceship Earth*. New York, NY: Simon & Schuster.

Burdea, G., & Coiffet, P. (2003). *Virtual Reality Technology*. Hoboken, NJ: John Wiley & Sons.

Castro, T. (2001). *La pensée cartographique des images: cinéma et culture visuelle*. Lyon, FR: Aléas.

Caudell, T.P., & Mizell, D.W. (1992). Augmented Reality: An application of heads-up display technology to manual manufacturing processes. *Proceedings of the Twenty-Fifth Hawaii International Conference on System Sciences*, 2, 659-669. doi:10.1109/HICSS.1992.183317.

Cavaletti, F. (2022). Making interaction accessible: Virtual and Augmented Reality for eye contact training in Autism Spectrum Disorder. *Italian Journal of Special Education for Inclusion*, *10*(2), 221-228. doi:10.7346/sipes02202221

Cavaletti, F., & Grossi, G. (2020). Take a deep breath: Virtual reality and real anxiety. In L. Malavasi & S. Tongiani (Eds.), *Technophobia and Technophilia in the Media, Art and Visual Culture* (pp. 103-118). Rome, IT: Aracne.

Cavaletti, F., & Terrenghi, I. (2023). Testing innovative preparation tools for immersive virtual environments.: A case study in the didactics of Art. IUL Research, 4(7), 89–108. https://doi.org/10.57568/iulresearch.v4i7.422

Chandrasekera, T. (2018). The Effect of Augmented and Virtual Reality Interfaces in the Creative Design Process. *International Journal of Virtual and Augmented Reality*, *2*(1), 1-13. doi:10.4018/ijvar.2018010101

Charara, S. (2017, May 16). Over two million school kids have gone on Google Expeditions. *Wareable*. Retrieved October 5, 2023, from https://www.wareable.com/vr/expeditions-two-million-cardboard-6665

Cinelli, R. (2022). A World of Imprints: The Epistemology of Visual Evidence Between Digital and Virtual Media-Ecologie [Ph.D. Thesis Abstract]. *Cinéma & Cie - Film and Media Studies Journal*, *22*(38), 153-155. doi:10.54103/2036-461x/17982

Conte, P. (2020). Reunited? On the aesthetics and rhetoric of meeting the dead through Virtual Reality. *IMG journal*, *2*(2), 216-229. doi: 10.6092/issn.2724-2463/12256

Conte, P. (2021). L'esperienza pre-morte come figura dell'immersività tra cinema e realtà virtuale. *Carte semiotiche. Rivista internazionale di semiotica e teoria dell'immagine*, 7, 127-136.

Craske, M.G., Kircanski, K., Zelikowsky, M., Mystkowski, J., Chowdhury, N., & Baker, A. (2008). Optimizing inhibitory learning during exposure therapy. *Behaviour Research and Therapy*, *46*(1), 5-27. doi:10.1016/j.brat.2007.10.003

Cruz-Neira, C., Sandin, D.J., DeFanti, T.A., Kenyon, R.V., & Hart, J.C. (1992). The CAVE: Audio visual experience automatic virtual environment. *Communications of the ACM*, *35*(6), 64-72. doi:10.1145/129888.129892

Dalmasso, A. C. (2019). The body as virtual frame: Performativity of the image in immersive environments. *Cinéma & Cie - Film and Media Studies Journal*, *19*(32), 101-119.

Dalmasso, A.C. (2022). Calco mobile. La costruzione del reale nelle produzioni di non-fiction immersiva. *PHILM Rivista di Filosofia e Cinema*, *1*, 111-130.

Dechsling, A., Orm, S., Kalandadze, T., Sütterlin, S., Øien, R. A., Shic, F., & Nordahl-Hansen, A. (2021). Virtual and augmented reality in social skills interventions for individuals with autism spectrum disorder: A scoping review. *Journal of Autism and Developmental Disorders*, *52*, 4692-4707. doi: 10.1007/s10803-021-05338-5

Eugeni, R. (2021). *Capitale algoritmico: Cinque dispositivi postmediali più uno*. Brescia, IT: Morcelliana.

Fabola, A., & Miller, A. (2016). Virtual Reality for early education: A study. In C. Allison, L. Morgado, J. Pirker, D. Beck, J. Richter & C. Gütl (Eds.), *Immersive Learning Research Network. Communications in Computer and Information Science* (vol. 621, pp. 59-72). New York, NY: Springer.

Foa, E.B., & Kozak, M.J. (1986). Emotional processing of fear: Exposure

to corrective information. *Psychological Bulletin, 99*(1), 20-35. doi:10.1037/0033-2909.99.1.20

Fontana, M. (2023a). A proposal for a bunker aesthetics from Paul Virilio's archaeology to virtual architecture. In S. Brusaporci, P. Maiezza, A. Marra, I. Trizio, F. Savini & A. Tata (Eds.), *Proceedings of 4th International and Interdisciplinary Conference on Images and Imagination* (pp. 162-169). Alghero, IT: Publica Press.

Fontana, M. (2023b). Virtual Domes: Utopian architecture at the dawn of Virtual Reality. *Aisthesis. Pratiche, linguaggi e saperi dell'estetico*, *16*(1), 95-103. doi:10.36253/aisthesis-14374

Fontana, M., & Pinotti, A. (2022). From cave to CAVE: Immersive environments in the paleocybernetic age. In T. Casini, A. Ducci & F. Martini (Eds.), *Art before Art: L'uomo cosciente e l'arte delle origini: con e dopo Carlo Ludovico Ragghianti* (pp. 107-121). Lucca, IT: Edizioni Fondazione Ragghianti Studi sull'arte.

Frosh, P. (2016). The mouse, the screen and the holocaust witness: Interface aesthetics and moral response. *New Media & Society, 20*(1), 351- 368. doi:10.1177/1461444816663480

Gallese, V., & Guerra, M. (2019). *The Empathic Screen: Cinema and Neuroscience*. Oxford, UK: Oxford University Press.

Garavaglia, A. & Petti, L. (2022). *Nuovi media per la didattica*. Milan: Mondadori.

Golinski, J. (2017). Sublime Astronomy: The Eidouranion of Adam Walker and his sons. *Huntington Library Quarterly, 80*(1), 135-157. doi:10.1353/hlq.2017.0005

Google (n.d.). *Arts and Culture Expeditions*. Retrieved October 2, 2023, from https://artsandculture.google.com/search/exhibit?project=expeditions.

Grespi, B. (2021). Passing through: Gesture interfaces in Virtual Reality. *Imago: studi di cinema e media*, *23*(1), 111-124. doi:10.1400/286748

Hamilton, D., McKechnie, J., Edgerton, E., & Wilson, C. (2021). Immersive virtual reality as a pedagogical tool in education: A systematic literature review of quantitative learning outcomes and experimental design. *Journal of Computers in Education, 8*(1), 1-32. doi:10.1007/s40692-020-00169-2

Heilig, M. (1992). El cine del futuro: The cinema of the future. *Presence Teleoperators Virtual Environment*, *1*(3), 279-294. doi:10.1162/pres.1992.1.3.279

Hernandez Barbosa, M.S. (2021). L'universo a scala umana. L'esperienza immersiva del Globo celeste nell'Esposizione Universale del 1900. In J. Arnaldo, S. Costa, D. Poulot & A. Rosellini (Eds.), *Atmosfere: Esperienze immersive nell'arte e nel museo* (pp. 151-164). Bologna, IT: Bononia University Press.

Hibberd, S. (2015). Principles of Geology and Sensory Experience at London's Cyclorama. *19th-Century Music, 39*(2), 167-183. doi:10.1525/ncm.2015.39.2.167

Humboldt, A. F. von (2010). *Cosmos: Sketch of a physical description of the universe* (Vol. 2). Cambridge, UK: Cambridge University Press.

(Original work published 1848).

Jensen, L., & Konradsen, F. (2018). A review of the use of virtual reality head-mounted displays in education and training. *Education and Information Technologies*, *23*, 1515-1529. doi:10.1007/s10639-017-9676-0

Kavanagh, S., Luxton-Reilly, A., Wuensche, B., & Plimmer, B. (2017). A systematic review of Virtual Reality in education. *Themes in Science and Technology Education*, *10*(2), 85-119. https://www.learntechlib.org/p/182115/

Kenderdine, S. (2015). Embodiment, entanglement, and immersion in digital cultural heritage. In S. Schreibman, R.G., Siemens, & J. Unsworth (Eds.), *A new companion to digital humanities* (pp. 22-41). Hoboken, NJ: Wiley/Blackwell. doi:10.1002/9781118680605

Khalid, A., Prusty, P.P., Arshad, I., Gustafson, H.E., Jalaly, I., Nockels, K., Bentley, B.L., Goel, R., & Ferrè, E.R. (2023). Pharmacological and non-pharmacological countermeasures to Space Motion Sickness: a systematic review. *Frontiers in Neural Circuits*, *17*, 1-9 doi:10.3389/fncir.2023.1150233

Kilteni, K., Maselli, A., Kording, K.P., & Slater, M. (2015). Over my fake body: Body ownership illusions for studying the multisensory basis of own-body perception. *Frontiers in Human Neuroscience*, *9*, 141. doi:10.3389/fnhum.2015.00141

Kounavis, C.D., Kasimati, A.E., & Zamani, E.D. (2012). Enhancing the tourism experience through mobile augmented reality: Challenges and prospects. *International Journal of Engineering Business Management*, *4*, 10. doi:10.5772/51644.

Lanier, J. (2017). *Dawn of the new everything: Encounters with reality and virtual reality*. New York, NY: Henry Holt and Company.

Le, Q.T., Pedro, A., & Park, C.S. (2014). A social Virtual Reality based construction safety education system for experiential learning. *Journal of Intelligent & Robotic Systems*, *79*(3/4), 487-506. doi:10.1007/s10846-014-0112-z

Liberati, N. (2016). Augmented Reality and Ubiquitous Computing: The Hidden Potentialities of Augmented Reality. *AI & Society*, *31*(1), 17-28. doi:10.1007/s00146-014-0543-x

Liberati, N. (2018). Phenomenology, Pokémon Go, and Other Augmented Reality Games: A Study of a Life Among Digital Objects. *Human studies*, *41*(2), 211-232. doi:10.1007/s10746-017-9450-8

Liu, R., Salisbury, J.P., Vahabzadeh, A., & Sahin, N.T. (2017). Feasibility of an autism-focused augmented reality smartglasses system for social communication and behavioral coaching. *Frontiers in Pediatrics*, *5*, 145. doi:10.3389/fped.2017.00145

Makransky, G., Andreasen, N.K., Baceviciute, S., & Mayer, R.E. (2021). Immersive virtual reality increases liking but not learning with a science simulation and generative learning strategies promote learning in immersive virtual reality. *Journal of Educational Psychology*, *113*(4), 719-735. doi:10.1037/edu0000473

Makransky, G., Mayer, R.E. (2022). Benefits of Taking a Virtual Field Trip in Immersive Virtual Reality: Evidence for the Immersion Principle in Multimedia Learning. *Educational Psychology Review*, *34*, 1771-1798.

doi:10.1007/s10648-022-09675-4

Malaspina, R.P., Pinotti, A., & Pirandello S. (2022). Emerging, Filtering, Symbiosing: Experiences in Augmented Art. *VCS: Visual Culture Studies*, *3*(4), 101-126.

Malaspina, R.P. (2023). The Obscene Device: Pornographies Between Cinema, Art, and Virtual Reality [Ph.D. Thesis Project]. *Cinéma & Cie. Film and Media Studies Journal*, *23*(40), 183-185. doi:10.54103/2036-461x/20561

Mann S., Niedzviecki H. (2001). *Cyborg: Digital destiny and human possibility in the age of the wearable computer*. Toronto: Doubleday Canada.

Manovich, L. (2006). The poetics of augmented space. *Visual Communication*, *5*(2), 219-240. doi:10.1177/1470357206065527

Mei, H.H., & Sheng, L.S. (2011). Applying situated learning in a virtual reality system to enhance learning motivation. *International journal of information and education technology*, *1*(4), 298-302. doi:10.7763/ijiet.2011.v1.48

Milgram P., & Kishino F. (1994). A taxonomy of mixed reality visual displays. *IEICE TRANSACTIONS on Information and Systems*, *77*(12), 1321-1329.

Milk, C. (2015, March). How Virtual Reality Can Create the Ultimate Empathy Machine [Video]. Ted Conferences. https://www.ted.com/talks/chris_milk_how_virtual_reality_can_create_the_ultimate_empathy_machine

Modena, E. (2022). *Nelle storie: arte, cinema e media immersivi*. Rome, IT: Carocci.

Modena, E. (2023). *Immersioni: La realtà virtuale nelle mani degli artisti*. Milan, IT: Johan & Levi.

Ng, J. (2021). *The Post-Screen Through Virtual Reality, Holograms and Light Projections: Where Screen Boundaries Lie*. Amsterdam, NL: Amsterdam University Press.

O'Regan, J.K., & Noë, A. (2001). A sensorimotor account of vision and visual consciousness. *Behavioral and Brain Sciences*, *24*(5), 939-997. doi:10.1017/s0140525x01000115

Page, R.L. (2000). Brief history of flight simulation. In *SimTecT 2000 Proceedings* (pp. 11-17). Sydney, SimTecT 2000 Organising and Technical Committee.

Park, M.J., Kim, D.J., Lee, U., Na, E.J., & Jeon, H.J. (2019). A literature overview of virtual reality (VR) in treatment of psychiatric disorders: recent advances and limitations. *Frontiers in Psychiatry*, 10, 505. doi:10.3389/fpsyt.2019.00505

Pinotti, A. (2017). Self-Negating Images: Towards An-Iconology. *Proceedings of the International and Interdisciplinary Conference IMMAGINI?*, *1*(9), 856. doi:10.3390/proceedings1090856

Pinotti, A. (2020). Towards an-iconology: The image as environment. *Screen*, *61*(4), 594-603. doi:10.1093/screen/hjaa060

Pinotti, A. (2021). *Alla soglia dell'immagine: Da Narciso alla realtà virtuale*. Turin, IT: Einaudi.

Pirandello, S. (2021). A journey into artworks: Storytelling in augmented reality and mixed reality. *Cinergie – Il cinema e le altre arti*, *10*(19), 135-145. doi:10.6092/ISSN.2280-9481/12219

Pirandello, S. (2023). *Fantastiche presenze: Note su estetica, arte*

contemporanea e realtà aumentata. Milan, IT: Johan & Levi.

Riva, G. (2011). The key to unlocking the virtual body: Virtual reality in the treatment of obesity and eating disorders. *Journal of Diabetes Science and Technology*, *5*(2), 283-292. doi:10.1177/193229681100500213

Riva, G., Malighetti, C., & Serino, S. (2021). Virtual reality in the treatment of eating disorders. *Clinical Psychology & Psychotherapy*, *28*(3), 477-488. doi:10.1002/cpp.2622

Schumacher, P. (2022). The metaverse as an opportunity for architecture and society: Design drivers, core competencies. *Architectural Intelligence*, *1*(11): 1-20. doi:10.1007/s44223-022-00010-z

Shakeri, S., & Ornek, M.A. (2023). How metaverse evolves the architectural design. *Architecture And Planning Journal*, *28*(3). doi:10.54729/2789-8547.1230

Shandler, J. (2020). The savior and the survivor: Virtual afterlives in new media. *Jewish Film & New Media: An International Journal*, *8*(1), 23-47. doi:10.1353/jfn.2020.0001

Sheikh, A.T., & Crolla, K. (2023). Architectural Education with Virtual Reality an Exploration of Unreal Engine 5 and Nvidia Omniverse. In W. Dokonal, U. Hirschberg & G. Wurzer (Eds.), *Digital Design Reconsidered* (Vol. 1, pp. 159-168), Brussels: Education and research in Computer Aided Architectural Design in Europe, and Graz: Graz University of Technology, Faculty of Architecture.

Slater, M., Banakou, D., Beacco, A., Gallego, J., Macia-Varela, F., & Oliva, R. (2022). A separate reality: An update on place illusion and plausibility in virtual reality. *Frontiers in Virtual Reality*, 3. doi:10.3389/frvir.2022.914392

Some People Studio, (2020). *Happy Stripe*. Retrieved MONTH, DATE, YEAR, from https://somepeople.studio/Happy-Stripe

Soulard, J., Stewart, W., Larson, M. & Samson, E. (2023). Dark tourism and social mobilization: Transforming travelers after visiting a holocaust museum. *Journal of Travel Research*, *62*(4), 820-840. doi:10.1177/00472875221105871

Southgate, E., Smith S. P., Cividino, C., Saxby, S., Kilham, J., Eather, G., Scevak, J., Summerville, D., Buchanan, R., & Bergin, C. (2019). Embedding immersive virtual reality in classrooms: Ethical, organisational and educational lessons in bridging research and practice. *International Journal of Child-Computer Interaction*, *19*, 19-29. doi:10.1016/j.ijcci.2018.10.002

Tredinnick, R., Vanderheiden, J., Suplinski, C., & Madsen, J. (2014). CAVE visualization of the IceCube neutrino detector. In S. Coquillart, K. Kiyokawa, J. E. Swan II & D. Bowman (Eds.), *Proceedings of the 2014 IEEE Virtual Reality* (pp. 117-118). Minneapolis, MN: IEEE. doi:10.1109/vr.2014.6802079

Turbyne, C., Goedhart, A., de Koning, P., Schirmbeck, F., & Denys, D. (2021). Systematic review and meta-analysis of virtual reality in mental healthcare: Effects of full body illusions on body image disturbance. *Frontiers in Virtual Reality*, 2. doi:10.3389/frvir.2021.657638

Vegetti, M. (2022). Phenomenology of space and virtual reality: An

experimental course for students in architecture. *AN-ICON. Studies in Environmental Images*, *1*(2), 184-229. doi:10.54103/ai/18166

Vilar, E., Filgueiras, E., & Rebelo, F. (Eds.). (2022). *Virtual and Augmented Reality for Architecture and Design*. Boca Raton, FL: CRC Press.

Virilio, P. (2008). *Bunker Archeology*. New York, NY: Princeton Architectural Press (Original work published 1975).

Wellner P., Mackay W., & Gold, R. (1993). Computer Augmented Environments: Back to the Real World. *Communications of the ACM*, *36*(7), 24-26. doi:10.1145/159544.159555

Wiener, N. (1988). *The human use of human beings: Cybernetics and society*. Boston, MA: Da Capo Press.

Youngblood, G. (2020). *Expanded Cinema*. New York, NY: Fordham University Press (Original work published 1970).

Yovcheva, Z., Buhalis, D., & Gatzidis, C. (2012). Smartphone Augmented Reality Applications for Tourism. *e-Review of Tourism Research*, *10*(2), 63-66.

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