

Troiage Aesthetics

Sheldon Brown, La Jolla CA 2007

Developing an aesthetic, manifested as a style, is a culmination of intention, intuition, capability, accidents, history, talent, intelligence, ignorance, resources, education, patience, frustration, passion, acuity and other miscellaneous ingredients from ones self and ones situation. In this case, the term “aesthetic” is employed. *Troiage style*, as an alternative, is a slightly different shading, a more reflective characterization which might be read as attributing more to personal flair, or building prescriptive rules from personal quirks than I am intending. An aesthetic is a proposition, a theory. A style is a description. The artworks that I attribute to pursuing *troiage aesthetic* qualities are meant to set in motion sets of gestures that are generative with the viewer. This relationship between artwork and viewer is the interactive mode of the work, across all manner of engagements: operational, perceptual and intellectual. The syntactic and structural elements of the work are used to develop this relationship.

I coin the term *troiage aesthetics* as a way to describe my inquiry into the operation of cultural conditions that come from the continuing development of computing. The term connotes a synthesis of multiple domains of visuality – collage, montage and assemblage – and their application to the domains of the still-image, the image in time and the object. However, the meta-medium that emerges from this synthesis is specific to the conditions of computing, obligating an interactive viewer to complete its expression.

Of primary concern for the development of this aesthetic are expressive modes which have efficacy to a set of conceptual concerns. The artwork is meant to be a territory in which the user/viewer is in an active inquiry to these concerns, sorting through primary relationships about how meaning is made and how it is received in the contemporary cultural condition.

A key strategy is the development of systems of generative constraints. The boundaries of these conditions catalyze the elements of the work. The boundaries are crucial markers in creating the “framework” of the art. It is necessary that the systems of constraint have apparency for a viewer, creating a self-conscious engagement with the art experience, engaging in an intellectual interactivity with the work. This interactivity is but one of a set of interactive engagements that the user has with the work, extending to perceptual interactivity and operational interactivity. The aesthetic uses the concept of interactivity as a spectrum of engagement between doing, seeing and thinking, and is the outcome of historical developments in the construction of subjectivity whose antecedents can be traced through painting and literature.

This system of generative constraints can be compared to how “mediums” were previously conceived. With computing, the notion of a medium differs from previous, discrete, media such as painting or photography or cinema. Computing

functions as a meta-medium, simulating previous media forms¹ as it becomes a platform for the continuous invention of new “mediums” of expression driven by the interests of its content. While there has always been bi-directional relationships between the evolving structure of mediums and the content of individual works, with digital media we have the opportunity with each new work to create - or at the least make considered choices about - their own media forms. The media form that is generated might last for 10 years and million's of works will be created with its expressive attributes or perhaps only one work will utilize its forms. Examples of this can be seen in such areas of recent digital culture as the CDROM, the web (will it exist in 10 years?), Flash, VRML, the CAVE, Quick-time VR, blogs, etc. Artist created multi-media installations are an extreme example of this, creating novel mixtures of media elements, architectural and sculptural forms².

In this conception of constraints as having a key role in the development of an aesthetic, we must consider how the mutable nature of computing might be operating as a constraint, and thus its catalyzing effects on aesthetic developments.

Computing as a Medium?

Expressive media erupt from technological and/or socio-cultural developments which enable new modalities of expression – and are then incrementally refined. We can see this in the development of the book (and its transformation by the printing press), painting (its history of development in relationship to such concepts as perspective or modernism), photography and film. Each of these media continues to develop and transform, but there are moments where major modalities were formed by broad strokes at particular points in its history.

The computer has been around for some time; the moment of its invention is a bit contested. For the sake of this argument I'll take the Eniac's operational debut in 1945 as the point of departure for the modern era of computing³. At roughly the same time, television was developing.

As mediums for cultural expression, however, television and computing have provided two very different development graphs. When video was deployed, it did so with many of its attributes fixed by government mandate. The form of television still in use today in the U.S. – NTSC –was established in 1941 by the FCC⁴

¹ "Real Art and Virtual Reality" by Sheldon Brown, ACM SIGGRAPH Computer Graphics, Volume 31, Number 4, November 1997.

² See for example any of the works off of my webpage, <http://crca.ucsd.edu/sheldon> – each of them constructs a mechanism for framing meaning that has content specific derivations from more ubiquitous forms.

³ The Computer, from Pascal to von Neumann by Herman H. Goldstine Princeton University Press, 1972

⁴ Federal Regulation of the Radio & Television Broadcast Industry in the United States: 1927 – 1959 by Robert S. McMahon, Arno Pr; Reprint edition (January 1980).

and still operates with significant components fixed from that day. Computing also has some of its major attributes in common with the Eniac, however they aren't fixed by regulatory mechanisms; rather, they became fundamental methods of contemporary computing due to their efficacy. What the Eniac codified is its use of Boolean logic to engage binary representations of data in a Turing machine architecture. These representations are still very much at the heart of today's computers, just as the NTSC TV specification is very much at play in today's televisions. However, the granularity of these computational principles has been doubling every 18 months or so. It has been about 700 months since Eniac. Moore's law tells us that "computer power" should have doubled 39 times since then⁵ Two to the 39th power equals 549,755,813,888: Moores' law is rough, but relatively accurate. Our computers are about a billion times more powerful than the Eniac. Furthermore, there was only one Eniac in 1945. Today there are several billion computers of widely varied computational capacity, and a great many of these are connected together, combining computational capacity in complex ways.

Television was invented as a medium for creative expression. From the start it was developed and refined around the combined notions of cinema and radio. Computing was developed to break codes and calculate gunnery tables. In the development of computing, its development wasn't driven by the needs of cultural expression. Those modes would arrive later, and develop slowly, taking decades for computing power to develop to the point that it could process such things as audio streams, images and synthetic environments.

Computing is mutable and continuously extensible, in a manner that is qualitatively different than previous cultural forms. While there can be said to be some quantitative relationships between the growth in the number of electronic pixels and the number of CPU cycles in existence, the quantitative expansion of CPU cycles brings new qualitative modalities under their control. The extent to which is a point of interesting debate: is it infinitely so? Is it at least as much as that of the human brain? Or is it a bound system, forever enticing us with its potentials, but never a culminating effect that quantities of Boolean operations can achieve – they will just make a more and more amazingly complex watch, but they will never be able to actually create time.

Creating art within this situation presents some different considerations than with other historical toolsets. Making art that has an apparent engagement with computing (addresses computing in part as a subject of the work - computing as

⁵ The ENIAC could perform 5,000 additions or subtractions or 360 multiplications of two 10-digit decimal numbers in a second.

<http://www.upenn.edu/computing/printout/archive/v12/4/crackpot.html>.

A 3 Ghz Pentium 4 (which weighs considerably less than 30 tons that the Eniac weighed) performs about 6 billion floating point operations per second, or about 16 million times more than the Eniac. At the high end is– the Earth Simulator computer, run by several Japanese scientific research agencies in Yokohama, (<http://www.top500.org/lists/2003/11/1>) which measures about 40 teraflops, or about 100,000,000,000 times faster than Eniac. Thus somewhere between the Pentium 4 and the current supercomputer champ is this misapplication of Moore's Law, which was actually coined to describe the growth of transistor density on a chip.

the medium of the work) means to work with tool that is in a perpetual state of becoming. Whatever the aesthetic or expressive components are that underlie the work, will have their fidelity trumped tomorrow, and possibly extended or combined with a new modal form as well. For instance, it wouldn't be too much of a surprise for a highly effective olfactory interface being invented. So if the modalities and fidelities are at best transitory with computing, are there more essential elements that can be employed to constitute a medium out of which a style or aesthetic can emerge?

Troiage

Troiage is an aesthetic concept that has evolved through the development of a series of artworks by the author, which engage the ideas and forms of interactive 3D computer graphics⁶. It posits that interactive 3D computer graphics have particular formal and expressive attributes that transform and combine previous cultural codes within cinema and architecture, through computational operations. Fundamentally, these computational operations are the performance of Boolean operations on binary numbers. These numbers represent concepts, images, words, and other numbers. They do so really fast, but they don't do anything else. In fact, each computational state could be statically represented by just tying together a bunch of NAND (Not And) gates. At the base of every computational gesture is this fundamental act. Looking at the edges of the computationally derived forms, at their limits of expressivity, you will find frays of Boolean operations. Thus we have a constraint of computing when seen as a medium, perhaps here we can find some generative energies where meanings fail and the normative and the abnormal exchange places.

Nothing is actually captured and fixed in a computer: the computer operates by simulating all of its representations. (Compare to chemical photography, where light physically transforms the object.) In computing, we can capture these events, but then we can continuously change how we want to interpret them. My digital picture of the Mona Lisa can be turned into a bit stream for playing on a sound synthesizer, or it can form a behavior system for a flock of micro robots or it can be the control code for the Tokyo traffic light system. This protean transmutation is a key attribute of computings' potency. Developing an aesthetic sensibility that effectively comments upon and derives from these attributes is a key aspect of the *troiage* aesthetic. Coining this aesthetic is an explicit nod to its meta-medium operation, and is an engagement of three antecedent forms – the imagistic, the spatial and the temporal.

⁶ Artworks that didn't use actual 3D computer graphics, but which used cultural forms that were being created via computer graphics include MetaStasis/MediaStatic 1999 <http://crca.ucsd.edu/~sheldon/metastasis/index.html> and The Vorkapithulator, 1992 <http://crca.ucsd.edu/~sheldon/vork/index.html>.

Collage: the imagistic antecedent

The creation of virtual worlds⁷ consists of defining a space. Internal subsets of this space are used to draw pixels which mimic visually the apparent properties of an object inhabiting the space under the rules by which govern that space. Those are a lot of qualifying statements to describe a visual form that typically uses the culturally familiar designations of Cartesian space. But I am explicitly delineating components of this to clarify the many contrivances that are utilized to create these synthetic worlds, where a simple approach is executed on a massive scale – geometric surfaces described in 3-dimensional space. Billions of calculations which place forms in spatial relationships, paint them with pixels and then image them to a particular plane are done each frame, and there are on average 30 of these frames created every second. The other dominant characteristic of those surfaces is obtained through the application of simulated lighting effects upon them. Techniques have a range of verisimilitude, from the relatively crude Phong, Lambert or Giroud shading, which simplifies light's subtleties in a few crass characteristics such as specular, diffuse and ambient components, or the more sophisticated simulations which map photonic interactions with material properties⁸

These polygonal surfaces are carefully constructed to simulate the surface of some consistent and coherent objects. As they are built, particular tricks are employed which utilize a mix of characteristics that can be obtained from the geometric specifications and the object's texture and material definitions to create the final effect. However, using these constructive principles directly and not simply in their illusionistic capacity can provide for a level of engagement that brings more meaning into play. As in any medium, expressive strategies that include artifacts of a medium's functional form bring into a work's discursive range concerns about the history of the medium – how it has been utilized in other expressions and the general representational mechanisms that it involves. It is an acknowledgment that the expressive tools that one is working with have applicability elsewhere, bringing a cultural contextualization into the work.

These faceted forms of spatial pixel maps are readymade containers for collage strategies. By making more conscious engagements of the combination of spatial form and surface description – one can multiplex these object definitions to create an intermix of referents to occupy their space. Spatial collage overtly brings at least two elements into radical consideration with each other. It isn't just the surface symbols that collide; it is the structures at work beneath them – what is brought together are all of the open-ended forms that are represented by the collaged elements. Collaged elements operate more overtly at the level of sign than

⁷ During 90's interactive, 3d graphic environments were called "virtual reality". Now it is thought of primarily as computer gaming environments. The technologies have migrated to the masses and transformed their implications.

⁸ "Photon Mapping on Programmable Graphics Hardware", Proceedings of the ACM SIGGRAPH/EUROGRAPHICS conference on Graphics hardware. San Diego, California, 2003.

do the elements that strive so hard to sit in a normative representational universe. Now there is no reason that the un-collaged can't and won't operate at a meta-syntactic level, it is just that they often don't – sometimes a pipe is just a pipe – and often in our banal world of continuous media consumption, the relationship of signifier to signified is just not as interesting as many of our old school post-modernists would have us believe. Or it is perhaps that, as an artist, the range in which we can work extends beyond the normative strategies of consumer media, allowing us a density of expression in the gestures of our work, that make these types of strategies effective.

Assemblage – a spatial attitude

Just as we can build the components of objects by considering the meaning of strategies we undertake for each element – the totality of these objects creates a context that provides a reflexive whole onto each element in-situ.

Again we can find ourselves working against normative engagements of media which strive to create illusionistic and banally consistent worlds. Even if the worlds have large transformations that occur in them, they most often do so with a seamless and narratively simple cohesiveness. It is not necessarily simple to do this with computer media: in fact it is very difficult, and thus doing so gives a work a certain virtuosity (motion pictures that pull off a blending of “visual effects” with live actors and sets often gain accolades of critics and the movie industry). However, one should ask “what meaningful ends does this technical virtuosity achieve?” These desires are ways to replace a responsibility for a meaningful engagement with an expressive form and substitute the external reason of believability for engaging an expressive strategy.

For the artist, the use of the tool is the continuous reconciliation of working from the inside out with the desires of the outside in. In doing so, the acknowledgement and embracing of incongruities tells more (and in a more efficient way) than all of the effort of seamless blending. The “making of” features of effects laden films on DVD are always more interesting than the obvious film itself. By laying out the incongruous realms of computer effects, models, live actors and possibly other forms of footage (such as historical or documentary), we see the play of the narrative erupting through multiple layers of human expression – it is completely unnecessary to obliterate their individual character through the process the movie industry tellingly calls “*conforming*.”

Montage

These ideas about spatial strategy owe their specific usage to the manner in which filmic montage has been theorized. Not that there is as reductive an approach to

meaning and effect that early Eisenstienian *montage* theory tried to derive,⁹ but simply understanding that radical temporal juxtapositions create a vocabulary of meaning. For computer game/virtual reality forms, this has become significantly utilized of late. However, its general use is simplistic and limiting; trying to extend the primitive first-person shooter into a more “cinematic” look, recognizing that the leap to a third person view aggrandizes the violent acts in a game.

The real opportunity that we have with these types of worlds goes beyond a montage strategy that employs the most flexible camera a cinematographer has ever had (and an infinite number of them). We have a situation where *world* and *camera* and *subject* are completely interchangeable and inter-mutable. We can shift subjectivity, object structure and world organization as simply as we can cut from camera 1 to camera 2. Montage is no longer just a strategy for the camera and the editor – it is now a strategy for, and between, the actor, the set, the score, the costume, the lighting, etc.

This of course follows upon the translational capacity of the computer. All of its processes are undertaken without any material prejudice. It does not matter that one method describes how time is edited and another strategy is a way space is defined.

As artists who engage in a culturally critical practice we should purposefully “mis” apply these codified forms as an expressive strategy. We need to script our scenes on the basis of lighting algorithms and derive our edits on the basis of sound filter synthesis. By applying these strategies across domains, value systems become apparent and revealed in way that transcends their usage “as intended”.

This is important work to do. It is important beyond the expressive boundaries of a single work at a specific time. It is important because it can provoke an examination of our own lived experiences – to look at the ways in which our world is becoming increasingly mediated and directed by algorithmic processes. We need to be able to read those processes in order to survive. We need to be able to hack them and jam them at times – in order to survive. We need to continuously allow our own humanity to transcend their dictates as they become increasingly interesting. At some point they may become more interesting than our humanity and then perhaps our job will be done.

Interactivity as reception

If *Troiage* describes the aesthetic operation of elements within these works, interactivity is the way in which they relate to the viewer. Interactivity describes a relationship between artist, artwork and viewer that has a primacy in contemporary cultural forms. This interactivity is an outcome of developments in western culture that have created a new set of relationships between the realms of representations and the realm of the real. In this aesthetic theory I want to reposition all methods

⁹ [Sergei Eisenstein](#), *Film Form: Essays in Film Theory*, Harvest Books 1969

of cultural reception to be considered interactive methods – viewing, reading, conversing, operating, etc. This requires us to abandon the simplistic ways in which less expanded notions of interactivity are generally used by contemporary media; critical of these methods as paradoxically producing a more passive consumer of culture, (but with new, voracious appetites) rather than an active participant in meaningful exchanges with cultural forms. Together, these two points of view provide a relationship between audience and experience which can create an active cycle of meaning generation.

The relationship of audience to cultural form has normative modes which tend to stabilize as the semantic structure of a form settles; however, within these forms, this relationship is never completely fixed, and often becomes the site of contention when modes of expression undergo transformation. Briefly, consider some moments in the history of painting. The development of perspective created myriad shifts in the relationships between artist, subject and viewer. Perspective provided a scheme that had a high measure of verisimilitude with perceptual experiences in the world.¹⁰ These specifically could be related on an almost one to one basis with such things as camera obscura, or camera lucida devices. As Alberti was codifying perspective schemes in his treatise “On Painting,”¹¹ devices such as mirrors, grids and tubes created a fixed view from which a scene could be rendered. They created an idealized virtual viewer for these works. Actual viewers could occupy the specific convergence spot (although often the schemes were more complex than those that resolved themselves to a singular viewing point, for the general advantage of the operation of the painting as a whole). However, it wasn’t necessary to occupy a privileged spot to view the work. We easily projected the spatial scheme to have coherency when our view is off-axis from this spot, perhaps through a type of 3rd person view, projecting our self into the role of the privileged viewer, without having to actually occupy it. The salient aspect of this scheme is that the space of the painting had a relationship to the space that our body occupied. That this worldly space was now able to be a subject of painting is tied up with general social and cultural shifts which revalued knowledge of the world, rather than just that of heaven. In turn, representations of the ecclesiastic became based on this effective schema of the world, and since these representations had to be put somewhere – they were put in the clouds.

With this scheme, our view is directly addressed. It infuses the primary scheme of how the painting is done. While it operates without necessitating our viewing location mapped strictly to the projected location of the painting, this congruity is often exploited to evoke a transcendent experience. An oft used instance of this is in church ceiling murals – for reasons that are both technical and those that are thematic. Several spatial attributes set this up. The distance from the viewer and

¹⁰ Perspective schemes are particularly important to current interactive cultural forms such as computer games and virtual reality. As silicon perspective engines have become embedded into all contemporary computers – perspective representations have become the norm for video game activities.

¹¹ Leone Battista Alberti, *On Painting*, 1435. Florence.

the expanse of the image plane allow a wide viewing area of perspectival congruence. Many people can occupy a near optimal viewing position, sharing the illusionistic experience of the painting. The expanse of the image at such a distance fills a great deal of the viewer's vision cone, with the distance softening the effects of real world textures and artifacts. The view is also disconnected from the normal view of the ground plane – viewers look up, instilling a slight vertigo. The subject of these church ceilings is the heavens. It reinforces the role of the church as a gateway to heaven, and while perspective provided a means of representing the earthly, the church is quick to turn this into a powerful tool for perpetuating its own worldview.

The act of viewing this type of work is more than just a passive reception of the image. It involves active participation within the logic of the image. We become a subject of the painting. A direct engagement of this is found within Diego Velázquez' *Las Meninas*, in which the viewer occupies a reversed vanishing point: the point of convergence of the gaze's of those depicted in the painting, as we stand in, or with, the King and Queen as the subject of the painting.

Between these two examples, there are differences in how this active engagement of the viewer is utilized. Both create a type "immersion" into the artwork. They collapse the world of the painting with the real world, situating the viewer as the bridge between them. The church mural does so in a way that suspends disbelief in the viewer, enticing them to momentarily cross this bridge and be in the world of the painting. *Las Meninas* prefers to keep the viewer vibrating in the interstitial space between the two. It does so by creating a self-conscious viewer, who intellectually inhabits the conundrum of the painting. This idea of "immersion" is re-invoked in our era interactive, virtual environments. But as we see in these examples from static painting, the immersive mode offers more than just the engagement of the senses, it creates an exchange between the subject, the subjects world and the world of the cultural form. These exchanges are not complete, but further the stakes of the symbolic relationships between the cultural and the real, into one that has quasi-operationality, and the viewers perceptual relationship is now an interactive one.

This folding of the represented into the fabric of the real (or vice a versa) is described in an allegory by Borges:

On Exactitude in Science . . . In that Empire, the Art of Cartography attained such Perfection that the map of a single Province occupied the entirety of a City, and the map of the Empire, the entirety of a Province. In time, those Unconscionable Maps no longer satisfied, and the Cartographers Guilds struck a Map of the Empire whose size was that of the Empire, and which coincided point for point with it. The following Generations, who were not so fond of the Study of Cartography as their Forebears had been, saw that that vast Map was Useless, and not without some Pitilessness was it, that they delivered it up to the Inclemencies of Sun and Winters. In the Deserts of the West, still today, there are Tattered Ruins of that Map, inhabited by Animals and Beggars; in all the Land there is no other Relic of the Disciplines of Geography.
Suarez Miranda, Viajes de varones prudentes, Libro IV, Cap. XLV, Lerida, 1658¹²

¹² Jorge Luis Borges, *Collected Fictions*, Translated by Andrew Hurley Copyright Penguin 1999

The narrative form that has a self-consciousness of its own operation as a narrative form, creates a role for the reader/viewer as an active subject within the framework of the narrative.

Borges provides other examples from literature which exhibit this self-conscious form: Don Quixote finding a copy of the book "Don Quixote" or Hamlet essentially watching the play "Hamlet". Later on, this type of literary device becomes a structuring element for entire books, as in Italo Calvino's "If on a Winter's Night a Traveler". This is a collapse of the represented with the act of representation. For Borges, the smudging of the boundaries between these two worlds creates an anxiety in the viewer. "Why does it disquiet us to know that Don Quixote is a reader of the Quixote, and Hamlet is a spectator of Hamlet? I believe I have found the answer: those inversions suggest that if the characters in a story can be readers of spectators, than we, their readers or spectators, can be fictitious."¹³

What good is this anxiety? It engages an ontological narrative of what constitutes the real and how our attempts to investigate, describe, communicate and extend our understandings of the real breakdown into seeming paradox when we examine our conventions. When we create new forms of expression, their ability to create and describe experiences previously unknown tends to create a crisis in our understanding of the boundaries of the real. Moving through the development of 3D interactive computer graphics has reproduced this anxiety. As the elements of interactive 3D computer graphics were becoming apparent, literary and cinematic fantasies extolled foreboding of the effects of this form. Computers were going to construct synthetic mediated worlds, whose perfect fidelity would plug directly into our sensory orifices, distracting those of us who are either lacking in our investment in reality, or are sophisticated meta-reality cowboys, to forego a relationship to the old real world. In the couple of decades that these fantasies gained widespread popular attention (examples would include Gibson's *Neuromancer*, almost any Phillip K. Dick story, and a series of movies such as *Lawnmower Man*, *the Matrix*, *Cronenburg's Videodrome* and later *Existenz*, *Oliver Stone's Wild Palms*, *Wim Wenders' Until the End of the World* and *Strange Days*, to name just a few), these types of virtual reality experiences have not become culturally prominent, despite massive improvements in their underlying technologies. What has driven this technological development has been something slightly different, the video-game.

With the video game, a model of cultural reception has been codified that operates via an internal interactivity. One of the most popular forms positions the viewer as the first person subject at the center of very violent exchanges with computer graphic representations of extra-human characters. Interactivity is a necessity for these forms to have any expression. If the viewer is not actively operating the game, it simply won't do anything. What the game does specifically is very dependent upon the viewers' actions. However, this interactivity is not a "freedom" of action. It doesn't offer the same type of interactivity as actions in the

¹³ Jorge Louis Borges, *Other Inquisitions 1937-1952*, University of Texas Press, 1964

world have. It is a very highly constrained set of actions that are permitted. These constraints are often part of the game qualities. For example, a character might be limited to one type of behavior; however, to progress to a different part of the game environment they need to have another type of behavior enabled. The way for that to happen is generally to perform the already-existing action in the right sequence, generally found through trial and error.

One of the attributes that an internal interactivity brings to a cultural form is the role of the viewer as complicit in the operation of that form. In some types of these forms, the viewer is seemingly put into the position of some type of author of a sub-genre whose parameters are established by the cultural object. In other instances, the viewer has the visceral reactive response because they have projected their sense of self into the media experience. They have become Ms. PacMan, the Pong paddle, the Master Chief (*Halo*), or Carl "C.J." Johnson (*Grand Theft Auto San Andreas*).

If one requirement of developing a vocabulary of interactivity is the ability of the interactive to rise above the simply operative, then the manner in which the users plays a role in the semantic form of the media operation is crucial. Modes that are alternative to the empathetic/reactive form are necessary. Creating a space of reflection on ones participation in the interactive form can cause one to become a viewer of ones own self as an actor in the interactive media form. This type of self-conscious participation can then lead to ones view of their interactive gestures as operating within a space of meaning creation, not simply survival reaction. As we have seen, this collapse of viewer as subject has precedence in most antecedent media forms.

These interactive game experiences have become popular, in contrast to how "virtual reality" experiences have not. Tremendous sensory immersion was not in their initial offering (although continuously improving image fidelity drives ongoing replacements of games and computers), but it is their reactive interactivity that produces a catharsis of accomplishment, which underlies their popularity. They have created some of our first syntaxes of interactivity, but as it is with many early media forms, these syntactical structures are limited in their expressive range. It has proven to be a challenge to have an engaged viewer as dependent operator and slippery subject of these media experiences. In order for this interactivity to transcend mere operationalism, and become an active mechanism of meaning construction, it will have to be stylistically engaged.

I'll stretch an analogy to text reading. The functional acts of reading: what are letters? How do they combine to make words? How do words combine to make sentences? Along with the manner in which markings are organized on pages (printed or electronic) and are moved forward by turning or scrolling or clicking... if all we were ever concerned about were the "operations" of each of these mechanisms, and whether or not we "successfully" engaged their operations ('I', 'n', ' ', 't', 'h', 'e', ' ', 'b', 'e', 'g', 'i', 'n', 'n', 'i', 'n', 'g', ' ', 'w', 'a', 's', ' ', 't', 'h', 'e', ' ', 'w', 'o', 'r', 'd' '...'), we would never get to the point of engaging much meaning via reading. Interactivity as a semantic cultural method must itself reach some discursive level.

Is this possible? As we have seen, one of the dominant modes of interactivity is tied up with reactivity in the video game. This form of interactivity taps deep into our evolutionary wiring, connecting us to survival skills that tuned our sensory apparatus for millennia. Our species survival had some dependency on our abilities to dodge rocks, swing along branches and avoid charging tigers. Engaging this type of reactive interactivity has turned out to be well-suited for the spatial/temporal/cinematic forms afforded by interactive 3D computer graphics and a variety of HCI input devices.

In addition to this reactive interactivity, which becomes the operational structure of the computer game form, there is method of interactivity that has also come to prominence due to computational developments, and perhaps could be ascribed to be even more ubiquitous - that is the interactivity between media forms themselves - the switching between media objects, which contain within them their own syntactic elements. This type of trans-media interactivity is more than just a means of organizing disparate experiences, it creates shifting contextual juxtapositions of media objects; some objects might try and ignore this condition, whereas others might actively exploit it. This condition comes about by quantitative changes in the media elements, as well as their qualitative heterogeneity, as well as the methods by which the objects are manifest. Methods such as their social construction, algorithmic form or data visualization, create new means by which media objects are derived. Some of these objects also engage interactivity as an internal method of articulation (such as the video games described above). Interactivity as a method for reading across media becomes possible because of the transformation of these media forms to computational elements. It is within this common space of data and algorithms that we can reconfigure any permutation of media elements. These characteristics of the expressive elements of computing are what the Troiaige Aesthetic theory is trying to set into motion. An example of how this operates can be seen in the artwork *The Scalable City*.

The Scalable City

The city is becoming inputs and outputs of algorithmic processes. The “real world” is an expression of algorithmic desire, conforming itself for optimized algorithmic consumption.

The Scalable City is a series of artworks by Sheldon Brown and his Experimental Game Lab. Members of this lab have included Alex Dragelescu, Mike Caloud, Joey Hammer, Erik Hill, Carl Burton, Kristen Kho and Daniel Tracy. The artworks of *The Scalable City* consist of prints on paper and canvas, computer animated videos, procedural animations, multi-channel video installations, and interactive 3D computer graphic environments. Common to the various manifestations of this work are the data, algorithms and aesthetics of the work. *The Scalable City*

is built via a data visualization pipeline. In this pipeline, data is taken from existing cities – satellite imagery, GIS data, statistics, photogrammetry – and is subjected to simple algorithmic transformations, creating a new city whose forms are applicable to our algorithmic future. Each step in this pipeline builds upon the previous, amplifying exaggerations, artifacts and patterns of algorithmic process.

The Scalable City consists of 5 major components - landscape, roads, lots, architecture and vehicles. The process of developing each of these begins with data taken from the real world. The initial real world referent is transformed by an algorithm that imprints its process into the result. In the case of the landscape, this begins with satellite data. The landscape is transformed by a simple process of duplication, rotation, copying and pasting; the process creates a new landscape which retains naturalism in its details, but with a high level of algorithmic decorativeness in its large scale structure.

Road systems are then “grown” into this landscape. First, an analysis determines suitable areas for occupation. These areas are demarcated by an encircling roadway and then space-filling curves are grown using an L-system graph. L-systems are recursive, self similar forms and are used for such things as the simulation of plant structure. The curves are derived from Archimedes spirals. The roads only intersect at their branching points, never crossing, ending in cul-de-sacs. The pattern created is a decorative spiral labyrinth, evocative of *art nouveau* iron grates, illuminated manuscripts, and other decorative uses of space-filling patterns. These curves are turned into roads with appropriate texture maps, including the demarcation of intersections and sidewalks. Each time the road system is generated, the specific end-result is unknown as it grows with the algorithms that simulate plant growth.

While the initial road system was built into areas that were determined to be within a large-scale average height variance, there can still be dramatic variances within the landscape regions. The roads are constrained by how quickly they can rise and fall over distance. Thus, when a road is drawn into a particular area, it will reshape the landscape around it, either cutting through small hills or building up road beds in small valleys. This road construction is done dynamically as one interactively navigates through the landscape in *vehicle systems*.

The *vehicle systems* also begin from real world data – in this case they are constructed from photo modeling processes that derive geometry from image data. This creates a perturbed derivative of an original form, strictly taken from the superficial skin of the image. Image artifacts tend to distort the form in unusual ways i.e., high degrees of specularities, broad contrast ranges etc., create difficult surfaces for the computer vision system to accurately discern object geometry from. What we end up with is form as perceived by the computer. The statement of *The Scalable City* is that the lived environment is a condition of inputs and outputs of algorithmic processes, our real world is an expression of algorithmic desire, and it conforms itself for optimized algorithmic consumption. When computer vision becomes the mechanism of the desiring gaze, we will engage in a seductive tease by transforming to excite its pixelated sensors to maximum capacity.

The *vehicle systems* become our embodied selves within this transformed environment. Each one of them consists not of a single vehicle but a particle system of vehicles that fill the environment with variant copies, swirling in a type of resonance with the spiraling labyrinth of the road forms.

The roads provide the basis by which lots are defined in the world. The lots are built with a computational geometry form called *voronoi*. Voronoi forms are a type of minimal surface that creates equidistant edges from distributed data points. With voronoi forms, each lot can have a boundary condition of equivalency; however the shapes of the lots themselves are irregular. Voronoi forms provide a base geometry type of several computer graphic techniques such as computer vision calculations and level-of-detail transformations of geometric forms.

Each lot becomes the site for architecture. Using a similar process to the one which creates the vehicles, automatic computer vision algorithms create a form laden with artifacts. An inverse kinematic system is placed on the resultant architectural fragments, which self assemble into an algorithmic shanty. Vortices created by navigating the swirling vehicles through the landscape, stir up these architectural fragments. The vortices become the agent of change in the environment, simultaneously ordering and disordering the cultural schemes embedded in the assets.

Throughout this environment, a variety of computer concepts take on physical form, providing both delight and foreboding. They offer a vision of cultured forms that we are rapidly creating, presenting an aesthetic with a heightened apperency of its underlying logic. All processes encode their results with artifacts that express their virtues and shortcomings. Culture has been undergoing a transformation from analog to digital forms and methods for several decades. These transformative moments produce tensions between speculation and anxiety. In *The Scalable City*, the aesthetic gestures embody the tension between exuberance and foreboding, neither embracing or rejecting an algorithmic world view, but inspiring its expressivity while cautioning of its own logic becoming the dominant determinate of its outcomes.

Installations of *The Scalable City* stage prints, video projections and interactive screens in various spatial/temporal experiences. Large projections of animated elements proceed in various time-frames, from non-interactive, non-cinematic pace, occupying architectural and contemplative zones to fully interactive experiences where the viewer controls a vortex, vehicle system using video-game like techniques, positioning them as a complicit participant in the interplay of elements. Prints from the environment, abstract the patterned environment to further extremes. Each of these uses visual strategies that entice the viewer into a visually deep engagement with the forms. Unlike a "game" there is no particular outcome or goal; the participation becomes an extended form of vision. Each manifest form strikes a relationship with the viewer that is an interactive engagement, and in fact considers interactivity is a key strategy of this aesthetic. The visual attributes of this artwork are the *troiage aesthetic's* conflation of collage, montage and assemblage.

As this aesthetic governs the internal relationships of the work's visual elements, it also governs the external relationships of the different modal components of the work in an installation environment. While any of the derivative forms of *The Scalable City* can be exhibited independently, the works engage the more complex notions of subjectivity and interactivity when they are able to be staged in careful relationships to each other, with each element creating different approaches to the choreography of space, time, image and interactivity.

Starting with the seemingly least interactive form, are digital prints of *The Scalable City*. Materially, they are digitally printed onto either photo paper or canvas. They take the initial satellite data of the project, and process it with the algorithmic techniques which are used to create the landscape. The images are further transformed to encompass at least two levels of visual scale, one imagistic in detail and one an abstracted field of color. However, unlike color field painting or neo-geo abstraction, this shift between image and field takes place due to a scale transformation of the data. When the data density reaches a certain level, the viewer reads the data field as not being made up of discrete imagistic elements, but as being a single imagistic element: a field of data.

The prints challenge the sense of visual field and the relationship between viewer and the viewed. The image extends beyond its frame via its use of optical patterns, creating visual conundrums which activate the viewer in relationship to the art. The engagement of perceptual phenomena transforms seeing into a haptic interface to the work – seeing is physical, akin to touching. As these patterns consist of scale that either reveals itself in further levels of detail, or fails to resolve as one moves closer to the images, the physical distance of the viewers position becomes an interactive element in the work. The viewer is the visualization apparatus of these images.

The next temporal stage of *The Scalable City* are animations of these images. Working with the same data and algorithms as are utilized for the prints, several of the variables are modulated over time. The resulting animation proceeds from barely perceptible shifts in the most abstracted forms of these images, to rapid shifts in the overall frame, as the images become more clearly identifiable with the original data. In this process, the viewer is moved through several states of recognition of the image phenomena. The first state is simply the viewing of a seemingly static image. This state is similar to that of the prints – except that this is no longer a physical object, it is simply light – projected or luminescent. Colors slowly start to shift. After some time, the shifts in color become more pronounced. Soon the stripes of color become more complex, and they then rapidly resolve into recognizable satellite imagery. They reveal more structure in this resolved image, before the entire frame collapses back into the abstracted form.

While this animation is a 2D image phenomenon, the cognitive experience is best compared to architectural experience. The ways in which one discovers spatial structure is the model for how this project creates a temporal structure. This animation is therefore not understood through cinematic vocabulary. However, further algorithmic transformation of these elements is expressed cinematically.

Two types of cinematic experiences have been created. One type is a “movie”, a relatively linear, “follow-the-data” narrative, where we witness ongoing transformations of initial data to stylized environment. The other cinematic forms are created as machinima, real-time computer graphic environments that are not interactive with the viewer, but play through scripts of behavior. These are used to show the transformed data in states that function as idealized pre or post conditions of interactive encounters.

The Scalable City culminates in its game-like, interactive 3D computer graphic form. This appears to be its zenith, as it seemingly is the direction to which all of the other data visualization processes lead; it is the most novel form culturally. It has a high level of visual spectacle and it is certainly the most difficult to produce. It is operationally dependent on the type of first person interactivity that is used in contemporary video games. While it can be experienced on a single computer monitor screen, it is typically staged with large projections to emphasize its visual form. It has also been exhibited using multiple stereographic projections. This stereographic form simultaneously pushes towards and pulls away from a collapse of the fictive and the real. The donning of special apparatus implicates one into the scheme of the work, and the stereography addresses the physiological underpinnings of spatial representation. However, when staging 3 separate stereographic images side by side, they each contain their own perspectival scheme. What is emphasized are the differences of each scheme, and their difference from the scheme of our own world. So, there is no invasion by the media space into the real space, nor an extension of the real through the media, we rather have the nexus of 4 spatial schemes and a transformation of forms and symbols as they are manifest in each.

The staging relationship of these various elements has to be considered. The hierarchy of attention moves from the interactive, to the cinematic, to the architectural to the image. Staging viewers experience starts with the static image and moves incrementally through the forms, providing each the space for interaction and contextualization.

The way in which this art “works” is the key to its revelations. While interactivity has been utilized as a concept that encompasses viewing, we could revert the approach and see interactivity operating in this work as an extensive gaze, a necessary approach to a type of visual complexity. Looking at this form of interactivity as a continuation of practices that complicated the art object through the 20th century, we can establish doing as a form of seeing. This work requires interactivity that involves reflective consideration – a cognitive space that extends beyond the moment of the impulse. The challenge for interactive forms is to engage the advantages that the interactive moment provides for viewer-to-artwork engagement, allowing the creation of a social environment for viewers to mediate relations through, while creating the space for reflection and consideration that gestures of contradiction and disruption provide. With 3D computer graphic space becoming the container for the various forms that this expression plays within and across, the operational interactivity of bodies in space is a dominant mechanism for providing initial coherency. Thus, we return to the stylistic conventions of

troiage as a means for creating semantic interactions between the qualities of forms that contextualize the interactive engagements of the work to its particular social and cultural conditions.

Sheldon Brown is Director of the Center for Research in Computing and the Arts at the University of California, San Diego. He is a Professor of Visual Arts and co-founder of the California Institute of Information Technologies and Telecommunications. Within CRCA and Calit2, Professor Brown directs the Experimental Game Lab, where new cultural forms are created by innovating techniques applicable to the computer gaming and scientific visualization.

crca.ucsd.edu/sheldon crca.ucsd.edu www.calit2.net crca.ucsd.edu/sheldon/expgamelab