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Résumé de l'article

AARON, 25 ans, est un programme informatique, doté d'une intelligence artificielle qui peut faire des dessins à main levée. Il a été développé par Harold Cohen, un peintre expressionniste abstrait anglais. En 1968, ce dernier s'intéressait à l'intelligence artificielle et faisait de l'ordinateur le véhicule principal de sa démarche artistique. Dans les années 70, les images d'AARON se limitaient à des dessins géométriques abstraits et, vers le milieu des années 80, son programme « cognitif » s'élargissait pour inclure la reconnaissance de la morphologie humaine et végétale, permettant ainsi de produire des dessins à main levée de gens évoluant dans des environnements de jardins.

Cet article retrace le développement conceptuel d'AARON par le biais de sa biographie, il explore les aspects spécifiquement masculins qui sous-tendent le programme et examine les implications de cette désignation sexuelle dans la construction des modèles théoriques de ce champ artistique en émergence.

AARON: Portrait of the Young Machine as a Male Artist

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Résumé

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Let me introduce you to AARON, a twenty-five-year-old computer software program that makes freehand drawings (Figs. 1, 2, 3). Originating from an artificial intelligence basis in computer science and the idea of an intelligent machine that models the brain, the program was developed by contemporary artist Harold Cohen. An acclaimed British abstract expressionist painter, Cohen in 1968 turned to artificial intelligence and the computer as the "primary output" media for his art-making.[1] Tate Gallery director Alan Bowness acknowledged in his catalogue introduction to Cohen's 1983 Tate Gallery exhibition featuring AARON drawings that with Cohen's transition from painting on canvas to the computer, and his relocation at the University of California at San Diego, the visual arts community "lost sight of one of the outstanding talents of our generation."[2]

Bowness's observation about Cohen signals a dilemma in the contemporary interaction of art, science and technology and in particular electronic computer-based visual arts; this evolving area finds itself located outside the parameters of the western art historical canon and its aesthetic concerns. Although current discourse is pushing to expand the established boundaries of art history, for example in the areas of multi-culturalism, the environment, sexual politics, and ethnic, class and gender concerns, it has not warmly embraced computer-based visual arts employing electronic technologies.

This cool response is understandable because the development of computer graphics in the mid-1960s was for scientific and military purposes. The first graphic accomplishments were produced by scientists, mathematicians and engineers who had accessibility to powerful mainframe computers and the expert knowledge necessary to use them for the production of visual imagery.[3] Ben F. Laposky's "oscillions" or "electronic abstractions," produced in 1950,

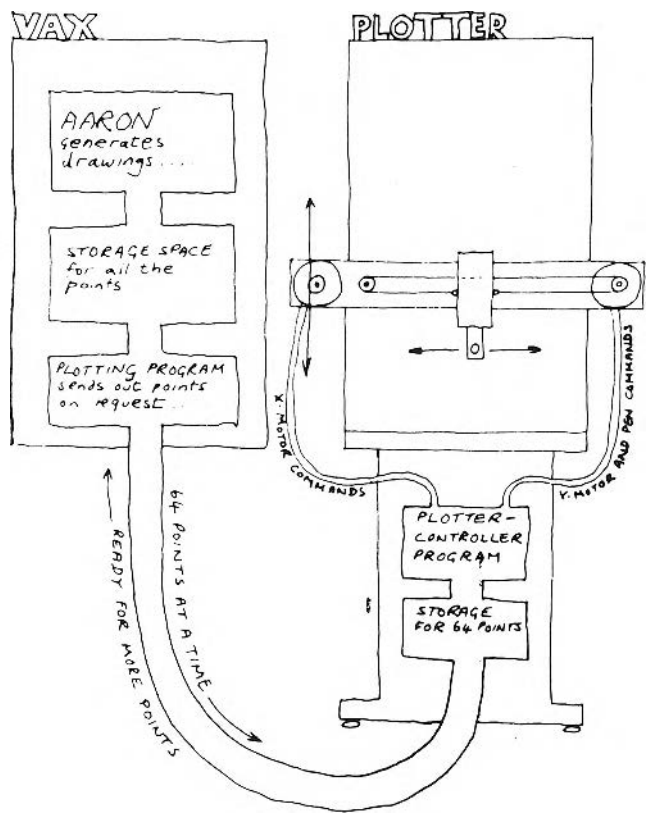
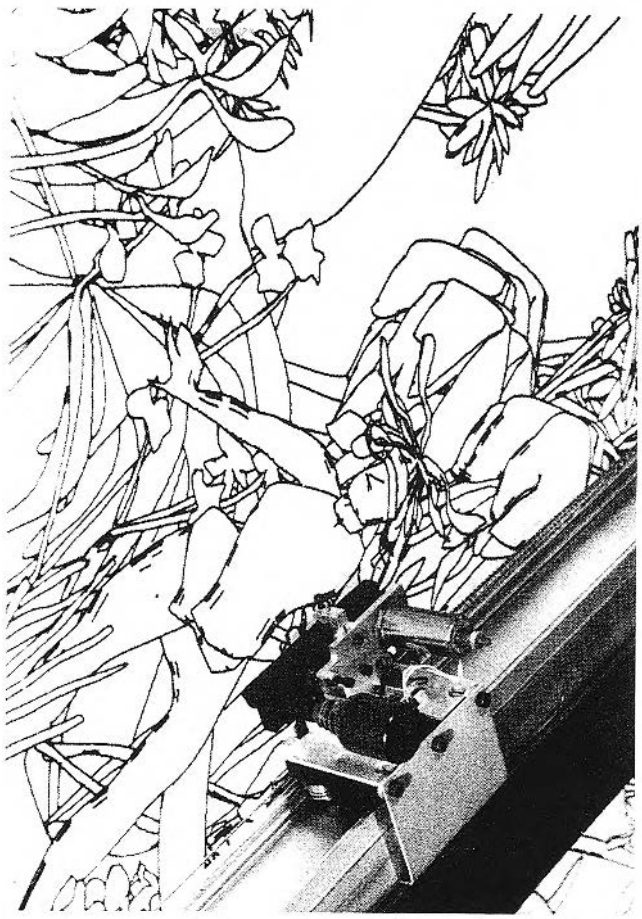


Figure 1. Diagram of Harold Cohen's computer hardware (Digital Equipment Corporation MicroVAX II) arrangement that runs the software computer program AARON. (Photo: Becky Cohen)

are considered the first graphic imagery generated by an electronic machine.[4] The technology that brought about computer graphics was originally produced for aerospace research, and was further developed by the military for surveillance and by industry for the design and manufacture of airplanes and automobiles. Later, the textile and print-

Figure 2. AARON computer-generated plotter drawing in progress. (Photo: Becky Cohen)



ing industries used computer graphic techniques for specific artistic applications, and now these tools, along with advances in telecommunications, have become available to the artist.[5]

Thus, much computer-based imagery has been produced by computer scientists who understand the technology but have no training nor expertise in art-making. This has resulted in a low quality of art production and a negative reputation for electronic computer-based arts. In contrast to the body of weak computer-based imagery produced by computer scientists and programmers, a small group of traditionally trained fine artists, having already made a reputation for excellent work in more traditional media, have had some success in generating strong computer imagery. Three notable examples are American Charles Csuri (b. 1922), Englishman Harold Cohen (b. 1928) with his AARON drawing program, and Dutchman Peter Struycken (b. 1939). These pioneers hold in common nuanced knowledge and expertise in both art-making and computer science. Although these artists have been working with electronically-based technologies for more than two decades, the problem of validity continues to plague the making and reception of electronic computer-based visual arts. David Carrier, in a 1988 *Leonardo* editorial, noted that neither art historical nor commercial journals have produced any model for the study of the interaction of art, science and technology.[6] Roger Malina, editor of *Leonardo*, argues that the area of computer-based visual arts suffers from insignificance because of "the lack of adequate theoretical, historical, and critical frameworks."[7] A more recent observation by electronic media critic Timothy Druckrey points out the simultaneous evolution of "computer art" and contemporary radical theories of representation, noting that a dialogue between the two did not occur. Druckrey further states that the merging discourses of contemporary technology and the visual arts have reached critical mass and urges the joining of theories of computer-based interactivity with contemporary theories of representation.[8]

Cohen's shift from an art-making basis situated in Kantian-shaped modernist aesthetics to one located in the developing area of artificial intelligence and the larger domain of computer science initiates an alliance of conceptual concerns of art-making with current developments in artificial intelligence.[9] Carrier, Malina and Druckrey alert us that there exist no adequate theoretical bases in aesthetics, art history and art criticism for analyzing the evolving interdisciplinary union of electronic technologies and the visual arts. Another difficulty plaguing this merger, and exemplified in the evolution of the AARON program, is the embodiment of a subtle male dominance in the philosophy, hardware and software, and education in the field of computer science, combined with a similar dominant male presence in the development, criticism and history of modern art.[10] An overt manifestation of a deeper male bias or leaning is Cohen's attribution to the software program of his own Hebrew birth name of AARON, suggesting an anthropological relationship between two particular bodies, the male developer and the male technologically-based computer program. This article will trace AARON's conceptual development through the employment of a biographical portrait, explore male aspects underlying the AARON program and discuss implications of these gender-biased facets for theory-building in the emerging area of electronic computer-based visual arts.

COMPUTER ART-MAKER AARON

Before proceeding to a critical discussion of male aspects underlying the AARON program, let me briefly sketch a biographical portrait of our maturing computer program's first twenty-five years. The unusual categorial choice of biographical portrait plays out anthropologically a basic as-

Figure 3. Harold Cohen, *Untitled*, AARON drawing, 1986. Indian ink on paper, 22" x 30". (Photo: Becky Cohen)

sumption of artificial intelligence: the idea that a computer program can mimic varying activities of a human kind.

The AARON program for simulating the act of human drawing, was developed by Cohen in 1973 for the purpose of addressing the central double-pronged question directing his art-making since the late 1960s: "What do computer programs — and, paradigmatically, human beings — need to know about the external world in order to build plausible visual representations of it [?] What kind of cognitive activity is involved in the making and reading of those representations?"[11] This question reflects Cohen's preoccupation with the puzzle of how we can make sense of marks, and combinations of marks, that form imagery. Cohen hypothesized that the structure of all drawn imagery is derived from the nature of visual cognition and developed the AARON program to work out this hypothesis.[12] Thus, the AARON program is designed to investigate the cognitive principles underlying visual representation.[13] AARON is an expert system drawing machine modelled on and simulating Cohen's own "expert" knowledge of image-making. Further, the AARON program operates as a functional model for Cohen's developing theory of visual representation, "specifically, as a model of the way in which we recall low-level data from memory and use it to build, in imagination, apparently visual images."[14]

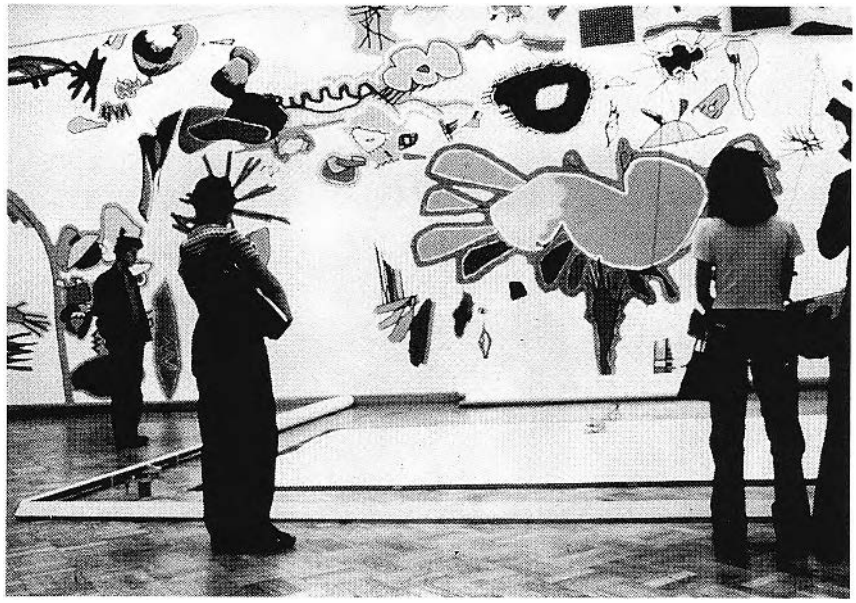
AARON's toddler years, therefore, were preoccupied with the puzzle that had plagued Cohen for many years:

> ...[H]ow it is that we were able to make sense of systems of marks generated within cultures utterly remote from our own, the cultural meaning of which we could not possibly know. For that matter, how are we able to make sense of any marks at all? I speculated that we would need to distinguish between meanings carried by mark systems and the *sense* of meaningfulness generated by those systems.[15]

When visiting in early 1973 the petroglyphs in the California Chalphant Valley, Cohen learned that these small images chipped into stone were made by the aboriginal ancestors of present-day American Indians, and that for millennia similar imagery has been chipped into rock by human beings all over the world.[16] This led him to speculate that these common phenomena pointed to a "set of perceptual constants in the human brain,"[17] shared cross-culturally and constant throughout human history and the history of art-making. A deepening understanding of how computers follow rule sets, coupled with his observations of the California petroglyphs, guided Cohen to consider the similarities and differences of the rule-based computer program to a set of perceptual constants in the human mind. Cohen surmised, "[S]ince we don't know how or why the petroglyphs of the California desert were made, or by whom, let us suppose they were made by a computer: what would the program have to know to persuade us that its efforts were meaningful?"[18] Thus, the starting point of Cohen's working hypothesis was that all image-making and image-reading "is mediated by cognitive processes of a rather low-level kind": less complex processes that enable us to cope with the real world.[19] Along with his acknowledgement of the absence of common cultural agreements, he proposed that these processes that structure the image, moreso than its content, unite the image maker and the image viewer in a single exchange and embody meaning.[20]

In these early years AARON's knowledge-based program was developed to know something about internal processes of human cognition and about drawing, and this is evident in the 1979 mural for the San Francisco Museum of Modern Art (Fig. 4). "The program thus succeeded in demonstrating [in drawing the San Francisco mural] the power of the cognitive system itself, devoid of world knowledge: and by implication, the degree to which all ('visual') representational systems take both form and power from the cognitive system."[21] The early AARON program worked out a set of low-level cognitive skills for image-making: the ability to differentiate between figure and ground, open and closed forms, insideness and outsideness, symmetry and repeti-

Figure 4. Cohen, *Untitled*, Mural (center and right portion), AARON drawing, 1979, San Francisco Museum of Modern Art, and in the foreground a mouse executing an AARON drawing on canvas. Hardware: Digital Equipment Corporation MicroVAX II. Software: by the artist. (Photo: Becky Cohen)



tion.[22] AARON functions as a rule-based program "in which certain fundamental rule-sets are bound to low-level cognitive processes" and models aspects of Cohen's image-making behaviour through the action of rules.[23] Thus, a rule-based program such as AARON uses a body of rules to represent the artist's expertise. A hierarchical ordering governs the computer programming, working from lower levels of mapping and planning to higher levels of lines, sectors and curves with each level responsible for its own decision-making in the image-making process.[24] Although the rule-based, hierarchical computer process is not evident in the imagery itself, one sees the delineations of figure/ground, open/closed form, insideness/outsideness, symmetry and repetition. A consistent problem in the analysis of AARON's image-making is our inability to view and understand AARON's code, that is the encoded computer processing steps, contrasted to the easy viewing accessibility of the completed imagery. As with any art object, we see the object without directly seeing the mental process that gave rise to it.

Sometime in 1979, the young AARON began the childlike process of scribbling, which developed into a "scribble and surround" mode that became the sole structuring format for his closed forms.[25] In developing the complex simulation of a child scribbling, Cohen discovered that he had stumbled on a child's "first attempt at representation: the first manifestation of that characteristic ability of the human mind, to make something stand for something else."[26] Further consideration brought Cohen to speculate that this initial stick-figure level of knowledge, for example of an animal, may be a core knowledge of a representation, which then passed as a visual representation.[27] Through this development it became clear to Cohen that AARON's knowledge base needed a continual input of the knowledge of structure rather than the knowledge of appearance, knowledge of structure being less difficult to represent than knowledge of appearance. This meant placing within AARON a model—for example, an animal structure—rather than the appearance of an animal in the external world. Cohen produced simple box-like cores to simulate animals' bodies, and the drawings suggested a likeness to Northern European Paleolithic art.[28] This similarity led Cohen to surmise "that the difference between the representations characteristic of these two cultures could be understood as differences of knowledge and not differences of 'style'[:] differences, that is to say, of what the two cultures thought important to represent of their respective worlds."[29] He also recognized, in the building of scribble and surround closed forms simulating what young children do, that drawing is basic to cognition, and that the closed form is common to all visual representation systems in human history.[30] The Tate Gallery mural of 1983 (Fig. 5) and the Ontario Science Centre mural of 1984 illustrate AARON's scribble and surround structuring mode of the early 1980s.

By the mid 1980s it became apparent to Cohen that he needed to provide AARON with explicit structure knowledge about the objects that he appeared to be drawing, namely knowledge of plants, trees and the human figure. A third stage, occurring in the early teen years and apparent in drawings of 1985 (Fig. 6), found AARON drawing the human figure by constructing a large closed middle form, a smaller closed form atop, two smaller appendages adjoining the mid-section of the middle form and two forms hanging from its bottom. Thus, by his teen years, AARON's expanding knowledge base contained drawing skills and basic information about nature and the human figure.

AARON's growth through his late teens brought forth a sophistication in his knowledge base of the human figure and advanced his information base about drawing, enabling him to create the illusion of three-dimensional space on the flat drawing surface. A 1985 Statue of Liberty image entitled *Liberty and Friends* (Fig. 7) provides the earliest example from this stage. The 1986 *Athlete Series* (Fig. 8) further demonstrates that AARON's knowledge-base extension includes an understanding of how the human figure balances in a variety of postures.[31]

Figure 5. Cohen, *Untitled*, AARON drawing, 1983, Mural. Hand-painted by Cohen, Tate Gallery, London, and a view of Cohen with plotter executing an AARON drawing at the Tate Gallery. Hardware: Digital Equipment Corporation MicroVAX II. Software: by the artist. (Photo: Becky Cohen)

Cohen sensed that the balancing figures in the *Athlete Series* lacked a context and he expanded AARON's knowledge base to include rules governing plant morphology and growth, from ground cover to large trees. AARON began drawing people located in garden-type settings (Figs. 3 and 9). In 1989 and 1990 AARON generated little imagery because Cohen was in the process of changing the computer language from "C" to the higher level and more flexible "Lisp." Along with the language change, Cohen continued to pursue experimentation that would enable AARON to work with a robotic arm, and to manipulate brush and paint. This would enhance the possibility of illuminating the visual cognitive processes of both line drawing and brush painting, the AARON model illustrating both processes. Thus far, either Cohen or a trained assistant have hand-coloured AARON's drawings.

Imagery by AARON in the early 1990s concentrated on human-like figures and faces located in sparse interior spaces. *Untitled* of 1991 (Fig. 10), AARON-drawn and hand-painted by Cohen, centres two full-bodied female figures with distinct facial features in front of a chinese-red wall. Cohen is building a more sophisticated internal structure of the human figure in this recent extension of AARON's knowledge base. The AARON program continues to facilitate Cohen's ongoing inquiry into understanding the mental activity behind human image-making and Cohen confesses that AARON's potential is a continuing story.

MALE ASPECTS OF THE AARON PROGRAM

With this biographical sketch in mind, let us proceed to explore two concerns about AARON's gender and his art-making: The first of these is the fact that male characteristics, are embodied in the structuring of modern science, and its offspring computer science, and, are worked out in the development of artificial intelligence and specifically in the AARON program. A second concern explores the implications of these male aspects exemplified in the AARON drawing program in relation to the development of theoretical frameworks for electronic computer-based visual arts.

Physicist and feminist critic Evelyn Fox Keller argues that the social structure of modern science, the theoretical parent of computer science, is male.[32] Keller, along with others, claims that science is a socially constructed category, pointing out the deeply held popular mythology that views "objectivity, reason and mind as male, and subjectivity, feeling and nature as female. In this division of emotional and intellectual labor, women have been the guarantors and protectors of the personal, the emotional, the particular, whereas science—the province par excellence of the impersonal, the rational, and the general—has been the preserve of men."[33] This division has brought about a deep rift between feminine and masculine, subjective and objective, and love and power. Further, she contends, this division has led to the fact that modern science has been produced almost entirely by white, middle- class males. The male construct of modern science, one in which females are outsiders, passes on to the field of computer science similar structural gender problems.

From the outset, claims Keller, these founding fathers relied on a language of gender that was explicit. Their philosophy and language was gendered as masculine, stressing their virile "power" over ineffectual predecessors and with a "capacity to bind Nature to man's service and make her his slave."[34] Accompanying this development of science came an epistemological ordering: a view of knowledge that gave privilege to a linear, hierarchic, rational and abstract approach to knowing. The early years of Keller's investigation of science and gender brought forth two important understandings: she shifted the emphasis of the question of male and female to that of "beliefs" about male and female nature, and concluded that such beliefs could and do affect science.[35] Second, her work leads us to realize that modern science embodies an ideology of gender that proclaims its own epistemology which is passed on to its offspring, computer science.[36]

With a view towards Keller's analysis of gender ideology and the prominence of a particular epistemological ordering situated in both science and computer science, let us explore

Figure 6. Cohen, *Untitled*, AARON drawing, 1985. Hand-painted, 30" x 40". (Photo: Becky Cohen)

the artificial intelligence basis of the AARON program. Cohen was introduced to the concept of artificial intelligence (AI) when working in 1973 with artificial intelligence specialist Edward Feigenbaum at Stanford University. In conversations Feigenbaum mentioned Herbert Simon who, along with Allen Newell, was instrumental in the development of the physical symbol and expert system approach to artificial intelligence, the strategy that attracted Cohen.

Newell and Simon, in landmark research on the perceptual abilities of chess masters, found that the storage of a single symbol functions as a single unit, or as a cluster or chunk.[37] The idea of cluster, or chunk, with the possibility of differing sizes of chunks, became the defining unit of the knowledge base. Thus, master chess players function with larger size chunks in their knowledge base. This knowledge-competence dimension of the work of Newell and Simon, linked to the early history of the study of expertise in computer science, contributes to the development of expert systems in artificial intelligence. Using the Newell-Simon approach to artificial intelligence, Cohen developed the expert system drawing program AARON that enables him to investigate the cognitive factors that underlie visual representation.

With the growth of artificial intelligence came differing viewpoints. In the early 1980s philosopher John Searle coined the terms "strong AI" and "weak AI" to differentiate between the two dominant positions:

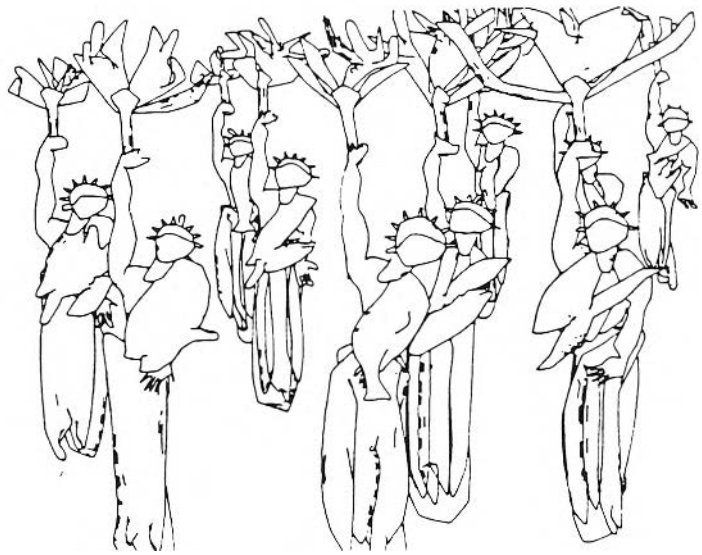
> According to weak AI, the principal value of the computer in the study of mind is that it gives us a powerful tool....But according to strong AI, the computer is not merely a tool in the study of the mind; rather, the appropriately programmed computer IS a mind, in the sense that computers given the right programs can be literally said to UNDERSTAND and have other cognitive states. In strong AI, because the programmed computer has cognitive states, the programs are not mere tools that enable us to test psychological explanations; rather, the programs are themselves the explanations.[38]

The strong AI position designation describes expert system drawer AARON and categorizes the work of Newell and Simon, Feigenbaum and Cohen. Cohen so fully adopted Simon's position that it has permeated all his thinking regarding his use of the computer and the AARON program to investigate visual representation.

The position of strong artificial intelligence within the symbol system approach to processing information is situated in the long, atomistic, rationalist tradition or epistemological viewpoint of western philosophy embodying the viewpoints of Socrates, Plato, Descartes, Hobbes, Kant and Whitehead.[39] The tradition of western philosophy stands behind this approach that emphasizes abstraction, rationality, linearity and hierarchy.[40] For example, Leibniz, working out the classical concept of mathesis (that is, the formalization of everything), attempted to develop a universal symbol system that assigns to every object a determined and characteristic number.[41] AARON's rules (number and symbol formulations) are steps of reasoning, with each specific subject matter of a particular rule broken up into atoms, as in, for example, the drawing of an arm. AARON is based on and continues the assumptions of this atomistic, rationalist tradition, and thus his program is a continuation of western scientific epistemological ordering.

Heidegger critiques this traditional philosophical approach of focusing on the facts of the world while at the same time passing over the world.[42] Thus traditional philosophy from its outset has systematically ignored or distorted the everyday social context of living. Plato, for example, held that theoretical domains were directed by context-free rules or theories, outside our everyday living contexts.[43] Keller argues that this viewpoint shaped modern science, and Ellen Spertus, Sherry Turkle, Seymour Papert and I argue that it has shaped computer science.[44] The structure of modern science and computer science perpetuates a single epistemological viewpoint and remains a male domain free of questions about gender ideology.

Figure 7. Cohen, *Liberty and Friends*, AARON drawing, 1985. (Photo: Becky Cohen)



Heidegger questions the omission of social context in the structure of traditional western philosophy; Keller's social-study examination of the structure of science points to the missing inquiry into the nature of male and female in the working of philosophy as it shapes modern science. AARON perpetuates the modern science/computer science structure that assumes anonymity from the social contexts in which it exists, perpetuating modernist enlightenment viewpoints of autonomy, omitting gender-based ideological considerations, and continuing the position of neutrality posited by modern science and computer science.[45] In addition, the epistemological ordering of the AARON program emanates from Greek thought which Keller labels as masculine. Hence, it is appropriate to speak of AARON as a male drawing machine.

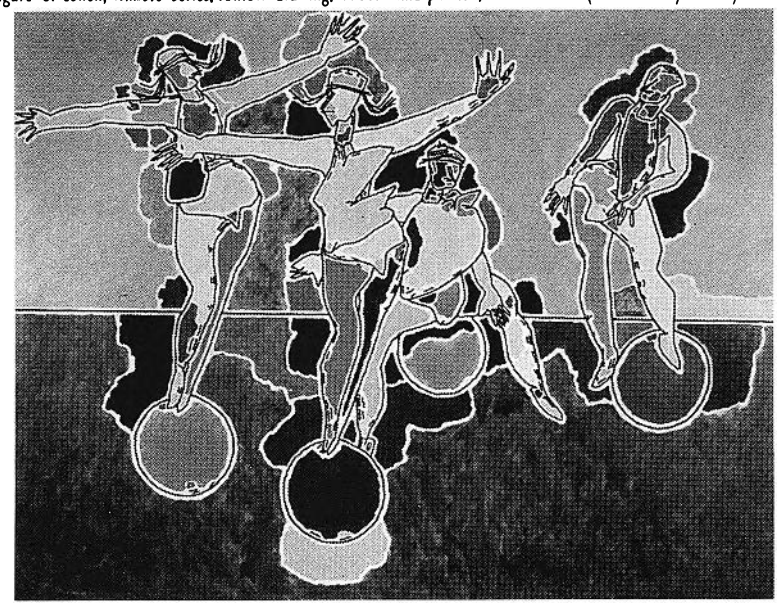
IMPLICATIONS OF THE AARON PROGRAM FOR THE VISUAL ARTS

The artificial intelligence community regularly boasts that AARON is one of the few successful expert systems.[46] What, however, does the computer-based work of Harold Cohen in the AARON program offer to the visual arts? Returning to the opening discussion of the article we recall that David Carrier, Roger Malina and Timothy Druckrey note the lack of theory in aesthetics, art history and art criticism to facilitate a critical discourse joining theories of electronic computer-based interactivity with theories of representation. Druckrey goes on to assert that "[w]ithout this, the affiliations between representation, intention, and technology will remain mired in outmoded presumptions about the 'two cultures.' Images can no longer be disassociated from the tools used to produce them."[47]

Cohen merges theories of computer science and artificial intelligence with a philosophical critique and ongoing investigation into visual representation in the AARON program. Therefore, we might conclude that the AARON project begins to address the concerns of Carrier, Malina and Druckrey. This, however, is not the case. The predicament inherent in the software program is its merger of Cohen's modernist expert knowledge base of drawing with the modernist, enlightenment enterprises of science and computer science. The AARON program links modernist viewpoints of art-making to modern scientific investigation that is limited by epistemological ordering and autonomy which separate it from the everyday world in which it exists, thus diminishing the "dream" of artificial intelligence to simulate realistic human activity. Hubert and Stuart Dreyfus, in an analysis of the symbol system approach to artificial intelligence, conclude that "[t]he rationalist tradition had finally been put to an empirical test, and it had failed. The idea of producing a formal, atomistic theory of the everyday commonsense world and of representing that theory in a symbol manipulator" seems to be almost hopelessly difficult.[48] The AARON project, in a sense, is frozen within its own theoretical modernist parameters and illustrates Druckrey's point of an affiliation between representation and technology that remains mired in outmoded presumptions of two cultures. This does not negate, however, the consistent prodding of Cohen over the last quarter-century for the visual arts community to seek out theoretical routes to merge visual arts discourse with contemporary developments in electronic computer-based technologies.

Although the Cohen project is contained within modernist boundaries, it raises valid questions about cognition and the visual arts. The AARON program began an inquiry into the contemporary discussion of cognitive science, investigating the relationship between artificial intelligence and visual representation, and the process of visual representation. Cohen argues that art is humanity's most nuanced and subtle exercise in knowledge representation. The history of art, claims Cohen, is not the recording of shifts in meaning or style; it is a record of meaning and style, smaller within one culture than between cultures.[49] His work continues to explore cognition and visual representation, although he is aware that AARON's AI basis may limit investigative possibilities. Cohen understands well that one

Figure 8. Cohen, *Athlete Series*, AARON drawing, 1986. Hand-painted, 88" x 106". (Photo: Becky Cohen)



needs expertise in both the domains of the visual arts and computer science to appropriately join the two in the development of electronic computer-based visual arts. This awareness will help address the weak imagery made by computer scientists working with knowledge of only their domain, and also artists who work as novices with electronically-based technologies. From the vantage point of theory, Cohen's project also points to a need for adequate theoretical, historical and critical frameworks for electronic computer-based visual arts.

Malina and Druckrey are joined by a growing host of cultural critics who understand that we live in a world beyond industry-based modernism and one directed by contemporary computer-based technologies. Charles Jencks, in his writings about Modern and Post-Modern architecture, argues that our contemporary world is being shaped by computer-based information technologies.[50] In his analysis of contemporary culture Jencks contends that from the vantage point of production, our culture has changed from an industrialized base to one that is information-driven.[51] Communications theorist Neil Postman argues as does Jencks that our culture is computer-driven.[52] Michael Benedikt moves the discussion into cyberspace, the invisible space connected by electrical and fibre optics lines through which computer-based exchange occurs.[53] How do we proceed theoretically to consider the making and criticizing of visual representations of our electronic computer-based culture, with many of its transactions taking place is cyberspace? And in our theory-building, how do we go about addressing the epistemological ordering particular to modern science and computer science, while also giving consideration to other epistemological viewpoints that are considered other than "masculine"? How do we include in our theoretical inquiry the social contexts that envelop the merger of electronic technologies and the visual arts, thus removing the mystique of the autonomy of modern science and computer science, and give place to considerations of gender ideology, including concerns of ethnicity and class? A critique of the underlying assumptions of the AARON program bring these questions to the foreground.

Advancing technologies developing in our contemporary computer-based culture with its post-modern directions leave the artist, aesthetician, art historian and art critic in a quandary because we seem to be moving paradigmatically away from traditionalist and modernist understandings of art, aesthetics, art history and art criticism. Although the alliance of science, technology and the visual arts has a long history covering millennia, the contemporary alliance of modern science, cognitive science and computer-based technologies in the visual arts covers new territory requiring fresh parameters for the making, evaluating and valuing of electronic arts.[54] French social scientist Françoise Gaillard places this in a philosophical context. With the waning of a modernist understanding of art and aesthetics based on Kantian theory, we no longer have the philosophical tools necessary to critique and evaluate artistic production—there exists a "death of our criteria for judging art."[55]

With the loss of Kant's notions of aesthetics for artistic evaluation, contemporary critics such as Suzi Gablik, Lucy Lippard and Janet Wolff suggest that aesthetics have to go through a period of relativism to allow for a revisitation of considerations for artistic evaluation in our contemporary culture.[56] This revisitation can lead us beyond some forms of post-modern relativism. Social theory in a post-modern culture is important for both the understanding of the function of representation in art and media, and the constitution of a culture enveloped by the emerging media of technology.[57] A striking thing about contemporary technologically-mediated art-making is that in the shaping of new frameworks one can provide criteria for judging art in our technological age and move towards addressing, for example, the problems brought forward by the AARON program. A developing theory about electronic computer-based visual arts can look to new assumptions that account for and merge the worlds of visual representation and com-

Figure 9. Cohen, *Untitled*, AARON drawing, 1987, Hand-painted. Acrylic on canvas. (Photo: Becky Cohen)

puter science in a connected and contemporary discourse. New configurations of understandings can include an ethic of justice and care that embody our everyday living contexts and manifest themselves in the development of aesthetic criteria for artistic judgment that not only take into account electronically-based technologies but also understand the reshaping of culture by emerging technology. These new understandings, incorporating justice and care, are applicable also in the epistemological realm. The inclusion of a variety of ways of knowing, beyond the singular approach of modern science and appropriate to both genders and varying ethnic cultures, can expand the limitations of what Keller labels as "masculine," while increasing electronic computer-based art-making possibilities beyond the first-generation AARON program.

1 For more thorough analysis of Cohen's shift from canvas to computer-generated imagery, see Pamela McCorduck, *Aaron's Code: Meta-Art, Artificial Intelligence, and the Work of Harold Cohen* (San Francisco, 1991); and Mary Leigh Morbey, "From Canvas to Computer: Harold Cohen's Artificial Intelligence Paradigm for Art Making" (Ph.D. diss., Ohio State University, 1992, UMI restricted, 1993).

2 Alan Bowness, Foreword, *Harold Cohen* (London, 1983), 5.

3 Cynthia Goodman, *Digital Visions: Computers and Art* (New York, 1987), 18.

4 Douglas Davis, *Art and the Future* (New York, 1973), 98.

5 Darcy Gerbarg, a traditionally trained artist who uses the computer for art-making, discusses the recent historical development of the employment of the computer in art-making in Sue Dunlap, *The Computer as an Artistic Tool* (Greenwich, Connecticut, 1986), 1.

6 David Carrier, "The Arts and Science and Technology: Problems and Prospects," *Leonardo*, XXI (1988): 341-342.

7 Roger Malina, "Computer Art in the Context of the Journal *Leonardo*," Supplemental Issue "Computer Art in Context" (1989), 67.

8 Timothy Druckrey, "Revisioning Technology," In Timothy Druckrey (Ed.), *Iterations: The New Image* (Cambridge, Massachusetts, 1993), 29.

9 For introductory discussions of this interdisciplinary crossing of fields see Howard Gardner, *Art, Mind, and Brain: A Cognitive Approach to Creativity* (New York, 1982); Howard Gardner, *The Mind's New Science: A History of the Cognitive Revolution* (New York, 1985); Hubert L. Dreyfus and Stuart E. Dreyfus, "Making a Mind Versus Modeling the Brain: Artificial Intelligence Back at the Branchpoint," *Daedalus*, MXVII (1988), 15-43; and Margaret A. Boden, "Creativity and Computers," *Harold Cohen* (London, 1983), 12-18. For broader discussions on the computer and the visual arts see Terry Gips, ed., "Computers and Art: Issues of Context," *Art Journal*, XXXXIX (1990), 228-300; Mark Resch, ed., "Computer Art in Context," *Leonardo* Supplemental Issue (1989), 1-126; and Margot Lovejoy, *Postmodern Currents: Art and Artists in the Age of Electronic Media* (Ann Arbor, 1989).

10 Over the last two decades a substantial body of criticism, mainly from the viewpoint of feminist scholarship, has expanded and deepened the discussion of gender across fields and disciplines. In the field of art history a vast body of literature has developed concerning gender, for example, the two focal references: Thalia Gouma-Peterson and Patricia Mathews, "The Feminist Critique of Art History," *The Art Bulletin*, LXIX (1987), 326-357; and Joanna Frueh and Arlene Raven, eds., "Feminist Art Criticism," *Art Journal*, L (1991), 6-77.

11 Harold Cohen, "How to Draw Three People in a Botanical Garden," *Proceedings of the American Association for Artificial Intelligence* (Minneapolis, 1988), 848. For Cohen's introductory explanation of AARON, see "What is An Image?" *Proceedings of the Sixth International Joint Conference on Artificial Intelligence* (Tokyo, 1979), 1028-1057.

12 Cohen, "Image," 1028.

13 Harold Cohen, "How to Draw Three People in a Botanical Garden," 846-855.

14 Harold Cohen, "Implementing An Expert Artmaking System," paper written for the lst International Symposium on Artificial Intelligence and Expert Systems, Berlin, May 1987, 28; however, the paper was not presented.

15 Cohen, "Implementing," 16.

16 Becky Cohen, *Harold Cohen Paintings 1965-1975* (Edinburgh, 1976), 6.

17 Cohen, *Harold Cohen Paintings 1965-1975*, 6.

18 Cohen, "Implementing," 17.

19 Cohen, "Image," 1039.

Figure 10. Cohen, *Untitled*, AARON drawing, 1991. Oil on canvas, 63" x 90". (Photo: Becky Cohen)

20 Cohen, "Image," 1039.

21 Cohen, "Implementing," 18.

22 Cohen, "Image," 1033, 1034-37, 1940. In hindsight Cohen realized that he had made a false assumption concerning AARON's cognitive primitives. Initially he assumed that the larger number of cognitive primitives given to AARON would bring about richer and more complex drawings. This assumption was false. Cohen concluded that "the cognitive system was remarkable for its combinatorial powers rather than for a great wealth of separate functions." Cohen, "Implementing," 17-18. He maintains that AARON constitutes a surprisingly powerful, but limited, model of cognitive activity. Cohen, "Implementing," 18.

23 Cohen, "Image," 1028.

24 Cohen, "Image," 1040.

25 Cohen, "Implementing," 19-21.

26 Cohen, "Implementing," 19.

27 Cohen, "Implementing," 20.

28 Cohen, "Implementing," 20.

29 Cohen, "Implementing," 21.

30 Cohen, "Implementing," 21.

31 Cohen, "Implementing," 24.

32 Evelyn Fox Keller, *Reflections on Gender and Science* (New Haven, 1985); and Evelyn Fox Keller, *Secrets of Life, Secrets of Death: Essays on Language, Gender and Science* (New York, 1992).

33 Keller, *Gender and Science*, 6-7.

34 Keller, *Gender and Science*, 7.

35 Keller, *Secrets of Life, Secrets of Death*, 24.

36 This viewpoint is documented in the booklet "Why Are There so Few Female Computer Scientists," (Cambridge, Massachusetts: MIT Artificial Intelligence Laboratory, 1991) by Ellen Spertus, a Massachusetts Institute of Technology Ph.D. student working in the field of computer science and specializing in the area of artificial intelligence. Spertus investigates also the social context of the female in the field of computer science. See also Sherry Turkle and Seymour Papert, "Epistemological Pluralism: Styles and Voices within the Computer Culture," *SIGNS: Journal of Women in Culture and Society*, XVI (1990), 128-157.

37 Allen Newell and Herbert A. Simon, *Human Problem Solving* (Englewood Cliffs, 1972), 93.

38 John R. Searle, "Minds, Brains, and Programs," *The Behavioral and Brain Science*, III (1980), 417-424.

39 Dreyfus and Dreyfus, "Making a Mind," 15-43.

40 Dreyfus and Dreyfus, "Making a Mind," 15-43.

41 Dreyfus and Dreyfus, "Making a Mind," 17.

42 Martin Heidegger, *Being and Time* (New York, 1962), sec. 14-21.

43 Dreyfus and Dreyfus, "Making a Mind," 25.

44 See note 36.

45 See Keller, *Secrets of Life, Secrets of Death*, 15-36, 73-92; Chester A. Bowers, *The Cultural Dimensions of Educational Computing: Understanding the Non-Neutrality of Technology* (New York, 1988); and Alice Jardine, "Of Bodies and Technologies," in *Discussions in Contemporary Culture*, ed. Hal Foster (Seattle, 1987), 151-158.

46 For instance, see Herbert A. Simon, "Harold Cohen's Computer Drawings: Comments on Computer Art," in *Harold Cohen: Computer-As-Artist* (Pittsburgh, 1984), 14-16.

47 Druckrey, "Revisioning," 29.

48 Dreyfus and Dreyfus, "Making a Mind," 34.

49 Pamela McCorduck, "Artificial Intelligence: An Aperçu," *Daedalus*, MXVII (Winter 1988), 81.

50 Charles Jencks, *What is Post-Modernism?* (New York, 1986), 43-56.

51 Jencks, *What is Post-Modernism?*, 43-50.

52 Neil Postman, *Technopoly: The Surrender of Culture to Technology* (New York, 1992).

53 Michael Benedikt, "Introduction," in *Cyberspace: First Steps*, ed. Michael Benedikt (Cambridge, Massachusetts, 1992), 1-25.

54 Carol Gigliotti, "Aesthetics of a Virtual World," *Leonardo*, in press; and Mary Leigh Morbey, "Sorties into Cyberspace: Art and Electronic Technologies," in *Art, Aesthetics and Culture*, eds. Lambert Zuidervaart and Henry Luttikhuizen, in press.

55 Françoise Gaillard, "Technical Performance: Postmodernism, Angst, or Agony of Modernism," in *Rethinking Technologies*, ed. V.A. Conley (Minneapolis, 1993), 143-155.

56 Suzi Gablik, *Has Modernism Failed?* (New York, 1984); Lucy Lippard, *Overlay* (New York, 1983); and Janet Wolff, "Aesthetic Judgment and Sociological Analysis," *Aspects*, XXI (1993), 42-44.

57 Druckrey, "Revisioning," 25.