ARCS Scholars' Keynote Speeches at the annual
Donor Appreciation Event
September 22, 2015

Our scholars are all exceptional students but each year we can select only two of our third year PhD students to represent them all. Here are this year's two scholars:

Michelle Guaragno, University of Pittsburgh

Good evening, I am a third year graduate student in bioengineering at the University of Pittsburgh. How many individuals here wear contact lens, spend a lot of time using the computer? These are a few of the risk factors for developing a condition known as dry eye disease. Other factors include antihistamines, age and autoimmune conditions such asrheumatoid arthritis. My research is focused on this common multifactorial eye condition known as dry eye disease. Approximately six million individuals in the United States have a severe form of DED and 20 million suffer from a mild case. Dry eye disease occurs due a disruption of your tear film resulting in a lack of lubrication to the eye. Symptoms of DED include blurred vision and eye irritation, cell damage, which may in severe cases result in corneal ulcerations leading to vision loss. Clinical research has also shown that DED can produce psychological side effects such as depression, and anxiety. Unfortunately, current gold-standard clinical treatments do not address the underlying etiology of the disease.

The current standard of care is dependent upon the severity of the disease. Mild forms of the condition are treated by lifestyle changes, such as wearing sunglasses and less exposure to drying winds. Additional therapies to aid mild to moderate DED include tear substitutes. Although "artificial tears" do provide temporary relief for patients, most formulations contain preservatives that can cause eye irritation, and hyperosmolarity of the tear film. For severe cases of DED, anti-inflammatory treatments are prescribed to patients such as Restasis. However, some of these treatments are intended for short-term use, and long-term usage can lead to both glaucoma and retinopathy.

Recently, ocular research has shown that the underlying etiology of dry eye disease is due to inflammation. Therefore, we are focused on developing a drug delivery system that will address the underlying cause of the disease by using a chemokine to recruit endogenous cells, which will resolve the inflammation. Thus far, we have seen promising results in animal studies using our treatment, and are continuing to gain a deeper understanding of the mechanism of dry eye disease.

Most importantly, the support we have as scientists plays an integral role in the advancement of our research. ARCS has enabled me to continue pursuing my dreams.

ARCS' enthusiasm for our research and financial support make a difference. We also appreciate the generous tickets to games and shows. However, I am normally too late to the punch. Through your contributions, I have been able to purchase a computer, and books. I am very grateful to the ARCs Foundation. Thank you.

Joseph Tassarotti, Carnegie Mellon University

Thank you Kathy, Pamela, and Leslie for giving me an opportunity to speak tonight. And of course, thank you ARCS donors for your generous support and interest in our work.

Let me start by saying a bit about the research I've done as an ARCS scholar. My work is about trying to eliminate bugs in computer programs. In some ways, writing correct programs is getting harder and harder these days. To understand why, you have to look at how computers have been changing.

It used to be that every year, new computers would just get faster, and all of the old programs we had would run more quickly. But about 10 years ago that trend stopped. Even though we can't make computers faster, what we can do is make them smaller. So, what's happening now is that new computers actually have multiple smaller computers inside of them. But that means that programs will only run faster if we can split them up into pieces that can run on each of the smaller computers.

However, writing programs like this is very hard because programmers have to think about all the ways the different pieces can interact. Anyone who has managed an organization knows that if you double or triple the size of a group, things can suddenly become a lot more complex to manage. And the same is true with programs – the more pieces there are, the harder it becomes to consider all the possible interactions, and the result is that programmers make mistakes.

Often, these mistakes are very subtle: usually everything works just fine, but under some rare set of circumstances something goes wrong. This means that the bug usually goes undetected until the program is being used by millions of people. Now, if the bug is in a game for an iPhone, that may not matter much. But if that bug is in a car or an airplane, it could cost hundreds of millions of dollars to fix. In the worst case, it can put peoples' lives at risk.

So what can we do? The approach taken in my research is to mathematically *prove* that there are no bugs. We start with a collection of simple rules about the behavior of small programs; these rules can then be combined together to derive facts about larger more complicated programs. This is a line of research that goes back for over

50 years, but the continuing challenge is to develop and adapt the rules to handle more and more complicated features of modern computers. Recently, my collaborators and I were able to use these rules to prove the correctness of an important algorithm that is widely used in the Linux operating system.

And the support I received as an ARCS scholar was an essential part of that work. A few months ago, I was given a last minute invitation to describe this work at an important seminar in Germany. Many experts in my field were at this seminar, including the inventor of the algorithm that I just mentioned! The organizers of the conference generously offered to pay for my trip. However, given the short notice, I had to pay up front for my flight and be reimbursed later. As you can imagine, booking a last minute trip to Germany is not cheap. But because I had my ARCS scholarship, this was not a burden for me. And, the feedback I received at the seminar is shaping the research that I'm doing now.

That's just one example of how the flexible nature of ARCS funds addresses a need that other kinds of institutional support cannot. But that's not the only thing that makes ARCS special. ARCS also introduces students to a group of women who are deeply committed to their community. I can't begin to say how wonderful it was to come to Pittsburgh and meet such a welcoming group of people who were genuinely interested in seeing me succeed. Thank you so much for all of the ways you support us.