

The Power of Ideas to Shape People, Whether or Not They Are Completely True

“There is more at stake for society than just the validity of our research papers. Ideas shape us, for better or for worse.”

Someone once wisely said that there is nothing more powerful than an idea whose time has come. New ideas bring forth innovation, which creates new medical breakthroughs. New ideas improve access to education and allow people to take preventive measures, which drastically reduces disease occurrence. At their best, ideas can be liberating. They can set us free from the bondage of oppression, whether by a political dictatorship or by other ideas that seek to constrain our personal identities. At their worst, they do the exact opposite: chaining us down, reducing us to robots that operate based on the whims of our basest appetites, unable to mature into nuance, depth, and beauty.

Let's consider an example of an idea's positive influence. It was just announced at this year's American Association of Clinical Oncology conference that Surendra S. Shastri, M.D., from Tata Memorial Hospital in Mumbai, and colleagues were able to reduce mortality due to cervical cancer by 31% in a study in India. They applied a simple test in-

volving the application of vinegar, followed by a visual inspection for abnormalities, which is very low-cost compared to a Pap smear. There are two ideas worth applauding here. First is the idea that we should develop affordable technology for those in disadvantaged circumstances. Second is the simple (after the fact, that is) idea of applying acetic acid (vinegar) with a cotton swab, which would reveal diseased areas. There was a prolonged ovation for the researchers at the conference. Well-deserved.

Now, let's consider an example of an idea that had negative influence. As a freshman in college, I used to wander the halls of Berkeley before classes began. I chanced upon a poster that was recruiting students for a social experiment to test the effect of something called "stereotype threat" on academic performance. The study of stereotype threat was pioneered by Claude Steele, Ph.D., a sociologist at Stanford, who showed that students' performance on an academic test could be inhibited simply by

telling them that the test would actually determine the intellectual capacity of their race compared to other races. The result would be that African American students, who actually had a stronger academic record than their counterparts in the experiment, ended up doing worse on the test even though they were selected because they were stronger students. The reasons behind the power of this false idea are complex. One of them may have come from a skewed understanding of molecular biology, which is aptly captured by the 1997 Hollywood movie *Gattaca*. This movie portrayed a futuristic world in which everyone's genome was sequenced, and based on this information everyone's future career potential could be accurately predicted. The thing is: the scientific premise behind *Gattaca* was false, or at best partially true. One of the reasons is epigenetics, which we already knew of back in 1997.

Epigenetics is a general category of chemical modifications to DNA or the proteins that pack DNA.

Letter From the Editor

These alterations can change the rate at which genes are turned on and off, without having to cause a mutation in the DNA sequence of that gene. The DNA sequence of a gene—we'll call it genetics—is akin to the notes of a guitar song on a music sheet; each note or set of notes corresponds to certain finger positions on the fingerboard of the guitar. A mutation that changes the song, then, would be a change of a note on the music sheet, which would change the placement of the fingers on the fingerboard. In contrast to DNA sequence mutations or naturally occurring sequence variations (called polymorphisms), epigenetics can change how the song sounds without having to change the notes. Imagine sticking gummy bears or chewed bubble gum on the fingerboard of the guitar, under the string and right on top of where the notes are located. If the gummies are stale and hard, the guitarist will have to exert more effort in order to play the song such that it will sound like what is on the music sheet. If the gum makes the string stick to the board or prevents the adequate pressure from being exerted on that note, the guitarist will have very fatigued hand muscles very soon, even if he can make the song sound as it should. This alteration in required effort and endurance, without needing to alter DNA note sequence, is epigenetics. Our epigenetic landscape is constantly changing throughout our lives because of things like social stress or chemical pollution. In other words, DNA sequence is important, but only tells us so much about how our physiology will manifest in the context of an ever shifting epigenetic landscape.

So, after another 16 years of discoveries in the field of epigenetics, *Gattaca* is an even more biased view of gene function today than it was back in 1997. Now, there is truth behind single mutations in familial disease genes such as *BRCA1*, which increases risk for breast and ovarian cancer, but those are extreme cases that dramatically decrease overall survival and would have little meaningful bearing on the question of intellectual potential. Why all my fuss over an old movie that wasn't meant to be a textbook? Well, while stereotype threat existed long before *Gattaca* brainwashed the populace, the movie did its part in reinforcing the notion that a person's career potential could be predicted based on the sequences of genes that affect skin color. There are such things as bad ideas. In 2011, Donna K. Ginther, Ph.D., and colleagues reported a study published in *Science* magazine, showing that African American scientists were 10-13 percentage points less likely than their Caucasian counterparts to get research funding from the National Institutes of Health. The reasons are likely complicated, but the numbers are concerning.

Indeed, a similar stereotype threat problem exists regarding the view of women's intellects. Jo Handelsman, Ph.D., a microbiologist at Yale, reignited the debate about gender discrimination against women in science with her recent study published in the *Proceedings of the National Academy of Science*. She showed that both male and female scientists had a subconscious bias that rated females lower than males in a pool of applicants vying for a lab manager position. For years, her

colleagues denied what her intuition told her was true, because they believed that scientists were trained to be objective and were thus immune to such simplistic bias. Luckily for this next generation of young female scientists, Handelsman proved her colleagues wrong, which is a loud scream for why we need more female leaders. (Or at least, more male leaders who have a well-developed "feminine intuition"? Oh, now, don't tell me that this trait is suddenly purely genetic! What if we defined intuition as just compassion?)

So, why is it important to understand our fundamental assumptions regarding any idea, especially scientific ones in a technologically advanced society? Because: there is more at stake for society than just the validity of our research papers. Ideas shape us, for better or for worse.

Sincerely,



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