

Science & Justice Working Group Rapporteur Report Green Neuroscience: Re-envisioning how we Study the Brain and Ourselves

January 22, 2013, 4:00-6:00 PM

Dr. Ann Lam (Director and Founder of the Green Neuroscience Laboratory)

Dr. Elan Liss Ohayon Co-Director and Founder of the Green Neuroscience Laboratory,
Research Associate at Salk Institute)

Discussant: Martha Kenney (History of Consciousness, University of California, Santa Cruz)

Event Description: In this Science and Justice Working Group event, Drs. Ann Lam and Elan Ohayon presented the story of establishing the Green Neuroscience Lab (<http://greenneuro.org/>). The aim of the Green Neuroscience laboratory is to advance our understanding of the brain by posing questions and conducting careful research in a sustainable and creative manner. The lab strives to demonstrate that neuroscience research can be less harmful to the environment and improve health while simultaneously recognizing the importance of neurodiversity, community, and the environment. Another central goal of the lab is to improve the dialogue between researchers and the publics they strive to help. In this presentation, they also outlined how their current research directions, in studies of neural imaging, cognition, and computational neural modeling, address their objectives.

Dr. Lam and Dr. Ohayon began the presentation by asking everyone in the room to describe what they think a “green neuroscience”, or more broadly a “green science” might entail. Their presentation outlined the issues with neuroscience research today and how the principles of their lab address and go beyond these trends. They also described the physical space and the research foci of their lab.

Problems with the Trajectory of Neuroscience Research

The presenters briefly described the concerns of brain/mind-related research as depicted by popular culture, referring to stories such as *Frankenstein*, *The Island of Dr. Moreau*, *Brave New World*, and *Total Recall*. They then outlined some troubling objectives and research of neuroscience that may actually go beyond those of the sci-fi realm. These included military and commercial applications, various psychiatric therapies, the extensive use of viral vectors, and a push toward mono cultures, pathologizing, medicalization, and marginalization. Examples discussed included: the Diagnostic and Statistical Manual of Mental Disorders, optogenetics, and bias due to close connections between academic research and for-profit industries. They also described the large quantities of hazardous waste generated by most neuroscience approaches and harm to other species.

Principles of Lab

They outlined some of the laboratory principles, which included: developing green, non-toxic, sustainable, and restorative research methods; no captive, experimental animal testing; aiming to

increase the overall autonomy of individuals; non-hierarchical research and just labor practices; nurturing of cooperative science; encouraging an appreciation of neurodiversity rather than “typical” brain structures and functions; sustaining responsible and rigorous research practices that also incorporate humor and deep fun.

Conceptual Space

The presenters described the conceptual space that has supported the formation of the Green Neuroscience Lab. This includes their affiliation with the NeuroLinx Research Institute (<https://neurolinx.org/>), which is a non-profit research institute that began operations in 2011 and whose mission is to further neuroscience research within a framework of open scientific collaboration. The institute addresses this mission by “building bridges between researchers, creating unique collaborations, linking diverse scientific data and information, and supporting high-risk but potentially high-reward research projects.” The mission is summarized in the moto “Liberating Science”.

Physical Space

Dr. Lam and Dr. Ohayon then discussed how they have worked to create a physical laboratory space that reflected their principles. This includes no animal testing, minimizing the use of hazardous materials for studies, and a practice of non-hierarchy (e.g., encouraging college student researchers to develop their own questions and research studies which is rare at the undergraduate level). They also described how the laboratory is the first net zero neuroscience laboratory powered with solar energy, how much of the equipment and furniture were reclaimed or repurposed, and how they increased green space in a primarily industrial area.

Research

The speakers then presented examples of their research projects. Dr. Lam outlined the Open Atlas of Brain Metals project (<http://greenneuro.org/atlas/>) that she and Dr. Ohayon are working on as part of the Green Neuroscience Laboratory. Using X-ray fluorescence imaging at the Stanford Synchrotron Radiation Lightsource, they are developing an open access atlas that will offer researchers new information on the distribution and function of metals in the human brain. Metals contribute to the basic architecture, function and plasticity of neural systems. By constructing this digital repository, they are documenting the diversity across and within so-called “typical developing” brains as well as conditions such as epilepsy and Williams Syndrome. The hope is to help identify the role of metals in the brain in order to understand how their distributions in brain structures contributes to function. By using synchrotron imaging they have avoided many commonly used carcinogenic substances in assessing brain anatomy, although a possible environmental trade-off is the large amount of energy that this method can consume (though relatively brief in duration). Beyond the accuracy and environmental benefits, the method also has additional scientific advantages in that it enables other histological techniques to be applied post-imaging.

Dr. Ohayon also outlined his neurocomputational research on neural activity, cognition and epilepsy. He described how he explores the effects of changes in the structure of large networks on their function. He also illustrated how he has thought about these models in the context of the environment and autonomous agents. As an example, he presented an experiment where embodied models (robots) were evolved from a seizure-like condition to a point where they could move around and avoid obstacles.

Question and Answer Period:

The discussant, Martha, began the question section of the event by asking Drs. Lam and Ohayon three questions (paraphrased in the following section):

Martha - In Science and Justice we have discussed this idea of “slow science.” It is a concept that we have taken from the idea of fast food as something that is output quickly, but has all types of negative consequences ecologically and socially. We have thought about the possible benefits of moving away from a fast-paced competitive atmosphere or a ‘publish or perish’ model to allow for time for experimental projects, potential false starts, the ability to “digest” the science, and a more positive workspace. In what ways might that concept resonate, or not resonate, with the Green Neuroscience Lab?

Ann and Elan - The analogy definitely works in many senses, in that there is definitely too much rote research being conducted, with little thought of the impact both within neuroscience and on society. Also, pressures to finish study quickly and considerations of how easy it will be to publish can bias both the approach and results. Proper experimental design should allow for thinking space and serendipitous discovery to occur. On the other hand, while we have to give space for things to happen slowly, we must also recognize that sometimes things happen very fast and great realizations can occur quickly. So we need to be flexible and act upon rapid developments in our studies and within neuroscience as a field.

They agreed that concept resonates at many levels and that the means of our practices should reflect our principles. In that sense it is very important to give things time to simmer and avoid "fast food" science. On the other hand, they also remarked on the urgent need to recognize and respond to the dangerous trajectories in neuroscience research. The detrimental consequences are speeding up and require fast responses to mitigate the damage. This urgency means that researchers who care about these ethical issues need to respond quickly and strongly.

There have also been some positive developments. For example, there is an important move away from ‘publish or perish’ that is now allowing for more inclusive and thoughtful science. In fact, some of the most momentous and rigorous results have recently been disseminated in non-traditional manners. An example is the solution to the Poincaré conjecture by Grigori Perelman who posted the proof online (on arXiv).

There are also many troubling social justice dimension to the competitive "fast food" model. For example, talented immigrant scientists are pressured to perform under the threat of losing their

jobs and visas. This can turn marginalized people against each other as well as potentially compromising the science and ethics. In the US, the problem is exacerbated by the lack of universal healthcare, so people may overwork themselves or cut corners because they are afraid of losing their health insurance benefits. Also, researchers who want to keep their positions and health insurance in order to protect their families will often sacrifice time with their families. Women in particular may feel the pressure to choose between work and family. The absence of social safety nets can also lead to researchers that are less likely to take chances. Dr. Ohayon remarked that this is exceedingly ironic since the lack of socialized health care can actually hamper the entrepreneurial spirit so celebrated by industry.

Martha - mentioned the work that she did with Ruth Müller that found women postdocs had an enormous amount of pressure to make sacrifices and felt they lacked role models for women who combined their work as scientists with family obligations.

Ann and Elan - This is certainly an important issue. As mentioned, there is a lot of pressure, especially on women that can pit research against family. This is very common at the postdoctoral level. However, while recognizing the problem, we also should be careful about reifying the issue. In many ways academia is much more flexible than other occupations and can offer a wonderfully rich and fulfilling life. It is important that the positive stories and aspects be told as well so that women are encouraged and supported in pursuing careers in science and academia.

Martha - Says she was struck by their use of language, namely the lab principle of encouraging “rich narratives.” Her work is on narratives in science, so she is curious about what inspired that way of framing their work and what does the idea of narratives might mean to them

Ann and Elan - Talked about the importance of listening to people’s stories in order to inspire and contextualize their research as well as for understanding the brain in context. SAND, for example, has had speakers such as a woman whose sister has epilepsy and a native elder. These narratives have often been amongst the most engaging presentations. These stories clearly affected the basic researchers and clinicians at the conference. Focusing on the telling of stories also allows for a conversation with society and invites people to participate.

They also mentioned that there is the need for more artists and writers to partner with scientists on interpreting some of the issues and depicting how science impacts people’s lives. It is often artists that perceive and interpret the impact long before scientists have even begun the research (as per examples from literature at the start of talk).

Martha- What kind of limitations have they encountered trying to implement Green Neuro?

Ann and Elan - The principles have eliminated a lot of the traditional funding sources given that the lab does not accept funding from military or industry (e.g., pharmaceutical). They have also met many incredible researchers that they would have liked to work with but unfortunately their research was ungreen either in their funding and/or outcomes. For example, research that is partially focused on the development of military devices or patented medical treatments.

However, although the funding has been an issue, in some ways the limitations have also led to creative solutions and opened up new possibilities. For example, much of the furniture and equipment was acquired through Craigslist which was both green and affordable. This also led to connecting to interesting individuals in the community such as environmental architects and engineers. The SAND conference has been an inspiration in this regard as it has run for many years with a zero budget. The conference takes place in academic public spaces which helps bring researchers from many fields together while nurturing connections with public institutes.

Andrew Matthews- asked how they came up with the concept of an “atlas” to describe their repository of information?

Ann and Elan: The term "atlas" is actually taking on many meanings in neuroscience. It's a very active domain. There have been very energetic discussions about this at the lab and with collaborators. The debate is quite lively. One of the most interesting connections is that the lab received a generous donation of vintage atlases from the Neurosciences Institute in La Jolla, CA. This has given the discussion a certain historical perspective and has led to many of the questions. Is the description of a single individual an atlas? Should an atlas be made up of a collection that reflects a population? What about the ethics of collecting the data (in humans and other animals)?

Magdalena Górka - Thanked the speakers for coming and said it is rare that scientists think so deeply about the social issues of science.

Andrew Matthews - Thanked the speakers and said that what they are doing is a very inspirational project.

Discussion continued after the formal event and future collaborations are being planned.