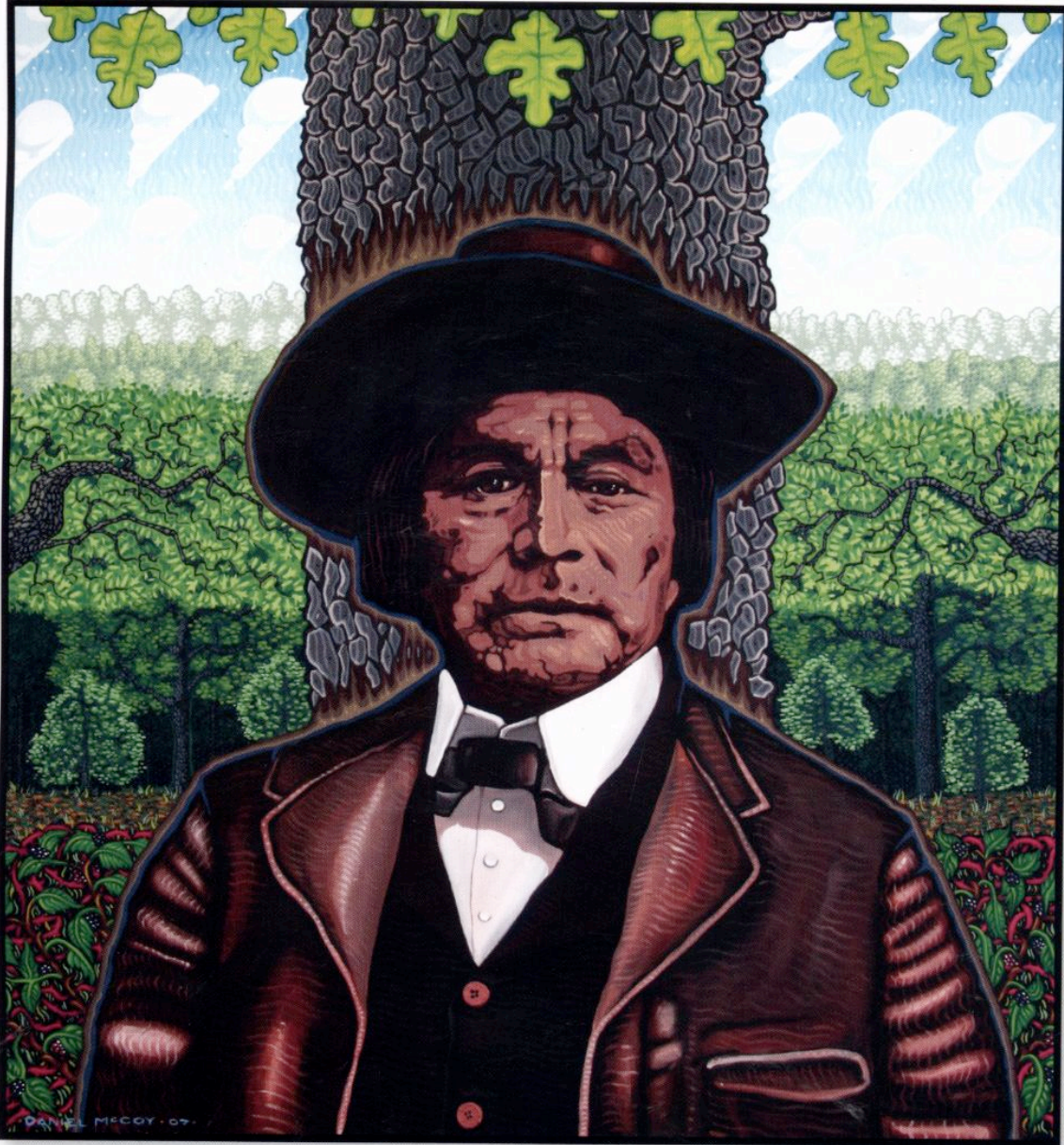


Winds of Change

American Indian Education & Opportunity

Spring 2008



Chitto Harjo



Connecting the Past to the Present

David Morales

David Abraham Morales, Opata/Yaqui, was born and raised in Marana, Arizona, a small farming community northwest of Tucson. A doctoral candidate in applied mathematics at the University of Arizona, Morales shares his unique appreciation of mathematics that has led to his current interest in genomics.

Winds of Change: What drew you to the field of mathematics?

David Morales: I remember playing in the Southern Arizona desert as a child and always noticing patterns that were all around me: the spacing of washboards on dirt roads, the puzzle pieces formed on an arroyo during dry periods, the symmetries found on plants,

etc. It may sound weird to a non-mathematician, but I have always felt that doing mathematics was my calling in life and rather that the spirit of mathematics chose me.

WOC: How does that initial connection play out in your current area of study and career interests?

DM: I am currently finishing my Ph.D. work at the University of Arizona. My research focuses on the mathematical modeling of human DNA sequence evolution, i.e., how our genomes have changed over time. We have lost a lot of information about our past during conquest periods, but clues to our past still remain encoded within our DNA. Mathematics is absolutely necessary to

decode this information that has been passed on to us from our ancestors.

Mathematics can always be applied to any situation where patterns arise, which is pretty much anything in the entire universe. In my work I apply math to human evolution. The simple patterns here that arise are that we get our genomes from our mother and father, and they get theirs from their mother and father, etc. Another observation is that the more closely related we are, the more similar our genomes are. So my siblings have more similar genomes to me than my cousins do, which are more similar than second or third cousins, and so on. So we can use genetic variation, the difference between our DNA sequences, to measure how closely we are related, and how many generations ago we had a common ancestor.

What is interesting is that the same math that is used in my field is the same math used in some areas of physics and engineering and even finance. With a strong mathematical foundation it is easier to change the field we are solving problems from.

WOC: What job trends do you see in the field of mathematics?

DM: As we enter this new information age, we are being overwhelmed with data. Computers are necessary to deal with all this data, from data storage to data analysis. Computers only speak the language of mathematics. The human-computer interface has been designed so that non-technical people can benefit from computers, whether it be by using iPhones, cell phones, MySpace accounts, or DVDs. But without knowledge of mathematics, we are destined to be only consumers of other people's technology, and thereby always giving money to other people when we buy their stuff. Mathematics is necessary if we ever want to be producers and have other people give us their money when they buy our products.

WOC: Many individuals have gotten the idea that they are mathematically incompetent, either through insufficient early training or through feedback from a specific teacher. How does one get beyond this thinking?

DM: The first step is to understand what math is, or perhaps what math is

not. Math is not just arithmetic or algebra. Math is not just what your math teacher is teaching. Math is the study of patterns. Our everyday language has a pattern. The mathematics of the internet and networks, graph theory, is something we as humans use all the time in our most mathematically intensive use, that of gossiping.

When we gossip we seek to explore the connections that exist between nodes. In terms of the Internet, this would be one computer connected to another computer. For gossiping, it's relationships; A is the brother of B, C is the best friend of the husband of a cousin of my wife's sister-in-law. We want to know how people are connected, and we want to know what those connections are. Perhaps A is connected to B, but that connection is dangerous so try to avoid bringing it up. Or maybe I have a common connection with U through a really great friend Y. That might cause I and U to form our own new connection.

So while gossiping may be seen as negative by some, it is nonetheless a fundamental part of human nature and part of our brain's desire to be mathematical. As long as we try not to dwell on or cause bad connections, gossiping can be beneficial. In the business world this type of gossiping might be called "networking."

Despite all the other ways we can be good at math without really knowing we are doing math, such as drawing perspective and using points at infinity in art (see works by MC Escher or Dali for beautiful uses of math in art), I truly believe that we all have the potential to be great mathematicians. The problem is that sometimes math is presented to us in a dull fashion. If the math teacher is not passionate about math, then the student might not understand the point of learning it.

In reality, the bored math student is doing some quick math in their mind: Time is limited and I want to maximize my use of time; Teacher is not interested so I am not interested. Therefore I'd rather spend my time doing something else. Doing math to decide one can't do math. It's an interesting paradox.

WOC: What advice do you have about studying math in college and pursuing a career involving math?

DM: The higher up you ascend on the ladder to learning, the more you will have to deal with the power structures that exist in our society. Our leaders talk a lot about the importance of education, but sometimes don't always put their money where their mouths are. Funding K-12 education is one thing, but finding funds for college is another. And if you are the first one in your family to navigate your way through the turbulent waves of our bureaucracy, it can sometimes seem that we are lost at sea. The most important thing you can do is to find a good mentor who can serve as a lighthouse to guide your way.

It is also important to be humble and to never give up. You will always run into obstacles on the path to higher education, and sometimes these will unfairly be placed in your way because of race and gender. But you have to keep on going and the benefit to this is that you will actually come out stronger and smarter than if these obstacles weren't placed in your way. Running a 100-meter race uphill with snow blowing down on you will make the regular 100-meter race on a track field seem trivial.

The other thing that has kept me going is something I talked about in the beginning. Mathematics is my calling. How can any professor or administrator tell me I'm not going to be a mathematician? I already am a mathematician! If you trust deep inside you that you will be a mathematician, or a scientist, or whatever you want to be, you will make it happen. There is always a way. ✚

To learn more about David Morales' study of mathematics, visit his website at <http://math.arizona.edu/~dmorales>

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