

NAS Sackler Colloquium

Creativity & Collaboration: Revisiting Cybernetic Serendipity

March 13-14, 2018, NAS Building, Washington, DC

<http://www.nasonline.org/sackler-creativity-collaboration>

Introduction

Ben Shneiderman, University of Maryland

Embrace Design, Rediscover Visual, and Go Social

This Sackler Colloquium begins by looking back at the 1968 Cybernetic Serendipity exhibit, but our ambition is to look forward. We seek to redirect the history of ideas, restoring the Leonardo-like close linkage between art/design and science/engineering/medicine through widespread use of internet-enabled creativity and collaboration. The key elements are (1) to embrace the methods of design and art to enable researchers to perceive more clearly, think more broadly, and create more vigorously, (2) to rediscover the power of visualization, now invigorated by interactive tools that put researchers at the center of data science exploration, and (3) to recognize the potent opportunities for enhancing teamwork and inspiring citizen scientists. While these directions will enliven research collaboration and empower creative endeavors, their true meaning is to produce outcomes that improve the lives of everyone.

Jasia Reichardt

In Anticipation of the Sixties

Cybernetic Serendipity did not emerge suddenly out of nowhere. It had a long gestation period. The fifties, the period of cultural recovery after World War II, was a vital decade during which many of the ideas which underlie the revolution of the 1960s were born. They were: Kinetic Art in Paris; Experimental Workshop in Tokyo, and Gaberbocchus Common Room in London. Each contributed towards building bridges between art, science and technology. What is obvious for us today was new and untested.

Session 1: Roger Malina: Introduction of panel and panelists

Roger Malina, University of Texas-Dallas

If you can plug it in, it can't be art :

50 years looking back and forward with the Leonardo Journal

The Leonardo Journal, founded by Frank Malina, first appeared in 1968. Coincidentally one of his Kinetic Art works was included by Jasia Reichardt in *Cybernetics Serendipity* also in 1968. At the time the art critics and art galleries in Paris told my father: "if you have to plug it in, it can't be art". We will present a fifty year overview of the art/science/technology landscape from the point of view of the Leonardo Journal, but also identify key emerging trends, opportunities and problems that will mark the coming decades. These issues have renewed interest with the STEM to STEAM movement and a new generation of artists and designers that are born digital and able to make major contributions to future science and engineering research.

Dr. Sara Diamond, President and Vice-Chancellor, OCAD University
Modeling New Knowledges – An Inclusive STEAM + D Imperative

In 2016, after months of facilitated strategic foresight research, broad community and institutional engagement, OCAD University (Ontario College of Art and Design University) adopted a new vision and mission that confirmed its thirteen year convergent pathway (Diamond, S. (2010) “Moving Out of Bounds”, in Buckley, B. & Conomo, J., eds. *Rethinking the Contemporary Art School*. Halifax: NSCAD University Press). The banner of the new vision states, “Transformed by Imaginations”, followed by, “OCAD University challenges you to audaciously and responsibly pursue the questions of our time through the powerful interplay of art, design, the social sciences, humanities, and the sciences.” Four mission statements follow, emphasizing the opportunity to, “engage with materials, data, technologies, ideas and pedagogy and diverse Indigenous perspectives, to support unique research, studio practice and learning, creating interdisciplinary and emergent forms of knowledge”. The institution’s philosophy emphasizes the need for artists and designers to work in concert with STEM disciplines in order to “act as transformative social, economic, environmental, and cultural agents” – hence the formulation of STEAM + D. The vision and mission have been followed by a new academic and research plan which implements a multi-dimensional model of Indigenous methods and learning, art, design and STEM.

My presentation will provide insight into the philosophy behind the new convergence of STEAM + D and Indigenous and culturally diverse knowledge at OCAD University. It will provide examples of pedagogical practices, transdisciplinary research, and research creation that draws on decades of experimentation, not only at this institution but beyond, including the Banff New Media Institute.

Curtis Wong, Microsoft

Leonardo da Vinci: Art/Science as the virtuous cycle of rendering and understanding natural world

More than 500 years have passed since the time of Leonardo da Vinci, yet his creative works continue to represent the pinnacle of mankind’s creative potential across art and science. What can we learn from Leonardo’s practices as an artist and a scientist that enhanced his ability to produce such extraordinary work across many disciplines?

Today, art and science are often separate fields with little overlap in theory or practice. In Leonardo’s view, art and science were two branches of the same tree. He saw art as rendering nature and science as knowledge of nature, deeply intertwined and inseparable. This deep association between art and science combined with his imagination allowed him to go beyond rendering nature in naturalistic detail to imagine a fantasy scene that appears completely real because it was created with a deep understanding of the behavior of light, shadow, perspective and color in the natural world.

How can revisiting Leonardo’s art/science + imagination create new opportunities for technology enabled learning, creativity, collaboration and inspiration? This talk explores examples of the close relationship between art/design + imagination that is associated with innovation in scientific discovery.

Patrick McCray, University of California-Santa Barbara

All Watched Over and Watching Machines of Loving, Sometimes Terrifying, Grace

Cybernetic Serendipity was but one manifestation in the 1960s of the fascination and fear of people-computer interactions. From rancorous congressional debates about manufacturing automation to artists' manifestos and Pentagon-purchased electronic warfare systems, cybernetics secured a place in 1960s-era thinking about the rapidly evolving relationship between society and information technologies. Jasia Reichardt's seminal exhibition contributed to this larger conversation. In my short talk, I'll consider the multi-valent ways in which cybernetic thinking and thinking about cybernetics are an essential part of understanding the histories of the 1960s.

Session 2a: Maneesh Agrawala, Stanford University and Donna Cox, University of Illinois

Maneesh Agrawala, Stanford University

Deconstructing Charts and Graphs

Over the last 300 years, data visualizations in the form of charts and graphs have become the primary means for communicating quantitative information. They are pervasive in scientific papers, textbooks, economic reports, news articles and webpages. In some cases these visualizations are the only publicly available representation of the underlying data. Yet, while people can easily interpret data from charts and graphs, machines cannot directly access it. The lack of machine readability significantly hinders analysis, reuse and indexing. Today, a vast trove of information is locked inside data visualizations. In this talk I'll show how we can unlock this data by deconstructing the way charts and graphs represent information. I'll then show how we can use the extracted information to redesign ineffective visualizations and add new forms of interactivity to static charts and graphs.

Jeff Heer, University of Washington

Constructing Charts and Graphs

Data analysis is a complex process with frequent shifts among data formats, tools and models, as well as between symbolic and visual thinking. How might the design of improved tools for visualization construction accelerate people's exploration and understanding of data? Covering both interactive demos and principles from academic research, this talk will examine how to craft a careful balance of interactive and automated methods for enabling effective visual analysis.

Alyssa Goodman, Harvard-Smithsonian Center for Astrophysics, and the Radcliffe Institute for Advanced Study

The Road from Explanation to Exploration, and Back

Twenty years ago, most scientists thought of visualizations as "pretty pictures" for public communication—harboring deep interest in visualization and/or public outreach was thought to diminish a researcher's scholarly output. Slowly, though, as data volume, availability, and complexity have grown at unprecedented rates, the design principles that lay bare data's meaning for a public audience have been applied to ever-more-complex, and ever-larger data sets. As a result, visualization has recently taken a journey, from the realm of public communication into the essential practices of researchers in data-rich fields. New software tools empower these researchers to explore data sets for deeply hidden patterns, enabling them to make astonishing discoveries, search for causal processes, and uncover actionable evidence

that supports bold decisions. The results of interactive data exploration are usually still captured, and published, in static explanatory data graphics. But, thanks to publishers' and readers' shared interest in giving everyone a chance to make their own discoveries, even these explanatory graphics are becoming more and more data-rich and interactive online. We are building new roads that extend from explanatory to exploratory data graphics, with the best work supporting swift travel back and forth.

Session 2b

Katy Borner, Indiana University

Data Visualization Literacy: Research and Tools that Advance Public Understanding of Scientific Data

In the information age, the ability to read and make data visualizations is as important as the ability to read and write. This research seeks to measure and improve data visualization literacy that is broadly defined as the ability to read, understand, and create data visualizations. The talk introduces the xMacroscope platform that implements a theoretical visualization framework meant to empower anyone to systematically render data into insights using temporal, geospatial, topical, and network analyses and visualizations, see Information Visualization MOOC (<http://ivmooc.cns.iu.edu>). xMacroscope supports the rapid research prototyping of public experiences at selected exhibits, such as collecting data on a runner's speed and height and the visualized representation of such data. It empowers exhibit designers, education researchers, and learning scientists to study how diverse audiences acquire and use data visualization literacy. Among others, it is used to study the role of personalization in the learning process using iterative design-based research methodologies; run meaning-making studies of visualization construction; identify opportunities for visualizing data in ways that are both personally and culturally meaningful; and understand how data visualization literacy affects communication and collaboration.

Fernanda Viegas, Google

Visualization as Lingua Franca in Machine Learning

Machine learning is playing an increasingly influential role in the world, due to dramatic technical leaps in recent years. But the technology has its complexities and limitations. How can we understand what is going on under the hood of deep neural networks? What is the best way to debug them? It turns out that visualization can play a central role in answering these questions. I'll discuss recent work that shows how interactive exploration can help people use, interpret, learn and think about machine intelligence.

Jonathan Corum, New York Times

Revealing Hidden Worlds: Visualizing Science at The New York Times

In her video introduction to the Cybernetic Serendipity exhibition of 1968 (<https://youtu.be/n8TJx8n9UsA?t=3m7s>), curator Jasia Reichardt said: "Anybody who has a visual idea but has no talent for drawing can use the computer and express himself in numbers or in ideas and get a visual result." Fifty years later there are many tools for transforming numbers into visual results, but tools alone are not enough to ensure that a visual idea will be effectively communicated. I discuss ongoing efforts to communicate scientific data to a broad audience using visualizations that inform, delight and reveal meaningful patterns.

Evening Keynote

David Skorton, Secretary, Smithsonian Institution

Branches from the Same Tree

The nature of work is changing rapidly in the digital age, increasing the demand for specific skills in particular disciplines. At the same time, the United States must not become a nation of specialists who cannot speak one another's language, especially since changes in individuals' jobs and even careers will increasingly be the norm. The sciences and the arts, as Albert Einstein said, are "branches from the same tree." David Skorton, Secretary of the Smithsonian Institution, will argue that there is enormous value – for individuals, organizations, and society – in promoting broad educational experiences that integrate the STEM disciplines with the arts and the humanities.

Session 3a

Youngmoo Kim, Drexel University

David Skorton, Secretary, Smithsonian Institution

Integrating Higher Education in the Arts, Humanities, Sciences, Engineering, and Medicine: A consensus report by the National Academies of Science, Engineering, and Medicine, Board on Higher Education and Workforce

Panel Discussion and Reflections with Report Committee Members

- David Skorton (Committee Chair), Secretary, Smithsonian Institution
- Tom Rudin, Director, NRC Board on Higher Education and Workforce
- Pamela Jennings, Constructus
- Laurie Baefsky, Executive Director, Alliance for the Arts in Research Universities
- Youngmoo Kim (moderator), Drexel University

Session 3b

John Maeda, Global Head of Computational Design + Inclusion, Automattic

Design and Inclusion

The Design In Tech Report is in its fourth year as a presentation of trends that are impacting technology, business, and design. As we uncover many biases that are implicit to the technologies that we use, the question of how to design more inclusively has come to the foreground and will be the center of this talk.

Robert Root-Bernstein, Michigan State University

How Arts, Crafts and Design Training Benefit STEMM Professionals: The Evidence and Its Limitations

Evidence that arts, crafts and design (ACD) training can benefit STEMM (the second M is for "medicine") professionals come from: 1) Large-scale statistical studies demonstrating correlations between ACD and STEMM success; 2) Well-controlled pedagogical studies employing ACD to improve learning of STEMM concepts and skills; 3) Case studies of how STEMM professionals use ACD-related skills and knowledge and 4) Case studies of ACD professionals who have made STEMM innovations.

Other studies show that similar cognitive skills and creative processes are used by ACD and STEMM professionals and that ACD proffer effective approaches to training students traditionally weak in STEMM subjects. Long-term, persistent ACD training is much more influential than short-term or episodic training and such training must be individually integrated or pedagogically “bridged” to be effective.

Robert Semper, Associate Executive Director, Exploratorium, San Francisco
Art as a Way of Knowing: Lessons from the Exploratorium Experience Integrating Art into STEM education

Art has been an integral component of the Exploratorium’s education approach from its very beginning in 1969. Artists, like scientists, are professional inquirers and as such they create important and uniquely accessible experiences for the public to learn about the world around them. From the Cybernetic Serendipity exhibits serving as the Exploratorium’s opening exhibition to the scores of artist in residence produced exhibits on display to the integration of artists into public programs, teacher education projects and out of school activities, art has added a critical dimension to all of the Exploratorium’s educational work. A key determinant for the success of this work has been the focus on artists as much as the art and the inclusion of practicing artists to our staff of scientists, educators, exhibit developers and program designers.

Suzanne Bonamici, Congresswoman, Oregon (Invited)
The Congressional STEAM Caucus (working title)

Session 4a

Jennifer Preece, University of Maryland,
Citizen Science: New Agendas, Broader Impacts

Citizen science employs design methods to organize large communities to provide reliable and trusted data that creates measurable and meaningful impacts. Compelling examples will illustrate new paradigms for doing research in which experts partner with citizens to exploit digital technologies in order to achieve scientific and broader societal impacts. New agendas that arise from citizen science include resolving the tension between encouraging public participation and ensuring reliable and trusted data.

Laura Trouille, Adler Planetarium & Zooniverse Project
Chris Lintott, Oxford University and Zooniverse Project
Citizen Science Frontiers: Efficiency, Engagement, and Serendipitous Discovery with Human-Machine Systems

The Zooniverse is the world’s largest platform for online citizen science, engaging more than 1.6 million volunteers in tasks including species identification in images, discovering planets, transcribing artist’s notebooks, and tracking resistance to antibiotics. Processing our increasingly large datasets poses a bottleneck for producing real scientific outcomes and citizen science - engaging the public in research - provides a solution, particularly when coupled with automated routines. In this talk we will use Zooniverse as the context to wrestle with a number of pressing questions in our field, including -- How do we balance creating the most efficient human-machine systems while at the same time optimizing for human engagement? How can our infrastructure and interface design best enable discovery? How do we foster a supportive

environment in which volunteers feel comfortable sharing their ideas and feel valued for their contributions?

Julia K Parrish, University of Washington

The Promise of Citizen Science: Scale, Technology, Agency and Saving the World

In a country turning away from science as a method of truth-telling, and a world racing towards environmental armageddon, hands-on citizen science is an island of hope. Over the past 20 years, ecological and environmental citizen science has increased at more than 10% per annum, adding millions of participants doing everything from water quality monitoring to beached bird identification, monarch butterfly migration to extreme weather measurements. These datasets are among the largest and oldest in the country, revealing the fingerprints of a changing climate in ways that are tangible to real people. Who are, after all, the participants. In the real, this movement opens the door of the science cloister, allowing the public to become a member of the science team. In the ideal, citizen science is more than another tool in the toolbox of science, it is the fulcrum that changes who has permission to participate, and even how we think about what science is, or could be. Because saving the world starts with understanding how it works locally, citizen science is uniquely poised to deepen the connection everyone has to their favorite outdoor place - their "backyard" - while scaling up observations into the emergent patterns only visible through the work of the many.

Session 4b

Niki Kittur, Human-Computer Interaction Institute, Carnegie Mellon University

Scaling Up Serendipity: Augmenting Analogical Innovation with Crowds and AI

There is a growing opportunity to dramatically accelerate innovation in both art and science by taking advantage of collaboration and computation at scale. Recent developments in crowdsourcing and AI could help researchers and artists to find the serendipitous analogical connections between fields that have driven innovation over the past 5,000 years. Doing so requires new approaches to connecting many human and machine minds together and making permanent the ephemeral thinking that each mind does such that others can build on it. Here I lay out the advances needed for getting to a future of scalable analogical innovation and first steps using crowds and AI to augment creativity that quantitatively demonstrate the promise of the approach.

Zeynep Tufekci, University of North Carolina, New York Times contributor

The New Information Infrastructure: Reconfiguring the Production of Knowledge, Authority and Networks

The power of social media for political influence and protest movements has been well-established and studied. For the first time in history so much of what people do is available online, enabling new forms of constructive research on health, sociological changes, family dynamics, economic trends, and much more. However, research is also needed on dangerous new forms of political oppression, terrorism, fake news, bullying, vigilantism, and cyber-attacks. This research could help redesign social media platforms to more reliably support pro-social uses.