Stanford

Melis Yilmaz Balban

Postdoctoral Research Fellow, Neurobiology

NIH Biosketch available Online

Curriculum Vitae available Online

Bio

BIO

Melis Yilmaz Balban joined Dr. Andrew Huberman's lab in May 2016 as a postdoctoral fellow to study the neural circuits underlying visually guided defensive behaviors in rodent and primate models. In her PhD she studied roles of retinal circuits in the innate visual behaviors of mice in Markus Meister's lab at Harvard University. During the course of those studies, she discovered and characterized a powerful visual behavior: mice exhibit fast avoidance responses such as escape or freezing to expanding dark stimuli from above. Using cell-type-specific-ablations she tested the roles of different retinal cell types in these and others visual behaviors. Discovering innate behaviors and linking them to specific circuits are her main interests.

HONORS AND AWARDS

- Peirce Fellowship, Harvard University (2009-2010)
- Herchel Smith Graduate Fellowship, Herchel Smith Fund (2009-2011)

PROFESSIONAL EDUCATION

- Doctor of Philosophy, Harvard University (2015)
- Bachelor of Science, Stanford University , BIOL-BSH (2008)

STANFORD ADVISORS

- Andrew Huberman, Postdoctoral Faculty Sponsor

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

I’m interested in understanding the neurobiology of fear and other innate responses. Fear is essential for our survival as people who have disorders that do not “feel” fear have a higher chance of death from accidents. On the other extreme, excessive or inappropriately expressed fear is a symptom of many psychiatric conditions such as PTSD, or other anxiety disorders. Even more common are the subtle forms of fear that many people feel in everyday life such as fear of failure or social interactions. These fears, though not immediately life-threatening, significantly limit our life quality and our ability to reach our full potential. Thus, understanding the neurobiology of fear at a mechanistic level: the cells and circuits involved and how they communicate with each other from perception to behavior- should be of major consequence for basic and translational neuroscience and psychology.

The definition of fear or any emotion for that matter is still an ongoing debate among psychologists and neuroscientists. How can one study an emotion that is hard to even define in scientific terms? Fear manifests itself most decisively through observable defensive behaviors. These behaviors provide the most objective handle for

understanding of the underlying biological processes that drive fear. My work on mouse behaviors during my PhD inspired me to follow up and expand on this topic. For the fellowship period and the rest of my career, I would like to focus on the scientific issues described below.

Scientific areas of interest

Interspecies comparisons of defensive behavior

Almost all current human studies on fear responses and psychiatric illnesses are anthropocentric, treating behaviors as if they are unique to humans, even though various forms of defense exist is almost all organisms. This approach hinders us from identifying the basic components of the fear responses. Having a comparative multi-species understanding of the core mechanism of fear can help simplify this by putting human behaviors in perspective with other animal's responses. Within mammals the mouse's fear responses are the most heavily studied, however its evolutionary distance to humans makes it difficult for direct comparisons in terms of brain circuitry and behavior. Therefore primate models are an invaluable source for enabling both the study of neural circuits and sophistical behaviors that resemble those in humans, especially visual and social behaviors. This is why I would like to dedicate my time during the fellowship to establish visual defensive behavioral assays in the marmoset monkey and in order to bring intense mechanistic rigor to these studies develop genetic strategies to manipulate specific neurons involved in the perception and generation of fear responses. This will set the stage for my long-term future goals of finding common behavioral and neural circuit themes that extend across species.

Long term goals and potential implications of this work

My long-term objective is to develop such models of innate fear and test the predictions on healthy and unhealthy human populations to gain understanding into disease states. In the long run, I would like to build behavioral tests for humans using virtual reality platforms for immersive experiences and obtain objective behavioral measures of their responses. One can imagine doing this to identify the sub-components of the behaviors disrupted in each individual; this in turn should help formulize targeted behavioral and neural therapies. The vision is to pinpoint ways for the optogenetic and pharmacogenetic techniques developed in animals to be applied to humans in order to develop therapies highly tailored for the specific needs of individuals and their symptomology. As much as this might seem like science fiction now, species that bridge essential work in flies and mice to humans- namely, non-human primates, are an essential next step.

LAB AFFILIATIONS

- Andrew Huberman, Huberman (5/1/2016)

Publications

PUBLICATIONS

- **Ventromedial hypothalamic neurons control a defensive emotion state** *ELIFE*
  Kunwar, P. S., Zelikowsky, M., Remedios, R., Cai, H., Yilmaz, M., Meister, M., Anderson, D. J.
  2015; 4
- **Rapid Innate Defensive Responses of Mice to Looming Visual Stimuli** *CURRENT BIOLOGY*
  Yilmaz, M., Meister, M.
  2013; 23 (20): 2011-2015

PRESENTATIONS

- Roles of retinal circuits in visual behaviors of mice - Society of Neuroscience Conference (November 2014)
- Mouse Visual Behavior: Expanding the Repertoire - Society of Neuroscience (October 2009)