Beyond blue eyes or brown eyes—rethinking genetics

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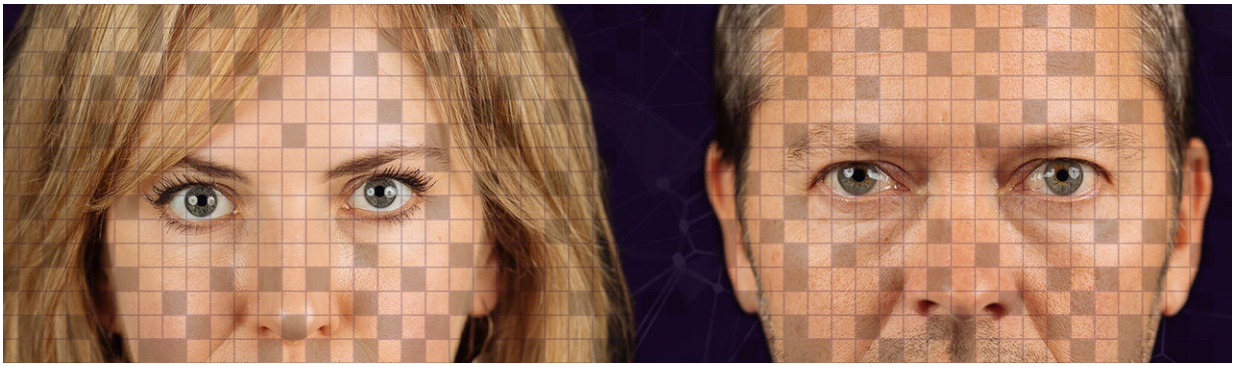

Credit: Northwestern University

We often hear that traits are "genetic." And to many of us, that's code for "fate." If both our parents are tall, we think our kids will be too. Or if our grandmother has Alzheimer's disease, we assume that's our future as well.

But it turns out, we have an incomplete picture of how genes work. Sure, certain genes give us blue eyes or brown eyes. But health and human development aren't that simple.

Using clinical measurement, observational research and DNA analysis, Northwestern researchers are showing that genes work not in a vacuum but in concert with the environment. By looking at conditions like

autism, researchers are showing that your grandma's dementia is not your destiny, and the way we think about health and disease needs an overhaul.

"When people hear the word 'genes,' I don't want them to think about the high school biology version," says Northwestern anthropologist Thom McDade. "I want them to think of genes as dynamic—not fixed—and as components of our biology whose structure and function is fundamentally impacted by the environment. Our experiences literally shape our DNA, helping to determine when genes 'turn on' and express themselves."

Nature and nurture

Epigenetics is a mechanism through which our environment impacts our genes. Much of the early work in this field, McDade says, came out of cancer research and the exploration of how environmental hazards impact cancer risk. But increasingly, social scientists like McDade are embracing epigenetics and what it could mean for development and health.

Northwestern anthropologist Chris Kuzawa cites obesity as an example of how epigenetics plays out: many body systems, from appetite and how our body regulates temperature, to how we handle stress, are involved in whether or not someone is obese. A toddler's high-sugar diet, for example, may prevent expression of appetite-regulating genes, increasing the likelihood of obesity. And then add in the factors beyond our body: our access to nutritious food, the air quality and altitude of our childhood home, and the amount of discrimination and stress in our early life. All these things, Kuzawa says, have a lasting impact on our body size and propensity for obesity.

Research from Northwestern Communication Sciences and Disorders

professor Molly Losh provides another example of epigenetics at work. Losh, who leads the Neurodevelopmental Disabilities Lab, says studies of twins show a genetic role in autism, but this research also indicates that genes aren't the full story.

"Identical twins share virtually all their genetic makeup, so if one twin has autism, the other is very likely to have autism," Losh says. "But it's not 100 percent, suggesting there are environmental factors at play."

In recent years, Losh, Kuzawa and McDade have ramped up their work in this area, confident that appreciating epigenetics can help us understand, treat and prevent disease.

"The epigenetic orientation is qualitatively different from a traditional genetics approach because it says that environments have a lasting impact on the genome, which highlights the role that social scientists can play in understanding development and improving health," McDade says. "By investigating these mechanisms, we can improve social and developmental environments in ways that have beneficial impacts across the life course."

In other words, eating healthier, cleaning up pollution or addressing stress can be a means to improve health at the genetic level.

Genetic codes meet zip codes

While social scientists like Losh, Kuzawa and McDade are embracing epigenetics, Northwestern physicians are also transforming the way doctors think about health and treat their patients.

"When I see patients in my clinic, I know that what I'm able to do as a doctor is only a small part of what's truly going to impact their health," says pediatrician Matt Davis. "Factors like housing, food, income,

education, employment opportunities, social support—all of these are extraordinarily important to health."

Davis is quick to note that epigenetics does not drive all health issues. In some cases, like obesity, lifestyle may be the key determinant. "If a person lives in a food desert where the only affordable options are inexpensive junk food and soda pop from the corner grocery, they are likely to become overweight," Davis says. "That's not an epigenetic thing—the diet they consume is way too high in calories. You don't always need epigenetics to 'turn on' obesity."

Earlier this year, Davis and fellow Northwestern pediatrician Tom Shanley proposed new terminology for social and environmental influences on health.

"This terminology aims to help clinician scientists and social scientists speak the same language," Davis says. "If we appreciate and speak about the various influences on health —medical, social, environmental—by using the same terms, we can be clearer about what's affecting human health and what we can do about it."

In their proposal, published in Clinical and Translational Science, the clinicians argue that a child's home and school environments frequently have a greater impact on the child's health than their genes, and the language of medicine should reflect that.

"We as physicians need to be asking about patient exposures—environmental and social—in order to help patients both manage their disease and return to health," says Shanley. "Eventually, we may even be blood testing for certain exposures and looking for certain epigenetic signals that we know are important for gene expression."

By incorporating socio-environmental factors into health care, both

clinical and social scientists can work more effectively toward better health for all.

"A great challenge we have in the U.S. health care system today is that we like to solve the scientific problems and we haven't done a good enough job yet of addressing the social problems that drive so much of health care needs," Davis says. "If we are going to achieve goals like reducing chronic disease rates and controlling costs, we can't just look for scientific solutions. We're going to need to find social solutions as well."

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Provided by Northwestern University