SEMANTIC RECIPROCITY: TOWARDS A NEUROSCIENCE OF CULTURAL CHANGE

NICHOLAS TRESILIAN

International Society for the Study of Time

INTRODUCTION

This chapter looks at the two great periods of creative change in Western visual art, the Renaissance and the Modern period, each of which correlates motivationally with a distinct phase in the evolution of the human ecology: the proto-Industrial and the Industrial respectively. These correlations raise two specific groups of questions for neuro-science. The proto-Industrial raises questions about the *reciprocal* nature of our cognitive sensitivities to broad evolutionary change, given that the Renaissance constituted a shift from *closed* to *open* evolution, yet the correlative cultural change was from *open* to *closed* images. The Industrial period raises questions about the nature of cognitive *capacity,* given that the 'shrinking signal' of Modernist visual art, far from being exceptional and against the cultural stream as at first thought, now stands revealed as one strand amongst very many `shrinking signals' marking the ubiquitous *reductionism* of the Industrial age: in information-theoretic terms, apparent evidence of a culture (or a population) experiencing semantic *overload*. A certain amount of art-historical brushwood first needs to be cleared away in order to reveal this picture: the Renaissance, with its cultural bias towards closed images, was largely successful in destroying the credibility of open images as an alternative basis for art – a bias arguably now working against the re-emergence of open images in the Installation and Contextual art of recent decades. In order to present neuro-science with the story of Western

art as it really happened – rather than as the West chose later to remember it – we must first of all reinstate the open ritualistic image as a valid alternative to the closed aesthetic image. In addition we will need 'think the unthinkable' by way of proposing a generalised mathematical description for the *attracting images* which are the common element in the art of every age.

MIRROR, MIRROR ON THE WALL

The essential connections between neuroscience and the single work of art, in this author's belief, have already been made in the pioneering work of Barbara Maria Stafford. Her recent publication *Echo Objects*[i] and her subsequent Templeton Lectures[ii] have treated at length of the mutual interpenetration of the individual mind and the single art-object, in the process combining an art-historian's sensitivity to the object with a neuro-scientist's curiosity about human cognition. Just as importantly, this work has greatly widened the range of 'objects' which can be considered relevant to the discussion of 'art', while locating mirroring at the centre of the process of creating and responding to visual images. When visitors to an art-gallery, like bees cruising an herbaceous border in search of pollen and honey, roam the picture-rows in search of the subjective 'hit' of aesthetic pleasure, Barbara Maria Stafford has in effect been there ahead of them – provides the most authoritative description yet of what may be said to be going on cognitively in the act of aesthetic contemplation.

THE HALL OF MIRRORS

There is another way of roaming the walls of any great art-gallery offering a representative survey of Western art-history since mediaeval times – at least where the works of art are displayed in chronological sequence and not in some 'curatorial' re-arrangement. That is, to pay heed to the changing `look' of visual art across the ages, much as when a succession of

still images on separate cards is 'flickered' between finger and thumb to produce an animation of a walking man, a jumping horse – or in this case, 'flickering' the existing art-historical record, to produce an animation of a distinctive strand of Western culture changing across time. But here we have a problem. The story of art[iii] as presented in our great art-galleries and museums, has been edited to align it with the long-standing Western bias in favour of closed images: mainly easel-paintings and free-standing sculptures. In this belief the sacred sites of the ancient world have been asset-stripped of their painted and carved images, to be brought back into the Western museums and art-galleries, for exhibition profoundly out of context, as examples of 'primitive' art: 'noisy', child-like evidence of the nursery slopes of an art-history exclusively dedicated to mankind's conquest of complex aesthetic space: a conquest first achieved in the 'noiseless' imagery of Classical art; replicated 2000 years later in Western Renaissance painting and sculpture.

What would we actually find if we could 'rewind the videotape' of the last several thousand years of art history: remove the barbed wire and tarmac encampments of the international heritage industry from around the ancient sacred sites: take away the signage, the public lavatories and the visitors' shops; undo modern attempts at conservation; restore the walls, re-tile the roofs, re-install the vandalised paintings and sculptures; re-populate the halls and courtyards with princes, priests and the common people; re-light the smoking censers, the guttering candles and the sacrificial fires and reinstate the ancient liturgies? Nothing resembling a modern art-gallery or museum for sure – at least insofar as a gallery is a site specialised for the individual contemplation of closed aesthetic images, impermeable to external events. The sacred sites of old – the found environments of Hunter-Gatherer 'cave' art, the constructed environments of Agrarian 'temple' art, were multi-disciplinary interactive art-environments, employed as *channels* for the production of collective *rites of passage*, and as such systemically open and permeable to external events. Their rich content of carved

and painted art-objects, representing divinities and positioned most often in inter-related series, were in place to participate as actors in the rituals: the rituals themselves taking the form of events-in-time rather than objects-in-space, and extended in the inexhaustibly novel space-time of human behaviour.

The later Western preoccupation with the aesthetics of the art-object has been allowed to bias the presentation of art-history to the virtual exclusion of art's alternative, ritualistic origins. Yet the provision of symbolic content within sites intended for the performance of ritual was clearly the main occupation of visual artists throughout most of the history of art itself: 30,000 years of Hunter-Gatherer ritualistic art in caves, sacred groves, mountain-tops and other 'found' environments; then succeeded by a further 10,000 years of Agrarian ritualistic art in ever more complex constructed environments: temples, henges, mastabas, tomb-complexes, stone-rows, basilicas, sacred cities, mosques – and not to mention the cathedrals, abbeys and churches of the Christian religion, many still in use to-day..

HOLDING THE MIRROR UP TO NATURE

If the Western-centric bias towards the object-in-space and against the event-in-time is one factor which undermines a more objective view of art-history, another is the prevailing Western bias towards communication as a distribution of information from a sender to a receiver, to the exclusion of *attraction* as an alternative form of communication. Yet semantic attraction is fundamental to art in all its forms.

In this sense a great work of Renaissance art is like a two-way mirror. It *reflects back* to the eye a quantitative image, an imitation of some external signified (real or imaginary): a portrait of an important personage, a reclining nude, a landscape, an historical or mythological event, a rural or domestic scene, a still life of flowers, or fishes, or slabs of beef . At the same time it also lets the eye *pass through* to relationships which are entirely

qualitative , extended exclusively in the categories of space – hue, texture, tonality, outline and volume – relationships which have no intrinsic representational value at all, but in which, as scholars, critics and art-lovers broadly agree, the ultimate aesthetic value resides. Both these views afforded by the work of art, its *outscape* and its *inscape*[iv] respectively, are equally present to the attentive eye. But they deliver quite different kinds of meaning. The imitative outscape delivers a signal composed entirely of quantitative information. As such it functions as a vector, obedient to the Aristotelian principle of contradictions which states that no entity may both have and not have the same property: black may not simultaneously be white, 'death' may not be 'life', X may not at the same time be 'not-X, and in engineering terms 'signal' may not simultaneously be 'noise'. But if we now turn to the aesthetic inscape, to which the rational outscape effectively acts as a portal, we encounter a different set of values altogether. The inscape is all about qualitative relationships: it has to do with the simultaneity rather than the separation of opposites; it speaks in syncretisms, light/dark, near/far, great/small, active/passive, warm/cold; it is about bringing these simultaneities into equilibrium within the confines of the image, so that every X balances out with its correlative 'not-X, every 'dark' is simultaneous with 'light', everything 'near' in 3-D perspective is simultaneous with 'far', and the work of art is thus cognitively 'self-sufficient' – contains all its meaning within its own boundaries.

So in Giorgione's *The Tempest* in the Venice *Accademia*, the fractured light of an approaching thunderstorm suddenly brings human figures, the landscape, the far-off townscape and the over-arching menace of the sky into a single emotional unity. In the late self-portraits of Rembrandt the grizzled head and battered features simultaneously emerge out of shadow and fall back into it, as the forces of life contend with the gravitational inevitability of old age. The muted but crystalline light of a Vermeer interior simultaneously reveals and conceals the relationships of the individuals portrayed. And on an altogether more

cosmological scale, Michelangelo's *Creation* in the Sistine Chapel, opens up the tangled wood of the mediaeval scholiasts to the brilliant sunlight of Renaissance humanism while simultaneously embodying forth the values of both epochs. In all these instances the juxtaposition and equilibrium of opposing states of mind is driven by the juxtaposition and equilibrium of opposing plastic values.

Classical works of art may thus be described as possessing the property of 'dual semantic organisation': they are at once *vectors* distributing meaning and *attractors* binding meaning. The distributed meaning is the rational description of the replicated external other. The bound meaning, the meaning implicated in the physical object itself, is essentially *relational:* that is to say, involves the observer in an act of bonding, an identification of self with the object observed, a willing suspension of separate identity, to achieve the necessary transfer of meaning between the work of art and the attentive eye.[v] In this sense a work of art is latently both 'smooth' and 'sticky': a platform for two orthogonally-intersecting genres of meaning in the same semantic space[vi]. Furthermore only the rational quotient of the meaning of the work of art can strictly-speaking be replicated. The relational quotient, namely the meaning embedded in the attractor, being integral with the materials of the work itself, constitutes a semantic singularity and as such is non-replicable[vii]. The tourists who queue to flash their cameras at the triple panes of bullet-proof glass protecting Leonardo's *Mona Lisa* may be prevented by the multiple reflections from ever seeing the work clearly, but have been *in the presence of the unique object,* and their experience of the iconic work is to that extent authenticated .

THE STELLAR CLOUD OF ATTRACTORS

If works of art can function semantically as attractors, then for sure art has little or nothing at all to do with the cultural isolation of the legendary ivory tower. On the contrary art-images

must be seen as constituting just one small, albeit privileged constellation, amidst the vast stellar cloud of semantic attractors which animates contemporary culture: advertisements, brands and commercial products are attractors; stars, celebrities, gurus and popular leaders are attractors; gigs, grand prix, grand slams, cup finals and *corridas* are attractors; fads, fashions and life-styles are attractors, as also on a notionally higher level of commitment are political ideologies and religious faiths; clubs, corporate cultures, gangs and families are attractors; siblings, parents, friends, personal possessions and superstitions are attractors. In effect attractors are the 'dark matter' of contemporary communication: still largely invisible to rational science, but massive in the cultural account.

That said, the great majority of semantic attractors in contemporary culture are directly subordinated to some over-riding vector of rational interest: rates of exchange, ratings, revenues, market share, profitability, votes cast and opinions sounded – or in the form of our personal dreams are simply subject to affordability. It is in this respect that the attractors of visual art (and works of art generally) earn their often tendentious privileges. In art, normatively at least, relational meaning takes precedence over the rational: 'fine' artists are in the business of producing *unsubordinated attractors*. In this way art fulfils its role as a 'path-finding-system' for relational meaning in the world within which it is produced, and thereby functions as a source of wider creative influence for related visual media.

This does not change the fact that Western concepts of communication are strongly biased against the idea of semantic attraction per se. Despite McLuhan's postulate of the elision of medium and message in the mass media[viii], despite the Structuralists' insistence on the syncretism of the signifier and the signified[ix], the way to full scientific recognition of the semantic attractor is still blocked by the rationalist's bible on semantic issues: Claude Shannon and Warren Weaver's *Mathematical Theory of Communication*.[x]

THE THERMODYNAMICS OF COMMUNICATION

Claude Shannon's great *aperçu* in the *Theory* was that communication could be equated probabilistically with thermodynamic process: information, as a statistical measure, correlating mathematically with the entropy function. Entropy is a negative value which measures the loss of thermal efficiency from a heat-engine due to turbulence within hot gas when it is performing work. The equation of information with `negative entropy' inspired Shannon to recognise equivalent inefficiencies in human communication, in the form of 'noise' - a source of semantic turbulence reducing the information in the transmitted 'signal' Communication engineers seek to maximise 'signal' and minimise 'noise'. Shannon showed that if the input information H could be matched very precisely to the channel capacity C, such that H=C, then with correct coding the 'noise' in the output could be reduced to a trivial quantity 'ε'[xi], and a `noiseless' transmission of information achieved.

THE PRIGOGINE ATTRACTOR

Though Shannon's Mathematical Theory itself makes no reference to the semantics of attraction, if we accept Shannon's equation of communication with thermodynamic process, then in another part of the thermodynamic woods there exists an equation by Ilya Prigogine[xii] which does indeed provide a generalised mathematical representation of an attractor. Consider any system with both closed and open characteristics (any living system would be a suitable example.) The system can thus be characterised by a pair of entropy flows, d_iS and d_eS, representing its internal and external processes respectively. Under the second principle of thermodynamics ('the entropy of a closed system cannot decrease') any flow of the d_iS must be positive. The flow of the d_eS on the other hand may be negative – representing the importation of more ordered materials into the system from the surrounding environment (e.g

information into the mind, food into the stomach). Where the internal and external entropy flows are equal and opposite and therefore the total entropy of the system dS sums to zero:

$$d_iS + d_eS \rightarrow dS \rightarrow 0$$

If the d_iS and d_eS are able to sum to zero in this way, then according to Prigogine the system will spontaneously return to equilibrium 'for small fluctuations in its environment'. In other words the equilibrium state for the system *is itself the attractor*. Here in information-theoretic terms we have the familiar characteristics of the semantic attractor referred to above: the simultaneity of opposites, their juxtaposition within a single system, the association of equilibrium with spontaneity, and the homeostatic conservation, or binding of systemic structure. *The ubiquity of semantic attractors raises the question whether the present experimental techniques of neuro-science, based as they often are on the presentation of simple flash-cards, yet match up to the inherent complexity and ambiguity of the cultural messages which form the everyday basis of human communication*.

A THOUGHT EXPERIMENT IN AN ARTIST'S STUDIO

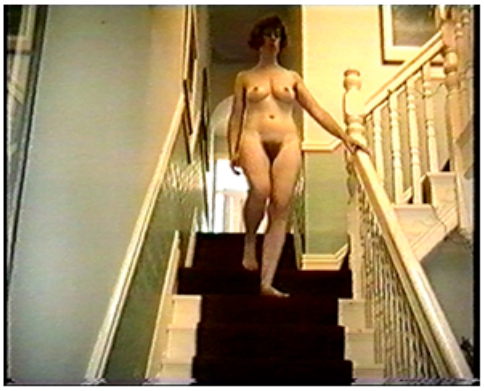
As to the question of the relative validity of closed vs. open attractors: consider the following thought-experiment.

In an artist's studio, compare the different way the eye perceives the artist's life model when a: the human body is at rest (the nude reclining) and b: the human body is in motion (the nude descending a staircase).[xiii]

The body at rest…the nude reclining

- *The nude reclining is an object-in-space, extended in the idiom of colour, tonality, texture, outline, volume*

The body in motion…the nude descending a staircase



- *The nude descending the staircase is an event-in-time, extended in the idiom of frequency, amplitude, momentum, orientation, velocity*

Furthermore there is a fundamental systemic difference between the two manifestations of the nude

- *The nude-as-object, isolated by the immobility of the pose, is systemically <u>closed</u> to events external to itself*

- *The nude-as-event, in motion and on an advance to contact, is systemically <u>open</u> to events external to itself*

As a result the distinguishing `signal' of each nude is a 'noise-source' for perception of the other - and vice versa

- *An event is a source of 'noise' in our intuition of the object (when the model breaks the pose the nude-as-object is immediately 'misted' with visual uncertainty and the artist must stop work)*

- *Immobility is a source of 'noise' in our intuition of the event (when the model stops moving the nude-as-event is misted in uncertainty and the advance to contact is broken off)*

Here then is one way of saying that ours is a species with one pair of eyes but two equally valid but mutually complementary ways of experiencing the world visually: as an object-in-space and as an event-in-time respectively. (Were human perception not polarised in this way, it would arguably be impossible ever safely to cross a busy road). For the same reason we also have two equally valid but mutually complementary opposite' ways of producing the images of visual art - as attracting objects and as attracting events – each with its own distinctive 'relations of production'. Since attractors 'bind' their own meaning, it is appropriate to distinguish between time-binding and space-binding art.

Time-Binding Art		**Space-binding Art**
Open attractors		Closed attractors
Rites of passage		Easel-paintings, plinth-sculptures
'Environmental' scale		Compact scale
Multi-disciplinary		Single-disciplinary
Macrocosmic perspective		Microcosmic perspective
Permeable to external events		Impermeable to external events

Temporal complexity		Spatial complexity
Inclusive of space		Exclusive of time
Interactive		Contemplative
Eye-inside-looking-out		Eye-outside-looking-in
Shared experience		Individual experience
Ritualistic value		Aesthetic value

Table 1.

The event-in-time and the object-in-space are in this sense the 'wave' and the 'particle' of human communications, complementary conjugates such that the more we have of the one the less we can possess of the other – and *vice versa*. Whence also that the ascendancy of the one genre of communications always undermines the validity of the other. Thus during the 500-year hegemony of the closed, spatial attractor in Western art, the alternative semantic potentials of the open, temporal attractor steadily lost their cultural appeal, progressively weakening the claims of the Christian religion, which ever since bifurcating during the Renaissance into Reformation versus Counter-Reformation versions has been in more or less continuous crisis. (It is to be noted that the hegemony of space was exclusively a feature of Western elite culture however. Popular culture remained firmly rooted in an earlier time-binding cultural tradition of ritualistic attractors – an orientation which still persists strongly in today's industrialised mass media).

TOWARDS A NEW 'STORY OF ART': THE RENAISSANCE

We can now begin to reconstruct the history of Western art on the basis of there being two equally valid but opposite 'ways of seeing'[xiv], and therefore also two 'equal and opposite' ways of producing the attracting images of visual art. 1000 years ago Western art, far from

being in a ‘primitive’ state as our museums are mostly arranged to suggest, represented the fully-ripened development of a tradition of Agrarian temple art whose earliest origins are to be found in Asia Minor some 10,000 years b.p.. Its churches and cathedrals were massively constructed, environmentally-scaled channels for the production of communal ritual in the form of the liturgy of the Christian religion, its key festivals locked into the seasonal cycle of the Agrarian year. Visual art in the form of painting, sculpture and the emergent forms of a new discipline of stained glass made its contribution to the multi-disciplinary continuum of music, movement, speech and structured space-time through which the liturgy was enacted. The liturgy itself was ‘chunked’ into formal modules of prayer, confession, intercession, celebration, readings and communion, to be combined in appropriately ordered strings to provide rites of passage for the crucial points of transition in collective and individual life: the outbreak of war, the coming of spring, deaths and entrances and so on.

The solidity and capital-intensive nature of the religious buildings in use 1000 years ago spoke of a world of settled ecological relationships, based on the Agrarian principle of ‘many-tools-for-one-use’ which had long since given civilised settlement its defining sinews: agronomy, husbandry, construction, irrigation, transportation, the large-scale working of wood and stone, ceramics, weaving, metal-working....and later numeration and writing. Whatever period of ecological improvisation and experiment had first brought Agrarianism into being in the course of the great global warming at the end of the last Ice Age, and whatever competitive advantage it conferred on its early adopters, the innovative momentum had dissipated millennia before, leaving Agrarianism a globalised ecology in closed, iterative evolution, constrained to slow, self-similar growth by an ‘economics of scarcity’ based on the deferral of risk through systems of reciprocal exchange and mutual obligation [xv] - not dissimilar in structure and purpose to modern derivatives .

In the course of the middle ages, however, Western European civilisation became the platform for a dizzying cross-weave of cultural changes, as the Western ecology migrated from closed/iterative to open/innovative evolution, while art migrated in the opposite direction, from the open to the closed attractor

The Gothic arch and perspective geometry were the two principal agents of change for visual art, supplying the 'push' and the 'pull' respectively. The Gothic arch leveraged the semantic de-construction of the old time-binding ritualistic environments by progressively penetrating, complicating and attenuating their fabric, thereby multiplying the number of internal boundaries and closed niches. The architectural trend to micro-enclosure in turn nudged church art towards the closed, space-binding attractor. (Milan cathedral offers an example of the niche-enclosing tendency carried to the ultimate extreme). The rediscovery of Classical art simultaneously tilted the balance of artistic production strongly towards illusionistic space. Here the particular Western contribution was to systematise perspective geometry, so that the vanishing point fixed the illusion and at the same time provided a fulcrum around which the image could be brought into equilibrium, thereby promoting aesthetic self-sufficiency. Creative de-construction and re-construction thus went hand in hand in the evolution of the new space-binding art of the Renaissance: bringing with it the 're-birth' of Classical culture in the West, some thousand years after the collapse of the original Western Roman empire.

Far from emerging in a state of isolation the new space-binding visual art was in its turn part of an exploding supernova of object-based 'fine arts' appearing at the end of the mediaeval period, as the ritualistic event gave way to the aesthetic object in literature, drama, music, dance, opera – books, poems, plays, ballets, operas, symphonies all being systemically 'closed' in the sense that their aesthetic value was vested in a fixed and unique text, score or notation essentially impermeable to time.

The proliferation of closed relational images in the fine arts was paralleled in the same period by a second supernova of mutually-discrete *rational* disciplines as the 'dark wood' of Mediaeval scholasticism with its rambling syncretism of religion, mythology, astrology, divination, alchemy, necromancy and plain superstition deconstructed also, to reveal newly emergent forms of philosophy, law, mathematics and science. These too took their lead from a rediscovered classical culture and were also produced in the form of closed, non-time-dependent cognitive images: equations, formulae, laws, principles and 'universals', all of them seeking to represent a non-time-dependent 'truth'.

This *swarming of the disciplines*, relational and rational together, with their synchronous transfer of attention from the open to the closed image and from temporal to spatial complexity, is the most remarkable phenomenon of the Western Renaissance,. The obvious question it raises is lent added force by the 'exploding supernova' aspect of Renaissance culture: why did so many strongly motivated individuals in mutually discrete and largely autonomous disciplines march in apparent lockstep from the world-as-event to the world-as-object – what was the communal causation for the collective cultural action? The question becomes still curiouser, as Alice might say, when we recognise that in the same period the human ecology was migrating *in the opposite direction*, from closed to open evolution.

THE PARADOX OF THE PROTO-INDUSTRIAL

*S*ome 1000 years ago the Agrarian world from which the Renaissance presently unfolded was itself characterised by a closed/iterative ecology rich in self-similarity and the internal connectivity which flows from a culture of open images. Yet throughout the middle ages the Western ecology was migrating systemically in the opposite direction to the Renaissance itself, towards a proto-Industrial ecology in open/innovative growth.

The proto-Industrial was the West's 'hidden' revolution: twice screened from modern eyes. Firstly screened because it was not in a full sense a 'revolution', being essentially reversible: the proto-Industrial retained the 'many-hand-tools-for-one-use' ecology of the Agrarians, speeding it up to deliver greater productivity by ganging tools together in machines and by coupling its machines to naturally available sources of energy within the biosphere, while retaining manual forms of control. (Classical civilisation, which was proto-Industrial in all but name, achieved a similar ecological mobilisation, which reverted back to a pond-like Agrarianism after the collapse of the Western Roman empire). Secondly screened by the much greater scale of the Industrial revolution proper, which replaced the naturally-available but unreliable energy-sources for its machines by more reliable and controllable high-energy prime-movers in the form of man-made engines: first the steam engine, later the internal combustion engine, the electric motor, the gas turbine and the nuclear reactor. Industrialisation, with its new techniques of mechanised mass production, rapidly overturned the refined materialism which lay at the heart of the proto-Industrial mode of production (epitomised in the infinitely subtle surfaces of the closed Renaissance art image) and in the process set in train the work of decoupling the human hand from the human ecology, which the recent development of automation has since then massively accelerated.

The historian Fernand Braudel[xvi] was the great chronicler of the proto-Industrial world and the poet of its refined materialism. Our concern with the proto-Industrial here is only insofar as it provided the platform for the Western migration from closed to open evolution by the development of a new and highly competitive ecology of machines: a direction which would be continued in ever-accelerated form in the Industrial age. Proof of the competitive superiority of the proto-Industrial over the Agrarian form of ecology was well established by the *annus mirabilis* of 1492, when the last Moorish dynasty was thrown out of Spain and the conquest of the Americas was set in train by Christopher Columbus. Thereafter the West

converted its ecological superiority over the world's great Agrarian civilisations into a licence to expropriate their economic and demographic resources, and on this basis developed its own highly competitive and risk-positive 'economics of plenty', animated by the permanent expectation of unlimited economic resources – the expectation which still drives Capitalism today (though in the light of growing global shortages it is perhaps no longer so plausible).

OF FIGURES AND GROUNDS

In the course of the middle ages, then, the proto-Industrial West went from closed to open evolution, while the culture of the Western elites went in the opposite direction: from the open to the closed image – in the process migrating visual art from a ritualistic to an aesthetic orientation. Yet for all that ideology and ecology seemed each to be going against the grain of the other, the two developments were mutually self-reinforcing. The cultural migration from the open to the closed image gave a new priority to the rational disciplines, particularly science, which in turn contributed materially to the ecological migration from closed to open evolution. In short we are looking at a process of *mutual co-evolution*, which suggests we should be looking for our source of causation *within the process itself*, rather than from somewhere beyond it. In addition, given that cultural change occurred across relational and rational disciplines simultaneously, we must be looking for a source of causation with a certain intrinsic universality.

The underlying causation for this pattern of reciprocal co-evolutionary change must therefore be found in some basic cognitive mechanism, common to creative individuals across the disciplines and with the characteristic of mutual reciprocity already 'built in'. In this sense the phenomenon of cultural reciprocity seems to point us directly to an already well-known feature of human perception: the mutual opposition of 'figure' and 'ground', whereby our visual system simplifies any visual scene into a 'figure' which is perceptually

dominant and a ‘ground’ which contains everything else and is perceptually recessive: an economical distribution of attention in full accordance with the principle of least action (in the unthinkable alternative the ‘ground’ would be dominant and the ‘figure’ recessive). The opposition has mainly been studied by perceptual psychologists in terms of figure/ground ambiguities: notably the `Rubin vase’, in which two juxtaposed profiled faces in black, simultaneously outline a vase in white between them. Figure/ground equivocation also generated the characteristic counter-illusionistic space of much Op and Kinetic art. But semantic reciprocity in the form we find it in art-history has more to do with the normative status of the opposition than with its marginal effects.

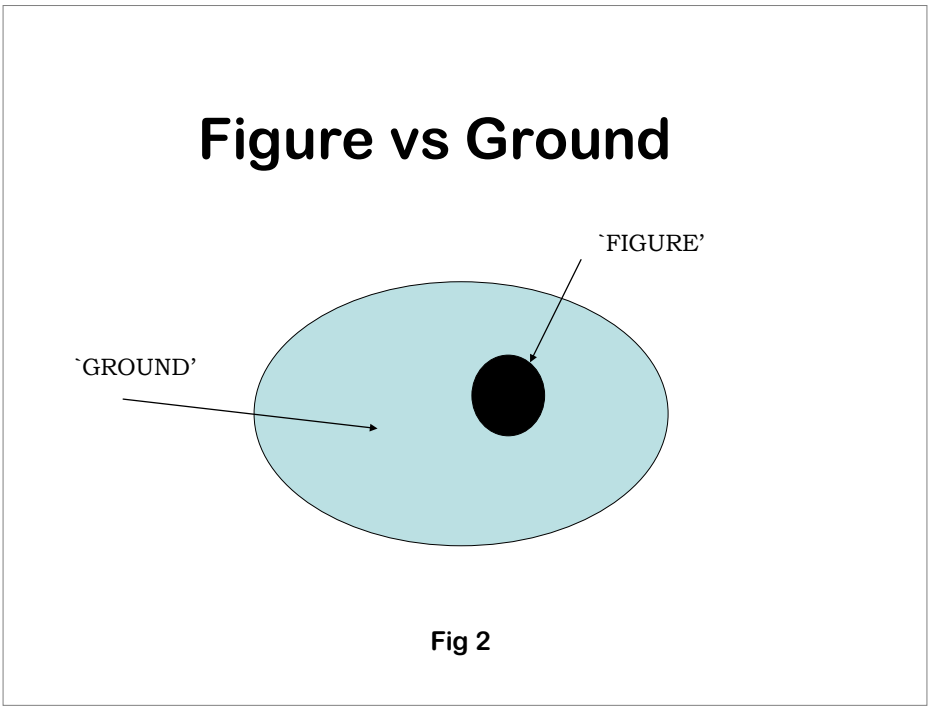


Fig 2

The perceptual dominance of the ‘figure’ vis-à-vis the recessive characteristics of the `ground’ gives rise to the impression that perceptual selection is driven by the choice of `figure’, which in turn determines what is perceived as `ground’ . The way images swarm synchronously across the disciplines in response to the changing dynamics of ecological evolution suggests, on the other hand, that where cultural evolution is concerned, variations in the perceived evolutionary ‘ground’ determine reciprocal variations in the produced

cultural 'figure' – whence the open image prevails under conditions of closed evolution, the closed image under open evolution, each 'figure' an emergent property of its complementary evolutionary 'ground'. In cognitive terms, it seems, the human mind is *individually* sensitive to the dynamics of evolutionary context, in a way which gives rise by aggregation to *collective* reciprocal behaviour. (Indeed sensitivity to evolutionary context seems confirmed by the division of sensibility between elite and popular culture which arose out of the division of labour in the machine age: the closed, competitive culture of the ruling elites reflecting a perceived opening of evolutionary boundaries; the open, convivial culture of the working class reflecting a state of enclosure within the poverty and hard labour of the factory system)

On this basis there is no need to postulate a 'collective consciousness', let alone a 'zeitgeist', to account for collective cultural change. The motivational drivers for collective cultural change are already present in the individual brain, in the form of cognitive sensitivities to broad evolutionary context: sensitivities giving rise to cognitive responses which periodically both refresh and refocus individual creativity and which at the same time complement rather than interfere in the localised mirroring activities we find expressed on the individual meme. But if human cognition is context-sensitive in its attention to the changing ecological boundaries of human life, at how many other levels of social, cultural, and economic openness or closure does the context-sensitive mind also influence cultural output? The whole question of the relationship of context to content in human cognition seems potentiality to lie open to neuroscience on this basis – at the same time opening yet another window upon the relationship between waking consciousness itself and 'the secret hegemony of the unconscious mind[xvii]*'.*

THE MIRROR FRAGMENTED

The Modern age was the second epoch of cultural deconstruction to shape and be shaped by the West's continued evolutionary progression towards open evolution. But whereas the evolutionary progression itself was intelligible enough – a process of ever-accelerating ecological development converting ever more economic resources to human use by the use of ever more powerful high-energy machines - the corresponding cultural changes were a source of considerable confusion – nowhere more so than in the 'modernisation' of visual art.

If further corroboration were needed of the linkage between change in art and change in the human ecology, it is surely to be seen in the progressive collapse of the 'noiseless' Renaissance image from the mid 19th century onwards, as the Industrial revolution with its ever-accelerating dynamic began decisively to over-write the proto-Industrial world which had provided the Renaissance with its basis of motivation. The notorious failure of the 'noiseless' image to support aesthetic spontaneity in mid-19th century Academic art prompted younger generations of artists to explore the alternative aesthetic potentials of the 'noisy' image. But the 'noisy' image in visual art proved to be a slippery slope. The 'low-noise' paintings and sculptures of the Realists, Impressionists and Symbolists of the later 19th century were followed by the 'intermediate noisiness' of the early 20th century Fauves, Expressionists and Cubists, which in turn prompted the 'high-noise' images of the Abstract Expressionists, Suprematists, Vorticists, Futurists, Constructivists and Dadaists – the pioneers of non-figural art. The Academic indignation which had greeted the first low-noise images was nothing to the mass outrage caused by the chaotically simplified imagery of early non-figural art: widely deemed to have abolished aesthetic value altogether. A worldwide backlash against 'modernist' art followed in the interwar years: a 'return to the figure' enforced by political violence in the totalitarian states, and in the liberal economies somewhat improbably led by the former arch-modernist himself, Pablo Picasso. Only after World War 2 was the drive towards the aesthetics of chaos resumed – albeit with a certain sense of déjà

vu – at first led by the New York School, later expanded into the international lingua franca of Minimalism. Minimalism in its turn would pave the way to the evanescent images of Concept Art, indeterminate between object and event, marking a new and potentially more disturbing creative threshold: the point of entry to a new phase of time-binding art.

Modernism in visual art effectively shattered the mirror of space-binding representation into a myriad smaller pieces, but each of these pieces continued in its own way to reflect an aspect of an external world, albeit a world seen 'in close-up', on an altogether larger scale of cultural magnification than before. In this sense non-figural art continued to produce images with the characteristic two-way mirror-function of traditional fine art, with a rational outscape acting as portal to a relational inscape, but now on the basis of greatly reduced amounts of visual information – Modernism's ever-shrinking 'signal'. Albeit that the portal to the Modernist image was characteristically austere, consisting in some apparently random assemblage of points, lines and planes, the vitality of the attractor still depended on the painter's or sculptor's ability to bring these elements into an active equilibrium, either in two or three dimensions of space. From this point of view it could be said that Modernist art plumbed the fractal of the visible world at ever more elemental levels, and at every level has continued to reveal new aesthetic potentials to the attentive eye.

THE AGE OF REDUCTIONISM

When Modernism made its first entry into Western art it had been as a thief in the night – stealing away from art itself piece by piece everything that had seemed to make it accessible - fine finish, sensuous complexity. narrative content, figural representation, and most of all the art-lover's cherished 'hit' of aesthetic pleasure. By the second half of the 20th century, however, the eyes of fresh generations of art-critics, dealers, public patrons and private collectors had recalibrated to the 'shrinking signal' of Minimalist art, while the Pop Art of the

same period had defused the old 'figural vs. abstract' conflict by transferring figural imagery directly into non-figural aesthetic space. In addition, in both Pop Art and Minimalism, artists were freely taking imagery from the commercial worlds of the mass media and industrial design – an exchange taking place in both directions, as commercial media reciprocally took imagery from contemporary art. By then the thief in the night had finally come in from the cold, and from the 1970s onwards non-figural art marched confidently into the world's great public art-galleries and museums as an authentic representation of the space-binding tradition of visual art in its latest and most elegantly parsimonious form.

By now too, Modernist art with its 'shrinking signal' could itself be seen as representative of an altogether wider movement in 20th century culture: the deconstructed idiom of *reductionism* – arguably the defining idiom of the Industrial age. Had reductionism an ideology, a conscious system of belief, it would have been the one ideology held in common by Left and Right alike during its long hey-day. But reductionism, like semantic reciprocity in the form in which we found it above, seems fundamentally reflexive - a subliminal bias which has driven a second cultural 'swarming' in the form of a worldwide shrinkage of the semantic signal across all disciplines. Ludwig Mies van der Rohe's often-quoted dictum 'less is more' was coined to rationalise reductionism. It also cleverly masked and mask reductionisms abrupt inversion of classical values: where the complexity of Renaissance art had been central to its aesthetic value, Modernist artists came to regard aesthetic complexity as so much 'noise' and to pursue an ever more simplified 'signal' – and in this they both set and followed the pattern of thought which characterised the Industrial age. The reductionist pursuit of ultimate simplicities in every domain of human activity has entailed a systematic assault on known complexity in all its forms. It has most famously 'split' the atom, reducing the complexity of the physical world to 'elementary particles'. In the same spirit it has also digitised money and meaning, atomised culture, McDonaldised the

consumer society and 'monadised' the individual consumer; it has nucleated the old extended family, 'dumbed down' education and mass entertainment; it has brought us human rights, global brands and the urbanised indifference of 'cool'; above all it has produced a form of civilisation uniquely adapted to continuous evolutionary development, a construction-site for a new globalised ecology, simultaneously both shanty-town and casino city, shimmering in its own bright lights, economically dissipative and therefore perhaps ultimately transient.

THE ISSUE OF COGNITIVE CAPACITY

The flight from Renaissance aesthetic complexity in the Modern age and the subsequent deconstruction of the work of art to the transient ambiguities of the artist's `mark', the `elementary particle' of aesthetic intuition explored in Concept art, introduces a different set of issues for neuro-science: namely *cognitive capacity and the cultural effects of informational overload*. In this context it is appropriate to begin with the classical statement on the matter. The 11th or 'capacity' theorem of Claude Shannon's *Mathematical Theory of Communication*[xviii] deals with the performance of communication-channels of finite carrying capacity, and with how they behave, depending on the amount of information transmitted through them. It states that for a channel of finite information capacity C, receiving an informational input of amount H, if the input H is less than or equal to the capacity C, ($H \leq C$ below), the informational content will be transmitted as an intact 'signal', excepting only the trivial residual amount of entropy, 'noise' or uncertainty 'ε' already mentioned, which can be disregarded for all practical purposes.

But then the 11th theorem goes on to deal with cases where the information content of the input signal H *exceeds* the channel Capacity C, ($H > C$ below). In these circumstances the theorem states that the surplus of H over C – the information overload (H-C) – will give

rise to a proportional amount of 'noise' in the channel output, thus reducing the informational value of the 'signal' by the corresponding arithmetical amount.

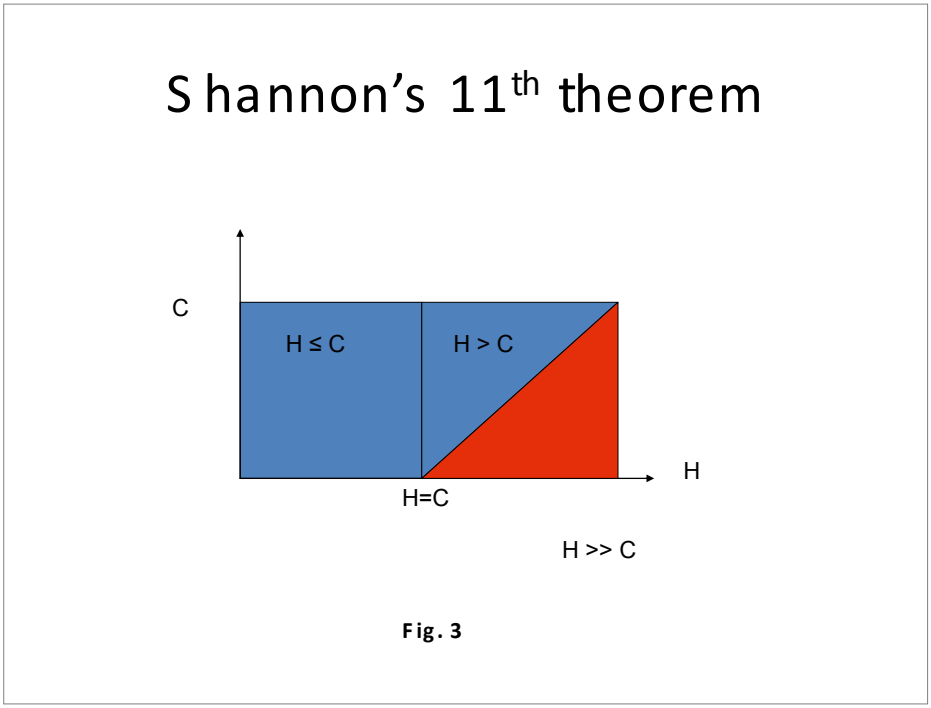


Fig. 3

In Fig. 3 above, the blue region corresponds to transmitted 'signal' and the red region represents the progressive increase of 'noise' in the transmitted output as the information overload H-C increases towards H = 2C and the signal 'shrinks' accordingly towards zero.

Taking both parts of the narrative together, left-hand side first and then the right-hand-side, Shannon's *Fundamental Theorem for a discrete channel with noise* seems accurately to represent the general evolution of cultural `signal' through the whole of the Western period of open/innovative ecological evolution: the left hand side of Fig.2 accounting for the 'clean feed' of cultural complexity in the proto-Industrial period ($H \leq C$); the right-hand-side for the shrinking aesthetic signal during the Modern age. – both migrations seen in the context of the steadily rising tide of cultural information resulting from the continuous expansion of the West's all-conquering machine ecology through its proto-Industrial and Industrial phases.

The evidence of Western art suggests that it was in the second half of the 19th century that the flow of information produced by continuing evolutionary growth began to exceed the capacity of human cognition or human culture (or perhaps both) to process it in its entirety – a subliminal threshold first marked in visual art by the spectacular mid-century collapse of `fine finish' academic model of attractor already noted, with its bifurcation into the rationalised (and more accessible) forms of Decorative and Narrative art respectively. The corresponding suffusion of aesthetic imagery with 'noise' in Realist, Impressionist and Symbolist painting and sculpture from the mid-century onwards, and with it Western artists' deeply controversial engagement with the shrinking cultural signal of the Modern age was from this point of view a necessary *sauve-qui-peut* for aesthetic spontaneity itself.

If so, as well as questions for neuroscience about macroscopic *sensitivities* in human cognition, we now also have questions about macroscopic *constraints* on human cognition, arguably themselves arising from cultural over-production. *Can the mind be treated scientifically as a channel of limited capacity in the sense of Shannon? If so, is it able to 'channel-switch' in order to produce different cultural outputs in different informational environments? Issues of cognitive 'editing', cognitive self-management- and for that matter cognitive management of the individual by third parties controlling an information-flow - are also raised here. In this respect an information-theoretic view of cognitive capacities seems to open the window directly onto issues of freedom and control in contemporary culture.*

REFLECTING FORWARD

Meanwhile the argument for semantic a-symmetry has taken an unexpected new turn at the end of the Modern age. Recent decades have seen the emergence of *post-reductionist* cultural forms, apparently seeking a new engagement between culture and its evolutionary context. Here Concept Art – reductionism's last word on the visual arts – with its images as already

noted *indeterminate between object and event,* far from representing the 'death of art' which many opponents of Modernism had forecast (and some Dadaists too), has turned out to mark the point of transition from the old space-binding painting and sculpture to the new Installation and Contextual art of the later 20th and early 21st century. For all its unexpected emergence from a `quantum foam' of fugitive imagery, for all its *à tâtons* mode of progress, the new post-reductionism brings artists to the foot of a potentially immense new creative learning-curve, associated with the rediscovery and representation of their world in terms of *temporal* (as opposed to spatial) complexity. If in this respect the new time-binding art is delivering *speculative value* rather than any kind of cultural consensus, it is at the same time close in its questioning spirit to the ethos of Professor Stafford's *Echo Objects* which has inspired this present chapter. *Echo Objects* in its turn, in its cross-disciplinary merging of art-history with neuro-science, shares a spirit of cultural convergence with the post-reductionist sciences of chaos and complexity, themselves actively addressing nature and culture as interrelating hierarchies of temporal systems[xix], and in the process redressing the former cultural imbalance towards elementary simplicities

In short, the cultural `figure' seems now to be migrating strongly towards systemically *open* cognitive images again, and is doing so apparently across both relational and rational disciplines. Might these changes in cultural production in their turn be giving us advance warning of a reciprocal change in the human ecology in the opposite direction, towards *closed* evolution*?* Notwithstanding the continuing capitalist commitment to the economics of super-plenty in the Industrial age, might the `early adopters' in art and science already be picking up a different set of subliminal signals from the world around them: signals from a global ecology increasingly constrained in real terms by the economics of super-scarcity – scarcity at a higher ecological level, the consequence of globalisation itself bringing the whole of the human species into the same competition for Industrial resources?

There are certainly enough indicators of a coming super-scarcity – in water, energy, agricultural land, clean air and communications band-width – to justify active speculation about a return to closed, iterative evolution after the recent centuries of open, innovative ecological transformation. After all, 30,000 years of Hunter-Gatherer `cave' art, followed by 10,000 years of Agrarian `temple' art sends us a strong message from the past that closed iterative, evolution resulting in self-similar growth has been the default position for the human evolution across many millennia at a time. On the same basis it could be argued that scarcity appears to be the default position for the human economy. In the circumstances it is no longer altogether unreasonable to postulate a possible, future, scarcity-constrained world in which ritual once again assumed the central role it used to play in human cultures, principally as a mediator of change. One of the abiding quests of the reductionist age has been for a Grand Unifying Theory or G.U.T. in physics, bringing gravitation, electromagnetism and the strong and weak forces into a single theoretic framework. On the same basis one might think of a post-reductionist age culturally dominated by G.U.Rs or Grand Unifying Rituals. Little would be gained by trying to second-guess the unguessable G.U.Rs of some post-Industrial world of the future, needing to balance out the imponderables of supply and demand in a globalised and automated machine-ecology. But a pointer to those G.U.Rs of the future might be found in certain G.U.Rs with origins far in the past. For instance, the formation-flying of murmurations of starlings over their roosting grounds creates a rite of passage in which vast numbers of birds participate simultaneously, appearing to mediate the transition from competitive feeding to co-operative roosting at the end of the day, and clearly functioning as an attractor.

As dusk falls, thousands of birds have already formed into a billowing balloon which swells and rolls around in the air over the chosen wood, like playful a cumulo-nimbus cloud suddenly drawn close to the ground. Smaller flocks of birds returning from further fields

continue to fly fast into the murmuration and are instantly absorbed into the great game. The game pits birds in compact formations flying rapidly outwards to escape through the outer skin of the balloon, against the entire formation of birds forming the balloon itself, just as rapidly bulging its outer skin to out-fly and contain the escapers. Occasionally groups of escapers fly fast enough to burst the skin, and the balloon billows out to re-absorb them. Other groups, playing their own game or simply outpaced, spin simultaneously in the air as they approach the freedom of the boundary skin, instantly merging back into the mass. Finally, in the last of the dusk and as though some desired point of mutual equilibrium between competition and co-operation has now been attained, the entire vast formation suddenly collapses into a thick black column of birds funnelling down through a single narrow aperture in the air, to spread out in their thousands across the tops of the trees and sink into the branches. Starlings are talkative birds, but the formation-flying had been carried out in total silence, barring the rapt whirring of thousands of pairs of wings. Now, as the birds touch down in the trees, suddenly the entire flock bursts out chattering.

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[i] Stafford, B. 2007. *Echo Objects: The Cognitive Work of Images.* Chicago. The University of Chicago Press.

[ii] Stafford, B. 2008. Lecture series as Templeton Fellow, "*Crystal and Smoke: Facets of Cognitive Aesthetics",* University of Southern California. cf the extended discussion of the cognitive implications of the patterned surface of a paved road in Lecture 2:: "*Cold Intimacy/Hot Entanglement: Meaning in Combinations.*

[iii] The definitive Western-centric account is to be found in: Gombrich, E.H. 1950. *The Story of Art.* London. The Phaidon Press Ltd..

[iv] The term `inscape' was coined the Victorian poet Gerard Manley Hopkins in reference to the unique patterning of individual identity in things and people. An updated version of the same idea is to be found in David Bohm's concept of *implicate order* in: Bohm, D. 1980. *Wholeness and the implicate order.* Routledge & Kegan Paul

[v] The art-lover earnestly bonding with the aesthetic attractor was the subject of much ribaldry over the years in the leading British humorous magazine *Punch*

[vi] In a longer discussion the 'orthogonal' relationship of relational and rational meaning suggested here might cautiously be bracketed with the concept of 'bi-sociation' as in: Koestler, Arthur. 1967.*The Act of Creation.* Dell. N.Y.

[vii] The element of relational non-replicability in works of art would seem to disqualify them as `memes' in the sense of Richard Dawkins in: Dawkins, R. 1976. *The Selfish Gene.* O.U.P.. Oxford. An alternative argument might be that meme-theory has not yet come to terms with the real complexity of culture, and if it is

ever going to do so it will surely need to prioritise the brain as producer of cognitive images over the brain as receiver.

[viii] McLuhan, M; Fiore Q, 1967. *The Medium is the Massage.* Bantam Books / Random House.

[ix] Levi-Strauss, C. 1963. *Structural Anthropology.* Basic Books Inc. USA

[x] Shannon, C.E. and Weaver, W. 1949/69. *The Mathematical Theory of Communication.* University of Illinois Press. Chicago, London

[xi] Shannon's 'ε' may arguably be seen as the communications equivalent of Planck's constant '*h*' – the acknowledgement of an irreducible least amount of semantic uncertainty in every act of communication..

[xii] Prigogine, I. 1955/67. Introduction to the thermodynamics of irreversible process. Interscience, New York, NY.

[xiii] Both photographs © Artstation 1990

[xiv] The critic John Berger came close to recognising the complementary relationship of space-binding and time-binding images, but was arguably prevented by his political commitment to an ideology of painterly realism. Qv. Berger, John (1972). *Ways of Seeing*. London: British Broadcasting Corporation and Penguin Books.

[xv] A statement of some of the fundamental issues of the economics of scarcity is to be found in: Sahlins, M. 1972/2004. *Stone Age Economics.* Routledge, London.

[xvi] Braudel, F 1981. *The Structures of Everyday Life, Vols I-III.* Collins, London and Harper & Row, New York.

[xvii] I owe this phrase to David Eagleman, from his lecture *The Brain and the Law,* at The Royal Society of Arts, London, April 21st 2009. (Available from the sound archive at www.thersa.com)

[xviii] Ibid. p.71.

[xix] A ground-breaking `hierarchical theory of time' is to be found in: Fraser. J.T. 1987. *Time the Familiar Stranger*, Amherst: University of Massachusetts Press, USA.