Roy Ascott – Early Interactive Work and Some Cybernetic Relationalities
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Beginnings

I initially met Roy Ascott at the San Francisco Art Institute. I was an undergrad and he was the Dean there. Much later Roy approached me about entering a new PhD he was creating called CAIIA – The Center for Advanced Inquiry in Interactive Art in 1995. I was already a professional in the field showing my work internationally, and also an academic working full time as a Graduate Program Director. His vision was perfect for me. 3 x 10 day periods of intense meetings in person and much email and electronic exchange of files - documents and images. His new program was one that focused on the mixture of theory and practice. It also was transdisciplinary in the sense that Roy encouraged the reading of scientific papers from many different branches of science including cognitive science and computer science, artist writings, philosophy, art history, and consciousness studies, among other things. One's practice could be informed by any number of foci. This was a huge shift for me as an artist. I had always read from many differing fields and studied art history, in particular the work of Marcel Duchamp, but I had never written in an informed manner about my own work and ideas, i.e. the exploration of meta-meaning and how interactivity could engage viewers in a very different way to that of traditional art. Working with both Ascott and Mike Punt, both the PhD program and focused writing changed my life. It was during this time that my concept of Recombinant Poetics was articulated.[1] Yet, from this distance in time I can see that the seeds of the ideas I came to explore computationally was already being explored in an analogue manner in 1960 by Roy, exemplified by his Change Paintings.

Analogue Cyberspace

Roy Ascott is extremely well read across a series of different fields. Along with consciousness studies Roy was quite interested in cybernetic ideas and how those ideas were enacted in interactive art — in circular causal accretive systems. In this paper I will point at a series of Roy's early works, and to his early interest in cybernetics. The PhD for me finished in 1999. Here we are discussing Roy's work in the late 50's and 60s. Yet, this was Roy discovering a kind of analogue cyberspace (short for cybernetic space). This analogue space was quite different to that of the Cyberspace that William Gibson articulated in the early 80s (which helped tospawn Virtual Reality), In *Neuromancer*— "Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts."[2] Roy's analogue cyberspace included an interactive system that could be 'steered' and perceived in an ongoing/changing manner through interaction. This interaction was part of a circular causal system that included the interactant in a dynamic manner. The space was thus generated via a comingling of conceptual space with actual physical space via the "authored" analogue system. I think of this space as having subject↔object unity. Perhaps this is akin to the Constructivist thought of

von Glasserfeld. He states: “the structure of behavior of living organisms can never serve as a basis for conclusions concerning an “objective” world, i.e., a world as it might be prior to experience.”[3] Ascott was designing interactive works as a way to “physically” point at the world and human experience—to point at meaning production over time by interacting with a world which is simultaneously being generated by bringing forward our remembered experiences, and projecting our memories, as well as drawing on our intellectual and linguistic frameworks related to a given situation. Shanken provides this perspective:

> Ascott’s emphasis on behavior included not only the production of objects, texts, and pedagogy, but led to a theorization of art as part of an integrated process in which thought and action were interconnected components of an inter-responsive system, fundamental to which is consciousness.[4]

Roy’s work was a way to enable a kind of physical pointing at the workings of consciousness through interaction and process, while also providing additional textual ideas through his papers, publications, book and talks. Of course all of this informed his pedagogy.

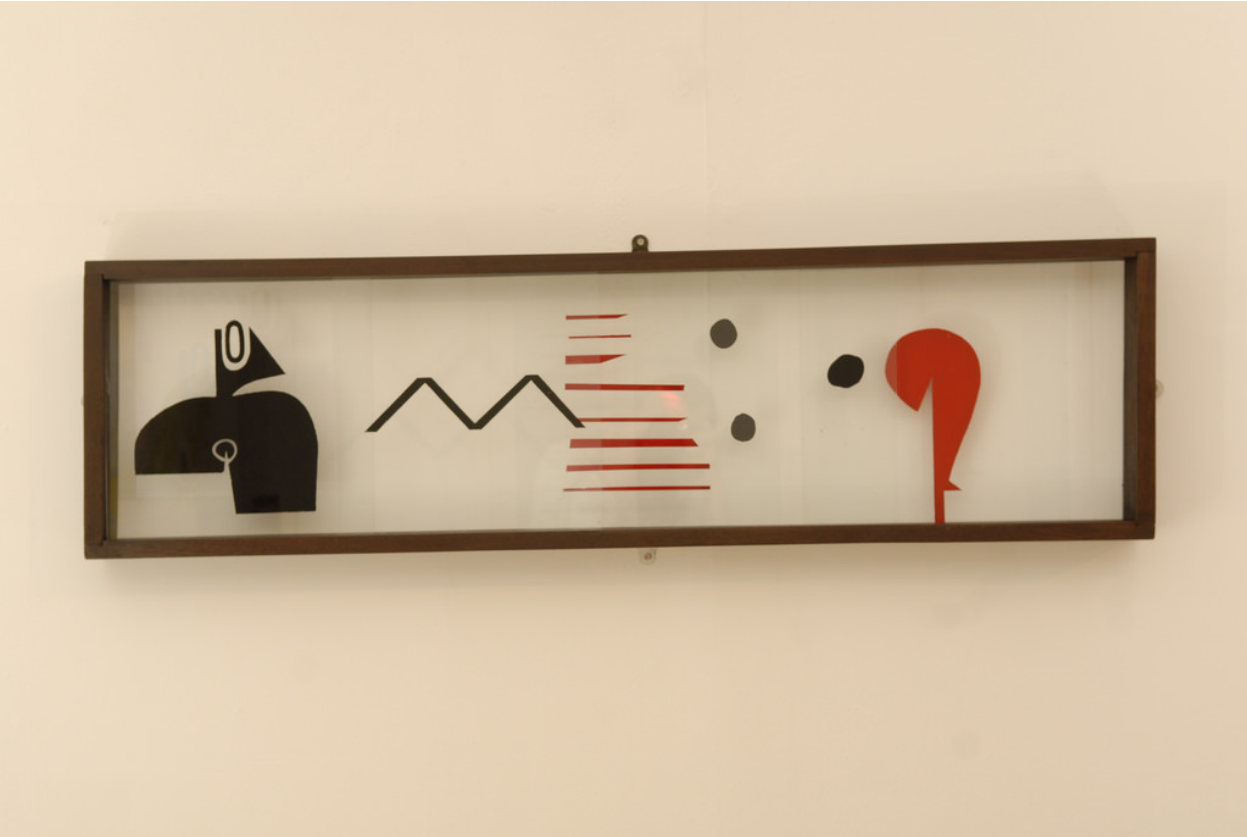
Roy’s Education – some precursors potentially leading to interaction as an artistic strategy

Between 1955-59 Roy studied Fine Art at King's College, University of Durham (now Newcastle University). During this time he had the opportunity to work with artist and designer Richard Hamilton and Victor Pashmore – Artist and Architect. Additionally he studied art history under Lawrence Gowing who is perhaps most famous for his writing on Vermeer, and his later exhibition related to the work of Turner,[5] and artist/historian Quentin Bell. Bell, the nephew of Virgina Woolfe, was a painter turned academic. I can imagine that in a living manner Bell embodied the theory / practice school of learning.[6] So here many different forms of painting and art history was introduced to Roy.

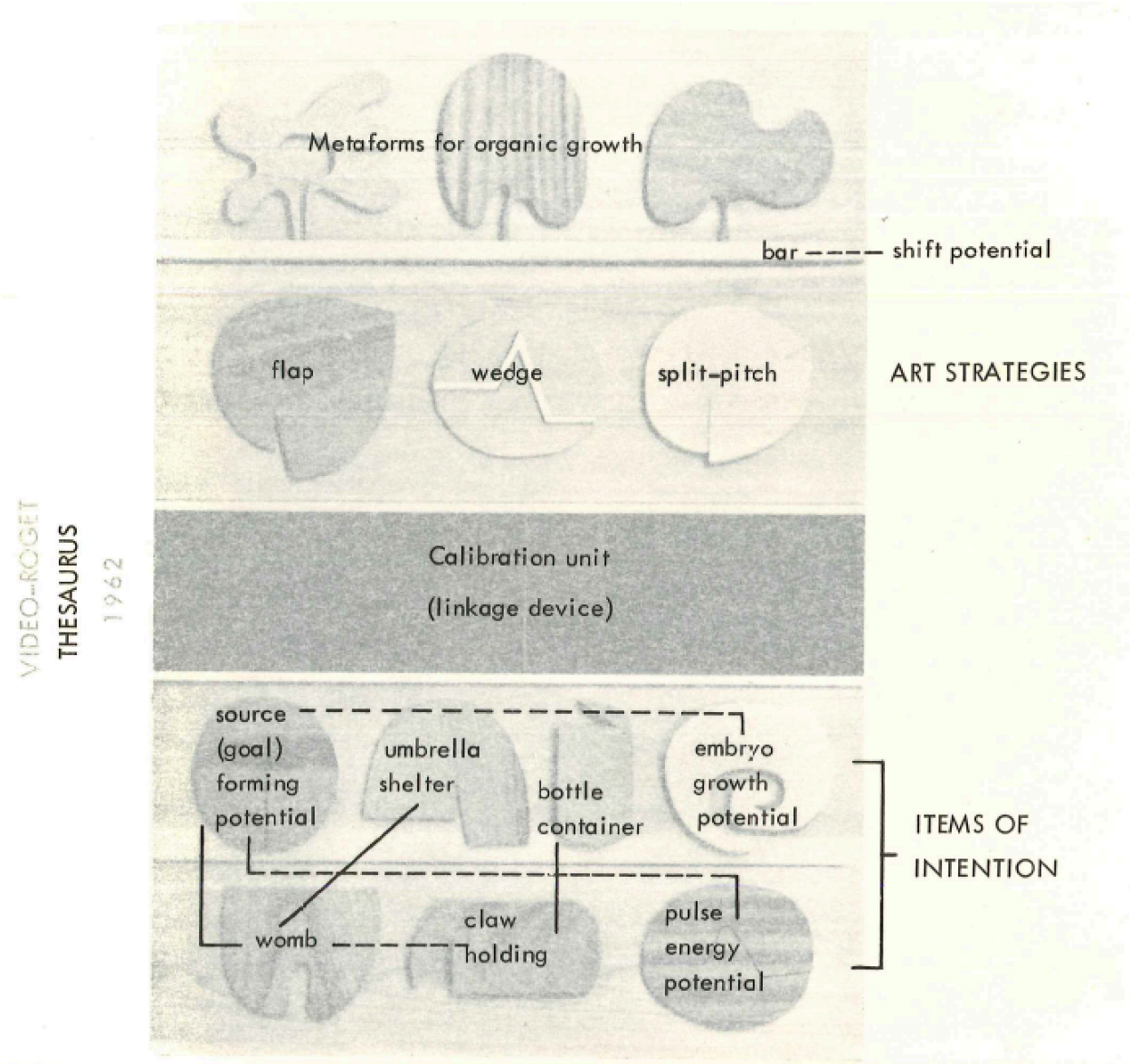
Richard Hamilton – potential influences on interactivity

I believe Hamilton was seminal as both a pop artist and a conceptualist contributing to Roy’s intellectual growth. In particular Hamilton was a Duchampian scholar and published in 1960 the important book— *A Typographic Version by Richard Hamilton of Marcel Duchamp's Green Box*[7], which comprised the translation of Duchamp's original hand written notes and diagrammatic sketches for the design and construction of Duchamp’s famous work, *The Bride Stripped Bare By Her Bachelors, Even* (also called *The Large Glass*). Duchamp’s notes were presented in a very legible typographic form. It is clear that Ascott was influenced by Duchamp especially in terms of his use of symbols, systems, diagrammatics, and machinic and engineering motifs. I would like to suggest this particular work by Hamilton may have planted some the conceptual seeds for Roy’s initial interactive practice. At very least it has some interesting parallels to Roy’s Change Paintings. The notes for the *Large Glass* were read at a conceptual distance to the physical, diagrammatic / symbolic work by Duchamp. They were loosely related and quite punningly unique and poetic. One could read them in differing orders and they conceptually “animated” or “brought to life” the symbolic system of the *Large Glass* via poetic association. This kind of participatory strategy, where one could interact with a work of art, in particular illuminating it through the notes, was quite novel at the time. The notes qualified the meaning of the symbols and made the interpretation much richer, pointing at highly sexually driven subject matter, among other “fields” and poetic readings. One could also become ‘mindfully aware’[8] of the conceptual process that was giving shape to the “readings” that such interaction enacted. So Duchamp/Hamilton produced an early work exploring what might be considered to be what I would call a ‘meta-meaning system’ – a system in which one could observe meaning arising and changing through their interaction in a self–reflective manner. Hamilton made the process quite accessible by making this typographic version, in that Duchamp’s original notes were hand scrawled and difficult to unpack, and basically unavailable to the standard viewer. Duchamp was an erudite conceptualist and father of conceptual painting, not to mention generating the conceptual approach to creative practice by defining the concept of the ‘Readymade.’ Through these works Duchamp laid out some interesting potentially moving “fields” for the viewer to consider in relation to each other. Duchamp was also interested in science and how it could inform art production. Also the work entitled 3 Standard Stoppages, Paris 1913-1914 by Duchamp – created by dropping of 3 equal 1 meter lengths of

thread, from 1 meter of height. This later informed the creation of a kind of visual template system based on the chance shapes that were formed. These forms were subsequently used in Duchamp's paintings to derive forms.[9] These forms are quite noticeable in Duchamp's work entitled Tu'M, an oil painting from1918[10]. Many of Roy's works, especially in the late 60s and early 70's also explored template like symbolic cut-outs which were quite polysemic in terms of meanings/readings.



Ascott, Change Painting 1968



Video-Roget Thesaurus, 1962

One can witness many such symbolic template forms play out in Roy's work, early on exemplified by his Video-Roget Thesaurus, 1962, via a open textual annotation poetics. This work also appears to be influenced by the Typographic version of Hamilton's Green Box notes. In the show catalogue entitled *Diagram Boxes and Analogue Structures,* Roy created a beautiful transparent overlay of word designations to qualify the symbolic shapes he had created. This set of qualifiers illuminates process-related strategies that were central to his early interactive works, being both subject and object, creating a system that again explored what I call a subject↔object unity.

Cybernetic Concepts falling in relation to Ascott's Early Work

Later and/or around the same time (I was trying to pin-point this exact moment in conversation with Roy), Roy began to incorporate a series of cybernetic concepts. These concepts helped to reify a set of ideas that I believe he arrived at initially through intuition, or at very least via the deep abstraction of ideas in originating in the defining Cybernetic texts of Norbert Wiener - *Cybernetics, Control and Communication in the Animal and the Machine*, and *The Human Use of Human Beings; Cybernetics and Society.*[11]

Of course many of his early works pointed at mind, at meta-views of experience and the enactment of ideas though observing systems and processes. I have always liked this title from von Foerster which has a double meaning Observing Systems and Observing Systems, but this book came much later.[12] Roy's work is here very close to ideas central to Second Order Cybernetic– Observing Observing Systems.[13] An excellent paper discussing 2nd Order Cybernetics is by Ranulph Glanville, a former colleague and friend of Roy's, and long time contributer to this publication, who has now passed. Glanville writes that the birth of second order cybernetics was between 68 and 75. We see these first Change Paintings by Roy in the early 60s and a major interactive work by Pask in 1953. So Roy's work which embodied these ideas relational to cybernetic thought were explored much earlier than the formal definition of 2nd Order Cybernetics. In his 1963 catalogue, Dialogue-Boxes & Analogue Structures, Ascott presented the following quote related to Cybernetics (so already by 63 he had found and had begun to incorporate cybernetic ideas in his discussion of art):

> Cybernetics has provided me with a starting point from which observations of the world can be made. There are other points of departure: the need to find patterns of connection in events and sets of objects; the need to make ideas solid (working in wood etc.) but interfusable (transparent panels, hinged sections), an awareness of change as fundamental to our experience of reality; the intention to make movement a subtle but essential part of an artifact… My independent enquiry is regularly reinforced with close reference to scientific publications and search into the methods of analysis and investigation.[14]

Thus the works enacted a form of both meaning production, observation as well as self-observation, and embodied philosophy.

This notion of "interfusability" is a beautiful one. It must be noted that Ascott has a great love of creating and employing language to point at the concepts that are enacted through his works. In particular Ascott has a wonderful history of generating neologisms. Here again is the theory / practice bridge central to both his art production and pedagogy. It is interesting to draw on the definition for cybernetics that Pask provides in his text *The Cybernetics of Human Learning and Performance* (again, a book written much later) He suggests that creativity is at the heart of cybernetics:

> The analogy expressed or represented in the *language employed to account for events* is a *metaphor.* In this sense; Cybernetics is the science or the art of manipulating defensible metaphors; showing how they may be constructed and what can be inferred as a result of their existence.[15]

Central to creative practice are both metaphors and analogies and Roy work embodied this very early on. There was also a new interest in Systems at that time. For me Pask is interesting in that he pointed to a theory of conversation that played itself out in differing ways – though natural language, thought analogue systems, and later through digital systems as well as through simple human conversation. To my mind the Change Paintings are early examples of metaphorical conversations with interactants through the work.

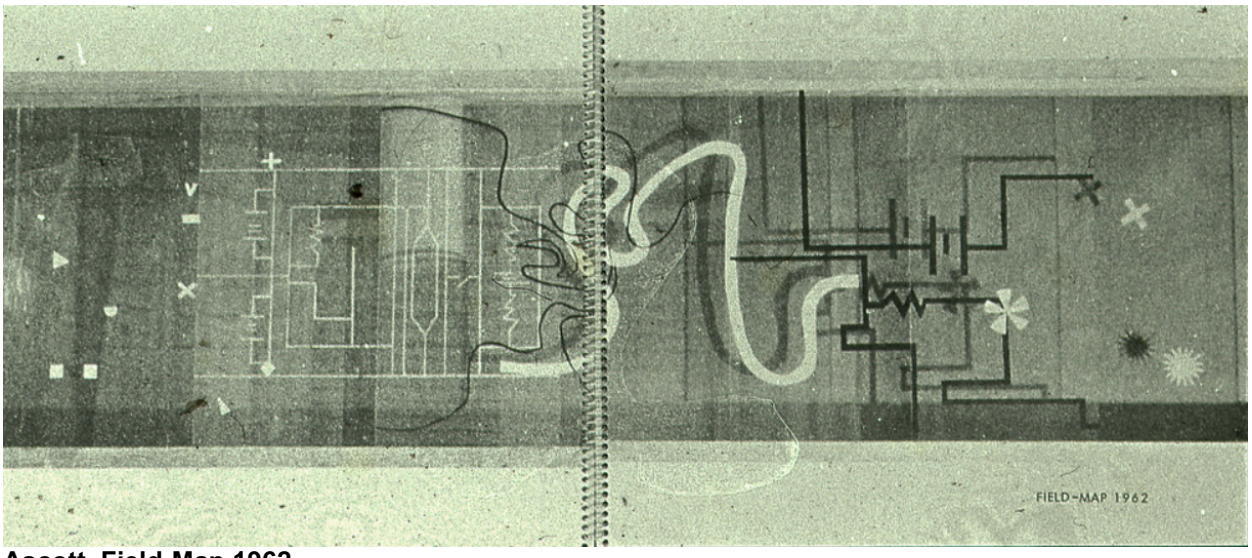
Biological Metaphors

Along with Hamiltonian, and Duchampian aesthetic pre-cursors, one might also point to the beautiful paintings of Victor Pashmore, another of Ascott's lecturers. Pashmore may have stimulated Roy's interest in biological metaphors and the nature of abstraction or should I say the abstraction of nature, and elements of abstracted diagrammatics. Roy's early work at times embodied a way to point at biological metaphors and processes central to being human, but it did this in a new way – through human interaction and centered, accretive observation, as well as through qualifying text as in the Video-Roget Thesaurus work. Of course every painting is interactive to a degree related to the nature of viewing. Ascott actually enabled an ongoing set of differing gestural (read behavioural) states for the participant to explore. Thus Roy sought to build systems that would both at times be aesthetically beautiful and simultaneously point at ideas – a form of painterly conceptualism–or to say it a different way, the beauty of an idea functioned at times as a separate layer of meaning to that of the formal— aesthetic beauty.

These two planes of thought were “interfused” through interaction to use Roy’s word. This seems different to that of Duchamp who sought (at times) to divest himself of concepts of “beauty” (although I somehow find Duchamp’s diagrammatic works highly beautiful).

Ascott, Change Painting 1960

Ascott, Change Painting 1960



Ascott, Field-Map 1962

Relational cybernetic musings? – *The Change Paintings*.

Roy's very early "Change" paintings, 1960-1962, are extremely elegant analogue interactive systems. The sliding nature of the panels point to relationality, changing "interfusability", and subtle infinite analogue combinatorics— the intermingling of gestures and the gestures of intermingling. They suggest to me "abstracted" Chinese pictograms (I need to discuss this with my Chinese and Japanese colleagues [and Roy]), as well as the practice of simplified zen calligraphy– making a perfect circle etc. I also personally associate the I Ching – The Chinese Book of Changes with this work. Alternately I am reminded of Jackson Pollock and the paper written by George Brecht about chance processes in Pollock's work – *Chance Imagery*[16]. Interestingly this "interactive" book (the I ching) is also an analogue change-structure albeit an ancient one. John Cage employed the I Ching like a computer program to explore chance. Chance was also a component in Roy's work. One could also say that Roy was interested in bringing together very different kinds of references, this included spiritual ones. He writes of these "change" works in a lovely text called *The Construction of Change/ Art and Didactics*:

> My Change Paintings and kinetic constructions are not intended only to discuss and project ideas, but as analogues of idea structures which are subject to change and human intervention in the way that ideas themselves are. It is predominantly the experience of Change and the concept of power which lies behind our control and prediction of events which holds my attention at present. In trying to clarify the relationship between art, science and behaviour, I have found myself able to become involved in a teaching situation without compromising my own work.[17]

Here again is the bridge between theory and practice…between interactive enactment and meta-thought processes – learning by doing. Edward Shanken points out in his text *Cybernetics and Art: Cultural Convergence in the 1960s:*

> Roy Ascott's early *Change Paintings* exemplify how ideas derived from aesthetics, biology, and philosophy could result in the creation of a visual analog to cybernetics, even though the artist was not yet aware [at that time emphasis Seaman] of that scientific theory.[18]

Edward A. Shanken, my longtime colleague and friend, who edited the *Telematic Embrace: A Love Story? Roy Ascott's Theories of Telematic Art*[19] wrote about the history of art and cybernetics in essays including "Cybernetics and Art: Cultural Convergence in the 1960s" – from which the above quote was taken.[20] As we piece this history together it seams clear that somewhere during this period between 1960-1963 Roy got very interested in cybernetics (given his catalogue statement discussed above). His interest in Cybernetics as it falls in relation to art, became highly focused in Roy's text "Behaviourist Art and the Cybernetic Vision" in 1966.[21] But Cybernetics was not the only science that informed Roy's work. Shanken in discussing the book he edited entitled *Systems,* provides this thought:

> In the late 1950s, experiments such as the cybernetic sculptures of Nicolas Schöffer or the programmatic music compositions of John Cage and Iannis Xenakis transposed systems theory from the sciences to the arts. By the 1960s, artists as diverse as Roy Ascott, Hans Haacke, Robert Morris, Sonia Sheridan, and Stephen Willats were breaking with accepted aesthetics to embrace open systems that emphasized organism over mechanism, dynamic processes of interaction among elements, and the observer's role as an inextricable part of the system.[22]

So one strategy central to Ascott's thought and pedagogy was that one could inform their work from multiple transdisciplinary perspectives. I believe this is also why Ascott was drawn to Cybernetics in that the systematic methodologies and conceptual modeling, as well as the employment of metaphor and analogy enabled many different kinds of practitioners to talk across disciplines. As I searched the history of Cybernetics, I found that there was not much written about art and aesthetics before Roy's text entitled: "Behaviourist Art and the Cybernetic Vision" (Ascott 1966). It is clear that that text impacted many people. *Behaviourist Art and the Cybernetic Vision*, was published in 1966. In it Ascott presented the following concept:

> Behaviourist Art constitutes, as we have seen, a retroactive process of human

> involvement, in which the artefact functions as both matrix and catalyst. As matrix, it is the substance between two sets of behaviours; it neither exists for itself nor by itself. As a catalyst, it triggers changes in the spectator's total behaviour. Its structure must be adaptive implicitly or physically, to accommodate the spectator's responses, in order that the creative evolution of form and idea may take place. The basic principle is feedback. The system Artefact/Observer furnishes its own controlling energy; a function of an output variable (observer response) is to act as an input variable, which introduces more variety into the system and leads to more variety in the output (observer's experience). This rich interplay derives from what is a self-organising in which there are two controlling factors; one, the spectator is a self-organising subsystem; the other, the art work is not usually at present homeostatic...
>
> There is no prior reason why the artefact should not be a self-organising system; an organism, as it were, which derives its initial programme or code from the artists' creative activity and then evolves in specific artistic identity and function in response to the environment which it encounters.[23]

Given Roy's early Change Paintings what I find interesting here is the notion that a "programme or code" might be analogue or digital. One can point at Sol Lewitt's "recipies" for making drawings and paintings which also acted in this territory – that of the analogue algorithm. Sol Lewitt in a related statement suggests, "The idea becomes a machine that makes the art"[2425] and Lewitt's ideas were often given in textual forms as algorithms to "follow" in the construction of works. His statements on Conceptual Art published in Artforum in 1967 are also quite related – yet, he also was not (at that time) interested in the formal aesthetics (read beauty), nor direct viewer behavioral participation in the "performative/behavioral" aspects of construction. Anyone who sees his work now knows that the notion of beauty somehow slipped back in…

The above quote shows that Roy by this time had made a big jump into the world of cybernetic nomenclature – 'variety', 'self-organising system', 'feedback', 'behavior' etc. There is also a tone to this writing which is very different to the typical artist statement. A tone which is clearly related to cybernetic texts. "We say of cybernetics that, before it is a method or applied science, it is a field of knowledge which shapes our philosophy, influences our behaviour, and extends our thought."[26]

Here, Shanken specifically points to a set of specific Cybernetic Texts that were important to Roy:

> Ascott was profoundly influenced by early writings on cybernetics, including F.H. George's Automation, Cybernetics and Society (1959), Norbert Wiener's The Human Use of Human Beings: Cybernetics and Society (1948), and W. Ross Ashby's Design for a Brain (1952). Cybernetics introduced a method for thinking about the relationships amongst the various interrelated elements of a system, concentrating on the regulation of these elements in order to control the outcome of the system. Primary to the management of the system was the ability for each element to offer feedback about its own status to the other elements of the whole. In this way, the elements could communicate with each other and provide information that would enable the regulation of the system as a whole in order to maintain homeostasis.[27]

I want to suggest that although "control" has some quite negative readings as a concept, in conversation with Ranulph Glanville, we sought to unpack this concept. Ranulph liked to use the example of a skier, who has the fine control over her/his muscles to enable her/him to ski through complex environmental conditions at great speeds. I believe this example goes back to Ross Ashby originally.

The Construction of Change

The second quote that I will seek to unpack in terms of cybernetic precursors is from "The Construction of Change" (Ascott, 1964)

> To Discuss what one is doing rather than the artwork which results, to attempt to unravel the loops of creative activity, is, in many ways a behavioral problem. The fusion of art, science, and personality is involved. It leads to a consideration of our total relationship to a work of art, in which physical moves may lead to conceptual moves, in which Behaviour relates to idea… "An organism is most efficient when it knows its own internal order"[28]

This quote was quite seminal in that it was the Introductory quote for *Six Years: The Dematerialization of the Art Object* by Lucy Lippard which first came out in 1973. This book is a wonderful compendium of works and ideas from that time period – 1966-1972. It also is a quote where Roy points to the centrality of behavior and interactivity as informed by art, science, and individual action.

Roy was quite an influence to the beginnings of this cybernetic / art field. Gordon Pask – perhaps notably his idea of "Aesthetically Potent Environments" paved the way for a series of later (post 1968) interactive works. Again, this text was published some 8 years after Roy's early change paintings…Pask defined this definition:

> a It must offer sufficient variety to provide the potentially controllable novelty required by a man (however, it must not swamp him with variety-if it did, the environment would merely be unintelligible).
>
> b It must contain forms that a man can interpret or learn to interpret at various levels of abstraction.
>
> c It must provide cues or tacitly stated instructions to guide the learning and abstractive process.
>
> d It may, in addition, respond to a man, engage him in conversation and adapt its characteristics to the prevailing mode of discourse.[29]

I believe Pask was also highly influenced by Duchamp, especially in his work featured in the famous *Cybernetic Serendipity* show curated by Jasia Reichardt, entitled *Colloquy of Mobiles* presented at the ICA in London in 1968. Pask's much earlier interactive work Musicolour,1953, was discussed in his text *A Comment, A Case History, A Plan,* which was included in the Cybernetic Serendipity catalogue in 1968 but it was written earlier. The above quote also came from this particular text. Pask's early interactive work explored interactivity, circular causal feedback, creativity, listening and thought processes. It also pointed specifically at human behavior and change in relation to a generative cybernetic system. I am not sure when Roy came to know about this early work – *Musicolour*, 1953.

The Fun Palace

Pask was on the scene in London and Roy collaborated with him on Cedric Price's *Fun Palace*. This work was an incredible visionary "virtual" architectural project. The Fun Palace began in 1962 so I imagine Pask and Ascott had many discussions related to the potentials of cybernetic ideas as related to architecture, aesthetics, behaviourial relations, changing environments, conversation etc. Stanley Mathews wrote an excellent paper entitled: *The Fun Palace as Virtual Architecture - Cedric Price and the Practices of Indeterminancy*[30]:

> In his Fun Palace project, Price turned not to traditional architecture or fantasy but to the discourses and theories of his own time, such as the emerging sciences of cybernetics, information technology, and game theory, as well as Situationism and theater, to develop a radically new concept of improvisational architecture capable of negotiating the uncertain social terrain of postwar Britain. As socially interactive architecture, the Fun Palace integrated concepts

> of technological interchangeability with social participation and improvisation as innovative and egalitarian alternatives to traditional free time and education, giving back to the working classes a sense of agency and creativity. The three-dimensional structure of the Fun Palace was the operative space-time matrix of a virtual architecture. The variable ‘‘program’’ and form of the Fun Palace were not conventional architecture but much closer to what we understand today as the computer program: an array of algorithmic functions and logical gateways that control temporal events and processes in a virtual device. [31] … In the early 1960s, London-based artist Roy Ascott abandoned static easel painting in favor of interactive and chance-based art. Decades before computer-based art, Ascott began to merge the avant-garde trends of Pop Art, Fluxus, and Happenings with cybernetics. The Fun Palace as Virtual Architecture and nascent information technology to create artworks that would interact with and respond to the presence of gallery-goers. Cedric Price knew both artists [Ascott and Pask emphasis Seaman] and invited Ascott to join the Fun Palace design team.[32]

With The Fun Palace Roy could spread his wings so to speak and explore new territories and human growth, not to mention very high-level collaborative behavior.

Looking Back / Looking Forward

Here we can point to Roy's interest in a social function for art and didactics. Roy has spent a lifetime building advanced educational networks; creating and promoting high-level conferences like Consciousness Reframed; fostering transdisciplinary discourse; he has been at the center of many books, conference catalogues and scholarly publications; he has attracted top intellectuals from around the world to become part of his expanded educational network; and has worked tirelessly on the international stage to explore the theory↔practice model. Perhaps this is best summed up by Edward Shanken who states that:

> … Ascott drew on cybernetics to theorize a model of how art could transform culture. He was particularly insistent that cybernetics was no simple prescription for a local remedy to the crisis of modern art, but represented the potential for reordering social values and reformulating what constituted knowledge and being. In 1968 he (Ascott) wrote:
>
> > As feedback between persons increases and communications become more rapid and precise, so the creative process no longer culminates in the *art work*, but extends beyond it deep into the life of each individual. Art is then determined not by the creativity of the artist alone, but by the creative behaviour that his work induces in the spectator, and in society at large. . . The [best emphasis Seaman] art of our time tends towards the development of a *cybernetic vision*, in which feedback, dialogue and involvement in some creative interplay at deep levels of experience are paramount.[33]

Early on Roy helped to outline a new field of creative practice. It must be noted that in 1968, Roy was elected Associate Member of the Institution of Computer Science, London (proposed by Gordon Pask). In 1972, he became a Fellow of the Royal Society of Arts. [34] In 2014 Roy was given an award from Prix **Ars Electronica** – the Golden Nica Award for Visionary Pioneers of Media Art. This award was much deserved. These awards and posts clearly speak to Roy's expansive creative vision.

Conclusion

It is certin that Roy intuited some very interesting ideas in his early Change Paintings, and that Cybernetic theory enriched and reified these early intuitions. To my mind there are three artists / designers that stand out in the history of Cybernetics – Roy Ascott, Gordon Pask, and Ranulph Glanville. They were friends and collaborators and their ideas are still very much important to this day! Additionally they have spawned

a new generation of artists, designers and theorists who draw on the cybernetic precursors that they enacted through their work and thought, their texts, and conversational gatherings.

Professor Dr. Bill Seaman 2017

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[1] *Recombinant Poetics – Recombinant Poetics: Emergent Meaning as Examined and Explored Within a Specific Generative Virtual Environment.* 1999 University of Wales.
See also the published book - Seaman, B. (2010), *Recombinant Poetics: Emergent Meaning Examined and Explored Within a Specific Virtual Environment*, Berlin: VDM Press.
[2] Gibson, W. 1984. Neuromancer. New York: Ace Books. p. 51
[3] von Glaserfeld, E. *An Introduction to Radical Constructivism*, http://www.univie.ac.at/constructivism/EvG/papers/070.1.pdf
[4] Shanken, E., Telematic Embrace: A Love Story? Roy Ascott's Theories of Telematic Art http://telematic.walkerart.org/timeline/timeline_shanken.html (accessed June 6, 2017)
[5] Gowing, Lawrence, https://dictionaryofarthistorians.org/gowingl.htm
[6] http://www.independent.co.uk/news/people/obituary-professor-quentin-bell-1315047.html
[7] A Typographic Version by Richard Hamilton of Marcel Duchamp's Green Box.1960 by Marcel Duchamp and Richard Hamilton
[8] See Varela, F., Thompson, E. and Rosch, E. 1991. The Embodied Mind, Cognitive Science and Human Experience. Cambridge/London: MIT Press. p.23
[9] Duchamp, M. Three Standard Stoppages, Paris 1913, 1914. https://www.moma.org/collection/works/78990
[10] Duchamp, M. Tu'M 1918, https://s3.amazonaws.com/classconnection/391/flashcards/2227391/png/screen_shot_2014-12-09_at_12041_pm-14A30853B295003FEFD.png
[11] Wiener, N. (1948 and 1961). Cybernetics, Control and Communication in the Animal and the Machine. Cambridge, MA: MIT Press. and
Wiener, N. (1950 and 1967). The Human Use of Human Beings; Cybernetics and Society. New York: Discuss Books.
[12] Foerster, H. von (1981). Observing Systems . Seaside CA: Intersystems Publication.
[13] See Glanville, R., Second Order Cybernetics, http://www.pangaro.com/glanville/Glanville-SECOND_ORDER_CYBERNETICS.pdf (accessed June 8, 2017)
[14] Ascott, R. (1963) Diagram Boxes & Analogue Structures. Molton Gallery, Catalogue design and photographs by Noel A. Foster.
[15] Pask, G. (1975) *The Cybernetics of Human Learning and Performance,* Hutchinson & Co Publishers: London (p13)
[16] Brecht, G., *Chance Imagery*, http://docplayer.net/34466425-Chance-imagery-ubuclassics-by-george-brecht-a-great-bear-pamphlet-new-york.html
[17] From Ascott, Roy (The Construction of Change) The Cambridge Opinion 41 (Modern Art in Britain) 37-42, 1964 See also https://www.academia.edu/740569/The_construction_of_change
[18] http://www.artexetra.com/CyberArtExc.html
[19] Shanken, E., Telematic Embrace: A Love Story? Roy Ascott's Theories of Telematic Art http://telematic.walkerart.org/timeline/timeline_shanken.html (accessed June 6, 2017)

[20] Shanken, Edward, **Cybernetics and Art: Cultural Convergence in the 1960s,** http://www.artexetra.com//CyberneticsArtCultConv.pdf (accessed June 24, 2017)
[21] Ascott, R. "Behaviourist Art and the Cybernetic Vision" (Cybernetica, Journal of the International Association for Cybernetics (Namur), Volume IX, No.4, 1966; Volume X No.1, 1967). This interest was to grow greatly over time. Ascott's paper

[22] *Systems*, Edited by Edward A. Shanken, Whitechapel: Documents of Contemporary Art. MIT Press, https://mitpress.mit.edu/books/systems
[23] Roy Ascott: Behaviourist Art and the Cybernetic Vision. In: Randall Packer and Ken Jordan (ed): Multimedia. From Wagner to Virtual Reality, New York, London: W. W. Norton & Company 2002, pp. 104-120.
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