Alter Ego: Computer Reflections of Human Emotions

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ABSTRACT
In this paper we briefly review and discuss the ideas of self, emotion, and facial expression, and describe how a digital art work in the form of an interactive installation entitled *Alter Ego* was created to publicly explore these concepts. This work makes use of a variety of strands of modern technology: facial feature tracking, automatic facial measurements from live video, facial expression detection, and realistic avatar and expression modeling in 3D. In essence, the image of an autonomous alter ego of the user is created as a mirror reflection in real time. We further consider the place of *Alter Ego* in relation to contemporary human subjectivity, digital game theory, and its possible applications in research into the human psyche.

Categories and Subject Descriptors
D.4.7 Organization and Design *Interactive systems*
H.5.2 User Interfaces *Input devices and strategies*
J.5 ARTS AND HUMANITIES *Fine Art*

General Terms
Measurement, Performance, Design, Experimentation, Human Factors, Theory.

Keywords
Emotion, Affect, Human-Computer Interaction, Facial Expression Analysis and Synthesis, Subjectivity

1. INTRODUCTION

This paper will look at the collaborative digital art work of Alexa Wright and Alf Linney, focusing specifically on *Alter Ego,* a screen based installation in which users interact with what appears to be their own mirror image. Originally conceived as an artwork, *Alter Ego* draws together practical and theoretical concerns from a wide number of discourses, among them psychoanalysis, cognitive science, HCI, and digital game studies. *Alter Ego* has largely been developed within the department of Medical Physics at University College London. In this context, the work has been characterised as a useful research tool with which to study disorders of the self in which 'normal' social interaction is disrupted. From a theoretical perspective, *Alter Ego* can be seen to mobilize and expand on two distinct models of subjective interaction with the computer. One of these models is based in Lacanian psychoanalysis, the other in cognitive neuroscience. This paper will examine these two models and the dialogue that exists between them.

Alter Ego emerges at a time when postmodern notions of the human/computer relationship are shifting emphasis. Seminal texts of the eighties, such as Donna Haraway's *Cyborg Manifesto* and William Gibson's *Neuromancer,* explored some of the ways in which the modernist dualism of organism versus machine might be broken down. Despite the insight of these and other arguments, much early cybertheory tended to interpret the cyborg myth in a technologically determinist way. Understanding self, body, and machine as ontologically distinct entities, cybertheorists argued for the replacement of the meat body with a techno-body that was free from material concerns such as aging, illness, and death. The fantasy of the 'downloaded mind' was cyber-discourse at its most paranoid, and its most utopic. This theatrical denial of the body is epitomized by the performance artist Stelarc, whose catchphrase – "the body is obsolete" – sums up perfectly the attitude of a generation who were all too keen to overlook the embodied and reflexive relation between subject and technology.

Figure 1 *Stranger Within* (Alexa Wright 1993)

Beneath the strident voice of postmodern technophilia, however, there ran a current of opinion which took a more holistic view of the relationship between human subjects and technology. Since the early 90s Alexa Wright has been interested in ideas of cybernetics, but was always an advocate for the necessity to recognize and to celebrate the irreplacibility of the organism. Early works such as *Stranger Within* (Figure 1) investigate the literal, physical and gross absorption of the machine into the organism. Watching orthopedic surgery, Wright was interested to think that cybertheory relates, on some level, to a real and pragmatic body/machine relationship in which the meat body is supported, rather than replaced, by technological implants.

The cybertheory of the late eighties and early nineties has since given way to an approach that addresses these 'real and pragmatic' aspects, embracing the affective, embodied, and emotional aspects of the human/computer relationship. Recent research in fields like HCI, artificial intelligence, digital game theory, digital art, and others focuses on these issues, taking a renewed interest in 'wetware' and the role of the sensual body in human/computer interactions. AI research, for example, no longer thinks of artificial intelligence systems as disembodied, fully functioning simulations of isolated parts of the mind, but as embodied systems that perceive, understand, and interact with their environment according to the affordances presented by this environment. The relationship between mind, body, and technology is an intricate and constantly shifting one. Neither of these terms can be teased apart in practice; their interactions are characterized by complex physical and psychological behaviours. It is within this context that *Alter Ego* is situated.

2. THE RESPONSIVE MACHINE: BASIC HUMAN-COMPUTER INTERACTION

Human relationships to computers go beyond the simply instrumental – a notion which can be traced back to one of computing's early innovators, Alan Turing. Elizabeth A. Wilson suggests that building computers was not Turing's sole fascination; he was equally 'captivated by the inter-relation of certain mathematical, emotional, social, and engineering puzzles.' [27] In other words, he saw the computer not simply as a tool under the control of a human operator, but as a more complex interactive and affective entity.

In his 1950 paper 'Computing Machines and Intelligence', Turing first proposed his famous test of the same name. Sidestepping the question 'can machines think?', Turing argued that a computer could be said to be intelligent if it could imitate human responses to a set of questions successfully enough to fool a test subject. In fact, Turing was less concerned with whether or not machines could pass the test, than with the philosophical questions it raised. As he remarked: "we are not asking whether all digital computers would do well in the game nor whether the computers at present available would do well, but whether there are imaginable computers which would do as well." [27]

This is a sort of limit exercise – a way of thinking through the perfect computer – and as such it occupies a very similar epistemological terrain to the work under discussion here. With *Alter Ego,* Alexa Wright and Alf Linney do not ask directly whether machines can feel, but instead ask questions such as: "what if computers could convincingly emulate human emotions?" and "can machines engage in meaningful social interactions with humans?"

Figure 2 *Face Value* installation shot

Wright & Linney's previous collaborative work, *Face Value* (Figures 2, 3) addresses the issue of social interaction by providing a catalyst for exchanges between participants. This work, which references 19th century physiognomic principles, relies on the computer's ability to measure the static features of the face. In the installation a computer screen displays a life-size image of an average face, derived from sixty different individuals. As the user sits in front of this screen, his or her own face appears superimposed over the average face. The image of the user's face is captured by pushing a button, after which the computer calculates differences between the facial dimensions of the user and those of the average face. An individual 'character reading' is printed out based on these measurements.

Here, the user's level of immersion in the technology is limited. Rather, the focus of the work is on the social interaction provoked amongst users as people gather to verify or deny the characteristics the system has attributed to them. Inevitably if someone smiles, or turns sideways whilst interacting with *Face Value* they will receive a distorted reading. This fallibility of the technology has become integral to the work, which is intended to invite people to consider the mechanisms they use to read character from one another's appearance, rather than to assert the validity of any physiognomic system. The most significant social exchange resulting from this piece is not between the user and the computer, but between individual participants.

The human facility for almost instantaneously 'reading' socially and culturally inscribed information from another person's physical appearance suggests that human character may well be genetically linked to physical appearance, although not in the simplistic and formulaic way suggested by reductive systems such as physiognomy. The complexity of the task of holistic interpretation (i.e. scientifically measuring a person's character from his or her appearance) remains beyond even the most powerful systems of logic. Although it was designed to set up a discursive environment where the

complexity of these interpretive mechanisms could be explored, *Face Value* also inadvertently points up the innate failure of the machine to contextualize and interpret information presented to it with the same intuitive flair as a human subject. *Face Value* characterizes the machine as a logician which, despite its formidable computational power, cannot avoid careless discrimination.

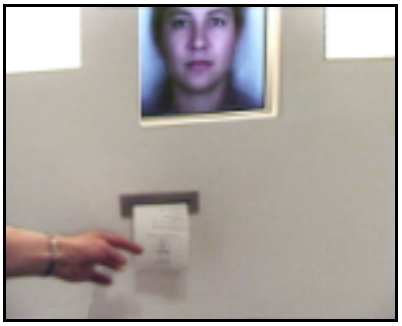

Figure 3 *Face Value* detail

As *Face Value* demonstrates, computers can successfully measure individual parts of the face – the length of a nose, the width of a mouth, and so on. They can also identify particular emotional clues in small movements of the facial muscles. Several hypotheses relating to human emotion claim that, to one degree or another, a series of physical measurements might be used to determine emotion and its intensity. Sometimes the level of belief in these hypotheses leads to their incorporation into significant elements of a culture. For example, lie detectors, which are based on measurements of heart rate, blood pressure, respiratory rate and electro-dermal activity as well as minute facial movement, are frequently used in investigating crimes. Increasingly, we rely upon the computer as a tool for the collection and interpretation of physiological data.

3. MACHINE AS MIRROR – AN INTRODUCTION TO *ALTER EGO*

After making *Face Value,* for which more than a hundred different types of faces were studied, Wright and Linney became interested in looking at the face more dynamically. The idea for *Alter Ego* came out of an interest in further studying and analysing the complexity of the human face to include measurement, analysis and re-creation of human facial expressions. It was also informed by a long-standing wish to fully exploit the current technology, whilst rendering the technological interface transparent (Figure 4). It was, therefore, important from the outset that *Alter Ego* should be fully automatic - requiring no intervention by the user (other than that he or she should sit still for some seconds).

Initially, *Alter Ego* behaves like a mirror, reflecting the subject's face on the screen and mimicking his or her expressions. The subject's relation to the technology may at this point be understood in terms of the self/other relation outlined by Jacques Lacan in his theory of the mirror stage. Though it is often interpreted as a developmental model, the mirror stage is more than a passing phase. It is a paradigm for the subject's ongoing relations with others and represents a fundamental aspect of the structure of human subjectivity.

According to Lacan and his followers, the ego comes into being during the mirror stage. This stage normally occurs in infancy, when the child first recognizes its mirror reflection as an image of itself. Through this encounter, the child comes to think of itself as an individual, distinct from its environment and from other humans. The mirror stage marks the subject's entry into the world of language and normal human interaction. From this point onwards, the subject's sense of identity depends upon the ability to differentiate between itself and its environment, itself and that which is 'other'. The consequences of disturbing this relation – of collapsing the boundaries between self and other, self and environment – range from simple neurosis to full-blown psychosis. While the mirror image provides a foundational image of the self, it also has a coherency and co-ordination that the real child lacks. The 'ideal-other' in the mirror, therefore, is and is not the self. Both real and ideal, this self-image is fraught with tensions and contradictions that persist throughout the child's life.

Within Lacan's argument, the ego arises on the basis of an identification with a visual image rather than a lived body. As Grosz remarks, for Lacan 'the ego is not an outline or projection of the real anatomical or physiological body but is an imaginary outline or projection of the body.' [11] Borch-Jacobsen states this even more forcefully, arguing that, within the Lacanian account of subjectivity, 'no type of relation with the world or the other – except the specular, spectacular, scopic one, as it defines the subject of representation through and through – is ever taken into account. The Lacanian ego is the ego as it theorizes itself, never as it feels "itself" or experiences "itself".' [3] This privileging of vision is symptomatic of a wider ontological dualism that characterizes Lacan's thought: 'for Lacan it is clear that language and subjectivity on the one hand, and the body on the other, are in principle two distinct orders, each following its own logic.' [26]

However, this model of subjectivity does not adequately explain human relations with technologies. It frames the machine as a simple tool, belonging to the same order as the body and meaningfully encountered only through the symbolic matrix of language. In fact, the situation is more complex than this. The human subject's sense of self, of 'being', is not based exclusively on a visible body schema, as Lacan's model suggests. It also depends upon the feeling that our body is our own, that it 'belongs' to us. [25]. This feeling is given in part by vision, but more significantly by the balance organs and proprioceptive sense – the awareness of the boundaries and position of one's own body. The technologies that we have built and through which we know the world are not simply tools or instruments; they are, quite literally, extensions of the body. [12, 16] Technologies evolve hand in glove with the subjects that create them. Rather than ontologically distinct entities, they are embedded or incorporated reflexively into the fabric of subjectivity itself, and our interactions with them suggest that the Lacanian model alone could never account for the spectrum of qualities that make up an embodied self.

Both of these concepts – the computer as a tool, and a key factor in subjective formation – inform Wright and Linney's work. *Alter Ego* draws on the predictability of the machine as a

tool and measuring device, and on the less easily quantifiable character of the user's relationship with it. Superficially, the success or failure of *Alter Ego* as an interactive work relies on the ability to measure and then to analyse the dynamic human face mathematically and logically. Because we, as humans, can fairly reliably 'read' the intention and subtle meaning of another person's facial expression, and can usually understand the emotional state reflected by that expression, it seems reasonable to suppose that if we could make enough measurements we would be able to reproduce the appearance of that emotional state on an avatar. However, the situation is more complex than this. Although changes from an 'expressionless' or 'neutral' face to an emotional one might reveal certain basic numerical patterns, these measurements along with the responses we are able to program the computer to perform, remain crude in relation to those perceived and performed by humans. *Alter Ego* draws our attention once more to the failure of the machine or, more accurately, to the inadequacy of measurement alone to interpret the emotional state reflected in a person's face which, in a human situation, is influenced by context and by subjective predisposition.

The problem of measurement is further compounded by the idiosyncratic nature of faces – the differences between the ways in which expressions are formed in the faces of a range of people are often greater (mathematically) than the differences between expressions in any one face.

Figure 4 *Alter Ego* Installation shot

However, it is surprising to note that even the basic, generic, symmetrical expressions the *Alter Ego* avatar is able to perform provoke a range of emphatic and instinctive emotional responses from the user. To put this another way – the data driving the *Alter Ego* mirror image is highly determined, but elicits a much less quantifiable set of reactions from the user. The appearance of a response is partly a function of the attribution of significance by the viewer to changing events on the screen, and could also be experienced as a projection of the change in emotional state produced by the user's own facial expressions. [14] This magical trans-formation from data to emotional response occurs even when the user is aware of the process that is taking place behind the screen, and to a much greater extent when he or she is not.

On a theoretical level, while *Alter Ego* instantiates certain aspects of the Lacanian argument, it also demonstrates the inadequacy of this argument in addressing the full complexity of human/machine relations. If, as we stated earlier, one of the intentions behind the *Alter Ego* project is to question the nature of contemporary human subjectivity, the work cannot be read simply in terms of the literal image in the mirror. It must also be seen to address the notion of a self that is born out of functional, embodied relations with computer technologies.

4. THE FEELING MACHINE: AFFECTIVE HUMAN-COMPUTER INTERACTION

Turing was fascinated by the notion of affective responses, such as joy, interest, and surprise, in human interaction with computers. Turing's initial questions have led to more complex investigations into the ability of the computer to model human emotions, and to evoke emotional responses in its human user. Emotion, however, is far from a simple term. Though emotions are often described as 'states of mind', it is more accurate to describe them as 'states of body'. Brian Massumi distinguishes between emotion and affective response. [15] Within his argument, affect is a way of addressing the multisensory and corporeal character of emotion. Affect is synaesthetic, embodied perception: a full-body, multisensory experience, temporally and corporeally delocalized, incorporating visibly expressed emotions but not reducible to them. Affect is a way of approaching the 'feel' or intensity of human/computer interactions, and refers to the *unquantifiable* features of these interactions – the phenomenological aspects of interactivity that are difficult to describe or to model theoretically, but which are responsible for animating our relations with computers and allowing us to encounter them as more than simple tools.

Emotions are not just states of mind, in other words, but *embodied events*. They are 'biologically based action dispositions that have an important role in the determination of behavior,' and as such they comprise subjective experience, expressive behavior, and specific physiological components [24]. Emotions are motivators for actions, and will change according to the range of actions that the subject is able to take in a given situation. Situations, in turn, are dynamic, and are constantly appraised and reappraised.

In the case of *Alter Ego,* the user's appraisal of possible actions is unsettled by the way the work mobilizes surprise and the level of control he or she is able to exert. Providing a mixture of predictable responses (mimicry of the user's expression) and unexpected ones (intervals where the piece begins to take on its own life), the user's action tendencies will vary during the time he or she is interacting with the work. So, when we note that *Alter Ego* mimics emotions and incites emotional responses in the user, we are in fact talking about a fairly complex set of dynamic behaviours and not simply the triggering of discrete and static psychological states.

5. THE MECHANICS OF *ALTER EGO*

The *Alter Ego* project is an art/science collaboration where the complex scientific or technological problem of creating the appearance of an automatic, realtime emotional response from the machine has so far been divided into several distinct processes. These include the detection and tracking of facial landmarks at video rates; the analysis of these measurements in relation to particular facial expressions; the derivation of a decision tree able to reliably classify more than a dozen facial expressions; and the creation of a series of morph targets representing the end point of each of these expressions.

Facial expression may, in reality, be interpreted by humans as a continuum, although we commonly recognise end points or discrete states which we describe linguistically: a smile, a frown and so forth. A number of research groups from around the world have attempted to make salient measurements which could be distilled by analysis into a single facial expression using both dynamic and static facial images, although this goal has not yet been fully achieved. [19] In the *Alter Ego* installation images of the subject's face are captured continuously from a Webcam with an attached telephoto lens which allows the face to occupy a large part of the video frame. Using video in this way it is possible to make dynamic measurements on the moving face, and at the same time to look at 'snapshots' represented by single frames.

During research towards the *Alter Ego* project a large number of people were observed making both spontaneous and 'enacted' facial expressions. This was done by videoing responses to carefully edited emotive video clips, and also by inviting people to make a series of expressions to order. This process allowed decisions to be made about what might be the most important features to measure. In the final analysis twenty-two facial features or 'landmarks' were used (Figure 5). The positions of these features were tracked using software provided by a commercial company.[1]

When the expression database was created it was noted that the difference between a spontaneous expression and one 'made to order' is easily distinguished by a human observer, but is extremely difficult to measure. Several research groups have attempted to create an automatic system for making this distinction. Most notably, Paul Ekman and Wallace Friesen proposed a method of reducing facial expression to a series of specific facial movements related to particular muscle groups, which they called the Facial Action Coding System (FACS). This method enabled Ekman and Friesen to develop techniques for reading facial expression in terms of emotion and for deciding whether a subject's expression was a true reflection of emotion or a fake expression consciously made to deceive. [9] Although this work was carried out more than quarter of a century ago, the roots of this idea can be traced further back to Duchenne de Boulogne who, in the mid 1800's, noted differences between real and fake smiles. [6] More recently, a number of research teams have developed computer imaging and video systems which can to a certain degree detect the facial actions defined by FACS, and hence characterize facial expression, but these are still either time consuming or have been reported to achieve limited accuracy. [18]

In order to derive a set of rules that would enable us to relate our measurements to actual facial expressions, we used the See5 non-parametric data mining tool. [23] This tool, which searches for patterns in any given set of data, enabled us to establish a set of classifiers that are expressed as a binary decision tree.[2] This tree is used to derive the most likely expression from a set of measured facial landmark positions.[3] The success rate of this method of classifying expressions was measured by constructing a truth table in which human assessment of facial images was used as the gold standard. As expected the concordance between human and machine classification is not perfect, but the results obtained compared well with other reported methods and were generated fast enough for real time use.

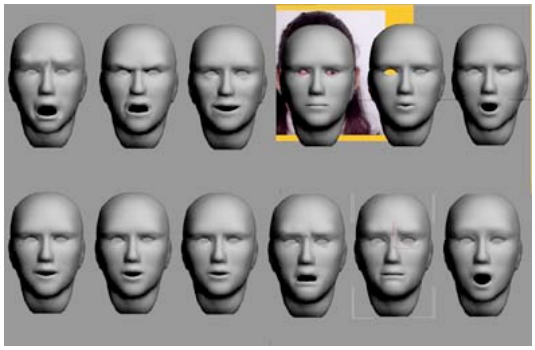

Figure 5 Morph Target Models

To create both a living 'mirror' and an apparently autonomous 'Alter Ego' image, a series of generic three dimensional (3D) polygonal facial models representing the end-point of fifteen facial expressions were constructed. (Figure 5) These include small and broad smiles, surprise, anger, laughter, disgust, sadness and fear as well as more self-conscious expressions such as winking and poking out the tongue. The 3D models are warped to fit key landmark distances on a two dimensional video image of the individual face of each user. The 2D image of the user's face is then mapped onto the 3D model, which is animated by interpolation between models representing different expressions. Standard computer graphics techniques are used to render the images of the resulting 3D models simulating the individual adopting different expressions.

[1] Eyematic Interfaces Inc., Inglewood, California, USA.

[2] The decision tree represents a procedure for using differences in facial measurements between the neutral face and an unknown expression to decide what that expression is most likely to be. At each stage in the tree a binary decision is made. The end point is the classification of the unknown expression. Typically a branching decision in the tree will be based on whether a particular measurement such as, for example, the change in width of the mouth between the unknown expression a neutral, is greater than or equal to a specific value.

[3] We have seen no other reports using this technique for facial expressions.

After mimicking the facial expressions of the user for some seconds, the avatar then begins to react to these expressions. This is termed the 'Alter Ego' phase. The expressions made by the 'Alter Ego' are not random, but are generated by each classified subject expression being linked to a subset of response expressions. There are three randomly chosen possibilities for each response. This ensures that the response made to a subject's expression is reasonable but not the same every time.

6. PLAYING IN THE MIRROR: USER EXPERIENCE OF *ALTER EGO*

On initially seeing his or her own face in the 'mirror', the user of *Alter Ego* often develops a language of expressive exchange the image. The strength of this impulse to communicate with the face on the screen was clearly demonstrated in a 'work in progress' prototype of *Alter Ego* shown at Kettles Yard Gallery in Cambridge (UK) in 2002 (Figure 6). Users of this work frequently copied the gestures of the face that was mirroring their own. In this version the avatar did not resemble the user at all – a texture was pre-mapped onto the model, which was able to simulate only four basic expressions (smile, frown, surprise, neutral). Despite the primitive nature of the exchange, everyone using the work at this stage found even this basic level of interaction with another human face surprisingly engaging. Some copied the face that was copying them; others were very vocal – exclaiming and calling for people to look. Other users – particularly children – could be found sitting quietly on their own interacting with their image as though trying to establish a private language with it.

Although the avatar is not an identical representation of the user's face, a critical process of identification is going on as in any conventional mirror experience. As Baudrillard remarks, 'there is always sorcery at work in the mirror…reproduction is diabolical in its essence; it makes something fundamental vacillate'. [2] The mirror has a potential for subverting the sense of being a singular self in singular body; it has the potential for creating an 'irregular doubling', a self that encounters more than one other.

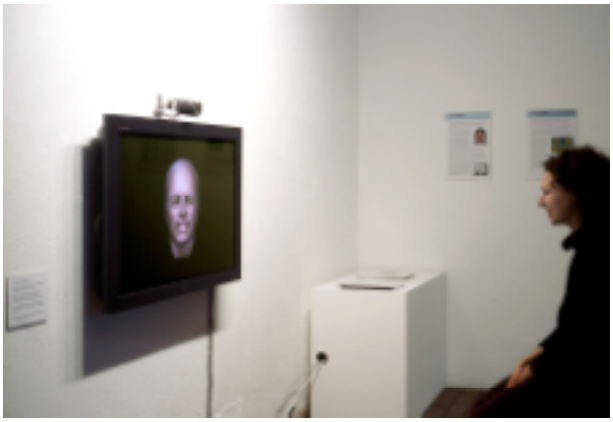

Figure 6 Work in Progress at Kettle's Yard Gallery 2002

In *Alter Ego* this problematic self-image is further troubled by the inadequacy of the technology to render a living likeness, and by the image's 'flickering' autonomy – sometimes it copies the user, behaving like a real mirror, at other times the image takes on a life of its own. The avatar is an image of the person, but it is also different from him/her to varying degrees depending on how well the software works on an individual's particular face type. Different users refer to the mirror image as 'I', 's/he' or 'it' – an unstable relation in which the image in the mirror is alternately rendered familiar and alien, thus disturbing the security of the individual's sense of his or her own subjective boundaries.

It is also likely that interactions with *Alter Ego* could bring about changes in the emotional state of its users. Ekman and his colleagues have recently produced evidence that even a voluntary facial expression leads to a change in internal state, and that we actually *feel* the emotion we deliberately attempt to express through facial actions. [8, 13] *Alter Ego* combines quantifiable inputs with unquantifiable outputs, simple interactions with complex emotional responses. Contrary to the Lacanian argument, however, this exchange is unlikely to precipitate an identity crisis or dissolution of self, but instead takes on the nature of a game.

The user of *Alter Ego* engages in a *playful* interaction with the piece. In order to better understand this interaction we will borrow Perron's distinction, drawn from digital game theory, between *artefact emotions* and *gameplay emotions*. [21] Although the experience of *Alter Ego* is somewhat different from that of digital gameplay, Perron's concepts provide a useful insight into the emotional exchange between computer and user. *Gameplay emotions*, Perron argues, are action tendencies. They arise from the interactions of the gamer with the game, and are better described as *processes* than *states,* as they involve both the appraisal of situations, and a readying of the self for a response to the situation. Gameplay emotions are determined by the interaction between a given situation and an individual and will differ according to the way a particular situation is perceived. *Artefact emotions* come into play when the viewer or gamer becomes aware, no matter how fleetingly, of artistry or manipulation in the experience. At this point, the object of the emotion is not the fictional world any more, but the game itself as a man-made artefact. If *Alter Ego* was able to perfectly emulate and re-animate the user's face, then artefact emotions would not likely be an issue. In its present state, however, *Alter Ego* generates an interesting combination of artefact emotions and gameplay emotions.

The playful, intuitive and 'non-interventional' nature of the interface is crucial to the user experience in *Alter Ego*. Here, the interface is an active agent in enabling the combination of artefact emotions and gameplay emotions. *Alter Ego* is one of a new generation of works that no longer rely upon the traditional keyboard, controller, or other pointing device to offer a portal for user activity. [14, 28] Moving towards a transparent interface, *Alter Ego* begins to blur the boundaries between technologically mediated and 'real world' experience.

At the start of the project, Wright and Linney researched ways of creating a non-symmetrical face that could be warped in real time to create perfectly realistic expressions. As noted earlier, however, the 'generic' expressions in the Kettle's Yard installation still held a considerable fascination. The texture map – i.e. surface detail – is enough to create a believable likeness. Despite the fact that *Alter Ego* still does not produce

a perfect reflection, users become deeply immersed in the work. In fact, it is this technological limitation, in part, that allows dynamic emotional states to emerge. Perron has suggested that such dynamic states may increase the level of immersion in digital environments. [21] It has also been argued that total perceptual immersion may be detrimental to positive user experience in such environments. [22] In the case of *Alter Ego,* the implication is that a perfect replica of the user's face may not necessarily improve user experience. Though *Alter Ego* falls far short of total perceptual immersion, the impression of emotional response greatly increases the sense of immersion.

7. RESEARCH APPLICATIONS OF *ALTER EGO*

Following a presentation of *Alter Ego* on the Danish Radio program *Harddisken* in May 2004, Wright and Linney were approached by Prof. Josef Parnas, a psychiatrist at Hvidovre Hospital in Copenhagen, who has a specific research interest in schizophrenia. Professor Parnas proposed a collaboration in which a version of *Alter Ego* could be used with patients with schizophrenia spectrum disorders because he believes that "[*Alter Ego] has a lot of relevance for research concerning disorders in self-awareness"*. Parnas notes that in the case of schizophrenics,

> all three core dimensions of subjectivity appear in the forefront: there are striking and unique disturbances of intentionality (e.g. loss of meaning and perplexity), self-awareness (e.g. "unstable first-person perspective" and other anomalies of self-experiences), and intersubjectivity (disturbances in interpersonal relations, communication and behavior). [20]

The use of the machine as a mirror to explore what we take for granted as 'normal' human subjectivity is particularly interesting when considered from the point of view of visuo-affective mapping – another dimension of response triggered by *Alter Ego*.

Visuo-affective mapping allows visual information about the world to be translated into specific actions taken by the body. It 'constitutes the foundation for the subjective, emotional elements of empathy, as they transform visual information about someone else's emotional state into similar emotional dispositions of our own.' [17] This form of mapping comes into play during social interactions, when we transform visual information about another person's emotional state (on the basis of facial expressions and other cues) into appropriate emotional dispositions of our own. Visuo-affective mapping is regarded as the foundation of empathy and is important in normal social interaction.

It is this part of the human neural mechanism that allows us to interpret the actions of others in immediate, first person terms – to put observed actions into egocentric terms. In people with conditions such as Autism and Asperger Syndrome, this process has gone awry. Scientists in the Autism Research Centre at Cambridge University[4] are researching the biomedical causes of these conditions, and working to develop new methods for their assessement and treatment. They have suggested that *Alter Ego* may offer a way of coaching people with autism or Asperger's in the art of interpreting and responding to facial expressions.

8. CONCLUSION

The postmodern notion that subjectivity can persist unaltered in a mechanical body is an extension of Descartes' partitioning of the human self into mind and body. Since Descartes, rationality and mind have come to define what it means to be human. They have also been thought of as diametrically opposed to the emotions. Recently, however, cognitive neuroscience and related fields have demonstrated the inseparability of emotion from rational thought and normal human function [5]. Our sense of self, in other words, is biological and not simply 'mental'. It is dependent upon a body schema which is not a static visual representation, but an evolving and dynamic awareness of one's status as an embodied being.

These changing notions of subjectivity are accompanied by a shift in our understanding of what technologies are and how we relate to them. The computer is more than a simple tool or a technological substitute for the human self. The machines we build shape our world, our relations with that world, and our sense of self – our very understanding of what it means to be human. Within this context, Scott Bukatman posits a rather bleak outcome for human relationships with computers:

> We used to live in the imaginary world of the mirror, of the divided self and the stage, of otherness and alienation. Today we live in the imaginary world of the screen, of the interface and the reduplication of contiguity and networks. All our machines are screens. We too have become screens, and the interactivity of men has become the interactivity of screens. [4]

Bukatman claims here that the screen has simply replaced the mirror as a paradigm for contemporary subjectivity. However, new technologies do not only occupy the conceptual space of old ones, they also extend that space. Though the screen in *Alter Ego* literally stands in place of the mirror, the work also demonstrates that the intervention of the screen in the mirror-subject relationship is more complex than Bukatman proposes. Derived from earlier conceptualizations of the human /machine interface, his argument remains in the visually biased conceptual space of the Lacanian model. Though it appears superficially to rely on vision alone, the user's encounter with *Alter Ego* involves many different sensory and affective modalities. Without a sense of embodied being - a sense of our body as our own - we would not be able to inhabit and respond to the other self in the mirror the way that *Alter Ego* invites us to do.

Alter Ego mimics – if only imperfectly at this stage – a real intersubjective reaction. Although its own expressions are still somewhat generic, it encourages individual, rather than generic responses from users. *Alter Ego* demonstrates that machines can enter into meaningful – if limited – social exchanges with human operators. Further, it suggests that the meaningfulness of these exchanges is based, in part, on their playful and reflexive nature.

[4] http://www.autismresearchcentre.com/arc/

This work is part of a wider tendency (also reflected in fields such as HCI research and digital game studies) to rethink the way that interfaces operate: "a shift toward a human-centered interaction architecture, away from a machine-centered architecture." [14] This shift recognizes the importance of human emotion and response in the design of interfaces and points up some changes in the human-machine relationship. For example, computers have begun to adapt to their users, rather than the other way round; the interface is becoming a responsive entity, rather than a passive portal. Instead of simply aiming to fit the physical body, interface design is now more concerned with engaging the embodied subject in all of its affective and sensory modes. As *Alter Ego* demonstrates, engaging these multi-sensory channels and affective modes need not mean the design of more complex portals. By simply taking all the buttons away, *Alter Ego* has opened up the possibility of heterogenous, affective, and less easily quantifiable responses from the user.

Alter Ego plays with the user's expectations, mapping visual and affective information along unexpected pathways in order to draw attention to the subtle relationship between technological development and the transformation of human subjectivity. Along with this goes the possibility of remapping of the geography of the imaginary world out of which identity emerges. This map must be redrawn to encompass the complex and shifting geography of the lived body, as well as the conscious mind.

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