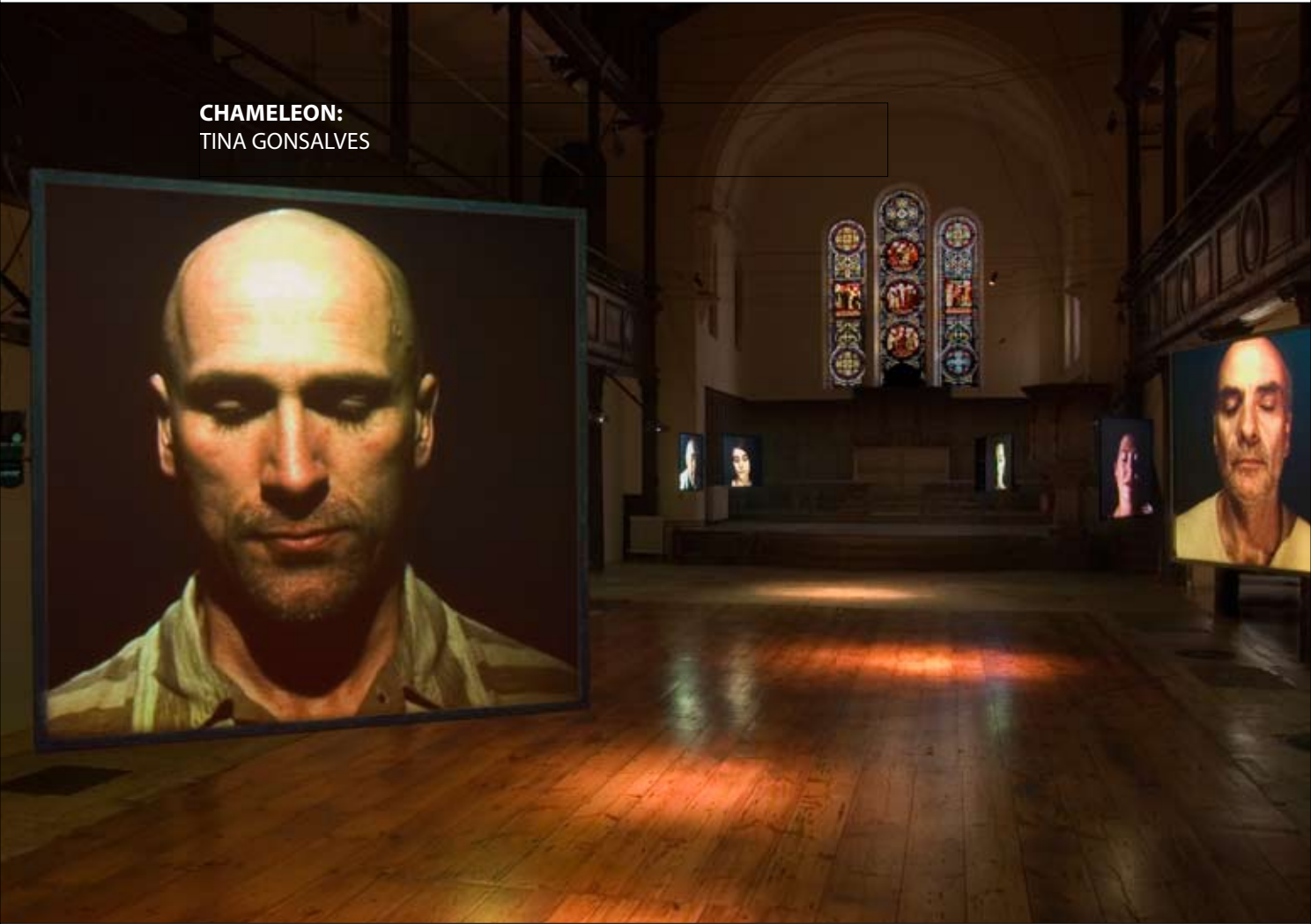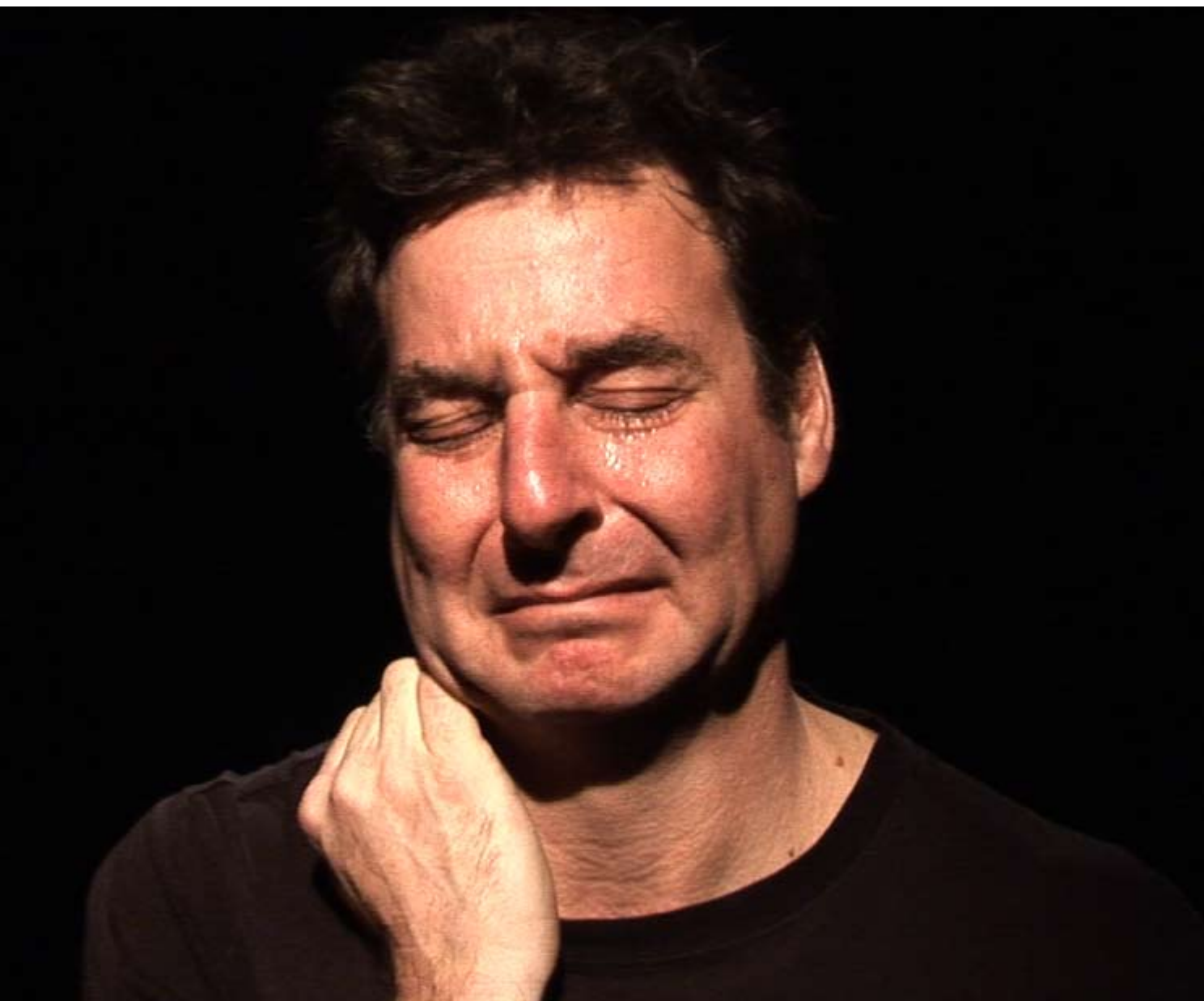**CHAMELEON:**
TINA GONSALVES

Chameleon is an interactive video installation exploring emotional contagion between groups and individuals. It stems from Tina Gonsalves' continuing fascination with human emotion, intimacy and vulnerability. *Chameleon* becomes art installations, research papers, and novel, more dynamic models for scientific research that incrementally reveal the emotional exchange, mimicry and contagion across social groups.

wellcometrust

Simon expressing sadness, frontal view,
Chameleon video portrait database, shot at the
Banff New Media Institute, Canada.
(Images: Tina Gonsalves)

Chameleon 9: Fabrica, Brighton, UK 2009. An interactive experiment in emotional contagion where the gallery becomes an emotional theatre in which visitors and digital video portraits interact. (Photo: Philip Carr)

1 monitor audience
2 track emotional expression of audience
3 tell computer the emotional state
4 match against emotional transference code
5 play video that empathizes with audience's emotional state

sad
angry
surprised
neutral
disgusted
happy

Time (seconds)

Above: A schematic illustration of the interactivity of *Chameleon*. (Image: Tina Gonsalves)

CHAMELEON INVESTIGATES EMOTIONAL CONTAGION, HIGHLIGHTING HOW WE INNATELY AND CONTINUALLY SYNCHRONISE WITH THE FACIAL EXPRESSIONS, VOICES AND POSTURES OF OTHERS BY UNCONSCIOUSLY INFECTING EACH OTHER WITH OUR EMOTIONS.

THE WORK USES FACE-READING TECHNOLOGY, VIDEO AND EMOTIONAL ALGORITHMS TO ASSESS AND RESPOND TO THE EMOTIONAL STATES OF THE AUDIENCE. CHAMELEON TRANSFORMS THE GALLERY SPACE INTO AN EMOTIONAL THEATRE, WHERE VISITORS AND CHAMELEON'S DIGITAL VIDEO PORTRAITS WILL INTERACT, INFECTING AND HARMONISING EACH OTHER THROUGH EMOTIONAL DIALOGUE. EACH DAY THE 'MOOD' OF THE CHAMELEON PORTRAITS SHIFT AND ADAPT DEPENDING UPON THE AGGREGATE EMOTIONAL RESPONSES OF INTER-ACTING AUDIENCES, THUS CHANGING THE AFFECTIVE TONE AND EMOTIONAL ECOLOGY OF THE GALLERY SPACE.

INDIVIDUALS BECOME IMMERSED IN AN EMOTIONALLY FRAGILE SPACE, INTIMATELY CONNECTED AND IMPLICATED INTO VARYING EMOTIONALLY PROVOCATIVE AND REFLEXIVE SOCIAL INTERACTIONS LEAVING THEM TO CONSIDER HOW THEIR OWN NON-VERBAL COMMUNICATIONS AFFECT SOCIAL GROUPS AND SOCIAL SPACES. A SENSE OF FLUX IS HIGHLIGHTED AS WE BECOME SHAPED BY OUR SURROUNDING ENVIRONMENT JUST AS OUR ENVIRONMENT IS SHAPED BY US. BEHAVIOURAL PATTERNS, HIERARCHICAL AND SOCIAL POWER STRUCTURES EMERGE AS BOTH THE DIGITAL PORTRAITS AND PARTICIPANTS CONSTANTLY SEARCH FOR AN EMOTIONAL HOMEOSTASIS AND UNDERSTANDING.

FOR THE ARTIST, THE PROJECT CONCEPTUALLY EMPHASISES HOW ART EXPERIENCES CAN ALLOW PARTICIPANTS A CONDUIT TO EXPLORE THEIR OWN VULNERABILITY, AND IN DOING SO, REVEAL AND SHARE EMO TIONS, CREATING MORE INTIMATE INTERACTIONS.

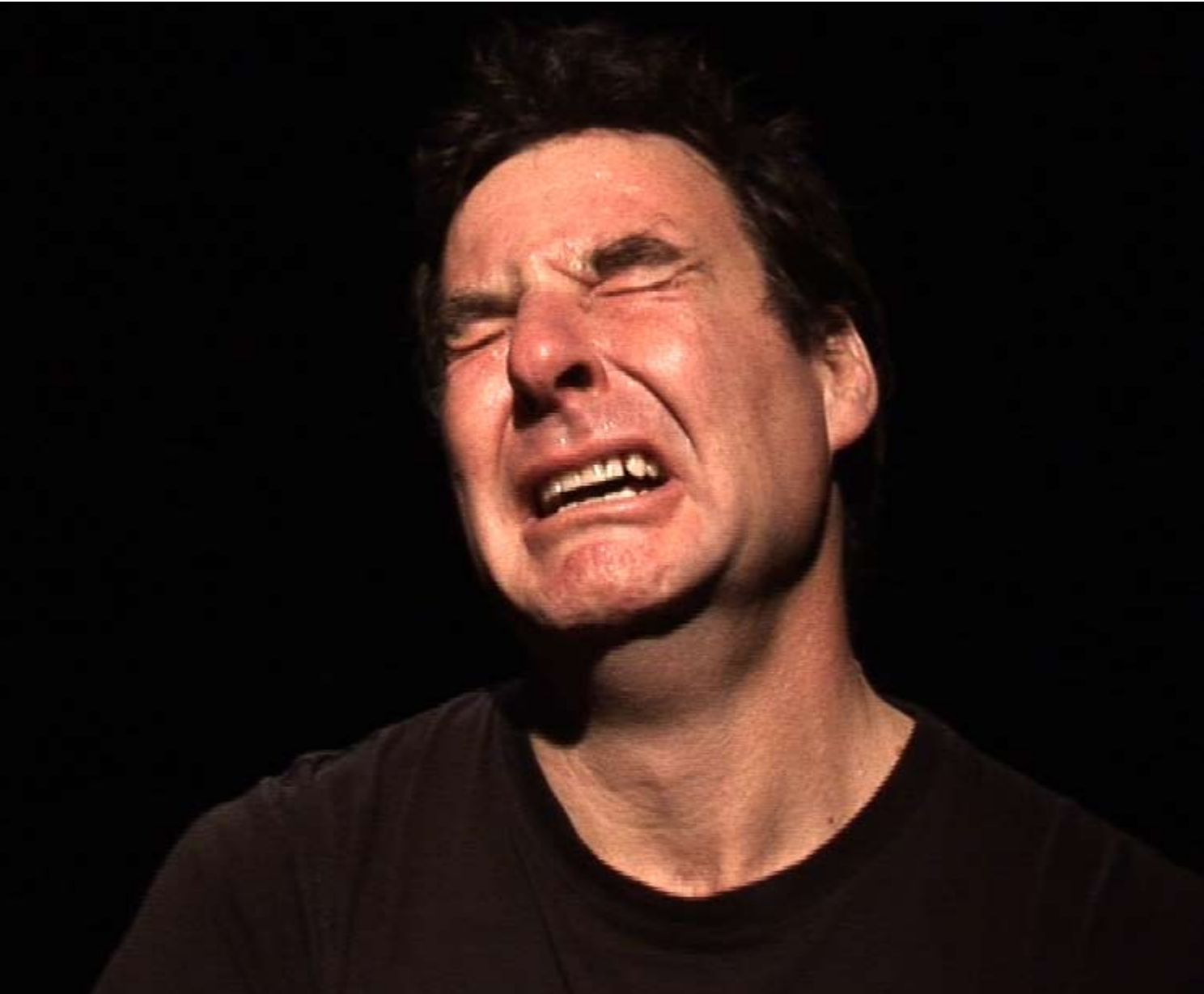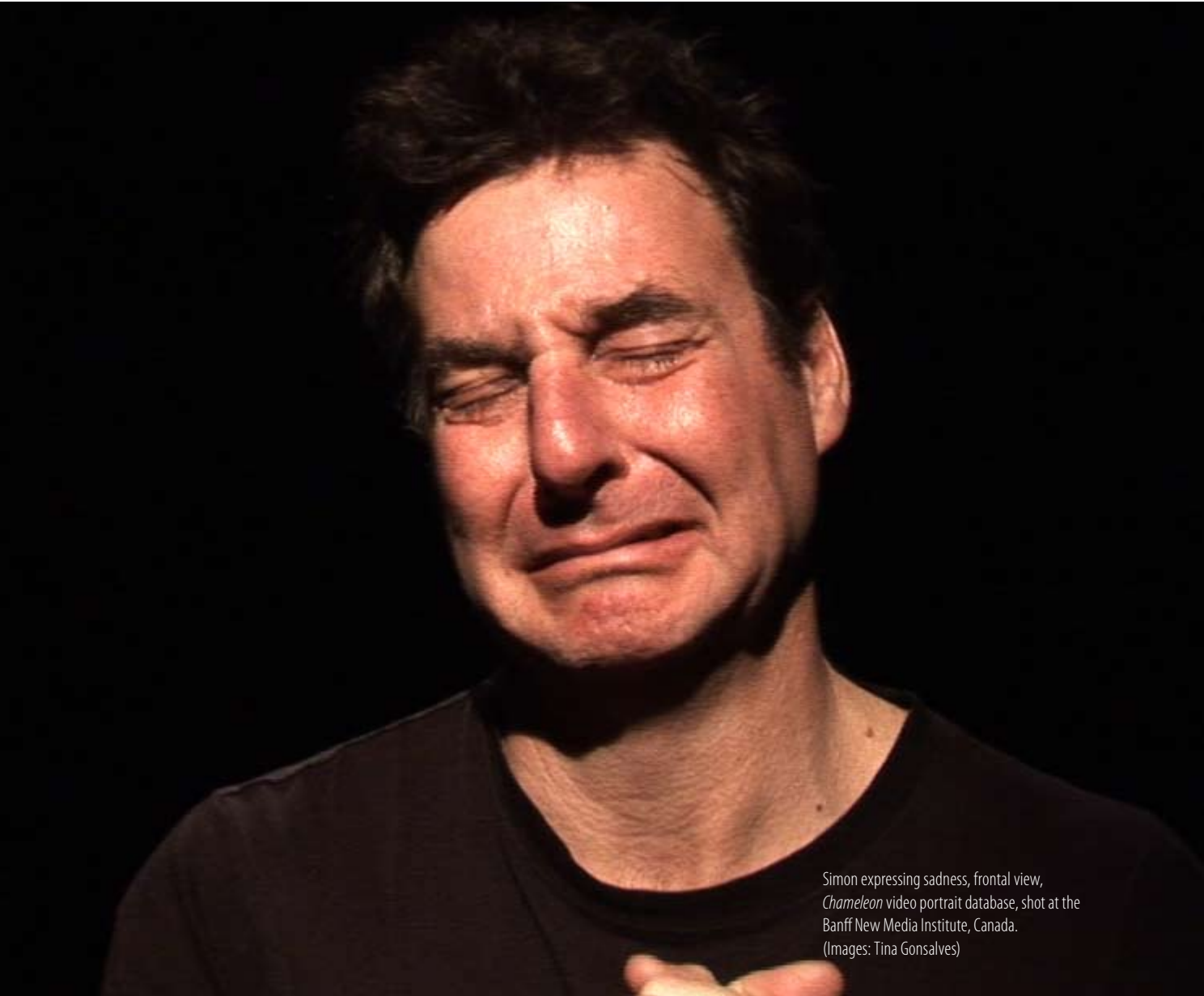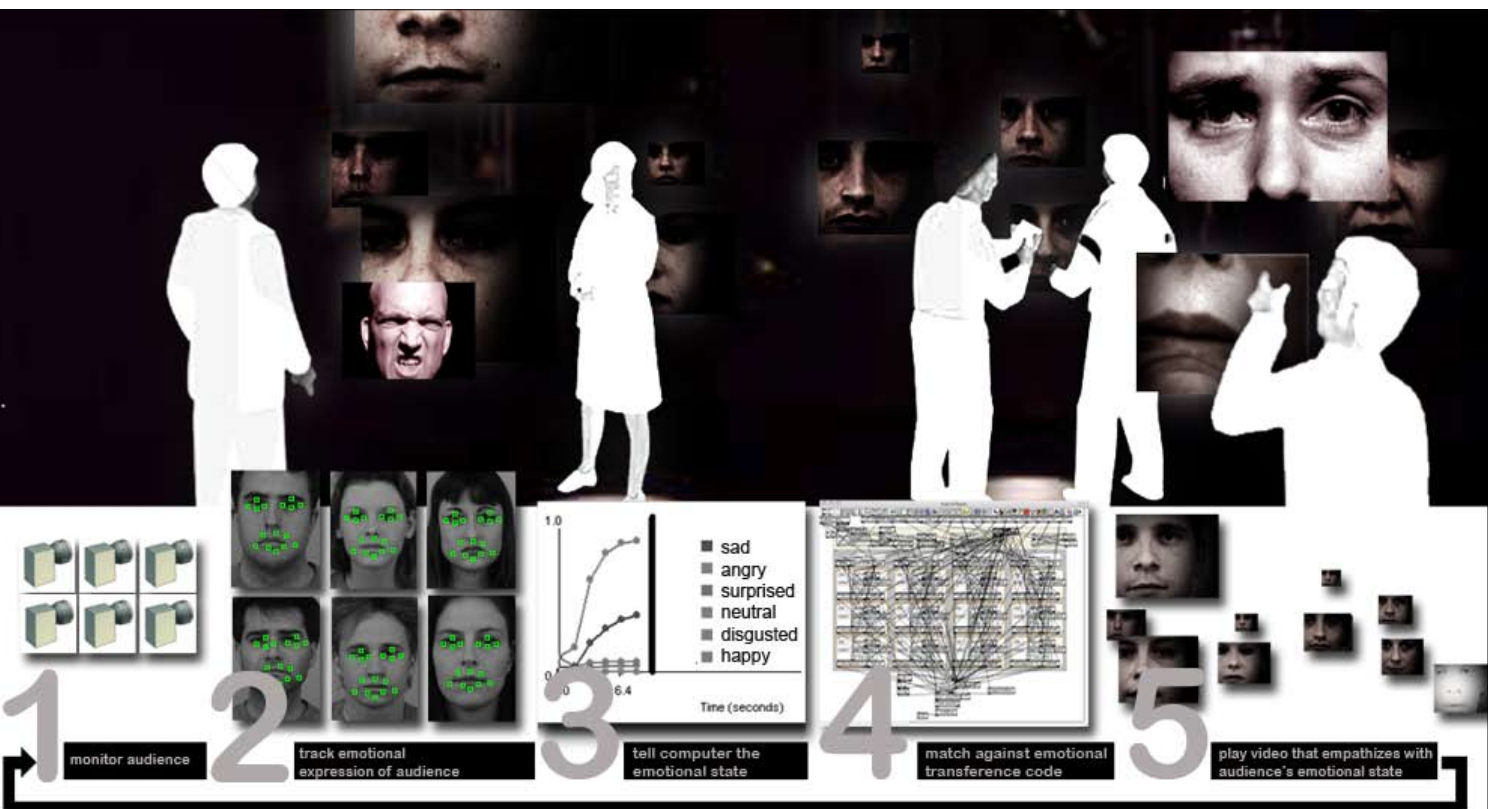Katherine expressing anger, frontal view,
Chameleon video portrait database, shot at the
Banff New Media Institute, Canada.
(Images: Tina Gonsalves)

For over a decade Tina Gonsalves has been using the fluid and malleable medium of video to explore complex emotional landscapes. Rich, painterly video abstractions evoke intimate associations with personal space, memories and emotions.

For over the last eight years, she has investigated the intersections of art, technology and science. Gonsalves is currently working with world-leaders in psychology, neuroscience and emotion computing in order to research and produce moving image artworks that respond to the audience's emotions. She has been awarded numerous Artist in Residence programmes and during *Chameleon*, she was artist in resident at the Institute of Neurology at UCL in London, visiting artist at the MIT Media Lab in Cambridge, USA as well as Nokia Research Labs, Finland.

Works by Gonsalves have been screened/exhibited at many prestigious galleries, festivals and events internationally.

My work has always explored aspects of the intimacies and vulnerabilities of being human. As technology becomes ingrained in our every day, I explore ways we can harness technologies as tools to disrupt habitual responses, lifting audiences out of their everyday, to elicit reflection, to create 'feeling'. I explore ways science are understanding and attempting to decode emotions and how that may make us feel. I look to science to find out more about the intuitive and biological engagement of images and objects to elicit felt experiences. I embed this knowledge into the technology, converging it most often with moving images. This coalesces into an experimental practice that spans collage, painting, moving image, installation, mobile technologies and interventionalist works.

Emotions and empathy are intrinsic to liveness. In the past I have explored the emotional signatures of our bodies, using pulse, sweat, prosody and movement as agency for moving image interactive works that highlight the nuances of emotions and its importance in our lives.

With *Chameleon,* an aim was to investigate the social role played by the unspoken language of emotional expressions and emotion transfer mechanisms that mediate social interaction. The ability to read emotions in both others and ourselves is central to empathy and social understanding. In everyday life, we are highly attuned to subtle and covert emotional signals and people automatically and continuously synchronize with the facial expressions, voices, postures, and movements of others. Through the dance of unconscious mimicry, we become carriers, infecting each other with our emotions, forging a bond with each other long before we utter a word. Our fluid, ever-fluctuating nature is highlighted as the body shape-shifts, morphing to the emotional nuances surrounding us. *Chameleon* reminds us that our body as a clear-cut distinction with the rest of the world is dissolved, and our relationship with the world is in flux, interdependent, tenuous, shifting our subjective experience.
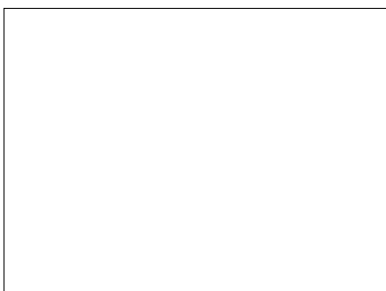
Above: interacte link to video documentation of *Chameleon 9* at Fabrica, Brighton, UK, 2009.
(Video: Tina Gonsalves)

Above: *Chameleon 9* at Fabrica, Brighton, UK, 2009.
(Photo: Tina Gonsalves)

The aim was to build *Chameleon* using a foundation of empirical research. Over two years, I led a collaborative team consisting of social neuroscientist Chris Frith from the Wellcome Department of Neuroimaging at University College London (UCL), emotion neuroscientist Hugo Critchley from Brighton and Sussex Medical School, affective computer scientists Rosalind Picard and Rana el Kaliouby from the Affective Computing Group at the MIT Media Lab, human computer interaction scientists Nadia Berthouze, Matt Iacobini and Kim Byers from the UCL Interaction Centre and curator Helen Sloan, director of the arts agency, SCAN. I was very aware in choosing the title *Chameleon,* as it related to the project, but it also reflected my artistic role. As I collaborated, looking at my work through new lenses, I was moderating my language accordingly, depending on whom I was working with. My work was becoming a synthesis, influenced by the qualities of multiple collaborators, attempting to reach a balance that would meet the needs of each collaborator. I felt like a *Chameleon*, shifting, adapting, a 'changing self.'

To build *Chameleon*, we focused on three parts, the emotional code developed with Chris Frith, Hugo Critchley, and technologists Jeff Mann, Evan Raskob and Christian Topfner. The facial reading technology was developed with Rana el Kaliouby and Ros Picard, and finally, I directed the video database developed with everyday people sourced over the world. While developing *Chameleon's* code, the video database and interaction, we worked with Nadia Berthouze to analyse user experience. We decided to take a more experimental and intuitive approach to building and exhibiting the work, developing the work in nine progressions, turning each exhibiting experience into a 'lab'. This was essential to understanding the complexities of the project; building a stronger collaborative dialogue; creating a visual language and recurring milestones for all collaborators; opportunities for frequent tests of the interactivity and constant tests for the robustness of the technology.

Creating *Chameleon's* emotional algorithms:
Scientists such as Paul Ekman studied the universal phenomena of emotions and their cultural nuances, establishing the idea of 'universal emotions', a theory that all cultures express and understand up to seven key emotions. This categorisation has been widely accepted by science and considerable research has shown that these basic emotions can be accurately communicated by facial expressions

As we were taking an empirical approach with *Chameleon*, the aim was to focus on these universal emotions (we followed the Karolinksa Emotion Expression Database selection). I was intrigued: How can the emotions that are expressed and monitored in laboratories correlate to the emotions that form the fabric of our everyday lives? In what ways can emotions be encoded, reduced and classified into bits of information that technology can understand, and we can feel?

Working with Chris Frith's hypothesis about emotional exchange, we coded the algorithms, embedding them into the video engine to trigger the video portraits. I worked with Nadia Berthouze and her research assistant, Matthew Iacobini to test Chris's Hypothesis in the lab. Emotions are passing external expressions, but moods are more sustained aspects of an
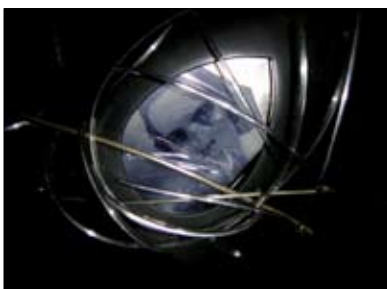
Above: *Medulla Intimata*, an emotionally responsive video jewellery project, 2002-2004, (collaboration between Tina Gonsalves and Tom Donaldson). *Medulla Intimata* is a necklace that contains a video screen and biometric sensors to monitor the emotional tonal range of conversaton to guide real-time video-generation that evokes a sense of seeing beneath the surface of the skin, exposing the emotional and physical inner body. Video is displayed on the screen embedded in the jewellery. The imagery displayed is an emotional portrait, an exploration into the secret life of the emotional, physical, spiritual and psychic body of the wearer. (Photo: Bill Seaman)

Above: framegrabs of *Feel: Inside,* an emotionally responsive video project, 2006. (Photo: Tina Gonsalves)

individual's personality. In the later prototypes of *Chameleon*, Chris Frith hypothesised how moods are formed and we implemented his ideas into a more complex learning algorithm written by neuroscientist at UCL's Institute of Neurology, Bruno Averbeck. This algorithm adapted and learned from its audience, attempting to bring context into the work. Each day the 'mood' of the *Chameleon* portraits would shift and adapt depending upon the aggregate emotional responses of interacting audiences, thus changing the affective tone and emotional ecology of the gallery space. For example, on opening night, the work would be quite responsive, but if *Chameleon* found that the participants were not spending much time with the work, *Chameleon* would become a little depressed, and a little reticent to interact. Over time, *Chameleon's* personality developed, fluctuating to the responses of its audience, shaping gallery spaces into ever shifting emotional hotspots, re-sculpting the space and participants.

Chameleon's emotional video portrait database:
Most scientists agree that we respond differently when we look at an image of a chair, and an image of a face. With the perception of faces, major activations occur in the brain, (particularly in the *fusiform gyri* which Chris Frith discusses further on page 40). With *Chameleon*, I aimed to exploit our intuitive and highly sensitive ability to interpret facial expressions. When I see a face, I can feel my body shift, an awareness takes over the body. (Hugo Critchley discusses the embodied response to socialisation on page 44).

I had had an interest in dynamics of portraiture for years. This started with 2D works, which looked to how the body is represented, constrained and fragmented by the portraiture of diagnostic medical imagery. With *Medulla Intimata* (2002-2004), an emotionally responsive video jewellery project, I had begun to explore self-representation and how vulnerability may be a pathway to empathy. In earlier work such as *Feel: Trace* (2005), and *Feel: Ferment* (2006), I had began to explore the static facial emotion recognition databases most often used in emotion research, such as the Ekman and Friesen Database and the Karolinska database. I attempted to re-construct them, making them time-based to reveal all the hidden emotions that we often suppress when we interact with others. In *Feel: Insula* (2007), I begun the creation of a new moving image portraiture database that searched for a more authentic expression of emotion. Over a few months, I worked with clinical hypnotist, David Oakley, asking him to hypnotize me into different emotional states to create a more genuine representation of emotional expression. This became the moving image and sound of *Feel: Insula*, and also the voice track for a short film, *Feel: Melancholia* (2007).

As a video artist, it was important to create *Chameleon's* emotion expression database using the medium of video. Although a 3D computer graphic rendered model of portraits would have been much easier to create, easier to control, and more fluid, I was adamant that I wanted to create a database of real people expressing emotions. I was concerned about the 'uncanny valley' affect of 3D imagery. The theory holds that when renderings of people look and act almost like actual humans, they become overly "strange", thus will fail to evoke the empathic response I was looking for.

Above: Matthew expressing disgust, frontal view and 45 degree view, *Chameleon* video portrait database, shot at the Banff New Media Institute, Canada. To elicit disgust, Matthew was asked to view a video database of disgust movies that I had created for a study with Hugo Critchley. (Images: Tina Gonsalves)

Faces are rich and varied, a brief glance of a face can provide us with knowledge to the individual's gender, their emotional state, their familiarity to us, their personality, their attractiveness or interest in us which in turn, influences our emotional response. I wanted to pick up on these nuances while also exploiting our biological predisposition to the image of the human face (Ursula Hess discusses more about how we read faces on page 74 of this catalogue).

Another factor that drove me towards the choice of video was that much of the current scientific experiments exploring facial emotion expression uses Paul Ekman's 1970's visual database of static facial expressions representing emotional states. I was interested in creating a new, more dynamic video database, and hoped this could be of use to science.

For over a year and a half, I asked volunteers from all over the world to be filmed expressing emotions. At the start, I attempted to stick to high production values using 3 HD cameras, large studios, and complex lighting. I realized I needed to release this ideal and respond to the people I met everyday. I had my camera, a black sheet and made do with ad-hoc lighting so I could work with a range of people, in range of countries.

It was important to shoot the work internationally to explore the cultural, social and individually determined responses to the six universal emotions being explored in *Chameleon*. Shoots often took place over weeks. The subjects were shot in a private studio space with a neutral black background with simple lighting. I elicited the emotional states using various techniques guided by my collaborators and others (psychologists, psycho-analysts, acting coaches, actors). I created scenarios in the studio where the emotions are reactions to staged events. I employed classical psychoanalytical techniques such as encouraging the volunteers to re-imagine emotional scenarios from their past and to re-enact them as if in the present. I would often discuss my own emotional memories while shooting the participants' facial emotion expression in response to the stories. The studio time became a very vulnerable, trusting and often moving process for all involved.

Cross-cultural effects revealed themselves. One participant from Portugal displayed barely discernable emotions. North American participants were often the most vocally and facially expressive. Generally, participants from the UK had a harder time expressing anger. I wrote in my studio notes in March 2008 while working in Canada:

> "...It's taken a while to get comfortable asking people to evoke emotions. It's been exhausting, because it feels so personal. It's been a varied response, ranging from deep deep crying for half an hour to more laughter and very light expression. It's been hard to watch people cry and stand over the other side of the camera documenting it. For some, sadness has been very close to the surface, and recent events such as loss make sadness the easiest to access."

Whereas my notes in April 2009, working in Paris:
> "It's harder to coax Parisians to reveal emotions. I need to spend more time getting to know participants, to develop a more trusting relationship... I am asking them to give a

Above: Nathalie expressing surprise, frontal view, *Chameleon* video portrait database, shot at Le Cube, Centre de Création Numérique, Paris, France. To elicit surprise, I talked softly to Nathalie for a few minutes, then screamed very loudly. (Image: Tina Gonsalves)

Above: Helen expressing sadness, frontal view, *Chameleon* video portrait database, shot at Lighthouse Arts Agency, Brighton, UK. To elicit sadness, I talked with Helen about sadness for a long time. Both Helen and myself recounted sad events that had happened in our lives. (Image: Tina Gonsalves)

Above: Sara expressing happiness, frontal view, *Chameleon* video portrait database, shot at the American University in Cairo, Department of Performing and Visual Arts, Cairo, Egypt. To elicit happiness, I asked Sara to remember some happy moments in her life. (Image: Tina Gonsalves)

lot, and it's hard without a closeness. The studio time needs to be much longer than it was in Canada..." (studio notes, April 2009).

On reflection, sadness was the easiest emotion to elicit. After the shoot I asked the participants to reflect on the experience. *"I felt messy and really really sorry for myself and very very lonely which made me feel even sorrier for myself... I felt like she had been my therapist and that I owed her £50 for the session."* Another writes: *"I learned that while it becomes possible to represent a range of emotions, the sudden and immediate proximity of some, particularly sadness and fear, was potent and very real."* (email correspondence with the artist August 2009).

Over two years, I had developed a database of emotional expressions that were both felt and acted. When exhibiting the work, the fact that the emotions expressed may not have been genuine caused concern for some audiences. However, I think this was essential to the work. In everyday life, we seem to have an embodied awareness, which drives a constant search of each other's faces for truth. I also wanted this dynamic to evolve in *Chameleon*.

By the end of the project, I shot 30 participants, adding up to a 23-hour database of emotional expressions. Some footage was given back to the participants to make their own works from. Some footage was further edited as it was *too* private, and exhibiting it could have compromised some of the participants. All material never left my studio. I edited the work by assigning inpoints and outpoints for each emotion. I wrote in my blog in August 2009, while in Brighton:

> *"It's been a really amazing journey of attempting to read people, give and take. I have enjoyed the journey of meeting the people who have been brave enough to venture into my studio. They have given, shared and often exposed a lot. It's been a privilege to have this deep listening time, but it is also an ambivalent relationship – I have built up compassion, friendship and attentiveness in the studio, I then take the footage into the edit, spending hours analysing and categorising that footage, examining the emotional expressions and commentary. It feels as if I am fragmenting a lovely relationship, objectifying it, making it into a production."*

The technology: Sensing the Audience's Emotions

When creating the interactive design of *Chameleon* it was integral to develop a novel interactive solution that matched both the conceptual and metaphoric content of emotional contagion. For a work about social emotions, it was an obvious choice to explore automatic facial emotion expression reading technology. It allowed for group interactivity, no training was needed with the audience and the monitoring of emotional state could happen from a distance, therefore a more fluid, seamless and naturalistic interaction loop could develop. Conceptually, interaction mode was delicate, provocative, and by analysing the face, it was intimate. It fore-grounded our dependence on reading each other's emotions in everyday life conceptually underscoring how we are constantly in flux, searching each other's meaning and authenticity through balanced codes of expressions. It also elicited an awareness of these types of emotion recognition technologies.

Above: *Chameleon 9* at Fabrica, Brighton, UK, 2009. Participants taking part in a side event at the *Chameleon* exhibition for the White Night Festival. 1600 participants were invited to draw and discuss *Chameleon*'s emotions. (Source: Fabrica)

Above: *Chameleon's* Interpretation Center, Fabrica, Brighton, UK, 2009. The Interpretation Center provided a more in depth look at *Chameleon* via video of interviewed collaborators, text further explaining the work, library selection of books explaining emotion and cognition as well as collaborators' research papers. (Photo: Tina Gonsalves)

I worked with Rana el Kaliouby and Rosalind Picard to reconfigure the FaceSense automatic facial emotion reading technology used in *Chameleon*. We also worked with Youssef Kashef, Abdelrahman N. Mahmoud and Marwa Mahmoud from the American University in Cairo. For *Chameleon*, the system uses a range of consumer webcams to scan the environment. It is trained to automatically recognise features of the face, pinpointing 24 key trigger areas like eye and mouth corners. It classifies the emotional state of the audience using Paul Ekman's Facial Action Coding Systems (FACS) to recognise a group of six emotions (happy, neutral, sad, angry, disgusted, and surprised). Picard and Kaliouby have a particular interest in the technologies use in working with people on the autism spectrum. Kaliouby talks more about the development of FaceSense on page 50 of this catalogue.

Building *Chameleon*

Building *Chameleon* was an involved, intense and rewarding experience. The concept of *Chameleon* began a few years earlier, inspired over a fellowship at the Institute of Cognitive Neuroscience at UCL. The core-funding from the Wellcome Trust Public Engagement Art Award allowed a rare and luxurious amount of time to be dedicated towards the devopment, production and exhibition of *Chameleon*. Over two years, I was immersed in *Chameleon*, working with talented collaborators and reknowned research institutes. It felt like little else existed. Adhering to a scientific reductionist methodology was challenging compared to my past artistic approach. Looking back over studio notes in March 2008, I write about feeling 'constrained':

> *"There seems to be limited emotions being explored, visually underwhelming databases being used, and the non-ecological settings such as the lab to test responses... Using small groups of subjects with narrow representation, what does the knowledge that science is building about emotions actually mean?"*

I was hoping that *Chameleon* could provide a more ecological environment for understanding our emotions, closer to real life. I was hoping the database could provoke stronger, more felt emotions in those that viewed it. I hoped the ideas and processes explored in *Chameleon* could be beneficial and inspirational to science, opening up pathways to more dynamic ways of seeing, monitoring, provoking emotions. Email feedback with my collaborators suggests that this aim seems to have succeeded. Nadia Berthouze writes:

> *"I see Chameleon as a source of ideas for the creation of digital environments conducive to patients becoming aware of their emotional states."*

Rosalind Picard is interested in how the database could be used for people who may have a more difficult time reading emotions:

> *"As I watch people to learn from the interactions portrayed. These are scripts with naked emotion, uncovered, and whether ugly or beautiful, they are hard to turn the eyes from. Here is an engaging palate for helping people who don't naturally understand emotional interactions, and who want to deepen their ability to do so."*

Chris Frith sees the cross disciplinary collaboration as liberating:

> *"This project has developed far beyond what I would dare to do in the carefully controlled experiments that we are restricted to. But the end result will provide us with marvelous tools for doing new experiments."*

Above: Tina Gonsalves, *Chameleon 9* at Fabrica, Brighton, UK, 2009. (Photo: Matthew Wild)

Above: Tina Gonsalves delivering an artist's talk about *Chameleon* at *SuperHuman: Revolution of the Species*, Melbourne, Australia, 2009. (Photo: Amanda Matulick)

Above: Tina Gonsalves delivering an artist's talk about *Chameleon* at Lighthouse Arts Agency, Brighton, UK, 2009. (Photo: Genevieve Bateman)

Hugo Critchley writes:

> *"The interdisciplinary collaboration has enriched my interest and understanding of emotional research beyond neuroscience and psychophysiology, developing links across disciplines arts humanities engineering etc that are still active, and developing as research collaborations."*

The human computer interaction evaluation team led by Nadia Berthouze was invaluable. The work was exhibited often, with most exhibition venues providing an opportunity to evaluate audience interaction (Nadia Berthouze and Karl Broome discuss audience experience on page 56 and 64). The constant, and some times varied feedback was illuminating, however, also a touch paralyzing! As an artist, I had always worked by intuition, making aesthetic decisions by what 'felt' right. The constant decision making of what information from the studies to implement and what to leave out was difficult, eroding the automatic sense of aesthetic that was usually key to my artistic approach. The constant displaying of the iterations was intense both for the team and the gallery spaces that risked showing work in progress. However, it proved a successful trajectory, building large and varied audiences and providing pathways to bring the public into the journey of the making of the work. Rachel O'Reilly writes:

> *"...Her (Tina Gonsalves') practice is interesting in this way that it cuts through discourses of spectatorship as a terminal or finite affectivity – this also reflected in her unfolding, multi-stage approach to research and experimentation of adaptations of works across sites and over time".*

Working with curator Helen Sloan, *Chameleon* was placed in varied spaces, for example: in waiting rooms such as University College of London's Hospital Foyer, café/bar scenarios such as the Science Museum's Dana Center and the Institute of Contemporary Art's bar in London, digital/new media galleries such as Lighthouse, more traditional gallery spaces such as Fabrica in Brighton, and museums such as the London's Natural History Museum. Helen Sloan writes:

> *"The connections and developments that have been made cross disciplines and to some individual research have given a richness and uniqueness to Chameleon that enables it to nimbly cross arts and science exhibition spaces and research environments. Embedding and linking both disciplines from the outset has ensured that the project has its own artistic signature while also enabling development of each collaborator's particular research area."*

Chameleon successfully brought together a genuine collaboration across the boundaries of arts and science revealing new models for experimentation through art installations, research papers, and novel, more dynamic models for scientific research that incrementally reveal the emotional exchange, mimicry and contagion across social groups. For myself, *Chameleon* has inspired a new series of works, exploring compassion, via a residency at the Max Planke Institute as well as Nokia Research Labs in Finland.

Following are the nine iterations of building *Chameleon*:

*Chameleon 1: Creating an Ethnographic Study of Emotional Contagion:* Resulting in a single channel film capturing, isolating and amplifying the transference of emotions between friends. Four HD cameras focused on the four participants. The video was then slowed, aiming to capture micro expressions that we often miss consciously in day-to-day interactions. Shot at the Banff New Media Institute, Canada. (Image: Tina Gonsalves)

Chameleon 2: Creating a Live Emotional Contagion Capture Tool, The Dana Center, Science Museum, London, UK, 2008. The work uses a series of web cams and software to slow down a display of live social interaction, decoding the unspoken, subtle elements of mimicry that come into play over social situations. It allows the audience and participants to view the micro-expressions and fleeting moments of cohesion and incongruence that we may often miss consciously. (Photos: Matthew Wild, Evan Raskob)

Chameleon 3: Mimicking Emotional Contagion: Installation view, Lighthouse, Brighton, UK, 2009. The work consists of a two screen video installation, exploring the emotional dialogue between two people. The screens display the profiles of a man and woman, staring at each other. The two video channels of the man and woman interact via Chris Frith's algorithmic hypothesis of emotional contagion. The audience are privy to view and listen to a couple who become caught into a never-ending personal journey of personal and uncontrollable array of arousing, disturbing and confusing emotional dramas and habitual responses. (Photo: Tina Gonsalves)
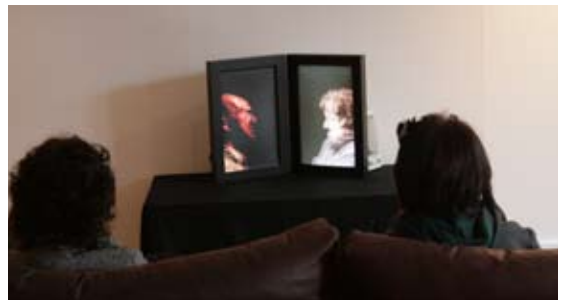
Chameleon 4: The Search for Meaning: ICA, London, UK, 2008. As each figure emotes, simultaneously, a live search to the web is triggered to capture and transpose recent textual chats about emotional states. For example, as the man feels sad, the engine searches for the most recent text written by a man about sadness and transposes the text on his portraits. A contextual dialogue is built up. (Image: Tina Gonsalves)

Chameleon 5: Shifting Emotions: never exhibited. *Chameleon 5* is an interactive single channel video portrait using emotional codes to build the visuals. The portrait is in flux as each fragment of the visuals constantly infects the fragment around it. (Image: Tina Gonsalves)

Chameleon 6: Mimicking Emotional Contagion in Social Groups: Artist Mock Up, 2008. A multi-channel video installation exploring how emotions transfer in social groups. The emotional feelings of each individual portrait constantly infects the emotional harmony of the group, as they undergo a never-ending search for an emotional homeostasis. (Image: Tina Gonsalves)

Chameleon 6: Installation view, *After Darwin: Contemporary Expressions:* Natural History Museum, London, UK, 2009.
(Photo: Natural History Museum)

Chameleon 6: Installation view, UCL Hospital Foyer, London, UK, 2008.
(Image: UCLH)

Chameleon 7: Integration of FaceSense Technology into the Interaction Scenario: Dana Center, Science Museum, London, 2009. The audience's emotional expression drives the video portraits to emotionally empathise with the audience. (Photos: Tina Gonsalves)

Opposite: *Chameleon 7,* Superhuman: Revolution of the Species, RMIT Gallery, Melbourne, Australia, 2009. (Photographer: Mark Ashkansy; Copyright: RMIT Gallery)

Chameleon 8: Testing More Scuptural Types of Displays: Lighthouse, Brighton, UK, 2009. *Chameleon 8*, Gordon Brand hanging one of the '3D' screens built for *Chameleon 8.* During the Lighthouse Residency, the team collaborated with Gordon Brand from The Centre for Innovation & Design at Solent University to create more immersive, sculptural and evocative screens to display the *Chameleon* portraits. The screens were built in layers, using rapid prototyping techniques guided by Brand. We set up a seperate testing room in the basement of Lighthouse Arts Agency, Brighton, UK. (Photo: Tina Gonsalves)

Chameleon 8: Testing More Scuptural Types of Displays: Lighthouse, Brighton, UK 2009. *Chameleon 8*, was built during a residency at Lighthouse Arts Agency in Brighton. The aim of *Chameleon 8* was to transform the gallery space into an emotionally responsive video sculpture. The *Chameleon* team experimented with different techniques to create a more immersive and intimate experience of *Chameleon*. (Photos: Tina Gonsalves)

For *Chameleon 8*, the *Chameleon* team collaborated with French artist group Experientiae Electricae to further develop *Pixy*, a large-scale flexible modular display. Tina met Experential Electricae in early 2008 at the Liminal Screens Residency at the Banff New Media Institute in Canada. The displays of *Pixy* are built using light, electroluminescent paper, breaking down the aesthetic and resolution of the video portraits into mono-toned, larger pixels. When we brought Experential Electricae to the Lighthouse Residency in Brighton, an aim was to build more pixels into the display so the image of a face could be read from the screen. I was interested in exploring how reducing the resolution of the image would affect the emotional reading of the video portraits. I write in my blog *"Its been a pretty intense time but really wonderful as well. The basement of Lighthouse has become a big contagion soup. Many ideas, emotions floating about infecting each other to a video soundtrack of people emoting. It been dark in here, while sunny outside. The screens are running heaps of electricity through them making it all more intense. Its been hard and also fun for everyone. But we are all tired now..."*
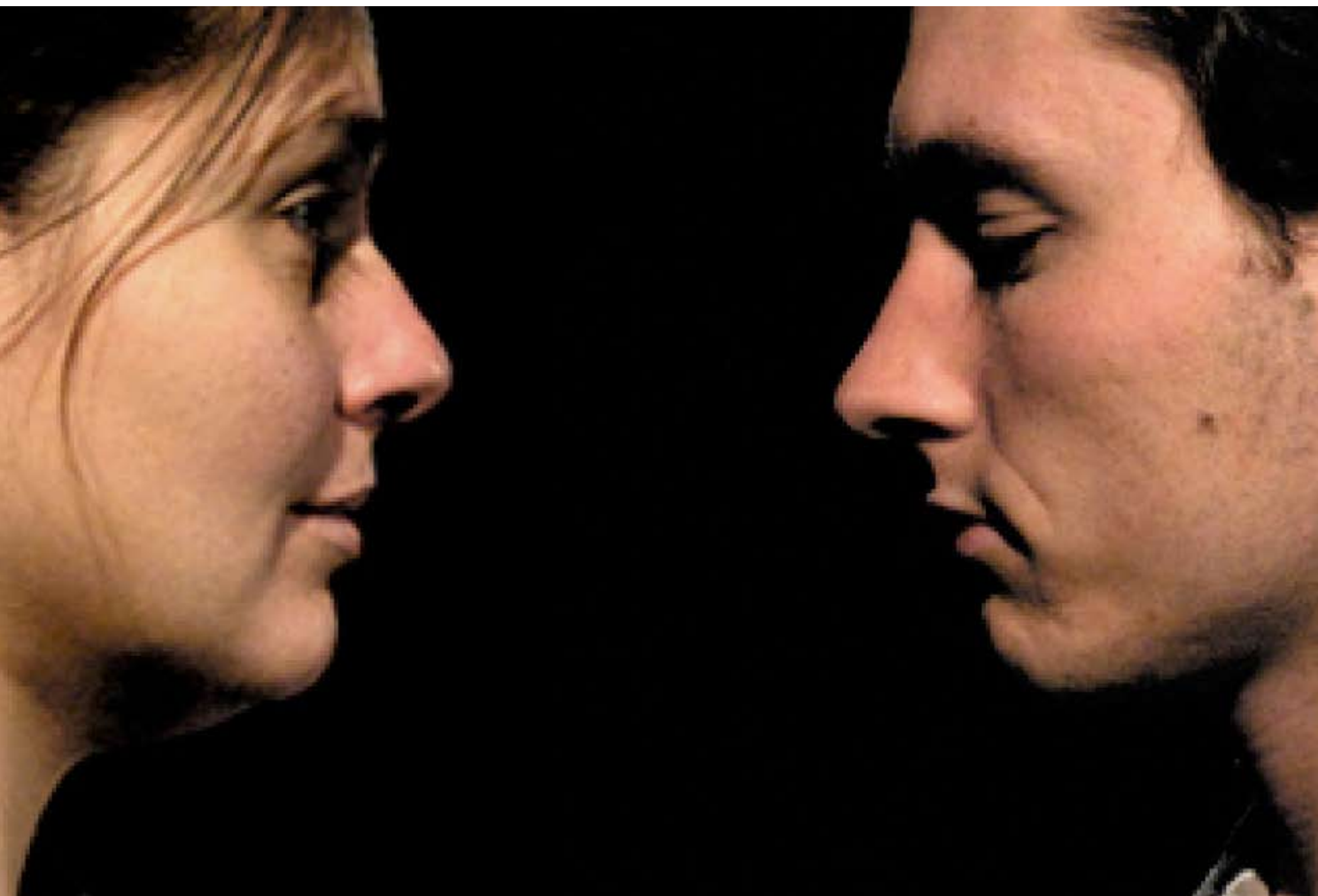
Chameleon 9: Fabrica, Brighton, UK 2009. An interactive experiment in emotional contagion where the gallery becomes an emotional theatre in which visitors and digital video portraits interact. (Photo: Pilip Carr)

COURTING EMOTIONAL CONTAGION:
DARREN TOFTS

Darren Tofts is a cultural critic who writes regularly for a range of national and international publications on issues to do with cyberculture, new media arts and critical and cultural theory. Formerly an editorial correspondent for *21C* magazine, he is a member of the editorial boards of *Postmodern Culture, Continuum, The Australian Journal of Media and Culture, Fibreculture Journal, Rhizome* and *RealTime*, where he is a commissioning editor for new media arts.

His publications include *Memory Trade: A Prehistory of Cyberculture* (with Murray McKeich) (1997), *Parallax: Essays on Art, Culture and Technology* (1999), *Prefiguring Cyberculture: An Intellectual History* (edited with Annemarie Jonson & Alessio Cavallaro) (2003), *Interzone: Media Arts in Australia* (2005) and *Illogic of Sense: The Gregory L. Ulmer Remix* (with Lisa Gye) (2007). His most recent project, with Lisa Gye, is *The Secret Gestural Prehistory of Mobile Devices*.

It starts with a sideways glance. The eye is mobile, hyper-sensitive, acutely attuned to its surroundings. Other receptors are simultaneously at work too. Light, temperature, the threat of danger, the presence of others all impact upon the visible drama of change. Reflecting psychological as well as physical responses to its environment, the chameleon becomes something other than itself. Its status as a thing in the world is always bound up with its relations to that world. It responds to change but affects it as well. White, sleek and invisible on the page, it slowly manifests facets of black along its sleek lines, alphabetic letters tessellating across its body likes words on parchment. It has become its environment.

This relational approach to being is the stuff of London-based Tina Gonsalves' most recent work *Chameleon*. Gonsalves has an impressive pedigree as an intermedia practitioner. As an artist she has evolved with the various media that constitute her explorations into the intimacy of the human-computer interface, from 2D imagery to video to complex adaptive environments. But Gonsalves is not interested in media for their own sake. Like her Australian counterpart, Linda Dement, Gonsalves approaches the space of interaction from the perspective of a deeply personal encounter between work and audience that is emotionally charged, visceral and intimate.

Media art has progressed sufficiently as a practice that its initial affiliations with CD ROM and the internet are now officially part of its history. What now constitutes the time-space of media art is diverse, conspicuously interdisciplinary and adventurously unfamiliar. Collectives such as London-based Blast Theory (led by Matt Adams, Ju Row Farr and Nick Tandavanitj) have moved their interventions to the street and the pedestrian relations of mobility, using mobile telephony and other locative media devices to create distributed, time-based media art events. *Can You See Me Now?* (2001), for example, critically responds to

Above: a still from *Feel: Ferment*, single channel video, 3.26 minutes, 2006. (image: Tina Gonsalves)

Following Page: Frame grabs from the visual documentation of *Feel: Perspire*, a psycho-physiologically interactive work monitoring the galvanic skin response (sweat) to trigger the video content. When the participant becomes calm, images of clouds verge into abstraction; if the participant becomes anxious, the clouds grow to be more stormy and violent, enveloping the participant in their fury. (Image: Tina Gonsalves).

the ubiquity of mobile telephony and its penetration 'into the hands of poorer users, rural users, teenagers and other demographics usually excluded from new technologies'. From within the architecture of a tactical pursuit game, it converges players within actual locations (the Blast Theory runners on the streets of Sheffield) and virtual, telematic spaces (anyone anywhere in the world), integrating ambiguous and unprecedented relations between individuals occupying different co-ordinates of place and time (Blast Theory, 2001). The Tissue Culture and Art Project (Oron Catts and Ionat Zurr) also breaks new ground, blurring the boundaries between installation and laboratory experiment in their pursuit of bio art. The Tissue Culture and Art Project experiment under sterile, laboratory conditions in gallery and exhibition spaces with tissue cultures and tissue engineering technologies. Bio art projects, such as *Semi-Living Food: 'Disembodied Cuisine'* (2003), involved the growth of living tissue (from frog skeletal muscle over biopolymer) that constituted a 'semi-living' steak. Dissociated from a body and cultured as a form of edible flesh, *Semi-Living Food: 'Disembodied Cuisine'* critically engages with issues to do with genetic engineering and modification of food, as well as projecting a 'future in which there will be meat (or protein rich food) for vegetarians and the killing and suffering of animals destined for food consumption will be reduced' (Tissue Culture and Art Project, 2003). Stelarc's ongoing dialogue with the technologised body also confronts expectations as much as the senses, queering the art-space of the gallery into something that also resembles a bio-hazardous zone. In his 2005 collaborative installation with Nina Sellars, *Blender*, for instance, subcutaneous fat and other tissue was extracted from both artists using liposuction then 'blended' into a large industrial vat, dramatically enacting their interest in 'alternative corporeal architectures and bodily functions'. Part atrocity exhibit, part weird science experiment, *Blender* engages with 'some of the more contentious issues surrounding the blending of contemporary technology with corporeality' (Stelarc and Sellars, 2005). Gonsalves' most recent work, as evidenced by *Chameleon*, also consolidates an ongoing dialogue between art and other paradigms, such as biotechnology, medicine and the life sciences.

The ambitious *Feel* series (2005-2007) crystallises this understanding of art as a poetic of strange, unlikely and often unnerving encounters between physical bodies and technology, between different ideas and disciplines. This series of installation works is underpinned by a poignant question: 'How do we know how we are feeling?' Such a question is perhaps taken for granted in a culture in which the phrase 'how are you?' presumes an immediate and unequivocal response. As Gonsalves pertinently observes in this respect, we 'have little control when strong feelings sweep us away, overwhelming us and causing havoc in reasoning' (Tina Gonsalves, email correspondence with author, 1 April 2009). The *Feel* series simulates personal encounters between visitors to the gallery and large-scale projections of virtual subjects. In *Feel: Ferment* (2006), an impassive face stares out at the visitor, accompanied by a reflective voice-over describing states of calm, relaxation and growing tranquility. The narrator speaks in the manner of a hypnotist, cajoling the subject into an emotional comfort zone. This is intercut by an abrasive, cacophonous soundscape that increases in tension and volume, precipitating changes in the demeanour of the subject's face, which becomes an agitated palimpsest of

extreme emotional signatures. For Gonsalves, this work dramatises the interplay of surface and depth in relation to appearances and what they either reveal or conceal. Consistent with the *Feel* series as a whole, this work engages with the problematic of reading emotions in others and ourselves which, for the artist, 'is central to empathy and social understanding' (Tina Gonsalves, email correspondence with author, 1 April 2009).

Chameleon (2008-2010) is indicative of and extends the dialogue and praxis Gonsalves has initiated between the arts, science and technology in the *Feel* series. Currently, Gonsalves is an Honorary Artist in Residence at the Wellcome Department of Neuroimaging at the Institute of Neurology at UCL in the UK and Visiting Artist at the MIT Media Lab working the Affecting Computing Group in the US, as well as Visiting Artist at Nokia Research Labs, Finland. Like the figure of the chameleon solicited at the beginning of this discussion, Gonsalves moves with stealth and ingenuity into those areas once thought foreign to artists. Adapting to, as well as exerting her own influence on these exotic habitats, she garners a *dramatis personae* drawn from the fields of psychology, social neuroscience, emotion and affective computing. Gonsalves' immensely rich collaboration with emotion neuroscientist Hugo Critchley, social neuroscientist Chris Frith and affective computer scientists Rosalind Picard and Rana el Kaliouby, generates a common-ground of shared, interdisciplinary inquiry into notions of social networks, empathy, affect and computing.

This art-science collaboration galvanises discrete discourses that are exploring the same psycho-social conditions, collapsing the silo approach to research that too often fails to take advantage of alternative insights or different disciplinary points of view. If we think of the chameleon as an organism that effectively responds to its environment through mimicry, regardless of its difference, then Gonsalves' collaboration in *Chameleon* reveals a hybrid approach to contemporary art practice that results in an experience that is more than the sum of its diverse parts. The theoreticians had better get cracking on a name to categorise the form.

Gonsalves describes *Chameleon* as a 'poetic interactive video and sound art installation driven by emotional expression of [the] participant' (Tina Gonsalves, email correspondence with author, 1 April 2009). This is familiar conceptual territory for the contemporary art goer.

But there is more to it. 'Through partaking in an art experience, participants will gain a personal insight and perspective of how mimicry can often build empathic relationships and trust to form cohesive social groups' (Tina Gonsalves, email correspondence with author, 1 April 2009). The implications of this are profound. The notion of publication in relation to research has the potential to be dramatically shaken up when an 'art experience' in a gallery is deemed the intellectual equivalent of traditional academic outcomes. Practice-based research has at last been recognised internationally within the Academy as a vital and robust form of scholarly inquiry. In addition, then, to the most recent bibliographical references on the set texts for Affective Computing 101, I can envisage gallery information details for the *Chameleon* installation.
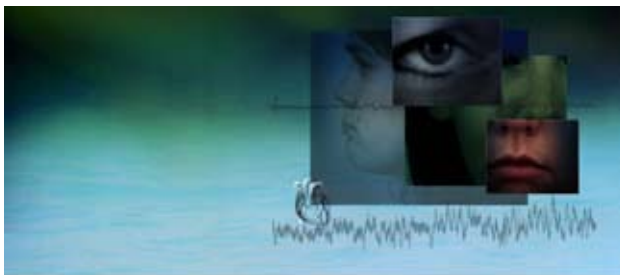
Above : Frame grabs from the visual interface of *Feel: Trace*, a psycho-physiologically interactive work responding to the participant's heart rate. The *Feel* series (2005-2007) are an interconnected progression of short films and interactive sketches aiming to sense, translate and provoke the psycho-physiology of the audience. The series forms the initial investigations of artist Tina Gonsalves and affective neuroscientist Dr. Hugo Critchley (Image: Tina Gonsalves)

Collectively, Gonsalves and her collaborators are interested in using advanced emotion and affective computing technology to explore the 'scientific foundations of emotional contagion – the phenomena of how emotions spread from one person to another in social groups' (Tina Gonsalves, email correspondence with author, 1 April 2009). The *Chameleon* installation is a kind of performance laboratory, a space of inquisition and enactment. Gonsalves' artistic sensibility absorbs scientific hypothesis and technological possibility into an interface, a psycho-somatic stage, at once theatre of cruelty, emotional catharsis and critical insight.

Gonsalves draws both conceptual inspiration and technical support from the scientific and computing communities. Drawing on theories of 'emotional contagion' and affect, as well as utilising advanced sensing and monitoring techniques such as bio-feedback and facial emotion analysers, she renders in *Chameleon* a 'more holistic and embodied view of the relationship between human subjects and technology' (Tina Gonsalves, email correspondence with author, 1 April 2009).

The chameleon metaphor works well here to contour the psycho-social interests of Gonsalves and her collaborators. Think of the gallery space less as a static built environment where the art is, than a social ecology where human subjects and digital personalities interact in unpredictable emotional encounters. Gonsalves describes this dynamic mise en scéne in the following way:

> A series of multiple networked monitors surround the participant. The content of audiovisual footage is a pre-shot database of facial emotional expressions of a select group of humans. Each face, presented on each monitor, will develop its own visual algorithmic code (personality) based on affective and social neuroscientific studies. All the faces on the monitors constantly adjust to any emotional response from virtual social group as well as the affective state of the participant, attempting to build an empathic emotional circuit with them. (Tina Gonsalves, email correspondence with author, 1 April 2009).

As the eponymous reptile disappears into its surroundings, so too empathy incites the participant to respond to and duplicate the emotions of others, be they digital or human.

Chameleon is also, in many ways, a poetic meditation on the role and pervasiveness of surveillance and other monitoring, sensing and diagnostic technologies within contemporary society, medicine and industry. Drawing on the most advanced research into biometrics, Gonsalves leaves no trace of human emotion beyond the scrutiny of scanning technology. As with the *Feel* series, the physical movement, heart rate and facial expression of human participants are all sensed, processed and communicated in various iterations of the *Chameleon* project. This information is in turn 'sensed' by the virtual subjects projected on to the walls of the gallery, who communicate emotional states back into the space through their own facial demeanor. Even more dramatically, some subjects speak directly to the audience, having first recognised their emotional state, then, accordingly, responding in such a way that the visitor is implicated in an emotional drama not of their making. If we think of the chameleon as a semiotic creature, it reads its environment as a complex tissue of signs and connotative super-abundance. Similarly, Gonsalves describes *Chameleon* as a 'facial emotion, expression reading art project that highlights awareness of our inner selves, as well as our innate tendency to synchronise and connect with others' (Tina Gonsalves, email correspondence with author, 1 April 2009).

In *Chameleon* there is an intimate conceptual and technical connection between social and computer networks. In purely anthropological terms, the computer network is an analogy of the subtle, overt and myriad channels of communication that integrate individuals into social beings and the higher orders of community to which they belong. Similarly, the very concept of social relations bears uncanny resemblance to the informational circuits that connect discrete nodes into a higher order or network, as well as the vectors of information exchange that flow within them. Michael Benedikt intuited something of this reciprocal enfolding of the human and the machine in a decisive and influential definition of cyberspace written nearly two decades ago:

> *Cyberspace: A common mental geography, built, in turn, by consensus and revolution, canon and experiment; a territory swarming with data and lies, with mind stuff and memories of nature, with a million voices and two million eyes in a silent, invisible concert of enquiry, dealmaking, dream sharing, and simple beholding.* (Benedikt 1991, 2)

This intimacy between the human and the informational has been given other names, such as the post-human. For Gonsalves and her techno-savvy collaborators, it is nothing so epochal. *Chameleon* reveals and attests to, in the spirit of Norbert Wiener's cybernetics, the essentially adaptive and empathic nature of emotive beings (virtual, human or otherwise), responding through largely unseen feedback loops of sensation to others and to their environment.
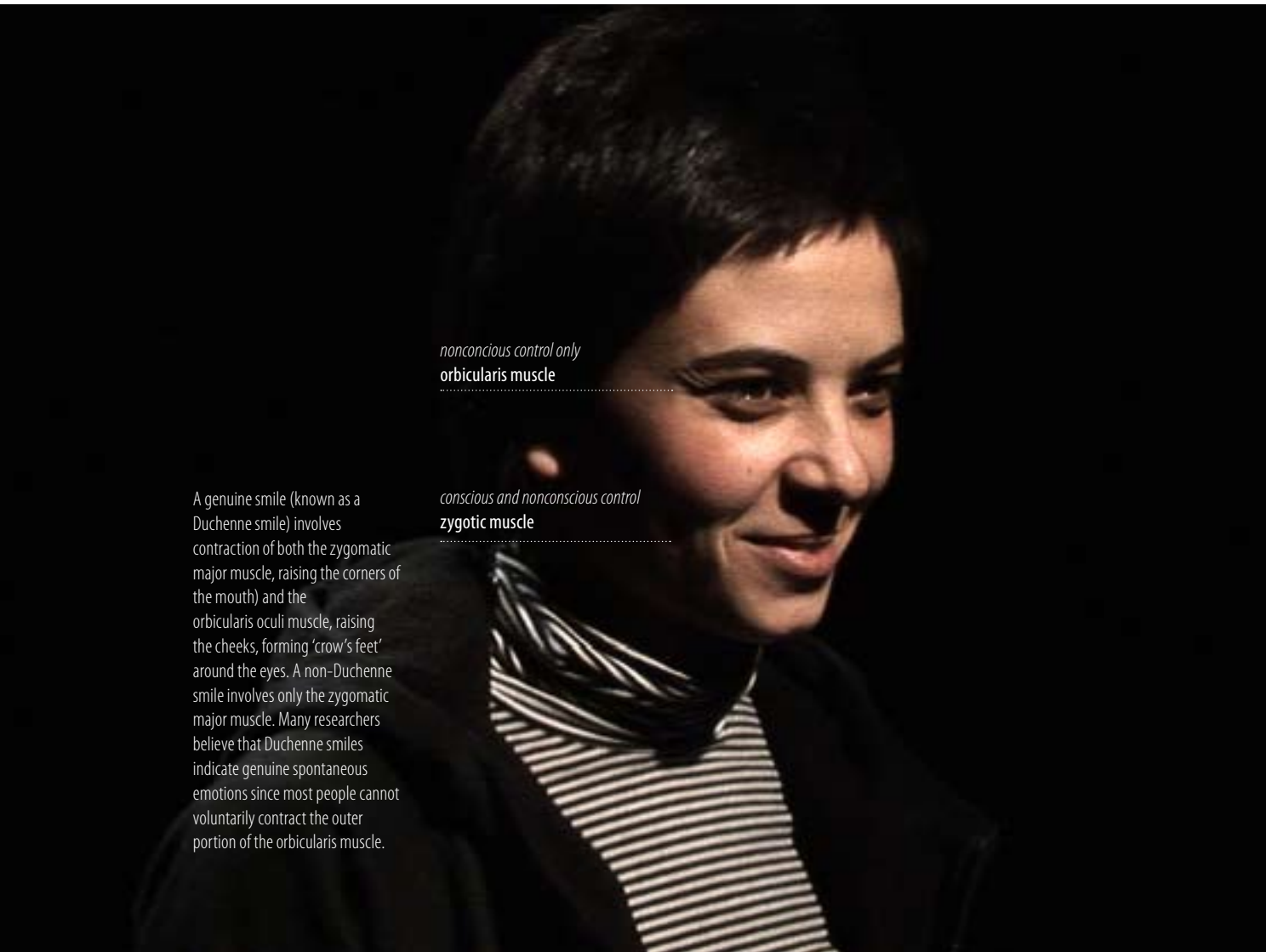
And so the chameleon changes once more. Letters slowly vanish before your eyes in a subliminal dissolve of unbecoming as it morphs into otherness, transforming into a tabula rasa, a blank page to be written at another time.

FACES MAKING FACES MAKE FACES:
CHRIS FRITH

nonconcious control only
orbicularis muscle

conscious and nonconscious control
zygotic muscle

A genuine smile (known as a Duchenne smile) involves contraction of both the zygomatic major muscle, raising the corners of the mouth) and the orbicularis oculi muscle, raising the cheeks, forming 'crow's feet' around the eyes. A non-Duchenne smile involves only the zygomatic major muscle. Many researchers believe that Duchenne smiles indicate genuine spontaneous emotions since most people cannot voluntarily contract the outer portion of the orbicularis muscle.

Chris Frith is a neuroscientific collaborator on Chameleon with a particular interest in the neural basis of social interactions. He is Emeritus Professor at the Wellcome Trust Centre for Neuroimaging at University College London. He is also Niels Bohr Visiting Professor at the University of Aarhus, Denmark, working on a five-year research project, *Interacting Minds*.

Chris is a pioneer in the application of brain imaging to the study of mental processes. He has contributed more than 400 papers to scientific journals and is known especially for his work on agency, social cognition, and understanding the minds of people with mental disorders such as schizophrenia. For this work he was elected a Fellow of the Royal Society in 2000.

The innovative feature of *Chameleon* was that the artwork would interact with the viewer who was looking at it. The idea was that when you look at a video of an expressive face, you cannot help but respond to that face by altering your own facial expression. Tina Gonsalves wanted to go one step further so that the face in the video would then respond to the changed expression in the viewer's face. I call this closing the loop. This is a core component of any human interaction: I am not just responding to you, I am responding to your response to me.

To achieve *Chameleon* all sorts of technical problems had to be overcome. For example, a computer had to be programmed to recognise and classify the facial expressions of the viewer. Then the computer had to decide which expression should be chosen for the video as a response. What Tina asked me to do was to come up with a plausible set of rules for making these choices.

We know a great deal about how faces display different emotional expressions from the work of Charles Darwin, who also pointed out the remarkable similarity in emotional expression between humans and other mammals. This similarity implies that there is a set of universal emotions for which a particular facial appearance expresses the same emotion in all human cultures, as well as in other animals. Paul Ekman has confirmed this idea and identified six such universal emotions: Anger, Disgust, Fear, Happiness, Sadness, Surprise. Research in facial expressions has concentrated on these emotions.

In the last 20 years, this research has been extended to explore the question of how our faces respond when observing facial expressions in others. The most striking discovery has been of the extent to which we mirror the facial expressions we see in others. If I see a frowning face then I will frown. If I see a smiling face then I will smile. These changes need not be obvious to the naked eye, but we can demonstrate our tendency to mirror the facial expressions of others by measuring electrical activity in

front

back
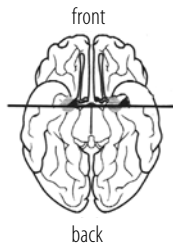
Above: The brain seen from underneath showing the location of the amygdala in the medial part of the temporal lobes. The amygdala is a small part of the brain concerned with detecting dangerous situations.
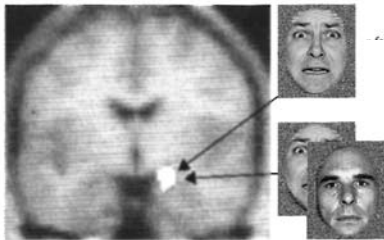
Above: The scan of the brain (a vertical slice along the line shown in the top figure) shows increased activity in the amygdala. Researcher Paul Whalen used scanning techniques to show that fearful faces cause activity in the amygdala even if you are not aware of them. Fearful faces (from the Ekman and Friesen database) were shown to the subject subliminally.

front

back

Above: The brain seen from underneath showing an area in the temporal lobe (on the right) that responds to faces. (Above images are modified from Chris Frith's book, *Making Up the Mind : How The Brain Creates Our Mental World*, Oxford 2007)

the muscles of the observer's face. When we see a frown, activity in the corrugator supercilii increases. This is the muscle that creates frown lines on the forehead. When we see a smile, activity in the zygomatic major increases. This is the 'smiling' muscle, which pulls up the corners of the mouth. This happens even if the expression we are observing is shown so briefly that we are not consciously aware of the frown or the smile.

Using brain-imaging techniques (e.g. functional magnetic resonance imaging, fMRI) we can also measure brain activity when volunteers observe different facial expressions. These studies suggest that, in addition to imitating the expression, we also share the emotion. When we see an expression of fear, activity increases in the amygdala, a part of the brain that responds when we are afraid. When we see an expression of disgust, activity increases anterior insula, a part of the brain that also responds if a disgusting smell is placed under our nose. These effects (or at least the effect of fear) also occur when the expression is shown so briefly that we are not consciously aware of it.

Given these observations, the simplest rule we could have implemented for *Chameleon* would be for the computer to choose expressions for the video that imitated the expressions made by the viewer. But this would not be a very exciting interaction since the pair would rapidly become stuck in a single expression. Also it is obvious that human interactions are much more flexible. We don't always imitate the expressions of others. To explore the nature of these interactions further we need to consider the function of facial expressions.

For example, is there any advantage to us of having an automatic tendency to imitate the facial expressions of others? In the case of the expressions of fear and disgust, imitation gives us a direct benefit by preparing us for danger. When we make a fearful expression we open our eyes wide and flair our nostrils. This makes us more receptive to sensory signals: our visual field of view becomes wider and we take in more air through the nose. We become sensitive to sensory signals that may indicate the nature and the location of the danger. A facial expression of disgust has almost the opposite effect: we half close our eyes and wrinkle our nose, reducing the intake of air. This has the effect of reducing the impact of the noxious sensations that are causing the feelings of disgust. Facial expressions of fear and disgust help us to escape from different kinds of danger. For an observer, expressions of fear and disgust in other peoples' faces are signals of different kinds of danger. By imitating these expressions we gain a direct benefit because the impact of these dangers on us will be reduced. When we express fear and disgust in these cases, we are doing this whether or not there are other people present: we are not trying to communicate. We are simply responding to danger. Nevertheless, our expressions provide useful cues to those who are observing us.

Most of the time, however, facial expressions play a vital role in social interactions. In this context our imitation of the expressions of others can be considered an example of empathy. Our change of expression shows that we share someone else's happiness or someone else's pain. But there is much more to empathy than just sharing emotions.

Above: Chris Frith, Matt Iacobini, Nadia Berthouze and Tina Gonsalves meet to discuss the algorithms of *Chameleon*. (Photo: Tina Gonsalves)

front

parahippocampal place area

fusiform face area

primary visual cortex

back
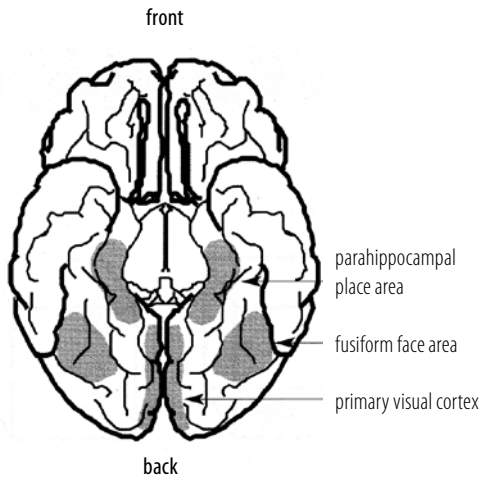
Above: The visual system in the brain. The brain seen from underneath. The fusiform face area is an area specialising in the recognition of faces. Damage to this area causes an inability to recognise faces (as in Oliver Sack's book 'The Man Who Mistook His Wife For A Hat'). The parahippocampal place area is an area specialising in the recognition of places, both landscape and buildings. A brainscanner allows us to observe activity in these circumscribed areas when people are looking at, for example, houses and faces. We can also see activity when people are imagining houses and faces. I would hypothesise that the fusiform face area would activate when people interact with *Chameleon*. (Image modified from Chris Frith's book, *Making Up the Mind: How The Brain Creates Our Mental World*, Oxford 2007)

The imitation of the expressions of others that occurs even when we are not aware of seeing the expression, might better be called emotional contagion rather than emotional empathy. In this case we are not even aware that the other person is having an emotion. We would be more justified in calling it empathy if we are aware of the other's emotion and are aware that we are sharing it. However, in the case of true empathy we are not just aware of the emotion in the other person, we also want to do something about it. If we see that someone is sad we want to cheer them up. In this case, imitating their miserable expression is about the worst thing we can do. We will try, perhaps with some difficulty, to make a cheerful expression in the hope that this will be contagious. This use of emotional expressions to manipulate a social situation is nicely illustrated by the use of the expression of embarrassment. Here is a possible sequence of events: person A says or does something socially inappropriate. This behaviour elicits an expression of anger in person B. In response to this anger person A produces an expression of embarrassment. By this expression, A communi- cates that he knows he has done wrong and is suffering from the knowledge that others also know that he has done something wrong. This expression elicits an expression of compassion in person B. Noticing the expression of compassion, A recognises that the anger has been diffused and can now afford to smile. As a result both are now happy again.

From these examples we can see that simple imitation was not sufficient. A much more complex set of rules was needed for the computer to decide how to respond to the expressions of the participants of *Chameleon*. And these rules have to be probabilistic. For example, in response to anger, the computer might sometimes imitate and choose anger, but might also sometimes choose surprise (to indicate that anger was not expected) and sometimes choose sadness (to diffuse the anger). On the other hand, the expression of happiness would most probably elicit happiness.

As yet there is very little research available for deciding what precisely the rules should be. As a result, my final choice of the rules that the computer used for deciding how to respond was largely intuitive, although based on the knowledge I have out- lined above. For me, one of the exciting features of *Chameleon* is that it will teach us a great deal more about how people respond to changing facial expressions and test the value of my intuitions.

THE EMBODIED MIND:
INTERNALIZING THE EMOTIONS OF OTHERS
HUGO CRITCHLEY

Chameleon 7, Lighthouse, Brighton, UK 2009.
(Photo: Tina Gonsalves)

Hugo Critchley is a neuroscientific collaborator on *Chameleon*, and longer term collaborator of Tina Gonsalves. Critchley's long term interest is the control of emotional and motivational behaviour. He now focuses on examining psychophysiological mechanisms underlying symptom expression in physical and psychological disorders; i.e. how brain and body interact to influence subjective experience, behaviour and physical health. Techniques typically combine functional brain imaging with autonomic monitoring and clinical studies of relevant patients. This work extends into behavioural medicine and is supported by the Wellcome Trust.

He is also a member of the Sackler Centre for Consciousness Science (SCCS) faculty. Its remit is to unravel the complex neural networks underpinning conscious experience, in health and in disease.

Neuroscience can explore the brain mechanisms underlying our behaviour, and in so doing may uncover new detailed knowledge about ourselves and our interactions with others. I am a neuroscientist interested in the brain processes controlling emotion. I typically use quite expensive and sophisticated technology, brain scanning with MRI, to look at what goes on in the brain during different emotional states. One aspect of this relates to something called 'interoceptive awareness' which describes the extent to which we are consciously aware of changes and responses occurring inside our bodies.

Everyday human interaction is shaped by information from the face. For those of us with intact sight, emotional facial expressions, along with cues in our posture and voice enable us to judge the arousal state, predict the behaviour and infer the social motivations of another person. Visual decoding of emotional expressions is highly skilled, refined over the course of evolution and our own maturational development. Whether or not communication is actively intended, our own emotional expressions communicate value and meaning to an observer. Emotional information from the face is also communicated internally: our own facial expressions change activity within emotional centres in our brain and can influence our own bodily responses, feelings and behaviour, including how we judge the emotions and behaviour of other people. Through interacting with *Chameleon*, participants become more aware of interoceptive awareness

Interoceptive awareness is relevant to both physical and mental health. Physical symptoms of pain discomfort and fatigue essentially reflect the signals from the body telling the brain that we are unwell. Mental states, particularly emotional states are also influenced by the internal body (one has only to think of how the feeling of breathlessness and a racing heart goes hand in hand with the experience of anxiety). The basis is ultimately
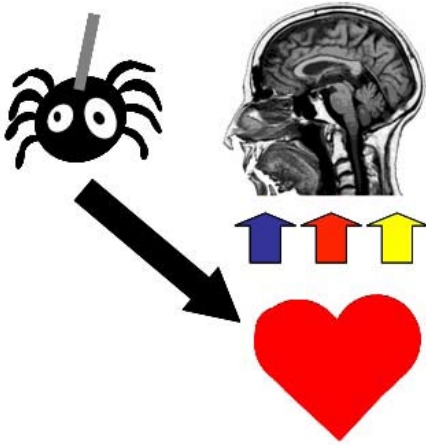
Opposite: Illustration of the James Lange Theory of Emotion: Seeing a spider creates changes in the autonomic nervous system, resulting in physiological changes such as muscular tension, a rise in heart rate and perspiration. The feelings of fear comes about as a result of the physiological changes, rather than being their cause.
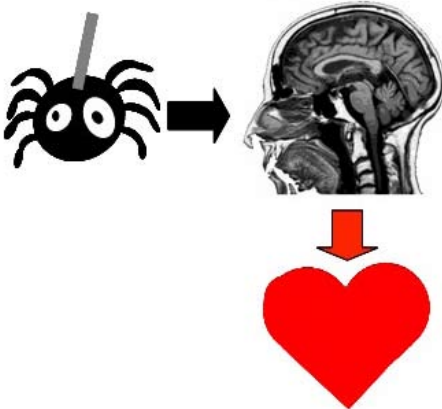
Opposite: Illustration of the Cannon Bard Theory of Emotion: Seeing a spider creates a feeling of fear and changes in the autonomic nervous system resulting in physiological changes such as muscular tension, a rise in heart rate and perspiration. The individual experiences fear and the physiological changes simultaneously.
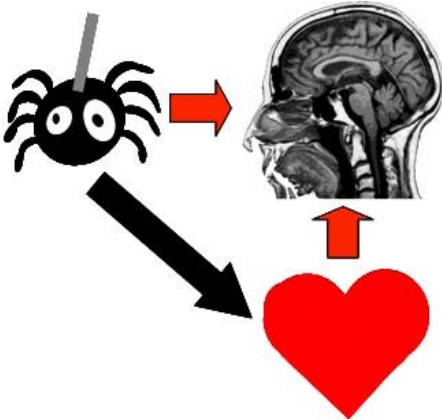
Opposite: Ilustration of the Schachter and Singer Theory of Emotion: Seeing a spider creates changes in the autonomic nervous system. This change in bodily arousal triggers the emotion and determines its intensity, but it is the context (here the perception of the spider) that makes the emotion one of fear. (Source: Hugo Critchley)

quite simple: our body states dictate fundamentally how we may interact with the environment. The obvious example of that is if we are water deprived or nutrient deprived - we feel these as basic emotional states of thirst and hunger. At one level up, if we detect something in our environment that threatens us, this will automatically trigger reactions in the body that would help us physically escape (fight or flight; the anxiety state mentioned above). Even more complex emotions such as grief or pleasure relate to the internal expression within the body anticipating discomforting or rewarding states. In sum, feelings emerge from the bodily changes and change the way we respond, react and behave.

This notion was proposed over 100 years ago, by "the father of psychology" William James and a physician in Denmark called Carl Lange who both proposed that emotional feelings are in fact the brain's perception of the internal body responses: If our body does not respond to an event or an object there is no emotion, if it does there is 'emotional colour' to the cold perception. An extreme example proposed by James was that we feel fear from the act of running from a bear. This reductionist view carries a number of predictions, for example that different emotions are associated with different body states. This assumption was hotly debated in the 1920's. The eminent scientist Walter Cannon was interested in these emotional responses and in fact was the originator of the phrase 'fight or flight'. Nevertheless, he argued that feedback of the body was uncoupled from emotions: for example, we can feel the same emotion whether or not we are running or resting and if our heart races we may be angry or sad (i.e. emotions are not dependent on different bodily states and bodily arousal states, compared to the rich language and experience of emotion are too undifferentiated). In the 1960's, a classic experiment was undertaken by Schachter and Singer in which they injected people with adrenaline (or inactive saline) and put them in a room with someone who is either angry or happy. The people that received adrenaline felt more emotional than the people who received the saline. However, the context determined *which* emotion they felt. If they were put in the room with the happy person they felt happier, if with the angry person they felt angrier. This led to a 'two-stage' model of emotion that suggested body arousal triggers and intensifies emotional feelings but the context, particularly social context, determines the quality of the emotional experience. While earlier work with Tina Gonsalves explored the role of the body in shaping an individual's emotion (*Feel* Series 2005-07), *Chameleon* extends this by exploring and exploiting the social context and exchange of emotion between individuals.

(i) stimuli

(ii) response
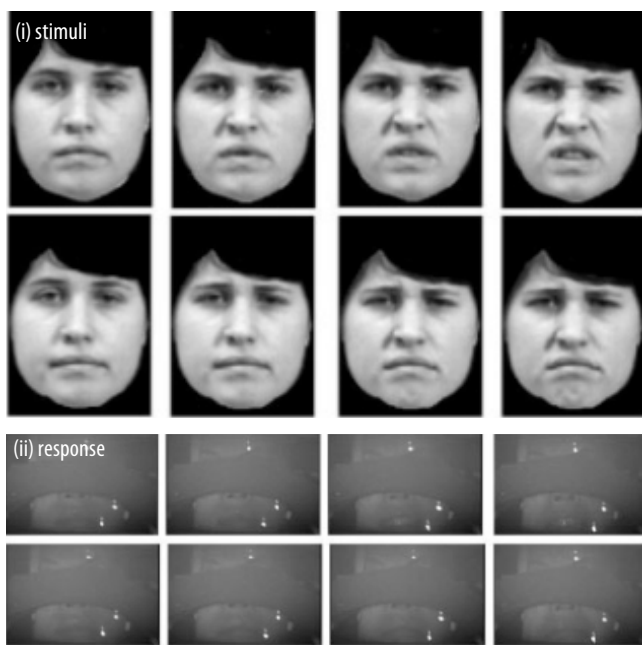
Above: Examples of (i) Experimental stimuli shown to subjects. (ii) Recorded frames of participant's imitation when watching the facial expressions, angry, then sad. (iii) The rendered view of the brain showing activation maps for angry and sad. Red circles highlight that the response of right inferior frontal region was common to imitation of emotional facial expressions. (Source: Modified from *'Imitating Expressions: Emotion-specific Neural Substrates in Facial Mimicry'*, Tien-Wen Lee, Oliver Josephs, Raymond J. Dolan, and Hugo D. Critchley, Oxford University Press)

(iii) angry   sad
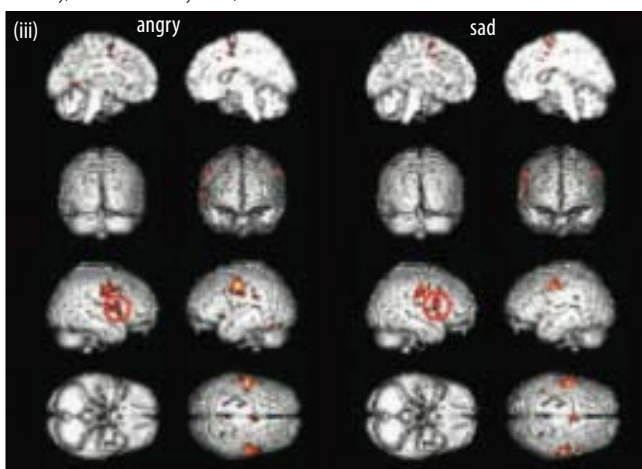
A basic premise is that of simulation. The impact of emotional facial expressions is conveyed at two levels: First, they act as powerful emotional triggers signifying rejections and acceptance, driving the body into reactive internal states that emerge as emotional feelings and behavioural response. The states that another person's emotional signal generates tell us about the emotional state of that person. Second, there is a more direct simulation within the brain; that of mirroring and facial mimicry. People are wired to mimic the motor expressions of others: we smile when we see others smile and frown. As with the changes in the internal state of the body, it is proposed that the facial feedback hypothesis (Zajonc; Buck, and others) creates often automatic changes in the muscles of our faces, which can influence the way we feel and through simulation allow us to understand the emotions of others.

One extreme example of simulation arguably does not require feedback from the internal body or the face and is encapsulated in the concept of "Mirror Neurons". In a laboratory in Parma (Italy) Rizzolatti, Gallese and colleagues showed, in a set of experiments in 1990s, that cells in motor parts of a monkey's brain would (like other motor neurones) 'fire' when specific actions were performed by the monkey (e.g. a pinch grip on a peanut), but more importantly they also fired to the *sight* of those actions being performed by the monkey *or anyone else*. The primary purpose of this function was clearly that of controlling precision movements through visual feedback, but the implications were far greater, as was inspirationally perceived by the research group. Here was a means through which we can automatically know the mind of another (at least the motor intentions of other primates) through direct simulation affecting individual brain cells. The search for mirror neurones and mirror mechanisms (in humans using brain imaging) has progressed dramatically. Mirror neurons are proposed by some to be essential to emotional behaviour and deficient in conditions like autism. As a model for understanding how we exchange emotions in social context the mirror neuron concept is influential.

Tina and I have a shared interest in interoceptive awareness, emotional exchange and the ways in which theses factors shape the way we make sense of the world. In 2005, Tina was an artist in residence working within my research group at the UCL Institute of Cognitive Neuroscience, as part of the Arts and Humanities Research Council/Arts Council England's International Fellowship. During this time, we worked on a number of projects. As scientists we benefited from Tina's skills in developing
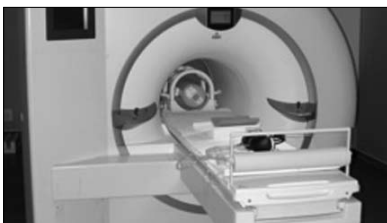
Above: An example of a Functional Magnetic Resonance Imaging scanner often used in neuroscientific studies of emotion. (Copyright: Wellcome Department of Neuroimaging, London)

Above: Research suggests that mimicking people's expressions can begin in the first few hours of birth. (Source: Marco Iacoboni, *Mirroring People*, Farrar, Straus and Giroux)


Above: Participants were asked to hold a pencil in their mouth to either facilitate or inhibit smiles while rating cartoons. Participants who displayed smiles reported more positive experience when pleasant scenes and humorous cartoons were presented. (Source: Niendenthal, illustrating Strack, Martin, & Stepper, 1988)

powerful naturalistic stimuli, in one instance to trigger different aspects of disgust in viewers (see images on following page). We were particularly interested in differentiating the type of disgust that can make you nauseous (involving food) from that which makes you faint (bloody scenes). In so doing, we were addressing some of Walter Cannon's criticisms of the role of the body in emotion, by showing different bodily reactions to subtypes of the same emotion (disgust). While people were in a brain scanner, we asked them to watch the powerful disgust films that Tina had created. We measured the brain responses in the scanner and had our participants rate the films individually. We also measured the responses of their hearts and stomachs (from electrical signals) at the same time as measuring their brain responses using the scans. The work was led by Dr Neil Harrison who demonstrated that the same brain regions that respond to increasing experience of 'nauseating disgust' also correlate with measured changes in the activity of the stomach. Different nearby brain regions responded to feelings of 'fainting/bloody disgust' and responses in the heart.

Some key moments fed into the inspiration behind *Chameleon*. A few years ago I was showing Tina a video which demonstrated a student being shown a video of a human face smiling or frowning. While the student watches the stimulus, the student was being covertly filmed with a high speed camera. As they watch the facial expressing, they automatically mimic the same movements: for example you can see brief micro-movements occurring around their eyebrows, and they're frowning. It illustrates that we automatically mimic expressions (particularly if we are not aware that we are being filmed). Studies using electrical recordings show facial muscles react automatically to seeing facial expressions in other people (studies showing faces subliminally show that these reactions can occur without us being consciously aware of it - see previous page images). In some of my own research, we studied brain correlates of facial expression, showing (why) it is that much harder to smile to an angry face or frown to a smiling face even if you want to and quantifying this as a 'cost' (if you are already smiling you perceive faces around you to be 6% happier). This experiment and others tapped into the simulatory mirroring of emotion mentioned above. One of the aims of *Chameleon* was to create an environment to highlight these implicit, complex and unconscious exchanges of emotion between people.

Around the same time that Tina was at the Institute of Cognitive Neuroscience in London, we started further investigating the internal communication of emotional signals, in particular, the role of pupils in emotional signalling. We first showed people different faces one-by-one and asked them to rate the intensity, positive and negative aspects and attractiveness of these faces. None of the people who took part in the experiment realised that we were also changing the pupil size in some of the images, so that the same face and expression would have small pupils on one occasion and large pupils the next time it was seen. We had expected that bigger pupils, signalling more emotional arousal, would make all the emotions look more intense, but what we saw was that small pupils on sad faces made the face look more intensely sad. In fact pupil size seemed only to affect the judgment of sad faces but no other emotion. Eye colour or skin colour does not matter for this in effect. While small pupils on sad faces made the face appear sadder, the people who were most sensitive to this effect scored higher on a questionnaire measure of empathy. Neil Harrison also scanned people's brains as they looked at the faces with different pupil sizes while measuring the observer's pupil size. He showed when people saw small pupils
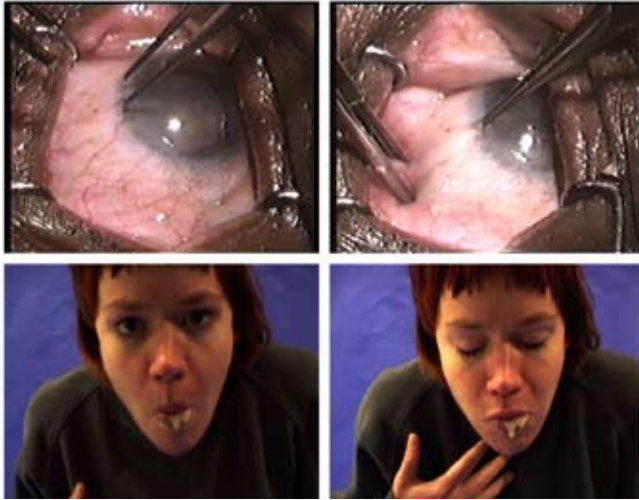
Above: Example of disgust video database created by Tina Gonsalves to to trigger different aspects of disgust in subjects. (Image: Tina Gonsalves)

Figure 1. Examples of face stimuli used in Neil Harrion's study, showing sad expressions at different pupil sizes. Subjects saw stimuli from the Karolinska Directed Emotional Faces Set (Lundqvist, Flykt, & Ohman, 1998) depicting 14 individuals portraying four different facial expressions, each at 60%, 100%, and 167% of the area of the original pupil size. Subjects rated the intensity and valence of each face on a visual analogue scale. Results show small pupils on sad faces made the face look more intensely sad. (Source: Harrison, Critchley)

Above: Helen Sloan, Tina Gonsalves and Hugo Critchley delivering a talk at Lighthouse, Brighton, March 2009. (Photo: Genevieve Bateman)

on sad faces, the observer's own pupils constrict more to match the pupils they are seeing. This finding illustrates, automatic mimicry and 'contagion' of pupil size; but only in the context of sad faces, a finding that can be related to how empathetic a person is.

In a more dynamic experiment, which reflects some of the technology interaction built in the *Chameleon* System, we conducted another experiment where we linked our measurement of pupil size of the subject being scanned to a moving stimulus; a pair of 'neutral' eyes. The participant's own pupils changed the size of the stimulus pupils, sometimes in the same direction (when increasing pupil size in the viewer was matched by increasing size of the observed pupils) and sometimes in the opposite way (i.e. the observed pupils constricted when the observer's eyes dilated or vice versa). Here, we were interested in the role of pupil signals in dynamic social exchanges. We found that differences in the stimulus and observers pupils triggered the biggest brain responses in 'emotional' brain regions, processing social significance. This kind of feedback experiment has fed into *Chameleon*, extending previous research of body and emotion into the notion of emotional exchange being a physically embodied reality.

There are many other examples of experiments in which the shared goals of art and my area of emotional and social neuroscience overlap within *Chameleon* and earlier collaborative work. What has been really valuable was the interaction with an artist to translate laboratory findings and proof-of-principle studies into powerful instantiations that give face validity to detailed mechanistic observations obtained through science. Putting someone in a scanner can rarely emulate social environments, constraining how much 'social neuroscience' can actually occur. The interaction with Tina has also facilitated a number of collaborations within and beyond my field of science providing insights and ideas relevant to a fuller understanding of the human condition ultimately fostering new science, experimental endeavour and communication to a wider public.

MAN, EMOTION AND MACHINES
RANA EL KALIOUBY
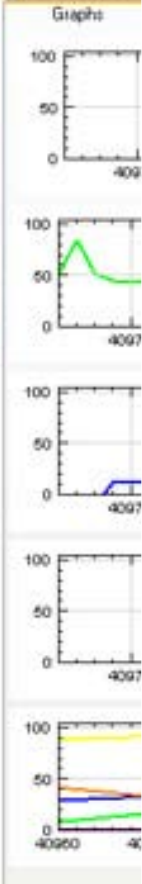
Framegrab of the back end of *Chameleon's* user
interface (Image: Tina Gonsalves)

Rana el Kaliouby is an Affective Computer Scientist collaborating on *Chameleon* and a Research Scientist based at MIT Media Lab, inventing technologies that sense and have a commonsense understanding of people's affective and cognitive experiences.

El Kaliouby holds a Ph.D. in Computer Science from the Computer Laboratory, University of Cambridge. She did her post-doctoral training at MIT Media Lab's Affective Computing Group with Professor Rosalind W. Picard, extending her doctoral work to measuring user experiences, human–computer interaction, personal robotics, as well as in learning contexts. Her post-doc research, developing the first in the world suite of social-emotional wearables for autism spectrum disorders was rated among the top 100 innovations of the year 2006 by *New York Times*. El Kaliouby works closely with sponsors of the Media Lab, including Google, Microsoft, Pepsico, Intuit, Samsung and others.

For as long as I can remember, I have been fascinated by people's ability to sense and make sense of themselves and others, and the important role this plays in how we connect to and communicate with others (across and in spite of distance, cultural and religious differences, and even in the absence of language). I am also interested in how the social and affective aspects of our life experiences influence our memories, how and what we learn, and eventually how the dots in our life connect.

People express and communicate their mental states, including emotions, thoughts, and desires through facial expressions, vocal nuances, gestures and other nonverbal channels. This is true even when they are interacting with machines. Our mental states shape the decisions that we make, govern how we communicate with others, and influence attention, memory and behaviour. Thus, our ability to read nonverbal cues is essential to understanding, analysing, and predicting the actions and intentions of others, and is known, in the psychology and cognitive science literature, as 'theory of mind' or 'mind-reading'. Mind-reading is a term for the subconscious notice and analysis of nonverbal cues, such as facial expressions and head movements, which humans regularly use to determine the emotional states of others. Mind-reading is something we do all the time subconsciously. We use behaviour and nonverbal cues to analyse the state of those you are speaking with to modify your own actions and those of others by trying to motivate them.

The importance of emotional expression as part of human communication has been understood since Aristotle, and the subject has been explored scientifically since Charles Darwin and others in the nineteenth century. Research on this theory has been around since the 1970s, it has recently gained attention due to the growing number of people with Autism conditions, who are thought to be 'mind-blind'. That is, they
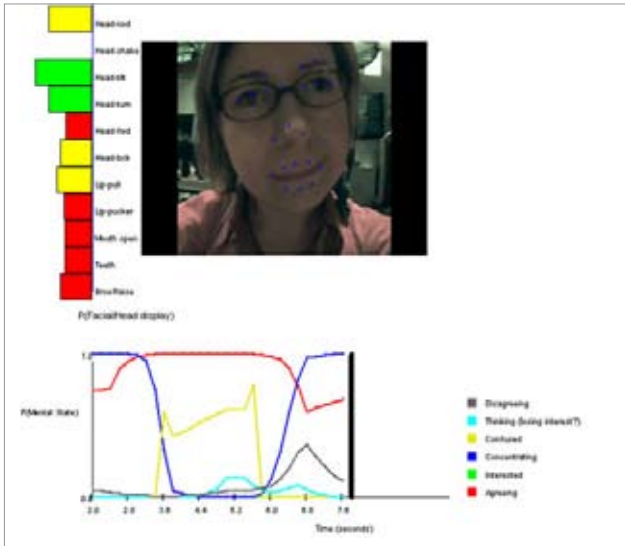
Above and below: Rosalind Picard, director of the Affective Computing Group at MIT Media Lab tests the FaceSense technology reading mind states. (Source: Rana el Kaliouby)
Previous page: Frame grab of background interface of the *Chameleon* system analysing facial emotion to trigger the video engine. (Image: Tina Gonsalves)
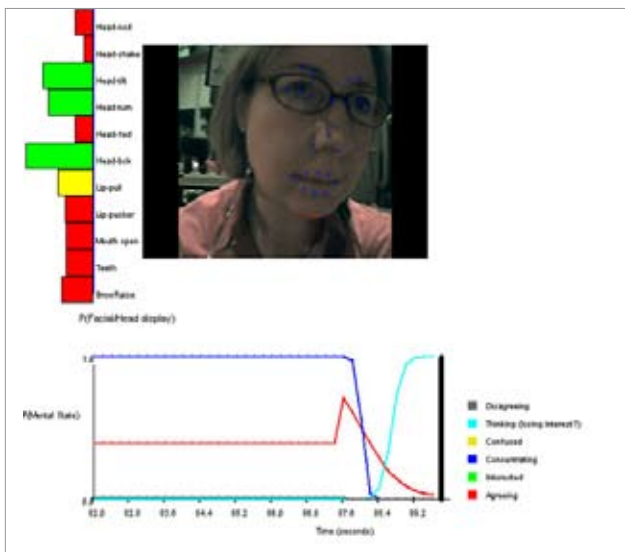
have difficulty interpreting others' emotions and feelings from facial expressions and other non-verbal cues.

Advances in computer technology now allow machines to recognise and express emotions, paving the way for improved human–computer and human–human communications. I began developing the automatic facial emotion reading technology, (FaceSense) used in *Chameleon* during my doctoral research at Cambridge University, which started in 2001. FaceSense uses a consumer webcam to scan the environment and find faces. It is trained to automatically recognise features of the face using Google's face tracker (formerly NevenVision). We used videos of actors expressing emotion states and mind states, in particular, Simon Baron-Cohen's (Director of the Autism Research Centre also at the University of Cambridge) taxonomy of facial expressions and the emotions they represent. In 2004, Simon published the Mind Reading DVD, an interactive computer-based guide to reading emotions from the face and voice showing as many as 412 different mental states. With Cambridge-based Computer Scientist Peter Robinson, we developed computer programs that could read facial expressions using what is known as machine vision. Machine vision is getting machines to see, giving them the ability to extract, analyse and make sense of information from images or video. We used probabilistic machine learning (which describes the mechanism of enabling a machine to learn an association between features of an image such as facial expression and other classes of information). We trained the computer via a machine-learning algorithm by feeding it hundreds of 8-second video clips of actors expressing particular emotions, so the computer could learn what was and was not a particular emotional expression. This learning algorithm is then implemented to work with real time camera feeds of faces. Twenty-four feature points are automatically located and tracked, focusing on areas of the face such as the eye and mouth corners, to classify the emotional state. For FaceSense, we had trained it to analyse 'mind states'. For example, our software deduced whether a listener is agreeing, disagreeing, concentrating, thinking, unsure, or disinterested (see images opposite). For privacy purposes, all that is logged are the 6 derived values which are reported about six times per second.

The catalyst for *Chameleon* began when I met Tina Gonsalves in 2006, at the Royal Society Summer Exhibition. We were showing one of the earlier prototypes of FaceSense. I was interested

Above: Illustration of *The Emotional Social Intelligence Prosthetic* that vibrates whenever the listener's attention veers off topic. The eventual goal for the system is to provide the mildly autistic with an auxiliary notification of other people's emotions on a daily basis.
(Source: Rana el Kaliouby)

Above: Rana el Kaliouby, *The Interactive Social Emotional Toolkit* (iSet) designed to identify the emotions expressed in a person's face. To use it, one points it at a person much like one would point a camera. When the computer thinks it's identified a facial expression, a colored dot appears above the corresponding label. The dot grows larger as the computer becomes more confident it has identified the correct emotion. (Photo: Victoria Arocho for the Boston Globe)

Below: Rana el Kaliouby presenting the FaceSense Software at TED, Cairo, Egypt. (Photo: TED, Cairo)

in how an artist could find news ways to use the technology but I was also very intrigued about the possibility of continuing to engage the general public in different aspects of my research from an artistic as opposed to a purely scientific perspective. I was interested in creating a space that foregrounded the language of emotional expression and the impact it had on our everyday.

For *Chameleon*, the application program interface (API) of FaceSense needed to be retrained to work with six key emotions (happy, neutral, sad, angry, disgusted, surprised). Within the constrained settings of the lab environment, faces are mostly still and well lit. *Chameleon* presented a challenge: in a gallery environment the faces we were monitoring were not well lit and were constantly moving, some had beards, some had glasses, and a range of skin colours. We had to train FaceSense work well with moving faces in darker lighting scenarios. Aside from the constant time spent attempting to perfect the technology's emotion recognition power, we needed to lower the computing power the technology needed. Tina was showing real time high definition video, which was also demanding on the processing power of the computer. We worked with Youssef Kashef, Abdelrahman N. Mahmoud from the American University in Cairo to address some of these issues.

Facial expression reading technologies have applications in commerce, education, product testing, entertainment, therapy and everyday life. We have used this technology to further understand customer experience. The facial emotion recognition software allows the computer to understand if their usability is frustrating or confusing to their audience and therefore, alter the experience accordingly. In vehicles, it may be used to identify drivers' emotional states, for example, excessive fatigue, frustration or aggression, serving to increase safety measures. It could be applied to e-learning and gaming fields will be sure to follow. We have used FaceSense to analyse if customers 'really' do like certain soft drinks. FaceSense can provide a new way to gain a greater understanding of user preferences and experiences. Do we really like that new brand of soft drink? Facial recognition software has the potential to be an important tool for analysis of customer experience.

However, one of my primary goals of developing the facial expression recognition software is to help people with autism relate to those around them. One of the problems facing people with autism spectrum disorder is an inability to pick up on social cues. Failure to notice that they are boring or confusing their listeners can be particularly damaging. It's sad because people then may avoid having conversations with autistic people. The aim of FaceSense is to alert its autistic user if the person they are talking to starts showing signs of confusion or distraction. We embedded the FaceSense API into an ultra-mobile device, (constructed along with MIT colleagues Rosalind W. Picard, Matthew Goodwin, Miriam Madsen and Alea Teeters). The device consists of a camera small enough to be pinned to the side of a pair of glasses, connected to a hand-held computer running image recognition software plus software that can read emotional expression. (See images on previous page, following page and opposite).

Above: Rana el Kaliouby wearing one of the *Social-Emotional Wearables* for autism spectrum disorders she designed, dubbed *Head Cam*. The device consists of a pen-sized camera, a small computer, and a wireless earbud that together provide the user with on-the-fly interpretations of facial expressions. The software evaluates the person's facial image and communicates its analysis by piping words into the user's ear, such as 'agreeing' or 'interested'. (Source: Rana el Kaliouby)

Above: Rosalind Picard, director of MIT's Affective Computing Research Group, wears *Head Cam*. (Source: Rana el Kaliouby)

We have tested the software (reading mind states) intensely. There is still much work to be done to perfect the system to read the more subtle emotional states. However, in earlier tests, machine versus people testing of this system reading mind states has shown the computer to be as accurate as the top 6% of people. To get a stronger sense of pinpointing an emotional response, it is most probable that multi-modal technology is needed (for example, facial expression, and voice).

One of the great contributions of *Chameleon* is that it started to engage the general public in ethical questions around this research and its potential uses, which is great! Do we want computers that can react to our emotions? Imagine a computer that could pick the right 'emotional' moment to try to sell you something? Can they manipulate our emotions? There is a general fear that emotion-sensing technologies might be used covertly. For example, security services could use face and posture-reading systems to sense stress in people from a distance. This may highlight if someone is lying, even if they are unaware of it. *Chameleon* was great, as Tina held a lot of talks where much of the dialogue centered around the vulnerabilities felt about the role of emotion recognition technologies in our lives.

In my research, I strongly advocate applications of this research where people opt-in to be recorded or have their face-analysed. I believe that if done properly and respectfully, people will be very willing to share their data, especially if there is value-add to the person. For instance, imagine a person's face being analysed while watching different movie trailers: his expressions along with many others, are then presented to media researchers who distill which movie trailer was the most engaging across this cohort of viewers. In such traditional tests, viewers never get to see their data. Well, imagine now if viewers are given a beautiful rendition of their personal emotional expressions per movie trailer, which they can share with friends, say on Facebook. It just changes the asymmetry in how this data is typically collected, analyzed and presented to people - I'd like to change that.

Technologies like FaceSense and projects like *Chameleon* have the ability to allow a large-scale sensing of multiple people's individual affect-related data but it also networks that data. Another interest I have in *Chameleon* is the way it could become a stimulus to create new databases to further train the emotion expression recognition technology. We trained our software via the databases of actors expressing emotion previously mentioned, which is often more exaggerated than our everyday emotional expression. By having every day people respond to the videos shown in *Chameleon*, we could capture and log their more subtle emotional responses, allowing a new, more ecological database to develop. This is an important development for facial emotion expression recognition technology, addressing the constant issues of the 'acted' expression which facial emotion expression is usually trained with. As Chameleon is reworked for science, it will give a wealth of information relating to face-to-face interactions of groups of people, or people to computer interactions. Within this framework, every instance of an interaction can be considered as an opportunity to learn more about each other and how we connect and communicate.

Above: Participant interacting with *Chameleon*, experiment 07 at Lighthouse, Brighton, 2009.
(Copyright: Tina Gonsalves)

STIRRING UP EXPERIENCE:
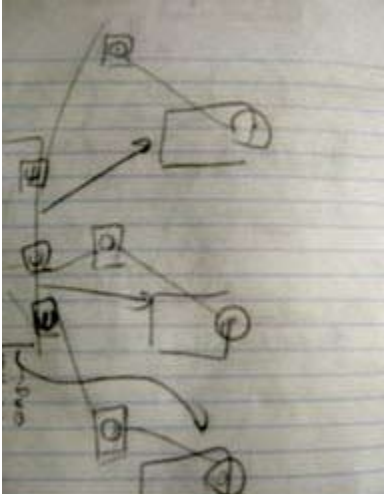**THE INTERACTION OF CHAMELEON**
NADIA BERTHOUZE

Installation view of *Chameleon 9,*
Fabrica, Brighton, UK, 2009. (Photo: Tina Gonsalves)

Dr Nadia Berthouze is a Human Computer Interaction scientist and collaborator on *Chameleon*. She is a senior lecturer in the UCL Interaction Centre at the University College London. Dr Berthouze's main area of expertise is the design of affect-aware systems, that is, systems that are sensitive to, and can respond to, their users' affective states. Using the tools of information theory, she has investigated the use of body language as powerful modalities for systems to recognise human emotional states, including cultural and gender specificities. She has pioneered adaptive recognition systems capable of learning affective categories through interaction for which she received the 2003 Technical Prize from the Japanese Society of Kansei Engineering. In 2006, she was awarded various grants to continue her work on these issues in the clinical context in the gaming industry and in the design industry. Dr Berthouze has published more than 70 papers in affective computing, data mining, human-machine interaction, and pattern recognition.

The premise of my research is that affect, emotion, and subjective experience should be factored into the design of interactive technology. What I want to learn is how people read and react to others' emotions when the other is not a physical person, and what the factors are that can facilitate or inhibit emotional interaction. This leads to the creations of systems/ software that can sense the affective state of their users and use that information to tailor the interaction process. Facial emotion expression as agency for interaction appears to be a promising medium for this goal: it supports cognitive processes, regulates emotions, and mediates affective and social communication.

As a Human Computer Interaction (HCI) expert, my role is to work with Tina Gonsalves and the audience to investigate how the audience interacts with and experiences *Chameleon*. I am particularly interested in how non-verbal language can be used to modulate emotional experience through the use of affect-aware technology. I am interested in how people interpret or appropriate *Chameleon* and how to improve its design to facilitate a rich emotional experience that is not only defined by the artist but also by the meaning the audience itself attributes to the interaction unfolding.

Tina built the work in a range of iterations, so we could test the interaction with audiences via exhibitions. We used the exhibitions as opportunities to further study how participants were experiencing the work. This information would then feed into the next iteration of the work, leading to the final work shown at Fabrica in Brighton in late 2009. Working within the gallery space was an interesting proposition for our team. Much research into emotional responses takes place in the laboratory. The unfamiliar environment of the lab may cause anxiousness in the subject. We looked toward exhibition spaces as a more ecological and engaging space to monitor emotions, so that participants can experience emotional exchanges more naturally, closer to our day-to-day social interactions.

Above: Initial sketchs of interaction design of *Chameleon* drawn by neuroscientist Bruno Averbeck. (Photo: Tina Gonsalves)

Below: Initial sketch of interaction design of *Chameleon* drawn by Tina Gonsalves. (Photo: Tina Gonsalves)

Chameleon aims to foreground concepts of emotional contagion or emotional transfer, re-configuring the emotional dynamics that implicitly form part of our everyday into a more explicit experience. What I like in *Chameleon*, by employing neuroscientist Chris Frith's ideas on emotional transference, is that it does not necessarily mimic the audience. Its coding is not deterministic. If you smile, it won't definitely smile back at you. The portraits of *Chameleon* respond via both individual and collective responses. The loose emotional transfer mechanism integrated in *Chameleon* keeps a certain level of ambiguity that leaves space for personal interpretation and reflection. The aim of *Chameleon* is not only to create an emotional bond with the audience and trigger reflection on emotions but also, as the name of the project indicates, to better understand the mechanism of mimicry and counter-mimicry of emotional contagion, often called the Chameleon Effect. From a HCI perspective, *Chameleon* is an interesting platform to explore emotional communication in all its facets.

The interaction scenario of *Chameleon* is based on various studies that have shown that emotional contagion takes place often. For example, in one study, participants were asked to listen to the voice of an actor reading an impartial script by using a sad, happy or neutral voice. Afterwards, when asked to rate their own emotions, the participants' emotion reflected the emotion of the actors they had listened to. In another study, facial electromyography (a technique for evaluating and recording the electrical activity produced by skeletal muscles) was used to measure the responses of observers to facial expression of sadness, fear, surprise, happiness, disgust and anger. The results showed that, to a large extent, the responses were consistent with the emotional expressions portrayed by the stimuli.

With *Chameleon*, we were hoping to create a better understanding of: 1) the power that *Chameleon*'s emotional portraits have in inducing some form of unconscious emotional response in an observer; 2) the dynamics governing such responses; 3) the ability to induce emotional introspection and reflection. We have (and are) publishing these results in a range of scientific journals in more detail.

Chameleon interacts with its audience by displaying videos of emotional portraits created by the artist. As the interaction mode of *Chameleon* was to be facial emotion expression recognition technology, it was essential that the video created an emotional response in the interactant that would be recognisable via the emotional recognition technology. The first study we undertook aimed to test that the video database was powerful enough to elicit recognisable facial emotional responses in its audience.

For the study, we used a subset of *Chameleon*'s emotional expression video portrait database created by Tina. Eleven observers were recruited on a voluntary basis to view the video portraits. The study revealed that *Chameleon*'s emotional expression video portrait clips were compelling stimulus, enough to elicit visible emotional reactions in the observers. Most of the subjects reported that they felt the stimulus emotion or the desire to react emotionally to it. These results are in line with the idea that reactions to emotional

Emotional contagion rules: Reaction probabilities						
Stimulus	Happy	Sad	Neutral	Surprised	Disgusted	Angry
Happy	60%	0%	10%	30%	0%	0%
Sad	0%	70%	20%	0%	0%	10%
Neutral	10%	10%	50%	10%	10%	10%
Surprised	15%	15%	5%	50%	5%	10%
Disgusted	0%	0%	0%	25%	60%	15%
Angry	0%	25%	0%	20%	15%	40%

Above: *Chameleon's* initial Emotion Reaction Hypothesis put forward by Chris Frith

Below : *Chameleon's* Emotion Reaction Results from study no. 2. Each entry represents the percentage of time that a certain emotional reaction was obtained in response to a certain emotional stimulus: the first value corresponds to the value reported in the previous table (i.e., *Chameleon's* Initial Emotion Reaction Hypothesis), the second value to observers that experienced the emotion expressed by the portrait, and the third value corresponds to the observers that didn't experience such emotion.

Results: Observers' reaction						
Stimulus	Happy	Sad	Neutr.	Surpr.	Disg.	Angry
Happy	60% 73% 84%	0% 0% 0%	10% 21% 15%	30% 6% 1%	0% 0% 0%	0% 0% 0%
Sad	0% 7% 2%	70% 65% 44%	20% 25% 47%	0% 3% 6%	0% 0% 0%	10% 0% 0%
Neutr.	10% 8% 6%	10% 1% 4%	50% 86% 86%	10% 4% 3%	10% 0% 0%	10% 0% 0%
Surpr.	15% 61% 53%	15% 0% 0%	5% 13% 24%	50% 26% 20%	5% 0% 3%	10% 0% 0%
Disg.	0% 19% 46%	0% 4% 15%	0% 63% 22%	25% 5% 11%	60% 9% 5%	15% 0% 0%
Angry	0% 1% 0%	25% 28% 4%	0% 42% 86%	20% 23% 9%	15% 0% 0%	40% 6% 0%

stimuli will arise with or without the perception, or intervention of the conscious part of the mind.

The following study was to test the emotion algorithm to be implemented in the *Chameleon* video engine to network the video engines, face reading technology and audience members. To create the feeling of more empathic interaction within *Chameleon* it was essential to create a video engine that triggered the video portraits in a way representative of how we transfer emotions in day-to-day life. Chris Frith put forward a model of emotional transference, a hypothesis that models how emotional expressions are exchanged between social groups. This study was performed through observations and interviews of people who visited the exhibition of *Chameleon*. Frith's initial hypothesis shows the expected frequency of response to each type of emotional portrait shown in the table opposite.

Our early experiments indicated that the reflex-mechanism of facial expression mimicry and counter-mimicry followed patterns similar to the hypothesis by Frith. The reaction patterns to Happy, Sad and Neutral stimuli reflected the algorithm implemented in the system whereas Angry, Disgust and Surprise showed lack of mimicry or emotional contagion and the presence of a possible counter-mimicry expressions. The level of mimicry and counter-mimicry correlated to whether the observer felt to be interacting with another person or not. The frequency of response to each type of emotional portrait is shown in table opposite. These findings became the base line for the code response.

In the next study, we used semi-structured interviews with the people visiting the exhibition to reveal what elicited and broke engagement in the work. Participants were also asked to fill out an Emotional Contagion Scale Questionnaire. The video interview was transcribed, then matched to the Emotional Contagion Scale Questionnaires. The team used Grounded Theory, a technique where key points are extracted from the transcribed interviews and grouped into similar concepts in order to make them more workable. From these concepts, categories were formed which allowed us insight into similar concerns and responses. The factors that emerged from the analysis of the interviews can be grouped under three different themes: environment, portrait believability, and affective experience. Finer details such as those that built and broke a feeling of engagement, immersion, connection and

Above: Jeff Mann, the technologist working on *Chameleon's* video engine, inputs the data revealed by the HCI team. (Photo: Tina Gonsalves)

Above: Kim Byers, a member of Berthouze's research team setting up for a study on the interaction experience of *Chameleon* at Lighthouse, Brighton, UK. (Photo: Tina Gonsalves)

Below: Matt Iacobini, a member of Berthouze's research team setting up for a study on the interaction experience of *Chameleon* at Lighthouse, Brighton, UK. (Photo: Tina Gonsalves)

emotional contagion were revealed, all which would affect ideas of narrative and display of the next iteration of *Chameleon*. Following, I use quotes from the transcribed interviews undertaken by my research assistant, Matt Iacobini throughout the various exhibition of *Chameleon*. Some quotes are taken from people writing about the project on blogs.

Environment: An aim of the later iterations of *Chameleon* was to employ multi-participant interaction. This was important, as the artist wanted the participants to interact and be aware of other participants as much as with the digital portraits of *Chameleon*. For most participants, the presence of others was a source of inspiration and playful challenge to understanding how the system worked: *"...We were all enjoying the same experience at the same time and then we were commenting on it as well... and swapping around and things like that... that was quite fun."* Visitors discovered and created ways of interacting with the system by observing and collaborating with others, but also through competitive behaviours: *"...If a character [the video portrait] was making more noise, I was looking at what expressions [the other participants] were making, trying to work out if it was reacting better to them than to me."* Multi-participant interaction could also prove a source of inhibition. Being aware of others and feeling observed made some of the participants feel embarrassed and inhibited their behaviour. However, the feeling of embarrassment often diminished as time passed: *"At first I felt silly... I felt really self conscious and wasn't quite sure how it all worked. But as I spent more time there I became more relaxed and not worried what was happening around me. And then my experience changed..."*

At different exhibitions, the artist experimented with different types of screens and different sizes of screens, as well as various hanging of the work. Screen size, and correct hanging of the work was important to interaction: Some participants felt that the large size of the videos and the high projection were intimidating, giving the audience the impression that the portraits wanted to control them: *"That scale thing – it makes you feel quite small, especially with someone shouting at you."* Also, *"I think I would have felt happier if it was a smaller screen instead of having to look up... You were getting eye contact with the person rather than looking up at the screen."* With the smaller screen, people reported a feeling of more intimacy: *"...I was close to the character. He was quite up front and in my face. And talking quite low and quite intimately."* In the later iterations such as experiment 8 at Lighthouse, the projection was made upon more scuptural three-dimensional structures hanging in middle of the room, at audience level (rather than projected on the wall), built using rapid prototyping techniques by The Centre for Innovation and Design at Solent University. This created a more human-human type of interaction. Initial feedback suggests that this scenario worked best for engagement. The final exhibition at Fabrica used smaller sized projections of the faces, just a little larger than average head sizes, creating more intimate interactions with participants. This was also advantageous for the facial recognition technology which was embedded into the frames of the screens that held the projections of the digital portraits. To work properly in the darker light, the facial recognition technology required the participants to be about 1.5 metres from the screen to latch onto their face.

We tested different scenarios where some participants were given instructions about the best ways to interact, and other scenarios where no explanation was given to participants. Initial feedback suggests that specific instructions tended to lead to very competitive deterministic behaviour. Viewing participants interacting with the work, it was noted that many people tried to control and test the system by pulling exaggerated facial expressions, and people often expected the portraits of emotion to reflect their emotions, not respond: *"You could control the clip but then they had their own agenda..."* When more vague instructions were given, people tended to explore the system more, letting the system drive the emotional story: *"At certain times they seem to be looking at me. I just responded to them, rather than trying to make them do things, and trying to make them interact with me."* This vagueness seemed to manifest a scenario where more was read into the interaction than was there. An observer reported that he felt that the video portraits were mimicking his gesture: *"If I did something with my hand he did it too."* Choosing the correct choice of wording to explain the interaction of *Chameleon* was important. Initially, the facial emotion recognition software used in *Chameleon*, now called FaceSense, was initally called 'mind reading software': *"I was impressed by one of the interactions, as the software recognised, as expressed by the portrait, that there had been a recent death affecting the participant. This was in fact true, and that was a very unnerving moment..."* This suggests the participant may have assumed the technology had vocal recognition and mind wave recognition.

These events are consistent with research that suggests ambiguity seems to generate a richer behaviour in people, as they assign meaning to it. These findings led the artist to relook at the *Chameleon* system, and to create a more complex system that on one hand was more straight forward, but also less deterministic. The artist built in initial thresholds that would override the system, so if someone pulled an exaggerated face to test the system, the system would most likely mirror it. However, the artist then built in a secondary level, a more complex learning algorithm with neuroscientist Bruno Averbeck, based on Frith's initial algorithms, that adapted to the audience, and had a memory of past interactions that would always influence the current interaction. For example, if the work was exhibited on a sunny day, and people seemed happier, the whole work would learn from this and develop a happier 'mood'. If everyone was bored with *Chameleon*, *Chameleon* would become harder to provoke. The introduction of mood and temperament was guided by Frith.

Portrait believability: The artist had initially set out to make a potent, expressive emotional portrait database. However, it was found that participants appeared to be able to create an emotional bond with the more subtle and ambiguous expressions: *"If there is a really big hysterical emotion, it's not giving me much space to figure out what that emotion is about, because it is so overpowering. But when the emotions were a little less obvious, less dramatic, it brought out empathy... It made me connect in a different way."* Initial results suggests that ambiguous and subtle expressions were easier to accept and get involved with because they left space for the audience to associate meaning to them, contextualising them, and making them more personal to their own experience, and therefore able to build an intimacy with the work: *"I was thinking of some sad things that happened to me, when [the*
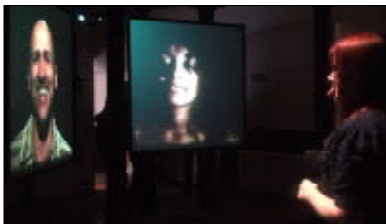
Above: Participant interacting with *Chameleon 9* at Fabrica, Brighton, UK, 2009. (Photo: Tina Gonsalves)

Below: The *Chameleon* video engine was developed in the Cycling 74 software program, Max MSP/Jitter. The image shows the back ground interface of *Chameleon* 6 built by Evan Raskob and later developed by Christian Topfner. (Screen grab: Tina Gonsalves)

video portrait] was sad for a while, it felt like a long time, and it reminded me of some things." Another observer reported: *"She was doing nothing, I was doing nothing, and it felt much more like a real interaction... She just looks around, and I am thinking, what's she thinking? And I was feeling quite the same, and it started to make me a bit more inquisitive."* Feedback shows that a lot of the dynamics that happen in everyday socialisation also happened when interacting with the digital portraits of *Chameleon*. An observer noted that when one of the portraits turned his back on him, it made him feel excluded: *"I was looking at him and he turned around, it was strange, I asked myself why he would do that, it never happened to me, so I was looking at him to understand."* Others played with social norms, laughing at some of the portraits that were crying: *"I was doing something I wouldn't normally do. You normally empathise, so your face would be as equally sad. Playing against it was quite intriguing as its something you just don't do. So, yes it made you aware of how often you alter your face to the person you are looking at."*

Some of the audience perceived the expressions as being acted: *"If I had thought they were genuine people in serious distress, or it had been slightly more believable and less 'acted', I probably would have reacted a bit more which would have then made it easier to read."* This was interesting, since most of the emotions expressed by the subjects were in a way genuine, given that the artist captured them in long filming sessions where the subjects were asked to remember and relive particularly emotional episodes of their lives. After the shoot, the artist asked the participants to write about the experience: *"It [the emotion] came so quickly and from such a deep space I felt as though I filled the room with this overwhelming deep grief and sadness..."* Another wrote: *"In the attempt to recreate the emotion, the feelings flooded back. I felt quite moved."* Most participants involved in the shoot reported to genuinely feeling the emotion. It's most probable that the lack of an appropriate context made the strong expressions to appear as acted even when they were not. Again, this led the artist to concentrate on the more subtle, nuanced emotional expressions that form more of a part of our everyday. She interspersed this with more confronting expressions that were stimulating on the one hand and vague on the other. They aim to capture the attention of the observer, and elicit him/her into a directed reflection by trying to clarify the meaning of the stimulus.

Affective experience: Throughout the interviews of participants, feelings of emotional bond and intimacy came up repeatedly, although they were not explicitly part of the questions: *"...He [the video portrait] was being quite flirtatious. The feeling I had inside was like having a connection with someone that you had met in a bar or something..."*

In many cases the audience was affected by the emotions expressed by the characters, and the constant search for meaning and introduction of context generally followed this: *"I was thinking of some sad things that happened to me, when [the video portrait] was sad for a while, it felt like a long time, and it reminded me of some things."* Also: *"I didn't like it when he looked sad and I didn't know why."* A goal of the work was to elicit reflective questions about our own emotional expressions: *"I made a man start to scream, which was a little worrying - did I look like I needed to scream? Did I look frustrated? I then of course looked worried, which made someone else smile to make me feel better..."* Another writes: *"...I did manage to make a man cry*

(for which I felt deeply sorry) and found myself looking over my shoulder. My abilities as a natural comic shone through when another seemed to laugh at me hysterically. This was a surreal experience to say the least..." Another reports that the lack of interaction had made one question their own facial expression: *"Maybe I have got a tired face, umm... And sometimes when I am not smiling people say to me 'oh cheer up', as if, you know, maybe I do give that off instead of my feeling like I am emotionally upset or angry."*

One of the participants thought that the reflections on this experience would be stronger after the exhibition, when more thinking space would be available: *"I suppose it is quite an intense experience and I will probably think about it later..."* Exciting Initial feedback suggests that the contagion of emotion leaks out of the gallery spaces: *"I went out afterwards and felt like I was picking up the feelings of everyone I passed."*

Naturally technological limitations influenced the experience. Further work needs to done to generate a more fine-tuned emotion recognition system to facilitate the emergence of more meaningful emotional dynamics. A barrier to engagement with the installation was the fact that emotional expressions were projected more than once to the same audience, due to the limited amount of video material in the database: *"At some points I was a bit frustrated with the one [portrait] that didn't react at all because I was doing loads of expressions and it was playing the same clip repeatedly... but then I walked away and then she started screaming.. it was really weird..."* Another reports: *"It draws you right in and you are fully involved with each of them and how they are. I supposed gradually you realize there a loop – you know, a range that they've got, that the other characters don't do."*

Conclusion: As an artist, Tina was interested in creating a place that allowed people to feel, 'an emotional hot spot'. Our results indicate that *Chameleon*, in its current form allows the feeling that an emotional communication loop had emerged. Reports show that for most interviewed participants it highlighted an awareness about emotional contagion, and the importance of facial expression in our everyday life.

Chameleon's intent was to develop some new tools/methodologies/critiques for science. We see *Chameleon* successful in this endeavour in a number of ways. Much research into emotional responses use underwhelming visual databases. The *Chameleon* portrait database provides a new, time-based dynamic stimulus set for emotional research using thorough techniques to entice emotions. This has the potential to lead to stronger results in the lab. *Chameleon* developed technology that senses and recognises patterns of emotional information. By perfecting these systems, there is an opportunity to capture a large amount data about emotional transference. Another consideration that revealed itself is that the interaction of *Chameleon* could provide an ability to capture more authentic, naturalistic and subtle emotional moving image databases for emotion research. This would be done by implementing a live camera capture and logging of the audiences emotional response to the digital portraits. The scientific collaborators agree that *Chameleon* has been informative in generating novel research ideas. An aim is to devise focal studies, using *Chameleon* as a tool to help people who don't naturally understand emotional interactions, such as people with autism, depression, or alyxthimea, a condition in which the person is unable to describe emotions in words.

CHAMELEON:
TECHNOLOGICAL AND EMOTIONAL PROVOCATIONS
KARL BROOME

Chameleon 8, photo of the digital portrait projected onto the rapid prototyping screens, Lighthouse, Brighton, UK, 2009. (Photo: Tina

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Karl Broome was part of the team involved with *Chameleon's* Lighthouse Residency in Brighton where the team built and exhibited *Chameleon 8*, which experimented with new types of displays to create a more sculptural and immersive installation.

Technological and Emotional Provocations

What can technology reveal to us about our emotional 'selves'? Answering this question is heavily dependent upon what we consider the 'self' or our 'selves', and others' emotions to be, and the 'nature' of and types of relationship we believe can exist between that which we refer to as the 'human' and 'non-human'. Although in the following, my primary concern will not be philosophical discussion of the ontological status of what a 'self' is – as a priori essence, a social construct, cultural process, a narrative achievement, an emergent property, a neuro-chemical process etc. – I will be engaging with some of these issues through a reflection upon the possible changing relationships between 'selves', new technologies, emotional being and social interaction, and thinking through how 'emotional technologies' may enable human beings to 'learn to be affected' in different ways (Latour 2004).   In the following, we will consider the powerful and provocative impact Tina Gonsalves' *Chameleon* makes upon its visitors/interactants, and how this work forces us to consider the pharmakalogical status of new and future emotional technologies as both 'poison' and 'cure'. 'Cure' in the sense that the technology which *Chameleon* utilises has already been put to use to improve the 'emotional literacy' of those who may have problems identifying and 'reading' other peoples' emotional states as in cases of autism. 'Poison' where such technologies become central to an increasingly technologically governed social world, where such technologies (here Michel Foucault's notion of "biopower" is instructive) are instrumental in the colonisation and regulation of what Nigel Thrift refers to as 'bare life', the previously imperceptible and unintelligible micro levels of existence. But 'posion' also in the sense that through processes of reductive categorisation, quantification and informationalisation, emotions may become abstracted, reified, disembodied and decontextualised. That is, emotions become reduced to discreet, identifiable, measurable and objectifiable units, and thus abstracted and detached from the socio-cultural-spatio-temporal-material, and significantly intersubjective milieus in which they are entangled.

Above: Participant interacting with *Chameleon 9*, Fabrica, Brighton, UK, 2009. (Photo: Tina Gonsalves)

Through considering the responses of visitors and interactants, in the following I want to reflect upon how *Chameleon 8* specifically provokes us to consider the social and situated nature of human emotion, and how 'technics', and new technologically mediated forms of interaction and 'relationality', both afford new forms of emotional literacy, and self/other emotional dialogue and intimacy, and the production of new kinds of 'emotional' subjectivities and 'inter-subjectivities'. But as well as this I want to briefly consider how *Chameleon* affords a particular type of intensive, affective experience that literally 'moves us' outside of 'the qualified intensities' and 'semiotically ordered' registers that scholars such as Brian Massumi (1996) have identifed as being central to characterisations of emotion. 'Feelings' are individual and biographical, individuals can check their experiences against previous feelings, and thus identify and label them. Central to understanding feelings is having the language to label them as such. 'Emotions' are social, and are displays, projections of feelings. Affects are prepersonal, outside of consciousness, and cannot be fully realised in language. Affects defy simple classification and are outside the rules of the normal and the predictable. Affect here is considered as something that is often outside such discursive registers associated with emotion, and often operates and articulates through a range of modalities that are prior to and beyond the word. Affect is not some- thing owned or posessed by the enclosed, autonomous individual, it moves in/across/ through bodies and milieus.   Following Brennan, "the transmission of affect means that we are not self-contained in terms of our energies. There is no secure distinction between the 'individual' and the 'environment'" (2004). As Fullager (2001) has argued, such an understanding of affect escapes the logic of closure, and is non-linear and potentially disruptive of Western reasoning.

I want to suggest that *Chameleon* forces us to reconsider the enduring power of emotion, and its ability to literally reconfigure feelings of space/spaces of feeling, not only through real-time 'face-to-face' encounters and more asynchronous technologically mediated human interaction, but also in terms of emotional and affective ways of 'knowing', human/non-human coupling and becoming that may complicate, and precede our cognitive and 'rational' ways of comprehending and reacting. I want to suggest that in the context of this discussion that the significance of *Chameleon* is not so much in its ability to induce discreet emotional states in its interactants through various technologi- cally facilitated and mediated forms of emotional contagion, but through its capacity to afford 'meaningful' experiences that preceed and exceed the discursive ordering most frequently invoked in the everyday categorisation of emotions, that is, to produce affective ways of being that are beyond the quotidian representational schemas that are associated with specific emotional types of experience.

Socially situated and technologically mediated emotions

Chameleon sets out to explore the scientific foundations of emotional contagion. Utilising the six key emotions of disgust, happiness, anger, neutrality, sadness and surprise, originally identified by Paul Ekman, the 'face reading' software attempts to identify the emotional expressions of the participant/interactant through 'reading' the emoting face. How should we understand these emotions in the context of the socio-emotional dialogue that *Chameleon* affords: where do they sit on the explanatory continuum with biological

explanations on one end and social on the other, and what is the place of technology in these emotional experiences? Ongoing sociological discussions concerning emotions have been characterised with the conceptualisation of emotions varying across a continuum with 'organismic' approaches on one end, 'social-constructionist' accounts on the other, and 'social-interactionist' inhabiting a space between the two (Williams and Bendelow 1999). At the 'organismic' end, we would find the likes of Charles Darwin, and Paul Ekman, emphasising the innate, biological and 'pre-cultural' basis of emotion and their expression - causes of emotion are understood as being wired in the brain for instinct and survival. At the other end of the continuum we find 'Social Constructionist' accounts of emotion that stress the primarily 'social' nature of human emotions, understanding the emergence of emotions in terms of their social, cultural, historical variability, meaning and experience, with the biological being understood as largely irrelevant. For Social Interactionists, emotions are recognised as having biological substrates, but socially shaped and subject to cultural translation, manipulation, and completion (Williams and Bendelow 1999). In contradistinction to constructionist accounts, Interactionists recognise the importance of biological process, and recognise the 'embodied nature' of emotions. Reflecting on 'visitors' experiences of interacting with *Chameleon* provides an interesting opportunity to revisit some of these polarities in sociological theorising. To think of emotions not as distinctly human in biological or social terms, but to broaden the interactionist scope to consider them as also emergent and relational processes, as part and product of socio-material-technological assemblages. Here I want to follow and develop upon the interactionist position by acknowledging the biological substrate of emotions, particularly through understanding emotion as being central to our anticipation and apprehension of the moment and the world (Thrift 2004), and as a way of thinking and responding to the world that is corporeal rather than discursive, and as pre-concious rather than reflexive. But also by considering emotions as a set of potential responses and ways of orientating in the world that are always enacted and completed as part of a socio-material-technological situated millieu.

Social Meaning and Management of Emotional Displays
When watching visitors interact with *Chameleon 8*, it is clear that the experience and understanding of 'emotional contagion' in this context is signficantly socially negotiated or rather socially enacted. Although the emotional expressions expressed through the moving images being displayed on Experientiae Electricae's *Pixy* display (incorporated into *Chameleon 8* at Lighthouse) are the outcome of how the mindreader software responds to the 'emotional data' provided by the individual face captured by the camera, the 'meaning' - and arguably the emotional experience - of this interaction in this situation seems to a considerable degree to be socially shaped. For example, if *Chameleon* responds to an individual's facial expression with anger or sadness, the interactant's response is not necessarily angry or sad in specific response to the screen, but is rather significantly dependent upon how his or her companions also responded to the sounds and im-ages produced through the interaction – that is, the individual's experience of emotional contagion is not directly the result of 'emotional dialogue' between the interactant and *Chameleon*, but is significantly affected by the collective responses of other people in the

Above: Participant interacting with *Chameleon 6*, *After Darwin: Contemporary Expressions*, Natural History Museum, London, UK, 2009.
(Copyright: Natural History Museum)

perceptual range of the event. The social milieu in which *Chameleon* is experienced makes a significant impact upon levels of emotional contagion and mimicry. The social ecology of the space in which works such as *Chameleon* are exhibited significantly impacts upon affective experience of the work. Mundane material, physical and spatial elements, and their affordances in terms of movement, interaction, proximity, distance and visibility all play their part in terms of interaction with the work, and the broader forms of social interaction taking place. At Lighthouse in Brighton, observing and interacting with people visiting the exhibition of *Chameleon 8*, I became aware of people's initial reluctance to stand in front of the face-reading camera for any extensive period.

Respondents spoke about how they frequently "checked" to "see what other people where doing", and to see how "other people reacted". Several spoke of a sense of reluctance and anxiety when initially entering the exhibit due to a concern of being seen "doing it right". Here then there is a concern with socially exhibiting what is understood as the 'correct' form of emotional/embodied competencies and dispositions. That is, there is a concern with not breaching both the explicit and implicit social rules concerning performance and interaction with *Chameleon*, and much of this relates to both bodily comportment, and 'emotional' performance - being seen to respond to and reproduce competently the socially and culturally prescribed 'feeling rules' of the space (Hochschild 1979). With *Chameleon*, the notion of feeling rules is of particular importance, both in the sense that work sets out to explore 'emotional contagion', that is to actively provoke interactants on an emotional register, and following from this as I will consider later, in the sense that the work operates on an affective level and intensity that may challenge and operate outside of such hegemonic feeling rules.

The Politics of Knowing Technologically: Emotional Disclosure and Anxiety

New Technological developments and knowledge practices (resulting in what Thrift refers to as revolutions in the means of perception) enable us to make intelligible those aspects of life which occupy a space and time that were previously imperceptible (Thrift 2004). Thrift notes how there is a growing capacity to sense and freeze "transitional" bodily movements, providing the example of Darwin's use of photography to capture facial expressions as an earlier example of a technological development leading to what he refers to as "new conditions of visibility". As Thrift observes, new forms of mechanical and digital imagination bring along with them their own politics of space and time - politics of visualising, mapping and ordering - resulting in what Thrift refers to as "new structures of attention". Examples of this can be found in the various forms of 'affective' mapping constructed through data produced by various bio-sensing techniques, but also in work such as that of Ekman's that set out to capture and categorise emotions. New technologies and technics have made even those smallest of spaces of time, that what were once considered as 'natural', pure and 'untouched', that which Thrift refers to as 'bare life', thoroughly politicised (2004). As Thrift comments, "simple natural life is now the most active zone of politics" (2004).

Technology and technics do not just reveal to us ongoing human processes that were always taking place but previously we lacked the technological means to identify them, these developments also affect the relationships we have with ourselves, impact upon the types of beings we take ourselves to be, and as a result produce new forms of subjectivity, intersubjectivity and afford new processes of becoming. Theorists such Donna Harraway,

and Bernard Stiegler have convincingly argued the historically ongoing intimate and co-constitutive relationship between what we call the 'human' and 'non-human' other (animal and machine), such thinking has put forward the perspective that humans are necessarily technological beings. For Harraway, most famously captured in her discussion of the cyborg, there ought to be no separation between bodies and objects, and that there should be no distinction between so-called natural or real organisms, and the artefacts that humans make. Following Harraway we can say that modern life is full of cyborgs, couplings between organisms and nature, and that we are cyborgs - "theorized and fabricated hybrids of machines and organisms" (Harraway 1991). For Spiegler, what he refers to as 'technics' shapes what it means to be human and the 'human' in this sense is constituted always through technics. Technics encompasses everything from primitive tools through systems of writing to modern telecommunications, 'technics is the condition of culture' and it would be 'absurd to oppose technics to culture'. Following from this, we can consider human emotions as a biologically based set of potential responses that are always enacted and completed in relationship to a thoroughly 'technological' culture. *Chameleon* invites us to think through how both Ekman's classifications, and the mind-reader that it informs provides us with the technics to classify 'our' emotions, and urges us to consider how they potentially affect the types of people we take ourselves and others to be, and how we in turn understand and respond to both our own and others' 'emotions'. To ask then what technology tells us about ourselves, is to a certain extent, a redundant, circular question – to pose the question is a performative act. That which we refer to as our 'self' at a particular moment is itself an outcome of the questioning, the situation that poses the questioning. Further still, technics in their various forms and intensities are always and necessarily immanent to such questioning. That is to say, technics are the grounding situation that both calls out the question, and simultaneously permits the type of answers given.

As Hacking (2006) puts it, in considering the kinds of people that exist:

> *"They are moving targets because our investigations interact with them, and change them. And since they are changed, they are not quite the same kind of people as before. The target has moved. I call this the 'looping effect'. Sometimes, our sciences create kinds of people that in a certain sense did not exist before. I call this 'making up people'."*

We can say then that these new technologies and technics affect the types of relationships we can have with ourselves, and the worlds around us, and in turn affect the type of human beings we can become. Following thinkers such as Deleuze (1988), and more recently Latour (2004), we can think of the body as a kind of process, rather than a 'thing' or an 'entity', and thus we can ask the question, not what a body is, but what can a body do? (Buchanan 1997). As Latour argues:

> *"One is not obliged to define an essence, a substance (what the body is by nature), but rather, I will argue, an interface that becomes more and more describable when it learns to be affected by many more elements. The body is thus not a provisional residences of something superior —an immortal soul, the universal, or thought— but what leaves a dynamic trajectory by which we learn to register and become sensitive to what the world is made of."*

Above: Participant interacting with the rapid prototyping screens of *Chamelon 8*, Lighthouse, Brighton, UK, 2009. (Photo: Tina Gonsalves)

In the context of *Chameleon*, we can consider how the installation milieu affords different types of bodies to come in to being, and how it affords these bodies to affect and be affected not only by other bodies (emotional bodies), but by objects, processes, practices, symbols and ideas/ideals in multiple ways.

As with all forms of technological development in all aspects of life, these technological forms in time become standardised, ubiquitous, and necessary to the satisfaction of the most mundane of everyday needs. As this process develops and such technologies become immanent to our ways of being, our awareness of their presence slips into the background. Through immersement and familiarity they become internalised both into our emotional and corporeal schemas, and as part of our habitus, where their presence only become forgrounded and enter into consiousness in moments of fear or crisis. With the introduction of new technologies and technics there follows the understandable and neccessary cautions and concerns regarding the implimentation of such developments and their potential impact upon life itself. *Chameleon* stirs many of these familiar concerns, thus acting as a testing ground, and microsm through which new technologies, and imagined futures of technologies are greeted head on by human fears and anxieties, particularly concerning what information technology can generate about us, and how such information maybe disclosed. With *Chameleon* we witness these stages, through initial anxiety concerning the technology and its uses, expressions of concern regarding what the technology does and what it tells others about us, and then moments of immersement. As one respondent commented:

> *"At first I felt silly. I felt really self conscious and wasn't quite sure how it all worked. But as I spent more time there I became more relaxed and not worry what was happening around me. And then my experience changed."*

"Oh, oh. Is it on? I am not being filmed am I?" The man is concerned with whether or not his face, and more importantly his emotional expressions are being recorded. Our core five facial muscles work throughout the day expressing emotions; concurrently others are constantly reading and responding to our facial expressions. Visitors to *Chameleon 8* frequently asked if it was their own face displayed on the *Pixy* display. Despite not being able to recognise whether or not it is actually their face on the screen, being verbally informed whether it is in fact their face seems to make a considerable difference to how they experience the 'image', and

perhaps more importantly how they think others may experience the image.

"Is that me on the screen? Is it?" The woman asked her companion in an anxious tone when interacting with the *Pixy* display in *Chameleon 8*. After spending a certain amount of time hovering around the area where the face-reading camera was located, finally she gathered enough courage to put her face in range of the camera, but this only happened after other visitors had left the exhibit space, and was alone with her friend and the rest of the team. When I informed her that it was not her face being represented on the *Pixy* display, her anxiety appeared to decrease more, seemingly more confident in allowing the camera to read her face. I explained that the camera that does the 'reading' feeds into a video engine that uses complex algorithms that respond to the emotional expression identified in her facial expressions. The woman at this point quickly withdrew her head out of the camera's range. I asked her why she had moved her head, and rather than answering my question, she asked if the character on the screen, this time pointing to the computer screen, is mimicking her own emotional/facial expressions. I responded by explaining that the character in the video does not only attempt to mirror the interactants emotions, but also generates its own 'emotional' responses to create a kind of 'emotional dialogue'. The woman appeared relaxed again after being provided with this explanation. She explained how she had felt uncomfortable when thinking it was her own emotional/facial expressions being 'represented' on the screen. Now more at ease, the woman spent much more time interacting with *Chameleon*, playing around, testing out its responses, pulling faces in a playful manner.

Here we have examples of anxiety concerning the 'mind reader' technology's ability to reveal the 'truth' of how interactants really feel 'inside'. A fear that the technology has the power to disclose that which we are unaware of or we may attempt to disguise: our emotions. If we choose to 'interact' with *Chameleon*, there is a concern with how much scope we may have for strategically controlling the reception of our mediated self-presentation, and its subsequent reverberations. Here then, the speed and immediacy of the emotional 'revelation' is of concern. Scott Lash argues one of the characteristics of the 'information society' in which we now live is the absence of a space for sustained reflection and critique. As Lash suggests, traditionally 'reflection' entailed a degree of distance - spatio-temporal, we can even suggest 'emotional' distance - a space for reflection. To use the language of dramaturgical theory, in the context of *Chameleon,* individuals may experience a lack of reflexive space to work upon and engage in strategic actions to moderate their self presentations. Thus there is a fear that emotional 'presentations of self' represented may not fit with the cultural scripts that one ascribes to. In the context of emotional expression, there is the fear that the individual may emote contrary to what the individual identifies as the correct feeling rules asssociated with that specific context of interaction. Ervin Goffman suggests that when people believe they are breaking the rules of feeling and display, they may end up experiencing negative emotions such as embarrassment or shame, and in turn attempt to repair such transgressions through various forms of impression management and emotional labour (Goffman 1967). The new forms of mechanical and digital imagination and "conditions of visibility" that they afford (Thrift 2004) brings forth to our concious awareness a whole range of new concerns regarding our feelings and their display. *Chameleon* provides a milieu through which we
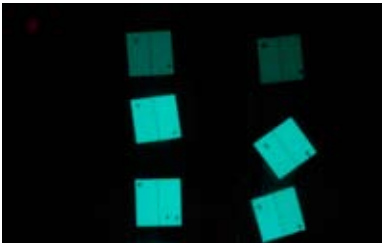
Above: Participants interacting with Experientiae Electricae's *Pixy* display incorporated into *Chameleon 8*, Lighthouse, Brighton, UK, 2009. Experientiae Electricae's *Pixy* is a volumetric display, made of electroluminescent paper. *Pixy* displayed the video portraits of *Chameleon* and became emotionally sensitive to audiences. Karl Broome (pictured in last photo) interviewed participants after interacting with the work. (Photo: Tina Gonsalves)

can observe both the ability of the new technological imagination to illuminate and make cognisable those aspects of human being and interaction that escape our awareness, but also it makes us aware of how such developments potentially bring with them their own politics of representation, interpretation, and reproduction. In this instance, the politics resides in the hegemonic understandings of emotions: their function, where and how they should be displayed, and in terms of what they 'represent'. Here is a concern for how in the future 'emotions' may become politicised in hitherto un-thought ways, subject to new forms of classification, informationalisation, production, surveillance and regulation.

Chameleon 8, More than Emotions: Intensity, Resonance and Affect

> *"but the work is not merely a cultural object, although it is that too. It harbours within it and excess, a rapture, a potential of associations that overflows all the determinations of its 'reception' and 'production'."* (Lyotard, *Critical Reflections* 93)

What was made apparent in responses to *Chameleon 8* was an awareness that the emotional performances of the emoting faces were simply that, performances. This awareness was in part informed by the respondents knowledge of the fact that the interactions taking place were part of an 'art' installation which is driven and mediated by digital technology, but also informed by a 'felt' sense, an embodied awareness that emoting faces were those of actors. As one respondent commented:

> *'Another thing, when you are using actors to respond, they are acting. I don't know what I mean – but reaction rather than an unconsious reaction and my emotion is subconscious."*

This above respondent is indentifying their own emotional responses as something that are not completely driven by conscious reasoning, reflection, and moderation but as a kind of pre-awareness response. Where as the actors emotional performances are described as a 'reaction', implying conscious reflection, and rationalised and controlled moderation of embodied response, what William Wundt referred to as 'aperception'. The following respondent furthers this point:

> *"You know you are interacting with a video of someone acting out emotions. Obviously you know it is part of an installation, and all you have to do is read the blurb about it to realise it isn't someone expressing their real emotions in relationship to you. But even without knowing that, I think most people automatically can sense if someone is being inauthentic, their emotions aren't real. You almost feel it without thinking about it."*

Yet as is made clear by some respondents, this awareness of the 'inauthentic' nature of the emotions being expressed does not neccessarily prevent some form of 'affective resonance' taking place between the 'actor' and the interactant, specifically in the case of what some respondents refer to as 'strong', and 'negative' emotions:

> *"One of the faces was so depressing, she just would seem sad all the time... and the sobbing face. You know it is only a face on the screen, but after a while you cannot help*

but start to feel moved by what is going on. When I first came down I was more aware of what everyone else was doing, but eventually I started to get caught up in it [meaning the installation], and it seemed that the few other people around me also started to get depressed [laughs]. I think you cannot but be touched by such strong emotions, I mean once you get caught up in the narrative, it is kind of like watching a powerful film. But I think it is more than that, it is the intensity of the sounds, voices, the faces you hear and see. Although you may not know what they are about, you can feel if they are negative."

The intensity of the auditory vibrations of the person crying on the screen seem to have the power to cut through the socially situated nature of millue, the affective resonance of the emoting performances, despite being identified by respondents as "performances" literally move certain visitors (Henrique 2010). What I want to suggest is being 'transmitted' here is in excess of emotional discourse, it cannot be reduced to the semiotic ordering that characterises emotions, or representations of feelings (Massumi 2002; Henrique 2010). When the above respondent comments that *"I think you cannot but be touched by such strong emotions"*, the word touch is instructive, refering to the almost haptic experience of emoting performers. Whether or not the emoting images and sounds are the products of actors, their sensory forms have the capacity and intensity to "touch" the interactants. This includes the intense sounds of the emoting performers either crying, sobbing or screaming, sounds that cut across the cultural, corporeal, and material registers (Henrique 2010:61), the visual intensity, frequency and variety of muscle contractions constituting different emotional states on performers' faces and broader corporeal arrangements, but also the material constitution and medium of the artwork itself. In the context of *Chameleon 8*, this involves the vastness of the *Pixy* display, its use of minimal pixels, the lighting of the room, and immersive experience of entering the gallery space. It also includes the creative use of curved rapid prototyping screens on which the emoting faces are projected. In the latter case I want to suggest that their 'affective' significance is not so much about to what extent they 'realistically' reproduce or represent embodied emotional expression as if one was interacting with a 'real' person, but the power of the installation in its different material/technological configurations to literally lift the interactant out of their everyday, quotidian emotional experiences into radically different spaces of affective intensity. Such an experience in *Chameleon 8* is intensively multi-sensorial, ineffable, outside of existing 'emotional discourse'.

This is what *Chameleon 8* offers us, an imagining of the new types of entanglement and co-action between humans/technology, and new technologically afforded and mediated forms of 'emotional' contagion, and attunement. Its power is in its ability to make us think about emergent forms of sociality that may operate outside of hegemonic emotional discourses, but also about some of the concerns regarding new forms of visibility that these technologies afford (Thrift 2004) and some of the anxieties and political issues they raise.

THE FACE IS NOT AN EMPTY CANVAS:
FACIAL EXPRESSIONS INTERACT WITH FACIAL APPEARANCE
URSULA HESS

Ursula Hess holds a Ph.D. in psychology from Dartmouth College. She has taught at the University of Quebec at Montreal and is now Professor of Social and Organisational Psychology at the Humbold University Berlin. She is the author of over hundred scholarly publications. Her current research is in the area of emotion psychology, in particular, the communication of affect with an emphasis on two main lines of research. First, using psychophysiological (e.g., electromyography) measures she studies the influence of a sender's expressive behaviour on the receiver, in terms of mimicry and emotional contagion. Second, she is interested in the role of social influences (e.g., beliefs about group membership) in the encoding and decoding of emotion expressions. More recent research efforts aim to combine these lines of research into a larger theoretical perspective.

Facial expressions of emotion have long been of interest to philosophers and psychologists. Charles Darwin's (1872/1965) seminal work *On the Expression of The Emotions in Man and Animals* was a first attempt to systematically understand emotion expression and its meaning. In this book he proposed a number of explanations for why certain facial and bodily behaviours communicate certain emotions.

In the intervening years, research on emotional facial expressions has blossomed. It has been shown that facial expressions are well recognised across the globe and observers consider them to be an honest signal of an underlying emotion. Yet, it is important to note that the stimuli used in this research generally have two features that set them apart from the expressions we see in the faces of the people we interact with on a daily basis. First, the expressions used in this research tend to be intense and unambiguous, hence the challenge posed by the more ambiguous expressions that most people show in most situations has not been adequately addressed. Second, in most studies the different expressions are shown on the faces of only a few expressers, thus, the impact of facial features (such as the shape of the face, the prominence of the eyebrows, the size of the eyes, etc.) on how expressions appearing on any one face will be interpreted, has been largely ignored. Lets first consider how facial expressions are understood to see the importance of these factors.

The literature on emotion perception describes two principal strategies for the decoding of emotion displays. First, pattern matching can be used to draw inferences regarding an expresser's presumed emotional state using a strategy where specific features of the expression are associated with specific emotions. Thus, upturned corners of the mouth or lowered brows are recognized as smiles or frowns and a perceiver can thus conclude that the individual is happy or angry respectively.

Above: Plate III from Charles Darwin's *The Expression of the Emotions in Man and Animals*, from Chapter VIII: Joy, High spirits, Love, Tender feelings, Devotion. (Copyright: Charles Darwin, *The Expression of The Emotions in Man and Animals*, London: John Murray, 1872. First edition, second issue)

Previous page: Maria expressing sadness, *Chameleon* video portrait database: frontal view, shot at the Banff New Media Institute, Canada. (Image: Tina Gonsalves)

This approach breaks down when the features are either too weak to be classified or lead to contradictory conclusions - such as would be the case when a person both smiles and frowns at the same time.

The second process is based on the knowledge that the perceiver possesses regarding the sender and/or the type of social situation in which the interaction takes place. This knowledge permits the perceiver to take the perspective of the encoder and helps him or her to correctly infer the sender's likely emotional state. For example, learning that someone's car was vandalised leads to the expectation that the person is angry. This in turn influences expectations regarding the likely expression shown - depending on knowledge about the person such as their temperament or how valuable that car was for them. In this situation, we may expect more intense anger from a choleric person than from an easy-going one and more anger if the car was cherished than if not. If the sender and the receiver know each other well, the receiver usually is aware of the sender's personality, beliefs, preferences and emotional style. This knowledge can then intervene in the identification of the emotion as well as in the identification of other aspects of the reaction such as its intensity.

But what happens when we do not know the other person well or at all? In this case, any social category that the perceiver is aware of and for which expectations regarding emotional reactions exist, can affect emotion identification. And importantly, the face tells us a great deal about the social categories into which our interaction partners fit. Faces tell us the sex, age, and race of the other person and this knowledge can be used by observers to predict the likely emotional reactions of the sender. Thus, in a study I conducted with my colleagues Robert Kleck and Reginald Adams, Jr., we found that when imagining that an individual's car had been vandalised, participants predicted that a man would show anger but a woman sadness.

In fact, there are at least two important reasons why the same somewhat ambiguous facial expressions shown by two individuals may not be interpreted the same way. First, the beliefs we have about the individuals may lead us to different conclusions regarding their likely underlying emotional state and second, facial features and facial expressions may interact such that pattern matching errors are made.

As regards to the latter, Charles Darwin first suggested that some emotion expressions may actually imitate features of the body. For example, he noted that piloerection - the raising of body hair - and the utterance of harsh sounds by 'angry' animals are 'voluntarily' enacted to make the animal appear larger and hence a more threatening adversary. Thus, the anger expression imitates the bodily feature of size, which is relevant when animals prepare to fight. This notion of a perceptual overlap between emotion expressions and certain trait markers, which then influences emotion communication, has been more recently taken up by Leslie Zebrowitz and her colleagues as well as by me and my colleagues. Specifically, we proposed the notion that some aspects of facial expressive be-

Above: Examples of facial emotion expressions from the Ekman and Friesen 1970's visual database of static facial emotion expressions showing anger, fear, disgust, surprise, happiness and sadness which are widely used in emotion studies today. (Copyright: Ekman and Friesen)

Above: Examples of The Karolinska Directed Emotional Faces (KDEF) showing surprise and disgust. KDEF contains 70 individuals, each displaying 7 emotional expressions, each expression being photographed (twice) from 5 different angles. (Copyright: Department of Clinical Neuroscience, Karolinska Institute, Sweden)

Above: Examples of the Cohn-Kanade database showing surprise. Each of the 486 sequences from 97 individuals begins with a neutral expression and proceeds to a target expression. (Copyright: Kanade, Cohn, & Tian)

haviour and bodily cues to the social dispositions of dominance and affiliation (in our case those related to facial appearance) are equivalent in their effects on emotional attributions, the functional equivalence hypothesis.

In fact, certain relatively static facial features are strongly associated with dominance and affiliation. Specifically, a high forehead, a square jaw and thicker eyebrows have been linked to perceptions of dominance, whereas a rounded baby-face is both feminine and perceived as more approachable and warm, central aspects of an affiliative or nurturing orientation. These behavioural tendencies are also perceived as predictive of an individual's emotionality. Thus, we found that dominant individuals are believed to be more likely to show anger than are submissive ones, whereas affiliative individuals are believed to be more likely to show happiness.

The beliefs about men's and women's emotionality referred to above and beliefs about the emotionality of dominant and affiliative individuals are not independent. Specifically, my colleagues and I could show that some of the stereotypical beliefs about men's and women's emotions can in fact be traced to beliefs about dominant and affiliative individuals. Thus, men's faces are perceived as more dominant in appearance and men are rated as more likely to show anger, disgust and contempt. By contrast, women's faces appear as more affiliative and women are expected to be more likely to show happiness, surprise, sadness and fear.

These beliefs are also normative. That is, the judgment of the appropriateness of showing anger or happiness is heavily dependent on the perceived dominance and affiliation of the protagonist, and not just the product of gender category membership per se. That is, some of the beliefs that people hold about men and women – and which influence the decoding of facial expressions shown by men and women - can in fact be traced to differences in facial appearance, specifically, to differences in perceived facial dominance and affiliation. These differences in turn are due to the variations in features that characterise men's and women's faces. Moreover, as shown below, these differences between men's and women's facial structure have an even more direct impact on facial expression perception when it comes to pattern-matching.

Specifically, the facial features that make a face appear male or female and in turn dominant and affiliative interact directly with the movement patterns that characterise specific emotional expressions. Importantly, certain of the perceptual cues that mark anger expressions, such as lowered eyebrows and tight lips, mimic features also associated with dominance. On the other hand, high eyebrows and smiling in happiness expressions reinforce affiliative features.

This implies that for all intents and purposes a highly dominant face looks angry even when no actual facial movement is present. By contrast highly affiliative neutral faces look happy. Put another way, the facial configurations that create impressions of dominance and

Above: Filipa expressing a range of emotions, 30 degree view, *Chameleon* video portrait database, shot at the Banff New Media Institute, Canada. (Images: Tina Gonsalves)

affiliation are the same that make a face appear to show anger and happiness. These perceptual similarities between dominance/anger and affiliation/happiness then can be expected to bias the perception of these emotions, especially when facial expressions are weak and ambiguous.

The perceptual overlap between dominant facial markers and expressive markers of anger on one hand, and affiliative facial markers and expressive marker of happiness on the other, also implies that male and female faces will be reacted to differently. As mentioned above, men's faces are perceived as more dominant and women's as more affiliative. Further, it has been shown by myself and others that anger expressions signal dominance on the part of the expresser, whereas happy expressions signal affiliation. In turn, perceptions of the dominance and affiliation tendencies of others are relevant to the approach/avoidance dimension. Specifically, in hierarchical primate societies such as ours, highly dominant alpha individuals pose a certain threat insofar as they can claim territory or possessions (e.g., food) from lower status group members. Hence the presence of a perceived dominant other should lead to increased vigilance and preparedness for withdrawal. In contrast, affiliation is related to nurturing behaviours and should lead to approach when the other is perceived to be high on this behavioural disposition.

Because anger, dominance and male sex markers on the one hand and happiness, affiliation and female sex markers on the other overlap perceptually and are functionally equivalent, anger shown by women and happiness shown by men can be expected to elicit different reactions from observers. In a study in my laboratory we could show that when anger is shown on a highly dominant face the threat signal of the expression and the threat signal derived from facial features are congruent and reinforce each other. By contrast, when anger is expressed on a highly affiliative face, the two signals contradict each other and hence weaken the overall threat message. The converse is true for happy expressions. Following this line of argument, the female anger expression can be viewed as a combination of an appetitive face with a threatening expression. Male anger, on the other hand, represents a less ambiguous example of a threat stimulus. Conversely, female happiness is a clearer appetitive stimulus than male happiness.

Above: Kevin expressing anger, frontal view, *Chameleon* video portrait database, shot at the Banff New Media Institute, Canada. (Images: Tina Gonsalves)

In brief, facial features and facial expressions interact when it comes to the perception of emotion expressions. The research summarized above, focused on male and female faces because these represent a natural category differing in facial dominance and affiliation. But obviously individuals within each sex differ on these dimensions and hence we would expect, for example, anger to be more threatening when shown on a highly dominant female face and conversely male anger to be less so when shown on a highly affiliative face. It is important to note that not only do men and women differ with regard to these dimensions, but other groups do as well. Thus, for example, age changes faces such that men's faces are perceived as increasingly dominant until very old age, when they appear as more affiliative. Women's faces also increase in apparent dominance as they age. The impact of these age related changes in facial appearance on emotional attributions is currently being investigated in our laboratories.

In sum, both beliefs and facial morphology have an impact on the perception of the facial movement involved in emotional expressions. In every day life these two sources of influence will often be confounded. Thus, as we have seen, male faces appear generally more dominant, masculine and mature than female faces and hence perceptually overlap with anger expressions. Conversely, social roles are such that women are expected to feel less anger and more fear and happiness. Yet, whereas beliefs based on social roles are based on such relatively more malleable factors as the distribution of power and nurturing versus agentic roles between the genders, facial appearance based effects are due to the relative distribution of facial appearance cues associated with perceived dominance and affiliation across genders. That is, these two factors, albeit confounded in our reality, actually represent conceptually different explanatory factors.

For all intents and purposes it is impossible to disentangle the unique contribution of gender differences in power, status, social roles, and facial appearance with regard to perceived emotionality in our society. In Western countries, men tend to occupy powerful social positions in politics and business and in many countries of this world they exclusively occupy these positions. Women not only exclusively bear children but also overwhelmingly are responsible for their upbringing, thereby assigning themselves a nurturing role.

Above: *Chameleon* video portrait database: Maria expressing sadness, frontal view, shot at the Banff New Media Institute, Canada. (Images: Tina Gonsalves)

However, it is not uncommon in science fiction to question gender roles and to imagine worlds where such roles are different from ours. This may include the addition of genders other than male and female or the redistribution of child rearing tasks (e.g., Cogenitors, in Star Trek Enterprise episode no.48). In one study we therefore created a science fiction scenario in which a planet is inhabited by members of a race that has three genders: male, female, and caregiver. We manipulated social roles by describing the male and female as exactly equal in social dominance, whereas the submissive and nurturing role was assigned to a caregiver who was described as entirely responsible for the bearing and upbringing of the young. Facial appearance of the members of each gender was manipulated to be high, medium or low in facial cues to dominance. Participants read a description of this planet, Deluvia, and its inhabitants and then rated the likelihood that a Deluvian would experience various emotions. The results showed that social roles and facial appearance had varying but comparable impact on these perceptions. Sex per se however did not influence ratings significantly. This suggests that the beliefs we have about men's and women's emotionality are indeed a composite of the emotions that are associated with nurturing versus agentic social roles on one hand, and the conclusions we draw about a person's emotional behavior based on the social signals that facial features transmit.

The line of research presented here shows that both the face and facial expressions of emotion have social signal value and that these signals interact in complex ways. Importantly, this means that when we perceive and react to the emotional facial expressions of others it really matters who shows what in which context. The appearance of the sender, what we know - or think we know about them and the situation, and the expressive movements themselves all contribute to this process.

The summary has focused on the behavioral tendencies of dominance and affiliation and their relation to sex on one hand and the facial expressions of anger and happiness on the other. However, dominance and affiliation are not the only personality characteristics which can be deduced from the face and which could interact with our interpretations of

Above: A frame grab from *Chameleon 6: A Never Ending Loop of Emotional Contagion*, reworked for The Institute of Art and Ideas' *HowTheLightGetsIn* Festival at Hay, 2010. Each of the twenty *Chameleon* video portraits infect each other with their emotional state. (Image: Tina Gonsalves)

emotion expressions. Thus, for example, Vaughn Becker and his colleagues found that perceived masculinity influences the decoding of anger expressions; other researchers found that facial maturity interacts with perceptions of fear. In a related vein, Alex Todorov found that anger and happiness have also been associated with another evolutionarily important behavioral intention, trustworthiness. Thus, trustworthy faces, which expressed happiness were perceived as happier than untrustworthy faces, and untrustworthy faces which expressed anger were perceived as angrier than trustworthy faces.

This slowly increasing list of evolutionarily important behavioral dispositions which people infer from facial traits and which interact directly with the perceptions of facial emotion expressions underlines the importance of emotions for social signaling. Specifically, the interpretation of facial features as signaling behavioral intensions is an extension of the signal value of facial expressions. What this means in the context of decoding facial expressions is that the face is not a blank canvas but more like a musical instrument that imbues the expression with its own timbre.

THE TEAM:

Tina Gonsalves is currently working with world-leaders in psychology, neuroscience and emotion computing in order to research and produce moving image artworks mobile and wearable technology works that respond to emotional signatures of the body. Tina Gonsalves is artist in resident at the Wellcome Department of Neuroimaging London, UK, MIT Media Lab, Cambridge, USA, Nokia Research Labs Tampere, Finland and Brighton and Sussex Medical School Brighton, UK. (www.tinagonsalves.com)

Hugo Critchley's neuroscientific interests focus on brain mechanisms by which human social and motivational behaviour is controlled, both in healthy individuals and people with physical or psychological disorders. He is funded by the Wellcome Trust via a senior fellowship in clinical science for a programme of research entitled: Psychophysiological mechanisms underlying psychological and physical morbidity. He trained in Physiology and Medicine at Liverpool before undertaking a DPhil degree in Experimental Psychology at Oxford. Critchley's specialist training in psychiatry at the Institutes of Psychiatry and Neurology combined clinical work with neuroscience research. He was appointed Foundation Chair in Psychiatry at Brighton and Sussex Medical School in October 2006. Critchley's research programme focuses on understanding how interactions between brain and body influence emotions and physical and psychological wellbeing. This work continues with the support of the Wellcome Trust.

Chris Frith studied natural sciences at the Universaity of Cambridge. He subsequently trained in clinical psychology at the University of London's Institute of Psychiatry. Since completing his Ph.D. (with H J Eysenck) on leaning and individual differences in 1969, he has worked as a research scientist funded initially by the Medical Research Council and subsequently by the Wellcome Trust. With the MRC he worked in Tim Crow's unit at Northwick Park Hospital on the biological basis of schizophrenia exploring the neuropsychological basis of the symptoms of schizophrenia. Here he was involved in some of the very earliest studies of structural brain changes in schizophrenia. He then moved to the MRC cyclotron unit, where he carried out some of the earliest functional brain imaging studies of consciousness, volition and theory of mind. He had a key role in setting up the Functional Imaging Laboratory at the Institute of Neurology funded by the Wellcome Trust. He is currently Professor in Neuropsychology at UCL and Deputy Director of the Functional Imaging Laboratory and works on the neural basis of social interactions.

Rana el Kaliouby is currently a postdoctoral associate at MIT's Media Laboratory, inventing novel technologies and experiences that enhance "mind-reading", or social-emotional and empathic abilities of people and machines. She is passionate about creating new ways for people to capture, learn from and share their experiences and memories, drawing on and exploring the important role of affect in learning and memory. El Kaliouby is the 2006 recipient of the Global Women and Inventors Network, Higher Education & Learning Institutes (Gold Award). She has written several books chapters and refereed articles on the topic of Mind-reading Machines. She also exhibits her work regularly to engage the public in the research and to encourage more under-represented individuals to pursue a career in technology innovation — she has exhibited her work at the Royal Society Summer 2006 Science Exhibition in London and Scotland, where 3000 people interacted with the mindreading system in real time, exploring their expressions of emotion. Her work has been featured in the NewScientist, Reuters, CNET, Wired, the Boston Globe, New York Times, Slashdot and BoingBoing.

Rosalind W. Picard is founder and director of the Affective Computing Research Group at the Massachusetts Institute of Technology (MIT) Media Laboratory and co-director of the Things That Think Consortium, the largest industrial sponsorship organization at the lab. She holds a Bachelors in Electrical Engineering with highest honors from the Georgia Institute of Technology, and Masters and Doctorate degrees, both in Electrical Engineering and Computer Science, from the Massachusetts Institute of Technology (MIT). She has been a member of the faculty at the MIT Media Laboratory since 1991, with tenure since 1998. Prior to completing her doctorate at MIT, she was a Member of the Technical Staff at AT&T Bell Laboratories where she designed VLSI chips for digital signal processing and developed new methods of image compression and analysis. She was honored as a Fellow of the IEEE in 2005.

Helen Sloan has worked as a curator, researcher, writer, editor and producer in media arts and culture since late 1980s. Since 2003, she has been Director of SCAN, a networked organisation and creative development agency for media arts in the South of England working on media arts projects and strategic initiatives in arts organisations, academic institutions and further aspects of the public realm. Helen has worked both freelance and as a curator at organisations such as Camerawork, FACT, ICA and Site Gallery as well as directing festivals such as Across Two Cultures in Newcastle 1996 (an early conference on the overlapping practice of creative thinking in arts and science) and Metapod, Birmingham 2001. Current areas of interest and curatorial work include the points of intersection of science and culture, immersive environments, wearable technology, high speed networks, and media art and the creative economy.

Nadia Berthouze is a Human Computer Interaction scientist and collaborator on *Chameleon.* She is a senior lecturer in the UCL Interaction Centre at the University College London. Dr Berthouze's main area of expertise is the design of affect-aware systems, that is, systems that are sensitive to, and can respond to, their users' affective states. Using the tools of information theory, she has investigated the use of body language as powerful modalities for systems to recognise human emotional states, including cultural and gender specificities. She has pioneered adaptive recognition systems capable of learning affective categories through interaction for which she received the 2003 Technical Prize from the Japanese Society of Kansei Engineering. In 2006, she was awarded various grants to continue her work on these issues in the clinical context in the gaming industry and in the design industry. Dr Berthouze has published more than 70 papers in affective computing, data mining, human-machine interaction, and pattern recognition.

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Chameleon 8: Experientiae Electricae: Natacha Roussel, Michel Panouillot, Michaël Roy
Chameleon 8: Gordon Brand, The Centre for Innovation & Design at Solent University

Chameleon Video Portraits: Jim, Kevin, Thomas, Henry, Florian, Filipa, Michael, Blair, Glen, Simon, Maria, Leila, Dave, Lawrence, Brendan, Florent, Rachael, Natacha, Michael Nathalie, Helen, Ron, Sara, Amy, Natalya, Julie, Sereena, Alice-Gale, Paula.

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SELECTED EXHIBITIONS AND PRESENTATIONS:

Selected exhibitions:
Chameleon 2,   Dana Center, Science Museum, UK, 2008
Chameleon 1,3   Banff Center, CANADA, 2008
Chameleon 4,   ICA, UK, 2008
Chameleon 6,   University College London Hospital Foyer, UK, 2008
Chameleon 7, 3, 4,   Dana Center, Science Museum, UK, 2009
Chameleon 7,   Lighthouse, UK, 2009
Chameleon 7,   Sharjah Art Gallery, American University Cairo, EGYPT, 2009
Chameleon 6,   After Darwin, Contemporary Expressions, Jerwood Gallery, Natural History Museum, UK, 2009
Chameleon 8,   Lighthouse, Brighton, UK, 2009
Chameleon 7,   Affective Computing and Intelligent Interaction, Amsterdam, Netherlands, Sept 2009
Chameleon 9,   Fabrica, UK, 2009
Chameleon 7,   Superhuman, RMIT Gallery, AUSTRALIA, 2009
Chameleon 6,   HowTheLightGetsIn, Hay, UK, 2010
Chameleon 7,   Australian Forum : The World Is Everything That Is The Case, ISEA 2011, Istanbul 2011
Chameleon 6,   Kickarts, Cairns Contemporary Art Space, Cairns, QLD, AUSTRALIA 2012

Selected talks:
Max Planke Institute, Leipzig, GERMANY: July 2011
James Cook University, Cairns, AUSTRALIA: October 2010, February 2011
HowTheLightGetsIn, Hay, UK, May 2010
Computer Art Society, London Knowledge Club, London, UK: May 2010
Nokia Design, Los Angeles, USA: March 2010
The Brain and Creativity Institute, Los Angeles, USA: March 2010
International Conference on Kansei Engineering and Emotion Research 2010 (KEER), Paris, FRANCE: March 2010
Superhuman: Revolution of the Species, Melbourne, AUSTRALIA: November 2009
Fabrica, Brighton, UK: October 2009
Exploratorium, San Francisco, USA: October 2009
Simulated Certainties, Meeting New Frontiers of Science, Art and Thought, Barcelona, SPAIN: October 2009
Affective Computing & Intelligent Interaction 2009 (ACCI), Amsterdam, NETHERLANDS: September 2009
Art, Science and Beyond, British Science Festival, UCA Art Science & Culture Research, Farnham, UK: September 2009
Le Cube, Paris, FRANCE: April 2009
Digital Media Arts, University of Brighton, UK: March 2009
Sharjah Art Gallery, American University Cairo, Cairo, EGYPT: May 2009
Lighthouse, Brighton, UK: February 2009, March 2009, August 2009
Consciousness Reframed, Vienna, AUSTRIA: July 2008
Dana Center, Science Museum, UK: February 2008/ February 2009
The Liminal Screen Residency, Banff New Media Institute, Banff, CANADA: March 2008
MIT Media Lab, Cambridge, USA: Feb 2008/October 2009
Nokia Research Center, Tampere/Helsinki, FINLAND: February 2008, August 2008, March 2010

Selected Papers:
Consciousness Reframed, Vienna, July 2008
Affective Computing and Intelligent Interaction, Amsterdam, Netherlands, Sept 2009
Superhuman, Melbourne, Nov 2008
International Conference on Kansei Engineering and Emotion Research 2010. Paris, 2010.
Simulated Certainty, Meeting New Frontiers of Science, Art and Thought,
Digital Creativity (Darren Tofts), Denmark 2010

Please visit: http://www.tinagonsalves.com for research papers, videos and more information on *Chameleon*.