Gordon Pask: Cybernetic Polymath

by

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Gordon Pask was unique in the intellectual landscape of the United Kingdom after World War II. He was one of the major figures in British cybernetics (along with Ashby, Beer, and Walter) and an active theater designer and producer. Pask was influential in various art-related fields including art installation, architecture and art theory. After fifteen years of cybernetic/cultural practice, he participated in the groundbreaking exhibition, *Cybernetic Serendipity*, curated by Jasia Reichardt in 1968 at the Institute of Contemporary Art in London and appeared prominently in the catalog and texts associated with that exhibition.[1] Among a select group of individuals, he introduced cybernetic concepts to the world of cultural practice. Yet, unlike artist/theorists Jack Burnham and Roy Ascott and enginee Billy Klüver, he was more than a conduit between the worlds of technology and the arts.

Pask developed his own unique flavor of cybernetics, which I contend was deeply informed by his intellectual interest and practice in the arts. With his theoretical writings he contributed to a diversity of fields including cybernetics, cognitive science, psychology, education, ethics, and sociology. He built a number of machines for socio-cultural purposes as diverse as teaching and "sensing." He wrote plays and musicals, drew cartoons and created works of cybernetic art. All these achievements notwithstanding, he is rarely acknowledged in histories of digital culture and is virtually unknown in the history of art.

Pask's education was as eclectic as his professional production. After completing his secondary education at Rydal School in North Wales, he obtained degrees in Geology and Mining Engineering from Bangor and Liverpool Technical Colleges. He obtained his B.A. from Downing College, Cambridge in 1952 and his MA in 1954. He completed his degree in Psychology from University College London in 1964 and was awarded the first doctorate of Science in Cybernetics by the Open University in 1974. He published over two hundred essays and six books including *An Approach to Cybernetics* (1961) and *Conversation Theory: Applications in Education and Epistemology* (1976).[2]

The history of digital art must acknowledge developments in multiple disciplines. Unlike most genres of art practice, it is a field in which scientific and technical concepts are as important as ideas from the humanities and the arts. Indeed, the entire field can be seen as negotiating and mediating between these two disparate and even conflicting areas. In the spirit of this broader art history, I will evaluate Pask's importance to the arts of his time, his legacy in the field of digital art and the relevance of some of his theoretical concerns to contemporary art practices. My discussion focuses on *The Colloquy of Mobiles (1968* ), a work that Pask discussed amply. Specifically, I analyze the piece with respect to relevant aspects of Pask's previous theoretical work in order to illustrate his characteristic unification of theory with material experimentation.

Pask's primary theoretical contribution to the arts was his concept of "aesthetically-potent environments," anchored in his understanding of the work of art as a system that evolved either independently or in interaction with a participant. These ideas, directly informed by cybernetics, entailed propositions involving interactivity, organization, intelligence, communication, learning and agency. Pask's influential "conversation theory" developed concurrently with his material experiments and his aesthetic theories.

Pask defined aesthetically potent environments as those environments designed to stimulate pleasurable interactions. Any work of art could be an aesthetically potent environment. It need not involve mechanical or computer-aided interactivity. Even when the work was responsive and adaptive, the resulting interaction may be between the spectator or participant and internal representations that the work elicited. This suggested that the boundary between thought and reality was fluid. Indeterminacy among lived, affective, and imaginary experiences also characterized conversation theory.[3] Although some of his contemporaries shared these preoccupations, Pask was among the earliest to instantiate them in both techno-cultural artifacts and theory. Consistent with the style of cybernetics (a science that has been applied to virtually all fields), Pask's work exemplified interdisciplinarity. His machines and theories were neither art nor science; they utilized and exceeded both. Regardless of the purpose of the system, each of Pask's machines built on his earlier experiments. For example, SAKI (1956) and EUCRATES (1957), both "self-adaptive keyboard instructors," incorporated aspects of his audiovisual interactive work, *Musicolour* (1953-55). The frustrations that he developed with all of these machines inspired his famous "Ear."[4] Similarly, his teaching machines influenced his theories and cultural projects.

Pask's best known artwork, *The Colloquy of Mobiles,* may be discussed as a contribution to art, cybernetics, engineering, simulation, sociology and artificial life. Intended to be primarily playful and humorous, the work incorporated theories of self-organizing systems, communication, learning and evolution that Pask had developed for over a decade. *Colloquy* anticipated contemporary interactive installations especially art employing artificial life (a-life) by stressing self-organization, interaction and cooperation among individual agents. It also shared a limitation of some contemporary a-life narratives in the elaboration of strongly gendered explanations for the behavior of the agents.[5]

Pask described *Colloquy* as a socially- oriented, reactive and adaptive environment in which entities communicated with each other and learned about one another even in the absence of a human participant.[6] The work consisted of five large mobiles suspended from a structure of metal bars, which allowed them rotational and horizontal displacement. Two of the mobiles were designated male and three female. The males had rectangular bodies made of aluminum and the females appeared as bulbous shapes fabricated from fiberglass. The female mobiles were created by theater designer Yolanda Sonnabend.

In this piece, Pask radically challenged traditional notions of a mobile as an arrangement of two-dimensional forms set in motion by air movement. The mobile elements in *Colloquy* were tri-dimensional sculptures powered by motors, individually programmed and also partly computer-driven. Thus, they were more akin to a group of autonomous robots than to the archetypal Calder mobile.

Pask provided each sculpture with a hierarchical set of goals, which allowed multiple levels of communication in the system.[7] In order to achieve their objectives, the mobiles had to learn to communicate, cooperate and compete with one another. People could enter in the environment, interact with and possibly alter the mode of communication of the sculptures but ultimately the human participant was not essential to the dynamics of the group.[8]

The principal goal of each mobile was to satisfy its pre-programmed "drives," which emulated the instinctual behavior underlying human mating. Each male had two drives, O and P. These letters stood for the colors orange and puce (though they also suggest forms of sexual stimulation), each associated with a light beam representing one drive. To reduce either drive, the male was required to project the designated light beam from a specific part of his body to another. This necessitated the cooperation of a female, who unlike the males, had a vertical

positionable reflector, which could take the beam from the male and reflect it back to the required body part. [9] Females also were equipped with the drives O and P, which they were compelled to satisfy. According to the state of her drives, a female was receptive to males offering cooperation. In order to engage with the females, males had to compete with each other. For instance, they could block each other's intermittent directional visual signals identifying them as males attempting to satisfy a given drive.

Pask's description of an encounter between Male I looking for O satisfaction and a female is worth quoting in full as it illustrates the bio-mimetic character of the mobile's behaviors:

> Male I sends out an intermittent directional visual signal which serves to identify it as ' male I' and its desire as 'O satisfaction'…Should the directional signal fall on the receptor of a female who is trying to cooperate, she produces an identifying sound in synchrony with the intermittent light signal. Male I detects the correlation between the female and his light signal and stops his motion (unless he is prevented from doing so by male II). At this point he triggers off an autonomous energetic event which consists in shining an intense orange light for at least a minimum interval in the direction of the located female. The immediate result is an increase of the O drive. However, male I anticipates reinforcement (which he will achieve if the female behaves appropriately and if the moving part, C, is appropriately positioned during at least some of this behavior). Reinforcement, which substantially reduces the O drive, is obtained if the O goal is satisfied; that is if orange light falls on receptor C. Supposing reinforcement occurs, male I emits an identifying sound signal which is received by the cooperating female; the autonomous energetic event is prolonged and the O drive is decreased. The cooperative encounter terminates after a short time if reinforcement does not occur, or if it is externally disrupted. Otherwise it continues until the drive state of male I is modified so that he aims for a different goal.[10]

Pask stressed that the mobiles's ability of each of the five units to satisfy its drives depended on previous experience. The females, for example, had to "learn" how to position the vertical reflectors. But the system required that females learn different strategies, as not all males demanded stimulation of the same body part. He explained: "some may like O light on D and P light on C. She can learn that trick also."[11]

*Colloquy* met some of the requirements for self-organizing systems that Pask had identified ten years earlier. In his opinion, self-organizing systems were "systems that we regard as though they have elements in them that make decisions."[12] This definition anticipated contemporary notions of emergence.[13] For Pask, a self-organizing system depended on the ability of the viewer to make sense of it; that is, "to make use" of it. This demanded both a

degree of self-identification of the observer with the system as well as the presence of a common "language" between the two.[14]

Reward, competition and cooperation also were vital to the structure and development of a self-organizing system. Pask constructed an abstract model of a self-organizing system consisting of an indefinitely large but finite set of points or elements, which he conceived of not as basic elementary particles but as "unitary elements, automata, players, decision makers, 'neurons' or the like."[15] He posited that some sort of currency, energy or food must be available in the system so that signaling or communication among diverse elements can occur. A reward, he explained, "is something that allows a system to exist and to survive, as a distribution of currency which the system, if it exists, will spend, constructing more pieces of the system in the process. If the system does not exist . . . it allows the system to come into being."[16]

Because a self-organizing system is always evolving, its structure is inseparable from its behavior. Pask argued that the rewards and the kind of games that entities within the system played, whether competitive, collaborative, or both, helped shape the structure of the system.[17] He posited that some games assigned specific elements in the universe to behave as individual players. Others required fixed coalitions, always involving the same set of players. Yet others allowed the formation of "functional coalitions," that performed specific functions. Functional coalitions were made up of different entities on different occasions. They lacked a fixed location and moved around the system. "When this picture appears," proposed Pask, "we are looking at a self-organizing system."[18]

According to Pask, observers interacted with a self-organizing system in order to control it.[19] In a symbolic domain such as art or literature, control was equivalent to problem solving, and additionally as "'coming to terms with' or 'explaining' or 'relating to an existing body of experience.'"[20] These interactions required various levels of abstraction, improvisation, and synthesis, which he believed were basic to human pleasure. Consequently *Colloquy* exemplified an aesthetically potent environment.[21]

*Colloquy* also met several of Pask's requirements for a self-organizing system, although in its original form it lacked the ability to expand by constructing more pieces of itself. The entities communicated with a rudimentary language of visual and auditory signs and appeared to make decisions. The similarity of the activities of the mobiles to sexual behavior hardly needs elaboration. Thus the piece encouraged identification from human observers. The energy or

currency in the system was manifested in the building up and satisfaction of each mobile's drives. Individual "programs" compelled each entity to communicate with others and allowed for collaboration and competition.[22] Each mobile was rewarded for successful collaboration with the satisfaction of its drives. Yet this distribution of energy in *Colloquy* failed to stimulate the system's growth. Only by interacting with humans could the system possibly expand.

In an abstract model of evolution elaborated in 1961, Pask distinguished between two classes of automata: "The first class… are things which are able to make decisions, moves, signals, or whatever. They do so on the basis of accumulating evidence about the activities of other automata and possibly about conditions in their environment engendered by other than the activities of their fellows…. the other class…when presented with this same dilemma [an undecidable situation], either evolves or dies. If it has enough substance it evolves; if it does not, it's had it!"[23] In my view, the *Colloquy* belonged to the first class.

In conclusion, *The Colloquy of Mobiles* is a material implementation of a complex theory of artificial organisms and self-organizing systems before the advent of artificial life. Pask's mobiles were machines that could "learn" and interact with each other and potentially with humans (given that they learned the mobile's visual language i.e., using a mirror and a flash light).[24] This was a significant innovation. *Colloquy's* reactive and emergent qualities anticipated later developments in digital art such as Myron Krueger's concept of "responsive environments" from the early 70's and recent examples of artificial life art including Ken Rinaldo's *Autopoiesis* (2000) and Christa Sommerer and Laurent Mignonneau's *A-Volve* (1994). Although not all of Pask's contributions to digital art were explicitly works of art, the prescience of his theories and artifacts established him as one of the pioneers in the field.[25]

Biographical note:

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Figure captions:

Fig. 1. Gordon Pask. Photograph (c) Paul Pangaro 1985, Pask Archive.

Fig. 2. Gordon Pask's *Colloquy of Mobiles* at Cybernetic Serendipity exhibition, ICA, London, 2 August - 20 October 1968.

Fig. 3. Gordon Pask's *Colloquy of Mobiles* at Cybernetic Serendipity exhibition, ICA, London, 2 August - 20 October 1968.

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[1] *Cybernetics, Art and Ideas,* ed. Jasia Reichardt (Greenwich, Connecticut: New York Graphic Society, 1971), 71-99.

[2] See Ranulf Galnville, "Gordon Pask-a Skeleton for an Unofficial Biography" in *Gordon Pask: A Festschrift*, *Systems Research, (*vol. 10, no. 3, 1993), 9-11. Published books by Pask: *An Approach to Cybernetics* (London: Hutchinson, 1961).
*The Cybernetics of Human Learning and Performance (London* Hutchinson 1975).
*Conversation Cognition and Learning (Amsterdam:* Elsevier, 1975).
*Conversation Theory, Applications in Education and Epistemology (Amsterdam:* Elsevier 1976).
*Calculator Saturnalia, Or, Travels with a Calculator : A Compendium of Diversions & Improving Exercises for Ladies and Gentlemen* with Ranulph Glanville and Mike Robinson (London: Wildwood, 1981).
*Microman Living and growing with computers* with Susan Curran (London: Macmillan 1982)

[3] The flows among materiality, language and virtuality in Pask's conversation theory begs for a comparison with the work of materialist philosophers such as Gilles Deleuze.

[4] Pask and Curran, *Microman, 144*; Peter Cariani, "To evolve an ear: epistemological implications of Gordon Pask's electrochemical devices." *Systems Researc*h (vol. 10, no. 3, 1993): 19-33.

[5] For critical analyses of a-life narratives, see N.Katherine Hayles, "Narratives of Artificial Life" in *Future Natural: nature, science culture,* ed., George Robertson, et al, London: Routledge, 1996),146-164; Sarah Kember, *Cyberfeminism and Artificial Life* (London: Routledge, 2003), Mitchell Whitelaw, "Theorizing a-life, art and culture' in *Metacreation*, 181-205; and Edward A. Shanken, "'Life as We Know It' and/or 'Life as It Could Be': Epistemology and the Ontogeny/Ontology of Artificial Life," *Leonardo* 31:5 (October, 1998): 383-388.

[6] Gordon Pask, 1971 "A comment, a case history and a plan" in *Cybernetics, Art and Ideas*, edited by Jasia Reichardt (Greenwich, Connecticut: New York Graphic Society, 1971), 88.

[7] Ibid.,89. Pask encountered some technical difficulties implementing the piece, including the color differentiation of the light signals. As my interest in this work is theoretical, I focus here exclusively on Pask's vision of the work.

[8] Ibid., 88.

[9] Ibid., 89.

[10] Ibid.

[11] Ibid., 91.

[12] Gordon Pask, "A Proposed Evolutionary Model" in *Principles of Self Organization* von Foerster and Zopf, eds. (London: Pergamon, 1961) 229.

[13] Peter Cariani, "Adaptivity and Emergence in Organisms and Devices" *World Futures*, 32(1991), 11-132; Stephen Johnson *Emergence: The Connected Lives of Ants, Brains, Cities and Software* New York: Simon and Schuster, 2001).

[14] Gordon Pask, "Artificial Organisms" *General Systems Yearbook* (Vol. 4, 1959), 151.

In these theorizations there was tension between Pask's ideas of the observer's involved participation in the system and the observer's detachment required for objective scientific observation. Such tensions were to be annulled in second order cybernetics, a field to which Pask's work was foundational. Glanville, "Gordon Pask," 10.

[15] Pask, " Proposed Evolutionary Model," 231.

[16] Pask, "Artificial Organisms"1959, 159.

[17] Ibid.

[18] Ibid., 160.

[19] Ibid., 151.

[20] Pask, "A comment," 76.

[21] Ibid., 88.

[22] Pask refers to 'programs'. Like the term 'software', the term 'program' was less codified than it is today. It can be inferred from his flow diagrams that the 'programs' were instantiated systems which combined relay logic with analog computing circuitry.

[23] Pask, "Proposed Evolutionary Model," 238.

[24] It is unclear from available documentation of *The Colloquy of Mobiles* what the extent of the learning was, or how it was technologically instantiated. We do know that a substantial part of Pask's professional practice at the time was concerned with machines, which could 'learn' and 'teach.'

[25] This paper was presented at the REFRESH conference, First
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