

Convergence: The International Journal of Research into New Media Technologies

<http://con.sagepub.com>

New Media Arts Hybridity: The Vases (Dis)communicants Between Art, Affective Science and AR Technology

Christine Ross

Convergence 2005; 11; 32

DOI: 10.1177//1354856505061051

The online version of this article can be found at:
<http://con.sagepub.com/cgi/content/abstract/11/4/32>

Published by:



<http://www.sagepublications.com>

Additional services and information for *Convergence: The International Journal of Research into New Media Technologies* can be found at:

Email Alerts: <http://con.sagepub.com/cgi/alerts>

Subscriptions: <http://con.sagepub.com/subscriptions>

Reprints: <http://www.sagepub.com/journalsReprints.nav>

Permissions: <http://www.sagepub.co.uk/journalsPermissions.nav>

New Media Arts Hybridity: The Vases (Dis)communicants Between Art, Affective Science and AR Technology

Christine Ross

Abstract: Following Annie Coombes's and Avtar Brah's (authors of *Hybridity and its Discontents: Politics, Science, Culture*, 2000) request that we not merely apply but in fact historicise hybridity, and arguing that the art and science explorations of new media art have produced some of the strongest new media hybridities to date, the author focuses on one of the important fields of investigation currently linking media art, science and technology: augmented reality or what should be called augmented perception of time and space. This aesthetic field of investigation has led to a reassessment of representation, one that is not without (1) sharing some of the fundamental concerns of current neuroscientific investigation of mental processes and (2) questioning the image/real continuum principle at the core of recent augmented reality technology research. The article examines media artist Bill Viola's *The Passions* series (2000–2001) to contend that new media's original contribution to the practice of hybridity lies in the interaction that it both articulates and encourages with affective sciences, an interaction that redefines representation as an approximation, a facilitator – a projection screen for complex mental processes.

Key words: hybridity, historicisation of hybridity, new media art, affective science, Augmented Reality technology, Bill Viola

In their introduction to *Hybridity and its Discontents: Politics, Science, Culture* (2000) art historian Annie Coombes and sociologist Avtar Brah describe the developments of the term hybridity as fundamentally paradoxical. Although hybridity does imply a necessary recognition of the realities of cultural exchange and métissage and has often been explored by cultural critics as a transgressive concept, whose efficiency lies in the contamination of essentialist notions of pure and authentic origins, it has easily led to a 'promotion of the signs of cultural syncretism' without any consideration of economic, political, and social inequalities.¹ A blind belief in the supposedly transgressive value of

hybridity has also made some critics forget how hybridity can and has been used strategically as a mode of reinforcement of the very racial purity it is meant to denounce. To counter its uncritical usage, the authors advocate the need of complicating such readings by opening the procedure of hybridisation itself to cultural scrutiny and encourage us 'to take account of the multiple uses and meanings of the term depending upon the configuration of social, cultural and political practices within which it is embedded at any given time.'² The cultural turn of the concept, traditionally associated with the development of botany and zoology (where it alludes to the results of a cross between two separate species of plant or animal), must be accompanied by the requirement of historicising the complex hierarchies of power through which hybridity is both constituted and contested.³ An important figure of this cultural turn, urban culture studies specialist Néstor García Canclini, examining the hybridisations shaping Latin American modernity, speaks more precisely of the need to approach hybrid realities following an interdisciplinary perspective that effectively transforms the involved disciplines instead of merely mixing them together.⁴ Here, I want to keep this model in mind, not only because it proposes hybridity as an interdisciplinary activity – one that best describes what is currently at play in new media art – but also because it suggests that hybridised disciplines relate to worlds which are themselves hybrid. In postcolonial terms this means, as Canclini puts it, 'a trans-disciplinary gaze' for transculturated worlds; in new media terms, a transmedia gaze for a world perceived as increasingly complex.

Contemporary to the development of postcolonial and cultural approaches to hybridity, the field of new media studies has also elaborated a hybrid reading of the digital image in a way, however, that usually suspends the question of the intercultural so as to focus on intermediality. In the early 2000s, media theorist Edmond Couchot defined the numerical image as the site par excellence of hybridisation, a qualification made to emphasise the almost limitless combination of data brought upon by digitisation.⁵ This reading was in turn strongly supported by Yvonne Spielmann who, although acknowledging the cultural ramifications of hybridisation, has examined the ways in which cinema, video and the digital both technically meet and diverge in new media, situating the latter in the larger paradigm of the *third space* 'where differing concepts, approaches, assumptions and techniques meet, merge and interact.'⁶ 'Hybridisation', she continues, 'does not produce a new culturally dominant form, but rather demonstrates the multiplicity of possible interactions between, science, art, and technology.'⁷ Although it is not certain that hybridisation by itself will prevent the formation of a dominant aesthetics, Spielmann's highlighting of the growing interactions between science, art and technology is crucial. I will come back to this point further down since this interdisciplinarity impulse has produced some of the strongest new media hybridities to date. To be sure, however, in the field of new media art, hybridity is mostly explained as a pivotal result of the digital revolution especially when it is understood as a

revolution of infrastructure whose uniqueness lies in its implementation of changes that, as media artist Bill Viola has explained, cut across disciplinary boundaries of categories and professional activities, and private life', a master code that codes, underlies and links practices and forms 'that were previously disparate, such as balancing your cheque book, booking a flight, seeing dinosaurs come to life in a film, writing a novel, watching a baseball game, designing a car, diagnosing an illness from X-rays, deciphering the structures of the human body and modelling how far it's evolved.'⁸ Yet, as Viola concludes, 'we are just at the beginning of seeing what can happen when these links are explored.' Indeed, it is too early to agree on the newness or inventiveness of the hybrid connectivity, but the general thrust lying behind new media work today is to see hybridity as the potential for something new, for innovative forms of narrative or interactivity for example, what Sean Cubitt has called the 'consciousness of what is Not-Yet.'⁹ More recently, media artist and theorist Lev Manovich has spoken of how hybridity, or more precisely the DJ logic of the mixing of 'samples', might be *the* paradigmatic shift of the software age.¹⁰

Wanting to take seriously Coombes's and Brah's warning of the need to historicise hybridity and to subject the operation of hybridisation itself to cultural scrutiny, also wanting to be attentive to both Canclini's association of hybrid approaches and hybrid objects and Spielmann's observation of how hybridity often translates into an interaction of art, science, and technology, I will be focusing here on one of the important fields of investigation currently linking new media art, science and technology: augmented reality or what should be called augmented perception of time and space. My argument is not that the newness of new media hybridity lies in this augmentation – many artistic practices in the past and more recent past (in the twentieth century, let us think of dada and surrealist photomontage, abstraction, and video art, to name the most obvious practices) have operated on these grounds – but to argue that new media explorations of hybridity have been key for the development of that specific field of research. Interestingly, in many cases, this has meant a reassessment of representation, one that is not without sharing some of the fundamental concerns of current neuroscientific investigation of mental processes and augmented reality technology research. For the sake of clarity but also with the hope that my argument will be sufficiently large to let the reader expand my conclusions to other artworks, I want to address Bill Viola's *The Passions* series (USA, 2000–2001) to argue that new media's original contribution to the practice of hybridity lies in the scientific interaction that it both articulates and encourages, an interaction that rethinks the status of representation in a fundamental way. As polymedia artist Peter Weibel has observed, although an important part of contemporary art seems to have abandoned its faith in the representative powers of the image, contemporary science (notably medicine, chemistry, astrophysics, and mathematics) is increasingly investing in the image. This investment has

important consequences on art for – and this is Weibel's main argument – images of science are becoming more necessary than images of art. 'Art', he argues,

is threatened with becoming obsolete because of its obsolete image ideology, and it is threatened with being marginalized if it does not try to compete with the new pivotal role of the image in the sciences by also developing new strategies of image making and visual representation. Art must look for a position beyond the crisis of representation and beyond the image wars, to counterpoint science.¹¹

New media hybridity might well be the occasion to meet that very challenge.

Let me first briefly refer to Viola's *The Passions* series produced between 2000 and 2001. Although diverging in screen size, composition, and display, these video wall projections or LCD transmissions share a common theme – the expression of emotions – that springs from the artist's interest in Medieval and Renaissance devotional painting. They all stage figures – a same man in different passions, a man alone, men, men with women – some of them grouped together in a single quintet composition or in LCD panel diptychs or triptychs, experiencing emotional transitions, including joy, sorrow, rapture, anger and fear. What is crucial here is the extendedness of the emotional unfolding, that is, the unfolding of the transitions in slow time as a manifestation of the passage of time, one that enables us to perceive what is imperceptible with the naked eye. This extendedness is made possible by the technical hybridisation of cinema and video. Indeed, most of the scenes were shot in 35mm film at very high speed, frame rates of up to three hundred frames per second, then transferred to digital video, radically slowed down, edited, and played on flat screens. The *Anima* triptych (2000), for example, Viola's slowest piece to date, stretches the original film footage of 1 minute to 82 minutes. Extendedness also derives from the hybridisation of the photographic (the quasi-stillness of the image) and the pictorial (the iconography of Medieval and Renaissance religious painting), which work to convey an affective devotional reception. Viola explains in these terms the hybridisation challenge of his series:

The subject I was working with – the passage of an emotional wave through a human being – is fleeting and in constant motion. I realized that these pieces had to be shot as single takes with no editing, since the movement was created by the emotion itself, and the medium for this emotion, its constant base, was the person. Any kind of editing would disrupt this relationship. However, I also knew that the medium of video, master of the long take, was only capable of shooting the action at thirty frames per second, and I needed more visual increments of time to capture the subtlety of the transitions and transformations. Also, for some of the pieces (especially the

flat-panel portraits), I wanted a photographic, not an electronic, quality of the image, along with a high level of detail and delicacy of light. So film became the only option. Most of the pieces in this series were shot on 35mm film . . . and then transferred to digital video and edited.¹²

I want to argue that the inventiveness of the *Passions* does not lie so much in the mixing of cinematic acceleration and video deceleration (to which must be added the integration of the devotional traditions of photography and painting) than in the ways in which representation is transformed in that very process. Note how the emotions are not shown in their causality nor are they embedded in any kind of narrative. In some works, such as *The Quintet of Remembrance* (Viola, USA, 2000), the event that triggers or supports the emotional transitions is acknowledged because of the converging gazes of the figures toward a common point but only inasmuch as the event is located outside the frame and thus unidentified and unknown to the viewer. This is not to say that the emotions are set out as being without a referent, a story or a cause but that these are either irrelevant or excluded so as to enable a specific type of response in the viewer, one that is close to the response expected from Medieval devotional images which inspired the pieces in the first place: projection, the opportunity to project one's own emotional story onto the screen. Affects are not so much represented as a means to produce an affective response in the perceiver. Aesthetics here goes with the imperceptible, the unrepresentable and the unpredictable – not only the imperceptibility of subtle emotional transitions but the unrepresentability of the complexity of these transitions. This is why the viewer's perception must be said to be paradoxically both augmented by affectivity and optically impoverished by the attentive failures that come about when one looks at a screen where barely anything is happening and where affects are often displayed in their ambivalence (oscillating for example between pain and pleasure).

In his reading of Viola's *Passions*, Mark Hansen, who situates the newness of new media not in the hybridity brought upon by digitisation in the ways in which the viewer's body becomes *the* place that transforms the endless self-differing of media 'into a concrete experience of today's informational (or 'post-medium') environment'¹³ – is thus right to insist on how the series' disclosure of imperceptible affective shifts works to augment the 'now' of the viewer's perception. Indeed, the works impose and disclose the *nowness* of emotional/perceptual response. But they do so not so much by disrupting what he calls the *pastness* of cinematic narrative (I would argue that all forms of narrative exist in the meeting of an already constructed story and the present act of reading or looking at it) as by giving way, as Hansen points out, 'to a kind of affective contagion through which consciousness, by being put face-to-face with what it cannot properly perceive and yet what constitutes the very condition out of which the perceivable emerges undergoes a profound self-affectation.'¹⁴ His neuroscientific reading of the *Passions* – a reading entrenched in the work of neurobiologist Francesco Varela – is also

inspired. Although it is problematic to simply *apply* neuroscience to art and although it is also questionable to situate affectivity as that which both initiates the genesis of time consciousness and prefigures changes in perception (current neuroscientific findings do not support such a hierarchy), Hansen's bringing together of these disciplines is crucial: it shows how much hybridity in new media art has to do with its leap into sciences of the brain and the mind. Again, as an attempt to follow Coombes's and Brah's claim as to the need to historicise the concept of hybridity, I want to push Hansen's art and science dialogue a bit further so as to show how art, neuroscience and technology interact, overlap and also diverge—through new media art hybridity—in their understanding of augmented perception. It is in this confrontation that the rethinking of representation can be clarified.

First, what the rapprochement between neuroscience and new media art discloses is how representation can be modified in hybridisation. As mentioned above, Viola's *Passions* convey the infinitesimal transitions of emotions, not only the particular transformation of a specific emotion but the thin line that joins opposite passions like joy and anger. They are rendered as though without a cause and devoid of any *istoria* that would ground them in the lives of various characters. Emotions are rendered in their complexity. One could say that their sheer complexity – the impossibility of attaching an emotion to a specific stimuli or cause, to grasp the plurality of interrelated causes and objects, to predict the precise emergence or unfolding of emotions, to separate one mental activity from another (affection from cognition, from attention, from memory), to universalise affective and perceptual experiences – forces a type of image that opens the referent, *istoria*, content and cause to an unfixable multiplicity, contradiction, interactivity, and unpredictability, that is, to the uniqueness of each viewer. In light of this observation, it is highly significant that affective sciences today approach emotions in a similar way according to a perspective that seeks to disclose the complexity of mental activities.

The study of affective processing has become a major area of research in neuroscience and cognitive sciences during the last decade, notably in the work of Antonio Damasio, Joseph LeDoux, Jaak Panksepp and Edmund Rolls. One dominant consensus coming out of this research is that it is impossible to segregate mental processes such as affection and cognition from each other. Emotion is not only necessary for but also affects various cognition activities such as attention, perception, decision-making, and memory. At this point in time, there is no empirical evidence that these processes are isolated in the brain, recent findings suggesting on the contrary that they 'are integrated seamlessly in everyday behavior and experience.'¹⁵ Hence, and I quote here from psychologists Richard Davidson, Klaus Scherer, and Hill Goldsmith:

the notion that emotions were somehow limbic or subcortical and cognitions cortical is giving way to a much more refined and

complex view. The older notions helped to perpetuate anachronistic dichotomies between thought and feeling. More modern approaches . . . clearly indicate that the substrates of complex emotion and cognition overlap considerably. It is simply not possible to identify regions of the brain devoted exclusively to affect or exclusively to cognition.¹⁶

This dimensional view of emotions is also retraceable in cognitive science where there is an increasing tendency to understand emotions not as discrete and separate but as differing 'only in degree on one or another dimension.'¹⁷ In other words, the linking of discrete emotions to discrete stimuli, cause or event – a linking the *Viola's Passions* refuse to articulate – is increasingly difficult to justify. Moreover, neuroscientific findings show that many affective processes occur implicitly, which means that a response to an emotional stimuli can occur without conscious awareness and that, in fact, 'some neural events are unlikely to have correlates in experience.'¹⁸ Reinforcing the hypothesis that many affects of everyday life occur in the absence of the physical stimuli that elicit them is the growing understanding that one of the main functions of some of the emotional regions of the prefrontal cortex (PCF) is to provide an affective working memory. In other words, neuroscience is contending that, as Davidson et al. explain:

we either maintain emotion following the off-set of affective events or we anticipate the occurrence of particular events that are affectively salient. In both cases, emotion is generated in the absence of physically present elicitors. The PCF in these cases likely plays an important role in sustaining the affect.¹⁹

Cognitive science also tends to understand emotion as a means of interpersonal adaptation, suggesting that there is no affection without constant emotion regulation and that this regulation is not only dependent on perceptual and cognitive development but also influenced by and influential upon the incalculable number of social relationships shaping any individual during his or her lifetime.²⁰ Such a complexity substantially complicates uni-causal or even contextual explanations of emotions. Studies focusing on the facial, vocal, olfactory, and linguistic expression of emotions – an area closer to *Viola's Passions* – serve to confirm this complexity. Recent findings show that different facial displays can express a same emotion, that various body signals interact in the transmission of emotions, and that sociocultural context shapes emotional expression in a variety of ways – for example, although results show that people across cultures judge facial expressions of emotions of anger, contempt, disgust, fear, sadness and surprise in similar ways, their description and appraisal vary culturally.²¹ For cognitivists Dacher Keltner, Paul Ekman, and colleagues, progress in the study of emotions will be made 'when, instead of trying to link emotions to events, emotions are linked to appraisals of events.'²²

Not only is there convergence between these neuroscientific findings and Viola's *Passions's* aesthetic but also disciplinary specificities that indicate important divergences. Both art and science privilege the dimensional mapping of emotions and tend to detach emotion from a direct physical stimuli or directly experienced cause; both prevent any clear distinction between affection, cognition, perception and memory (as much for the observing subject as for the subject under observation); and both disfavour a direct (narrative) reading of emotion so as to disclose how much affection is more a question of interpretation and appraisal than a universally readable thing easily retraceable to a specific, single and identifiable stimuli. These interactions disclose how complex aesthetic approaches to emotion are favoured by interdisciplinary and intermedial hybridisation. Simultaneously, however, it is important to note that *The Passions* activate projection from the viewer; the series encourages mental wandering and even withdrawal from the viewer as he or she enters emotional individuality while neuroscience is occupied with the operation of observation and measurement. I am arguing here that Viola's exploration of hybridity – not only the mixing of cinematic and video technologies that make possible the acceleration and deceleration of time required for the rendering of minute emotional transitions but also of the affective functions of photography and painting – prepares, supports and confirms the neuroscientific view of affection as a complex, and thus non-representable and only suggestive, mental phenomenon, but it also defers from neuroscience by favouring the observation *and* experience (through that very observation) of passions. As Viola states himself, his work is not about the optical rendering of emotions but the grasp of the imperceptible aspects of emotions, one that favours projection and not readability from the viewer. In this, his work is highly abstract – although still – paradoxically figurative.

Representation, when elaborated by a hybrid view of new media, is thus the site where abstract art changes registers in that abstraction ceases to be incompatible with figuration. Here, as in the work of AELab (a duo of artists composed of Gisèle Trudel and Stéphane Claude) which edits non-optical images of different objects taken from nanotechnologies currently used in chemistry labs (Atomic Force Microscopy and Scanning Electron Microscopy) without clarifying in any way the identities of these objects, or Douglas Gordon's video installation *24 Hour Psycho* (Scotland, 1993) that stretches Hitchcock's *Psycho* to a twenty-four hour screen projection that not only prevents us from seeing the film in full but also disrupts the legibility of the images, what becomes important is not what the image *actually* represents or how it succeeds in rendering the world *out there* but how it can only be, after the twentieth-century invention of abstract art and in the midst of the growing investment of science in visual representations of complex systems, an approximation, a facilitator, or a projection screen for complex mental processes.

Hence, if the viewer's perception can be posited as enlarged and extended in Viola's work, it is because representation prevents or at least problematises the establishment of a real-image continuum. This is to say that the interaction between art, science and technology articulated by hybrid investigations of media is also a debate. As I have argued above, neuroscience's and art's investment in complexity operate at different levels although they do nourish each other.

Moreover, and this brings us to the third term of the interaction – technology – recent research in augmented reality (AR) technology assumes perceptual augmentation to be optimised when image and real coexist in a continuum, a position which defers substantially from what is at play in *The Passions* series. This growing field of technological application aims at solving the main limit of virtual reality (VR) – the separation of the immersed user from the immediate physical environment – by ensuring the overlap of virtual data and the perceived scene. If VR seeks to replace the real AR attempts to supplement it.²³ To achieve this goal, AR technology research is working at perfecting the alignment (continuity, mixing, interpenetration) between the image (the overlaid material) and real, between the eye trajectory and the point of view from which the image was taken, with the hope of amplifying the user's perception of reality.²⁴ In a medical application of AR, for example, the surgeon can wear a see-through device on the head, which overlays pre-operation studies of the internal anatomy (such as CT or MRscans) on his or her own view of the patient's body. In the military domain, AR displays in cockpits transmit information to the pilot on the visor of the flight helmet or the windshield of the cockpit. What is important to emphasise here is that the development of AR operates on the assumption that, in its production of a composite view of reality – a view that imbricates as though it was *one* scene the scene perceived by the user and the virtual scene generated by the computer – the system amplifies not only the performance of the user *in* the world but also his or her perception *of* the world. The perfecting of that technology therefore relies on the elimination of jumps, noise, time delay and perceptual effort which still occur in the alignment of two frames of reference (the real and the virtual image).²⁵

The Passions, although partaking of an aesthetics that augments perception by exposing the viewer to imperceptible affect transitions and injecting affectivity into perceptual activity, explores hybridity so as to radically complicate the real-image continuum at the core of AR technology research. Let us briefly refer here to other artworks dealing with similar concerns: Peter Weibel/Thomas Fürstner's *Waypointing Weibel's Vienna* (Austria, 2002), for instance, a mobile communication system integrating the telephone, the computer, a panoramic camera and a Global Positioning System (GPS), which allows the user to circulate in the city of Vienna while receiving in real time audio-visual information on the history of the visited sites, or Janet Cardiff's walkman pieces which transmit short stories to the spectator while s/he circulates in different urban spaces, or again Igor Vamos's *Grounded* (USA, 2002), a system

which gives to the user (equipped with headphones and a portable wireless computer connected to a GPS and to an Internet data bank) a variety of photo and video information on a desert in the region of Wendover in Utah (where one finds the Great Salt Lake). In all these installations, the user moving in space sees his or her experience 'augmented', his or her perception doubled by other perceptions and multiple visual, audio and textual information. If this is so, however, it is because, as in Viola's *Passions*, the continuum between the image, the referent, and the cause is significantly problematised, favoring image-sound ruptures with the real. In this, these hybrid aesthetics are not only explored to activate an art, science, and technology interaction, but also a critical debate between these disciplines, a questioning of what exactly constitutes today a representation.

Notes

1. Annie E. Coombes and Avtar Brah, 'Introduction: The Conundrum of "Mixing"', in *Hybridity and its Discontents: Politics, Science, Culture*, eds Avtar Brah and Annie E. Coombes (London and New York: Routledge, 2000), pp. 1–2.
2. Coombes and Brah, p. 1.
3. Coombes and Brah, p. 2.
4. On García Canclini's concept of hybridity, see John Kraniuskas, 'Hybridity in a Transnational Frame', in Coombes and Brah, pp. 235–256.
5. Edmond Couchot, 'Digital Hybridisation: A Technique, an Aesthetic', *Convergence*, 8, no. 4 (Winter 2002), p. 21.
6. Yvonne Spielmann, 'Aesthetics of Hybridity in Visual Culture', unpublished paper presented at the 31st International Art History Congress, Montreal, August 2004 and 'Hybridity: Arts, Sciences and Cultural Effects', *Leonardo on-line*, <http://mitpress2.mit.edu/e-journals/Leonardo/isast/events/caa05hybridity.html> (14 February, 2005).
7. Spielmann, 'Hybridity: Arts, Sciences and Cultural Effects'.
8. Bill Viola, 'Bill Viola interviewed by John G. Hanhardt', in *Bill Viola: Going Forth By Day* (Berlin: Deutsche Guggenheim, 2002), p. 111.
9. Sean Cubitt, 'Spreadsheets, Sitemaps and Search Engines: Why Narrative is Marginal to Multimedia and Networked Communication, and Why Marginality is More Vital than Universality', in *New Screen Media: Cinema/Art/Narrative*, eds Martin Rieser and Andrea Zapp (London: British Film Institute, 2002), p. 10.
10. Lev Manovich, 'Info-aesthetics', unpublished paper presented for the Department of Art History and Communication Studies at McGill University, at the Musée d'art contemporain de Montréal, Montreal, February 14, 2005.
11. Peter Weibel, 'An End to the "End of Art"? On the Iconoclasm of Modern Art', in *Iconoclasm*, eds Bruno Latour and Peter Weibel (Cambridge, Mass.: The MIT Press, 2002), p. 670.
12. Bill Viola, 'A Conversation: Hans Belting and Bill Viola', in *Bill Viola: The Passions*, ed. John Walsh (Los Angeles: Getty Publications, 2003), p. 200.
13. Mark B. N. Hansen, *New Philosophy for New Media* (Cambridge, MA: The MIT Press, 2003), p. 32.
14. Hansen, p. 265.
15. Richard J. Davidson, Klaus R. Scherer, and H. Hill Goldsmith, 'Neuroscience', in *Handbook of Affective Sciences*, eds Davidson, Scherer and Goldsmith (Oxford and

- New York: Oxford University Press, 2003), p. 3. Also see Antonio R. Damasio, *Looking for Spinoza: Joy, Sorrow, and the Feeling Brain* (Orlando, Fla. and London: Harcourt, 2003).
16. Davidson, Scherer, and Goldsmith, p. 5.
 17. Dacher Keltner, Paul Ekman, Gian G. Gonzaga, and Jennifer Beer, 'Facial Expression of Emotion', in Davidson, Scherer and Goldsmith (eds), p. 422.
 18. Richard D. Lane, Lynn Nadel, John J. B. Allen, and Alfred W. Kaszniak, 'The Study of Emotion from the Perspective of Cognitive Neuroscience', in *Cognitive Neuroscience of Emotion*, eds Richard D. Lane and Lynn Nadel (Oxford and New York: Oxford University Press, 2000), p. 4. They base this statement on the findings of Joseph E. LeDoux, *The Emotional Brain* (New York: Simon & Schuster, 1996).
 19. Davidson, Scherer and Goldsmith, p. 6.
 20. Gerhard Stemmler, 'Autonomic Psychophysiology', and H. Hill Goldsmith, 'Genetics and Development', in Davidson, Scherer, and Goldsmith (eds), pp.131 and 296.
 21. P. N. Johnson-Laird and Keith Oatley, 'Cognitive and Social Construction in Emotions', in *Handbook of Emotions*, eds Michael Lewis and Jeannette M. Haviland-Jones (New York and London: The Guilford Press, 2000), pp. 458-475; and Keltner, Ekman, Gonzaga, and Beer, pp. 413, 420-21.
 22. Keltner, Ekman, Gonzaga, and Beer, p. 418.
 23. Ronald Azuma, 'Tracking Requirements for Augmented Reality', *Communications of the ACM* 36, 7 (1993), pp. 50-51; and Ronald Azuma, et al., 'Recent Advances in Augmented Reality', *IEEE Computer Graphics and Applications*, 21 (November/December 2001), pp. 34-47.
 24. S. Aukstakalnis and D. Blatner, *Silicon Mirage: The Art and Science of Virtual Reality* (Berkeley: Peachpit Press, 1992).
 25. P. Milgram and F. Kishino, 'A Taxonomy of Mixed Reality Visual Displays', *IEICE Transactions on Information Systems*, E77-D, no. 12 (1994), pp. 1321-1329; and P. Milgram, et al., 'Augmented Reality: A Class of Displays on the Reality-Virtuality Continuum', *SPIE Proceedings: Telemanipulator and Telepresence Technologies*, H. Das, *SPIE*, 2351 (1994), pp. 282-292.