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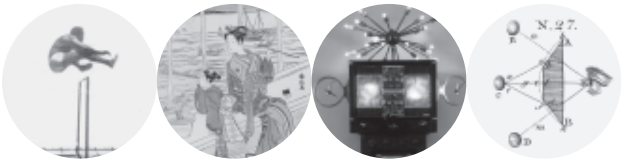

Perceptual Machines: Communication, Archiving, and Vision in Post-War American Design

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Abstract

This article examines historical transformations in the relationship between the image, time, and knowledge after the war. One site to investigate these changes in representation is at the locus of science, design, film and architecture in the works of Charles and Ray Eames and Gyorgy Kepes for the Center for Advanced Visual Study at MIT and in the interests of science education. In these works, including many science education and pedagogy films, the nature of the image, the materiality of vision, and the relationship between documentation and communication were being aggressively rethought. All these projects were deeply invested in the emergent terms of cybernetics and electronic media. Ontology, documentation, and representation were seemingly replaced by discourses of communication, performance, and modularity; the world as interface for the mediation of ongoing, lively communicative exchanges. The work of Charles and Ray Eames and Gyorgy Kepes provides evidence of a more global reformulation of the work of the document, the relationship between abstraction and materiality, and among science, aesthetics, and visuality.

Keywords

affect • archive • Charles and Ray Eames • communication theory • cybernetics • Gyorgy Kepes • information design • pedagogy • science education • visuality

> The aerial observer for whom camouflage has to be largely considered today is a mobile observer. Every factor involved in his vision is in continuous movement. His eye is moving, the light conditions are changing and the landscape is moving' (Scott et al., 1942: 10).[1]

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With these words written in 1942, the prominent designer and artist Gyorgy Kepes inaugurated a new concept of visual perception. Written for an issue of *Civilian Defense*, Kepes described a course on designing camouflage that he taught at the School of Design with László Moholy-Nagy as part of the New Bauhaus in Chicago. Working for the US Department of Defense, the designer took flights above the city where his perspective was transformed. He wrote of an eye no longer moored in a single space or time. He was trained to trust instrument panels streaming data from radar and radio transmissions, to rely on the guidance of machines and the recordings of surveillance teams. Calling upon this experience, Kepes described a new form of vision, one that was mobile, relative, nomadic, and autonomous. He began to consider designing for information flows emanating from communicating machines.

Developing this theme of technically transformed vision, Kepes later insisted, in a text fittingly titled *The New Landscape of Art and Science,* that 'precise observation' and a new armory of sensory devices coming from atomic physics and electronic computing; which no longer operated at the levels of the human sensorium, had produced a 'new foundation for our material existence'. This material existence converted what he had previously labeled the 'language of vision' to a 'landscape' of 'forms'; the terms 'language' and 'vision' mutated into 'environment' and 'process' by way of a new form of computational sense (Kepes, 1956: 17). This scene marks a critical moment in the histories of visuality when perception gained autonomy as a material process and the image was no longer understood as representational (a language) but rather as a landscape or environment. Observation was reconceived as a scaleable channel traversing the space between the isolated individual choosing a personal path through a rich data field and the vast territory of human knowledge.

Figure 1a Image from *Sample Lesson* (1953). Courtesy Charles and Ray Eames Collection, Library of Congress. © 2012 Eames Office, LLC (www.eamesoffice.com).

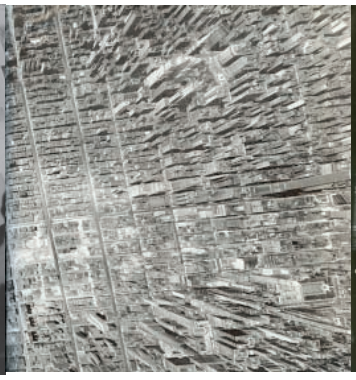

Figure 1b Gyorgy Kepes, *The New Landscape in Art and Science* (1956).

Figure 1c Image from 'The People's Wall' from *IBM at the Fair*, Charles and Ray Eames (1964). © 2012 Eames Office, LLC (www.eamesoffice.com).

Kepes demonstrates a mid-century reconfiguration of cognition, perception, and sense that continues to underpin our relationship to the screen, the mind, and the body in the present. To offer further sustenance to this argument, let us consider another example. In 1953, the prominent designers Charles Eames and George Nelson stood before a crowded hall at UCLA and proceeded to run an experiment. The purpose of the course: to see 'how much information could be given to a class'. The function of the class: to combine and apply the latest theories at the time in communication science, cognitive and behavioral science, and design to the training of budding engineers and business management students (Eames, Nelson et al., 1953).

Titled 'A Sample Lesson', Eames and Nelson implied that this would be but one element of a process, a 'sample' of something larger. In the optimistic tone that personified Eames design, the brochure announced that 'something new' was happening 'bringing down the barriers between fields of learning'. This something was not, or perhaps could not be described, because, 'a *sample* lesson is more of an experience than a tangible solid … because it is more of an emotion than an action … it is difficult to explain … a sample lesson must be seen and heard and felt and smelled …' (Eames, Nelson et al., 1953, emphasis added) Implying that language itself was behind the times, Eames and Nelson appear to suggest a pedagogy of sense. Emotion described as active, and pedagogy as affective and material (touchable, feelable, seeable), it was not clear what the course would teach, except perception itself.

Coming at a moment of massive change in higher education spawned by the Second World War and perpetuated by the GI Bill, the work of Eames and Kepes marks a historical shift in the relationship between knowledge and vision. In this span between the training of the camoufleur in design to the education of the future manager of the information economy, wartime imperatives of surviving through the identification and evasion of the enemy became autonomous and self-referential technologies of perception. Vision and cognition were rendered equivalent, a 'process' to repeat Kepes, and envisioned as part of a single communicative channel that could be algorithmically represented, materialized as technology, and circulated autonomously separate from content.

The infrastructure for this transformation was an epistemology of informational surfeit. All these designers participated in a discourse of data inundation emerging from their interactions with communication science and computation. While much scholarship attends to the relationship between the military, communication sciences, computation, cybernetics, and fields ranging from design to the social and the life sciences, what has not received much attention in the historiography of post and Cold War science and its relationship to art and visual culture are the attendant forms of epistemology that condition and accompany such aesthetic transformations (Colomina, 2007; Edwards, 1997; Lee, 2004; Lemov, 2009; Martin, 2003; Masco, 2010). Even in the histories of design and architecture, the attention to the work of these designers has largely evaded any specific discussion of what terms like

'information', 'image', or 'knowledge' actually denote in these practices, and more importantly how the specific tactics, methods, and strategies by which perception was reconceived as measurable, modifiable, and the subject and object of design separate from previous histories of cinema, psychophysics, and media. Counter to Beatriz Colomina's (2001: 14) claim about enclosed spaces, architecture, and sensory overload, the purpose of these design practices was to network space and to enhance, modulate, and increase the capacity of human cognition and perception. This is not an architecture of enclosed spaces, nor is it an architecture of perception analogous to the theaters of distraction and shock evoked by figures like Sigfried Kracauer or Walter Benjamin in discussing the cinema and modern mass mediums (Benjamin, 1974[1969]: 155–200; Kracauer, 1995: 323–336, 2004). While Eames discussed 'distraction' as a desired effect of his design practice, we cannot understand this as a form of attention related to modern ideas of a fallible human sensorium, or a dialectic between attention and distraction (Colomina, 2001: 14). Instead, these practices must be understood in terms of a move from normative concepts of perception to ideas of thresholds and capacities. These were not practices based on disability or sensorial lapse, a limit to human perception, but regimens to enhance and increase the ability of observers to handle data without limit. And as the nature of the observer was reconceived, knowledge claims were also transformed. As cognition, perception, and the body (both social and individual) came to be redefined in terms of feedback and patterned interactions *between* objects and subjects (as a communication process), what it meant to produce a truthful account of the world (or a product) shifted, becoming no longer about hidden truths, invisible elements, or psychological depths, but rather about affect and behavior.

This channeling of the divide between the object and subject redefined aesthetic practice and human perception not in terms of surfaces, screens, or mediating bodies obscuring fantasized political or natural realities but rather as interfaces and conduits for communicative exchanges. Counter to our standard assumptions of information theories as disembodied or abstract, this was, in Kepes's words, an 'experiential' form of vision, even as it was grounded in nascent concepts of information and communication. In post-war design practices, cognition and perception were rendered equivalent, and both took on new forms of materiality that could be technically and aesthetically manipulated—objectivity was redefined as subjective. To be objective, Kepes wrote, was to learn the 'basis of the language of vision', a 'basis' that was a process and a technology to be designed (Kepes, 1956: 104). Objectivity, Kepes and his colleagues in the information and communication sciences and psychologies intimated, was no longer about documenting an external truth or reality about the world, nor was it about taxonomy or ontology (describing the essential characteristics of objects), instead to be objective would now require producing the most effective and affective method or process to induce, if not replicate, conscious experience (Kepes, 1944).

This article excavates this epistemology by which how we might think is linked to the design of a new type of screen—the interface—and attached to machineries of computing and marketing. In the course of this article, I will trace the relationship between the emergence of a new form of observer, one both radically individuated and simultaneously networked, and a novel form of knowledge production based on assumptions of informational infinitude. In the immediate post-war period one can document a shift from modern normative and disciplinary concerns with documentation, objectivity, indexicality, and archiving to a new set of investments in process, communication, and circulation now encoded into built environments, machines, and attention spans.

Linking design and engineering pedagogy, discourses of information inundation, and the marketing and education spectacles produced by such computer companies as IBM, this article thus charts a topography that is a map to our contemporary relationship to the interface. What emerges is a geography of both unfulfilled desires and now obsolete technologies that continue to haunt the present and trouble the now automatic, and often automated, concept that more information is always better and that interactivity is equivalent to thought.

Learning to See

In 1951, Kepes wrote to the MIT mathematician and cybernetician Norbert Wiener thanking him for his contribution to *The New Landscape of Art and Science*: 'After reading your essay I saw that your contribution could be the focal point of my book and that gave me the courage to ask you more than I originally dared.'[2] This exchange between the designer and the cybernetician prompts the question: what was this 'focal point'? Kepes's answer – 'method' – introduced a pedagogy that rested on this 'focal point'.

As one of the foremost design and arts pedagogues in America at the time, Kepes had much to say about the future of media and education. With a biography that traversed many legacies of modern design and art, Kepes's life mirrored his recombinant, archivally dense practice that merged influences from multiple genealogies in design and art and re-mixed aesthetics of nation, identity, and class. A Hungarian émigré who fled fascism, he was born into an aristocratic family in the final moments of the Austro-Hungarian Empire. In his memoirs, he recalled turning to art, at the age of 18, in order to address 'the inhumane conditions of the Hungarian peasantry' who lived on his father's estate. This interest in social welfare apparently inspired his obsessive desire to reconcile art and science throughout his life. Kepes maintained a modern utopian aspiration to use technology in the interest of improving the human condition. Design should put technology in service to humanity.

Seeking an ideal with which to negotiate industrial modernity and the human being, he seemingly found sustenance and inspiration from both Soviet Constructivism and the Bauhaus (although he never formally joined

either). Befriending his fellow Hungarian Moholy-Nagy in the late 1920s in Berlin, he would flee with him to London in 1936, arriving in Chicago to teach in the New Bauhaus in 1937.

Kepes's career, however, was largely marked by his time at MIT, where he taught for over 30 years. Invited in 1945 by the president of MIT, James Killian, to begin a program in visual arts and design, Kepes started the Center for Advanced Visual Culture and became a central figure in revising the university's architecture, design, and urban planning programs. Kepes's work had great influence on American (and global) design; in the United States, his colleagues and interlocutors included George Nelson, Buckminster Fuller, and Charles and Ray Eames; and his students included Kevin Lynch, whose pioneering work in environmental psychology would reconfigure urban planning through psychological models of feedback between subjects and surroundings (Kepes, 1978; Lynch, 1960).

Kepes opened *The New Landscape of Art and Science* with the following words about methodology:

> The method … has served as a kind of laboratory experiment—fuses visual images and verbal communication in a common structure. The visual images … are the content. The verbal statements … are illustrations. They do not constitute a connected systematic account. (Kepes, 1956: 17)

Kepes's focus was not a specific image or text but the 'systematic account' and the 'common structure' organizing the 'experiment' that emerges if the reader can create connections between media objects. The fact that Kepes labeled this approach an 'experiment' implied that the goal underpinning the book was not to train individuals in a style, or single practice, but as scientists in a method of conducting inquiry. The foundation for this design was a 'new structure-order' that emerged from the recombination of vast data fields constituted from archives of images that the designer had compulsively collated through a constant outreach campaign to corporate and academic labs, art museums, and a wide range of colleagues in almost every field imaginable. Kepes's personal archive at the Smithsonian is largely composed of a network of correspondence concerning the imaging techniques and image acquisition technologies of various institutions and labs in the physical, human, and life sciences (Kepes, 1960: 187, 1965, 1966).[3]

Archive Frenzy

Kepes's archives contain a highly idiosyncratic collection of images, texts, diagrams, charts, and mathematical equations. The books are not organized according to taxonomies of historical periods or content. There is no set organization of history in the display of images or artifacts. Chapters in the books, and sections of his courses at MIT, were organized around neither a material or medium. Syllabi left in Kepes's papers list, for example, guest

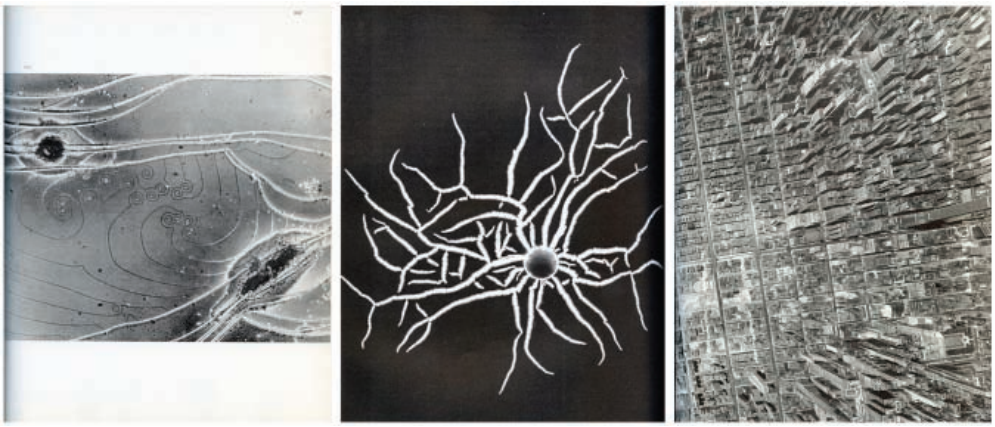

Figure 2 Images from *The New Landscape of Art and Science* (Kepes, 1956).

lectures combining neuro-scientific ideas of vision and perception with urban planning studies of space.

Kepes did insist, however, that both courses and books should be organized around three terms – pattern, problem, and scale. He collected different ways to capture processes and to compare seemingly disparate phenomena. So, for example, in *The New Landscape* (1956), he grouped aerial photographs of a city taken through the advanced fish-eye lenses of geographical surveillance teams with an architectural rendering of the Crystal Palace from the mid 19th century with aerial images of crop planting alongside short texts by William James, Samuel Taylor Coleridge, and Franz Kafka. Whether town and country are necessarily linked is a matter of ongoing debate by urban planners but, from a pedagogical standpoint, these many forms of life were aligned through tactics of scaling and a focus on line and movement that drew attention to the similarities among the graphic line of a blueprint, the traces of crop tilling, the curvature of a skyscraper due to a wide-angle lens, and the selective introduction of poetic and literary prose.

Together these elements comprise a process where the focus is not on the representation of the world per se but on the many modes that may be used to achieve the representation. Kepes repeated such exercises with many physical and social phenomena, such as recombining photomicrography and crystallography with aerial views of geological formations and patterns of urban development visualized through aerial photography and fish-eye lenses. It should be noted, however, that Kepes never discussed the actual technology or practices by which these images were taken. Rather, he only demonstrated an interest in seeing patterns between the images, citing, but never describing, the method of capture.

Authorship had become a curatorial project and learning became about scanning. Students in Kepes's courses were inundated with data shorn of context. They were urged to examine the relationship between images and to extract relations between objects. This was, therefore, a matter of collecting

not artifacts but methods. This was a collection, and celebration, of the many (particularly technologically) modes of apprehending the world. (Kepes, 1956: 80–82,108–112).[4] Kepes proposed the term 'action-seeing' as part of this new method. The conjunction of 'action' and vision denoted both a materiality to the perceptual process as well as its autonomy as an object of study and as an independent actor. The visual process was equated with method and made an object to collect, curate, and reorganize (Kepes, 1944, 1969; Martin, 2003)

Archival Objectivity

This was a pedagogy predicated on an imperative to agglomerate data. What made this practice historically novel was not, however, this encyclopedic tendency but the disinterest in any particular data point or fact. While it has perhaps always been the nature of design to deal with generalizable approaches to the production of objects, Kepes demonstrated a particular reconfiguration of the relationship between process and material. He wrote:

> What is called technical education, the mastery of a particular skill or a particular habit of visual representation, should be put off as long as one learns the objective basis of the language of vision. (Kepes, 1944: 23)

Situated historically, this comment marks a break from an object-oriented or utopian design practice. For such iconic designers as Walter Gropius, different elements and media were taught separately and then brought together into an utopian synthesis identified with architecture (Lupton and Miller, 1991; Golec, 2002; Vrachliotis, 2009). Kepes, however, articulated no such linear and progressive structures for the student to work towards. The student was explicitly encouraged to concentrate on the method before developing expertise in any single medium or technique. Vision itself was understood as an algorithmic method or a logical pattern that could be extracted and made the object and 'objective' of education from which designers must form 'experience' (Kepes, 1944: 15).

This experience was based on data inundation as a form of truth and moral virtue. 'These observations [made by sensory technology, computational, and electronic devices]', Kepes (1956: 104) would write

> have made a new order of objectivity possible when looking at the world. The permanent record that the camera provides gives us the opportunity for sustaining visual experience as long as we wish, long enough to overcome the errors that the eye makes because of our impatience, prejudice and inability to recall.

Objectivity here was associated with the power of recall; the human eye is fallible in a way that the machinic eye is not. The perfectly extended memory of the machine affords a perfect recall that facilitates a 'sustaining visual experience'. Ignoring or dismissing problems of recording, Kepes focused on memory and access as the fantasized sites defining both objectivity, and the

objective, of science and design. The designer being trained in these courses was building a process and 'landscape' of vision, not producing individual and isolated objects to be seen. Correlating memory with objectivity, Kepes argued that error was *not* the result of subjectivity, embodiment, or mediation but was, rather, based on a failure to recall and store data. Kepes depicted an informationally dense world, where access, not recording data, would be the future challenge. Objectivity was the ability to produce different forms of subjectivity. To be objective, Kepes implied, was to be able to 'sustain' and modulate an experience for as long as one 'wishes'.

Histories

This cannot be understood as an extension of earlier modern concepts of objectivity. As the historians of science Lorraine Daston and Peter Galison have prosaically noted, throughout the 19th century a new concept of truth claim emerged. Whereas personal affect, intuition, judgement, reason, and sensibility were privileged in the documentation of nature during previous eras, modernity saw a privileging of replicatability and standardization as the valued forms of documenting truth to nature, even before the advent of photography. The work of scientists, and the claims made over nature, came to rest on a 'mechanical objectivity' defined by a moral privileging of qualities such as standardization, indexicality, replicatability, and verisimilitude in scientific documentation. Mechanical approaches to documentation came to be valorized over immanent and personal methods as human perception and cognition came to be morally derided as subjective and embodied.

If mechanical objectivity became the scientific standard for the image of nature, it came with its corollary of the archive as a fantastical site of order and meaning production. The practices of organizing and storing observations in standardized ways was part of the fantasy of a mechanical and taxonomical technology that might overcome, aid, and abet the physiologically bound and fallible human sensorium: a sensorium overwhelmed by information from an outside world (Sekula, 1992).

Objectivity, particularly its 19th-century mechanical form, as Daston and Galison (2007) note, is never actually achieved, but it served as an impossible desire driving scientific practices. In this post-war period, what was once the impossible desire became a technologically opportunity as the interest in attaining the perfect record and finding the perfect taxonomical system was displaced. Representing reality no longer served to inspire or frustrate the scientific and aesthetic imagination.

Objectivity was redefined in terms of the production of algorithms, methods, and processes that facilitate interaction based upon the assumption of an infinitude of stored information. The best, which is to say most objective, system for Kepes was the one that allowed the most conditions of possibility for seeing to emerge from recombining data. Objectivity was redefined as finding the patterns that made experience, in his language, the most malleable, 'sustained' and 'wishful.' (Kepes, 1956). His work gestured to a wholesale relocation of

objectivity away from unearthing a perfect record to the management and organization of patterns. He wanted the designer to produce these autopoietic structures, to mime and perhaps materialize the process of seeing.

So dedicated was Kepes to pure affect and this materiality and autonomy of perception that, by the 1960s, he had turned entirely to producing light sculptures, films, and environmentally focused design projects. He went on to assist in the development of the field of environmental psychology. Kepes always treated the city as an interface for aesthetic experimentation and a conduit between social and individual psychology (Bacsó, 2011; Kepes, 1978).

Kepes thus demonstrated an aesthetic dedicated to producing an economy, and perhaps a world, out of the recombination of images and forms. These works do not explore an existing world but aspire to produce a self-referential one from the detritus of a pre-recorded world. Perception becomes material and subject to design, capable of being circulated as an autonomous process. Knowledge is redefined as the subjective ability to modulate, enhance, and manipulate perception.

Found Educations

Kepes's work should not be seen in isolation but rather understood as a broader effort to revise concepts of knowledge and the practice of business, science, and design. In a reflective post-war moment, where concern with the ethical impact of technology was high, Kepes's initiatives were hardly unusual. Many universities instated new art, technology, and design pedagogies. This reform impulse was spurred by CP Snow's famous discussion of the 'two cultures' and his critique implying the degraded moral and ethical effects of such a condition. MIT, UCLA, Bell Labs, and many other labs, corporations, and universities developed programs over the next 20 years to integrate (successfully or not) arts training into the engineering curriculum. Guiding this reform impulse, however, may have been less a concern with ethics and morals and more a steadfast belief that knowledge (and business) was being transformed, and central to this transformation was the paradigm of information, communication, and computing.[5]

Designers and university administrators propagated a regularly articulated faith in vision as a tool to reconcile the humanities, sciences, and arts, providing a universal language for what was increasingly understood as a global, interconnected planet (Goodyear, 2004; Leslie, 1993). The aforementioned course taught for business-school and engineering students at Georgia Tech and UCLA in 1953 is a particularly instructive example. The instructors were the pre-eminent post-war designers, and intimate Kepes colleagues, Charles Eames and George Nelson, whose clients included IBM, Herman Miller, and the United States Information Agency. Eames and Nelson are most commonly associated with the public face of government, the aesthetics of the Cold-War consumer lifestyle, and the office space and style of the post-war (modern) corporation.

Considering the interactive and contemporary language of the brochure, it is somewhat surprising to witness Eames arguing that this 'something new' must come from something old. He repeatedly spoke of a 'found education', suggesting that education should be about recombining data. Reflecting upon this 1953 course, he argued that the main concern for designers and managers was to reduce 'discontinuity' between disciplines in an information age. The inverse and implicit corollary was that such a reduction in information flow would result in an increase of the capacity of the individual or the institution to process data (Eames, 1977: 32).

To produce this smooth space between disciplines, Eames felt 'vision' was the best tool. To teach students to see, however, they must be exposed to an excess of data. For Eames, only through information *inundation* could learning commence. He was very specific on this point: the purpose of the class was to experiment with 'how much information *could* be given to a class'. Data overload was his pedagogical principle. Eames believed that design should *amplify* and accelerate the availability of information. In what, from the vantage point of contemporary debates over attention-deficit disorders appears as anathema, Eames spoke of distraction and over-stimulation as educative. Rather than worry about information overload, Eames thought that more data offered more 'choice', giving the spectator a freedom to 'choose' from and produce his or her own patterns and combinations. He spoke throughout his career about 'connections' and how making connections possible was the purpose of good design (Eames, 1974: 14–16).

Figure 3 Image of 'Sample Lesson'. Courtesy Library of Congress and the Eames Office. © 2012 Eames Office, LLC (www.eamesoffice.com).

Communication Channels

This was not just any form of choice, but a specific type – choice understood as digital communication. As the premier science educators in the USA, the Eames Office maintained close contact with individuals in cybernetics, psychology, computing, and communications engineering. In this 'sample' lesson, Eames and Nelson specifically sought to teach both cybernetic and communication principles involving information and feedback.[6]

The course was structured by and dedicated to the *Mathematical Theory of Communication*, which defined information in terms of probability and was formally introduced by Claude Shannon and Warren Weaver in 1949. This model, emerging from the multiple influences of telephony, anti-aircraft defense systems, cybernetics, computing, and military radar research, famously split form from content. In the realm of communication theory, information does not denote meaning, rather it designates only a choice between possibilities within a *structured* situation. Weaver summarized this emergent idea as 'not so much what you *do* say, as what you *could* say … The concept of information applies not to the individual message (as the concept of meaning would), but rather to the situation as a whole' (Shannon and Weaver, 1949: 8–9, emphases added). Redefining information not as an index of a past or present event but as the *potential* for future actions (not what you *say* but what you *could* say) encouraged engineers to defer concern about particular messages and focus instead on interactions between sources of signals; this move mirrors the turn in design to complexity, process, and connection.

Under the joint pressures of military and economic interests, the *Mathematical Theory* recoded building channels or communication systems in terms of efficiency, compression, and logic. This recoding led to the decision for a digital code – a choice between only 0/1 – as the basis for digital communication systems, which was the most efficient (least choice) possibility for transmitting the most potential types of data. In communications science there is no ontology or interest in presence, the present, or the index, there is only the modeling of a situation or a relationship that delimits the types of future exchanges to be conducted.

Eames and Nelson's classroom method was an experiment in attempting to produce a new type of informatic spectator and designer who would be both the consumer and the producer of such communication systems. In a language mimetic of the rational choice decision theories of the time (with which they were very familiar), Eames spoke of design as providing spectators with 'choice' and 'connections'.[7]

Under the influence of these theories of communication, rationality, and computing but also influenced by ideas of feedback and behavioral psychology, the team, repeating Kepes, defined the class as a methodological experiment where students were exposed to a vast amount of data that they were asked to distill into a single, coherent visual presentation. Anticipating our contemporary multi-media perceptual field, this understanding of vision should not be understood as a singularly optical register. In the class,

students were inundated with sensory stimuli, 'a live narrator, a long board of printed visual information, and complementary smells … piped into a chemistry lecture theater'. The principle, Eames argued, was not to produce a 'far-out' experience but to develop the concepts of the class. This concept was that of information theory as it applied to design and architecture (Eames, 1974: 14).

The purpose was for students to unearth a distilled logic or pattern within a non-media-specific data field that comprised sound, smell, and vision, which they could then isolate and re-enact through a slide show or short film. Decades before the age of PowerPoint presentations, Eames trained budding engineers, architects, scientists, and business managers to present their information in the logic of visual language and succinct bullet points. Eames wrote that the best tactic was

> to put it on film because through the medium the central idea can be supported by images which give substance and liveliness to it. This reduction of one idea to its essence, using the support of visual images, is the core of several films we made on mathematical topics.

He wanted students to distill the 'essence' of the data, and he felt that vision offered the best tool to do so (Eames, 1974: 17, 20,14).[8] The image, here, is lively and substantial while also reductive and essential. Eames hints that this form of image is a process and pattern that embodies 'ideas'. This durational image is also historical. It is through the legacy of a different medium, film, that Eames hoped to move to computation. This was not a discourse about the end of cinema but rather simply the consumption of one medium into another.

The remaining slides from the course, now in the Eames office in Santa Monica, demonstrate some of what was shown. The slides comprise hundreds of images. They are arranged in a way that one detail or a repetitive pattern links what are otherwise discontinuous and unrelated phenomena. So, for example, an eagle claw's circular shape is compared to a staircase that through a sequence of shots of architectural form becomes a dinner party. The slides were flashed rapidly in sequential order, but Eames and Nelson also set up large cardboard displays with many images and graphs on them and piped in smell and smoke.

In the film that resulted from the course, *A Communications Primer*, similar principles are demonstrated. In the movie, a red traffic light, for example, becomes an on/off message, a logic gate, an example of the mathematical theory of communication. Eames uses rapid cutting, switching between sequences abruptly, and varying between two types of conventions. The first convention is that of still photographs filmed to look like a slide. The second convention is scenes filmed as unfolding stories and actions, sometimes as stop-motion animation. These two conventions are interspersed to create attention by having high velocity moments of slides, and then slower more narrative unfolding reenacting an idea. What stays stable is the structure of

presentation, the ratios, the patterns and speed of image delivery, the set-up of the screen or interface to the observer. This stability in the organization of vision and sense makes the content malleable in scale and meaning.[9]

Archival Practice

Eames did not leave this archival vision in the classroom. The Eames Office as a design practice largely operated through recombination, and he argued for 'found films'. Storing literally everything from production stills, mock-ups, and slides, to numerous objects collected in world travels, the work of the Eameses regularly repeats images and conventions from other pieces. Their extensive archive at the Library of Congress was already well catalogued upon donation, and their office contains seemingly endless rows of cabinets where Ray Eames stored every button, doll, piece of cloth, yarn, string and other objects – often toys from around the world used in their work. Almost all their films have a scene using pre-existing footage, as in their 'found education' work. They even recycled the human life cycle. Arguably the distinguishing feature of the Eameses' design was their sense of play, the ability to bring in toys, buttons, games, representations of childhood to the presentation of topics like computers and math.

These archives, however, are not organized according to a logic of classifying objects but through modes of apprehending objects. It is perhaps no longer even appropriate to label these practices archival in the sense of the 19th-century interest in taxonomizing and organizing objects, artifacts, and peoples into stable relationships with one another. In the histories of cinema and photography, the tireless efforts of Etienne-Jules Marey to capture physiological movement, or the documentary zeal of Alphonse Bertillon or Francis Galton to capture, type, and organize bodies have laid the foundation for theorizing archiving. While these individuals all worried about informational excess, they also worried about capture, recording, and organizing data. The archive was not always already there, it had to be built through complex assemblages of instruments, machines, and techniques (Canales, 2009; Stoler, 2009; Tagg, 1988). If the archive has implied a structure, this structure had become not the implicit and repressed function of the storage endeavor but the *explicit* and openly advertised purpose – 'found educations', 'found films' – a spectacular discourse of remainders, recycling, and storage. This discourse was emphasized by the disregard for, and silence about, capture, organization or taxonomy.

These students were thus being trained to become both consumers of data capable of choosing patterns *and* the designers of vision itself, the managers of this consuming algorithm. Eames noted that to observe was to scan, with the implication that the cognitive process of learning to see would become equivalent to his self-defined 'language of vision'. To see, to think, and to speak all became part of a single channel that could be re-engineered, manipulated, and enhanced.

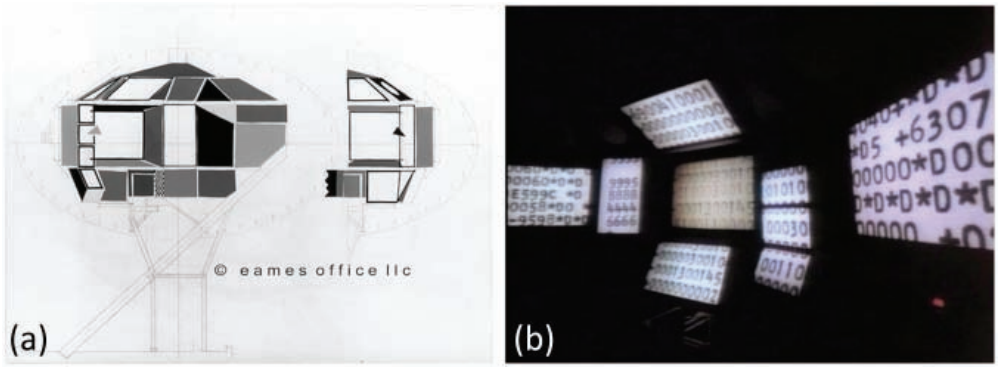

Figure 4a Architectural rendering of the 'Information Machine', whose interior displays images from film *IBM at the Fair* (1964). Courtesy of Eames Office © 2012 Eames Office, LLC (www.eamesoffice.com).
Figure 4b Frame grab from *IBM at the Fair* (1964).

To See Is to Think

If today computer companies exhort their users to 'Think Different' this is but a variation of the predecessor IBM's motto 'Think'. But what form of thought was introduced to the public at the dawn of an age of ubiquitous computing?

In 1964, IBM unveiled its World's Fair pavilion, labeled the 'Information Machine', were designed by the office of Charles and Ray Eames (the building itself was designed by Eero Saarinen). The pavilion was the centerpiece of a World's Fair famous for restructuring New York's racial and urban landscape through Robert Moses's aggressive redevelopment and highway planning as well as for being a final moment of universalism and technical optimism – its mottos were 'Peace through Understanding' and 'Man's Achievement on a Shrinking Globe in an Expanding Universe' – before the Vietnam War and the emergent countercultural revolutions. American racial apartheids and class battles repressed beneath the new highways and glitzy displays by way of an emergent discourse of scaleability and globalization was a mix that proved popular – some 51 million people visited. (Rosenblum,1989; Cotter and Young, 2011; Samuel, 2007).

IBM's pavilion was the centerpiece of this spectacle, and the ascendant computer company took the concept of thought quite literally. Viewers were lifted from the ground into a closed oval and entered a space of multiple screens that filled the field of vision. There, on 15 screens of different shapes, was projected a flow of images from different sources and in different formats, including animation. The intention was to get viewers to make willful connections among images and through choice, to create new connections and thoughts.[10] The multiply sized screens projected varied types of discontinuous information, forcing the eye (at least in theory) to move rhizomatically, making unexpected, and non-linear, connections. The 'host' welcomed the audience to the IBM Information Machine with the words:

> [This is] a machine designed to help me give you a lot of information in a very short time … the machine brings you information in much the same way as your mind gets it—in fragments and glimpses … *like making toast in the morning* (emphasis added).[11]

Inside this machine, the spectator was exposed not to any singular piece of content but to a perceptual field. Fifteen screens flashed sequences of football games, train exchanges, dinner parties, and mathematical equations (Colomina, 2001: 20).

Wavering between screens filled with photographic stills and screens showing unfolding sequences, the attention field was maintained by cadencing the amount of data and recombining older forms of spectatorship. The display went from very fast moments where screens changed regularly and very quickly every few seconds displaying a variety of unrelated images to reenactments of a problem being solved, such as a coach planning for a football game, which unfolded in narrative time and with a slower tempo. The piece fluctuated between classical cinematic narrative conventions and avant-garde tactics of shock and disjuncture, the spectator vacillating between alienation and identification.

Reiterating the logic of their engineering courses, the Eames' argued their installation was like a computer providing 'a lot of information in a short time' to model how the mind 'gets it'. Like Kepes's algorithmic design, this pavilion was composed of a design strategy where finding the pathway through an already-recorded and infinitely available archive is what constitutes thought. Identification or recognition of subjects or objects is not what mobilizes the spectator's eye and maintains attention in this environment. This installation could be understood as a mimetic re-enactment of the process of perceiving data in an information economy; a process that was now so automated as to be like making toast in the morning (IBM, 1964: 2).

IBM's promotional materials for the exhibit confirmed the idea that this pavilion was a new form of entertainment and a new mode of spectatorship. The materials given to journalists announced:

> Here from fifteen screens, a new kind of motion picture entertainment leaps out at the viewer … The aim of Charles Eames and Eero Saarinen Associates, co-designers of the pavilion, was to create an entire environment … After a number of seemingly unrelated scenes unfold the viewer discovers for himself that computers are not mysterious.

Through these discontinuities that replicate thought, the viewer will come to understand, or perhaps 'think', like a machine (IBM, 1964: 2).

IBM and the Eameses took this literally. Large portions of the presentation were dedicated to a hostess attempting to plan a dinner party, with its many strategic decisions about whom to invite and where they should sit to ensure social balance and harmony. The implication of this film

was that these decisions are just like those made by a machine. In fact, Charles and Ray Eames created algorithmic diagrams of the hostess's decisions, demonstrating how her thinking and the machine's logic were the same.[12]

But, more significantly, this machine operated through random, 'seemingly unrelated' sequences. From the hostess in the living room, the film cut to infrastructural images of railroads and urban space, to numbers and equations, to football games and the strategic plans of a sports coach. There was no historical narrative structure, or stable referent, for the presentation. The editing is choppy – the Eameses rarely use fades, for example – preferring abrupt image changes between concepts. Users were incorporated into a feedback loop, and each was trained similarly to create a personalized pattern from the data; there was no pre-determined order to the pattern. There was, however, an established method, process, or approach amenable to linking any points in any data set … even if 'unrelated' (IBM, 1964: 2).

Recycled Media

These 'found' multi-media films contained large amounts of stock imagery, but they should not be understood as cinematic. If to see was to think, this notion should not be analogized to Surrealist or Constructivist fantasies of an unconscious made visible by the cinematic apparatus or an autonomous camera eye creating consciousness. Charles Eames regularly and explicitly insisted on separating this multi-media architecture from cinema. Usually, he argued, people confused multi-media with multi-image, in which case any movie is multi-media. But his multi-screen projects were different:

> It had not only multiple images, including the relationship between still and motion pictures, but also sensory things … We used a lot of sound, sometimes carried to a very high volume so you could feel the vibrations … We did it because we wanted to heighten awareness' (Eames and Gingerich, 1977: 331)

In this new site of technical articulation, awareness, itself, took on a materiality, modeled and encoded as a form of media.

Perhaps the most interesting element was the Eameses' attitude to editing. They viewed idiosyncratic changes in images as useless, but relational shifts, the changing of a series or set of images together, facilitated information exchange and communication. No image, for them, was static or isolated. No image could represent something outside of its activity and relationship to other images. Building numerous multi-screen displays, they developed an editing tactic where screens would shift in sets of three or four, moving in one direction diagonally or horizontally across the installation. They also created attention by varying still photographic sequences with narrative, action, and animation series, shifting between movement and stillness.

Mobilizing this aesthetic strategy, the Eameses hoped to force the spectator to understand general concepts instead of remembering any specific data point. They repeated this relational concept, which is different from the tactics of dialectical montage, in their films as well, where often multiple types of data were shown simultaneously to express a mathematical concept, or they used repetitive patterns of scaling – going from micro to macro images of a phenomenon or environment – to make this point. Charles said of his filmic installations:

> You get a feeling about relationships you didn't have previously. In thinking about decision making in the future – whether it be recombinant DNA or what have you – we believe some attention should be given to honing the techniques of showing critical things simultaneously. We had hoped that by now this might be a rather general procedure. (Eames and Gingerich, 1977: 334)

This language evokes a future, generated out of a structure, like DNA, emerging from the relationships between images, where simultaneity and feedback replace the linear time of montage or the progressive time of history and mechanical and modern objectivity. Eames wanted this idea to become a 'procedure'. He desired a new technology for seeing. He viewed attention as related to DNA; perception as given the autonomy to self-reproduce.

Capacities and Channels

Continuing this theme of generative growth linked to scientific authority as embodied by DNA, Eames spoke of a massive, multi-screen installation created in 1959 for a cultural exchange between the USA and the Soviet Union, a precedent for his IBM show, in terms of producing 'credibility'. He defined credibility as a threshold between authority and inquiry, a limit zone that balanced spectatorship between identification (offering spectators the ability to recognize images they were familiar with and that were real in a documentary sense), without necessarily allowing a total identification or categorization of any one image. 'We wanted', said Eames in an interview,

> to have a credible number of images, but not so many that they couldn't be scanned in the time allotted. At the same time, the number of images had to be large enough so that people wouldn't be exactly sure how many they have seen. (Eames and Gingerich, 1977: 326, 333)

This perceptual architecture insisted on an eye capable of finding patterns in vast data flows. This eye, however, could never be fully 'sure'; never stable, always available, as in the new epistemology of communication and computing, to anticipate and assimilate more data. This lack of 'surety' mirrors Kepes's roving eye. These figures gesture at an epistemic transformation in the definition of observation and authenticity. Credibility,

here, was not about knowledge but about the capacity to absorb data and to continue to scan (Eames, 1977). This scanning, then, was not just any form of choice, but choice understood as communication; a search for the pattern or algorithm that compresses, and distills, data, in order to circulate more information through a channel. Just as today's engineers remove sound or light waves outside the threshold of human perception and remove redundancies to build algorithms in the interest of faster download, mid-century designers sought the most efficient pattern that might transmit the most information. The autonomy to choose would not be about freedom but capacity. Objectivity was now about effectiveness, actions, and thresholds to be maintained, manipulated, and re-organized.

This procedure, a new DNA of vision, would rest on an endless genealogy of infinitely recombinable data, using the past to generate the future. This archival discourse redirected a previous discourse of indexicality and objectivity into a technical drive to accumulate more data in order to encourage more analysis.

Affective Logics

This smooth self-referential world was not, however, without its conflicts. At some point, the logic of data inundation appeared to fold back onto a history of meaning and representation. Not all spectators found these tactics successful. One reviewer, Mina Hamilton, upon seeing the Eames installation, remarked, 'Visually the show is a sensation', but she added that sometimes the show was a 'deluge', implying that there might be a threshold over which too much information became threatening. Hamilton was astute in noting that: 'Eames did not expect everybody to see everything. Quite the contrary, he expected each person to come away with separate sets of information and experience.' Ultimately, though, this justification did not work for her: 'The pace of the show, however, is so fast that a person does not have enough time … to weed out what he wants to see or not … The Kaleidoscope-like result is overwhelming and "spectacular" but too fragmented to be entirely successful' (Hamilton, 1964: 36–41). Hamilton immediately identified the individuating aspects of the show, the element of giving a sufficient data field, allowing each user to come out with a 'separate set' of information and experiences while deploying the same tactics as everyone else of pattern seeking and connection making.

What are we to make of this deluge, where the user cannot reduce the data field, fails to find the pattern, and is 'overwhelmed'? As Hamilton noted, this mode of viewing was contingent on a viewer's capacity to assimilate certain quantities of data; the Eameses were producing an observer understood as possessing thresholds for information processing that could be enhanced or overwhelmed. Hamilton also noted that the show was 'sensational' and provoked affect but without linear narrative or space for identification ('the person does not have enough time … to see what he wants to see or not').

It might be concluded after surveying the dense, temporally and spatially disorienting displays of these classrooms and installations that the implied observers of this environment must be interdisciplinary, capable of relating to the significance of a statement by a famous author and a scientific image simultaneously. These observers might be able to recognize, but not necessarily identify or authoritatively define, what they were looking at, immersed as they were in pedagogical and spectacular environments offering no establishing shots or stable perspectives on the data field. In keeping, perhaps, with the idea of camouflage, these designers opted for a mimetic perspective, a perspective from within the machine, not a perspective external to the information field.

Kepes (1960: 91) wrote that the purpose of good design and art 'is to bring the outer and inner world in correspondence', implying a psychic space flattened into a perceptual process that was also cognitive and structural, a 'vision of felt order'. Order which was implicitly defined as stable, rational, patterned, and logical was equivalent to sense, while the subject was envisioned as a smooth space for the transfer of information between the inner and the outer worlds, between the registers of analysis and stimulus. Kepes's intimated observer privately scanned data in the interest of participating in an innovative process without any clear-cut end. This subject was rational and orderly as well as affective, touchable, seeable, and visible. This subject's consciousness, cognition, perception, and memory were envisioned as part of one interactive process, a flat space, without inside or outside, only feelings and order; a subject who is also a channel, a conduit for the ongoing circulation and reorganization of data.

These analogies between objectivity and sensation, modulation, vision, and memory should also force us to reconsider commonly articulated beliefs often ingrained (even if through dispute) in our theories and histories of media that separate objectivity, science, and rationality from embodiment, sensory affect, emotion. For here is a sense configured to be both affective and logical. As interior and exterior were reconceived in terms of communication, the sensual, perceptual, and cognitive became part of single order, a rational and algorithmic set of processes or logical patterns that could be studied, built, and modulated. This point is particularly significant when viewed as the very infrastructure for interactivity. The reformulation of abstraction as material, of perception as cognition, of sense as logic makes possible our contemporary interactive environments. Deferring concern with documentation and refocusing on process facilitated a vertiginous reformulation of the relation between mind, body, and machine that made seeing and thinking both part of an autonomous process and material for a communication architecture. The resulting observers were radically individuated, personalizing their data space in seeming isolation. At the same time, these spectators were psychically flat, always networked, a conduit for accelerating the circulation of information.

Dream Machines

What are we then to make of this transformation between the screen and the psyche? Remaking the boundaries of the subject, the definition of rationality and objectivity, and re-conceptualizing the screen, these mid-century environments have complex relations with the present. The critical reviewer, Hamilton, still perched between different histories of visuality, gives us insight into a moment of potentiality and vacillation. She apprehended the display not as a given and desired form of life, but as a choice, one not defined by a mathematical communication theory. This choice would be contingent on the relationship between the interface and the older histories of storage and representation upon which it rested. It is still not clear, even today, how this deluge that 'overwhelms' the subject will be organized – do these communicative forms of interaction offer the possibility to remake the body, self, and other? Or do they herald a descent into a self-referential vortex of consumption without a concept of futurity? Between older concepts of normative perception and ideals of ever enhancing capacities lie the decisions that link aesthetics to the organization of life in the present.

This story is neither simple nor complete, it cannot be told as a causal history of the relentless militarization of attention. When Eames took up communications theories redefining choice and rationality in his displays, perception and cognition were also reconstructed and offered novel forms of embodiment and materiality. When Kepes appropriated cybernetics and computing, it was to produce affective environments. These surprising reconfigurations demonstrate potentials, some unrealized, that still lie in the storage banks of our contemporary media circuits.

This historical interface among design, aesthetics, and communication sciences and discourses reveals that contemporary media environments were not technically determined. There were many machines in post-war America, most of them imaginary. We are left to ask what other dreams for our perceptual future emerge from our interfaces and from these histories? Every day we negotiate this question in front of our many screens, through our communication networks and channels, in the architectures of our contemporary perceptual field.

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Notes

1. I was alerted to this citation by Reinhold Martin, *The Organizational Complex* (2003).
2. Gyorgy Kepes to Norbert Wiener, 27 September (Norbert Wiener Papers, MIT Archives, MC22, Box 9, Folder 141). Wiener to Kepes,1 August 1951 (Norbert Wiener Papers, MIT Archives, MC22, Box 9, Folder 140).
3. Material on Kepes's interactions with the many pioneering and cybernetically informed art and design practices includes his letters to Buckminster Fuller, who participated with the Experiment in Art and Technology group. See also Kepes Papers, Archives of American Art, Reel 5305-168-170, for founding documents on the Center for Advanced Visual Study at MIT.
4. Kepes also discussed these ideas in his notes from plans for a course at MIT (c. 1945); Gyorgy Kepes Papers, Archive of American Art, Smithsonian Institute, Reel 5312.
5. For background on MIT's history with CAVS, see the founding documents and history of the arts at the institution at: http://cavs.mit.edu/about.html?id=3
6. Norbert Wiener worked on the film emerging from this class. Eames corresponded with the mathematician John von Neumann and most significantly with Claude Shannon, the inventor of the Mathematical Theory of Communication, in the course of preparing this class, and many of the subsequent Eames Office projects. See the Papers of Charles and Ray Eames, Library of Congress Manuscript Collection, Letters to Oscar Morgenstern, Box 70, Folder 3; notes for IBM Museum, Box 148, Folder 1; credits for *Communications Primer* (1953).
7. The Eameses worked regularly with one author of the theory of games, John von Neumann, on a number of films, including *Communications Primer*, and corresponded with the other author, Oscar Morgenstern, for a number of shows on mathematics. They also worked with consultants from RAND very regularly. See the Papers of Charles and Ray Eames, Box 70, Folder 3: Oskar Morgenstern.
8. See also Charles Eames, Norton Lectures at Harvard, Papers of Charles and Ray Eames, Manuscript Collection, Library of Congress, Folder 10, Box 217 and Folder 7, Box 202.
9. Shown slides, of which only a series of about 50 remain, at the Eames Office on 16 August 2009.
10. For information on the original exhibit, see the IBM Corporate archives at: http://www-03.ibm.com/ibm/history/exhibits/vintage/vintage_4506VV2085.html, 15 April 2006 (accessed 21 April 2009).
11. Script of the IBM film *View from the People Wall* for the Ovoid Theater, New York World Fair, 1964. Transcribed on 17 April 2009 from movie reconstruction, courtesy of Eames Office Archives.
12. A re-enactment, storyboard, and the script are available at the Eames Archive in Santa Monica.

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