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FIRST PERSON

First person – Travis Armiger

First Person is a series of interviews with the first authors of a selection of papers published in Journal of Cell Science, helping early-career researchers promote themselves alongside their papers. Travis Armiger is the first author on 'Determining mechanical features of modulated epithelial monolayers using subnuclear particle tracking', published in Journal of Cell Science. Travis is a PhD student in the lab of Kris Noel Dahl at Carnegie Mellon University, Pittsburgh, USA, investigating cellular biophysics and the ways in which the physical properties of cells influence gene expression and tissue function.

Travis Armiger

How would you explain the main findings of your paper in lay terms?

Mammalian cells can sense and interact with the physical environment that surrounds them, which could be other connected cells or the proteins and other molecules present in the body. In addition to the physical connections between a cell and its environment, within individual cells there are also structural connections between various parts of the cell – thus, if you pull on one part of the cell, other areas of the cell can respond. In this paper we use a new technique to look at how disrupting these physical connections, and cell-generated forces, ultimately changes the physical properties of single flat layers of cells. Specifically, we image fluorescently labeled proteins that bind to DNA in the cell nucleus to determine what aspects of cell biology are responsible for the movement of DNA within the nucleus. This work can be used to determine how far cells can 'feel', which has implications in areas such as wound healing and tissue stiffening or fibrosis.

Were there any specific challenges associated with this project? If so, how did you overcome them?

There is a constant trade-off between acquiring high-resolution images of our cell systems and making sure cells remain alive during the experiment. Additionally, we take time series images to make movies of live cells, where there is a similar trade-off between the number of images we can acquire while maintaining cell viability. By running multiple experiments, we were able to determine the proper microscope setting to maintain cell viability for the time required to generate movies with enough frames and resolution to measure the motion we were investigating. We also aimed to address the following question: what factors within cells lead to DNA motion? There are likely numerous overlapping factors involved in regulating DNA motion, so to address this question it was necessary to perturb the cells using multiple methods. Therefore, we used chemical treatment, mutant protein expression and environmental stiffness changes to begin to investigate DNA motion in live cells.

When doing the research, did you have a particular result or 'eureka' moment that has stuck with you?

We were interested in how cell-generated forces (e.g. actomyosin contractions) might influence motion within the cell nucleus. Initially we thought about cell structure in an overly simplistic manner: more forces lead to more motion. However, what we found (which may seem obvious now) is that, while the total extent of cell-generated force is important, the distribution of this force through the cell is also important. Therefore, we imaged the actin cytoskeleton (a common protein under tension) to get a better idea of where forces might be distributed throughout the cell to determine if forces were approaching or bypassing the nucleus.

Why did you choose Journal of Cell Science for your paper?

Journal of Cell Science is a very well-respected journal. We wanted our results to reach a wide range of scientists. We aimed to keep this work fairly general in terms of addressing fundamental questions in cell biology such as 'how far can cells feel?' and believe that Journal of Cell Science will allow us to reach many researchers, and stimulate new ideas and experiments. This work will hopefully be applicable to researchers using multiple cell types and multi-cell systems.

Have you had any significant mentors who have helped you beyond supervision in the lab?

Dr Stephen Spagnol was a senior PhD candidate when I first joined the Dahl lab. While he was a fantastic mentor in terms of training me on various lab techniques, he was also influential outside of the lab in shaping how I approach research and science in general. Through our formal discussions at lab meetings, or informal discussions elsewhere, he reinforced the idea of science as a continually growing field in which the current state of the art is constantly being critiqued, adapted and expanded. He was also a positive voice when

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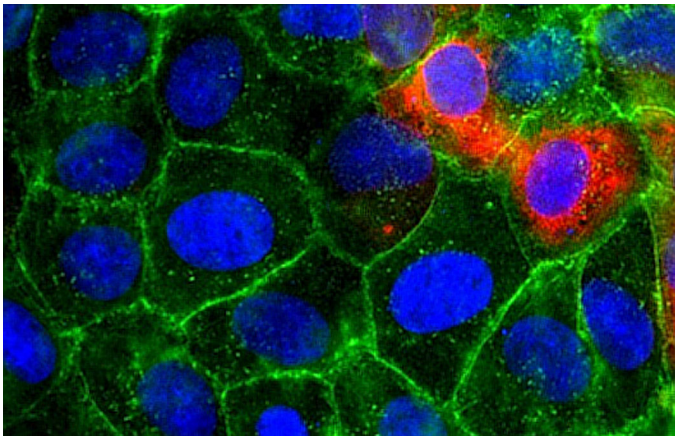

Epithelial cell monolayer stained for DNA (blue), and actin (green). Certain cells (top right) also express a mutant protein (red) to physically decouple the nucleus from the cytoskeleton.

research was challenging, which kept me going during the difficult times in the lab and reassured me that no one does anything perfectly the first time.

"[…] when my brother (who is now a middle-school science teacher) and I would play outside after school we were often performing our own made-up experiments wonderfully disguised as games."

What motivated you to pursue a career in science, and what have been the most interesting moments on the path that led you to where you are now?

At a young age I was always curious about how things worked and was interested in bugs, reptiles, amphibians and dinosaurs, as many young children are. Although I didn't realize it at the time, when my brother (who is now a middle-school science teacher) and I would play outside after school we were often performing our own made-up experiments wonderfully disguised as games. For example, we used to run the hose down our driveway and float leaves of various shapes down the asphalt to see which shape was fastest or least likely to get stuck on an obstacle. This kind of creative game playing was always encouraged by our parents. I believe that this type of curiosity, in addition to the wonderful teachers and professors I had, later allowed me to be successful in science and math courses throughout my academic career.

"The ability to become an expert in one's field and still communicate in an interesting and accurate way to someone outside of that field is a true challenge that I am still trying to perfect."

Who are your role models in science? Why?

David Attenborough and Edward O. Wilson. They both have such a passion for biology and ecology that when I read their books or listen to them speak I am instantly captivated by what they have to say. The ability to become an expert in one's field and still communicate in an interesting and accurate way to someone outside of that field is a true challenge that I am still trying to perfect.

What's next for you?

I will be graduating from Carnegie Mellon University with a PhD in chemical engineering this May. I am currently looking for industry positions or postdocs that will foster my passion for both biology and engineering.

Tell us something interesting about yourself that wouldn't be on your CV

My love of bugs, reptiles, amphibians and dinosaurs never really faded away with age. I have a pet frog, two cats, and love to visit the Carnegie Museum of Natural History in between running experiments. After all, getting to stand underneath two massive *Tyrannosaurus rex* skeletons dueling over a carcass is impressive no matter what age you are.

Reference

Armiger, T. J., Lampi, M. C., Reinhart-King, C. A. and Dahl, K. N. (2018). Determining mechanical features of modulated epithelial monolayers using subnuclear particle tracking. *J. Cell Sci.* **131**, jcs216010.