Empathy and Interactivity: Creating Emotionally Empathic Circuits between Audiences and Interactive Arts

1. Introduction

This paper will overview four collaborative artistic works that use various techniques to attempt to create emotionally empathic circuits between audiences and interactive art works.

2. Sensing You, Sensing Me

Empathy is the capacity to recognise or understand another's state of mind or emotion. Although a definition of what emotions are still lies on shifting ground, most researchers agree that emotions comprise of subjective experience, expressive behaviour and specific physiological components. Being angry makes our blood pressure rise, therefore we frown, our palms sweat and our heart jumps a beat, further causing us to feel and look anxious. Today, there are a variety of tools that can sense and respond to this affective information. The affective and cognitive sciences are arriving at a more detailed knowledge of what this information may mean.

Audience's heartbeats, sweat, brainwaves and breathing have been used as triggers for often compelling interactive art works by artists such as Char Davies, George Khut, Diane Gromala, Mariko Mori, Ansuman Biswas, Thecla Shiphorst, Christa Sommerer and Laurent Mignonneau. These art works also revealed a small number of gaps that I aim to work through with my own practice. First, artists often did not use an empirical lens to analyse the data emitted from the sensors. By working with neuroscientists, I aimed to intelligently assess the data, to understand how it relates to a feeling state of the participant, and match this information to drive meaningful moving images. Secondly, the interaction design of these works means that the viewer had to be constrained, dressed in obtrusive technology to monitor the body. By working with affective computing scientists, human computer interaction specialists and neuroscientists, the aim was to research and develop more naturalistic and transparent monitoring techniques. Thirdly, artists often used ambiguous generative abstract moving images or sound to respond to the data of the body. I was interested in working with scientists to produce figurative and narrative-based video works that could engage, reflect and provoke the feelings of the viewer.

By building more transparent, empirically analysed sensing tech-niques embedded into 'naturalistic' interaction scenarios, a conduit could be created, to all viewers to become more sensitive to reading their own body: their unconscious and conscious responses. The information of the audiences' bodies could then cultivate meaningful video responses that provoked, entrained or empathised with the viewer. I hypothesised that this may evolve into more empathic interaction circuits between viewer and art work.

3. The search to create an empathic circuit

My interest in this area began a decade ago. I used various techniques to translate emotional feelings into a metaphorical artistic moving image form.

1 'Chameleon', a responsive video installation using mind reading, mock-up of experiment four (2008/10)
This led to early wearable works (Medulla Intimata 2002-2004) that monitored and probed the wearer’s emotional body.

I quickly realised that if I was going to explore ‘emotion’ sensing works, I needed to become further empirically informed in order to monitor, assess, and provoke the emotional body in more intelligent and meaningful ways. I began my role as artist-in-resident at the Wellcome Department of Neuroimaging (WDIN) (2005-08) at the Institute of Neurology at UCL in the UK and Visiting Artist at the Affective Computing Group the MIT Media Lab in the US (2008). I built an ever-shifting collaborative group including emotion neuro-scientist Professor Hugo Critchley, social neuro-scientist Chris Frith, psychologist and clinical hypnotist, Prof. David Oakley, affective computer scientists Rosalind Picard and Dr. Rana El Kaliouby, and a range of very talented computer scientists, HCI specialists, sensor manufacturers and programmers. Our different disciplines gave alternative insights into our cross over interest areas of social networks, empathy, affect and computing.

3.1 “Feel” Series: “Feel Trace” (2005): Movement and Hypnosis to Create Empathic Interaction

We embarked on the “Feel” Series, an interconnected progression of short films and interactive sketches aiming to sense, translate and provoke the psycho-physiology of the audience. Darren Tofts writes “(with “Feel” Series), Gonsalves’ artistic sensibility absorbs scientific hypothesis and technological possibility into an interface, a psychosomatic stage, at-once theatre of cruelty, emotional catharsis and critical insight.”

The first prototype of the series, “Feel Trace”, investigated the use of heart rate variability (HRV) and heart to monitor the arousal of the audience, using this data to trigger the video footage.

With Critchley, I built a set of potent viscerally directed videostimulus sets (VDVSS) for specific research experiments designed to differentiate between arousing the sympathetic (“fight-or-flight”) and parasympathetic (“rest and digest”) nervous system of the body. Working with Oakley, I used his hypnotic voice and word structure to entice the audience into different emotional states. Critchley and I designed a simple interaction: If the audience’s heart rate decreased, a ‘calm’ video sequence would be triggered, and if it rose an ‘aroused’ sequence would be activated.

We exhibited “Feel Trace” at a range of venues. The sensors were small, aesthetic, but they proved to be unreliable as any movement created a dropping-out of the signal. The sensors were not wireless, constraining the scenario of naturalistic inter-

action I had envisaged. Interestingly, applying the sensors caused a rise in heart rate. Using only heart rate gave little insight into defining emotional states, only arousal states. The video content I created was very potent, producing significant rises in the heart rate of the participants. However, as an art work, the potent nature of the piece was confronting to sit through for the participants (and myself). “I wanted to rush out of there but could not move my eyes from the screen... antinomic but automatic, this art work elicited what was unsettling”. There was a sense that the imagery was reflecting and provoking the ‘inner body’ of the participants, though most users felt they had no control over the piece, that it was taking them on a journey. “… it was quite dramatic to feel the installation reflecting your own bodily responses. I did feel as though I had no control over what would happen although I did attempt to do so. I felt as though the installation was leading me into a sort-of more emotional feverishness (mainly through the use of the soundtrack as I remember it) which was very difficult to then calm down …”

3.2 Feel Series: “Feel Insula” (2006/07) Movement and Hypnosis to Create Empathic Interaction

The problems encountered while building “Feel Trace” led to “Feel Insula” (2006/2007). We aimed to test a more immediate and naturalistic interactive design using a camera to monitor the audience’s movement, which would trigger intimate video content. Using movement to trigger video has been used frequently in the past. As a result of this, today, at interactive exhibitions, you regularly see participants waving their arms around wildly (in non-naturalistic ways) to interact with the work. However, the interaction of “Feel Insula” was driven by the stillness of the audience.

I worked with Oakley to create the video content. I asked Oakley to hypnotise me into states of fearfulness, sadness, happiness and calm, in order to re-experience potent emotional memories of my life. We used two video cameras to capture each session. These live recordings formed the content to “Feel Insula”. The footage captured was simple, emotional and continuous, which seemed appropriate to the simple interaction design.

For the audience, as they enter a darkened space, they encounter a video projection of my face. Darren Tofts writes:

“She is encountered in a hypnotic state, at peace, silent, yet vulnerable. The scale of the projection is itself unnerving, provocative. The simple act of entering the gallery prompts her to wake up, as if in direct response to your presence. You keep still, vigilant. The artist, comforted by this quiescence, drifts back into
hypothesis, speaking from the depths of her unconscious, recalling distressing memories and anxieties. The more still you remain, the more intimate the recollections become. These recollections in turn impact upon the emotional state of the unprepared visitor, who is now situated as an unexpected confidant.  

Helen Sloan writes:  
"In becoming still, the viewer minimises their presence and almost becomes a part of the projection of the artist. Feel Insula asks us to question what is inside our consciousness through the experience of another. It is very much an analysis of the self for the artist as well as the viewer. By asking the viewer to minimise themselves in the piece, they become conscious of their presence in other contexts."

3.3 Feel Perspire (2006/07): Using Sweat to Create Empathic Interaction  

From the feedback gathered, I came to the conclusion that “Feel Insula” achieved the naturalistic interaction and engaging content I was searching for. However, I felt the interaction mode of reading movement was too generic and didn’t allow for the more personal sensing mode needed to create more empathic interaction.  

This led to “Feel Perspire”, a psycho-physiologically responsive video installation, using galvanic skin response (sweat) to trigger footage.  

Galvanic Skin Response (GSR) is usually used as an indicator of stress. It provides a continuous and immediate response, giving participants a sense of control, creating a biofeedback loop. Biofeedback is a technique in which people are trained to improve their health by learning to control certain internal bodily processes. For “Feel Perspire”, we used the signal to trigger video sequences.  

I developed and tested a few video databases, finally arriving at time-lapsed cloud footage. If the participant is relaxed, the footage would blur and become ‘Rothko-esque’. If the participant became stressed, storms would roll in, enveloping the participant in their fury.  

After testing the work, the GSR monitor proved troublesome – it was not wireless, which hindered the naturalistic interaction I was searching for. Any movement of the viewer caused drop out of signal. Again, applying the sensors caused an arousal reading in the signal. I hadn’t quite anticipated for the variability of GSR data sets across multiple participants. To tackle this, the GSR monitor needed to be calibrated for each participant.  

The simple imagery, using real-time effects that responded to the GSR reading, provided a fluid biofeedback interaction scenario. Initial observations demonstrated that participants felt that the video work was analogous to their psycho-physiological state, and offered a sense of control. Past research has shown, that when the participant has a modality of control in the environment, they experience a greater sense of presence. “The most unsettling part of the art work is that after some time, I started to feel like I could control the content of the feedback, while remaining unable to explain how. Falling into the skies accompanied by stormy winds or quietly floating with restoring noise, the art work transported me throughout neatly intermingled settings related to my feelings”. The interaction design assumed that when the GSR level rose, this meant you were ‘stressed’, triggering video of a storm clouds and loud noise to fill the exhibition space. When discussing the project with Picard, she stated a higher GSR reading could mean you were stressed or happy, and I had not created a narrative that catered for happiness. The limited sensing modality didn’t allow us to differentiate the data to denote an emotional feeling, only ‘aroused’ or ‘calm’.  


We decided to explore how we could implement the sensing of facial emotion expression. No calibration would be needed so the interaction design is naturalistic, several cameras can be installed making multi-participant interaction possible and we could infer an emotional state from the emitted data.  

This lead to “Chameleon”, a more ambitious multi-participant video installation exploring emotional contagion. “Chameleon” uses mind reading technology, video and emotional algorithms to assess, respond and provoke the emotional states of the audience. When participating in “Chameleon”, individuals become intimately connected and implicated into varying emotionally provocative and reflexive social interactions.  

3.4.1 Developing algorithms for empathy  

I am working with Chris Frith to develop ‘emotional algorithms’ to integrate into the video engine. These algorithms will form an intelligent emotional response system in the engine, in order to build ‘empathy’ with the participant. To build empathy, we innately and continuously synchronise with the facial expressions, voices and postures of others. Frith believes that the brain’s mirror system (mirror neurons) is one of two components that makes communication possible. But, we don’t ‘always’ mimic each other to understand each other. Chris Frith extrapolates: “A person commits a social faux pas. This elicits and expression of surprise and then an
The person then displays embarrassment. This reflects compassion (for the distress of the person) in the observer. This expression of compassion indicates that the person is forgiven and everyone is happy again. I used these ideas to make a best guess about the parameters for the emotional algorithms.”

We have built Frith’s algorithm into the initial experiments of “Chameleon”. Frith’s algorithmic hypothesis is currently being tested in the lab by Human Computer Scientists Nadia Berthouze and Matt Iciabani (University College of London Interaction Center).

3.4.2 Developing Mind-Reading Technology

The mind-reading technology implemented into “Chameleon” is being developed by El Kallouby and Picard from the MIT MediaLab. Covert cameras are used to analyse the facial expression of the participants, sending this information to the empathically responsive video engine. When someone feels happy, they smile, and this lets the video engine know that they are happy, which triggers an intelligent response based on Frith’s algorithms of how we socialise. We are currently developing the technology to work in darker lighting scenarios, training it to recognise six emotional states, and output this information in a way that the video can understand.

3.4.3 Building the Project

To understand “Chameleon’s” complexities, we are building the work in small stages:

Experiment one: creating an ‘ethnographic style short film’ to understand the most potent actions that cause emotional contagion (shot at BMNI)

Experiment two: creating a live emotional contagion tool that transposes live social interactions and slows it down to reveal micro-expressions

Experiment three: implementing Frith’s emotional algorithm to drive two still portraits that emotionally respond to each other

Experiment four: understanding how emotions propagate in social groups

Experiment five: Building a video engine that integrates the emotional algorithm and drives a social group to emotional interaction

Experiment six: integrating mind-reading technology to drive one emotional portrait.

Experiment seven: using three networked computers and cameras to drive three emotional portraits

Experiment eight: final work: up to five participants enter a space, triggering video portraits that aim implicate you into an emotional drama.

4. Conclusion

These works mark the beginning of a longer investigation, working with many cross-disciplinary researchers to understand how ideas of empathy can be integrated into interactive art works. Bio-sensors are difficult to work with. The more robust versions are mostly created for lab research, meaning that they do not hold up well in exhibition spaces, and are usually obtrusive and not very aesthetic. To differentiate emotional states, multi-model sensing is required, which leads to the complex analysing of data, calibration and dressing the participant, which influences the data emitted (unless we built them into clothing, jewellery or furniture). I have found new consumer wireless sensors unreliable, and too blunt to read the more subtle changes in psychophysiology. Using more figurative narrative video was considered successful and seemed to engender a more empathic relationship with the work. While developing the databases, the final content we arrived at was often more ambiguous than I would have anticipated.

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