27th ANNUAL BAVRD
Bay Area Vision Research Day

***Provided by*: the UC Berkeley Vision Science Graduate Group**

8:00 a.m. - 5:00 p.m.

Sutardja Dai Hall, Banatao Auditorium

University of California, Berkeley

September 18th 2015

We thank all of the sponsors for their generous support of the 27th Annual Bay Area Vision Research Day

27th Annual Bay Area Vision Research Day Conference Schedule

8:00 a.m. **Doors open**

8:45 a.m. **Opening remarks**

9:00 a.m. **Pieter Abbeel**, Associate Professor, EECS, UC Berkeley; Co-Founder of Gradescope. *Deep Reinforcement Learning for Robotics*

9:30 a.m. **Matilda Chan**, Associate Professor, Department of Ophthalmology and the Francis I. Proctor Foundation, UCSF. *Global Characterization of DNA Methylation Changes in Fuchs' Endothelial Corneal Dystrophy*

10:00 a.m. **David Schaffer**, Professor of Chemical and Biomolecular Engineering, Bioengineering and Helen Wills Neuroscience Institute; Director of Berkeley Stem Cell Center, UC Berkeley. *Directed Evolution of New Viruses for Gene Therapy*

10:30 a.m. **Break** (refreshments offered) and **Poster Session I**

11:00 a.m. **Jacqueline Snow**, Assistant Professor, Psychology, University of Nevada, Reno. *"The treachery of images": Studying behavioral and brain responses to real-world objects*

11:30 a.m. **Kathy Dumbleton**, Director of Clinical Operations, Ocular Technology Group International. *A novel method of assessing tear film stability in contact lens and non-contact lens wearers*

12:00 p.m. **Lunch** (provided onsite for registered attendants)

1:00 p.m. **Deborah Dean**, Founder & Executive Director, Children's Global Health Initiative, Chlamydia Research Laboratory, Children's Hospital Oakland Research Institute. *Trachoma: from Egyptian mummies to the ocular microbiome*

1:30 p.m. **Gideon Caplovitz**, Assistant Professor, Psychology, University of Nevada, Reno; project leader for the Center for Integrative Neuroscience. *Stationary and rigidly rotating objects perceived through the integration of form information over space and time*

2:00 p.m. **Kalanit Grill-Spector**, Associate Professor, Psychology & Neurosciences Institute, Stanford. *The functional neuroanatomy of face perception*

2:30 p.m. **Break** (refreshments offered) and **Poster Session II**

3:00 p.m. **Mark Lescroart**, Postdoctoral researcher, Gallant Lab, Psychology and Neuroscience, UC Berkeley. *Scene-selective areas in human cortex represent the configuration of large surfaces in scenes*

3:30 p.m. **KEYNOTE: Felice Dunn**, Assistant Professor, Department of Ophthalmology, UCSF. *Development, Function, and Disassembly of the Visual System's First Synapse*

4:15 p.m. **Closing Remarks**

4:30 p.m. **Reception**

Pieter Abbeel

Deep learning has enabled significant advances in supervised learning problems such as speech recognition and visual recognition. Reinforcement learning provides only a weaker supervisory signal, posing additional challenges in the form of temporal credit assignment and exploration. Nevertheless, deep reinforcement learning has already enabled learning to play Atari games from raw pixels (without access to the underlying game state) and learning certain types of visuomotor manipulation primitives. I will discuss major challenges for, as well as some preliminary promising results towards, making deep reinforcement learning applicable to real robotic problems.

Matilda Chan

Purpose: To investigate DNA methylation changes in the corneal endothelial (CE) tissue of patients with late onset Fuchs endothelial corneal dystrophy (FECD). *Methods:* Total DNA was extracted from the CE of 11 patients diagnosed with FECD who underwent endothelial keratoplasty at a single institution as well as from 4 age and sex matched normal control CE from an eye bank. The Illumina Infinium Methylation 450k assay was used to profile DNA methylation patterns within each sample. *Results:* Methylation analysis at 485,000 microarray probe sites, which annotated to 99% of Refseq genes was performed. The correlation structure of the patient data was consistent with the experimental variables, such that the FECD patients clustered away from the normal samples. Differential methylation was generally isolated, and few genes contained multiple loci with altered methylation in FECD. Genes containing differentially methylated sites were disproportionately annotated to ontological categories involving cytoskeletal organization, ion transport, hematopoetic cell differentiation, and cellular metabolism. While methylation profiles were distinct between control and FECD samples, there was a lack of association with age, sex, pachymetry, or guttae grading.
Conclusions: Our results suggest that altered DNA methylation patterns may contribute to loss of corneal transparency in late onset FECD through a global accumulation of sporadic methylation changes in genes critical to basic CE biological processes rather than the consistent methylation of a few individual genes.

David Schaffer

Strong basic and translational efforts in the gene therapy field have culminated in successes in an increasing number of human trials, establishing that viral vectors are capable of efficient, safe, and therapeutic gene delivery to numerous target cells and tissues. The retina has been a tissue that has been particularly amenable to gene therapy approaches, with positive results in trials for Leber's congenital amaurosis and choroideremia. However, numerous challenges can in general limit the broader applicability of gene therapy, such as anti-vector immunity, difficulty in transduction of therapeutically relevant cells in vitro or in vivo, and an inability for targeted delivery to specific cells. These challenges are not surprising, as nature did not evolve viruses for our convenience to use as human therapeutics. We have developed and implemented directed evolution, a process that emulates natural evolution by generating large libraries of biomolecules and selecting for enhanced function, to greatly enhance the properties of numerous viral vectors. In particular, we have enhanced adeno-associated virus (AAV) for a broad range of applications including the treatment of retinal disease.

Jacqueline Snow

Ultimately, we aim to generalize and translate scientific knowledge to the real world, yet our understanding of human visual cognition is based almost exclusively on studies of impoverished stimuli. In terms of richness of visual experience, visual inputs can be defined along a continuum, from artificial representations of objects, to real-world exemplars that have a definite surface texture, weight, distance, location, and that afford genuine physical action. In this talk I will discuss emerging evidence for differences behavioral and neural responses to images versus real-world objects, and describe the novel stimuli, apparatus, and paradigms we are developing to reveal the integrated workings of the perceptuo-motor system.

Kathy Dumbleton

The assessment of tear film stability is important clinically in the diagnosis and assessment of treatment in dry eye patients. It is also widely used to evaluate the performance of the pre-lens tear film in contact lens wearers. The tear film stability test that is most commonly used in clinical practice is the assessment of the tear film break up time. This is the interval of time that elapses between the blink and the appearance of the first break in the tear film. In non-contact lens wearers sodium fluorescein is often instilled to aid in viewing the break; however, fluorescein is known to reduce tear film stability and therefore non-invasive methods of assessment are recommended and are required when assessing the pre-lens tear film in contact lens wearers. Unfortunately the tear film break up time is only able to provide limited information regarding the tear film stability since it only provided information about how long the tear film is performing well, and no information concerning the severity of the tear film anomaly at the time of the break, the length of time during which the compromised tear film is present before the natural blink and the severity of the tear film anomaly at the time of the blink. The novel method described reports on the non-invasive assessment of tear film kinetics during the full interblink period in both contact lens and non-contact lens wearers and identifies the characteristics of the tear film that may be associated with symptoms of ocular discomfort.

Deborah Dean

Chlamydia are ancient Gram-negative obligate intracellular bacteria that cause a diversity of mild to severe infections among humans and livestock on a global scale. According to the World Health Organization, *Chlamydia trachomatis* alone is responsible for over 100 million cases of sexually transmitted infections (STI) and 125 to 600 million cases of trachoma, a blinding eye disease. *C. trachomatis* is the leading bacterial cause of STIs and the leading preventable cause of blindness in the world today. Identification of new species since 1995 and emergence of zoonotic infections, including abortions in women and ocular trachoma from other *Chlamydia* species as well as *C. trachomatis* urogenital strains, underscores the need to expand our knowledge of host immunity, comparative *Chlamydia* genomics and the ocular microbiome to advance novel therapeutics, rational vaccine design and strategic interventions.

Gideon Caplovitz

Objects in the world often are occluded and in motion. The visible fragments of such objects are revealed at different times and locations in space. To form coherent representations of the surfaces of these objects, the visual system must integrate local form information over space and time. I will introduce a new illusion in which a rigidly rotating square is perceived on the basis of sequentially presented Pacman inducers. The illusion highlights two fundamental processes that allow us to perceive objects whose form features are revealed over time: Spatiotemporal Form Integration (STFI) and Position Updating. STFI refers to the spatial integration of persistent representations of local form features across time. Position updating of these persistent form representations allows them to be integrated into a rigid global motion percept. Neural correlates of objects formed through these spatiotemporal integration processes are identified within extra striate cortex beyond V1 and V2, with evidence suggesting a specific role for KO and hMT+ in positional updating.

Kalanit Grill-Spector

Human ventral temporal cortex (VTC) is the latest stage of the ventral "what" visual pathway, which is thought to code the identity of a stimulus regardless of its position or size. In contrast to predictions of classical theories, recent data from our lab reveals that voxels in high-level regions in VTC, that are involved in face perception, are surprisingly modulated by the position and size of the face in the visual field. This response characteristic can be modeled with a population receptive field (pRF), which models where and how much of the visual field is processed by the neural population in a voxel. This finding raises an intriguing new question: *what is the utility of pRFs for face perception?* Data from recent experiments show that the properties of pRFs in face-selective regions may form a neural basis for holistic processing necessary for face recognition. Furthermore, our data demonstrate that pRF properties in VTC are correlated with face perception abilities: participants with larger pRFs perform better in face recognition. Strikingly, developmental prosopagnosics (who have deficits in face recognition) have smaller pRFs in VTC than typical individuals, suggesting that a deficit in spatial integration can impact the holistic processing required for face recognition. Overall, these data highlight the importance of understanding fundamental computational properties of neural populations in VTC, as they offer a new mechanistic understanding of high-level visual perception.

Mark Lescroart

A network of areas in the human brain—including the Parahippocampal Place Area (PPA), the Occipital Place Area (OPA), and the Retrosplenial Cortex (RSC)—represent visual scenes. However, it is still unclear whether these areas represent low-level features (such as high spatial frequencies or local edges), intermediate-level features (such as the orientations or boundaries of surfaces in a scene), or high-level features (such as categories of objects or scenes). To address this issue, we collected BOLD fMRI data while human subjects watched a set of movies. The movies consisted of realistically varied scenes of a virtual world. We modeled the BOLD responses to the movies as a function of low-level features (Gabor wavelets, computed from the rendered image pixels), intermediate-level features (orientations and distances to scene surfaces, derived from the virtual 3D world used to generate the scenes), and high-level features (human-assigned labels for the scenes and the object in them). We found that BOLD responses in PPA, OPA, and RSC are best described by models based on intermediate-level surface features. Individual voxels in scene-selective areas are selective for different configurations of surfaces. These results suggest that PPA, OPA, and RSC represent conjunctions of the depth and orientation of walls, ceilings, and other large objects in scenes.

Felice Dunn

Diversification of inputs and parallel processing in the visual system begins at its first synapse, between photoreceptors and bipolar cells. Here, a single cone photoreceptor communicates with 10-12 bipolar cell types, forming multiple parallel channels. In this talk, I will present data showing how a small subset of bipolar cell types establish connections with cones using different strategies and over different timelines. I will present preliminary work on the functional properties of bipolar cells. Finally, I will show how synapse disassembly between cones and bipolar cells begins and progresses in situations where the presynaptic photoreceptor has been eliminated.

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Poster Sessions

Cameron Baker	Optogenetic Depolarization of Müller Cells Modulates Retinal Light Response		Joel Kubby	An Adaptive Optics System for Microscopic Imaging of Retinal Cells in Live Mice
Corinne Beier	Rod Bipolar Cells in the Adult Retina Search for and Synapse with Rod Photoreceptors		Justin Migacz	Optical Coherence Tomography Angiography Imaging of the Human Chorioretinal Complex
Laura Cacciamani	The role of the perirhinal cortex in tactile perception and memory in the blind		Jeffrey Mulligan	Psychophysical Calibration of Mobile Touch-Screens for Vision Testing in the Field
Andrew Coia	Cortical Responses to Real and Illusory Surface Colors		David H. Peterzell	Do praying mantises have multiple visual channels for spatial and temporal frequency? Preliminary factor analytic study of individual differences in optomotor-based contrast sensitivity functions
Michael T. Compton	The real object memory advantage: graspability enhances performance		Rafal M. Skiba	Eye movements to tool images are predicted by frequency of physical experience with the tool
Gennady Erlikhman	Shape identity information is not preserved along the path of apparent motion in early visual areas		Aaron Sullivan	Relative importance of the T3SS and LasB in epithelial barrier penetration by P. aeruginosa
Michael A. Gomez	Real objects elicit stronger action affordance effects than images		Christina Vu	A Phenotypic Study of the Overexpression of Inducible Nitric Oxide Synthase in Transgenic Mice
Zachary Helft	How Azobenzene Photoswitches Bestow Degeneration-dependent Light Sensitivity on the Blind Retina		Chris Warner	Retinal Circuits for Image Segmentation and Coding
Desiree E. Holler-Kidde	Real-world size improves object recognition in visual agnosia		Zhiheng Zhou	Persistent contour integration and the association field