Who You Are Does Not Show Up on a Brain Scan

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By Alfie Kohn

Kids who are taken on expensive skiing vacations are more likely than their peers to attend selective colleges. This, however, doesn't mean these students are accepted by Ivy League schools *because of* the lift tickets they've collected. One of the first principles taught in Statistics class is the difference between correlation and causation. Just because A and B reliably show up together doesn't mean that B was the result of A. Maybe A was the result of B. Or maybe there's a C that's responsible for A *and* B.

Even though most of us understand the limits of correlation, we tend to forget it from time to time – and by "we" I include some academics. If, for example, there's a slight relationship between high school students' test scores and the amount of homework they're assigned, it's commonly (and unjustifiably) assumed that the homework was responsible for raising their scores.[1] If we hear that children who regularly eat dinner with their parents fare better in a variety of ways than those who don't, we're apt to attribute those outcomes to their having sat through the meals – even though the kinds of families that eat together (and have the time to do so) might have provided their kids with the same benefits in any case.

You get the idea.

One particularly stubborn example of this sort of thinking, which I'd like to explore here, falls under the heading of biological determinism. We're told that brain activity, or levels of a specific hormone or neurotransmitter, is associated with certain patterns of behavior, so we take it for granted that the former produced the latter. Indeed, we may be taking our cue from the researchers themselves, many of whom present their findings that way.

Some years ago, the late psychologist Leon Kamin, a coauthor of the book *Not in Our Genes*, explained it to me this way: "There *have to be* biological correlates [to behavior]. Every time I emit a word, something has changed in my brain. Everything is a biological condition. But so what?" By "so what?" he meant that just because a behavior or emotion corresponds to a change in a neurotransmitter, this doesn't mean the neurotransmitter caused the behavior. To assume that it did, Kamin added, is like "finding mucus in the nose of someone with a cold and saying, 'Aha! Mucus causes colds!'"

In fact, a steady stream of evidence shows that the causal arrow sometimes points in the opposite direction from what biological determinists assume. Physiological changes can actually be the *effect* of our actions and circumstances. To wit:

* In the early 1960s, Mark Rosenzweig and his colleagues discovered that giving rats objects to play with changed not only their brains' enzyme activity but the weight of their cerebral cortexes. "There can now be no doubt that many aspects of brain anatomy and brain chemistry are changed by experience," they wrote.

* A number of studies have found changes in brain function as a result of psychotherapy and meditation.

* Testosterone levels rise or fall *in response to* changes in

males' social status. Scientists established this long ago, both for monkeys and for humans. A study just published in June 2018 showed that if men achieved a prestigious standing in an organization's hierarchy, their testosterone levels subsequently went up.

* Nerve cells at the base of a rat's spinal cord change just because the rat has sex. "It is possible that differences in sexual behavior cause, rather than are caused by, differences in brain structure," commented the neurobiologist who did the research (and whose last name is actually Breedlove).

* In the days before Uber, a study of London cabdrivers, who are required to memorize the city's elaborate street grid, found that their "hippocampus changed its structure to accommodate their huge amount of navigating experience," according to neuroscientist Eleanor Maguire.

* Stress, including family-related trauma and the long-term impacts of poverty, can affect the development of children's brains in various ways. "If you really want to change neurodevelopment," says psychiatrist Robert Philibert, "alter the environment."

* The well-established placebo effect demonstrates that our biology changes in response to our beliefs. Fake surgeries and other sham treatments, inert drugs, prayer – all these things can affect the body's immune response and release of endorphins, among other things. They work to the extent that (and purely because) we think they'll work.

* It has been argued that willpower is like a muscle – a resource that's depleted after use, which suggests a physiological constraint to mental effort. But look again: Newer research shows that this effect isn't a biological given after all. Rather, it's a function of, and dependent on, individual beliefs and cultural values.

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Social and psychological realities can produce biological changes as surely as they can be produced by them. But the larger point is that we're entirely too eager to invoke brain-based explanations and to reduce complex human interactions to something that seems reassuringly "scientific." Studies have found that readers are much more likely to accept an article's claim about human behavior – even a patently absurd claim – if the article makes reference to the brain or, better yet, includes a picture of a brain scan. Our powers of critical analysis seem to dissolve at the mere mention of functional magnetic resonance imaging – even though a lot of claims regarding fMRI data turn out to be unreliable. [ADDENDUM 2022: …and based on studies far too small to support conclusions about specific brain functions causing specific behaviors. Moreover, the tasks selected for these experiments may be of questionable validity.]

We act as if "activity in a brain region is the answer to some profound question about psychological processes," Paul Fletcher, a professor of health neuroscience, has remarked. "This is very hard to justify given how little we currently know about what different regions of the brain actually do." (Fletcher was quoted in an article called "Your Brain on Pseudoscience," an extended exercise in exasperation by Steven Poole.) We (sort of) realize that the expression "It's in [an individual's or organization's] DNA" is just a metaphor, but we may need to be reminded that the same is usually true of "[He, she, we, they] are hard-wired to…."

By "we," this time, I'd like to explicitly include educators. Twenty years ago, the cognitive scientist John Bruer warned, in an important article in *Educational Researcher*, that casual claims about "critical periods" of brain plasticity were mostly unjustified and that neuroscience research really couldn't be used as a defense of specific classroom practices. Experts say that's still basically true.

But boy do we ache to anchor our choices in what we think of

as “hard science.” Apparently it’s not enough to point to a reasonable practice – for example, making sure kids feel cared about, having them learn actively and interactively, supporting their need for autonomy – and show that it results in students being more engaged and effective learners. No, we want to be able to claim that what we do is “brain based” – which entails pretending that phrase is more meaningful and prescriptive than it actually is. We thereby do a disservice to the complexity of human thought and feeling by trying to reduce all of this to brain activity.

Sometimes we’re led to believe that the biological realm explains what all of us do. Other times, no less disturbingly, we’re persuaded that by invoking biology we can explain why some people’s actions differ from other people’s. The latter category includes dubious assertions about different “learning styles” that students are supposedly born with.[2] It includes facile, often smug, claims about how the “teenage brain” determines adolescents’ decisions and actions. And it includes a tendency to treat as pathological and biologically based the tendency of many kids to resist sitting still for long periods of time on command.[3]

Then there’s the way we think about boys as opposed to girls. To begin with, gender differences are vastly overstated with respect to most meaningful psychological and other educationally relevant characteristics: Across an enormous range of criteria, males and females are much more similar than different. (The differences *within* each gender are far greater than the average difference *between* the genders.) That was confirmed in 2005 by an ambitious review of dozens of meta-analyses by one of the most respected experts on this subject, University of Wisconsin psychology professor Janet Hyde – and then again in 2013, with even broader array of characteristics, in a review by University of Rochester researchers.

As for differences that do exist, moreover, we would do well

to resist the temptation to reach unthinkingly for biological explanations.[4] As Hyde told a reporter a few years ago, “You never hear a good, modern neuroscientist say the brain is hardwired” for gender differences. Indeed, scientists who have studied brain scans report that it’s a flat-out mistake to talk about male brains versus female brains.[5] Yet plenty of consultants are still doing just that — and advising educators to teach boys and girls differently (or even separately) based on that error.

None of this should be read as a denial of our biological underpinnings. There can be no minds, no selves, without brains. But we are complex, self-aware social beings, and a study of how we function, how we learn and plan and interact with one another, simply cannot be reduced to biological structures and processes. An account that draws on the natural sciences may complement but doesn’t replace or subsume other ways of making sense of human life.

NOTES

1. It’s at least as likely that a third variable — the same one that predicts both ski vacations and college admissions — explains higher scores, on the one hand, and attendance in the courses or schools where more homework is assigned, on the other. Even apart from the absence of evidence for a causal relationship, though, this particular correlation provides scant support for homework. First, note that we’re not talking about an improvement in understanding, just better scores on standardized tests (which, as I and many others have argued, measure what matters least, intellectually speaking). Second, the correlation is quite modest. An hour or more of homework every night is associated, at best, with only a few more points on a test. Third, even that unimpressive correlation vanishes when other variables, such as student motivation and instructional quality, are held constant. Fourth, all of this refers only to high school. For younger students, there is no correlation at all between homework and scores — or at least not a positive correlation. (I’ve reviewed research relevant to these issues in a book called *The Homework Myth*.)

2. Separate from whether learning styles are innate is the question of whether the concept itself is meaningful and has any educational relevance and predictive power.

Pedagogical traditionalists and behaviorists routinely claim that the answer to the latter question is no, but Carol Black offers an incisive criticism of their criticism and a qualified defense of the idea that people do in fact have identifiably different learning styles.

3. After decades spent researching the subject, L. Alan Sroufe, professor emeritus of child psychology at the University of Minnesota, remains a skeptic of the biological determinism that has become the conventional wisdom about ADHD. (I first learned of Sroufe's work when I wrote about this subject for *The Atlantic* almost 30 years ago.) "Are there aspects of brain functioning associated with childhood attention problems? The answer is always yes," he wrote in the *New York Times*. "Overlooked is the very real possibility that both the brain anomalies and the [attention deficit problems] result from experience."

4. Early research found that only men's epinephrine and cortisol levels spiked in response to achievement pressures at work – just the sort of result that traditionalists love to cite as proof of biologically rooted gender differences. But when scientists checked again a few decades later, when it was easier to find examples of women in stressful, higher-status jobs, it turned out that their hormone levels, too, increased. Apparently the decisive factor all along was the job, not the number of X chromosomes.

5. A few resources on this topic: Cordelia Fine's *Delusions of Gender* (Norton, 2011); Lise Eliot's *Pink Brain, Blue Brain* (Houghton Mifflin, 2009); Rosalind Barnett & Caryl Rivers's *Same Difference* (Basic, 2005), and Gina Rippon's *Gender and Our Brains* (Pantheon, 2019).
