

Journal of the New Media Caucus | ISSN: 1942-017X

Inhuman Vision

Orit Halpern

Assistant Professor, History, The New School

In a recent piece *Serious Games I-IV* (2011), filmmaker Harun Farocki cuts onto four screens different scenarios from recent wars and war games. In the longest segment, filling two of the channels titled *Immersion*, we see juxtaposed between images of war simulated and mediated, a soldier undergoing post-traumatic stress disorder therapy for experiences in Iraq – through reliving the memory in a simulated game. The viewer is torn between learning how to use or see all the images in this installation, and producing some sort of coherent diegetic upon which to focus. The horror of this scene is the striking similarity between the pre-battle training and the post-trauma treatment The conclusion one might garner is that we are being conditioned to never experience war as pain or trauma. This trauma of being unable to feel care or empathy for others is doubled, in that the installation itself creates various barriers to proximity with its chosen subject of war.



Detail from *Serious Games I:Watson is Down* (2010), Harun Farocki. (Stills from Video, taken from: http://www.moma.org/visit/calendar/exhibitions/1196)

Through its multi-screen architecture, this installation strenuously insists on a disjuncture

between the camera apparatus and the human eye. Vision, for Farocki, is an activity beyond and outside of the human subject –a product emerging from the realm of machines and apparatuses of capture – one that retroactively conditions and manufactures "human" vision. Farocki's work reveals how our vision and cognition is now so thoroughly mediated, and in many ways mechanized, such that it is almost completely inhuman.

In the face of an apparatus for automating not only vision but also thought, Farocki's concern about seeing speaks to our present. It is particularly vital, because his investment in engaging the very infrastructures of war and violence in our present sits at a radical juxtaposition to most contemporary art concerned with infrastructures. The current fetish for showing power lines, pipelines, ports, and other sites of "infrastructure" runs directly in opposition to Farocki's treatment of infrastructure as a question of organizing sensations, something that can never be directly apprehended through representation. His work poses a fundamental question that is often absent in infrastructure art works which is: what is the infrastructure for "seeing" or "vision?" And what does it mean to witness at all within our contemporary environments?

In this essay, I address the question of what is historically specific to our contemporary forms of image making, perception, and cognition; and further ask how our history of these practices informs our future imaginaries. It is my contention that work on responsive environments in the 1970s, particularly informed by cybernetics, reconfigured the idea and practices of visuality and cognition in a manner that made perception itself a medium – material that is able to be made abstract and technically replicable – in unique ways that separates it from earlier histories of subjectivity and objectivity. If Farocki can posit a machine vision whose gaze is fundamentally irreducible to the human body, then I argue this is also a particular historical statement.

I will address how witnessing and vision is constituted in our present by examining one case of design informed through cybernetic and communication sciences – the 1978 *Aspen Movie Map*, and its predecessor projects created by the MIT based Architecture Machine Group. The *Map* is largely considered one of the first fully immersive, responsive environments, and is widely touted as the predecessor to everything from first person shooter games to Google Earth. Of interest is that what inspired designers was nothing less then a reconfiguration of the nervous system, from cognition to sensation, as the very medium and material for design.

As we shall see, the designers and scientific theories that built this piece were as insistent as Farocki on affirming the inhuman nature of visual perception. Simultaneously, however, the map contained archival and aesthetic elements from documentary work that clarify temporal layering as a fundamental aspect of producing images and screens. Such imperatives to archive and circulate substantiate our contemporary turn towards seeking patterns in data and "visualizing" information. In the case of *Aspen Movie Map*, these productive tensions also emerge around a new mandate to produce interactive modes of viewing.

Not surprisingly, biology, race, and gender play critical roles in conditioning spectatorship within this architecture of sensation. The Architecture Machine Group (Arch Mac) prototyped its conception of interactive and immersive media through the act of engaging with race as a 'demo' for the production of future responsive environments. In merging the representation

of race with the science of machines, the final effect is to insist not only on the limits of human vision, but to produce new ideas of species and territories, linked through literally nervous stimulation and speculation – a new neuro-political situation – that goes beyond the initial bio-politic formulation of subject and population. Population, here, is not the target, but rather the constituent, of media. This work also poses serious questions for our contemporary obsessions with "showing" infrastructure, and the possibilities for human witnessing and command over a now autonomous visual terrain.

The Architecture Machine

Built through the careful survey of Aspen, Colorado by gyro-stabilized cameras that took an image for every foot traversed down the streets, *Aspen Movie Map* worked through laser discs, a joystick and computer. Together the system allowed a user to virtually traverse Aspen at their leisure and speed. The film was shot both forward and backward, so one could navigate in reverse and insert objects into the space. The effect, Nicholas Negroponte said, was to have so much recorded that the experience was "seamless." [1] Upon looking at the screen what is immediately evident is that viewers are both "there: in Aspen and abstracted / held at a distance? as the film offers a map to overseeing one's spatial coordinates. The subject here is both integrated into the space, and simultaneously trained to navigate space as malleable and scalable. The perceptual field is plastic in that it expands both temporally (forward and backwards) and spatially via a bird's eye view.. Arguably, navigating these scales and planes becomes a new form of perceptual training, where one is both taught to integrate oneself into the network while preserving older ideas of command over space.

The movie lab's design interface implicitly uses a double strategy of deferral and meconnaissance to elicit users to input demands into the system. In this interface, the world seemingly resembles the familiar world, while the mapping system on the top of the screen "resembles" the usual maps for navigation. What makes this deceptive is that the coordinates of "real" and "virtual" cease to exist and this floating 'map' is not stable in time and space, but is rather generated from within the system. The interface thus recruits participants to use what looks familiar while deflecting their visual plane from observing a space to instead *interacting* with it, and to modulate their bodies and responses to the timings of the networked space.

By designating the Movie Map a "demo," the group distinguishes between simulation and "responsive" architecture (a term coined by Negroponte). [2] The demo is a test, a prototype —neither a representation of the real world, nor a finalized reality in itself. It hangs in an anticipatory, or preemptive, expectation of the next technical development.

Stewart Brand, evangelist of the computer, popularized the lab's work in a 1987 book, describing it as a place where corporate sponsorship and creativity exist in perfect harmony. His book depicts the group in its later identity as the MIT Media Lab as a "techno feast of goodies" to improve human life with project titles such as "School of the Future," "Toys of the Future" and so forth. Brand argues that the Lab's apocryphal vision of the future is based not in older, "publish or perish" mythologies of knowledge, but rather in a new vision of truth and prediction. "In Lab parlance it's 'Demo or Die'—make the case for your idea with an unfaked performance of it working at least once...focus is on engineering and science rather than scholarship, invention rather than studies, surveys, or critiques." [3] This idea of the

demo as demonstrating the future direction of technology, and in fact telling us something about the truth of the world and what users need, was the particular mark of the lab.

Demo or Die x 1:

The world was not, of course, always a demo. In the early 1960's, the lab had begun with ideas of testing and simulation. At first, like all artificial intelligence researchers, the Arch Mac group wanted to make machines smart. Initial efforts at simulating machines in the design process began with a series of initiatives labeled URBAN 2 and 5. These were "block worlds." The point of such programs was to build a micro world, a simplified abstract model of the real world, that world, which was made of blocks that designers could move around. The program delimited the actions a designer could take, but at the same time sought to understand the 'style' or process of different designers and how they approached a problem. These early efforts to produce machine intelligence asked designers to choose a state or type of process they adhered to (Fig. 2); the computer was to learn how different types had different design approaches, and how to model the process of design itself. It did not work. In Negroponte's words, the system was not very full of "play." [4]

While these first efforts at computer intelligence adhered to models put forth by individuals such as Marvin Minsky and Seymour Papert, the Arch Mac group quickly turned to more cybernetic ideas and inverting the question for intelligent systems. Instead of asking whether machines could be made like people, they turned to asking how people are machine-like – or more correctly, how people might become part of machine systems.

Demo or Die x 2: Race in the Machine

Interestingly, in the move from machine to human intelligence, race was a critical conduit of passage. The first functional demo of computer-aided design run by the Arch Mac Group was a series of Turing tests performed on tenants of a then under-privileged neighborhood inBoston's the South End. Negroponte's lab recruited three African American men from public housing projects and asked via a machine interface, what their main concerns were regarding urban planning and neighborhood improvement, what they wished urban planners and designers would take into account.



Page spread from The Architecture Machine, 1970, Nicholas Negroponte. pp.56-57.

Importantly, the simulation was entirely fake. at the time computers could not handle such sophisticated questions. The test was run through a human being (lower right image within the spread). The participants, however, were kept ignorant of this fact.

One can read the whole test as an interface—a demo—of what a real computationally-aided interaction would like. What gives this demo such force is that it is the performance of a "wish image" of the future. If, from historical distance, it might appear to be nothing more then play acting, at the time Negroponte argued that demos are truth: experiments that prove the forms of research and technology that need to be invoked next, that *should* exist and must be built.

In articulating this vision of the future, Negroponte said something vital, regularly repeated at the time by many human scientists and engineers, and evocative of the forms of changes in attitudes to race, population, and intelligence that this new epistemology of the demo induced:

...the three-user-inhabitants said things to this machine they would probably not have said to another human, particularly a white planner or politician: to them the machine was not black, was not white, and surely had no prejudices.... Machines would monitor the propensity for change of the body politic...What will remove these machines from a "brave New World" is that they will be able to (and must) search for the exception (in desire or need) the one in a million. In other words, when the generalization matches the local desire, our omnipresent machines will not be excited. It is when the particular varies from the group preferences that our machine will react, not to thwart it but to service it. [5]

Key to this discussion are the norms and individuals that become about capacities and differences. This new form of urban planning brought with it no pre-ordained organization, instead growing through consuming differences or varieties into the system. This model assumes that many different agents making minute decisions can collectively produce a smart environment – an intelligence without consciousness.

Implicitly, Negroponte was also introducing a new idea of population as a cloud or source for difference, a "propensity for change." The Arch Mac group was imagining assimilation machines. This automation of emergence—the making of change the very site of technical investment and design concern—is key to understanding the place responsive environments have within a broader political-economy of globalization in our present. What systems—from financial algorithms to smart cities—do, is capitalize on change and "unknowabilty" or "the known unknowns," as a site for speculation or growth.

Therefore, one of the preconditions in making the world both a testing ground and a responsive environment appeared to be a reconfiguration of the citizen and the population of this space. The Arch Mac simulations transformed United States race warfare into evidentiary examples for the necessity of computing. The implication of this demo was that if social structures could not help, then hyper-individuated, technologically managed responsive environments could.

Demo or Die x 3:

Having reached the limits of institutional review board protocols with people, Negroponte and his team at Arch Mac turned to a new frontier art, and another micro-world, titled *SEEK* (Fig. 4), an exhibition done for the Jewish Museum's famous "Software" exhibition in 1970. The exhibit consisted of a small group of Mongolian desert gerbils, chosen according to Negroponte for their curiosity and inquisitive nature, and placed in an environment of Plexiglas blocks that was constantly rearranged by a robotic arm. The mechanism would observe the interaction of the gerbils with their habitat (the blocks), and would gradually "learn" their "living preferences" by observing their behavior, and by how they moved the blocks. "This machine," Negroponte argued in an interview, "was conceived as both a 'cybernetic world model' and a 'behaviourist laboratory for observation and experimentation'". [6] This experiment introduced cognitive and neuro-scientific models of intelligence into environmental design.



Detail from *Seek*, 1970, Nicholas Negroponte and the Architecture Machine Group from the catalogue of *Software: Information Technology Its New Meaning for Art* (1970), Courtesy of the Jewish Museum Archives, pp.20-21.

Negroponte opened his text on "the Architecture Machine" with two premises. The first was that, "Computer-aided design cannot occur without machine intelligence." This intelligence, Negroponte explained, must be "behavioral" and "must have a sophisticated set of sensors, effectors, and processors." [7] For Negroponte a true "Architecture Machine" would not be a modern machine serving human needs, but an integrated system based on a new type of environmental intelligence related to the regular capacity to sense and respond to sensory inputs. His articles and books distilled a constellation of theories about intelligence and complexity to argue that design had to become a process, a "conversation" between two intelligent species – human and machine – and not a linear cause-effect interaction. [8] "We are talking about a symbiosis that is a cohabitation of two intelligent species," wrote Negroponte. [9] He was not interested in computerizing design, so much as rethinking the design process itself. "Architecture as a machine" posed design as a process to network humans and machines into new assemblages. This demo, which was now life reframed as a "conversation" between machines and animals, found its first perhaps comprehensive actualization in the installation of the *Software* Exhibition at the Jewish Museum in 1970.

Unfortunately, this experiment went quite badly – or perhaps creatively, depending on your point of view. The exhibition's computers rarely functioned, due to both software and hardware problems; the museum almost went bankrupt; and in what might be seen as an omen, the experiment's gerbils confused the computer, wrought havoc on the blocks, turned

on each other in aggression, and wound up sick . No one thought to ask, or could ask, whether gerbils wish to live in a block built micro-world. [10] In a witty *Art News* editorial critic Thomas Hess described the gerbils as covered in excrement and shadowed by the broken arms of the robot. "Artists who become seriously engaged in technological processes might remember," he concluded, "what happened to four charming gerbils." [11]

Demo or Die x 4:

No matter – demo or die – is now quite literally the lab motto. Within a few years of the Jewish Museum experiment, Negroponte published a new book *Soft Architecture Machines* and soon thereafter changed the name of his lab to the Media Lab. In this new "soft" world, the actual computer disappears from sight, the environment itself immersively connected to the user. Both populations and environments transformed into material mediums.



Detail from *Spatial Data-Management*, 1979, Richard Bolt, p.12. downloaded from: http://www.media.mit.edu/speech/old/papers/1979/bolt_1979_spatial_data-management.pdf.

This new approach centered on a new structure, the "Media Room" (Fig.4), featuring quadrophonic sound, seamless floor to ceiling displays, and probably a couple million dollars of hardware. [12] It was an immersive environment, fully networking human sense and computation—perhaps an end of architecture and its consumption into media. The new

Media Lab's explicit goal was the integration of broadcast, motion picture, print, and publishing industries with the computer industry. The new lab would be a machine for assimilating differences—between people, between mediums, and between the virtual and real world. The simulation no longer existed: now it was the world.



Aspen Interactive Movie Map, 1981. Embed https://www.youtube.com/watch?v=Hf6LkqgXPMU

The new lab's pioneer project in the Media Room, and one of the first three dimensional digitally mediated responsive environments ever built, was the aforementioned *Aspen Movie Map* (Fig. 6). The project's creators didn't set out to model Aspen; the project is Aspen. As Michael Naimark, an artist who worked on the project has written, "Aspen [is a] *verb* ...Aspen is known for two processes, or 'verbs' relating to heritage and virtuality. One is to 'moviemap' ...the other is to 'Aspenize', the process by which a fragile cultural system is disrupted by tourism and growth". [13] The movie map is not a representation – it's an operation, a way to live, a way to be in the world. The architects, designers, and engineers of this project imagined it not as a room, or simply an interface, but as a "cultural system' and an entire ecology."

Originally commissioned from MIT by the Cybernetics Division of the Defense Advanced Research Projects Agency (DARPA) of the US military, the inspiration came from stories of the Israeli use of a simulated environment to accomplish the mission of saving hijacked Israeli citizens at Entebbe in Uganda in 1976. The project, however, was not secret, and this feature recognizes another fact.

Even as counter-terrorism and urban warfare had become a pressing issue by the 1960s with decolonization, particularly in light of the conflicts occurring in Algeria and Vietnam; yet there was another war going on. Urban riots sparked by Martin Luther King's assassination and white refusals to desegregate had prompted a new discourse of "war" and crisis in America's cities. Historian Jennifer Light has shown that this discourse of "crisis" was coproduced with an influx of defense intellectuals leaving the analysis of nuclear strategy to apply their operations research and cybernetic methods to the burgeoning (and increasingly profitable) sector of urban security and development. [14]

By the 1970s, however, as Aubrey Anable argued, the urban "crisis" had dissipated or dissolved. It was replaced by a new Nixon administration investment in privatized solutions and a turn away from Johnson-era 'Great Society'-style programs. This privatization and fatigue, she argues, refracts itself in the *Movie Map*'s hyper-individualized mode of traversing urban space. [15] Certainly, the *Movie Map* sat within a longer tradition at MIT of investment in behavioral and computational sciences within the schools of planning and architecture. Planners from MIT did not answer the original "crisis" with a turn to sociology or structural discourses but rather continued using the tools of environmental psychology, cognitive science, and computer science. [16]

This approach could best be summarized in the 'demo or die' adage. The construction of simulations was part of a process whereby the environment and the user would be adjusted to one another, and eventually the simulation itself would be dispensed with. The culminating success of this approach was the *Movie Map*, a system that could integrate the senses, create an immersive environment that was also a place, and help train users to live in this new, technically generated a new world. In this system, concerns about military tactics and race conflict were consumed into personalization and interactivity.

Aspen was a system – the first fully, in Negroponte's words, "responsive" environment. It offered an individualized but networked way to negotiate space, a new form of life, to answer, perhaps, the seeming ruins of modern urbanity. As we watch the film of the original demo, questions of race, urbanization, war, and society fade into the calm embrace of interaction. We are forced to confront what it means to live in this eternally extendable computer enhanced world. What had started therefore as game theories around military concerns, and then the simulations of Artificial Intelligence, had now become about total life.

In documents of the project, one sees an individual slowly navigating the space of Aspen. The field is analogous to a first person shooter game, but at the same time in the sky hangs an abstract map that offers the observer a global view of the scene. One is at once in the local and in the global. As the map slowly unfolds, the video enclosing the user with historical distance, we can see the idea of a self-organizing system now networked into an attentive system. The environment slowly spirals away into the affective space of preemption, as one awaits the next bend in the road even as the network remains invisible.

The user is simultaneously individuated, and constantly linked to the network of machines, and media. This user is no longer fully a subject, but perhaps, to cite Deleuze a "dividual," compartmentalized into pieces of information and attention. In a move that

anticipates contemporary trauma treatment, historical and contextual features of the image are used not to produce affiliation, nostalgia, or memory, but to reorganize the perceptual field and attenuate it into the system. More critically, the individual here is both given a sense of control over the space while simultaneously being consumed into the network. The structural politics of both militarism and race-war/security rechannel into interactivity.

This returns us to the question of art, and to the small sad gerbils, in their excessively responsive environment. In this case the logistics of computation had folded upon itself to produce something other from what was intended, but also radically nihilistic. How are we to encounter this demo, or test bed, that has now become our world? How are we to encounter difference, complexity, and chance? In an age where chances itself, the changes in the system, are the very site of automation—we must produce a politics, and criticality, of chance and complexity. If anything the *Aspen Movie Map* cannibalized older structures of vision and gaze in the interest of consuming the possibility of evidence or witnessing all together. I might ask if this is the genealogical underpinning to what the anthropologist Rosalind Morris has argued is the "narcissistic economy" of contemporary warfare and torture. [17]

In our present, returning to the Farocki installation, despite a ubiquity of violent images and performances of ethical horror at torture, there appears to be no scopophilia, or pleasure in looking. It is possible that looking is not even possible. Images appear to no longer prompt identification or desire—whether in love, hate, or disgust. Morris argues that what has disappeared is any concept of a social structure organizing vision and judging witnesses or participants. [18]

Under such conditions, circulating images do not produce evidence, proof, or emotional attachment (even if negative), but only an imperative to circulate more images. Thus soldiers who torture prisoners continue to circulate images of their work, despite potential judgment by military tribunal without, in Morris' words, "satisfaction" on the Internet. We as a public "see" them, but only as an incentive, perhaps, to use Facebook or YouTube, and not, as one might hope, as an invitation to action or commitment to stop these actions. [19] In the ability to always already feed the image of ourselves to ourselves in the near future, we make it impossible to feel shame or remorse. Morris stunningly argues that we cannot encounter difference in the field of vision. The imperative to encounter is renegotiated towards an imperative for interactivity and informational circulation. Morris' account refracts my opening scene of an image of war whose only purpose is perceptual, perhaps nervous, rewiring and training through no communicative, or even anthropomorphic function. [20]

Here game and play become a serious affair. Reduced to ideas of choice, the play of images becomes a conduit to move between an older model of psychological subjectivity based in the individual body, into a new global nervous network, operating perhaps at the synaptic level of species, and whose only imperative is circulation. Viewers pass through the error of recognition into the pure action of pattern seeking, cadencing, and affect. Perception and cognition are compressed into a single channel and agglomerated at the level of populations. Under such conditions, the screen does not serve any anthropomorphic function, but rather serves to recruit the user at the level of nervous energy and psychic energies into the network. Behavior is modulated into becoming a resource for producing populations, and often market data. Population becomes a site of value.

This posits a fundamental challenge for art. What Farocki's installation does, perhaps, is make us realize the limits of human vision, and the place of the image in recruiting our affective energies for war or capital. What his work does not do in this piece is make empathy possible. The question, for both critical art practice and theory, remains how to produce modes of encounter with difference. While this essay is hardly a solution, it suggests one path via thinking about a history of our responsive environments in terms of difference, rather then homogeneity. There is still critical work to do—in art and in scholarship – to envision alternative images of the future, and different forms of time and experience that do not operate at the scale and tempo of our eternally preemptive, affective, and nervous networks.

References

- 1. Lian Chikako Chang, Drew Harry, Mohsen Mostafavi, and Nicholas Negroponte, "Live Blog: Mohsen Mostafavi in Conversation with Nicholas Negroponte," *Archinet* Blogs, Last accessed June 18, 2014, http://archinect.com/lian/live-blog-mohsen-mostafavi-in-conversation-with-nicholas-negroponte
- Tristan d'Estrée Sterk, "Building Upon Negroponte: A Hybridized Model of Control Suitable for A Responsive Architecture," (Chicago: The School of The Art Institute of Chicago, 2003), Last accessed: September 30, 2014 http://www.orambra.com/survey /~ecaade/media/sterkECAADE_03.pdf
- 3. Stewart Brand, Media Lab, 2 ed. (New York: Penguin Books, 1988), 4.
- 4. Nicholas Negroponte, The Architecture Machine (Cambridge: MIT, 1970), 74-76.
- 5. Ibid., 57.
- 6. http://openarchitectures.wordpress.com/2011/10/27/an-interview-with-nicholas-negroponte/
- 7. Negroponte, *The Architecture Machine: Toward a More Human Environment*, (Cambridge, MIT Press, 1973), 1.
- 8. Negroponte and his colleagues argued that their model of intelligence in design differed from other architects of the time, and that what marked the separation is their concept of an ecology, formed out of constant feedback loops of machine-human interactions, one that evolved and changed, grew "intelligent". Ibid., 7.
- 9. Ibid.
- 10. Edward Shanken, "The House That Jack Built: Jack Burnham's Concept of "Software" as a Metaphor for Art," *Leonardo Electronic Almanac* 6:10 (Novembr 1998).
- 11. Thomas Hess, "Gerbils Ex Machina," Art News, no. December (1970): 23.
- 12. Chang, Harry, Mostafavi, and Negroponte, Last accessed: June 18, 2014.
- 13. Michael Naimark, "Aspen the Verb: Musings on Heritage and Virtuality," *Presence Journal* 15, no. 3 (2006). http://www.naimark.net/writing/aspen.html, Last accessed August 1, 2014. Personal Interview with Naimark August 12, 2013.
- 14. Jennifer Light, *From Warfare to Welfare: Defense Intellectuals and Urban Problems in Cold War America*, (Baltimore: John Hopkins Press, 2003).
- 15. Aubrey Anable, "The Architecture Machine Group's *Aspen Movie Map*: Mediating the Urban Crisis in the 1970's," *Television and New Media* 13, no. 6 (2012): 512-14.
- 16. See Orit Halpern, Chapter 2 in *Beautiful Data: A History of Vision and Reason*, (Durham: Duke University Press 2014).
- 17. Rosalind Morris, "The War Drive: Image Files Corrupted," Social Text 25, no. 2 (2007).

- 18. Ibid.
- 19. Ibid.
- 20. For more on ideas of the image and its use in PTSD treatment see: Pasi Vailiaho, "Affectivity, Biopolitics and the Virtual Reality of War," *Theory, Culture & Society* 29, no. 2 (2012).

Bio

Dr. Orit Halpern is an assistant professor in History at the New School for Social Research and Lang College. Her research is on histories of digital media, cybernetics, art and design. Her recent book titled *Beautiful Data: A History of Vision and Reason since 1945* (Duke University Press, 2014) is a history of cybernetics, cognitive science, and design. Her published works and multi-media projects have appeared in *Public Culture, C-theory, Configurations, Post-Modern Culture, and The Journal of Visual Culture* and at ZKM in Karlsruhe, Germany. She has been a fellow at the Institute for Public Knowledge at NYU as part of the Poiesis Fellowship, and also a fellow at the Max Planck Institute for the History of Science in Berlin.

 \odot

www.orithalpern.net

This work was supported by a grant from the Graham Foundation.