Ludic Neuro-Performances: An Approach Towards Playful Experiments

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The Ludic as a method for game-based design sheds light on the human condition. It allows dynamic change, free play with art, science, and game rules. A new conceptual ludic art explores rules of play, systems of investigation and knowledge acquisition through an open-ended game mechanic in the design process. The fundamentals of perception, experience and cognition are considered (Jahrmann, 2021).

Abstract *Building on the ludic method as an approach to artistic research, the concept of ludic neuro-performance is explained via the description of two performative plays developed as part of the artistic research project Neuromatic Game Art: Critical Play with Neurointerfaces (2020–2023). The concept explores the use of play as a process to be used by artistic researchers; more generally, it challenges research methods, experimental rules, artificial settings, and technologies. Finally, the ludic neuro-performances elaborate new forms of play related to emerging technologies such as neurointerfaces and AI.*

Introduction

In this article, I propose the use of the ludic method as an experimental system in research. In an interdisciplinary practice, this method was developed over the last decade, involving various formats of play and art. As an artistic research method, it builds on dynamic game mechanics, arts, and science. It results in the creation of artworks which aim to connect the human and non- human, the cognitive and the

emotional, the political and societal with a new form of artistic games to reflect and intervene in contemporary conditions of the world based on technologies.

Using the ludic method, we developed neuro-performances in the *Neuromatic Game Art: Critical Play with Neurointerfaces* research project.[1] This approach aims to develop games as experiments and to use neuro-interfaces in performances. The experimental setup becomes a subject of research; insight is gained through the collection of brain data during performances and via reflection on the experimental setting in combination with the experiences undergone during a performance. It constitutes a playful 'ludic' version of an epistemic thing[2] in the sense of Hans Jörg Rheinberger (2006). Here the experimental apparatus is at the centre and is an element of the performance.

The term 'ludic method': Explanation and definition

In my artistic doctoral dissertation submitted at the University of Plymouth, *Ludics for a Ludic Society. The Art and Politics of Play* (2011)[3] , I elaborated the ludic method. In an effort to establish the ludic method, with the aim of integrating play mechanisms and research, I founded the Ludic Society. The projects of the 'Ludic Society'[4] were a series of urban and exhibition games, shown at international venues, such as Piksel

1 https://neuromatic.uni-ak.ac.at. See also: A Dobrosovestnova, M Coeckelbergh, M Jahrmann, 2021. 'Critical Art with Brain-Computer Interfaces: Philosophical Reflections from Neuromatic Game Art Project.' In: *HCI International 2021-Late Breaking Papers*, Springer International Publishing.

2 In the research process, the 'epistemic thing' is the object of investigation, which can develop into a 'technical object' in the course of the investigation, i.e. into something that can be used as an instrument in the investigation of further 'epistemic things'. However, this boundary is not static and the identification as either an 'epistemic thing' or a 'technical object' is not necessarily permanent. Cognition is therefore neither inevitable nor complete. Rheinberger's experience as a molecular biologist has brought the 'materiality of the natural sciences' into the focus of the history of science. Extracted from Wikipedia, referring to the book: *Experimentalsysteme und epistemische Dinge. Eine Geschichte der Proteinsynthese im Reagenzglas*. Frankfurt am Main 2006.

3 This dissertation provides an analysis of, and critical commentary on, the practice of playfulness as a persistent phenomenon in the arts, technology, and theory. Its aim is to introduce political reflections on agency through the study of playful technological artefacts, which have largely been ignored in recent discussions on games and play. Following the critical analysis of historical discourses and studies of concrete play under differing auspices, seeking to understand play as an inherently political form of agency, this thesis's research question addresses the immersive effects of playful agency in symbolic exchange systems and in the material consciousness of the player. https://pearl.plymouth.ac.uk/handle/10026.1/453

4 http://ludic-society.net.

Fest Bergen, Laboral Gijon, and ars electronica Linz. With 45 international members from various disciplines – both researchers and artists – we were able to examine the effect of the use of new technologies and game mechanics in the context of art (Objects of Desire, 2008).[5] On stage, we also reflected the human condition of the player by using new technologies such as the internet of things ('The evening of the Ludic Society', Ro Theatre Rotterdam, 2006).[6]

By means of playful exchange in various fields of expertise, the ludic method allows transdisciplinary teams of artists, performers, researchers, and early adopters of technologies to critically examine how a certain research question is shaped and what effect the topic has on the audiences. To grasp the method in greater depth, we need to understand play in relation to technologies and arts as based on an open set of rules, which puts a focus on self-reflexivity. A central aspect of the ludic method is experiencing the essence of technologies as a subject. Following the ludic method introduces a new trope to artistic research via public play with emerging technologies. In ludic method settings, an element of play is applied to demonstrate and sometimes also invert the role of technologies and the artistic researcher.

The ludic neuro-performances

In the ludic neuro-performances, we applied a ludic method and used neurointerfaces to measure and analyse brainwaves during public play and performance. Often in ludic neuro-performances, only minimal action was required from the performers as players and from audiences as observers of a public play. As we found out, the ludic neuro-performances correspond very well with studies of idle games,[7] which is a common term for very simple incremental games that only require minimal action. In the Ludic Soirée Series 2022, Larissa Wild describes the increasingly present passivity in some art games (think about the games of David O´Reilly, such as 'Mountain' or 'Everything') as a mirror of the world as we know it. In these idle games the player can do very little, mostly only one action to trigger the process of the gameplay. In her presentation Wild gives numerous examples of consumer games:

> The new genre of low-interaction games challenges the definition of games, their limits, and their rules. Low-interaction games take away an integral part of games and thus propose a new range of definitions. They develop a new type of relationship with the player – almost a dominant one – and are still widely enjoyed and played by thousands. Through analysing low-interaction

5 http://ludic-society.net/desire/.

6 https://v2.nl/events/the-evening-of-the-ludic-society.

7 Idle games are often called 'click and tap' games. On many gaming forums, they are defined as simple incremental games.

> games we can find and compare patterns in other game genres as well as in our society. [8]

In the ludic neuro-performances, artists and researchers used such low-interaction game principles. The use of neurointerfaces does not allow a lot of physical action in performances.

An alarming consequence of these tendencies is self-optimisation as a digital imperative in everyday life. Sensitive personal data is increasingly capitalised and becomes part of a social scoring system. Neurointerfaces, currently on the cusp of becoming consumer articles (for example, as EEG headsets), provide direct access to brain activity, thus enabling the user for the first time in history to control devices by pure thought. Scientific investigations are using the possibilities of neurointerfaces to improve understanding of brain functions, or to help people with disabilities to regain better quality of life. However, the devices also breach the privacy of our thoughts, recording and measuring very personal data on brain activity; this raises major ethical issues.

Neurofeedback installations are increasingly present in the arts. Investigating perception was always also an artistic endeavour. From the first experiments that turned psychophysiological research into experiential formats, such as Marcel Duchamp's optical apparatuses, via Gysin and Burroughs's Dream Machines, to the Ganzfeld installations of James Turrell or Olafur Eliasson's perceptual experiments, the analysis and manipulation of human brain function has often been a site of strong intersection between the arts and the sciences. A database of artworks using brain-computer interfaces,[9] though probably incomplete, lists over 40 works, starting with Alvin Lucier's seminal *Music for Solo Performer* in 1965, which used electroencephalography (EEG) to generate music. More recent examples include pieces with multiple participants exploring brainwave synchronization[10] or questions of intimacy,[11] a film that can be controlled via a brain-computer interface,[12] complex interactive multi-media installations,[13] and an opera influenced by the actor's brain waves.[14] These examples show the increasing overlap with other media, such as wearable technologies, and also reflect the growing mutual interest of neuroscience

8 https://www.dieangewandte.at/aktuell/aktuell_detail?artikel_id=1644244159247.

9 Prpa M, Pasquier P: https://bci-art.tumblr.com (School of Interactive Arts+Technology, Simon Fraser University, Canada).

10 Dikker S, Oostrik M, *The Mutual Wave Machine* (2013), supported by the Marina Abramovic Institute at the EYE Amsterdam.

11 Lancel K, Maat H (2016) *The E.E.G. Kiss* (http://www.lancelmaat.nl/work/e.e.g-kiss/).

12 Richard Ramchurn [firstpost.com]. source: http://braincontrolledmovie.co.uk/trailer/.

13 ::vtol:: (2014) Solaris. http://vtol.cc/filter/works/solaris.

14 Pearlman E (2017) *Brain Opera: Exploring Surveillance in 360-degree Immersive Theatre*. PAJ 116: 79–85.

and art.[15] While the performative quality of these works can serve as an inspiration, most of them miss a participatory aspect (an exception is an artistic neuro-feedback game)[16] and barely address critical aspects of neurointerfaces.

By contrast, in the Austrian Science Fund's artistic research project *Neuromatic Game Art: Critical Play with Neurointerfaces* (National Research ID AR 581) from 2020 to 2023, our aim was to critically reflect upon the potential of neurointerfaces for arts and artistic research. Mobile brain-computer interfaces are now capable of linking body, brain, and electronic networks. In the *Neuromatic Game Art* project, we wanted to use neurointerfaces as functioning scientific apparatuses that were props for performances. We combined the experimental measuring and collecting of data using neurointerfaces on stage with a *mise en scène* featuring the visualisation of brain data and the use of AI in performances. Because of the sensitive technology machinery of brainwave analysis and the difficulty to distinguish data noise caused by muscle movements, in short artifacts from brain data, we had to reduce activity caused by play on these interfaces. The rules of play in the ludic neuro-performances were thus very limited. To enact research during live situations, we also used the process of artistic writing as a performative act during our research. In an act of hacking the discourse, this was thus an experimental means to examine the subjective experience of alternative research possibilities. We developed experiments, analogous to scientific experiments, on cognition, behaviours and performance.

The series of performances developed in the *Neuromatic Game Art* project feature a combination of experimental settings from neuroscience, where the audience is both participant and player; the application of game design principles for the performance score; and the use of electroencephalograms, transforming brainwaves into sound and visuals. The personal data of artists, researchers, and participants in experiments was merged into installations, which served as a stage for public play with audience participation in the experiment. The participants own insights into how the measurements of their brain activity reflected their internal perceptions were also displayed as part of the stage design.

Two ludic neuro-performances

In the following section, I will use two performance examples that were conceived using the ludic method and explain what happened in these two performances with

15 Public event with Jahrmann, Glasauer, and others (https://www.bernstein-network.de/de/bernsteinconference/past-conferences/2018/insights-in-art-and-science-exploring-the-boundaries).

16 Stober JM (2015) *Ride Your Mind*. http://rideyourmind.com.

respect to the performers, the audience, and the technology, as well as what was achieved as a result.

Example one: *Brain Machine Dérive*, 2020

Figure 1: Margarete Jahrmann engaging visitors in a Tarot-game conversation. Photo: Martina Lajczak.

Brain machine dérive (2020) is an example of an elastic writing performance with neurointerfaces.[17] It was performed at the Colloquium on *Artistic Research in Performing Arts* (CARPA7).[18] Following current tendencies in the arts to incorporate gameplay and technologies in theatre performances, four performers gave a staged public philosophical reading on the 'philosophy of the interface'. The readings followed game rules and showcased the brain activities of the reader measured by electroencephalography in real-time. Poetical references, for example dealing with expectations and superstitions regarding neuro-interfaces as brain reading devices and a means for telepathy, were factored into the texts to empower the audience to take a critical stance towards neurointerfaces.

17 https://neuromatic.uni-ak.ac.at/blog/derive-performance-critical-philosophy-play/.

18 Performance documentation on Carpa Website: https://nivel.teak.fi/carpa7/brain-machine-derive/.

The choreographer and artistic researcher Charlotta Ruth developed a score for this neurointerface performance. Its aim was to record brainwaves with a consumer neurointerface headband and to record the data while playing a card game and live writing. We wanted to measure and indicate arousal levels in reaction to certain playing cards displayed. During the performance, we then invited the audience to ask questions about the future. As part of the ludic method we used a game rule: to react to each question with a card. For that purpose, we used a self-designed set of cards for telling the future. At the same time, another performer undertook an act of automatic writing, typing the same questions into an early version of Chat GPT. We read out the answers produced by Chat GPT to the audience. Then we concentrated on the playing cards and displayed the visualisation of our brainwaves using the *Mind Monitor* software tool, running on our mobile phones. During the whole performance we measured and recorded the brainwaves of the four performers. Finally, we analysed the brainwave data to interpret the feelings we had while performing.[19]

Our aim was to demonstrate a new form of technological writing in artistic research, in which the audience and AI both contribute to producing the text of the performance. A key outcome of the performance was that the performers found the interaction with the audience in text production to be highly motivating. The live visualisation of our brain activity influenced the focus of questions from the audience during the performance and, in a feedback loop, also our own behaviour as performers. The use of a self-designed set of fortune-telling cards was the stimulus in the experiment. The technological setting with neurointerfaces, visualising brain activity, was key to the performance.

The performance allowed discursive reflection with the audience in a live situation. It triggered a discourse about mind reading, neuroscience, and ethical questions around public data harvesting. In a live research process during the performance, we were able to use neurointerfaces to investigate the application of technologies of quantification of the self and surveillance. This neuro-performance constituted an interplay of performance and neurointerfaces. As an experimental research game, it connected art and science.

19 https://www.uniarts.fi/en/documents/margarete-jahrman-and-charlotta-ruth-brain-derive-detournement-a-neuro-philosophical-situated-gpt-3-writing-game/.

Example two: *Zero Action in the Savings Bank*, 2022

Figure 2: Performance view, hyperscan with two players in Zero Action, *Margarete Jahrmann, Zarko Aleksic, Stefan Glasauer. AIL Angewandte Interdisciplinary Lab Wien, 2022. Photo: Stefan Glasauer.*

In the performance *Zero Action in the Savings Bank* we wanted to demonstrate how the brain activity of performers involuntarily synchronizes during a performance and how we can play a kind of idle game, as described by Wild (2022). The performance involved two performers, Žarko Aleksić and Margarete Jahrmann, lying on examination beds, looking at each other. Four cameras monitored each performer's body, filming the unintentional micro movements of the two performers and displaying these videos publicly. Unintentional muscle contractions were blown up on the screens in front of the performers and displayed to the audience. Each noise or other indicator of the presence of the audience influenced the measured brainwave activity of the performers – as displayed on a huge, game-like projection behind the performers. Both performers' brain waves were recorded using a 32-channel EEG (electroencephalogram) in a simultaneous hyperscan. Because the brain activity of the two performers was recorded at exactly at the same moment, it was possible to store comparable valid datasets. The brain activity was interpreted and visualised using a custom-made software, developed by Stefan Glasauer, the chair of Computa-

tional Neurosciences, from the Brandenburg Technical University Cottbus.[20] The visualisation of the brain activity of the two performers was represented in two circles. The moment the neurointerfaces registered synchronization, lines appeared inside the circles, representing the activity in certain brain areas. The audience watching noticed that it was possible to influence the intensity of connections between the two 'brain' circles on the screen via noise or other indicators of their presence.

This setting was presented as a *zero-action game*. The game mechanic was divided between the audience and the performers: The performers on the examination beds, equipped with neurointerfaces, played a 'passive' game. The playing activity was unintentional, in other words 'idle': muscle movement and brain activity. The audience took part in the experiment through its also largely 'idle' presence. It acted as a stimulus to the performers, who tried not to react, but who of course reacted involuntarily.

The outcome of this ludic neuro-performance was to integrate the neuro-interface with a new orientation in artistic play that is opposed to capitalist logic because it refuses to actively play. In this inter-passive micro performance, we entered into a dialogue without words with the audience. The topic was mutual unintentional interplay between performers and audience. In that sense the audience was passive/idle in the conventional understanding of play, but active in terms of its presence as part of the performance.

Afterword

The ludic neuro-performances use idle game principles of minimal action. They demonstrate how the increasingly available neuro-interfaces are not just tools for self-optimization but can be used as vehicles for a new form of passive play. In this way, neurointerfaces can be turned into tools of artistic expression. This approach critically addresses via performances the non-consensual play by technological systems with human entities that directly capitalises biometric data.

The ludic neuro-performances use ludic methods to reflect upon the social significance of neurointerfaces. The connection to science is underscored by the use of repeatable experiments and experimental design. We see how scientific tools become part of artistic research and then contribute again to the performance research process. The ludic neuro-performance as an artistically exploratory approach, relates performative practice to playful but rule-governed procedures. The performative play allows the testing of a new genre of performance using neurointerfaces – between science and art, where subjective experience is at the centre.

20 https://neuromatic.uni-ak.ac.at/blog/zero-action-in-the-savings-bank/.

One of the future possibilities for ludic neuro-performances will be to contribute to experiments in our partner research field of behavioural neuroscience that can be carried out under more natural conditions. Experiments are usually conducted in restricted and unnatural laboratory situations, which makes generalization to everyday life questionable. The ludic neuro-performances demonstrate how this situation can be amended by means of publicly accessible art.

The emergence of mobile and consumer interfaces for the measurement of brain activity promise a new genre and research field in performance that includes hybrid spaces between interfaces, technologies, and the body.

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Biography

Margarete Jahrmann is an artist and artistic researcher, full university professor, and has been head of the department and master's programme in Experimental Game Cultures at the University of Applied Arts Vienna since its establishment in 2021. As an experienced researcher and pioneering game artist, she led the research

project 'Neuromatic Game Art: Critical Play with Neurointerfaces'[21] from 2020 to 2023. Since 2024, she has been principal investigator of the interdisciplinary research project 'The Psycho-Ludic Approach: Exploring Play for a Viable Future'. Both projects have been funded by the Austrian Science Fund (FWF). Her art and research projects focus on play as an experimental system. Jahrmann publishes and exhibits internationally (e.g. 2024: featured AI artist Spike Magazine; 2023: AI Institute Nagoya; 2021–2023: Re:publica Berlin Art Show; 2021–2023: AMAZE Playful Media Festival Berlin; 2022: Havana Biennale; 2017: ars electronica Linz; 2004: transmediale, Haus der Kulturen der Welt Berlin.

21 https://scilog.fwf.ac.at/magazin/das-spiel-mit-den-gehirndaten.