Lots of upcoming Neuroscience Program events this Spring! Outside of the regular Thursday neuroscience seminars and Superfriends symposia, the annual student retreat is occurring April 30th to May 2nd, and six senior students (six!) will be defending their theses. Check out a brief biography of each of the graduating students, plus the abstracts of recent first-author Stanford Neuroscience publications. This issue also includes a summary of some professional development seminars sponsored by the Biological Sciences program here at Stanford. The purpose of these seminars was to discuss topics on “Being a Professional”, ranging from choosing scientific projects, writing papers, presenting posters, and giving memorable talks. The best “nuggets of wisdom” are described here.

**CONTENTS**

- Thesis Defenses
- Student Research Publications
- On Being a Professional
- Upcoming Seminar Talks

**Thesis Defenses**

*Please make it your highest priority to attend all thesis defenses.... this academic milestone is a celebration for the entire program and a special moment for all graduating students.*

**Viviana Gradinaru**, lab of Karl Deisseroth
Friday, May 14, 3pm.

Viviana’s research has focused on developing optogenetic tools to control neural circuitry with light, as well as using these tools to investigate the mechanisms behind deep brain stimulation in movement and mood disorders such as Parkinson’s disease and depression. One of Viviana’s major accomplishments was to selectively mutate the sequence of Halorhodopsin (NpHR), a chloride pump activated by yellow light that can be used to hyperpolarize neurons, in order to reduce toxicity and improve efficiency. Her work led to the development of “enhanced Halorhodopsin (eNpHR)” and then later to eNpHR3.0, now a highly sought-after tool in dozens of neurobiology laboratories. Along with co-first author Murtaza Mogri, she used optogenetic tools to dissect the mechanism by which deep brain stimulation relieves symptoms of Parkinson’s disease.

Viviana has applied her interest in optogenetic tools to several teaching experiences, including frequent demonstrations to visitors to the Deisseroth lab, serving as an instructor for the optogenetics module of the “Advanced Techniques in Molecular Neuroscience” course at Cold Spring Harbor laboratory, and TAing “Principles and Practice of Optogenetics for Optical Control of Biological Tissues” here at Stanford. In addition to these teaching opportunities, Viviana served as a Journal Club rep during the 2006-2007 school year.

Viviana just gave birth to a boy, Theodor Gradinaru Faraon. She and her husband, Andrei (who also received a Ph.D. from Stanford), are planning to stay in the Bay Area in the near future and eventually find jobs in research and/or industry.

**Rachel Kalmar**, labs of Bill Newsome and Krishna Shenoy
Tuesday, May 18, 1pm.

Rachel’s research is about how the brain prepares upcoming movements, and how these motor plans relate to behavior. In particular, she has sought to understand the neural dynamics underlying movement preparation and how these differ for eye and arm movements. Using multielectrode recordings from the oculomotor system, Rachel has developed analyses to demonstrate how populations of neurons contribute to an upcoming decision or movement on a trial-by-trial basis. This research is important from a basic science perspective, but also lays the groundwork for the development of neurally-controlled prosthetic devices.
Rachel's interest in prosthetic devices reached beyond her thesis research. In the Entrepreneurial Design for Extreme Affordability class at Stanford's d.school, Rachel and her team built a $20 knee joint for Ethiopian amputees. She was inspired by how this process could be used to tangibly improve users' lives on relatively fast timescales.

In the neuroscience program, Rachel sought to create more opportunities for scientific interaction, both within the local neuroscience community and with visiting seminar speakers. To achieve this, she organized weekly student lunches with the seminar speaker and piloted a run of student-hosted seminars. These programs received enthusiastic feedback and led to the formation of the position of Seminar Series Representative, which Rachel filled for two years. Rachel also ran the neurostudents website from 2005-2009, and has been experimenting with Stanford Neuro's social media representation.

Rachel's long-term goal is to integrate what she has learned in science and her design and engineering projects to work at the interface between neuroscience and medical devices. She also plans to continue her studies of complex motor skills outside the lab: mountain unicycling, capoeira, and tap-dancing spike trains.

**Matt Carter**, lab of Luis de Lecea
Friday, May 21, 3pm.

For his thesis research, Matt used optogenetic techniques to reverse engineer sleep/wake circuitry in mice. He has especially focused on neurons in the hypothalamus that express the neuropeptide Hypocretin, as well a population of noradrenergic neurons in the brainstem called the Locus Coeruleus (LC). By selectively stimulating or inhibiting these populations during sleep and wakefulness, Matt has shown that each provides a unique contribution in promoting arousal and that both populations functionally interact to regulate the sleep/wake cycle. Lately, Matt has expanded his research to elucidate context-specific roles for the LC in detecting salient stimuli and reinstating previously extinguished addictive behaviors.

Outside of the lab, Matt has taken advantage of numerous teaching opportunities, co-creating and teaching Understanding Techniques in Neuroscience (with Saul Villeda), serving as a lab TA and then head TA for Neurobiology 206, and guest lecturing in undergraduate neurobiology courses. In 2009 he co-wrote “Guide to Research Techniques in Neuroscience” with Jennifer Shieh, published by Elsevier. Matt won the School of Medicine’s Excellence in Teaching award two years in a row, and in 2008 won the University-wide Walter J. Gores Award for Excellence in Teaching (allowing him to meet Oprah during commencement).

During Matt’s time in the neuroscience program he highly valued the neuroscience community, serving as a student rep, and starting community builders like neuroscience happy hours (and becoming the first “happy hour rep”), the big red campus map that hangs in Fairchild D202, and this very newsletter.

After defending his thesis, Matt will stay in the de Lecea lab until at least the end of the calendar year and then begin a postdoc (in a lab yet to be determined). Eventually, Matt hopes to become a faculty member at an institution where he can continue to research the neural basis of instinctive behaviors, as well as find a good amount of time to teach, write more books, and maybe even pursue his hobby of filmmaking. Matt and his wife, Ali, are expecting their first child in August.
**Lora Sweeney**, lab of Liqun Luo
Friday, May 28, 3pm.

Lora’s research has focused on the role of semaphorins in olfactory circuitry formation using *Drosophila* as a model organism. Axon-axon interactions have been implicated in neural circuit assembly, but the underlying mechanisms are poorly understood. Shortly after joining the Luo lab, Lora showed that Sema-1a acts nonautonomously to control olfactory receptor neuron (ORN) axon-axon interactions. Furthermore, she showed that PlexinA acts as the Sema-1a receptor in ORN targeting. She is currently examining other molecules in the semaphorin family and attempting to ascertain their role in correct axonal targeting.

During her time at Stanford, Lora has become interested in evolutionary biology in addition to neuroscience research. After graduating from Stanford, Lora hopes to do postdoctoral research in a lab that combines the study of invertebrate olfaction with evolutionary biology. Eventually, Lora hopes to become a faculty member at a research university.

Lora is engaged to another neuroscience student, Phil Jaeger, and they will be married twice this summer, once in the US and again in Germany!

**Branden Cord**, lab of Theo Palmer
Date TBA

Branden is an MSTP student interested in using stem cells to develop treatment for neurodegenerative diseases. He has especially focused his research on coaxing stem cells into becoming functional dopaminergic cells for the potential treatment of Parkinson’s disease. By selectively adding specific growth factors to the cell culture media at specific times, it is possible to grow dopaminergic cells with sufficient purity to be therapeutically useful. Additionally, Branden is interested in how these implanted dopaminergic neurons could successfully integrate into the adult brain. Branden was one of the first students in California to receive training funds from a California Institute for Regenerative Medicine (CIRM) grant.

After completion of his Ph.D., Branden will return to medical school for his final two years of training.

**Monique Barakat**, lab of Matt Scott
Thursday, June 17, 2pm

Monique’s thesis research has focused on defining the roles of ciliary proteins in developing, adult, and neoplastic cells. In particular, she has sought to understand how primary cilia are related to Hedgehog signaling in developing and mature cells and in the Hedgehog-driven cancer medulloblastoma. To address these questions, Monique disrupted primary cilia in cultured fibroblasts and medulloblastoma cells to explore the molecular basis for involvement of primary cilia in Hedgehog signaling. She then turned to *in vivo* experiments and selectively ablated genes important for cilium formation in the neural precursor cells that give rise to medulloblastoma. These experiments have led to a better understanding of the role of the primary cilium in development and neoplastic transformation of this neural precursor population, leading to a more detailed understanding of the role that primary cilia play in normal and pathological Hedgehog signaling.

Monique is an MSTP student who will be returning to the last two years of medical school after her thesis defense. During her time in the program, she was a TA in multiple medical school courses including NBio 206.

Outside of the lab, one of Monique’s hobbies is ultrarunning. She now runs about 60 miles a week and has finished a few local 50K and 50 mile trail races!

Congratulations to Viviana, Rachel, Matt, Lora, Branden, and Monique!
Congratulations to the first-authors below for their recent contributions to PubMed!

Viviana Gradinaru, lab of Karl Deisseroth
“Molecular and Cellular Approaches for Diversifying and Extending Optogenetics”


Optogenetic technologies employ light to control biological processes within targeted cells in vivo with high temporal precision. Here, we show that application of molecular trafficking principles can expand the optogenetic repertoire along several long-sought dimensions. Subcellular and transcellular trafficking strategies now permit (1) optical regulation at the far-red/infrared border and extension of optogenetic control across the entire visible spectrum, (2) increased potency of optical inhibition without increased light power requirement (nanoampere-scale chloride-mediated photocurrents that maintain the light sensitivity and reversible, step-like kinetic stability of earlier tools), and (3) generalizable strategies for targeting cells based not only on genetic identity, but also on morphology and tissue topology, to allow versatile targeting when promoters are not known or in genetically intractable organisms. Together, these results illustrate use of cell-biological principles to enable expansion of the versatile fast optogenetic technologies suitable for intact-systems biology and behavior.

Lisa Gunaydin, lab of Karl Deisseroth
“Ultrafast optogenetic control”


Channelrhodopsins such as channelrhodopsin-2 (ChR2) can drive spiking with millisecond precision in a wide variety of cells, tissues and animal species. However, several properties of this protein have limited the precision of optogenetic control. First, when ChR2 is expressed at high levels, extra spikes (for example, doublets) can occur in response to a single light pulse, with potential implications as doublets may be important for neural coding. Second, many cells cannot follow ChR2-driven spiking above the gamma (approximately 40 Hz) range in sustained trains, preventing temporally stationary optogenetic access to a broad and important neural signaling band. Finally, rapid optically driven spike trains can result in plateau potentials of 10 mV or more, causing incidental upstates with information-processing implications. We designed and validated an engineered opsin gene (ChETA) that addresses all of these limitations (profoundly reducing extra spikes, eliminating plateau potentials and allowing temporally stationary, sustained spike trains up to at least 200 Hz).

Nick Steinmetz, labs of Tirin Moore and Kwabena Boahen
“Changes in the response rate and response variability of area V4 neurons during the preparation of saccadic eye movements”


The visually driven responses of macaque area V4 neurons are modulated during the preparation of saccadic eye movements, but the relationship between presaccadic modulation in area V4 and saccade preparation is poorly understood. Recent neurophysiological studies suggest that the variability across trials of spiking responses provides a more reliable signature of motor preparation than mean firing rate across trials. We compared the dynamics of the response rate and the variability in the rate across trials for area V4 neurons during the preparation of visually guided saccades. As in previous reports, we found that the mean firing rate of V4 neurons was enhanced when saccades were prepared to stimuli within a neuron's receptive field (RF) in comparison with saccades to a non-RF location. Further, we found robust decreases in response variability prior to saccades and found that these decreases predicted saccadic reaction times for saccades both to RF and non-RF stimuli. Importantly, response variability predicted reaction time whether or not there were any accompanying changes in mean firing rate. In addition to predicting saccade direction, the mean firing rate could also predict reaction time, but only for saccades directed to the RF stimuli. These results demonstrate that response variability of area V4 neurons, like mean response rate, provides a signature of saccade preparation. However, the two signatures reflect complementary aspects of that preparation.
Recently, some graduate students within the Biological Sciences Ph.D. Program asked various Stanford faculty to lead a series of four talks on various topics related to being a professional scientist. James Nelson (Professor of Biology) talked about how to choose a project and know when to abandon it, John Boothroyd (Professor of Microbiology and Immunology) talked about how to write and submit a paper, Tim Stearns (Professor of Biology) talked about how to give a memorable talk, and Steve Block (Professor of Applied Physics) talked about how to make and present a poster. Even though the faculty were asked to speak about those specific subjects, many overlapped in their advice, and the overall conclusion from the four talks was that it is important to be a true professional in all aspects of science, both in the lab and out. Below is a summary of some of their best points.... None of these are absolute truths, but definitely great nuggets of wisdom to contemplate upon.

On being a professional:

- One key aspect of being a professional in science is knowing how to choose a project that will result in meaningful progress. Knowing how to choose a successful project (and knowing when to abandon projects that are unsuccessful) may be the biggest keys to success in science, greater than good ideas, good work-ethic, and good luck.

- Being a professional in science is more than just doing good science.... it is also about presenting yourself and your work in the best possible way. It is necessary (not just useful) to learn and master the tools that will allow you to present yourself professionally. Take a lot of time to really get to know the software (e.g. Photoshop, Illustrator, PowerPoint, Keynote, SigmaPlot, Final Cut, etc.) and the tools (e.g. your laptop, room lighting controls, laser pointers, remote slide controllers, etc.) that will make you a professional. The unstated truth about modern day bioscience research is that being a professional in science is about mastering these applications and tools just as much as it is about doing good experiments.

- Even though most grad students and postdocs strive to do the best science possible, many feel content to be mediocre when it comes to figures and text preparation for papers, slides, and posters. Try to strive beyond mediocrity, producing not simply adequate figures and presentations but professional figures and presentations. Your audience will notice the difference.

- Just because most people around you may not know the ins and outs of graphical, video, and presentation software is not an excuse for you to remain mediocre. Besides, being good at these tools will make you uniquely great at something that everyone will appreciate. And if you bring something to the table, you will be more welcome there....

On choosing a scientific project:

- No matter which project you choose to work on in your lab, make sure you can say and believe the following mantra: **“This is my project. I take full ownership of the project. It is ultimately my responsibility to make it successful. It is mine to think about, worry about, and celebrate!”**

- In keeping with the mantra above, choose a project in which it is impossible to blame others for failure. Don’t choose a project in which the failed experiments, broken promises, or lack of help from others will keep you from reaching your goals. Instead, choose a project you can complete with the tools available in your lab with resources close at hand.

- The goals of your thesis project are: learn how to do science (hypothesis, experiments, results, conclusion) and bring your project to completion. Evidence of completion is at least one peer-reviewed, published paper.

- The choice of project will be between you and the PI, but make sure that the situation best fits what you know about yourself and your goals.

- When you decide on a project, get feedback as soon as possible. Give a lab meeting (no data necessary) to make everyone in the lab aware of what you want to do, and get their feedback. Talk to your committee members inside and outside of committee meetings, even if you haven’t already passed your qualifying exam.

- Perhaps the single most valuable tip in choosing a project is to get feedback from as many people as possible.... each unique perspective will show you limitations or caveats in your project you may not have thought about, as well as useful experiments and approaches that could make your project even better.
On driving a project you have already started:

- When you have decided on a project, it is critical to be able to define progress. You must be able to visualize the project as a series of milestones embedded within medium-term goals (figures), within an over-arching long-term goal (paper). By defining short-term milestones, you will be able to be honest about how much progress you are (really) making.

- Continually request feedback from others throughout the short-term milestones on your project.

- Use lab meetings effectively. Many students and postdocs hope to present at lab meeting after they have already completed a project (or major milestones). Instead, try to present lab meetings as often as possible, continually phrasing each experiment in terms of question-hypothesis-method-results-conclusion. Don’t use lab meetings for validation at the end of experiments, use them for feedback before, during, and after experiments.

On changing/abandoning projects:

- It is important to remember that all projects go through changes in emphasis or direction depending on the feasibility of proposed experimental approaches, the results/data, and their interpretation.

- Changing or abandoning projects should occur due to a lack of progress. This can be due to several reasons: the proposed experimental approaches are not feasible; there is a lack of meaningful results/data, or interpretation despite thoughtful work by you; or maybe you got scooped and it is no longer productive to continue the same research paradigm.

- Changing projects should ideally be a gradual process, not an abrupt decision. Have regular meetings with your PI and lab to discuss your attitude towards your project, and have a timeline for when to transfer attention to other potential projects.

On having multiple/side projects:

- Having side projects can be okay and make a student or postdoc more successful, but it depends on how good you are at multi-tasking. Obviously, every day’s work on the side project is a day lost on the main project, so make sure these projects will produce meaningful, tangible outcomes (i.e. potential projects or papers for the future).

- Consider working on side projects as collaborations with other lab members, or other labs. This helps to spread out the experimental tasks amongst several people, and it might help you to work as a team on a project rather than on your own.

On writing a scientific paper:

- The purpose of writing a paper is to make your work public for the greater good, to establish your reputation as a scientist, and to establish your reputation as a responsible grantee that delivers.

- Good writing implies clear and careful science. Scientists who write better come across as better scientists. Good writing also makes your story easier to understand and potential readers more likely to read it.

- Authors are all those who contributed data that are presented in the paper and/or who served an important, on-going intellectual role in the design and interpretation of the experiments. Authors are not those who simply funded the work or offered a few helpful suggestions, and definitely not those who just “need another publication.”

On the different sub-sections of a scientific paper:

- The TITLE of the paper should be a succinct declaration of the conclusion reached (and not the methods used, unless the paper is a “methods” or “hypothesis-generating” paper). It must be FOREVER an UNDENIABLY TRUE statement based on the DATA SHOWN. It is okay to temper the title with phrases like “Evidence for...” or “Putative” or “Apparent” if the conclusion is not ironclad.

- The ABSTRACT of the paper should be short and sweet. 1-2 sentences to set the stage (description of the system or what was known previous to the research). 1-2 sentences to say what was done. 2-3 sentences of what was observed. 1-2 sentences of conclusions reached. No references unless requested by the journal. No unexplained abbreviations. No unsubstantiated conclusions. Consider deliberately using key words for search discovery (so people searching on Pubmed are more likely to find it based on the words in the abstract).
• The **INTRODUCTION** of the paper should describe the big picture first. Described the current state of knowledge. Cite other studies strategically but be sure to include the competition’s work! They might be potential reviewers and it is good to acknowledge other points of view. Don’t discuss or anticipate results. End with just two sentences summarizing what you did and what you found.

• The **MATERIALS and METHODS** are included to enable others to repeat your experiments and understand what you did, especially around key details. Do not describe standard techniques that could be done many ways and wouldn’t alter the results. Do describe crucial details of how a gene was cloned, antibodies used (how raised or catalogue number and supplier), all strain details, database versions, etc.

• The **RESULTS** section should be written such that every paragraph is a mini-paper. The first sentence should be an introduction, followed by the materials and methods, results, interpretation, and conclusion. Try beginning the first or second sentence of most or even every paragraph with the word “To...”, as this will force you to explain the rationale behind every experiment. Use past tense in describing what was done and use present tense in stating what we learn.

• The **DISCUSSION** should start with a recap of one or two sentences only. Do not go back over all the results; instead, only discuss those that truly need further discussion. Let the data speak for themselves—avoid hyperbole and claims of “This is the first....”

• In the **FIGURE LEGENDS**, provide every detail of the figure, including every symbol, color, and representation of data. Give only enough experimental detail to understand the essence of what was done.

• Phrases to avoid in a paper: “In order to....” (just use “To....”); “Whether or not....” (just use “Whether....”); “Since....” (use “As....” or “Because....”); “The data were analyzed....”

• Hierarchy of strength for conclusions reached by your data: “The results prove/show/demonstrate > indicate > strongly suggest > argue for > suggest > support the notion > are consistent with > are not inconsistent with....” Always use the most appropriate conclusion that supports the data in your paper.

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**On giving a professional presentation**

• A professional always knows the electronics he or she is working with. Get to know your computer’s presentation software, the lighting system of the room you are presenting in, the method of connecting your computer to a projector, and the versatility of your laser pointer.

• Know how your computer connects to projectors and how to get the projector to recognize your laptop. If you have a Mac, always bring the appropriate connector as Mac laptops often require their own special adaptor. Don’t depend on others to provide this for you.

• Get your own laser pointer and bring extra batteries for back-up.

• Consider purchasing a remote slide advancer so that you do not have to always stand next to your laptop. These slide advancers work at a great distance, can hide within the palm of your hand, and often have laser pointers built in.

• Know what every button on your keyboard (or slide advancer) is for. Know how to get around your presentation with ease and stop/start your slideshow on any slide you wish. Know how to get audio and movie files to play with no hassle.

• Remember that your polish and professionalism in knowing your presentation software and tools will imply to your audience your polish and professionalism as a scientist.

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**On giving a memorable talk**

• Studies have shown that audiences pay the most attention at the beginning of a talk and rapidly stop paying attention. Therefore, routinely provide audiences with attention-getting segments throughout the presentation to bring them back with you.

• Know your audience. What do they already know? What do they need to know? Why did they come to this particular talk?

• Conceive of your talk as a story with a beginning, middle, climax, and ending.

• Get good at using your voice. Practice projecting your voice if you feel this is something you
struggle with (projecting your voice is not the same as yelling). Learn to modulate your voice, as a monotone voice implies monotony in your presentation. Convey enthusiasm and minimize vocal tics (“Um”, “like”) as much as possible.

• Make eye contact with your audience. Focus on those obviously interested, not those who are asleep. Read your audience and ask yourselves if they are understanding you or if they are lost.

• Develop your own personal style. Figure out the kinds of slides you like to design and the way you like to present concepts and data—there are many ways of presenting your data well, but only one that works best for your presentation style.

• When presenting data, consider the “QuERY” method: Question, Experiment, Result, Your interpretation. Do this for every new experiment in your talk.

**On presenting a professional scientific poster:**

• Just as in presentations and papers, be very professional in the aesthetic quality and clarity of a poster presentation. Spend a lot of time making your poster look as professional as possible, as a top-notch poster will imply that you are top-notch in other skills.

• Don’t write your poster as if it is were a scientific paper. It’s not. A poster should succinctly describe your main data in a clear, accessible manner.

• Don’t use overlong titles. Titles with colons in them are overused. “Cute” titles also imply a lack of professionalism.

• Don’t vary the type sizes or typefaces excessively throughout the poster. Don’t use something different for every bit of text and graphics. Instead, design your poster as if you were designing the layout for a magazine or newspaper. Select fonts and sizes that work together well. Strive for consistency, uniformity, and a clean, readable look.

• Don’t make your reader jump all over the poster area to follow your presentation. Don’t segregate your text, figures, and legends in separate areas. Do lay out the poster segments in a logical order, so that reading proceeds in some kind of linear fashion from one segment to the next, moving sequentially in a raster pattern.
# SPRING 2010 NEUROSCIENCE SEMINARS

All talks begin at 4:15 and take place in Clark Center Auditorium.

<table>
<thead>
<tr>
<th>DATE</th>
<th>SPEAKER</th>
<th>TITLE</th>
<th>HOST</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 1</td>
<td>Matthew Dalva</td>
<td>Constructing excitatory synapses: roles for EphBs and ephrinBs</td>
<td>Poh Hui Chia</td>
</tr>
<tr>
<td>April 8</td>
<td>Karel Svoboda</td>
<td>The neural circuits underlying somatosensation</td>
<td>Stephen Baccus</td>
</tr>
<tr>
<td>April 15</td>
<td>Jeff Magee</td>
<td>Circuit influences on input transformation by CA1 pyramidal neurons</td>
<td>Anthony Ricci</td>
</tr>
<tr>
<td>April 22</td>
<td>Richard Andersen</td>
<td>Cognitive neural prosthetics</td>
<td>Krishna Shenoy</td>
</tr>
<tr>
<td>April 29</td>
<td>Kathleen Rockland</td>
<td>Connections and the single axon</td>
<td>Brain Wandell and Davie Yoon</td>
</tr>
<tr>
<td>May 6</td>
<td>Lawrence Goldstein</td>
<td>Using stem cell approaches to test the role of axonal transport failure in Alzheimer’s disease</td>
<td>Nathan Woodling</td>
</tr>
<tr>
<td>May 13</td>
<td>Tom Jessell</td>
<td>Measured motion: The neurons and networks of spinal motor control</td>
<td>Ben Barres</td>
</tr>
<tr>
<td>May 27</td>
<td>Kent Kiehl</td>
<td>The neuroscience of the criminal psychopath</td>
<td>Bill Newsome</td>
</tr>
<tr>
<td>June 3</td>
<td>Gerald Zamponi</td>
<td>Regulation of NMDA receptors—implications for pathophysiology</td>
<td>Ricardo Dolmetsch</td>
</tr>
<tr>
<td>June 10</td>
<td>Tony Movshon</td>
<td>Brain mechanisms of visual perception</td>
<td>Daniel Kimmel</td>
</tr>
</tbody>
</table>