

From Neuro-potentials to Aesthetic Perception. BCI and the Arts

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Received date: September 12, 2014, Accepted date: November 19, 2014, Published date: November 26, 2014

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Raffaelle Locked In

A cup with a straw was on the table in the oversized light-flooded room and several cigarette boxes were randomly lying there. The artist was sitting besides the table on a mobile office chair with rests of worn out black leather, slightly leaning his head side- and backwards. The body was so infirmly and strangely twisted cowering on the chair as if it would fall to ground soon. He had a cigarette fixed between the middle and the index finger of the hand at his left drooped arm by a young assistant. With an iron will and like a Foucault pendulum he now swung his left arm, in an angle of about 30 degree against the body, as long back and forth till he got, at the highest amplitude of the arm, the cigarette caught by his mouth and avidly sucked up the smoke. He repeated these acrobatic movements several times till the cigarette was consumed up to the filter. Then he dropped it from the flabby hand to the floor laced with color splatters. Now the assistant reaching with both arms through the armpits from behind the chair skillfully grasped the artist's right flexed arm by a kind of Rautek-grip, lifted the saggy body up so that it wasn't any more at risk of falling down, and then brought the cup with the straw to the artist's mouth.

In this situation the artist's mental presence and alertness seemed to rise, to spread all over the room, to apprehend all and everything. The resulting electrified atmosphere and mood could almost be felt physically. But the usual lively ado and creative fabricating in an artist's workshop had given way to an unbearable silence. The assistants moved slowly, carefully and thoughtful as if time would stop soon. The pictures, the assistants, the interior, and the room itself appeared in their surreal interconnectedness like the inner of a cocoon irresistibly going to dissolve into pastel colored blurs. In that very moment, in the moment of cessation and immobility, the completely flagged skinny and via a tracheostoma ventilated body merged with the medical machines and gadgets and, from the aesthetic point of view, turned into a sculpture of timeless beauty within his 'cathedral'.

The encounter with the ALS diseased painter who couldn't hold a pen with his weak hands any more refers to the question an artist asks the prince in Gottfried Ephraim Lessing's play Emilia Galotti: „Or do you hold, Prince, that Raffaelle would not have been the greatest of all artists even had he unfortunately been born without hands?“ (part I, scene1) Though for Lessing this question had a rather rhetorical function it nevertheless brings an interesting issue on the social and cultural canvass in the beginning 'cyborgzoikum', the era of BCIs, robots and avatars: Can we still speak of a painter and his/her creation? Can we see this creation? How can we perceive it? And is it a picture at all? Can we debate about it? Or is it an elusive, immaterial, virtual work? Where does it come into being? In the artist's head? Is the process in the brain the actual creative act?



Figure 1: EEG brain activity measuring in visitors who were beholding pieces of art.

Origins and Development of Brain Painting

Painting without hands, drawing without muscular force, sculpting without hammer and bit, only by the power of thoughts, willful imagination, and concentration: all this was realized with comprehensive research from the universities' side (Tübingen and Würzburg 2004-2012) but was motivated by artistic ideas. The starting point for the artistic involvement, currently culminating in the project 'Pingo ergo sum', was the question about the place where a piece of art comes into being. Where is the borderline between the artistic idea and the piece of art as such – concerning both the artist and the beholder? Can the creative, cerebral or mental processes be measured before they are realized in a transformative process of confection?

What meanwhile has been experienced in several exhibitions, performances and during workshops and training sessions of the Brain Painting project and what is permanently developing further began 2003 with the Ars Electronica festival. There I did EEG brain activity measuring in visitors who were beholding pieces of art (Figures 1 and 2).

Interesting were the statements coming from the participants in these experiments who were at the same time the recipients of a performance. Nearly concordantly all the participants were convinced that the thoughts they had when beholding pieces of art can be recognized and decoded from the EEG graphs, as if they would exist in the EEG apparatus in a digitalized shape. This led them to observe art more intense and concentrated. Thus, this connection of machine and

brain (art played the role of a stimulus) changed and enhanced the quality of reception in the sense of 'event correlated evoked aesthetic'.



Figure 2: EEG brain activity measuring in visitors who were beholding pieces of art.

This work, continued in other exhibitions, lead to EEG-sculptures (SIGGRAPH Los Angeles 2004, Figure 3) displaying the mental flow of art viewing. This was a first step towards finding creativity where it becomes measurable for the first time: as electrical flows in the brain evoked by external stimuli. The next step, from the measurement of stimuli when watching art to the translation of stimuli into form and color is based on software making effects out of stimuli. To match the electrical signals coming from the brain with the 'right' effects a BCI and the innovative painting software 'Brain Painting' or 'Matrix' (designed by Dirk Franz) is needed. Basically, the BCI is calibrated to causally connect certain patterns of brain activity with certain thoughts.

In artistic practice this happens for instance by choosing alternative tools on the matrix (Figure 4): among other things, colors, geometrical forms, and the place where they will appear. You can also make them disappear again or 'explode'. Since only the thoughts determine the result, selection of materials, manual activities, painting, drawing, hammering, sawing, cutting, taking pictures, making movies, etc. is not part of the overall message.

Only the thoughts are directly translated by the software. It's an impressive, non-verbal process when only the will makes things happen. De facto, it needs high concentration that the BCI recognizes

the intended and distinguishes it from the non-intended and has it realized by the computer. "What the human being thinks is already deed without being done by his hands [1]." This citation alludes to the intensely debated creative act. In the field of arts and cultural history this triggers the question, how ideas are merged into art and when this process is completed and a piece of art is finished. With Brain Painting this question becomes transparent for the first time and can be taken up again and developed further. Can we map the creative act without materializing it? Has art to materialize itself at all? Or can the creation stay in a virtual state, 'realize' into virtual reality?



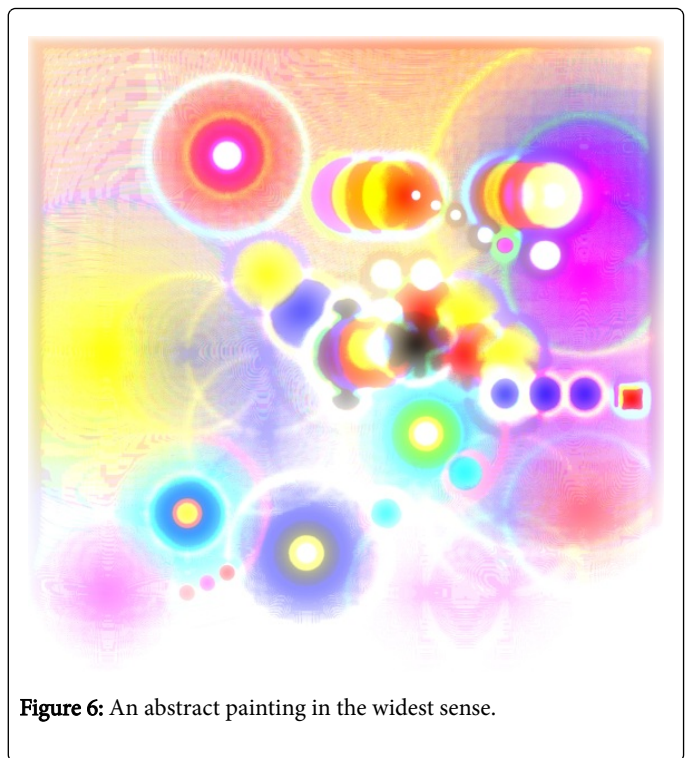
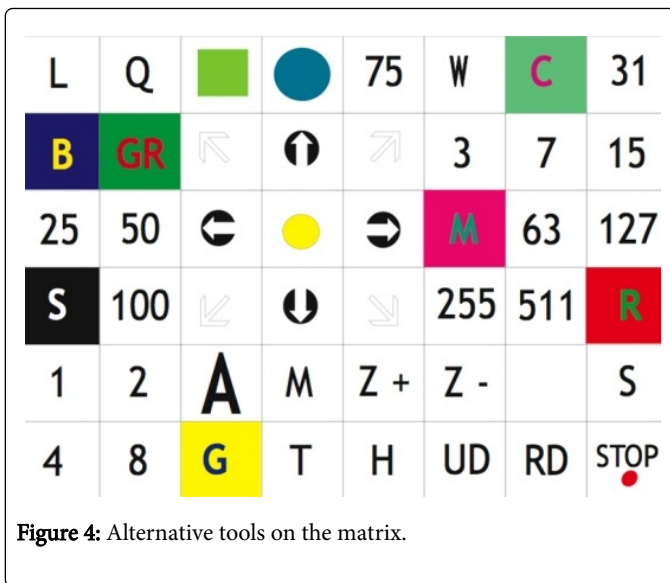
Figure 3: EEG-sculptures displaying the mental flow of art viewing.

'Pingo ergo sum'

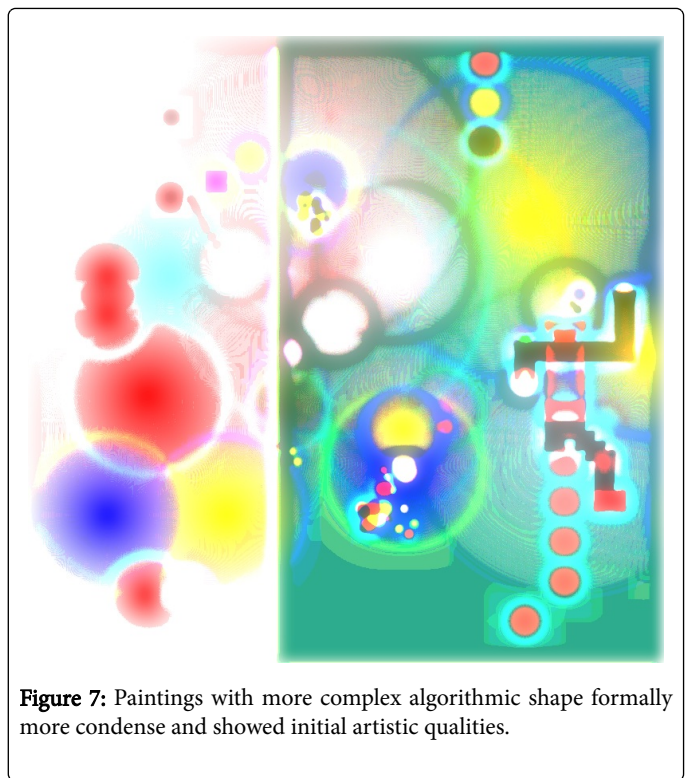
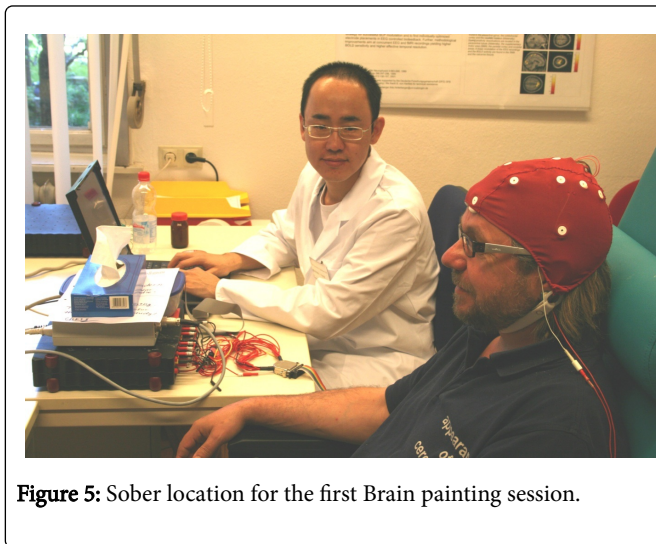
The artistic field research is accompanied by scientists. Between 2005 and 2012 the Brain Painting software was tested in practice, integrated in art projects, scientifically evaluated, and permanently optimized. What started out of an interest in immediate applicability has become an interdisciplinary project. The necessity to actively express one's own thoughts (becoming obvious after that many years of artistic research in this project) extents Descartes' dictum cogito ergo sum - I think therefore I am - to pingo ergo sum - I paint therefore I am [2].

In 2005 an EEG lab of the University of Würzburg has been the sober location for the first Brain painting session (Figure 5): Putting on the EEG cap, gel to the hair, connecting the electrodes to the amplifier, calibration, classification, localizing the p300 wave. Now I was 'in line' with the machine, I turned into a cybernetic organism.

The flashing stimuli coming from the paint matrix (oddballs) pervaded my brain via the nervus opticus and provoked event-related potentials (ERPs). It was an exciting moment and sublime feeling when I saw how my imagination of colors and well defined or diffuse figures were decoded and appeared on the screen that transformed into a digital canvass. Peu à peu color patches came into being: an abstract painting in the widest sense (Figure 6). It was fascinating and beguiling how my will got power over the brain machine. I chose pink, I chose a square, a blue one... moved the cursor to the right seven times, in between focused the color blue on the matrix, concentrated on the flashes, thinking 'square'.



This short description shows that Brain Painting is not about creating nice things. Rather it became clear that the cerebral events and the events at the brain-machine interface are the artistic process. Is this the borderline between the idea and the work?



Not the EEG lab was the workshop but my brain transformed into the artist's workshop of the third millennium for a short moment when I 'painted' the first picture worldwide without muscular power, without brush and colors. I myself was a cyborg. Soon my paintings became more complex, lost their algorithmic shape, were formally more condense and showed initial artistic qualities (Figures 7 and 8). I developed a certain ability and routine in dealing with the system. The BCI became more and more part of myself. During the sessions my self-perception changed. There was a feeling as if my thoughts would leave my brain and start flying but only to finally turn around and enter into an alter ego. This other I now surfs through my gyri, senses my cortex, breaks in the darkest corners of my grey matter, watches me and makes itself independent. My thoughts emancipate, distance themselves from me, and make aesthetic decisions wrapped in gamma band potentials crisscross through my personality. I don't perceive time and space. No passing and passing by, but only an eternal being: A moment of highest aesthetic sensation in the no man's land between brain and machine.



Figure 8: Paintings with more complex algorithmic shape formally more condense and showed initial artistic qualities.

Meanwhile I have spent more than 150 hours wearing the BCI cap, partially up to eight hours with more or less no interruption: In the beginning in the EEG lab, later on also at home, and today at any place. In connection with the 2012 exhibitions in Kunsthalle Rostock and in AECentrum Linz more than 200 private persons and 30 internationally renowned artists took part in Brain Painting. Ten ALS patients have brain-painted.

Brain Painting is not only a platform where artists and scientists meet. At the first place it opens up a cosmos of questions comprising medical, socio-cultural and artistic aspects. Given the wide scope of these aspects at the interface of art and science and the openness to understand this cooperation as the realization of an art project as well, pingo ergo sum is an experiment unique in the world. Art writes the screenplay. Society is on stage. An artist's workshop is the stage and becomes a scientist's lab. To engage with brain painting means to understand the arts differently, to free oneself from the idea that art is embodied in separate works displaying the ingenious human drive of expression. Here, art is not the destination but the way, not a singular evidence but a question about the process of becoming. The beholder as well as the researcher do not stand on the firm ground of usual cultural activities being in line with our historical fundaments. They are rather in between art and science, concrete results and elusive thoughts, genesis and decay. They can not only see an experiment, they are part of an experiment based on understanding the manifestation of creativity as being neither time- nor space-dependent.

The painted is no longer bound to a material substrate, but can be reproduced at various places in realtime, i.e. in the moment of its origin in the artist's brain. It is a virtual appearance that, different from a singular space-dependent realization, brings time and space together. After completion the picture can be saved or printed, but on screen it disappears. The product is ephemeral; only the conviction of being able to make thoughts visible stays. This enables a global project opening besides the already existing digital worlds of finances and communication another one: the digital world of art. Following our technical evolution, art might become another not any more material

but digital medium of our culture and could be moved both in expression and reception to any place being in command of the necessary equipment. The further the de-materialization of events goes the less evident is the spatial definition of a piece of art as such. In the logic of this development it seems obvious that a piece of art has no fixed spatial qualities but is rather a temporal experience. The object that is watched becomes an ephemeral part of watching itself. It exists in the moment of appearing.



Figure 9: The Austrian painter Christian Stock marched on the Tuxer glacier.

2012, as a Brain Painting performance, the Austrian painter Christian Stock marched on the Tuxer glacier (Figure 9). Having arrived there he unpacked the Brain Painting equipment from his backpack, put on the EEG cap and started 'painting'. Live and in real time the process of developing the picture could be monitored both in Ars Electronica Center Linz and in Kunsthalle Rostock. In addition, any user worldwide could follow this event via life-stream on smart-phone. The artist imagines the picture, it 'falls out' of the head, rolls down the mountain, and reaches the walls of the museum and the beholders' heads.

Extending 'Pingo ergo sum'

Brain Drawing (in cooperation with the University of Würzburg) and Brain Sculpting (in cooperation with the University of Rostock) followed after Brain Painting. Further similar procedures furnished with both artistic and scientific aura extend the label of 'pingo ergo sum' shown in the Figures 10 and 11.

In 2012, as a direct cooperation of scientists and artists, Lars Schwabe (University of Rostock) and I founded the Art Research Lab (ARL). The scientific part of this lab works on the premise that perception and artistic expression are based on neuro-biological activity which can be made visible. In that sense, ARL is itself an image of the brain and its activities that 'falls out' of the brain. From the artistic point of view ARL is work in progress.

"My mirror neurons dance Tango with me" is the poetic label of the project that is in the center of ARL since 2012 while Brain Dancing is its scientific name.



Figure 10: Artistic and scientific aura extend the label of 'pingo ergo sum'.

Applied to Brain Painting or Brain Sculpting the aesthetic experience is to be found exactly at the brain-machine interface. With the project Brain Dancing Prof. Schwabe and I go even one avantgardistic step further. The project aims at enabling locked-in people to actively dive into virtual reality and to dance there Tango together with a partner. An avatar, taking on the role of the Tango dancing partner, is controlled via shared control mechanisms according to implemented dance steps. The locked-in dancer extends the brain-machine interface, overcomes it, excorporates and dematerializes him/herself, and mutates into an alter ego in a virtual space when slipping into a second dancing avatar. The emotional and erotic feelings associated with dancing Tango are to be elicited by closing feedback loops. To do so we developed the so called pneumatic- and MES dancing dresses. An aesthetic whole will arise when action and perception start dancing.

The option of influencing biological beings technologically will change the human being into a cybernetic being, a cyborg, during the

third millennium. Seen from an evolutionary perspective, the human being, then, would successively be changed and reduced in its physicality; as it is already anticipated in fashion when legs seem to be shortened (Figure 12). For what do we need arms conducting the partner or legs performing pirouettes? What, if we would, kidnap also several others of our senses to virtual reality by some 'injections'? What if the dancers could not separate anymore between top and down, between inside and outside? Would this help overcoming the cerebral construction of reality?

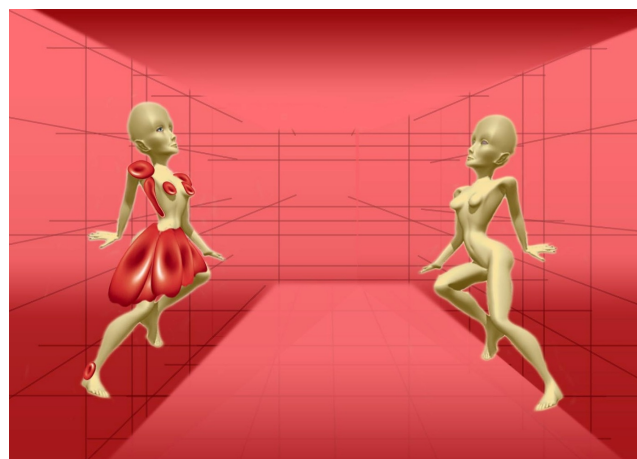


Figure 11: Artistic and scientific aura extend the label of 'pingo ergo sum'.



Figure 12: Anticipated in fashion when legs seem to be shortened.

References

1. Böttcher, Dirk (2012) Pingo ergo sum.
2. Polte, Maren (2012) Pingo ergo sum.