Aura:
A holographic brainwave interface

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Aura investigates the relationship between spirituality and technology. When Roy Ascott asked whether there is love in the telematic embrace (Ascott 1989), he questioned technology's role in empathy. Perceived as antipodal, contradictory phenomena, the relationship between technology, and the meta-physical is complex and multi-layered. The ambiguity between technology and spirituality has historic roots. The quest to differentiate between science and spiritualism, physical and meta-physical, played a central role in the roots of modern day science, in pragmatist discourse. To this day, the term presence still entails a dual connotation of remote presence in virtual environments and spiritual presence in religious or ontological discourse.

Brainwave art. Holographic display. EEG. Analema Group. Introspection.

1. TECHNOLOGY AND MAGIC

As an interactive piece, Aura explores this dichotomy between science and spirituality. Aura connects users spiritually with themselves by enabling novel means of introspection. The piece projects an abstracted, emotional imprint of a person's cognitive state across a network onto a holographic projection environment. An electroencephalogram (EEG) extracts brainwave data, which is visualised as a reactive, real-time light sculpture. Presented on a Pepper's ghost screen display, the projection alliterates the dual nature of presence as spirit and as a perceptual condition. Arthur C. Clark's famous quote that "any sufficiently advanced technology is indistinguishable from magic" carries a lot of weight in discourse on digital creativity and related industries (Clark 1961).

1.1 Technology between function and mysticism

Conceptions of magic and technology have long been intertwined: For those uninitiated to a technology, the inconceivability of technical advances tends to exude a sense of magic. When Cisco's CEO John Chambers first introduced Pepper's ghost as a telepresence display, the Times of India's headlined with "Telepresence Magic". Pepper's ghost displays became a familiar sight in election campaigns or networked business environments.

The ideas of magic and remote presence have long been associated with one another: The anthropologist James George Frazer defined magic as the belief that "things act on each other at a distance through a secret sympathy." Magic quite literally encompasses phenomena that are remotely orchestrated through invisible forces. According to the anthropologist Marcel Mauss, magic arises in the hiatus between wish and fulfilment (Mauss cited in Stivers & Stirk 2001). And yet a trained magician is the one who quite literally depends most on technology, in order to effectively stun his audiences (Bhownagary 1972).

The word technology derives from the Greek word *techne* – the arts of the mind, crafts and fine arts. Jacques Ellul defines technology as "the totality of methods, rationally arrived at and having absolute efficiency (for a given stage of development) in every field of human activity" (Jeronimo et al. 2013). Technology is understood as culturally bequeathed knowledge and methods. Martin Heidegger differentiates between an instrumental and an anthropological use of technology, i.e. technology as means to an end, or as a social practice (Heidegger 1977). Technology thus comprises a set of instruments that allow a collective to reach an objective, whether this is to produce, to consume, to communicate or to

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distribute. The number of processes involved to reach such a goal is congruent with the level complexity of a technology (Gell 1988). Technology has a tendency to become mythical: The more disenfranchised a culture from an understanding of its underlying techniques, the more a technology is portrayed as magical. Magic is perceived as a symbolic bridge between technology and the unknown. Magic acts as an emic shortcut between cultural objective and technological practice, obfuscating and mystifying the knowhow involved in achieving a set goal. The piece Aura (Figure 1) exemplifies the complex relationship between technology and magic.

1.2 Magic explaining technology

According to Malinovski, magic fills in the gap where technology is absent (Malinowski 1931). The anthropologist Alfred Gell goes so far to claim: "if we no longer recognise magic explicitly, it is because technology and magic, for us, are one and the same". (Gell 1988) Malinowski famously described the Trobriand salt gardens, as a site of rituals and magic. These Yam gardens were created in the belief of using theurgy, thereby confounding technical processes with the practice of magic. In the eyes of the tribe, technology disappeared behind rites and myths. Magic provided a symbolic framework for codified techniques. In this light, magic can be understood as the veil of technology. But not only for consumers, magic and technology are intrinsically connected, interrelated phenomena. Futurist and anthropologist Genevieve Bell describes the early days of Silicon Valley as conjuring a vision that was both "manageable and magical" (Bell 2011)] and asks for future development of spiritual technologies (Bell 2004, 2006). When, in 1863, Dr John Pepper wowed audiences with ghostly apparitions, he glorified and demystified spiritualism at the same time. Presenting at the Royal Polytechnic Institution, he ultimately explained technology while at the same time creating stage magic.

Figure 1: *Aura, as presented at Kinetica's Gravity show, 2015.*

In contemporary art, Analema Group, Rachel Garrard or Madi Boyd conjure a similar suspension of disbelief using the same method – Pepper's ghost displays. The fascination with technology consists in a two-way stream between magicians, artists, engineers and academics. To distinguish science from spiritualism, technology from magic, reality from make-belief was one of the key discursive objectives in 19th and early 20th century Pragmatist debate from Pierce to Popper.

2. SPIRITUALISM AND ACADEMIA

For Popper, science, myths and magic are fundamentally interrelated: "Science must begin with myths, and with the criticism of myths; neither with the collection of observations, nor with the invention of experiments, but with the critical discussion of myths, and of magical techniques and practices" (Popper 1966). As contemporaries of the early spiritualist movement, the fathers of pragmatism, William James or Charles Sanders Pierce were deeply engaged in debates on the spiritual. Spiritualism, a 19th century mass phenomenon, was seen as an instrument to distinguish science from charlatanry. A key role within this debate was held by the Society for Psychical Research (SPR), formed in 1882. Pivoting around academic circles emerged from Cambridge, its core consisted of distinguished scholars in their field: Sir William Crookes, Lord Rayleigh and Sir Oliver Lodge. Henry Sidgwick, Professor for Moral Philosophy at Cambridge, was the first president of the Society. The term *"telepathy"* was deeply intertwined with the Society for Psychical Research and remained one of its key points of focus until at least 1911 (Hacking 1988).

The pragmatist William James was actively involved with the Society, first for the American branch, then directly for its less sceptical London mother-organisation. Whereas James' enthusiasm for the spiritual raised eyebrows among his colleagues, C.S. Pierce differentiated between science and magic by introducing an element of accountability into the debate. Pierce's invention of the double-blind experiment –now one of the pillars of academic best practice- can be seen as an indirect result of dealing with swindlers, so abundant in the discourse on telekinesis and telepathy. Pierce demonstrated interest as much as scepticism in spiritualism, a movement that had influenced Anglo-American academia in the mid 1800s (James 1896, Peirce 2001). His development of the Randomisation method can be seen as a strategy to combat missing objectivity in the debate on remote mind control. Despite his plea for academic rigor, Peirce warmed to the idea of telepathy, conceding that "small differences of sensations" might explain "telepathic phenomena."

The fascination with telepathy, as a form of magic, gripped even the most sceptic in academic discourse of the 19th century.

The term *telepathy* itself was coined by the Society of Psychical Research and first used by Frederic W.H. Myers. Myers defined telepathy as "the communication of impressions of any kind from one mind to another, independently of the recognised channels of sense" (Myers 1882). The expression "thought-reading", a synonym for telepathy, was used in print as early as 1850 (Hacking 1988). The debate on telepathy and spiritualism was held with the objective, to gain scientific clarification of unexplained phenomena. Fascination with spiritualism started around 1848 on the East Coast and swept over the Atlantic by 1952, triggering a wave of enthusiasm for the occult that would last decades. At the same time, quantum leaps in technological developments blurred the boundaries between technology and magic (Stivers & Stirk 2001). In 1844, telegraphy was invented. The patent for the telephone was filed by Alexander Graham Bell in 1876. The fact that human voices were being transmitted across the Atlantic in real-time, was accompanied by a discussion of immaterial presence at the Society for Psychical Research. Developed in 1873, Crookes' radiometer was presented at the Society as an example for "psychokinesis", as an instrument to measure telepathy.

Figure 2: Mumler – Spirit photography.

The ideas of spirituality, spiritualism and spirit changed dramatically through the introduction of "spirit photography" by William Mumler in 1861 (Figure 2). Prior to this cultural craze, ghosts were visualised predominantly as physical entities. The conception of non-physical or disembodied presence influenced the reports of sightings. Mumler's spirits were transparent, ethereal and so spiritual perceptions changed with the availability of new technology: New terms were coined such as "Telesthesia" – sharing feelings at a distance or "Telekinesis" – the ability to manipulate matter through the mind. The concept of spirit (Geist) became once again subject of philosophical (Martin Heidegger) or metaphysical (William James) exegesis. The spiritualist movement is temporarily confined, dating from 1848 to the early 1920s. By 1905, the Society itself admitted missing proof for human ability to communicate telepathically. At that point, telepathy had been part of mainstream academic discourse for almost 20 years.

3. TECHNOLOGY REPLACING MAGIC

The debate on telepathy, however abstract, continued well into the 20th century. Joseph Rhine's Parapsychology Center conducted experiments throughout the 1930s at Duke University. Stanford Research Institute concentrated on remote viewing throughout the 1970s – a fact that was revealed by the CIA retrospectively (Langford 2001, Puthoff 1996). These experiments point to an academic obsession with remote viewing across a distance without the aid of technology. But interest in telepathy waned through the invention of telegraphy and then the telephone. Later stealth cameras and video-conferencing combatted academic interest in psychic remote viewing. The CIA's experiments in parapsychological telepathy stopped, just as telepresence became a consumer technology from the 1980s onwards. Technology had eclipsed spiritualism.

With technological improvements, magic soon turned into a technical reality: Marvin Minsky at MIT coined the term telepresence in 1980 (Minsky 1980). A few years later, Texas Instruments introduced video transmissions for business purposes throughout the United States. With desktop applications such as Skype, telepresence became a reality for nuclear households worldwide. Combining Pepper's ghost displays with videoconferencing, telepresence was no longer restricted to the world of screens. Holographic projection creates photo-realistic, three-dimensional experiences of presence. Stelarc performed "Rotating Brains and Beating Hearts" as a real-time telepresence performance at Kinetica 2011 (Stelarc 2011). The artist Madaleine Trigg appeared inside her own alter ego, blurring the lines between realism and projection (Figure 3). As ever-improving recording standards assure realism in depiction, remote presence ceased to

resemble spirit photography. In 2014, India's Prime Minister Narendra Modi appeared in 120 locations at the same time as a life-like hologram without ever changing his location. Telepresence is no longer restricted to ghostly apparitions, but provides realistic presentations for businesses, academics and artists worldwide.

Figure 3: Madaleine Trigg: Sutre, 2011.

Telepresence is a tool not at least for spiritual quests, frequented by millions of individuals online. Taylor Shelton et al. mapped religious cyberspaces across the world. The tool "Prayer Companion" allows nuns to receive real-time twitter feeds from catastrophe stricken places for real time online presence through prayers. Created by Interaction Research Studio in 2010, Prayer Companion was presented at MOMAs Talk To Me exhibition (Interaction Research Studio 2010). Wyche et al. developed praying card technology at the Georgia Institute of Technology (Wyche 2009). However, technology is all too often understood not only as source, but also as surrogate for spirituality. Evolution of technology replaced human dreams that were once confined to the realm of magic – such as aviation, telecommunication or telepresence. With Aura, technology tackles a new territory hitherto preserved to the field of magic: "Telepathy." Combining "mind reading" technology with remote presence, Aura interprets affective states through the use of EEGs by transmitting these signals across a network. With this, the idea of receiving brain wave signals across large distances becomes a reality. The form of this interpretation is visually and conceptually linked to the phenomenon of the human "Aura".

4. AURA: MARGINS OF ACADEMIA

Far Eastern philosophers conceptualise the human as a complex being, penetrated by interconnected levels of energy: The model of the chakra system in Hindu and Vedic traditions influenced Western conceptions of the Aura. The Chinese energy system of channels and the Tibetan concept of energy through breathing, chanting and meditation are in contrast to Western concepts of the body as a self-enclosed, hermetic system. Academia remains hesitant about accepting the idea of measurable electric fields around the body, despite a wide range of research carried out to date; Experimental research points towards the existence of vibrational frequencies around the human body. The still contested researcher Valerie Hunt worked for over 25 years on measuring energy fields at UCLA. The use of telemetric and hard-wire instruments such as EMG, sensoring muscular activity allowed her to measure energy fields before, during and after healing session (Hunt 1989, 1995, 1996). According to Hunt electrical activity in the brain and around the body is the result of non-local events taking place within human ontology – a conception that decouples the mind, symbol for human consciousness, from the brain.

Famously, Walter Benjamin evokes the image of the human aura in his writings as "the distance of the gaze that awakens in the object looked at." Benjamin understands the Aura as a metaphor for a radiating, incandescence of the mind, as a reactive, echoing effect (Benjamin 2008). The notion of reflexivity through parallax, of change through interactivity of the gaze is thus central to the term – and so are its ethereal, fading and not at least spiritual qualities. As a coloured halo effect, Aura perception can be traced back to spiritualism, and the spiritualistic publications of C.W. Leadbeater's "Man Visible and Invisible." (Leadbeater 1902). In 1911, Dr. Walter J. Kilner speculated that the aura would be the result of mystic N-rays, which could be of medical use. This stance was heavily contested by the British Medical Journal (Kilner 1930). To this date, no evidence has been found to prove the physical existence of a measurable human aura, other than as an optical illusion. In Psychology, individual aura perception is largely regarded as a synaesthetic phenomenon. Disregarded by social psychology and clinical medicine as a metaphysical concept, without any real-world substance, the concept persisted as metaphor in philosophy, as a phenomenon of mystic interest (Marris 2004, Bratu-Hansen 2008)

Dr. Harold Saxton Burr dedicated over 40 years to the research of electro-dynamic fields around live organisms, that he called «L-Field». Contested by mainstream academia, he proposes invisible, but measurable fields that reflecting the current health condition. UCL scientist Emma Marris links the human "Aura" to synaesthetic experiences (Sheridan 1992): Synaesthesia is an experience that links the sensation of a stimulus to the

perception of another, i.e. sound is perceptually linked to colour experiences. Milan et al. (2012) differentiate between the two phenomena: In a series of experiments, they compared esoteric aura experiences against synaesthetic perceptions. Although the body is now widely understood as a bioelectrical field, perceptions of the human aura remain mystic, unexplained and beyond mainstream Western academic discourse. Regardless of these ambiguities, an Aura can be deconstructed, and physically and technically re-created. Technology can evoke "telepathic" communication from one mind to another – through EEGs and networked telepresence interaction design.

5. PRESENCE RESEARCH

Virtual reality environments aim to evoke presence through a range of different audio-visual strategies. A degree of academic consensus supports the claim that realism plays a crucial role in presence perception. Sheridan (1992) Held & Dulach (1992), Witmer & Singer (1994) cite realism as a key component of presence, Bouchard and others expanded extensively on the subject. A wide range of literature investigates different angles of the phenomenon, such factors as image recording, generation, transmission, display and user perception. Research conducted in the framework of this project, looks at presence generating factors, and asks important questions on defining boundaries of the concept. Is realism confined to audio-visual parameters? Can fidelity as an abstracted concept transcend realism? Is causality a factor of realism? Can invisible characteristics such as emotional states be perceived as realism?

A range of studies examine the relationship between realism and presence experiences: A comprehensive meta-analysis was conducted by Nick Yee, Jeremy N. Bailey et al. (2007) at the University of Stanford – with a specific focus on the relationship between anthropomorphism, realism and presence. The strength of this meta-analysis lies in its specific focus on a clearly defined subject matter (compare: Bouchard et al. 2004). Also at Stanford, James Cummings, Jeremy Bailenson and Mailyn Fidley's study "How immersive is enough?" (2004) investigated the effect of immersion on measured presence. This descriptive analysis engages in a thorough literature review, identifying key components of immersion. In both cases, a meta-analysis provides an overview on relevant research in the field, furthermore identifying a weighted status quo of their respective results. Scanning existing studies on realism indicates the heterogeneity of the phenomenon. Realism in animation displays a different level of abstraction, than filmic representation – yet both follow the same rationale and objective: Realism strives for an approximation of real-world experiences in virtual representation through simulacra of technical and subjective conditions. The definition of realism in the context of VR remains a controversial subject. Attributes are subsumed as fidelity, to plausibility, similarities to real-world environments, or accuracy in representation. What constitutes realism seems to be influenced by a range of contextual, behavioural, psychological co-factors: can fidelity of emotional representation be regarded as realism, despite its invisible and visceral characteristic? Aura explores these questions artistically.

Aura contrasts realism in remote communication, with ideas of abstracted spiritual presence. Such presence can be self-referential or remote controlled. Telepathy is considered a means to transcend states of mind across time and space. Electroencephalography (EEG) allows to measure thoughts and brainwaves and to transform them into meaningful imagery. Translating brainwave frequencies to specific colour codes, meaningful results can be inferred across a distance. Its visual interpretation can be streamed live and in real-time.

As the third in a series of telepresence pieces, "Aura", as a symbol of self-reflection evokes presence by mirroring inner states. The user is wearing an EEG headset measuring his or her cognitive state of mind. The participant's cognitive concentration is measured through the EEG (Neurosky), which transmits Open Sound Control (OSC) messages via Max/MSP. These signals are interpreted as a coloured light sculpture using a Processing script (Wood 2004). Pepper's ghost is used as a "medium" to project this aura. Users are experiencing their own attention levels as a colour-coded, ethereal sculpture on the Pepper's ghost display. Cooler colours represent phlegma, boredom or indifference. Warmer colours symbolise concentration, excitement or engagement.

The setup contrasts realism used in telepresence with an abstracted landscape of participants' inner state of mind. Pepper's ghost acts as an interface, either self-reflectively or across a network. The projection is at once a mirror for passive reflection or for "telepathic" interaction. The piece can be seen as an interface for telepathic communication, when participants' brainwaves are interpreted in a remote location in real time. When technology disappears behind artistic intention, presence turns into a form of magic. Technology recedes behind the communication process. Between locations, Aura presents a form of telepathy: The mind is being read independently of the recognised channels of our senses.

6. AURA: CONCEPT & DESIGN

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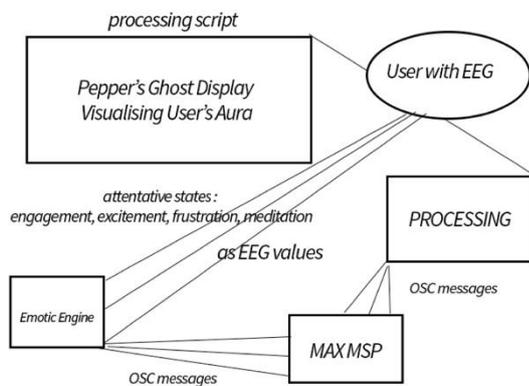
***Figure 4:** Aura Technical setup*

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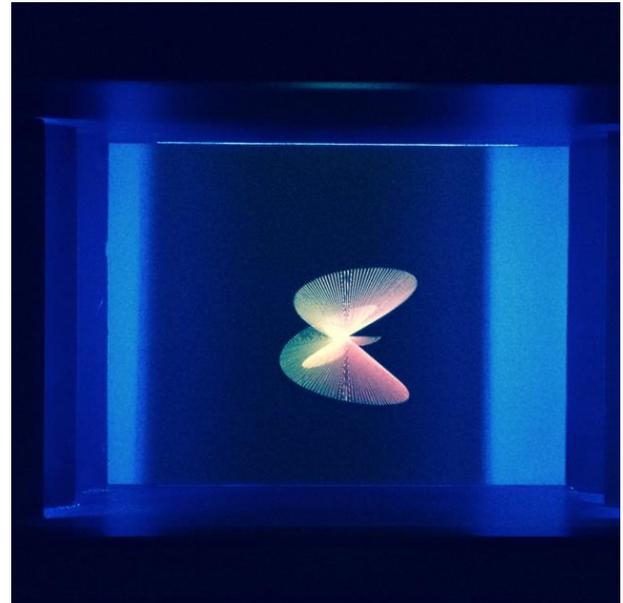
***Figure 5:** Aura at Kinetica 2015*

7. CONCLUSION AND FUTURE RESEARCH

A number of relevant studies within telepresence research focused on realism, the role of display resolution and display quality (Shapiro et al. 2006, Rademacher 2002). Bracken (2006) compared HD and SD signals and their effect on perceptions of presence in news broadcasting. Sound, lighting, transmission standards and recording cues all feed into the wider debate on how realism affects presence experiences. Aura is a take on a different form of realism, evoking a spiritual form of image fidelity: An emotional, cognitive reality leads to a new form of presence. Accordingly, Aura is first and foremost an introspective piece about presence, a take on the intricate relationship between spirituality and realism, magic and technology, spirit and presence (Figure 6).

Viewers perceive presence as a trigger for engagement, a mirror into their own soul. Interaction influences this inner landscape; in Aura this effect of interactivity becomes visually tangible. A single user mode enables visitors to engage with themselves, provides a means of reflection, a mirror to their souls. As Roy Ascott stated, the universe is a participatory universe. Our "auras" change through and with interaction, proving that there is love in the telematic embrace after all. Aura was displayed at the Festival of Learning (2015), Kinetica's Gravity show (London 2015) as well as FLUX Events' "Illusions" (2017).

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