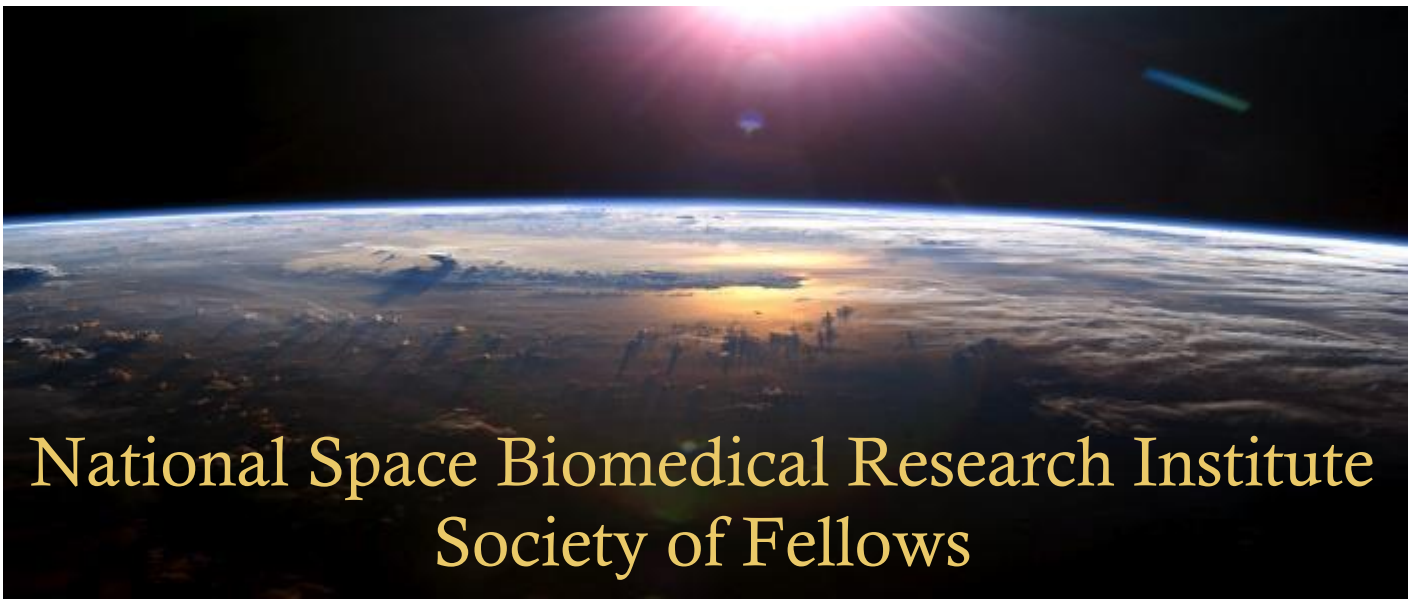


National Space Biomedical Research Institute Society of Fellows

Quarterly Newsletter

Information for First Award Fellows — Winter 2015

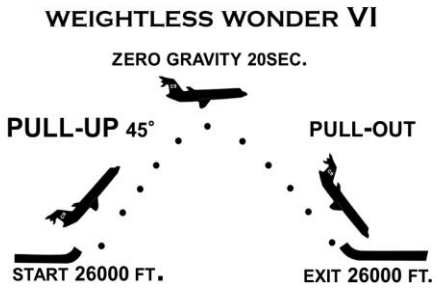
Cool Research Corner

Measuring Intracranial Pressure aboard the Weightless Wonder VI

Justin Lawley, Ph.D.
2013 NSBRI First Award Fellow

In August of 2014, NSBRI investigators took to the sky in order to help identify the reason for visual impairments in astronauts. The current working hypothesis is that microgravity causes pressure inside the brain to increase, which causes deformation of the optic globe and thus changes in vision. To answer this question, Dr. Benjamin Levine of the Institute for Exercise and Environmental Medicine at UTSouthwestern Medical Center and his First Award Fellow, Dr. Justin Lawley, performed experiments onboard NASA's C-9 aircraft (Weightless Wonder VI).

Continued on Page 4



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Thoughts from the Top

Interview of Dr. Jeffrey Sutton by 2013 NSBRI First Award Fellow Torin Clark, Ph.D.

QN: Students and postdocs always wonder what the CEO does. Describe your "average day" at work.

Dr. Sutton: The CEO is responsible for leading the development and execution of NSBRI's strategy, in accord with our NASA cooperative agreement and to the benefit of all stakeholders. As CEO, I have daily management decisions, oversee the implementation of our plans, and am authorized to move funds, including those from the lead consortium institution (Baylor College of Medicine) to >60 recipient institutions in support of our science, technology, career development, and outreach programs. As a physician-scientist, I am involved in scholarly activities that contribute to NSBRI's mission and believe that a good CEO needs to lead by example.

QN: What is the most challenging part of your job?

Dr. Sutton: The greatest challenge is that there is not enough funding to support many excellent proposals received by NSBRI. This speaks to a larger issue of national priorities and budgets for science, space, technology, and education. In this regard, NSBRI is a strong advocate for human space exploration. We also recognize the importance of investing in the careers of young promising scientists who will advance the field of space biomedical research and be tomorrow's leaders.

QN: What about the most exciting?

Dr. Sutton: There are many exciting aspects to my job. One is the individual and collective talent, dedication, intelligence, and creativity of the people that I have the good fortune to work and interact with nationally and internationally. There is a wonderful spirit and common sense of purpose that pervades the community. Another exciting aspect is the nature of the work itself. Every day, I have the privilege to work at the interface of space and medicine, addressing some of the most interesting and challenging scientific questions of our time.

Jeffrey P. Sutton, M.D., Ph.D.

- President, CEO, and Institute Director of NSBRI
- Friedkin Chair for Research in Sensory System Integration and Space Medicine at Baylor College of Medicine
- Educated and trained at the University of Toronto and Harvard University
- Has earned M.D., M.Sc., and Ph.D. (theoretical physics) degrees
- Has received many awards including the NASA Distinguished Public Service Medal and an NIH Career Development Award

From: www.nsbri.org/Jeffrey-Sutton/

QN: In your opinion, what is the most serious biomedical threat for astronauts venturing to Mars?

Dr. Sutton: Space radiation is generally considered the most serious health threat for long-duration missions beyond low Earth orbit. NSBRI has advanced knowledge in this area through its biomedical radiation studies that incorporate simulated solar particle events (protons) and galactic cosmic rays (including heavy ions).

From: http://nssdc.gsfc.nasa.gov

QN: Describe a NSBRI science research project that you find particularly exciting.

Dr. Sutton: NSBRI plays a pathfinder role for NASA in elucidating individual differences in risk susceptibility, prevention, and countermeasure development. Within our Consolidated Research Facility, we are establishing the first-ever Astro-omics Laboratory, which will become operational in early 2015. Bringing advances in –omics knowledge and technology to space medicine will likely be transformational.

QN: Any advice to bioastronautics students or postdoctoral fellows (career-wise or otherwise)?

Dr. Sutton: Work hard, think boldly, pursue excellence, be passionate, seek good mentors, help others, enjoy friendships and family, never worry alone, and of course have fun.

QN: Any changes/things to look forward to in the future for NSBRI?

Dr. Sutton: Change is inevitable and NSBRI has been commended repeatedly on its ability to adapt to changing NASA needs. The Institute adds unique value to our nation's space program in many ways, including the depth and breadth of our training opportunities such as the First Award Program. It will be important to sustain what we do well and add new ventures, possibly generated from those in the NSBRI Society of Fellows, that push the frontiers of knowledge and discovery. ■

Where to be at NASA HRP IWS

For those of you planning on attending the NASA Human Research Program Investigators' Workshop taking place on January 13-15, 2015, there are a few NSBRI-related events you should try to attend:

Thursday 11:30 am in Grand Ballrooms A & B: Dr. David Watson Poster Competition Awards and the NSBRI Pioneer Award Presentations

Thursday 12 pm in the Clipper Room: NSBRI Society of Fellows Luncheon

Thursday 3 pm in the Yacht Room: Innovation by a New NSBRI Generation Session chaired by Drs. Amanda Hackler and Ron McNeel

Thursday 4:30 pm in Grand Ballrooms A & B: Plenary by Dr. Graham Scott: Outbriefs of NSBRI Workshops

Cool Research Corner: An Interview with Dr. Justin Lawley

QN: Can you describe your experiment?

JSL: Sure. The main aim of the experiment was to directly measure pressure inside the brain (intracranial pressure) of healthy human volunteers when we remove the influence of gravity. To do this, we required the most accurate measurement of intracranial pressure in humans. Therefore, we recruited individuals who, due to a prior medical condition, had an Ommaya reservoir placed inside their brain. This device allows us to safely and very accurately measure intracranial pressure in healthy humans. Alongside intracranial pressure, we also measured other important parameters such as: pressure just outside the right side of the heart (by a peripherally inserted central catheter), blood pressure, heart rate, brain blood flow, and the size and shape of the optic nerve sheath and globe. Next we needed a zero gravity laboratory. To create periods of microgravity, we teamed up with the reduced gravity office at NASA and Wyle Laboratories, Inc. to fly onboard the C-9 Weightless Wonder VI. The C-9 flies a special parabolic flight pattern that creates several brief (20 s) periods of true zero gravity.

QN: What did you find?

JSL: The take-home message from this experiment was that pressure inside the brain is exquisitely sensitive to the effects of gravity. Indeed, pressure inside the brain increases markedly when you simply lie down relative to standing on your feet. However, contrary to what the research community expected, pressure inside the brain actually fell below that observed in the supine position during every single zero gravity maneuver, in every subject.

QN: What implications do you think this new information will have on astronaut health?

JSL: These findings will challenge us to think carefully about the mechanisms and possible countermeasures for visual impairments in astronauts. Indeed, a common message in Dr. Levine's laboratory is you always learn more from discovering things you didn't expect. Clearly removing gravity and the associated acute fluid shifts did not result in elevated intracranial pressure. However, pressure inside the brain remained elevated compared to the upright position. Therefore, perhaps the inability to stand up in space and temporally reduce intracranial pressure during waking hours is the problem? Also, these are acute studies (20 s), perhaps very prolonged (months) periods of weightlessness are required to cause changes in intracranial volume and pressure? This experiment has brought us one step closer to understanding the pathophysiology of visual impairment in astronauts, although clearly there are still very exciting experiments to be undertaken.

QN: What advice would you give anyone else who is thinking of undertaking parabolic experiments?

JSL: Chance favors the prepared mind! Start preparing months (years) in advance. When you're onboard parabolic flight with human subjects, you typically only get one shot – so you better get it right. This experiment was the most invasive and complex human experiment to have been flown onboard the C-9. Indeed, a 20+ strong team that included a neurosurgeon, a cardiologist, a sonographer, two nurses, five engineers, multiple flight personnel, and I were required to test each subject. To achieve this, we performed, what now feels like, an uncountable number of dry runs and simulations in our laboratory and at Wyle Industries. We even went to the extremes of labeling every single part of the assembly and every piece of equipment, even down to the clipboard and pens. However, this all paid off tremendously come flight day when everyone onboard is hectically trying to setup after takeoff and again after landing. I also recommend blocking off a substantial amount of time for the love of administration. ■

Justin enjoying some zen time aboard the Weightless Wonder VI.

2014 Summer Bioastronautics Institute Recap

Alix Black, Ph.D.
2013 NSBRI First Award Fellow

The Summer Bioastronautics Institute is an NSBRI workshop focusing on improving research, presentation and mentoring skills for the NSBRI fellows. Held last May at the NSBRI headquarters in Houston, the 2014 institute brought together nearly 30 individuals including 20 undergraduate students from the Summer Internship Program, 4 graduate students in their first year of the Mentored Research Program and 5 Postdoctoral Fellows. The 4 day institute aimed to provide NSBRI fellows with enhanced skills and techniques in scientific research and education. To many of us, this event served as an introduction to the NSBRI and a way to meet our fellow fellows.

Participants at the 2014 SBI with former astronaut Dr. Scott Parazynski.

Mornings were devoted to developing educational skills in mentoring, presenting, grant writing, and outreach. These morning sessions combined lectures by experts such as Dr. Tracy Volz, Director of the Program in Writing and Communications at Rice University, followed by hands-on activities. These activities included, reworking presentation slides, developing outreach activities, and finding solutions to

mentoring issues. Rihana Bokhari stated, "I learned some wonderful tips on how to create a good presentation and use body language to convey what you want in a presentation." The importance devoted to education at the SBI really showed the NSBRI's commitment to not only supporting research, but to preparing its fellows to work, present, learn, and teach in the current research environment.

From Left:
Lawton Crentsil, Zach Donoviel, Lyle Babcock, and Calvin Miller working to improve their presentation slides after the talk by Dr. Tracy Volz.

Afternoons focused on scientific advances in the field of health on long-duration spaceflight. The presentations were a combination of research talks by the First Award Fellows, updates on NSBRI research by in-house scientists, and lectures about job opportunities at NASA and NSBRI. The scientific talks spanned a wide range of topics. Hanelle Fares, one of the SIP students said, "The most interesting thing I learned from the NSBRI was the effects of space on the body. I had known some of the things before – like the fluid shift and swelling – but it was really interesting to find out about the bone degradation leading to kidney stones and the loss of some vestibular function by astronauts in microgravity." For many participants, this was a great introduction to the multitude of health issues associated with space-flight. Beyond the lectures, Dr. Gregory Vogt also took us for a whirl on the rotary chair. The diversity of talks, the testimonials by individuals such as former astronaut Dr. Scott Parazynski, and the hands-on experiences, brought the importance of space health research to the forefront of all of our minds.

Throughout all of the sessions, meals, and activities, the SBI was a wonderful opportunity to meet new people and create personal networks. Although networking was never taught as a specific topic during the institute, it permeated the entire atmosphere of the SBI. As a postdoctoral fellow, it was such a pleasure to have an opportunity to meet, talk, and interact with undergraduate, graduate students and postdocs interested in the field. They provided me with so much insight into the work we were doing and where science is heading. The institute was also organized such that there was plenty of time to interact with the speakers after the lectures. The bonds created at the SBI will not soon be lost.

Overall, the 2014 Summer Bioastronautics Institute was a huge success. After 4 days at the institute, everyone left with new friends, new knowledge, and new skills. NSBRI's constant investment in their fellows was clear every step of the way. A special thanks goes out to Drs. Ron McNeel and Amanda Hackler who did an amazing job putting everything together and keeping us organized. ■

Left: Rihana Bokhari in the rotary chair built by Dr. Gregory Vogt. The chair helped us understand the vestibular illusions that occur in spaceflight. *All SBI photos courtesy of Dr. Ron McNeel.*

Fellow Spotlight

Allison Anderson, Ph.D.
2014 First Award Fellow

Project Title:
Feasibility of DPOAE mapping as an in-flight measure of intracranial pressure in space

Dartmouth College
Geisel School of Medicine
Smart Medical Systems and Technology Team
Mentor: Jay Buckey, Ph.D.

QN: Can you describe your NSBRI-funded research? **AA**: My project focuses on assessing distortion product otoacoustic emissions (DPOAE) as a non-invasive measure of changes in intracranial pressure. When entering microgravity, astronauts experience a headward fluid shift, which could increase intracranial pressure (ICP) above baseline levels, while spaceflight evidence suggests that intraocular pressure decreases. We hypothesize that visual acuity changes in spaceflight are caused by the long-term interaction between intracranial pressure and the ocular globe. However, there is no noninvasive, easy-to-perform, on-orbit measure of ICP. Changes in DPOAE response have been shown to correlate with changes in ICP, potentially making them very useful as a proxy measure. To administer a DPOAE test, sound is emitted into the ear at two different frequencies that interact and trigger certain hair cells in the cochlea. The activated hair cell re-emits sound out of the ear that is recorded by our device. I will statistically assess DPOAE as a tool to help monitor astronaut vision changes by isolating the effects of fluid shifts and changes in hydrostatic gradients, two separate response mechanisms by altering body position (hydrostatic gradient) and lower body pressure (fluid shift). In conjunction with this work, I will also be collecting additional measures using MRI, ocular geometry/structures, and cardiovascular data to look for anatomical and physiological predictors for changes in the DPOAE maps. **QN**: What are your future plans or career goals? **AA**: As long as I am doing research and working on human spaceflight, I will be happy! I would love to be a professor at a university, as it would allow me to collaborate with other researchers in many different fields, as well as industry and civil servants. My greatest dream, though, is to be an astronaut. **QN**: Do you have any tip or piece of advice you would like to share with current or future postdocs? **AA**: Find a project that stretches you a bit, but one that you can become totally engrossed in. Having finished your PhD, it will be nice to try something new and equally interesting. Doing this type of postdoctoral research is a perfect opportunity to jump into something new and expand your skill set, which ultimately will make you a better researcher. **QN**: What do you do outside the lab? Do you have any particular hobbies or interests? **AA**: I love to cook, read, play sports (especially triathlon), and being outside exploring. And of course I'm jumping right in

to all of these New Hampshire snow-based activities! **QN**: What motivated you to apply for this fellowship in biomedical space science research? **AA**: This is the only fellowship dedicated to Bioastronautics, giving people like us the freedom to study exactly what we want. I feel really blessed. ■

Right: Allie looking for hammerhead sharks in the Galapagos Islands.

NIH K-Series Awards Explained

Julianna Simon, Ph.D.
2013 NSBRI First Award Fellow

Whether you are just starting out in your field or are a faculty-level candidate, the NIH K-series awards generally provide 3-5 years of support to promote career development. These K-series, or career development, awards can be broken down into two categories, including mentored career development awards, which are geared towards senior postdoctoral fellows or clinical doctorates, and independent investigator career development awards. The overarching goal of the career development awards is to "help ensure that a diverse pool of highly trained scientists is available in appropriate disciplines to address the Nation's biomedical, behavioral, and clinical research needs" (http://grants.nih.gov/grants/guide/pa-files/PA-14-044.html). New K-series applications are due in February, June, and October so plan ahead! More information about K-series awards can be obtained at: http://grants.nih.gov/training/careerdevelopmentawards. ■

For those looking to continue in academia, a K-award might be your next application after the NSBRI First Award Postdoctoral Fellowship. Look in the next newsletter for helpful hints on preparing a successful K-grant from two recent K01 recipients.

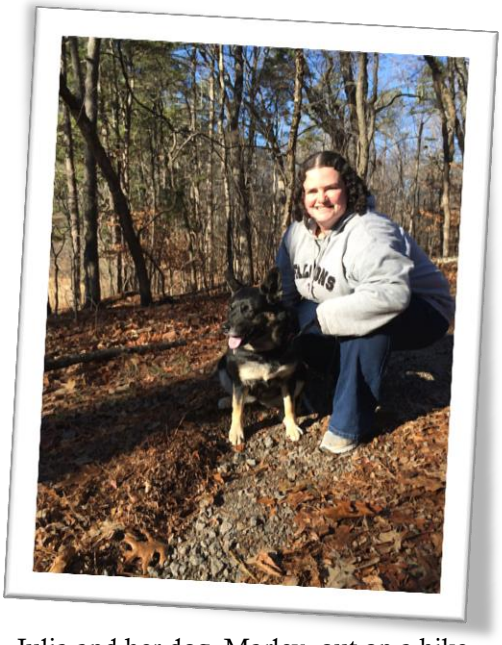
Fellow Spotlight

Julia Raykin, Ph.D.
2014 First Award Fellow

Project Title:
Effects of intracranial pressure and 1-carbon metabolites on the optic nerve sheath in VIIP syndrome

Georgia Institute of Technology
Sensorimotor Adaptation Team
Mentor: Ross Ethier, Ph.D.

QN: Can you describe your NSBRI-funded research? **JR**: Many astronauts experience visual impairment following long duration spaceflight. One of the hypothesized mechanisms that lead to Visual Impairment and Intracranial Pressure (VIIP) syndrome development is remodeling of the optic nerve sheath due to increased intracranial pressures from exposure to microgravity. Carbon-1 metabolites have been shown to be elevated in astronauts presenting with VIIP and have been linked to pathological cardiovascular remodeling. The goal of my research is to develop an in vitro system to culture the optic nerve sheath under increased intracranial pressures and carbon-1 metabolites and monitor the remodeling responses to these conditions. The results will give us a better understanding of the mechanisms involved in this condition and help identify possible interventions to prevent future visual decline in astronauts. **QN**: What are your future plans or career goals? **JR**: I would like to pursue a career in academia to continue my research. I am interested in studying how various cells in the body respond to altered loading environments. I also look forward to teaching and mentoring students. **QN**: Can you share some advice for those individuals wanting to apply for the First Award program? **JR**: I would recommend trying to come up with an idea where you can apply your previous knowledge to a new area of research. Also, start early, a good proposal takes a lot of time to write. **QN**: When you're not in the lab, where can we find you? **JR:** I enjoy playing soccer, hiking, swimming, and traveling. **QN**: What motivated you to apply for the NSBRI First Award fellowship? **JR**: I had the opportunity to work on a project studying VIIP and it gave me the chance to learn more about it and come up with ideas of my own. The prospect of continuing research on VIIP fascinated me and it is an important problem to resolve so that we can further pursue space exploration. ■



Julia and her dog, Marley, out on a hike

Calendar of Events

January 12-16, 2015

- NASA HRP Investigators' Workshop in Galveston, TX (Jan. 13th-15th)
  Theme: Integrated Pathway to Mars
- Behavior, Health, and Performance Working Group meeting (Jan. 16th)
- NASA Space Radiation Investigators' Workshop (Jan. 12th-14th)

May 10-14, 2015

- Aerospace Medical Association (AsMA) Annual Meeting in Lake Buena Vista, FL

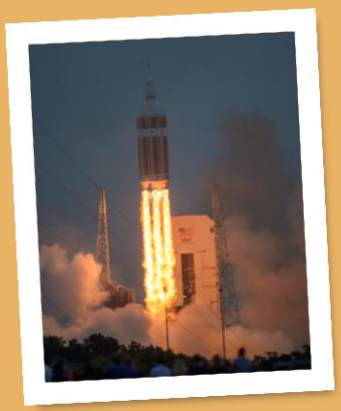
Comments, Questions, & Suggestions

The current NSBRI Frist Award Fellows created this newsletter and participated in editorial duties.

If you have suggestions for future newsletter topics or know a First Award Fellow or other NSBRI researcher who you would like to see featured here, please let us know!

Send any comments, questions, or suggestions via email to Julianna Simon, Lead Newsletter Editor at jcsimon@uw.edu or Amanda Smith Hackler, Head of Career Development and Outreach at hackler@bcm.edu.

Space Fun: Orion Exploration Flight Test-1 Quiz



Did you watch Orion's launch? Think you know all the facts? Check your knowledge of Orion Exploration Flight Test-1 in this fun quiz!

Images and facts courtesy of www.nasa.gov/orion.

1) When was Orion's first space launch?
2) What rocket launched Orion into space?
3) What altitude was reached by Orion in EFT-1?
4) How many times did Orion orbit the Earth?
5) Approximately how fast was Orion travelling when it entered Earth's atmosphere?
6) What maximum temperature did the heat shield withstand upon reentry?
7) What ocean did Orion land in?
8) How many parachutes were deployed to slow Orion's descent for splashdown?
9) What is the name of the vessel that transported Orion back to shore?
10) What *Sesame Street* character flew on Orion?

1) December 5, 2014; 2) Delta IV heavy rocket 3) 3604 miles; 4) 2 times; 5) 20,000 mph; 6) 4000° F; 7) Pacific 8) 8; 9) USS Anchorage; 10) Slimey the Worm