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Animated Expressions: Expressive Style in 3D Computer Graphic Narrative Animation

Pat Power

Abstract The development of 3D animation systems has been driven primarily by a hyper-realist ethos, and 3D computer graphic (CG) features have broadly complied with this agenda. As a counterpoint to this trend, some researchers, technologists and animation artists have explored the possibility of creating more expressive narrative output from 3D animation environments. This article explores 3D animation aesthetics, technology and culture in this context. Synthesizing research in CG, neuro-aesthetics, art history, semiotics, psychology and embodied approaches to cognitive science, the nature of naturalistic vis-à-vis expressive visual styles is analysed, with particular regard to expressive communication and cues for emotional engagement. Two foundations of naturalistic 3D CG, single-point perspective and photorealistic rendering, are explored in terms of expressive potential, and the conclusion considers the future for an expressive aesthetics in 3D CG animation.

Keywords 3D animation, creative, emotion, expressive aesthetic, naturalism, non-photorealistic rendering, perspective, realism

Realism, naturalism and expression

Realism and naturalism, ideas of art as an imitation of reality, are currently the primary ethos of 3D animation culture and technology. These issues are 'far larger and more far-reaching than aesthetics or artistic convention' (Kress and Van Leeuwen, 2006: 167), involving not only questions of aesthetics, but of ontology, epistemology and phenomenology. Their history is at least as old as Plato's derogation of art as mimesis, and its subsequent defence by Aristotle. In modern times they again became prominent with the advent of photography, then the birth of cinema. Photography and cinema differ somewhat from painting and animation with regard to realism as, in lens-based arts, the indexical nature of the image is generally a given, whereas in both non-photographic imagery and animation the constructed nature of the imagery is salient.¹ Other non-lens-based visual arts flourished subsequently by actively exploring denaturalization as both theme and technique. Since the late 1960s, when Roland Barthes' analyses of the codes of reality effects and referential illusions undermined aspirations to realism and naturalism, contemporary cultural or semiotic theory has also aimed at denaturalization by revealing the socially coded basis of cultural phenomena which are taken-for-granted as *natural*. Ironically, during the same period, naturalism has become the sine qua non of CG research, the achievement of photorealism being 'the main goal of research' in this field (Manovich, 2001: 199).

'Different realisms exist side by side in our society', but the standard by which we judge visual realism remains conventionally understood naturalism, that is *photorealism* (Kress and Van Leeuwen, 2006: 158). In fine arts and animation, the term *realism* is often used interchangeably with *naturalism* to define a style of visual or audio-visual mimetic representation that aspires to photorealistic or cinematic verisimilitude. Andrew Hemingway (2007: 103) argues that the term *realism* is too confusing a term to apply to visual arts such as painting and suggests that, following E.H. Gombrich, the term *naturalism* (despite its own ambiguous associations) better reflects 'the general idea of pictorial verisimilitude'. Though both terms are used where considered appropriate in this article, the term *naturalism* does seem somewhat less confusing, and better reflects the technological drive towards verisimilitude in 3D animation.²

Theories of art as expression also have a controversial history. Having been particularly out of favour in the second half of the 20th century, they have recently been revived due in part to advances in the study of emotion, like those by neuroscientists Antonio Damasio, Joseph LeDoux, Edmund Rolls and Jaak Panksepp, by psychologists including Jerome Kagan, Nico Frijda and Arnold Modell, and by theorists who deal specifically with emotion and expression in the arts, for example Jenefer Robinson, Noël Carroll, Greg M. Smith and Christopher Butler.

In a narrative context, naturalist and expressive modes of representation can be seen as dialectically related. Generally, illusionistic 3D attempts mimesis of an external (or cinematic) reality whereas expressive styles play more with the nature of mind and of perception, emotion, memory and imagination. However, in common with live action (as in German Expressionism or *film noir*, for example), a virtual visual reality can still be expressive in modalities such as lighting or sound, while a non-naturalistic animated narrative might not express anything successfully at all. But in animation as in painting, whereas some artists strive for visual verisimilitude, others prioritize expressiveness, and these are aesthetically divergent styles, the former dealing primarily with denotation, and the latter, either consciously or intuitively, with expressive connotation.³ There are resonances here with dialectics such as objective/subjective, logical/emotional and noumenal/phenomenal and with language, where prose can be contrasted with more poetic and expressive forms.

Traditionally, animation has been one of the most expressive of the visual arts, but in 3D animation, quantitative has trumped qualitative, due in part to what Vivian Sobchack (2008) calls 'the calculative and quantitative tendencies of the computer' (p. 262). The issue in question here is whether or how an aesthetic culturally and technologically rooted at one end of this continuum can be taken for a creative stroll towards the other end. The exercise should prove worthwhile, because as Kostas Terzidis (2003: 58) suggests, the expressive has many advantages over the realistic and, whereas the computer-graphic quest for realism is essentially about completeness, 'notions of incompleteness, imperfection, and subjectivity' invite interactive participation and have an expressive value that can surpass this explicitness. As Michael Davis (1999), a specialist in Greek philosophy and translator of Aristotle sees it, mimesis should comprise 'a stylizing of reality in which the ordinary features of our world are brought into focus by a certain exaggeration . . . like the relationship of dancing to walking' (p. 3). He concludes that 'the more "real" the imitation the more fraudulent it becomes.'

3D computer graphics and photorealism

There are strong historical, technical, commercial and cultural reasons for a dominant naturalist aesthetic in contemporary 3D CG. The homology of applied science and technology research and development ensured a legacy of ideologies of objectivity as opposed to subjectivity. As digital techniques have supplanted analogue techniques in many design and production contexts, including graphics and animation, 3D animation has co-evolved symbiotically and stylistically with developments in 3D CG technology. There has been co-development and cross-over in technical advances for computer-aided design and manufacturing (CAD/CAM) and developments for use in

3D animation and entertainment, largely ‘determined by the needs of the early sponsors of this research – the Pentagon and Hollywood’ (Manovich, 2001:193). Whether they are for use in architecture, car design, military applications, medical imaging or feature animations, they all come under the rubric of 3D CG visualization, and can be traced back to Ivan Sutherland’s 1963 Sketchpad system that exemplified this ‘new paradigm of interacting with computers’ (Manovich, 2001: 102). Autodesk Inc., one high-profile contemporary example, develops systems for use in architecture, engineering, manufacturing, and media and entertainment. It develops CAD systems (such as Autocad) in tandem with 3D animation solutions (such as 3D Studio Max and Maya), and research and development in specialized graphics hardware and software are congruent across all these sectors (Figure 1).

Though these markets are largely distinct, there are important historical, cultural and technical syntheses. For example, volumetric modelling and rendering using voxels (volumetric pixels) has been used for some time in areas such as medical imaging (visualizing MRI scans), but now, combined with physics simulation, this synthesis comprises a prominent research and development focus both for animation and effects for arts/entertainment, and in particular for water, ocean, cloud and other fluid or gaseous effects. Of the 10 technical Oscars awarded in 2008, over half were for development of such dynamic fluid effects systems.

Most of the commercial, educational, governmental/military organizations and individuals involved in 3D research and development are driven predominantly by an ethos of realistic or naturalistic visualization, and this is understandable in terms of goals for technical achievement. SIGGRAPH is the major cross-industry professional organization for CG and its research proceedings point towards realism as a common goal (Manovich, 2001: 191). 3D CG animation software for arts/entertainment is currently focused on three main markets;

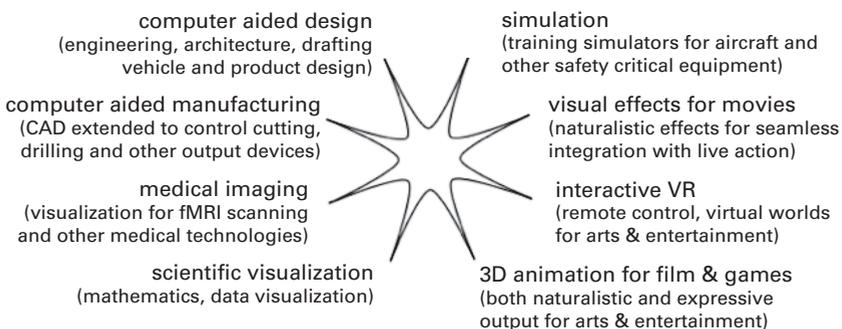


Figure 1 3D CG markets and applications (only those towards the bottom left are potential markets for expressive output).

animated movies (including features, adverts and shorts), 3D games and special effects generation (SFX). Although, to some extent, producers of animation and games have a broad choice as to the aesthetic they choose, the special effects industry by its nature requires seamless integration with live action and thus depends on verisimilar naturalism. In this world of what Manovich (2006: 26) calls *hybrid aesthetics*, the goals of a naturalistic aesthetic for SFX have a strong influence on the world of animation.

In spite of the fact that much in 3D animation has been technically determined, artistic innovation has also played a part, and many 3D animation and special effects companies have developed ad-hoc solutions to specific problems encountered by directors or designers that are often problems of aesthetics or style. Such advances have often disseminated into the wider CG community through forums such as SIGGRAPH, resulting in 'the development of important algorithms that became widely used' (Manovich, 2001: 194) and, despite commercial competition, a range of top-end systems has evolved with broadly similar functionality (for example, variations on sub-division surfaces, inverse kinematics, fluid effects, particles and dynamics).

There have always been technically gifted iconoclasts with an eye for aesthetics (for example, John Whitney, Ed Catmull, Chris Landreth), who were as much concerned with artistic as with technical advances. Landreth (2004), an engineer turned artist who worked on the development of Maya and whose animated short *Ryan* won an Oscar in 2005, calls this a *renaissance field*, bringing together artists, programmers, musicians, engineers and other eclectic talents to develop new kinds of storytelling. As these systems evolve they are gradually becoming more accessible to artists and, as 3D CG output becomes more pervasive, artists are becoming more attuned to their creative potential. Landreth sees this as a process of democratization and forecasts that 'individuals, not just large studios, will soon be able to develop huge works of art, such as CG feature films, on their own'. More affordable digital systems and tools with more intuitive interfaces and better educational resources play their part in this increased accessibility, and Norman Klein (2000) cites animation students who want their work to look 'haunted . . . as an antidote to the hygienic digital screen' (p. 35). Despite the naturalistic orthodoxy, all of this signifies the ongoing evolution of a more eclectic and expressive aesthetic in 3D CG animation environments.

Aesthetic expression and emotion

The concept of *expression* or *the expressive* is ubiquitous in the arts, but 'few terms are as poorly understood' (Robinson, 2005: 231).⁴ The quotidian use of *expressive*, as in gesture/facial expression, points to emotion as underpinning expression, and despite the fact that 'the

Expression Theory of Art came in for widespread and formidable criticism' from the 1950s onwards (p. 231), contemporary theories of aesthetic expression have emerged based on recent psychological and neuroscientific research in emotion, such as that advocated by philosopher of aesthetics and psychology, Jenefer Robinson, in *Deeper than Reason* (2005). Suggesting a 'New Romantic Theory of Expression', Robinson argues that although all works are expressive in some respect, some are what she refers to as *central cases* of expression (p. 266) while other *secondary cases* are more peripheral.

Emotions are processes that involve an initial fast, unconscious but coarse affective appraisal of the immediate environment involving low-level neural circuits, particularly the amygdala, that result in physiological responses affecting attention, motivation and action tendencies. This rapid response is accompanied by a slower cognitive appraisal that assesses the appropriateness of the quick-and-dirty affective appraisal and that monitors, labels and feeds back into the overall emotional process (p. 231). This view is consistent with LeDoux's (1998) fast low-road and slow high-road theory of emotion, and with Rolls' (2005: 452) explanation of that perennial philosophical conundrum, the affective paradox of fiction.⁵ Through aesthetic engagement, the arts can educate us emotionally by initially evoking instinctive emotional responses, followed by cognitive monitoring and reflection upon them, with aesthetic reflection comprising a later part of this process.

Understanding in the arts is dependent on affective embodied experience, and expressive qualities of artworks are ultimately 'qualities that can be grasped through the emotions they arouse' (Robinson, 2005: 291-2). Oxford Professor of English, Christopher Butler (2004), writing of emotions and the arts, observes that:

ultimately it is these emotional responses which count for our pleasure or pain; it is our emotions and moods, apart from physical pain, that contribute most to our sense of the happiness, and the sadness of our lives. (p. 36)

Both Robinson (2005: 292) and Butler (2004) suggest that it is wrong to equate expressive qualities in an artwork with named emotion labels such as *happy* or *angry*, as artistic expression of emotion evokes complex emotional reactions in audiences that cannot easily be labelled, that are often the very *raison d'être* of the creation. Edvard Munch's archetypal Expressionist painting *The Scream* might be characterized as expressing anguish, for example, but evokes much more complex states (including aesthetic pleasure) which may be ineffable outside of the work itself. Robinson argues (2005: 292) that successful artistic expression arouses appropriate emotions in audiences, and quoting from Coleridge's *Dejection: An Ode*, she suggests the purpose of expressive art is,

From outward forms to win
The passion and the life, whose fountains are within.

This resonates with the everyday use of *expressive* (as in facial expression) and contrasts with the naturalistic focus on an objective reality that is without.

Expressive arts need to be experienced emotionally if they are to be properly understood. Butler (2004) sees understanding and emotion as being aesthetically interdependent and sees expressive form as 'a provocative rhetoric' (p. 20) that aesthetically guides our attention in experiencing works of art. Like the experience of hearing a funny joke compared to an explanation of it, experiencing a work of art and knowing about it are qualitatively distinct phenomena. 'Wagner's music is better than it sounds' was Mark Twain's (1924) twist on this phenomenon.

Creative expressive signification

The genre comprising the rapidly growing body of 3D CG animated features for children or family audiences, led by Pixar's *Toy Story* (John Lasseter, 1995), and including titles such as Dreamworks' *Shrek* (Andrew Adamson and Vicky Jenson, 2001), Sony Pictures' *Monster House* (Gil Kenan, 2005) and Warner Brothers' *Happy Feet* (George Miller, 2005), is the main focus of attention here, together with some contrasting work that may point the way towards a more expressive 3D aesthetic. This dominant genre shares not only a common technological genesis but exhibits many consistencies in content, form and style. One way these can be summarized is in terms of semiotic modality markers or cues, as proposed by Kress and Van Leeuwen (2006).

Building on ideas from Habermas, Bourdieu and Bernstein, Kress and Van Leeuwen outline four reality principles or coding orientations that modulate the motivated signs comprising modality markers or cues within specific social contexts (p. 165). In 3D animation, modality cues are generally interpreted through the dominant, common sense, *naturalistic coding orientation*, with high modality aspiring to naturalism. Stylistically, most 3D CG features favour high modality cueing for movement (e.g. motion capture data), relatively high modality cueing for form (detailed but stylized 3D character models), high modality dialogue soundtracks (high-profile actors) and low modality characterization (e.g. talking tortoises or dancing penguins). Synthetic reality effects are uneven, and some 'privileged signs of realism' (Manovich, 2001: 196), for example fluid effects, are high modality cues that might compensate for others, such as human form. Due to our cognitive sensitivity to the latter, lower modality stylized cues can be more aesthetically effective or expressive, and are less likely to cue dissonance as in, for example, the uncanny valley effect (Power, 2008).

Besides the dominant *naturalistic coding orientation*, Kress and Van Leeuwen (2006: 165) also posit *technological*, *abstract* and

sensory coding orientations that modulate modality cues differently within specific social contexts (Figure 2). Whereas high modality would be ascribed to audio-visual verisimilitude in a naturalistic orientation, to accuracy in a technological orientation (e.g. in technical diagrams), or to generalization in an abstract orientation (e.g. in pie-charts or abstract works of art), the sensory coding orientation is affectively based, and congruent with an expressive aesthetic. It is an orientation or context in which high modality or value might be ascribed to non-naturalistic qualities that are tacit, suggestive, exaggerated, affective, connotative, evocative, or in some way expressive.

In its sensory coding, traditional animation is often closer to theatre than to cinema, and ‘animated narration recalls the fluency of *mise-en-scène* in contemporary theatre’ (Hernandez, 2007). The constraints of space and live production often require theatre to be more expressively inventive than film, and from moment to moment or scene to scene, whole sets or scene props might transmogrify magically, and a trunk might become a bed, or a coffin or a car. Julie Taymor (1998), a writer/designer/director of theatre, film, musicals and opera, who has successfully adapted animation for stage,⁶ sees art as essentially about transformation, and argues that an artist must transform and distort reality in order for an audience to be transformed. Echoing Coleridge’s lines (cited earlier), she sees an expressive approach as having the potential for powerful impact, enabling more active and creative interaction by audiences in making their own aesthetic and imaginative connections. Taymor also sees the attempt to recreate external realities as a fundamental mistake, and believes instead in internal realities as the only reality we can really know. This too is precisely the premise

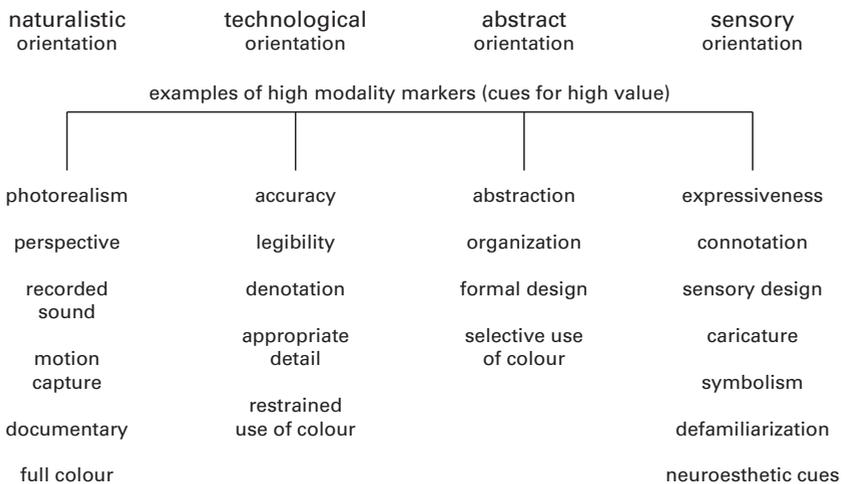


Figure 2 Coding orientations & modality cues (following Kress and Van Leeuwen, 2006).

of playwright and writer Michael Frayn's (2007) book *The Human Touch: Our Part in the Creation of a Universe*.

'Ultimately, a profound evaluation of artistic expression must involve both the world at large, which is its inspiration, and the human brain, which is capable of being inspired' (Harth, 2004: 115), and contemporary neuroscientific research, in particular recent findings in neuroesthetics, sheds new light on many of the classical and gestalt principles of expressive art. Ramachandran's (2004) neuroesthetic concepts such as *peak shift*, *isolation*, *metaphor* and *problem solving* point to how an expressive aesthetic can facilitate cognitive, creative and emotional engagement.

Ramachandran's concept of *isolation*, for example, is equivalent to Scott McCloud's (1994) idea of *amplification through simplification* and to the Minimalist design aphorism *less is more*. The neural basis of this is a bottleneck of visual attention; 'there cannot be two overlapping patterns of brain activity simultaneously' (Ramachandran, 2004: 52),⁷ and realistic imagery has a poor signal-to-noise ratio that can distract attention. The brain, as a complex dynamic system, responds to stimuli through associative Hebbian resonance in its neural networks that dynamically activates multimodal attractors affecting (and affected by) the complex reflexive interplay of phenomena such as emotion, attention and memory. Emotion drives attention, and stylized or expressive imagery can isolate and accentuate rhetorically, guiding and focusing attention by amplifying the signal, and through metonymic and synesthetic connotation and resonance, can act as a multimodal neural hyperstimulus, capable of encapsulating an entity's essence in a blended aesthetic gestalt. Active audience engagement can intensify these effects, and Semir Zeki (1999) argues that artistic hyperstimulation of areas of the visual cortex through expressive cues such as use of creative ambiguity, expands the viewer's imagination and invites participation in constructing meaning.

Recent brain imaging research has also compared responses to naturalistic video imagery, and then its rotoscoped, expressively animated equivalent. Rotoscoped from video, Linklater's *Waking Life* (2001) embraced a deliberate visual stylization for expressive effect, using imagery as metaphor, reflecting characters' altered states of mind. Evidence from the research suggests that, whereas naturalistic live-action evokes brain responses that characterize recognition and mind-reading, expressive animated footage is more likely to activate areas associated with emotional reward (Power, 2008). In other experiments, brain imaging of subjects shows that the amygdala, a centre of emotion, responds more strongly to impressionistic than to naturalistic faces, and that expressive works distract conscious vision while engaging more directly with emotions (Cavanagh, 2005).

The qualitative aspects of imagery are those that are expressive (Green, 2007), and a central case of expressive work is imbued with aesthetic cues (for example, exaggeration, isolation or defamiliariza-

tion) that, in contrast to a literal or verisimilar depiction, conveys a poetic or metaphorical psycho-verisimilitude that can evoke appropriate emotional responses in an audience. An animator might aspire to an expressive aesthetic in any of several different modalities; through use of form, music, dialogue, lighting, colour, movement, setting, narrative dynamics, or through the complex isomorphic or metaphoric interplay between these. Expressive aesthetic cues can apply in any modality, for example peak shift (i.e. caricature or exaggeration), and Gooch (2002) notes that in imagery 'the human responses to color, motion, form, highlight, outline, and depth are all susceptible to peak shift effects' (p. 194).

Expressive effect can be amplified by creating a resonating harmony or counterpoint between different modalities,⁸ and this involves metaphor. Metaphor is a creative fusion of similarity and difference that may have its evolutionary origins in symbiogenesis. Biosemiotics provides insights into how the capacity for creative joining together of different, even competing, phenomena in nature (evidenced in most cells in our bodies) may emerge as semiosymbiogenesis in culture through a capacity for metaphor (Wheeler, 2006: 137). Metaphor is also one of Ramachandran's (2004) neuroesthetics principles: 'in many ways . . . the most important' (p. 56), and he sees it in the brain's capacity for cross-modal connectivity, an exaggerated form of which, synesthesia, is relatively common amongst artists (p. 74). Such cross-modal metaphoric and metonymic associations might enable a staccato sound to resonate with sharp edges in imagery or to evoke edginess as a feeling. Similarly, for both artist and audience, the gestalt of an expressive aesthetic emerges through the *poiesis* of sensory interplay, through the sensorium's synergy of metaphorically harmonizing modalities. Discussing the semiotics of feeling, Modell, a Harvard Professor of Psychiatry, agrees that the connection between sensation, emotion, feeling and meaning is based primarily on the cross-modal associations of metaphor and metonymy. 'Metaphor mediates, categorises and thus organizes the perception of bodily sensations' (Modell, 2006[2003]: 145), including emotion, and not only transfers meaning but transforms it. In cross-modal metaphoric *poiesis*, the energy inherent in a hand-drawn character can echo inner emotion, the sorrow experienced in a tragedy can be transformed into aesthetic pleasure, or representations of others can imaginatively and empathetically become ourselves.

Artists and theorists, for example McCloud (1994) and Sobchack (2008), have highlighted the expressive qualities inherent in drawn lines or brushstrokes. Another insight into this source of expressive energy is provided by recent research on the brain's mirror-neurons' capacity for active simulation, that helps explain the nature of the expressive human warmth evoked by hand movement and vibration through a drawn line, or the embodied energy indexically evident through a thumb imprint on a clay model. Expressiveness and empathy

are closely linked (Green, 2007), and simulation theory suggests that the quality of the artist's gestures embedded in the work can induce empathetic engagement through active simulation, and that 'visible traces of goal-directed movements' will activate the mirror-neuron system (Freedberg and Gallese, 2007: 202). This is described as 'feeling the movement behind the mark', and helps explain some of the aesthetic appeal of expressive work that foregrounds expressive strokes, fingerprints, gouges, or any indexical artefacts of embodied gesture involved in its construction (Power, 2008: 43).

3D CG is usually indexically dehumanized through absence of such qualities. Marjane Satrapi, writer and co-director of *Persepolis* (2007), who uses pen-and-ink says that there's a perfection about computer generated animation that doesn't look 'natural' and a 'coldness' she doesn't like, compared to the expressive 'vibrations of the hand' that give life to hand-drawn animation (Satrapi, 2008). Klein (2000: 24) observes a similar phenomenon with *ani-morphs* in which 'the audience is supposed to sense the hand intruding', and proposes an aesthetic that foregrounds production methods. Aardman's supervising director Richard Golezowski insists that audiences can tell the difference between CGI, drawn and stop frame, and that in contrast with the automated, synthetic, even plastic-looking nature of much 3D animation, if 'you know it's a hunk of plasticine and occasionally you can still see the fingerprints - some of the process is revealed and that actually helps you tune in to the character' (Strike, 2007). Such indexical expressiveness 'captures the ontological spirit of form and its shaping forces', as Terzidis puts it (2003: 1). 'It manifests form's meaning, significance and quintessence.'

Creative expression in 3D CG animation

Expressiveness is about 'personality, individuality and idiosyncrasy' (Terzidis, 2003: 1), and expressive works in animation are more likely to be independent or auteur-type works, whereas many of the more formulaic animated features belong at the mainstream end of the spectrum. Though many of the latter will have an identified auteur such as Lasseter or Byrd, they are less likely to be driven by personal experiences or by strong empathy with others' experience, as is for example, Ari Folman's *Waltz with Bashir* (2008), about personal experiences connected with the 1982 Sabra and Shatila massacres in Lebanon, or Landreth's *Ryan* (2004), about Canadian animator Ryan Larkin, an Oscar nominee in 1969, who had fallen on hard times. It is intriguing that such expressive animation should come as documentary, traditionally the archetypal realist form. Independent animation will not necessarily be more successfully expressive than mainstream output, but in common with the film and music industries, cultural and economic factors, such as the scale, automation and economy of

production and distribution, have a huge impact on how creatively or idiosyncratically expressive 3D animated output is likely to be. Culture and economics influence narrative style too, and no matter how clever the graphics, formulaic storytelling will tend to be not only less expressive but less creatively satisfying. Creative scriptwriting in Hollywood is undervalued⁹ and use of formulaic narrative structures such as Joseph Campbell's a hero's journey in a fairytale setting lead to lack of originality in narrative (McClellan, 2007: 219), a scenario all too common in CG features.

Many artists or directors of moving image projects choose animation over live action explicitly for its expressive potential, and Linklater's *Waking Life* (2001) and Folman's *Waltz with Bashir* (2008) are just two examples (extensive live-action was shot for both). The latter was shot first in studio on video and subsequently animated using a combination of cel animation, Flash, 3D CG and live-action rotoscoping (Figure 3). The producers pitched to 40 international TV station managers at the Toronto Documentary Film Festival, but only two expressed any interest, eventually supporting the film. 'The other 38 attendants at the pitch did not comprehend why a film should be animated' (Folman, 2008). In contrast, reaction to the finished documentary seemed to justify Folman's animated approach. In *Variety*, Leslie Felperin (2008) observed that a subject that might have been just another war documentary, was 'transmuted via novel use of animation into something special, strange and peculiarly potent'. Jonathan Romney in *The Independent* (2008) wrote that choosing to 'depict his quest in impressionistic, often dream-like animation initially seems like an outrageous poetic liberty - but it makes his film all the more personal and gives it the urgency of a true cri-de-coeur'.

Emotional rather than visual realism is the stylistic choice for Folman and also for Chris Landreth in his Oscar-winning documentary short film *Ryan* (2005). Landreth is interested in what he calls *psycho-realism*, 'in co-opting elements of photorealism to serve a different purpose; to expose the realism of the incredibly complex, messy,



Figure 3
Still image from *Waltz with Bashir*
(Ari Folman, 2008).

chaotic, sometimes mundane, and always conflicted quality we call human nature' (Landreth, 2004). To achieve this he uses 3D graphics to reflect the characters' states of mind, and the 3D scenes include expressive non-photorealistic rendering and multiple, warped, non-linear, simultaneous perspectives (Figure 4).

There is some indication of expressive advances in CG features. Disney-Pixar's *Wall-E* (2008) is unusual, in that in contrast to most movies of this genre that rely on high modality dialogue voiced by Hollywood actors, for much of the film, the blips and whirs of robots are the only dialogue. Ben Burt's sound design is minimalist and highly expressive, and *Wall-E* was nominated in all sound and music categories for the 2009 Oscars, and won the Oscar for best animated feature.

Dr Seuss's *Horton Hears a Who!* (Chuck Jones, 2008) by Blue Sky Studios, the computer animation subsidiary of 20th Century Fox, is adapted from Dr. Seuss's book of the same name. An animated version was first produced and written by Theodore Geisel (Dr. Seuss) in 1970, and directed by Chuck Jones. Dave Torres, the lead animator, says the film enabled them to 'push the boundaries of expressiveness for an animated character' (Bekins, 2008). Co-director Steve Martino tried 'to bring Chuck Jones-style animation into 3D' using the original pen and ink drawings as stylistic inspiration, and describes 'a zone of Seussian exaggeration', where everything has a 'very hand-drawn, free-flowing style', with Who-ville being stylistically 'the very opposite of the rectilinear and symmetrical graphics that computers are fond of making' (Bekins, 2008). While the finished film fits comfortably in the mainstream genre, aspirations to more expressive output are clearly evident amongst some of those working in CG features.

Of course, 3D CG is modular and object-oriented (both under the hood and in the animation process), making 3D metamorphosis, figure-ground reversals and some distortion effects difficult, even counter-intuitive. Despite being digital, it lacks some of the flexible simplicity of pen and ink, and the 'dream of plasmatic freedom', signified for



Figure 4
Still image from Landreth's
psychorealistic *Ryan* (2005).

Eisenstein in the fluidity of the animated line (Sobchack, 2008: 262), can prove somewhat less lucid in 3D space.

Alternative perspectives

Two of the primary cornerstones of 3D animation are single-point perspective, the sine qua non of 3D CG technology, and its co-signifier in naturalistic illusion: photorealistic rendering. In exploring how 3D animation is expanding its stylistic horizons, it is worth examining briefly how both these conventions have recently been explored in terms of their expressive potential.

'The system of perspective is fundamentally naturalistic' (Kress and Van Leeuwen, 2006: 131), and 3D animation is defined primarily by consistent linear single-point perspective. Nevertheless, this convention is paradoxical, as it offers a point-of-view, often socially determined, that is encoded as though it is 'subjective, individual and unique', while it simultaneously rests on 'an impersonal, geometric foundation, a construction which is a quasi-mechanical way of "recording" images of reality' (p. 129). Thus, socially constructed viewpoints are naturalized, and single-point perspective remains one of our most pervasive abstractions. Nevertheless, experimental evidence shows that 'no culture-dependent learning is required for adequate perception of perspective images' (Zorin, 2002: 119), and linear perspective is a good approximation of the human visual system and will always be the norm when depicting 3D scenes in 2D.

Although the earliest documented observation of perspective has been dated to approximately 4000 BC (Coleman and Singh, 2004: 129), it failed to take off until the early renaissance in Europe and remained dominant in Western art until the 20th century when, unshackled from service to verisimilitude by photography and perhaps inspired by non-Euclidean perspectives or by Einstein's theory of relativity, modernist artists painted convolutions of space-time rather than just space. Cubists and later Surrealists (in particular René Magritte) played thematically with perspective and challenged conventions of naturalism and realism. Alternative projections don't just belong to ancient and modernist art, and to non-Western traditions,¹⁰ but to mainstream animation too; in cartoons, it became a convention for foreground characters and backgrounds to be treated differently, not just stylistically but in terms of their projection.

Many experimental alternatives to single-point perspective systems have been tried in CG with varying degrees of success, including systems for computing Escher-like impossible scenes, 3D warps and combined multiple projections (Agrawala et al., 2002: 158). Andrew Glassner, a CGI technical researcher turned writer-director, has worked on what he calls non-linear or free-form optics for computer graphics (Figure 5), as detailed in a paper titled 'Cubism and Cameras' (2000).



Figure 5

Image from a storyboard for a thriller using expressive projections. Artwork by Tom McClure from Glassner (2000).

He insists these are much more than curiosities, and that just as the cubist painters found new angles to communicate, his ‘animated, fluid form of cubism’ using free-form optical models can do likewise with synthetic images and animated sequences’ (p. 1). Agrawala et al. (2002, amongst others) have also developed systems for simultaneous 3D multiprojection, as artists often use multiple projections for ‘expressing a mood, feeling or idea’ or for improving comprehensibility of the scene (p. 155).

Karan Singh, who had worked on the development of Maya, was R&D Director on the production of *Ryan* (2004). He was motivated by the surreal storyboard and inspired by the artwork of people like Picasso, Dali, Albright and Bacon to develop a system (subsequently implemented in Maya), that could render out multiple simultaneous projections and camera angles to a single frame. These warped non-linear projections helped express the characters’ psychological perspectives and could also be used to create cinematic mood or create a sense of uneasiness in the audience (Coleman and Singh, 2004).

Capacity for simultaneous multi-projections needs to be built into the compositional space and many problems remain to be solved with such systems.¹¹ However, the seamless integration of multiple perspectives with appropriate lighting, shadows and effective artistic control may provide a projection palate freed from the hegemony of the quasi-objectivity of perspective, enabling the animator to choose dialogically what aspects of the scene to accentuate, from what angle and to what aesthetic effect.

Expressive (or non-photorealistic) rendering

Alternative rendering algorithms can be used to output a naturalistic scene in eclectic styles from cartoon-style to Canaletto. Some similar off-the-shelf effects are common in 2D paint applications such as Adobe Photoshop, and simpler image-based post-processing techniques can also be used in 3D. However, effective non-photorealistic rendering in 3D applications is a more complex affair. Non-photorealistic rendering (NPR) is the collective name for a range of

techniques that have been developed to render 3D models and animations in alternative modes to the photorealistic norm for the genre, and the term *expressive rendering* is synonymous and seems preferable to the negatively couched default term *NPR*. Durand (2002a) argues that, although computer graphics has long been defined as a quest to achieve photorealism, 'as it gets closer to this grail, the field realizes that there is more to images than realism alone. Non-photorealistic pictures can be more effective at conveying information, more expressive or more beautiful' (p. 11).

Typically, NPR flattens output from 3D animations and offers a plethora of output effects. Amongst these have been simulated artistic media (e.g. watercolours, oils, charcoal or stained glass), painterly styles (e.g. impressionist, pointillist or Van Gogh), and even cartoon or *toon-style* rendering that has been integrated into mainstream 3D applications such as Maya (Figure 6). In *Ratatouille* (Brad Bird, 2007), a brief 2D effect where a book illustration of the famous chef Gusteau comes to life and talks to the protagonist Remy was created using a regular 3D scene output with a *toon-style* render.

If well handled, expressive rendering has the potential to meaningfully expand the palate of artistic effects and can open up expressive opportunities for animation artists. On the down side, many of the effects implemented using NPR have been trivial or gimmicky. There is a difference between images of expressive or artistic merit and ones that look vaguely artistic, and switching on a *Van Gogh style* filter will most likely generate kitsch. A paper titled 'A Real-Time "Boiling Style" Nonphotorealistic Rendering System for Low Fidelity Animation' describes an NPR system that 'produces jittery style drawings' that mimic 'low-fidelity animation conventions to produce rendered models that look hand drawn rather than machine interpreted' (Hesselgren and Naftel, 2003). Without denigrating the system in question, the description does beg the question as to whether algorithms that automate 'jittery style drawings' that 'look hand drawn' can help output genuinely expressive animation. Animation



Figure 6
Expressive rendering – contrasting naturalistic and expressively rendered duplicate objects from a single 3D scene (using a Maya toon-style render).

that mimics expressiveness, perhaps, but much depends on implementation and on how much control the animator has over the output.

Although some NPR work has focused on derivative artistic effects or effects derived from other media, expressive rendering effects do offer creative options for animators if well implemented. Much depends on whether the effects are relatively pre-determined or automated, or whether they offer interactive, intelligent and intuitive tools for expressive artistic control. Further creative developments are feasible, with recent research focusing on findings from cognitive psychology and empirical research on perception, including neuroscientific work on visual perception, which is one of the most advanced fields of neuroscience.

Conclusion: evolving an expressive 3D aesthetic

Mainstream 3D animation culture continues to be driven by a naturalistic agenda, and the convergence of live-action SFX and animation is one of the driving forces. For example, James Cameron's *Avatar* (mostly CG with some live-action and due for a 2009 release), uses seamless performance capture, so that the actors can be directed in real-time with the director simultaneously viewing the actions of the CG characters set in 3D CG environments. The aim is a seamless synthesis of the real and the virtual, even during direction and production. *Avatar* is made in stereoscopic 3D for 3D projection. Assessed as a gimmick during the early 1950s and again in the early 1980s, the 3D projection phoenix has arisen again, perhaps to persist this time, particularly for mainstream feature animation, as the technology has improved immeasurably and 3D CG production techniques are highly suited to flexible and economically viable production in this mode.¹² Heightened realism as immersive spectacle is the primary aesthetic goal of 3D projection and it is another indication that Hollywood is still hot on the trail of the virtual reality grail. Physics simulation, seamless performance capture and 3D model generation from video, for example, are all particularly active research and development areas, and all are linked to the naturalistic agenda.

As the technology gets faster and more sophisticated, the limitations that have so far precluded attempts at fully photorealistic 3D animation will eventually be surmounted. But material constraints can have creative advantages, and often lend a medium its charm, requiring artists/animators to adopt expressive solutions. Durand (2002b) outlines three ways to handle them: by elimination (finding technological solutions); by compensation (alternative hacks or workarounds); or by creative accentuation, which he says 'can bring important richness to pictures' (p. 27). Accentuation foregrounds constraints stylistically for expressive aesthetic effect. *Less is more* can apply to

creative freedom too, and the capacity to do work with few material constraints in a digital environment may prove to be a mixed blessing.

These developments are fine as long as more expressive approaches are not culturally and technologically sidelined. Presently there are many modes in which 3D animation can be used as an expressive storytelling medium. Expressive 3D models can be designed by choice using distorted geometry for non-naturalistic modelling effects. Animation data (including motion capture data) can be augmented stylistically either by keyframing, or by using algorithms enabling, for example, hyper-energized, fluid, languid, robot-like, rubbery, sticky or other effects. As outlined earlier, expressive effects can be achieved through implementing warped or multiple cubist-like camera projections, or through expressive rendering techniques or post-rendering effects.

3D is often digitally integrated with live action and other animation techniques, and this hybrid aesthetic is one obvious way forward for expressive animation. Mixing live action and animation is hardly new (the Fleischer brothers composited live action and animation in the 1920s in the *Out of the Inkwell* series starring Koko the Clown). Originating assets in digital format simplifies manipulation and synthesis, however, as evidenced by many modern hybrids: for example, Luc Besson's *Arthur and the Invisibles* (2007) and the *Stuart Little* series. Both *Horton Hears a Who!* (Chuck Jones, 2008) and *Kung Fu Panda* (John Stevenson and Mark Osborne, 2008) are 3D animated movies, but both use brief 2D animated sequences to code dream/fantasy altered states of consciousness. In the former there are two, one based stylistically on Dr. Seuss's pen-and-ink illustrations from the book and another based on anime, and there is one in the latter, styled on Chinese shadow puppetry. The flexible nature of a digital environment enables this fruitful fusion of styles and a simultaneous dialogical synthesis of alternative animation traditions for expressive aesthetic effect.

Looking to the future, there are a number of developments that would help enable the evolution of an expressive aesthetic in 3D animation. Interface design is an area in which 'the amount of user vs. computer control is an exciting issue' (Durand, 2002a: 17), and many animation systems are not intuitive or easy to use, as focus has been on high-profile developments in naturalistic functionality and effects, with comparatively little development in intuitive interfaces.

There is the real danger that computerization produces what Terzidis (2003) calls *Whorfian effects*,¹³ where 'through the use of commercial applications and the dependency on their design possibilities, the designers' work is at risk of being dictated by the language-tools they use' (p. 69). This conundrum can be observed regularly when novel or 'cutting-edge' effects (for example, morphing) become fleetingly fashionable and are consequently over-used in adverts or films to the extent that they soon become clichéd or passé. Terzidis suggests

that, on the other hand, what he calls *algorithmic design* enables creativity and discovery of new forms and novel phenomena (p. 68). This involves more open-ended, complex or programmable options being available to the animator or designer as opposed to default presets or a relatively finite range of ready-made effects. Such algorithmic design capabilities are already enacted on some systems (through scripting, for example), but their current effectiveness depends on an animator's capacity (or at least that of one of the team) to program them effectively.

It is a lot to ask of animators (or anyone else) that they should excel in visual and motion design, character design and storytelling, and then be capable programmers as well, so the implementation of intuitive interfaces for algorithmic design processes is critical. Many modern interfaces are still encumbered with numerical or other non-intuitive forms of input, often into a bewildering host of variables with indeterminate functionality. Interfaces with iconic or indexical relationships to real-world equivalents enabling embodied interaction can be more intuitive and easy to use for expressive effect, providing they do not bind the artist to the constraints of their real-world equivalents. What might be called a *magical-realist* approach to interface design would be optimal in this context, with functionality based on real-world analogues where helpful, but with 'magical' digital capability besides.

Although limited gesture-based input already exists, for example on paint systems, complex gesture-based interfaces (and those with haptic feedback) are likely to become more common, and evolving versions of these can be seen with recent products such Nintendo's Wii, and those using Apple's MultiTouch and Microsoft's Surface technologies. Gesture-based interfaces for 3D animation systems would be particularly apposite and would lend a reflexive element to animating – the animator animates character gestures in software through using gesture. Use of gesture on input could facilitate more expressive and intuitive computer-based animation, including virtual gesture-based aesthetic phenomena such as *feeling the movement behind the mark*.

In terms of theory, emotion is an important basis for understanding expressiveness. Despite their hypothesizing the concept of a *sensory coding orientation*, Kress and Van Leeuwen (2006) acknowledge that affect/emotion has been 'too thin a thread in the tapestry' that comprises their influential semiotic theory of imagery and visual design (p. 267). Emotion is both psychological and visceral, embodied minds and their physical and cultural environments are complex systems, and can best be explained, as Antonio Damasio argues (Liston, 2001), by blending theories at several levels of organization, from molecules and cells, to large-scale systems, and physical, social and cultural environments. Symbiotic paradigms such as complexity theory, phenomenology and biosemiotics can embrace the connectedness of biology and culture and provide fertile environments in which embodied approaches to expressive aesthetics can flourish.

Although we are ‘inextricably shaped by embodied action’ (Gibbs, 2005: 276), ‘our linguistic, imaginative and symbolic capacities provide a degree of freedom from the demands of our environment’ (Modell, 2006[2003]: 138). While the semiotic freedom of creativity is the fullest expression of human communication (Wheeler, 2006: 133), naturalistic or other conventions impose ‘limitations of conformity on sign-making’, constraining its ‘semiotic scope’ (Kress and Van Leeuwen, 2006: 12). By qualitatively transcending its calculative and quantitative genesis, the contemporary expressive turn in 3D CG animation has a creatively liberating potential through which we may be moved, even transformed by the reflexive resonance of the human touch.

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Notes

- 1 *Photorealism* as a style in painting and *Hyperrealism*, a more recent and expressive variant, add somewhat to the potential for confusion in terminology.
- 2 Although 3D computer graphics has its own compound term *virtual reality* that is relevant in this context, it suffered from over-hyped usage in the 1990s and still suggests headsets and real-time simulation in virtual space.
- 3 It is worth pointing out that denotation can be seen as just a dominant naturalizing connotation, an illusion perpetuated by a naturalist ideology.
- 4 Labels for art movements such as *Expressionism*, *Abstract Expressionism* and cinema’s *German Expressionism* muddy the terminological waters considerably.
- 5 This concerns how we are able to have strong emotional responses to fictional situations we know are not true. Rolls suggests, like Robinson, that though the emotions may be real enough in an arts context, there is slower top-down cognitive mediation of the emotion that contextualizes response.
- 6 Taymor’s multiple award-winning adaptation of Disney’s animated film *The Lion King* (1994) for the stage was produced by Disney Theatrical Productions, who have similarly adapted other animated works for Broadway including *The Hunchback of Notre Dame* (1996) and *Beauty and the Beast* (1991).
- 7 This phenomenon is the basis of visual illusions such as The Rubin vase/profile figure/ground illusion and the Necker Cube ambiguous line drawing illusion.
- 8 Conversely, dissonance between modalities can evoke effects such as tension or irony.
- 9 The 2007/8 100-day US writers’ strike had a minimal effect on animation production (with some exceptions such as *The Simpsons*), as for historical reasons many animation writers belong to the Animation Guild whereas

the strike was called by the more live-action oriented Writers Guild of America.

- 10 Many other cultures used alternatives to linear perspective, e.g. Japanese and Chinese artists typically used oblique parallel projection in their drawings.
- 11 Multiple projections, metamorphosis (morphing), image distortion and NPR effects can all be added relatively easily as post-render or 2D image effects. However, these can be qualitatively different from more challenging 3D implementations that are integral to the scene and rendered as such.
- 12 On the commercial front, it also helps differentiate a lucrative theatre release market from a domestic one, at a time when high definition technologies such as Blu-ray are leading to market convergence.
- 13 The controversial Whorf or Sapir-Whorf hypothesis in linguistics suggests that different language patterns give rise to different patterns of thought and that thought is determined to a great extent by language.

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