

“Künstliche Erfahrungswelten” – How Digital Technology is mediating Human Experience

Original Study

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Abstract: Experience is a vital element of human cognition; therefore, to learn something new, humans need new experiences. How can the use of artifacts¹, such as instruments and technologies contribute to this objective? The idea of a direct experience of an object is not completely outdated. Still, it is becoming rare: communication is mediated by smartphones and apps, and instruments and computer simulations mediate scientific discoveries. Instead of visiting a museum, we can browse through its online collection. Hence, by designing the methodologies and technologies that mediate experience we are shaping the experience itself. The article introduces Charles S. Peirce's concept of experience to discuss the structure of technological mediation of experience and the potential for artificial experience. It reflects on how digital technologies contribute to the development of new experiences to allow for new or deeper knowledge of our world.

Keywords: Charles S. Peirce, Experience, Digital Technology, Bioacoustics, Spaceflight

¹ for further discussion of the term, see, for example, Hoffmann, M. & Schmücker, R. 2022. In: *Handbuch Kunstphilosophie*; also Cassirer, Ernst 1930. "Form und Technik".

The history of science reveals that many significant discoveries have been made unexpectedly. In fact, American scientist and logician Charles S. Peirce argued, that scientific discovery is facilitated by surprises. When testing a hypothesis in an experiment nothing new can be learned from its confirmation, only the observation of an unexpected element may lead to a novel insight. The surprising event within this process is what Peirce called experience, ultimately the origin of all new knowledge. Thus, to learn, we need novel experiences, for which we can actively create the conditions by facilitating an experiment, for example.

With contemporary computer technologies, unique possibilities open up to mediate unknown experiences eventually leading to original discoveries. This idea will be discussed here with examples from Astronomy and Bioacoustics, two research fields that use digital computing

and AI technology to expand their studies beyond human senses.

The literature on experience is diverse, writers such as William James, John Dewey, and John Locke had differing views on the topic. In this paper, the focus will be on Charles Peirce's concept of a mediated experience. The outline of Peirce's concept will be introduced to unfold the course of past, present, and potential future experiences. This approach allows for an understanding of experience as a relational process. Peirce's concept is topical because it includes the idea of creativity and imagination, moreover, it has a strong focus on experience being mediated. The idea of a direct experience of an object is not completely outdated but it is becoming rare: communication is mediated by smartphones and apps, instruments and computer simulations mediate scientific discoveries and instead of visiting a museum

one can browse through its online collection. This development has posed the question of whether it diminishes or enriches the experience. It has become clear that in the virtual space, it is largely possible to design experiences in a customizable manner through digital technology. After the introduction to Peirce's concept of experience, the question of how it could be applied and extended in terms of technological mediation of experience and the potential for artificial experience will be discussed.

Peirce's main ideas on experience focus on an interplay of perception, cognition, and action (cf. *The Century Dictionary* 1889, 2079). He holds that all human knowledge originates in experience. Although it might be, partly, due to one's own action, it is involuntarily forced upon the "experient, or person who undergoes the experience" (Peirce 1906[2009], 344). For example, when conducting an experiment, the resulting experience is due to the researcher's action, the outcome, however, forces itself upon her recognition. Thus, experience is not volitional. With Peirce, it can be seen as a broad concept that relates different mental states, like perception and memory, as well as our internal and external world. It spans over a period of time, enabling us to connect the present moment we are in right now with the knowledge we remember—which is our accumulated experience from the past. A characteristic trait of experience is that it comes by surprise. We expect one thing and discover another. For example, an astronomer observing a certain section of our galaxy would be surprised to discover a curved motion of a planetary object that acts against the known laws of physics. This surprise is a true experience in Peirce's terms. It serves as a connection to reality, exercising control functions to beliefs, expectations, and hypotheses (cf. Peirce 1906[2009], 247). The following example will illustrate his argument: Imagine a scientist conducting experiments in fundamental physics at CERN, the particle accelerator facility in Switzerland. Every scientist setting up an experiment, Peirce argues, is expecting some result: "We anticipate a result and we figure to ourselves with more or less confidence what the character of that result is to be". Thus, the imagined scientist starts the experiment, the result comes and he observes it. "Sometimes," Peirce says, "it is as we expected, and we have learned nothing. We are only confirmed in our former opinion. But very often,—perhaps I should say always when we are sufficiently wide awake,—the result comes when we expected it to come, but it is not such as we expected it to be: it is quite a surprise" (Peirce 1903[1997], 144).

To Peirce, the surprising experience is considered to be an event which means it takes time: The "[...] striking in of a new experience," as he phrases it, "is never an instantaneous affair but is an event occupying time" (Peirce 1868, 147). In his understanding, experience is of a more intellectual kind than perception alone. The present experience, the actual moment we are in, can only be understood as a surprise by connecting it to the individual past experiences. We can only be surprised when we *realize* that something differs from our

expectations. This process takes time, even if it is only a fraction of a second it is not immediate. Additionally, in order to learn something from experience, the concept also has to include an element of anticipation of future experiences, for the new knowledge cannot be applied in the present or past but only in the future.

It can be concluded that Peirce's concept of experience consists of past, present, and future experiences. The interrelatedness of memories and imagination with the present moment is supported by recent studies on the function of the hippocampus, which suggest that memory formation and imagination are located in that specific brain area (cf. Comrie et al. 2021). Something the individual already knows from past experiences, something she is living through in this very moment that she understands to be different from the past, and the anticipation of future consequences from her most recent discovery. What renders his concept specifically interesting is that experience is not limited to the actual and existent, therefore does not only allow for thinking about "[...] what *is* experienced," but also what "[...] *might* conceivably *be* experienced [...]" (CP 5.37 after Scott 2006, 85, emphasis added). Peirce, in many places, states the importance of imagination for the advancement of knowledge. Without it, planning, preparing, and scheduling in any context would become senseless, as well as the invention of new technological devices. The development of a more powerful telescope, for example, is driven by the imagination of what could be discovered with it. As much as it is our actual experience—the surprises, disappointments, and failed experiments— it is our imagination that drives transformation. The vision of what could be experienced in the future sets the goals for today's actions.

Future experiences, however, cannot be seen. In fact, they are not accessible to any of the human senses but they are, nevertheless, real. Peirce has a broad notion of reality, which includes existing objects as well as non-existing relations, actuality, and possibility. Thus reality can be perceptible and imperceptible, but experience itself—the surprising event—needs to be perceived. Therefore, the question of how the non-existent reality of possibility and imagination can be experienced arises. Peirce's answer as to how we access a world beyond our senses, is, that we model it, which means shaping an observable object based on the knowledge we have. We then imagine what could be true or potentially become true if certain conditions were fulfilled. Models can be hypothetical (as in mathematics) or applied (as in engineering) and embodied in "constructions, algebras, computer programs or graphics" (Ketner 1990,1) as well as a novel, a symphony, or a painting. Once we have the model, we can observe, manipulate, and experiment and eventually come to new insights through experience with the model.

Different models are not neutral; on the contrary, they shape our experience. As mentioned in the introduction, scientific discoveries are not made with the naked eye anymore. They are mediated by instruments and

technologies. The invention of the telescope, for example allowed for a different kind of experience. And every new experience adds to our “store-house of knowledge” (Peirce 1905[2009], 257) thus, changing the basis for future experiences. Peirce makes it very clear that the unaided mind is limited but given the right kind of instrument, it can overstep the limitations of its capacity. Developing better telescopes paired with new insights into the nature of light has allowed us to explore deep space on a whole new level. Those new instruments allow for novel experiences but have also made the process of experiencing more complex. When there are multiple elaborated instruments involved we need to reflect on how the implemented technologies mediate our experience. The advancement of computer algorithms and digital media in recent years has contributed tremendously, both to the expansion of human experience and the need to reflect the effect of media on ourselves. The discussion of the truthfulness of digital instruments and media has recently sparked great interest and many contributions. It is, however, not a new debate: The use of instruments to enhance human perception has a long tradition in science and the invention of a new instrument has often initiated a discussion about its truthfulness, as can be seen for example in Galilei’s use of the telescope (Freedberg 2002). Thus, we as scientists, especially in the Humanities, have to keep an eye on both sides. To do so, the following paragraphs will discuss examples.

HOW TO BREAK THE SILENCE

One example of how digital technology expands and shapes our experience can be found in the field of Bio-acoustics. Humans have comparably poor hearing ability hence we consider many other species to be silent who in reality produce sounds the human ear cannot hear. Much like our eyes, which cannot see the full electromagnetic spectrum, our ears are only receptive to certain frequencies. As a consequence, we cannot perceive the wide range of sounds nature emits (Bakker 2022, 1). Humans, for example, do not hear a calving iceberg, a tornado, or the rhythmic vibration of the Earth’s crust caused by ocean waves. Many sounds of nature are beyond our senses; thus to gain new experiences humans need to expand their biological capabilities. Digital technologies are a powerful tool to listen to nonhumans, thus changing the way we experience the world we inhabit. Contrary to recent discussions claiming that digital media are alienating humans from nature, they can allow us to better understand our environment (cf. Bakker 2002, 2). In fact, some researchers and activists believe that enabling humans to better understand animal communication for example would raise awareness for conservation efforts (Bromley 2023). There are multiple ways digital technologies are used in research, one is the translation of sounds humans cannot naturally hear, others are data collection and analysis with AI models and another is inspired by the idea of creating tools for interspecies communication that are fueled by the software we use for translation or natural-language processing.

Various examples of how digital technology is helping scientists break the silence² are given in Karren Bakker’s 2022 book “The Sounds of Life: How Digital Technology is Bringing Us Closer to the Worlds of Animals and Plants.” It introduces the pioneering work of Jacqueline Giles and Camila Ferrara, who first pursued research on the vocalization of turtles for their respective PhD dissertations (Bakker 2022, 63-64).

Turtles were long believed to be silent animals (Ferrara et al. 2014). However, some turtle sounds are just on the edge of human hearing, which made it possible for the two attentive researchers to make their initial discoveries (cf. Bakker 2022, 63-79). The field of acoustic communication in turtles is still developing but has produced many experiences for the research community. In 2014, for example, Ferrara and collaborators were able to record the communication between hatchlings on the beach and their mother turtles in the water (Ferrara et al. 2014), falsifying the belief that mother turtles abandon their offspring (Bakker 2022, 72).

Only two decades ago, researchers would have to go places and hold a microphone up to collect sound samples of that specific site or a certain species. They then would have to listen to audio files trying to identify different species or individuals by their comparatively poor human hearing. Jacqueline Giles spent over 230 days in the field and recorded over 500 hours for her initial research (Gilles 2005). With new technologies today, researchers can amplify sounds beyond human perception, be less invasive (because no human has to be on-site), and even monitor a local habitat to hear, for example, what the turtles living there are hearing (74-75). A biollogger can be placed anywhere and collect a continuous audio stream for up to a year. The data is then fed to a trained machine-learning algorithm to discriminate different animal voices (Bromley 2023). This enables researchers to study the relationships between individuals and their relationship with their environment. The examples show that digital technologies can amplify human perception and, therefore, allow for new experiences, resulting in novel insights.

The next step some researchers envision is to translate animal sounds into human language and vice versa. The research of David Gruber a Professor of Biology and Environmental Sciences in New York, for example, focuses on sperm whale communication and the idea of combining large-scale datasets, digital data processing, and machine learning to decode whale communication (Andreas et al. 2022). The advances in AI, as seen for example in Chat GPT or Dall-E2, are promising although many questions remain unanswered. With sufficient data to be trained on machine-learning systems are expected to be able to mimic bird or whale songs to the extent that the animal would not be able to discriminate between an artificial and a natural vocalization. It would pass the animal Turing Test so to say (Parshley 2023). The content of the conversation, however, could still remain unknown, at

2 reference to Depeche Mode song intended

least to humans. Based on pattern recognition the computer may discover the structure of an animal's communication and imitate it without understanding the content. Aside from the technological challenges this discussion leads to fundamental semeiotic questions about communication, the nature of signs, and meaning. One aspect I would like to highlight here is the role experience plays in those communication processes. Quoting from the *Scientific American*, "Designing a "whale chatbot," as Project CETI aspires to do, isn't as simple as figuring out how to replicate sperm whales' clicks and whistles; it also demands that we imagine an animal's experience" (Parshley 2023). Life as a whale is fundamentally different from being a human. What sounds trivial is actually fundamental. Living in the deep sea with poor eyesight because sunlight hardly penetrates the water that far but equipped with excellent hearing and a body shaped to the sea is quite the opposite of a human's life experience (cf. Bromley 2023). This leads to the question of whether it would be possible to understand the meaning of those animals' communications.

One of the prerequisites for any type of successful communication is a common ground in the form of shared experience. Charles Peirce explained it with the following example:

"For instance, I point my finger to what I mean, but I can't make my companion know what I mean, if he can't see it, or if seeing it, it does not, to his mind, separate itself from the surrounding objects in the field of vision. It is useless to attempt to discuss the genuineness and possession of a personality beneath the histrionic presentation of Theodore Roosevelt with a person who recently has come from Mars and never heard of Theodore before" (Peirce 1931-58, CP 8.314).

It has been mentioned before that Peirce proposed modeling as a method to gain new insights. Would it be possible to create virtual experiences with new digital technologies? Another research field where this question is highly relevant is space flight. The production of prototypes is standard practice for technological developments in the field (see for example the latest Mars Rover). In addition, astronauts regularly train in analog environments where geological conditions match those on the moon, for example, in Sardinia or Iceland. Mostly, only certain conditions can be simulated at a specific site. Thus, the experience remains incomplete, which has sparked research into the question of whether VR is capable of providing "[...] embodied and contextually rich aspects of speculative experiences" (Nilsson 2023).

MODELING EXPERIENCES

In 2022 the authors of the book "The End of Astronauts" asked if real experiences could be created with Virtual Reality:

"Imagine that advances in technology could produce a superior form of virtual reality that would allow you

to transport your senses to Mars, so that you could feel yourself walking on its surface, feeling the light martian breezes, watching the sun set over Olympus Mons or Tharsis Tholus, or admiring temporary rivulets at the edge of the ice cap at the South Pole. How less satisfactory would this be than traveling to Mars in your actual body?" (Goldsmith, Rees 2022, 92).

Peirce made it clear that experience is more than perception, but when modeling experience or creating virtual experiences it is hardly possible to provide more than a sensory stimulus which is mostly visual. With no technology currently available to transport all of the human senses to a virtual space, can we still create real experience? Experience was defined by Peirce as a surprising event arising from an interplay of memory, perception, and imagination. Consequently, we need to ask what a virtual space must look like to allow for humans to bring all of these faculties together. In a paper from 2023, Nilsson et al. report an experiment they made to test Virtual Reality (VR) in a Design Study for a specific task within a future lunar mission (Nilsson et al. 2023). The team created a VR scenario in a lunar environment to virtually test the design of a European Large Logistics Lander. A group of astronauts and space experts were invited to immerse themselves in a simulation of "cargo-reception and offloading procedures" and to then "critically evaluate the simulated design solutions" (2023). Since the simulation was only visual it could not supply the participants with any haptic feedback which was evaluated to be one of the key limitations of the experimental setting. The study showed that the VR environment was strong in providing the participants with a realistic field of vision, allowing them to experience the specific lighting situation on the moon. The handling of cargo, the reduced gravity, and the limitations in astronauts' movement due to their spacesuits were not representative because the scenario was only visual. However, the paper states that since the participants were experts they could draw on their own personal experience which "[...] has permitted some level of abstraction and simplification with regard to the simulated interactions" (2023). This statement leads back to "The End of Astronauts" where the authors describe how today's (and future) generation(s) of students for example have "[...] greater knowledge and acceptance of virtual reality than their predecessors [...]" which results in "[...] superior abilities to project themselves mentally to other worlds without losing sight of where they are" (Goldsmith, Rees 2022, 13). It can be concluded that the possibility for—and also the success of—virtual experiences is related to the experience of its users. Since Virtual Reality remains incomplete due to technological limitations the missing elements need to be imagined. However, imagination needs to connect with memory since we humans cannot think about the completely unknown (Peirce 1893–5). Therefore the virtual experience or experience in virtual reality needs

to be related to past experience in the actual reality. A careful and conscious connection of these parts of the relationship would then result in the utilization of digital technology to model the unknown.

DISCUSSION

The examples discussed show how digital technology is used to broaden human experience beyond our biological senses. Upon critical reflection of the various applications, it becomes clear that a simple amplification of the biological senses does not facilitate this broadening of human experience. The early studies of turtle sounds may fall in the first category but the more recent scientific discoveries were generated within a highly complex process using multiple instruments and computer processing. Thus, the following needs to be considered:

- Contemporary scientific discoveries are technologically mediated.
- By designing technologies that broaden the scope of experience, we are at the same time shaping or designing possible experiences.
- Consequently, researchers must understand the employed technology to evaluate their results.

Moreover, researchers need to account for the fact that in the Anthropocene, not only is human experience shaped by technology but also the experience of many other species. Human activity largely alters natural habitats, affecting diverse wildlife populations. The effect of vessel noise on whale communication is but one example of such alterations, the effects of which are far from fully understood yet (cf. Dunlop RA. 2019). Thus, contemporary research must account for technology's consequences on multiple levels.

What follows is a new form of experience, an artificial (künstliche) experience, because the general set-up for the experience was designed and is technologically mediated. However, it is by no means unreal. The Lunar Lander Design Study has shown that real-world results can be deduced from the virtual environment, although the VR application was limited. Understood as a model rather than an imitation, it can lead to true discoveries, especially when modeling is the only way to attain any experience. If new technology is used by critically thinking humans who are aware of its function as a medium, we will see valuable progress and discoveries in various scientific endeavors. With these requirements fulfilled, someday it might be possible to communicate with whales, but with our limited experience of life underwater, they should find us rather boring. To broaden the human experiential horizon and raise awareness for the complex and often multimodal communication other species have developed is a goal to strive for regardless of their response.

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