Meeting Report: SfN 2022, San Diego Convention Center, San Diego, CA, Nov 12-Nov 16, 2022

By Zhongwei Qu (postdoctoral associate, Duke University)

On Nov 12th-Nov 16th, the long-awaited Neuroscience 2022 was held in-person at the Convention Center in San Diego, CA. This was the first on-site meeting of Society for Neuroscience after the COVID-19 pandemic. Over 20,000 enthusiastic scientists from all over the world congregated to share their new discoveries, discuss their new ideas, and network with others. There were outstanding Special Lectures, Clinician-Expert Sessions, and Nanosymposium Sessions where presenters shared cutting-edge achievements and novel concepts in the field of neuroscience making this a truly meaningful and memorable meeting for the attendees.

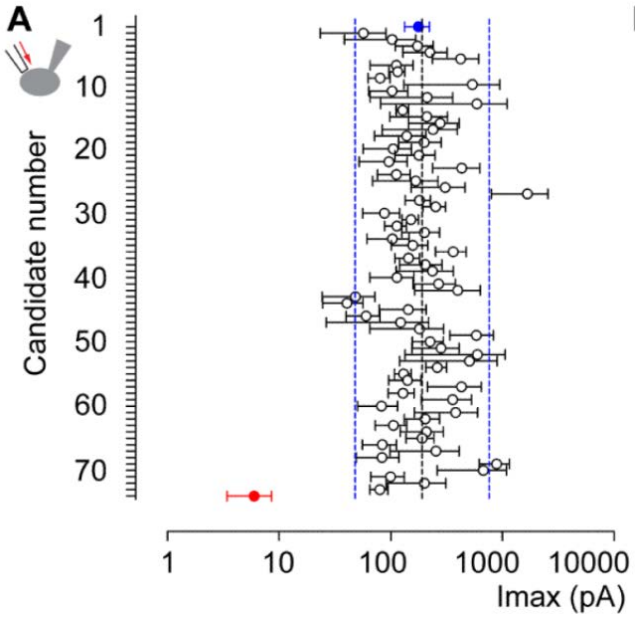
Remarkable discoveries from basic questions

1. **How do you feel? The Molecules That Sense Touch.**

Dr. Patapoutian gave his talk. Picture was taken with Dr. Patapoutian's permission during the lecture.

One of the most attractive Special Lecture was from **Dr. Ardem Patapoutian**, who is a professor in the Dorris Neuroscience Center at Scripps Research in La Jolla, CA. Dr. Patapoutian was awarded the Nobel Prize in Physiology or Medicine for his groundbreaking findings concerning how our body senses touch and other mechanical pressure. Through the lecture, Dr. Patapoutian reviewed the whole research process of how his group started with a fundamental question and then traversed a series of complex experiments leading to discovery.

Dr. Patapoutian stated that their investigation started with a simple question-"how pressure and touch are perceived?". The meaning for exploring the answer to this question goes far beyond simply understanding the pain of a pinch or pleasure of a caress. Getting to know the principle of mechanosensation will help us to understand how one cell communicates with another. Further, the meaning can be extended to how our body senses the environment and warns us of injury, how our organs sense pressure from blood flow, bladder fullness and so on. For identifying the candidate ion channel which is in charging of mechanosensory sensation, Dr. Patapoutian's group first screened several cell lines to determine which can show dramatic mechanically-activated current, after much painstaking work the Neuro2A (N2A) mouse neuroblastoma cell line was chosen. The next roadblock in front of them was the screening of more than 300 candidate ion channels. The best strategy at that time was to knock out one ion channel at a time until they discovered which one eliminated the mechanically-induced current. Without doubt, it was time and labor consuming work. Was it boring? The answer may be negative, at least to Dr. Bertrand Coste, a postdoctoral researcher from Dr. Patapoutian lab. After spending several months screening and with 71 negative results, Dr. Coste finally found that the mechanically-induced current was suppressed by knocking down Piezo1(Fam38A). Sequentially, they further found that PIEZO1 mediated many mechanosensory roles throughout the body, and PIEZO2 was the principal mechanical transducer for touch, proprioception, baroreception and bladder stretch.



The 72nd candidate was tested and PIEZO1 was identified (picture was from the published paper).

The story of studying PIEZO1 and PIEZO2 is continued in Dr. Patapoutian lab. What they found not only broadened the knowledge in the textbooks, but also has translational potential in future

clinical trials. One example is that gain of function of PIEZO1 provides protection against malaria infection in mice. It is also reported that some people who are carrying mutation on Piezo1 and/or Piezo2 showed severe defects in sensing the environment, some of them can't walk without assistance. I truly believe that, the discovery from Dr. Patapoutian's lab will bring insights to clinical applications and ultimately benefit our world.
(The Patapoutian Lab: https://patapoutianlab.org/)

2. Mechanisms of Axon Growth and Regeneration

Dr. Bradke (picture is from Dr. Bradke lab website).

Another intriguing plenary lecture was from **Dr. Flank Bradke**, who is a senior research group leader at DZNE, Bonn, Germany. As implied in the title "Mechanisms of Axon Growth and Regeneration", the major interest of the Bradke lab focuses on understanding how nerve cells grow during development and whether and how these processes can be reactivated to induce nerve regeneration in the injured spinal cord. As Dr. Flank Bradke said, what they do is based on the simple logic, that is "By understanding how neurons grow their axon during development, we learned how we can employ these mechanisms to induce axon regeneration in the adult".

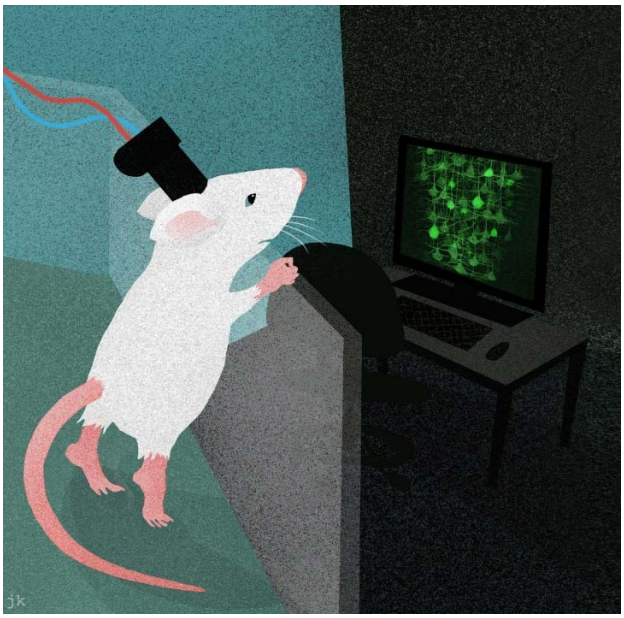
Acute axon injury happens in many situations, such as car accident, sports accidents and so on. Due to lack of regeneration ability, those injuries cam cause permanent loss of neuronal functions. However, it is hard for neurons to regenerate new axons after injury in adult. In contrast, neurons exhibit remarkable ability to polarize during development. Thus, Dr. Bradke and his lab focus special interest on the cytoskeleton, which is the determined power for neuronal polarization. Specifically, distinct cytoskeletal dynamics and organization of the cytoskeleton determine which neurite can develop into axon while the other neurites become dendrites. So, they questioned whether it is possible to reinitiate this impressive growth potential after a spinal cord injury, especially in adult model animals. To better answer this question, they have performed many marvelous works to dissect the molecular processes underpinning embryonic development. After years of effort, many key molecules have been identified, such as RhoA. Dr. Bradke and his colleagues found that RhoA is involved in a molecular signaling pathway which directly targets neurons' cytoskeletons. Based on their understanding of neuronal development,

Dr. Bradke and his colleagues finally achieved the goal to induce the regrowth of axons after injury in adult animals through manipulating related genes or by using low dose anti-tumor drugs. Although Dr. Bradke has many amazing achievements in this field, he never overstated these outcomes. As he said before, “we are still far from a potential clinical application, ... we still do not know if the drug has the same effect on human nerve cells.....”. He ended his talk with a question “Can we eventually translate our findings into a therapy?” I think the answer in most attendees’ heart is positive.
(The Bradke lab: https://www.dzne.de/en/research/research-areas/fundamental-research/research-groups/bradke/research-areasfocus/)

Technological development-Optical Approaches for Large-Scale Cell-Resolved Imaging Across Species.

Advances in three-photon head-mounted microscope
In vivo deep imaging of freely moving model animal’s brain in real-time by optical methods has been a major technical challenge in the field of neuroscience research. Although two-photon microscopes have enabled impressive progress in this field, the imaging depth is limited by scattering. For example, when imaging a signal from neurons in vivo at and below 500 µm, the background signal increases dramatically making it impossible to track the neuronal activity with satisfying resolution.

Along with the demand in the field of neuroscience, there was an exciting symposium about the latest technological developments in imaging. **Dr. Jason Kerr** from Max Planck Institute for Neurobiology, Bonn, Germany kicked off the first talk, with the title “A three-photon head-mounted microscope for imaging all layers of visual cortex in freely moving mice”.



Picture was from Max Planck Neuroscience website (https://maxplanckneuroscience.org/three-photon-head-mounted-microscope-for-imaging-deep-cortical-layers-in-freely-moving-rats/).

Different from two-photon microscopes, three-photon microscopes use three exciting photons,

which can reduce the fluorescence from the focal plane. Advances in head-mounted three-photon microscopes can overcome most difficulties mentioned above and have enabled imaging of neuronal activity in freely moving mice. However, these microscopes are restricted to recording in minimally lit arenas and imaging upper cortical layers. Dr. Kerr and his team built a three-photon excitation-based microscope with only 2-g weight, which can image all cortical layers while mice are freely moving in a fully lit environment. With the help of the new equipment, they successfully imaged neuronal activity from cortical layer 4 and layer 6 neurons expressing jGCaMP7f in mice roaming in a fully lit or dark arena. The establishment of the new three-photon head-mounted microscope raises the possibility of linking the neuronal activity from all cortical layers to behaviors of model animals, which may greatly deepen our understanding of the neuro-mechanisms underlying natural behavior.
(Website: https://www.mpg.de/7905761/neurobiology-of-behavior-kerr)

As it is mentioned at the beginning, more than 20,000 scientists joined in the SfN 2022. There were too many interesting topics and amazing lectures in this conference, as well as countless outstanding symposiums and posters, it was hard to choose which to cover for this report. Here, only a few lectures that particularly piqued my interest are summarized, but I believe all attendees received profound inspiration from this conference. I am looking forward to the SfN 2023 in Washington D.C..

Zhongwei Qu is a postdoctoral fellow at Duke University. He wrote this meeting report as part of the Tianqiao and Chrissy Chen Institute Science Writers Fellowship which aims to extend the conversation beyond the meeting with the hopes of sparking new ideas and collaborations. Zhongwei got the support from his mentor Dr. Dong Yan for applying for this fellowship.