Poietry – communicational prosthesis to seemingly overcome loneliness

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Abstract

This paper presents results from an artistic research process on methods to seemingly overcome the loneliness of operationally closed psychological systems through a musical interface powered by brainwaves and their interpretation, based on a novel way to translate emotions into compositorial sound structures in real time. Poietry is an artistic experiment that serves as a communicational prosthesis, which appears to enable accessing another human entities' internal operations.[1] It is a cellular automata and real time sound improvisation tool triggered by emotion.

Keywords: brain-computer interface, emotions, brainwaves, artistic mapping, musical performance

1 Introduction

As individuals we are not able to look through somebody else's eyes; we are not able to feel, what someone else feels, because every feeling we are capable to produce will ultimately remain our own. What really happens in another person's consciousness will necessarily stay an eternal mystery.

Communication allows us to externalise what happens in our inner world, but it inevitably implies a transformation followed by a decodation of this transformed information. Furthermore, not everything that happens in our consciousness is communicable, just as not every part of communication can be captured by our consciousness. Communication simply allows us to draw analogies, to interpret meaning and our approach of the inner world of somebody else can therefore only ever be indirect as we simply can not verify it conclusively. An immediate access to the inner world of another person is denied by our reciprocal boundaries, so we remain in solitude within these boundaries.

Technical tools serve as prosthesis and therefore extensions of men. Whereas tools traditionally used to be extensions and amplifications of the human body, digital interfaces extend the human mind and can consequently enrich the communicational process.

The technical ability to measure brain activity and the ongoing research of its interpretation promises growing access to the correlates of consciousness. This doesn't imply that we can access consciousness itself as the mind mustn't be understood as being a trivial machine, which finds itself biologically encoded within the brain. Given that one of the if not the most important disposition of consciousness is experiencing it, it is actually questionable altogether whether consciousness will ever be accessible from outside the organism that it happens in. Neural correlates of consciousness however can be measured and it is feasible to examine reoccurring patterns of neural activity to draw certain analogies about their meaning even if the results of these measurements might be

[1] The term Poietry is a neologism etymologically based on the terms Poiesis and Poetry. This neologism is a consequence of the consideration that the experiment is created through a poietic instead of a practical approach and further, that the created prosthesis expresses something without literally translating it to unfold an effect beyond this literal translation, which is according to the definition of Schopenhauer, the classical characteristic of poetry.

unequivocal. These measured correlates allow a certain access to seemingly incommunicable data, which can paradoxically be used for what it per definition can't be used for - communication.

Following the implications of Antonio Damásio emotions can be triggered and executed entirely non-consciously and have to reach the state of a feeling made conscious to even be communicable. (Damásio, 1999, 37) What they share in their biological core is being a complex yet stereotyped collection of chemical and neural responses, which are biologically determined and can be externally observed through bodily display. Lying underneath the level of consciousness, they are particularly hard to control even though it is possible to prevent their expression at least partially. Damásio phrases it this way: „We can educate our emotions but not suppress them entirely, and the feelings we have inside are a testimony to our lack of success." (Damásio 1999, 49)

Whereas neural activity per se is entirely neutral and therefore doesn't give any information about the function it fulfils, the localisation of this activity within the brain allows certain conclusions about the content of the operation the activity is related to. Roughly there are parts of the brain that are free to react to irritations of the organisms surroundings and parts that represent the organisms own state and are consequently fully tied to keeping the organism alive. States of consciousness are – to our current knowledge – tied to the activity of the neural cortex and consciousness vanishes as soon as there is no activity detected within the neural cortex anymore. Depending on the specific part of the neural cortex and the precise pattern of the activity we are told by researchers like the molecular biologist, biophysicist and neuroscientist Francis Crick and the neuroscientist Christof Koch that we can gain a specific idea about how cognitive and emotional processes are related to their neural representation within the brain. (cf. Crick/Koch 2003)

2 Method

Based on the theoretical considerations outlined herein a brain-computer interface which transforms live interpreted EEG data into sound was developed. EEG-based technology offers easy access considering wearability, price, portability and ease-of-use, and more importantly the EEG is a highly temporal method allowing to collect and process real-time data, which is necessary for the analogy to the operations within a psychological system. The data collected by the EEG is transformed into OSC signals and sent to a Pure Data patch where it is expressed in five basic emotions, namely Anger, Fear, Happiness, Sadness and Tenderness. The categorisation of emotions is generally controversial and even more so decoding them from neural patterns or brainwaves. The number of research activities on EEG-based emotion recognition algorithms increased within the last years, yet it remains a new area of research and its effectiveness and efficiency are somewhat limited. If one understands science as a fluent process to generate suitable findings rather than revealing an ultimate truth, categorisations of this sort can nevertheless be productive. Even more so when applied in an artwork, which in itself, following the definition of Niklas Luhmann, is the result of a self-binding process evolving along its own code of suitability. (Cf. Luhmann 1995, 328f.)

The quantification of five basic emotions Anger, Fear, Happiness, Sadness and Tenderness, which are the foundation for the transmission into sound, are derived from a combination of measurements: Raw brainwaves - alpha, beta, theta and delta - are correlated with the interpretation of the Emotive EPOC EEG software - instantaneous excitement, long term excitement, frustration, engagement and meditation - based on a matrix of calculations developed through artistic experimentation and tested qualitatively. The developed algorithm is not aiming to deliver scientific accuracy, but deemed suitable for the Poietry project through the results of the experiment and for the reason that the artwork is about raising questions within spectators and subjects rather than giving definitive answers.

The collected data is consequently translated into sound in realtime. Sound as a medium seems to be preferable over visualising the data in this case, given that the visual sense is strongly relying on a reduction of complexity, whereas the auditorial sense is hyper-aesthetic and therefore more sufficient to the analogy to operations of complex psychological systems. The transformation aims to increase complexity rather than to reduce it, which does not imply that it is formed arbitrarily. The algorithm used is based on a set of rules adapted from a meta study of the psychologists Patrik Juslin and Petri Laukka. (cf. Juslin/Laukka 2003) This meta study analyses 104 studies on vocal expression and 41 studies on music and compares the accuracy with which discrete emotions were communicated to listeners and the emotion-specific patterns of acoustic cues used to communicate each emotion. Their results centred on six categories of cross-modal patterns of acoustic cues for discrete emotions, which served as the initial basis of the Poietry interface algorithm. The following table summarises these results.

Table 1. Summary of Cross-Modal Patterns of Acoustic Cues for Discrete Emotions

Emotion	Acoustic cues (vocal expression/music performance)
Anger	Fast speech rate/tempo, high voice intensity/sound level, much voice intensity/sound level variability, much high-frequency energy, high F0/pitch level, much F0/pitch variability, rising F0/pitch contour, fast voice onsets/tone attacks, and microstructural irregularity
Fear	Fast speech rate/tempo, low voice intensity/sound level (except in panic fear), much voice intensity/sound level variability, little high-frequency energy, high F0/pitch level, little F0 pitch variability, rising F0/pitch contour, and a lot of microstructural irregularity
Happiness	Fast speech rate/tempo, medium–high voice intensity/sound level, medium high-frequency energy, high F0/pitch level, much F0/pitch variability, rising F0/pitch contour, fast voice onsets/tone attacks, and very little microstructural regularity
Sadness	Slow speech rate/tempo, low voice intensity/sound level, little voice intensity/sound level variability, little high-frequency energy, low F0/pitch level, little F0/pitch variability, falling F0/pitch contour, slow voice onsets/tone attacks, and microstructural irregularity
Tenderness	Slow speech rate/tempo, low voice intensity/sound level, little voice intensity/sound level variability, little high-frequency energy, low F0/pitch level, little F0/pitch variability, falling F0/pitch contours, slow voice onsets/tone attacks, and microstructural regularity

Note. F0= fundamental Frequency
Source: Juslin/Laukka 2003, 804

3 Conclusion

The collected data transformed by the Poietry algorithm is expressed in classical piano sounds using the principals of twelve tone scale music, major and minor. During the performance of Poietry the sound generated by the apparatus is being transmitted to a different person wearing the same kind of prosthesis and vice versa. This way a communication feedback loop is established as the transmitted sound influences the collected neural data starting a continuous process going back and forth. This primarily theoretical prediction is supported by the results of the neurologists Greg Stephens, Lauren Silbert and Uri Hasson, who discovered similar neural patterns of communicators in the process of communication due to neural coupling and furthermore finds practical proof in the occasional syncing of the two generated audio streams. (cf. Stephens/Silbert/Hasson 2010, 14425-14430)

4 Indicative Bibliography

Agamben, G., The Man Without Content (1970; first publication), Stanford: Stanford University Press, 1999

Berti, A./Frassinetti, F., When far becomes near – re-mapping of space by tool use, in: Journal of Cognitive Neuroscience, 2000, p.415-420

Bever, T. G./Chiarello, R. J.,Cerebral Dominance in Musicians and Nonmusicians (1974; first publication), in: The Journal of Neuropsychiatry and Clinical Neuroscience, Number 21, 2009, p.94-97

Boltz, M. G., The processing of temporal and nontemporal information in the remembering of event durations and musical structure, in: Journal of Experimental Psychology: Human Perception and Performance, Number 24, 1998, p. 1087-1104

Crick, F./Koch, C., A framework for consciousness, in: Nature Neuroscience, Number 6, 2003, p.119-26

Dowling, J. W., Perception of music (1988; first publication), in: Goldstein, E. B.: Blackwell Handbook of Sensation and Perception, Malden: Blackwell Publishing, 2001, p.469-499

Juslin, P. N./Laukka, P., Communication of Emotions in Vocal Expression and Music Performance: Different Channels, Same Code?, in: Psychological Bulletin, 2003, Vol. 129, Number 5, p.770-814

Luhmann, N., Individuum, Individualität, Individualismus (1989; first publication), in: Gesellschaftsstruktur und Semantik – Studien zur Wissenssoziologie der modernen Gesellschaft, Band 3, Frankfurt am Main: Suhrkamp, 1993

Luhmann, N., Die Kunst der Gesellschaft, Frankfurt am Main: Suhrkamp, 1995

Luhmann, N., Soziologische Aufklärung – Die Soziologie und der Mensch (1995; first publication), Wiesbaden: VS Verlag für Sozialwissenschaften, 2008

McLuhan, M., Understanding Media - The extensions of man (1964; first publication), United Kingdom: Routledge Classics, 2001

Meyer, L. B., Emotion and meaning in music, Chicago: University of Chicago Press, 1956

Patel, A. D., Music, Language and the Brain, New York: Oxford University Press, 2008

Roth, G., Aus der Sicht des Gehirns, Frankfurt am Main: Suhrkamp, 2003

Schopenhauer, A., Die Welt als Wille und Vorstellung - 283 Meisterwerke der Literatur (1819; first publication), Altenmünster: Jazzybee, 2012

Stephens, G. J./Silbert, L. J./Hasson, U., Speaker-listener neural coupling underlies successful communication, in: PNAS 107, Number 32, 2010, p.14425-14430