ALSO BY CORDELIA FINE

A Mind of Its Own

DELUSIONS *of* GENDER

How Our Minds, Society, and Neurosexism Create Difference

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For my mother

4 I DON'T BELONG HERE

In the opening of her book *Brain Gender*, Cambridge University psychobiologist Melissa Hines dryly reports on the experience of being, in 1969, a member of the first freshman class at Princeton University to include women. Having been assigned by the university to what was described as a "two-man room," she was allocated to a precept leader who "called me Mr Hines for several weeks, apparently before realizing that I was not male."[1] A similar confusion over sex identity surrounded Sally Haslanger, now a philosophy professor at the Massachusetts Institute of Technology. When she received a distinction in her graduate exams, "it seemed funny to everyone to suggest I should get a blood test to determine if I was really a woman."[2]

Mary Beard, a classics professor at Cambridge University, recalls the Roman epigraphy classes she took as an undergraduate in the 1970s, "where her tutor would pose 'clever questions for the clever men and domestic questions for the dumb girls.'"[3] At least there *were* questions for the "girls." Mary Mullarkey, who eventually became Chief Justice of the Colorado Supreme Court, was one of the few women to be enrolled at Harvard Law School in 1965. Although it had been fifteen years since the decision to admit women, she describes the change as still being, to many, "a raw wound." Mullarkey and her friend Pamela (Burgy) Minzer (destined to become Justice of the New Mexico Supreme Court), waited in vain to be called upon in their property class. Asking a

woman to answer a question about law was an event considered by the professor of the class best limited to "Ladies' Day." The topic for that day, when it finally arrived, was marital gifts:

> Leaning over, [Professor] Casner said to me, "Miss Mullarkey, if you were engaged—and I notice you're not"—he paused for laughter—"would you have to return the ring if you broke the engagement?" That was the sole question asked of me in a full-year property class.[4]

Nor, Mullarkey and Burgy found, was a degree from Harvard Law School the same ticket to successful employment that it was for their male counterparts. Even though the federal Civil Rights Act, passed in 1964, prohibited employment discrimination based on gender, strangely, the law firms seemed unaware of the legal situation. "It was commonplace for a law firm recruiter to tell a woman to her face that, although he would be willing to hire her, his senior partners or the firm's clients would never agree to have a female lawyer," Mullarkey recalls.[5]

It doesn't require any special sociological training to read the barely veiled message being communicated to these talented and ambitious women: *You don't belong here*. We tend to think of this sort of outright sex discrimination as being a thing of the past in Western, industrialized nations. *The Sexual Paradox* author Susan Pinker, for instance, writes of barriers to women as having been "stripped away."[6] Her book is peopled with women who, when asked if they've ever experienced ill-treatment because of their sex, scratch their heads and search the memory banks in vain for some anecdote that will show how they have had to struggle against the odds stacked against women. As we'll see in a later chapter, blatant, intentional discrimination against women is far from being something merely to be read about in history books. But here we're going to look at the subtle, off-putting, *you don't belong* messages that churn about in the privacy of one's own mind.

As we learned in the previous chapter, women who are invested in masculine domains often have to perform in the unpleasant and unrewarding atmosphere created by stereotype threat. Anxiety, depletion of working memory, lowered expectations, and frustration can all ensue. But there is a solution, albeit a rather radical one. As Claude Steele observed, "women may reduce their stereotype threat substantially by moving across the hall from math to English class."[7] Stereotype threat can do more than impair performance—it can also reduce interest in cross-gender activities.

A striking demonstration of this was provided by Mary Murphy and her colleagues at Stanford University. Advanced math, science, and engineering (MSE) majors were asked to give their opinion on an advertising video "for an MSE summer leadership conference that Stanford was considering hosting the next summer."[8] Under the cover story that the researchers were also interested in physiological reactions to the video, heart rate and skin conductance were recorded, to give a measure of arousal. After watching the ad, the students were asked questions to assess how much they felt they would belong at such a conference, and how interested they were in attending. There were two, near-identical videos, depicting about 150 people. However, in one video the ratio of men to women approximated the actual gender ratio of MSE degrees: there were three men to every woman. In the second video, men and women were featured in equal numbers. Women who saw the gender-equal video responded very much like men, both physiologically and in their sense of belonging and interest in the conference. But for women who saw the more realistically imbalanced version, it was a very different experience. They became more aroused—an indicator of physiological vigilance. They expressed less interest in attending the conference when it was gender unbalanced. (Interestingly, so did men—although this was probably, one can't help but think, for different reasons.) And although women and men who saw the gender-balanced video very strongly agreed that they belonged there, the conviction of this agreement among women who saw a gender imbalance was significantly lower. Under the naturalistic condition of male dominance, they were no longer so sure that they belonged.

Being outnumbered by men is simply a fact of life for women in MSE domains—as is being exposed to gender stereotypes in advertising. At first, it's not obvious why an advertisement depicting, say, a woman bouncing on her bed in rapture over a new acne product might serve as a psychic obstacle to women looking to enter masculine fields. However, images of women fretting over their appearance or in ecstasy over a brownie mix, although they have nothing to do with mathematical ability directly, nonetheless make gender stereotypes in general more accessible. Paul Davies and his colleagues showed either these or neutral commercials to women and men who were invested in doing well in math. They were then given a GRE-like exam that had both math and verbal problems. Men in both conditions, and women who had seen neutral ads, attempted more math problems than verbal ones. But women who had seen the sexist ads showed exactly the opposite pattern, avoiding the math questions. Their career aspirations were also influenced, with a flipping of occupational preferences, from those that require strong mathematical skills (like engineer, mathematician, computer scientist, physicist, and so on) to those that depend more heavily on verbal abilities (such as author, linguist, and journalist).[9] Ads that trade in ditzy stereotypes of women also, Davies and colleagues found, reduce women's interest in taking on a leadership role. Male and female university students were equally interested in leading a group—except for women exposed to the gender-stereotyped commercials, who were more likely to choose a nonleadership role instead.[10]

Entrepreneurship is another male-dominated arena, and one in which the traits usually assumed to be vital for success—strong-willed, resolute, aggressive, risk-taking—have a decidedly male feel. Here, then, is another occupational niche to which women could easily be made to feel that they don't belong. Female business school students were given one of two fabricated newspaper articles

to read. One described entrepreneurs as creative, well-informed, steady, and generous—and claimed that these qualities are shared equally between men and women. The other article, however, depicted the prototypical entrepreneur as aggressive, risk-taking, and autonomous, all traits that belong firmly in the male stereotype. The women were then asked how interested they were in being self-employed, and owning a small or high-growth business. For women who scored low on a proactive measure (the tendency to "show initiative, identify opportunities, act on them, and persevere until they meet their objectives") it made no difference which article they read. But what about the highly proactive women? As you might expect of these go-getting women, their interest in an entrepreneurial career was high but significantly reduced after reading the entrepreneurship-equals-male news article.[11]

What psychological processes lie behind this turning away from masculine interests? One possibility is that, as we learned in an earlier chapter, when stereotypes of women become salient, women tend to incorporate those stereotypical traits into their current self-perception. They may then find it harder to imagine themselves as, say, a mechanical engineer. The belief that one will be able to fit in, to belong, may be more important than we realize—and may help to explain why some traditionally male occupations have been more readily entered by women than others.[12] After all, the stereotype of a vet is not the same as that of an orthopedic surgeon, or a computer scientist, and these are different again from the stereotype of a builder or a lawyer. These different stereotypes may be more or less easily reconciled with a female identity. What, for example, springs to mind when you think of a computer scientist? A man, of course, but not just any man. You're probably thinking of the sort of man who would not be an asset at a tea party. The sort of man who leaves a trail of soft-drink cans, junk-food wrappers, and tech magazines behind him as he makes his way to the sofa to watch *Star Trek* for the hundredth time. The sort of man whose pale complexion hints alarmingly of vitamin D deficiency. The sort of man, in short, who is a geek.

Sapna Cheryan, a psychologist at Washington University, was interested in whether the geek image of computer science plays a role in putting off women. When she and her colleagues surveyed undergraduates about their interest in being a computer science major, they found, perhaps unsurprisingly given that computer science is male-dominated, that women were significantly less interested. Less obvious, however, was *why* they were less interested. Women felt that they were less similar to the typical computer science major. This influenced their sense that they belonged in computer science—again lower in women—and it was this lack of fit that drove their lack of interest in a computer science major.[13]

However, an interest in *Star Trek* and an antisocial lifestyle may not, in fact, be unassailable correlates of talent in computer programming. Indeed, in its early days, computer programming was a job done principally by women and was regarded as an activity to which feminine talents were particularly well suited. "Programming requires lots of patience, persistence and a capacity for detail and those are traits that many girls have" wrote one author of a career guide to computer programming in 1967.[14] Women made many significant contributions to computer science development and, as one expert puts it, "[t]oday's achievements in software are built on the shoulders of the first pioneering women programmers."[15] Cheryan suggests that "[i]t was not until the 1980s that individual heroes in computer science, such as Bill Gates and Steve Jobs came to the scene, and the term 'geek' became associated with being technically minded. Movies such as *Revenge of the Nerds* and *Real Genius*, released during these years, crystallized the image of the 'computer geek' in the cultural consciousness."[16]

If it is the geeky stereotype that is so off-putting to women, then a little repackaging of the field might be an effective way of drawing more women in. Cheryan and her colleagues tested this very idea. They recruited undergraduates to participate in "a study by the Career Development Center regarding interest in technical jobs and internships." The students filled out a questionnaire about their interest in computer science in a small classroom within the

William Gates Building (which, as you will have guessed, houses the computer science department). The room, however, was set up in one of two ways for the unsuspecting participant. In one condition, the décor was what we might call geek chic: a *Star Trek* poster, geeky comics, video game boxes, junk food, electronic equipment, and technical books and magazines. The second arrangement was substantially less geeky: the poster was an art one, water bottles replaced the junk food, the magazines were general interest, and the computer books were aimed at a more general level. In the geeky room, men considered themselves significantly more interested in computer science than did women. But when the geek factor was removed from the surroundings, women showed equal interest to men. It seemed that a greater sense of belonging brought about this positive change. Simply by altering the décor, Cher-yan and colleagues were also able to increase women's interest in, for example, joining a hypothetical Web-design company. The researchers note "the power of environments to signal to people whether or not they should enter a domain," and suggest that changing the computer science environment "can therefore inspire those who previously had little or no interest . . . to express a newfound interest in it."[17]

You might think that this is a nice sentiment, but that a narrowly focused, unsociable personality simply goes hand-in-hand with talent in computer science. But as developmental psychologist Elizabeth Spelke and Ariel Grace point out, "personality traits that are *typical* of a given profession often are mistakenly thought to be *necessary* to the practice of the profession." They provide, as a historical example, the assumption by an early-twentieth-century psychologist that his talented Jewish students could not succeed in academia because they did not share the traits of the predominantly Christian faculty: he "mistakenly assumed that the typical mannerisms of his Harvard colleagues were necessary for success in science."[18]

Underscoring Spelke and Grace's point is a fascinating natural experiment in the Carnegie-Mellon computer science department that suggests that geeky traits may indeed be extrinsic to success in computer science. In the mid- to late 1990s, an intensive study of male and (the very few) female computer science students at Carnegie-Mellon found that the men were very focused on programming—the sort of person who "dreams in code"—while the few women in the program were more interested in the applications of computer science. But in the late 1990s, the admission criteria were changed so as to no longer unnecessarily and unfairly exclude applicants without a lot of programming experience.[19] This led to a fivefold increase in the number of women, from about 7 percent to 34 percent. Lenore Blum and Carol Frieze took the opportunity of this situation to interview the students who entered the computer science program in 1998. In 2002, when they were interviewed, these students were, uniquely, the babies of the old, hacker-favoring admission criteria, yet were now in a department with a much more diverse student body. Remarkably, Blum and Frieze found that interest in programming versus applications was now a point of similarity, rather than difference, between men and women. "Almost all students saw programming as one part of their interests and the computers as a 'tool' for their primary focus, which was applications." But also, there was evidence that the "students were constructing a new image," and one in which the "narrowly focused computer science student" was no longer the norm:

> Our cohort included students who played the violin, wrote fiction, sang in a rock band, participated in university team sports, enjoyed the arts, and were members of a wide range of campus organizations. We found that men and women alike appear to be moving toward a more well-rounded identity that embraced academic interests and a life outside of computing. Students described themselves as "individual and creative, just interesting all-round people," "very intelligent, . . . very grounded, not the traditional geek, . . ." "much more well rounded than people five or six years ago."

Recall that these students had been chosen according to the old criteria. They were the geeky programmers. And yet, as the researchers suggest, the years spent in an increasingly gender-equal environment "had shaped their image of themselves. We might also speculate that such a transitional culture gave the men 'permission' to explore their nongeeky characteristics."[20]

Both women and computer science are the losers when a geeky stereotype serves as an unnecessary gatekeeper to the profession. And recent work by psychologist Catherine Good and her colleagues shows that a "sense of belonging" is also an important factor in women's intention to continue in math. This feeling of belonging, however, can be eroded by an environment that communicates that math ability is a fixed trait and not something that hard work can increase, especially in combination with the message that women are naturally less talented than men, Good and colleagues found.[21] Philosopher Sally Haslanger has suggested that a difficulty even today for women (and minority) philosophers is that "it is very hard to find a place in philosophy that isn't actively hostile toward women and minorities, or at least assumes that a successful philosopher should look and act like a (traditional, white) man."[22]

But choosing a career is not just about finding a place socially in which one can feel at home. It also entails finding a fit with one's talents. People of course tend to be drawn toward jobs in which they are likely to succeed. If gender stereotypes can affect people's perceptions of their abilities (as we now know that they can), then it would not be surprising to discover that this then has effects on career decisions. Sociologist Shelley Correll has shown that beliefs about gender differences in ability have an important role to play in people's perceptions of their own masculine abilities and, as you might expect, this affects their interest in careers that rely on such skills. Correll used the data from the 1988 National Educational Longitudinal Study, involving tens of thousands of high school students, to carefully compare students' actual grades with their own assessments of their mathematical and verbal competence. She found that boys rated their math skills higher than

their equal female counterparts. This was likely due to the culturally shared belief that males *are* better at math, because boys were selective in their self-embellishment: they didn't inflate their verbal competence. These self-assessments proved to be an important factor in the students' decision making about their careers. With actual ability (assessed by test scores) held equal, the higher a boy or girl rates his or her mathematical competence, the more likely it is that he or she will head down a path toward a career in science, math, or engineering. Correll concludes that "boys do not pursue mathematical activities at a higher rate than girls do because they are better at mathematics. They do so, at least partially, because they *think* they are better."[23] For example, gender differences in self-assessment of math ability fully explained the gender gap in calculus enrollments.

Correll then went on to show just how easy it is to create a gender stereotype that diminishes women's confidence and interest in a supposedly male domain. She used a contrast sensitivity test, in which the participant has to guess which color, black or white, covers a greater area in a series of rectangles. Her participants, freshmen at Cornell University, were told that "a national testing organization developed the contrast sensitivity exam and that both graduate schools and Fortune 500 companies have expressed interest in using this exam as a screening device."[24] (In truth, the test is a fake one: black and white appear in essentially equal proportions, so there is actually no correct solution.) Participants were then told either that males, on average, perform better on tests of contrast sensitivity or that there is no gender difference.

The participants were all given the same feedback on their test performance, but *how* this score was perceived depended on the context—male-advantage or gender-equal—in which the test was presented. When the students thought that contrast sensitivity was a nongendered ability, women and men's self-assessments were very similar. But it was a different story when the underlying assumption was that one sex had the upper hand. In this male-favorable context, men rated their contrast sensitivity ability more

highly and claimed to have done better on the tasks. They also set themselves a more lenient standard against which to judge their performance. Correll then investigated whether, as in her real-world data set, higher self-assessments would lead to higher aspirations. She found that they did. When men thought that they were, as a group, better at contrast sensitivity, they were more likely than women to say that they would enroll for courses or seminars based on the ability, and to apply for graduate programs or high-paying jobs that relied heavily on the skill. And it was their higher self-assessments of ability that appeared to bring about this greater interest in contrast-sensitivity-based aspirations. We like what (we think) we are good at.

But of course many women do persist in male-dominated careers like mathematics, despite the stereotype threat and lack of sense of belonging. Luckily for them, there is an alternative to turning away from math—and this is to turn away from being female. Emily Pronin and her colleagues found that female undergraduates at Stanford University who had taken more than ten quantitative courses were less likely than other women to rate as important and applicable to them supposedly math-incompatible behaviors such as wearing makeup, being emotional, and wanting children.[25] The researchers then went on to provide evidence that it is not simply that women who like to wear lipstick and fondly imagine having children one day are *intrinsically* less interested in math. Rather, women who want to succeed in these domains strategically shed these desires in response to reminders that math is not for women. The researchers recruited a group of Stanford undergraduate women, for all of whom math ability was important. Half of the women read a (fabricated) scientific article about aging and verbal ability. But the remainder of the women read a shortened version of an actual scientific article about gender and math, published in *Science*.[26] This was a study of the Scholastic Aptitude Test results in math for nearly 10,000 high-achieving seventh and eighth graders. Boys were more likely to score highly than girls, and the article concluded that there is "a substantial sex difference in mathematical reasoning ability in favor of boys,"[27] together with the assertion that this advantage reflects boys' innate superiority in spatial ability.

The women certainly found the article threatening, and put some effort toward challenging its findings and conclusions. But it still had an effect on them. Women who read the nonthreatening article identified equally with feminine characteristics believed to be both relevant and irrelevant to math-related careers. But the women who had read the *Science* article about math and gender identified less with female characteristics regarded as a liability in quantitative domains. Parts of their identity were being hurled overboard in an attempt to remain afloat in male-dominated waters. If these are particularly cherished parts of the self-concept that must be abandoned then, in the end, the woman may prefer for the boat to sink.

The behavior of colleagues may also sometimes make it harder to keep female and work identities compatible in male-dominated domains. The recent Athena Factor report conducted by the Center for Work-Life Policy found that a quarter of women in corporate engineering and technology jobs thought that their colleagues believed their sex to be intrinsically inferior in scientific aptitude. "[M]y opinions and reasoning are always questioned, 'Are you sure about that?'" complained one focus group participant, "whereas what the men say is taken as gospel." The focus groups of the Athena report told tale after tale with a common theme: female engineers whom men assumed were administrative assistants; senior women assumed to be the most junior person in the room; double takes in the meeting room at the sight of a woman.[28] In reaction to the Athena report, a woman in a senior engineering position blogged that "[m]any of our clients think I'm in the meetings to take notes for the men . . . some even apologize for boring me with the technical discussions, assuming I have no idea what they're talking about."[29] It's not hard to see that these sorts of attitudes and assumptions could not only rapidly become rather tiresome but also chip away at women's sense of belonging. Echo-

ing Emily Pronin and her colleagues' discovery that mathematically inclined women shed the feminine attributes they perceived as a liability, the Athena report sketches a disquieting picture of the psychological changes that take place in women who remain in SET careers. For the easiest solution to the problem of being female in a setting in which women are made to feel that they are inferior and do not belong is to become as unfeminine as possible. At the most superficial level, makeup, jewelry, and skirts—icons of femininity that draw attention to their wearer's femininity—were rarely in evidence, the researchers noted. The women also took up antifemale attitudes, denigrating other women as emotional, and "heaped scorn" on women-focused programs and any work-related gatherings dominated by women. "By definition nothing important is going on in this room: In this company men hold the power," was how one female engineer explained her policy of avoiding female work gatherings. The awful, intractable incompatibility of being a woman in a male-dominated SET workplace was starkly encapsulated by one woman quoted in the report who described how, more and more, she had developed a "discomfort with being a woman."[30]

As the arguments that women lack the necessary intrinsic talent to succeed in male-dominated occupations become less and less convincing, the argument that women are just less interested has grown and flourished.[31] Yet as we've seen in this chapter, interest is not impervious to outside influence, at least in the young adult samples with which most of this research is done. It is remarkably easy to adjust the shine of a career path for one sex. A few words to the effect that a Y chromosome will serve in your favor, or a sprucing up of the interior design, is all that it takes to bring about surprisingly substantial changes in career interest. Having seen what effect on career interests a simple, brief manipulation in the lab can have, one can't help but wonder at the cumulative influence of that giant, inescapable social psychology lab known as life.

The existing gender inequality of occupations, the sexist ads, the opinions of presidents of high-profile universities, not to mention all the "brain facts" that we'll get to later—these all interact with, and shape, our minds.

And then, there are people in our lives whose minds, just like ours, are richly endowed with implicit and explicit attitudes about gender. The tilting of the playing field that their half-changed minds and behavior create, as we'll see in the final few chapters of this part of the book, are still an important part of the half-changed world.

which overinterpretation can occur. And I certainly don't think that research into sex differences in the brain is wrong or pointless. There *are* sex differences in the brain (although, as we've seen, agreeing on what these are is harder than you might think);[43] there are sex differences in vulnerabilities to certain psychological disorders, and hopefully greater understanding of the former might help to illuminate the latter. My point is simply this: that neither structural nor functional imaging can currently tell us much about differences between male and female minds. As Rutgers University psychologist Deena Skolnick Weisberg has recently argued, we should "remember that neuroscience, as a method for studying the mind, is still in its infancy. It shows much promise to be someday what many people want to make it into now: a powerful tool for diagnosis and research. We should remember that it has this promise, and give it the time it needs to achieve its potential—without making too much of it in the meantime."[44]

Are early twenty-first-century neuroscientific explanations of inequality—too little white matter, an unspecialized brain, too rapacious a corpus callosum—doomed to join the same garbage heap as measures of snout elongation, cephalic index, and brain fiber delicacy? Will future generations look back on early twenty-first-century interpretations of imaging data with the same shocked amusement with which we regard early twentieth-century speculations about the relevance of sex differences in spinal cord size? I suspect they will, although only time will tell. But to any scientist considering trying to relate sex differences in the brain to complex psychological functions . . . well, let's just say, "Remember Dr. Charles Dana."

And it *is* important to remember him. For as we'll see in the next chapter, the speculations of a few scientists quickly evolve into the colorful fabrications of popular neurosexism—the subspecialty within the larger discipline of neurononsense to which we now turn.

14 BRAIN SCAMS

My husband would probably like you to know that, for the sake of my research for this chapter, he has had to put up with an awful lot of contemptuous snorting. For several weeks, our normally quiet hour of reading in bed before lights out became more like dinnertime in the pigsty as I worked my way through popular books about gender difference. As the result of my research, I have come up with four basic pieces of advice for anyone considering incorporating neuroscientific findings into a popular book or article about gender: (1) unless you have a time machine and have visited a future in which neuroscientists can make reverse inferences without the nagging anxieties that keep the more thoughtful of them awake at night, do not suggest that parents or teachers treat boys and girls differently because of differences observed in their brains; (2) if you don't know what a reverse inference is, read the previous chapter of this book; (3) exercise extreme caution when making the perilous leap from brain structure to psychological function; and (4) don't make stuff up.

When it comes to selecting examples from those who have failed to follow one or more of these four simple rules, one's choices abound. Possibly my favorite illustration of a self-serving projection of prejudices onto brain jargon is a section in John Gray's *Why Mars and Venus Collide* in which he discusses the inferior parietal lobe (IPL). In men, says Gray, the left IPL is more developed, while in women it is the right side that is larger. It will be no surprise to anyone, I am sure, to learn that "[t]he left side of the

brain has more to do with more linear, reasonable, and rational thought, while the right side of the brain is more emotional, feeling, and intuitive." But it *is* extraordinary just how differently the IPL serves its master and its mistress. According to Gray a man's large left IPL, being involved in the "perception of time," explains why he becomes impatient with how long a woman talks. By contrast, the IPL also "allows the brain to process information from the senses, particularly in selective attention, like when women are able to respond to a baby's crying in the night."[1] Perhaps deliberately, we are left in the dark as to whether the male inferior parietal lobe enables a man to do the same.

In *Leadership and the Sexes*, Michael Gurian and Barbara Annis inform executives that "women's brains tend to link more of the emotional activity that is going on in the middle of the brain (the limbic system) with thoughts and words in the top of the brain (the cerebral cortex). Thus a man might need many hours to process a major emotion-laden experience [*I . . . just . . . got . . . fired. . . . I . . . am . . . sad . . . and . . . angry.*], whereas a woman may be able to process it quite quickly [*Oh, crap!*]."[2] A further neurophysiological disadvantage for men may be found in another of Gurian's books, *What Could He Be Thinking?* Implicitly drawing on a working metaphor of *The Brain as Pinball Machine*, he explains how in men the "signal" of an emotional feeling, having made it to the right hemisphere, "may well get stopped, disappearing into neural oblivion because the signal found no access to a receptor in a language center in the left side of the brain." This doesn't happen in the female brain because, according to Gurian, while men have just one or two language centers in the left hemisphere, women have as many as seven such centers, dotted all over the brain, as well as a 25 percent larger corpus callosum. (Despite this embarrassment of neurological riches, the contrast Gurian draws between male and female brain function leaves me speechless.) And so, in men, a feeling signal is much less likely to hit the jackpot of contact with a neuron involved in language.[3]

We also discover in *Leadership and the Sexes* that when a woman leader asks her colleagues, "What do you all think?" this is a typically female "white matter" question. It seems that white matter isn't just involved in integrating information from different parts of the brain, but also from different people in the office.[4] Brain differences may also be behind a female-leadership problem-solving style: when a female leader "knows what to do, she's not as worried as a man might be about proving it with data." Gurian and Annis suggest that "[o]ne reason for this intuitiveness may be that she has a larger *corpus callosum* connecting both hemispheres of the brain." By contrast, male leaders favor a problem-solving style that, in part, "relies on more linear data and proof."[5]

Perhaps my own corpus callosum runs to a smaller size than the standard female issue, but I find these intuitive leaps from brain structure to psychological function unconvincing, as noted in the previous chapter. Why should arriving at a solution to a problem through an analysis of data and proof require any less integration between hemispheres? As an example of just how wrong our intuitions can be in these matters, despite the popular assumption that a more lateralized brain will be worse at multitasking, neurobiologist Lesley Rogers and her colleagues found precisely the opposite to be the case in chicks.[6] Chicks with more lateralized brains were better at simultaneously pecking for food grains and looking out for predators (the established chick equivalent of frying a steak while making a salad).

While it may not be too surprising to discover self-appointed "thought-leaders" dressing up stereotypes in neuroscientific finery, it is more of a shock to see this in an alumnus of Harvard Medical School, the University of California–Berkeley, and Yale School of Medicine. Step forward Louann Brizendine, director of the University of California–San Francisco Women's Mood and Hormone Clinic. Her book, *The Female Brain*, cites literally hundreds of academic articles. To the unwary reader, both she and the book seem reliable and authoritative. And yet, as a review of the book in *Nature* comments, "despite the author's extensive academic credentials, *The Female Brain* disappointingly fails to meet even the

most basic standards of scientific accuracy and balance. The book is riddled with scientific errors and is misleading about the processes of brain development, the neuroendocrine system, and the nature of sex differences in general." The reviewers later go on to say that, "[t]he text is rife with 'facts' that do not exist in the supporting references."[7] This is a common discovery made by people who take the time to fact-check Brizendine's claims. Mark Liberman, a professor at the University of Pennsylvania with no special interest in gender issues, has nonetheless been provoked to provide many detailed but humorous critiques of pseudoscientific claims about gender differences on his online Language Log. His patient corrections of Brizendine's many false assertions about sex differences in communication is a chore that, as he puts it, "is starting to make me feel like the circus clown that follows the elephant around the ring with a shovel."[8]

But despite these forewarnings, when I decided to follow up Brizendine's claim that the female brain is wired to empathize, it nonetheless proved to be an exercise that turned up surprise after surprise. I tracked down every neuroscience study cited by Brizendine as evidence for feminine superiority in mind reading. (No, really, no need to thank me. I do this sort of thing for pleasure.) There were many such references, over just a few pages of text, creating the impression it was no mere opinion, but scientifically established fact, that the female brain is wired for empathy in a way that the male brain is not. Yet fact-checking revealed the deployment of some rather misleading practices. For example, let's work our way through the middle of page 162 to the top of page 164 in her book. We kick off with a study of psychotherapists, which found that therapists develop a good rapport with their clients by mirroring their actions.[9] Casually, Brizendine notes, "All of the therapists who showed these responses happened to be women."[10] For some reason, she fails to mention that this is because only female therapists, selected from phone directories, happened to be recruited for the study.

Brizendine's next claim—that girls have an advantage in understanding others' feelings—does find support in the work of Erin McClure and Judith Hall, which she cites. These researchers both conducted meta-analyses that found advantages for females in decoding nonverbal expressions of emotion.[11] The edge is, however, moderate. McClure's meta-analysis suggests that about 54 percent of girls will perform above average in facial emotion processing, compared with 46 percent of boys. Hall's review of research with tests such as the PONS nonverbal decoding task (which we encountered in Chapter 2) suggests that if you randomly chose a boy and a girl, over and over, more than a third of the time the boy would outperform the girl. Brizendine does not understate these findings, then, when she says that "[g]irls are years ahead of boys" in these abilities.[12] She then speculates that mirror neurons may lie behind these skills, enabling girls to observe, imitate, and mirror the nonverbal cues of others as a way to intuit their feelings. (Mirror neurons are neurons that respond to another animal's actions as though the animal-observer itself were acting. Some scientists think that mirror neurons may provide the neural grounding for understanding people's minds. Other scientists are dubious about the whole concept.) The study she cites here does explore the potential role of the mirror system in intuiting others' mental states—but not specifically in females.[13] Indeed, its participants (some of whom had autism-spectrum disorders) were all male.

A little later, readers are told that "brain-imaging studies show that the mere act of observing or imagining another person in a particular emotional state can automatically activate similar brain patterns in the observer—and females are especially good at this kind of emotional mirroring."[14] Cited as support for this feminine superiority in emotional mirroring is a 2004 neuroimaging study by cognitive neuroscientist Tania Singer and colleagues, who compared brain activation when someone was either receiving a painful electric shock to the hand or was aware that a loved one was receiving the same painful electric shock to the hand.[15] Singer and colleagues found that some brain regions were activated both by being shocked and watching someone else be shocked. If you

think I'm going to be nitpicky about what any sex differences in activation in this study *mean*, you're wrong. Actually, the problem of interpretation is rather more basic. Only women were scanned.

Continuing the theme of women's special sensitivity to the pain of others in the next paragraph, Brizendine informs us that when a woman, for example, responds empathically to the stubbed toe of another, she is "demonstrating an extreme form of what the female brain does naturally from childhood and even more in adulthood—experience the pain of another person."[16] Brizendine marshals two functional neuroimaging studies as support for this claim. The first is Singer's 2004 study of females' empathic responses to pain. The second is a study by Tetsuya Iidaka and colleagues, who asked participants to judge the gender of faces showing positive, negative, or neutral expressions. They compared brain activations in young versus old participants, but not in females versus males.[17] (Her third citation is a review of anxiety and depression in childhood and adolescence. It doesn't discuss responses to others' pain, or gender differences in this capacity, although the authors note that "[b]ecause females are known to be more emotionally responsive than males to the problems of *others*, a wider range of interpersonal contexts may arouse them.")[18]

In the last part of this page range, Brizendine describes Singer's 2004 study, and states that "the same pain areas of [the women's] brains that had activated when they themselves were shocked lit up when they learned their partners were being strongly shocked."[19] She references the Singer 2004 study here, naturally, but also another functional neuroimaging study by the same research team, published in 2006.[20] This study was similar, but instead of being a romantic partner who was shocked, it was a confederate who had played either fairly or unfairly in a game just before. In this study, both men and women were scanned. Again, empathy-related responses were seen in reaction to the pain of another, although in men this was only the case when the confederate had played fairly. Having referenced these two studies, Brizendine concludes that "[t]he women were feeling their partner's pain. . . . Researchers have been unable to elicit similar brain responses from men."[21] She has, however, just cited a study that *did* elicit similar brain responses from men, albeit only in response to people they liked.

By this point the reader may have a poor opinion indeed of the male neurological capacity for empathy—especially since earlier on in the chapter Brizendine suggests that females may have more of the neurons that enable mirroring. She writes that "[a]lthough most of the studies on this topic have been done on primates, scientists speculate that there may be more mirror neurons in the human female brain than in the human male brain." Look to the notes at the back of the book and no fewer than five scholarly references appear to affirm this claim.[22] The first study is in Russian. Although it did compare the sexes, from the abstract I would lay a substantial bet on it not offering much insight into gender differences in mirror neurons, as it was a postmortem study of neuron characteristics in the frontal lobes. (One would, I imagine, have to see mirror neurons in action to be able to identify them.) Three further studies did indeed look at some aspect of what is thought to be the mirror neuron system. However, none of them compared males and females, or speculated about possible differences between the sexes. And that leaves just one remaining citation, which is "personal communication" with Harvard-based cognitive neuroscientist Lindsay Oberman, entitled "There may be a difference in male and female mirror neuron functioning." When I emailed Dr. Oberman to confirm, to my surprise, she informed me that not only had she never communicated with Brizendine, but went on to write that, "to the contrary, I have looked at many of my studies and have not found evidence for better mirror neuron functioning in females."[23] (Once you've picked your jaw up off the floor, don't forget to briefly think about the 5 percent rule I mentioned in Chapter 12, in which only sex *differences* get reported.)

What is deliciously ironic about all of this is that Brizendine presents herself as the reluctant but fearless messenger of truth:

In writing this book I have struggled with two voices in my head—one is the scientific truth, the other is political correctness. I have chosen to emphasize scientific truth over political correctness even though scientific truths may not always be welcome.[24]

When I am in the mood to be irked, I flip through Brizendine's book. Perhaps because of the particular stage of life I happen to be in, I found myself most enraged by her claim that only when "the children leave home, the mommy brain circuits are finally free to be applied to new ambitions, new thoughts, new ideas."[25] But it's the sexism that bursts through the doors of preschools and schools, cleverly disguised in neuroscientific finery, that I find most disturbing. As neuroimaging takes its first steps on the long journey to understanding how neuronal firing yields mental abilities, you will find no shortage of so-called experts willing to explain the educational implications of differences in boy wiring and girl wiring. The medal for the most outrageous claim must surely go to an American educational speaker. According to reports sent to Mark Liberman's Language Log, this educational consultant has been informing audiences that girls see the details while boys see the big picture because the "crockus"—a region of the brain that does not exist—is four times larger in girls than in boys.[26]

I should reassure you that most people who talk about the educational implications of sex differences in the brain do limit themselves to regions recognized by the majority of the scientific community. I also have little doubt that many of them have the very best intentions behind their use of the brain science literature. They want to improve educational outcomes for children of both sexes. Those who promote single-sex schools may certainly have good reasons for their cause that have nothing to do with the brain. But promoting that cause by projecting gender stereotypes onto brain data is worse than useless.

Perhaps the most influential of this group of educational speakers is Leonard Sax of the National Association for Single

Sex Public Education (NASSPE), and author of two books that argue a brain-based need for single-sex schooling. Sax has a punishing speaking schedule, that so far has included the United States, Canada, Australia, and New Zealand, as well as countries in Europe—and some schools are clearly impressed. NASSPE has been involved in about half of the 360 single-sex public school programs in the United States, and Sax has told *New York Times* journalist Elizabeth Weil that about 300 of them "are coming at this from a neuroscience basis."[27] Let's take a closer look at what that means.

Take English class, for example. In the girls' class, you will find teachers asking their students to reflect on story protagonists' feelings and motives: *how would you* feel *if*? . . . sort of questions. But not in the boys' classroom, because "[t]hat question requires boys to link *emotional* information in the amygdala with *language* information in the cerebral cortex. It's like trying to recite poetry and juggle bowling pins at the same time. You have to use two different parts of the brain that don't normally work together." The problem for boys and young children, according to Sax, is that emotion is processed in the amygdala, a primitive, basic part of the brain—"that makes few direct connections with the cerebral cortex."[28] (In fact, the amygdala appears to be richly interconnected with the cerebral cortex.)[29] This supposedly renders them incapable of talking about their feelings. But in older girls, emotion is processed in the cerebral cortex, which conveniently enables them to employ language to communicate what they're feeling. The implications for teaching are clear: *girls to the left, phylogenetically primitive apebrains to the right!* Yet this "fact" about male brains—variants of which I have seen repeated several times in popular media—is based on a small functional neuroimaging study in which children stared passively at fearful faces.[30] It's doubtful whether any negative emotion was involved during the study (except perhaps boredom);[31] the children were not asked to speak or talk about what they were feeling and, critically, brain activity was not even measured in most of the areas of the brain involved in processing

emotion and language.[32] As Mark Liberman has pointed out, "the disproportion between the reported facts and Sax's interpretation is spectacular."[33] Even if studies *did* show what Sax claims (questionable),[34] why on earth would we assume that the language parts of the brain wouldn't get involved if the child wished to speak? Shifting information from A to B is, after all, what axons and dendrites are *for*. Yet Sax describes with admiration a boy-brain-friendly English class in which boys study *The Lord of the Flies* by reading the text not with an eye on the plot, or characterization, but so as to be able to construct a map of the island.

And it's all happening at a school near you. At a coeducational school in my neighboring suburb, "parallel education" is provided for boys and girls in certain years. As a journalist explains, "teaching boys [math] was more about hands-on practice: drawing, doing the exercise. But in a class with girls, Davey [the middle school principal] discusses the issues for a full 10 minutes at the start of the class, while the graph is put in the context of a relationship between two people."[35] Perhaps Davey has read one of the other "neurofallacies" propagated by Sax, that because boys process math in the hippocampus (another one of those primitive parts of the brain that males so seem to favor), but girls process geometry and math "in the cerebral cortex" (a statement so unspecific as to be a bit like saying, "I'll meet you for coffee in the Northern Hemisphere"), this indicates a need for very different educational strategies. Sax claims that because the primitive hippocampus has "no direct connections to the cerebral cortex" [um, again, not quite right] boys are happy dealing with math "'for its own sake' at a much earlier age than girls are." But for the girls, because they're using their cerebral cortex, "you need to tie the math into other higher cognitive functions."[36] The goal of inspiring children to get excited about math is certainly admirable. But Sax's claim that the results of a neuroimaging study of maze navigation point to a brain-based need to teach girls and boys in these different kinds of ways is simply neurononsense.[37]

Mark Liberman has analyzed in meticulous detail many of

Sax's dubious brain-based educational claims, and has described the way so-called educational experts like Sax and Gurian use scientific data as "shockingly careless, tendentious and even dishonest. Their over-interpretation and mis-interpretation of scientific research is so extreme that it becomes a form of fabrication."[38] While it might be amusing to think up romance stories involving stolid Mr. X-Axis and flighty Ms. Y to amuse the girls, or an interesting challenge to discuss a book without mentioning mental states, the danger is that self-fulfilling prophecies are being delivered alongside the new-look, single-sex curriculum.

Vicky Tuck, while president of the Girls' School Association, UK, recently argued that there are "neurological differences" between the sexes that are "pronounced in adolescence." The practical implication? "You have to teach girls differently to how you teach boys."[39] Is she right? Remember how easily spurious findings of sex differences can lead to premature speculation. Remember what Celia Moore and Geert De Vries have pointed out—sex differences in the brain can be compensation, or a different path to the same destination. Bear in mind that neuroscientists are still quarreling over the appropriate statistical analysis of highly complex data. Recall that many sex differences in the brain may have more to do with brain size than sex per se. Remember that psychology and neuroscience—and the way their findings are reported—are geared toward finding difference, not similarity. Male and female brains are of course far more similar than they are different. Not only is there generally great overlap in "male" and "female" patterns, but also, the male brain is like nothing in the world so much as a female brain. Neuroscientists can't even tell them apart at the individual level. So why focus on difference? If we focused on similarity, we'd conclude that boys and girls should be taught the same way.

You're not convinced? You feel sure these brain differences must be educationally important? Okay, fine. Separate your boys and girls. Or, if you want to be really thorough, because there is overlap with these sex differences, strictly speaking one should

provide separate streaming for, say, Large Amygdalas and Small Amygdalas, or Overactivated versus Underactivated Left Frontal Lobes. And now tell me *how* you tailor your teaching to the size of the amygdala, or to patterns of brain activity to a photo of a fearful face. There is no reliable way to translate these brain differences into educational strategies. It is, as philosopher John Bruer has poetically put it, "a bridge too far": "Currently, we do not know enough about brain development and neural function to link that understanding directly, in any meaningful, defensible way to instruction and educational practice. We may never know enough to be able to do that."[40] And so, instead, we quickly find ourselves falling back on god-awful gender stereotypes.

We never seem to learn.

No discussion of the brain, sex, and education would be complete without mention of the now-notorious theory of Professor Edward Clarke of the Harvard Medical School. In his highly successful nineteenth-century book, *Sex in Education* (subtitled, somewhat ironically as it turned out, *Or, A Fair Chance for Girls*), he proposed that intellectual labor sent energy rushing dangerously from ovaries to brain, endangering fertility as well as causing other severe medical ailments.[41] As biologist Richard Lewontin dryly remarked of this hypothesis, "Testicles, apparently, had their own sources of energy."[42] From our modern vantage point we can laugh at the prejudice that gave rise to this hypothesis. Yet we may have little cause for complacency.

Tuck says she has "a hunch that in 50 years' time, maybe only 25, people will be doubled up with laughter when they watch documentaries about the history of education and discover people once thought it was a good idea to educate adolescent boys and girls together."[43] But when I survey the popular literature, I suspect that this will not be where the people of the future will find their biggest laughs. Frankly, I think they will be too busy giggling in astonished outrage at the claims of early twenty-first-century

commentators who, like their nineteenth-century predecessors, reinforced gender stereotypes with crude comparisons of male or female brains; or who, like Brizendine with her talk of "overloaded brain circuits," attempted to locate social pressures in the brain. (*Here it is, Michael! I finally found the neural circuits for organizing child care, planning the evening meal, and ensuring that everyone has clean underwear. See how they crowd out these circuits for career, ambition, and original thought?*)

I end with a plea. Although, as we'll see in the next chapter, there is something captivating about neuroscientific information, please, no more neurosexism! Follow the four simple steps I set out at the beginning of the chapter or leave the interpretations to the trained professionals. Neuroscience can be dangerous when mishandled, so if you're not sure, be safe.

As the blogger known as Neuroskeptic wisely advises those who peddle neurononsense, "Save yourself . . . put the brain down and walk away."[44]

15 THE "SEDUCTIVE ALLURE" OF NEUROSCIENCE

I once bought a toy drum that promised to stimulate my child's auditory nerve. I took this to mean that it made noise. Clearly, the genius minds behind the marketing had stumbled on the discovery that information sounds far more impressive when couched in the grand language of neuroscience. (By the way, have I mentioned yet that these words of mine you're reading are stimulating your occipital lobe, as well as refining the neural circuitry of your anterior cingulate gyrus and dorsolateral prefrontal cortex? This isn't just a book—it's a neurological workout.) There's something special about neuroscientific information. It sounds so unassailable, so very . . . well, *scientific*, that we privilege it over boring, old-fashioned behavioral evidence. It brings a satisfying feel to empty scientific explanations. And it seems to tell us who we really are.

After Lawrence Summers's controversial suggestion that women might be inherently less capable of high-level science, Steven Pinker and Simon Baron-Cohen were not the only ones to talk brain differences. So did Leonard Sax. Refreshingly, Sax did not argue that brain research hints at an innate female inferiority, on average, in science and math. Instead, he argued that the problem lies in an educational system that teaches boys and girls the same things at the same time. This is a mistake because, as he explained in the *Los Angeles Times*, "while the areas of the brain involved in

language and fine motor skills (such as handwriting) mature about six years earlier in girls, the areas involved in math and geometry mature about four years earlier in boys."[1] Sax argues that teaching should be sensitive to sex differences in the timing of development of the various regions of the brain because "[a] curriculum which ignores those differences will produce boys who can't write and girls who think they're 'dumb at math.'"[2]

Now, I'm all behind Sax's goal of improving educational outcomes for boys and girls. There might be good reasons for single-sex schooling. But what are we to make of his claim that, as he put it to *CBS News*, "[b]oth boys and girls are being shortchanged as a result of the neglect of hard-wired gender differences"?[3]

By now, you will probably be uneasy about the idea that complex psychological skills like language, math, and geometry can be pinpointed to a single part of the brain. It's simply not the case that people use one particular lobe, or a circumscribed area of the brain, to read a novel, or write an essay, or solve an equation, or calculate the angle of a triangle. And, unfortunately, neuroscience has yet to reach the stage at which it can peer into the brain and determine capacity for solving simultaneous equations or readiness to learn calculus. I can understand why this relatively subtle point didn't set off alarm bells in Sax or the editors or journalists who brought comments like this to the public eye. But why did no one query the relevance of Sax's statement on the grounds that boys are clearly *not*, in fact, four years ahead of girls in math—they are not ahead of them at all, as it happens.[4] Nor, of course, is the language ability of a twelve-year-old boy comparable to that of a six-year-old girl. Even if we are happy to relate one part of the brain to complex cognition, clearly, this concept of neural maturation is a very poor index of actual ability—a far worse measure than, say, a math test. So why does this kind of neurononsense get column inches?

One reason may be that neuroscience easily outranks psychology in the implicit hierarchy of "scientificness."[5] Neuroscience, after all, involves expensive, complex machinery. It generates smart-looking three-dimensional images of the brain. The tech-

nicians almost certainly wear white coats. It involves quantum mechanics, for goodness' sake! I ask you, what kind of a match for this is a simple piece of paper on which a six-year-old girl has successfully added 7 and 9? Bioethicist Eric Racine and colleagues coined the term "neuro-realism" to describe how fMRI coverage can make psychological phenomena somehow seem more real or objective than evidence collected in a more ordinary fashion. They describe how, for example, brain activation in the reward centers of the brain while people ate unhealthy food was provided as evidence that "[f]at really does bring pleasure."[6] If patterns of firing in the brain can be seen as better proof of someone feeling pleasure than them selecting the box on the questionnaire marked "Yes, I really enjoyed eating that doughnut," then it's not surprising that children's actual academic skills can be so easily overlooked when brain research is enjoying the spotlight.

I also suspect that because the brain is such a biological organ, with its axons and fat and neurochemicals and electrical impulses, there is the temptation to chalk up whatever sex differences we see in the brain to differences in male and female nature, as Michael Gurian and Kathy Stevens do in *The Minds of Boys*:

> The social thinkers of the 1950s, 1960s, and 1970s did not have PET scans, MRIs, SPECT scans, and other biological research tools available to them. . . . Because they could not look inside the heads of human beings to see the differences in the brains of males and females, they had to lean away from nature-based theory toward social trends theory. They had to overemphasize the power of nurture in gender studies because they didn't have a way to study the actual nature of male and female.[7]

Gurian and Stevens seem to equate "actual nature" with "brain." But really, when you think about it, where else but in the brain would we see the effects of socialization or experience? As Mark Liberman puts it, "how else would socially constructed

cognitive differences manifest themselves? In flows of pure spiritual energy, with no effect on neuronal activity, cerebral blood flow, and functional brain imaging techniques?"[8] The "neuro-curmudgeons" from the James S. McDonnell Foundation have picked up on this "brain = innate" tendency, too. In response to an article in the *New York Times* that claimed from an fMRI study that "a mother's impulse to love and protect her child appears to be hard-wired into her brain" one neuro-curmudgeon put out a plea to "take experience and learning seriously. Just because you see a response [in the brain]—you don't get to claim it's hard-wired."[9]

Another draw of neurononsense is what Yale researchers have referred to as "the seductive allure of neuroscience explanations." Deena Skolnick Weisberg and her colleagues found that people are pretty good at spotting bad explanations of psychological phenomena. Suppose, for example, you read about a study in which researchers found that men performed better than women on spatial reasoning tasks. Would you be satisfied by the circular explanation that "women's poor performance relative to men's explains the gender difference in spatial reasoning abilities"? Probably not. The researchers aren't explaining their result, they're redescribing it: *women are worse at spatial reasoning because women are worse at spatial reasoning.* But simply add neuroscience and the same non-explanations suddenly seem much more satisfying:

> Brain scans of the right premotor area, known to be involved in spatial relational tasks, indicate that **women's poor performance relative to men's** causes different types of brain responses. This **explains the gender difference in spatial reasoning abilities.**

In bold text is the circular explanation that people found unsatisfying. The extra neuroscience bit tells us that spatial reasoning recruits a part of the brain, which should hardly surprise us. But it doesn't tell us *why* women performed worse than men. The explanation is still circular. But the neuroscience disguises

this, even for students enrolled in an introductory cognitive science class, Weisberg and colleagues found.[10] Although it's not yet clear what it is, exactly, about neuroscience that is so persuasive, it's been found that people find scientific arguments more compelling when accompanied by an image showing brain activation rather than, say, a bar graph showing the same information.[11]

All of which should make us very concerned that this talk of brain differences might influence opinion and policy far more than it should. As Weisberg suggests, the seductive nature of neuroscience creates "a dangerous situation in which it may not be the best research that wins debates in the public sphere."[12]

The effects of neuroscience may be personal as well as political. Gender stereotypes are legitimated by these pseudo-scientific explanations. Suddenly, one is being modern and scientific, rather than old-fashioned and sexist. Do you want to claim, in a book for teachers and parents, that "the world of the abstract . . . is explored more by the male brain than the female," thus explaining males' dominance in physics?[13] Why then, go right ahead! So long as the magic word *brain* is there, no further information required. But we have to wonder about the effect of this kind of information as it feeds back into society. As we saw in the first part of this book, the activation of gender stereotypes, even by means as subtle as our suspicion that they have found a home in the minds of others, can have measurable effects on our attitudes, identity, and performance.

Neurosexism may also effect such changes directly. We can currently only speculate on the enervating effect of popular gender-science books on male patterns of leaving the milk to be bought by someone else. But there is evidence that media reports of gender that emphasize biological factors leave us more inclined to agree with gender stereotypes, to self-stereotype ourselves, and even for our performance to fall in line with those stereotypes.[14] For example, one study found that women given a journal article to read that claimed that men are better at math because of innate, biological, and genetic differences performed worse on a GRE-like

math test than women shown an essay saying that men's greater effort underlies their superior performance. Likewise, women who had just read an essay arguing that there are genetically caused sex differences in mathematical ability performed substantially worse on a GRE-like test, compared with women who read that experiential factors explain sex differences in math ability, psychologists Ilan Dar-Nimrod and Steven Heine found. (Being told this information by the experimenter had the same effect.) This damaging effect of the genetic account, the researchers suggest, may stem from people's assumption that genetically based differences are more profound and immutable than differences that arise from social factors. "[M]erely considering the role of genes in math performance can have some deleterious consequences," they conclude. "These findings raise discomforting questions regarding the effects that scientific theories can have on those who learn about them and the obligation that scientists have to be mindful of how their work is interpreted."[15]

"Caveat lector" is Weisberg's advice. Neuroscientists who work in this area have some responsibility for how their findings of sex differences in the brain are interpreted and communicated. When this is done carelessly, it may have a real and significant impact on people's lives. Many neuroscientists do appear to be aware of this. They are appropriately cautious about interpreting sex differences in the brain, and many also take the time to remind journalists of just how far we are from mapping sex differences in the brain onto the mind. (And of course they may find their work being misrepresented, regardless.) Others, however, as we have seen, are more cavalier.

Not everyone would agree that the topic of sex differences in the brain requires a particular sensitivity. For example, sex-difference researcher Doreen Kimura has argued that "[w]e can't allow ourselves to get into a situation in which we say . . . 'This is a finding that won't upset anyone, so I'm willing to generalize from

it, but this other finding may be unpopular, so I need more evidence to support it before reporting it.'"[16] I am not inclined to agree that the content of the research makes no difference to the degree of care scientists should take in generalizing a result, or their concern in how it is popularized by others. I have, for example, heard neuroscientists who work in the area of drug dependency talk about the efforts they go to to prevent simplification or distortion of their findings by the media. This is not because they are worried about "upsetting" people, but because it is a sensitive area, and "brain facts" about dependency can change people's attitudes and feelings about a particular social group. These neuroscientists didn't seem to consider it unreasonable to work under a heavier burden of caution—a burden that I suggest it is also appropriate to place on those who comment on sex differences in the brain.[17]

Finally, there's an urgent need for editors, journalists, and schools to develop far more skeptical attitudes toward claims made about sex differences in the brain. It is appalling to me that one can, apparently, say whatever drivel one likes about the male and female brain, and enjoy the pleasure of seeing it published in a reputable newspaper, changing a school's educational policy, or becoming a best seller. Scientists can help here (as many already are). Weisberg suggests (in relation to the interpretation of imaging studies in general) that we "take a more active stance as scientists, medical practitioners, and researchers." She advocates that researchers become "vocal critics" of misleading articles, put more pressure on "newspaper and magazine writers to cover scientific issues with more depth and nuance," and, to this end, offer their expertise to members of the media.[18]

Neurosexism promotes damaging, limiting, potentially self-fulfilling stereotypes. Three years ago, I discovered my son's kindergarten teacher reading a book that claimed that his brain was incapable of forging the connection between emotion and language. And so I decided to write this book.[19] To make this kind of confident claim about hardwired psychological differences between males and females is to overlook the likelihood of

spurious findings, the teething problems of new technology, the obscurity of the relationship between brain structure and psychological function, and the difficulty of inferring psychological states from neuroimaging data. Dazzled by the seductive scientificness of neuroscience, commentators become blind to low-tech behavioral evidence of gender similarity, or flexibility in response to the social context. And, as we'll explore more in the next chapter, the very concept of hardwiring needs some updating.

16 UNRAVELING HARDWIRING

A member of my family, who shall remain nameless, refers to all newborns as "blobs." There's a certain, limited truth to the description. Certainly, research continues to reveal just how sophisticated the neonate mind really is: already tuned to prefer its mother tongue, seek out facelike stimuli, time its waking up to coincide precisely with when its parents have just fallen most deeply into sleep. But it would not be an overstatement to say that newborns still have much to learn. Ideas about how this happens have been changing in important ways in neuroscience.

For decades, brain development has been thought of as an orderly adding in of new wiring that enables you to perform ever-more-sophisticated cognitive functions. According to this maturational viewpoint, gene activity at the appropriate time (and with the necessary experience and environment) brings about the maturation of new bits of neural circuitry. These are added in, enabling the child to reach new developmental milestones. Everyone, of course, acknowledges the essential role of experience on development. But when we think of brain development as a gene-directed process of adding in new circuitry, it's not difficult to see how the concept of hardwiring took off. It's been helped along by the popularity of evolutionary psychology, versions of which have promoted the idea that we are the luckless owners of seriously outdated neural circuitry that has been shaped by natural selection to match the environment of our hunter-gatherer ancestors.

But our brains, as we are now coming to understand, are

changed by our behavior, our thinking, our social world. The new neuroconstructivist perspective of brain development emphasizes the sheer exhilarating tangle of a continuous interaction among genes, brain, and environment. Yes, gene expression gives rise to neural structures, and genetic material is itself impervious to outside influence. When it comes to genes, you get what you get. But gene *activity* is another story: genes switch on and off depending on what else is going on. Our environment, our behavior, even our thinking, can all change what genes are *expressed*.[1] And thinking, learning, sensing can all change neural structure directly. As Bruce Wexler has argued, one important implication of this neuroplasticity is that we're not locked into the obsolete hardware of our ancestors:

> In addition to having the longest period during which brain growth is shaped by the environment, human beings alter the environment that shapes their brains to a degree without precedent among animals. . . . It is this ability to shape the environment that in turn shapes our brains that has allowed human adaptability and capability to develop at a much faster rate than is possible through alteration of the genetic code itself. This transgenerational shaping of brain function through culture also means that processes that govern the evolution of societies and cultures have a great influence on how our individual brains and minds work.[2]

It's important to point out that this is not a starry-eyed, environmentalist, we-can-all-be-anything-we-want-to-be viewpoint. Genes don't determine our brains (or our bodies), but they do constrain them. The developmental possibilities for an individual are neither infinitely malleable nor solely in the hands of the environment. But the insight that thinking, behavior, and experiences change the brain, directly, or through changes in genetic activity, seems to strip the word "hardwiring" of much useful meaning. As neurophysiologist Ruth Bleier put it over two decades ago,

we should "view biology as potential, as capacity and not as static entity. Biology itself is socially influenced and defined; it changes and develops in interaction with and response to our minds and environment, as our behaviors do. Biology can be said to define possibilities but not determine them; it is never irrelevant but it is also not determinant."[3]

And so, what do popular writers, scientists, and former presidents of Harvard *mean* when they refer to gender differences as "hardwired," or "innate," or "intrinsic," or "inherent"? Some philosophers of biology, so far as I can tell, devote entire careers to the concept of innateness and what, if anything, it might mean. As cognitive neuroscientist Giordana Grossi points out, terms like *hardwired*—on loan from computer science where it refers to fixedness—translate poorly to the domain of neural circuits that change and learn throughout life, indeed, in *response* to life.[4]

Certainly, there is far more acknowledgment now of the role of experience and environment compared with a century or so ago. In the early twentieth century, "[g]enius was considered an innate quality which would naturally be manifested if it were possessed," as psychologist Stephanie Shields summarizes.[5] No one now, I should think, would agree with this. And yet there remains, in some quarters, a Victorian-style attachment to notions of innate, immutable, inevitable qualities. How else to explain why the Greater Male Variability hypothesis—the idea that men are more likely to be outliers, good or bad ("more prodigies, more idiots"[6])—appears to be no less appealing now than it was over a century ago?[7] In the early twentieth century, the Greater Male Variability hypothesis offered a neat explanation of why men so outnumbered women in eminence, despite the fact that there was little sex difference in the average scores of men and women on psychological tests. As Edward Thorndike (the sociologically unimaginative psychologist we met in the Introduction) explained it in 1910:

> In particular, if men differ in intelligence and energy by wider extremes than do women, eminence in and leadership of the world's affairs of whatever sort will inevitably belong oftener to men. They will oftener deserve it.[8]

And today, it seems, they oftener deserve high-ranking positions in mathematics and science, according to Lawrence Summers:

> It does appear that on many, many different human attributes—height, weight, propensity for criminality, overall IQ, mathematical ability, scientific ability . . . there is a difference in the standard deviation and variability [statistical measures of the spread of a population] of a male and a female population. And that is true with respect to attributes that are and are not plausibly, culturally determined. If one supposes, as I think is reasonable, that if one is talking about physicists at a top twenty-five research university . . . small differences in the standard deviation will translate into very large differences in the available pool.[9]

I'd love to know, by the way, how extreme *non*criminality manifests itself. (Number of Supreme Court judges, perhaps?) But more to the point, the assertion that males are more variable in all regards—whether you're talking weight, height, or SAT scores—certainly helps to frame variability as "a guy thing" across the board. The implication is that there is something *inevitable* and immutable about greater male variability in mathematical and scientific ability. Certainly, in the furor that followed, Steven Pinker defended the idea of the timeless, universal nature of greater male variability ("biologists since Darwin have noted that for many traits and many species, males are the more variable gender").[10] Susan Pinker also plays the argument that "[m]en are simply more variable" in the shadow of the Summers controversy.[11] Her book displays a graph showing the findings from a report published by psychologist Ian Deary and his colleagues—a massive IQ study of 80,000 Scottish children born in 1921. Boys' and girls' average IQs were the same, the study found, but the boys' scores were more

variable. But as the educational psychologist Leta Stetter Hollingworth pointed out in 1914, and as Ian Deary and his colleagues felt compelled to reiterate nearly 100 years later, "the existence of sex differences either in means or variances in ability says nothing about the source or inevitability of such differences or their potential basis in immutable biology."[12] This should be more obvious to us now than it was a hundred years ago when capacity for eminence was regarded as something that was simply "in there." We realize that, as Grossi has pointed out, "[m]athematics and science are learned in a period of time that spans across several years; passion and application need to be constantly nurtured and encouraged."[13]

And, as it turns out, contemporary investigations of variability—both in the general population and in the most intellectually blessed pockets—have been showing that "inevitable" and "immutable" are adjectives that need not apply when it comes to describing greater male variability in mental ability. One cross-cultural study, published several years before the Summers debacle, compared sex differences in variability in verbal, math, and spatial abilities to see if the greater male variability in the United States was invariably seen in other countries. It was not. In each cognitive domain, there were countries in which females' scores were more variable than males'.[14]

More recently, several very large-scale studies have collected data that offer tests of the Greater Male Variability hypothesis by investigating whether males are inevitably more variable in math performance, and always outnumber females at the high end of ability. The answer, in children at least, is no. In a *Science* study of over 7 million United States schoolchildren, Janet Hyde and her team found that across grade levels and states, boys were modestly more variable than girls. Yet when they looked at the data from Minnesota state assessments of eleventh graders to see how many boys and girls scored above the 95th and 99th percentile (that is, scored better than 95 percent, or 99 percent, of their peers) an interesting pattern emerged. Among white children there were, respectively, about one-and-a-half and two boys for every girl. But among Asian American kids, the pattern was different. At the 95th percentile boys' advantage was less, and at the 99th percentile there were more girls than boys.[15] Start to look in other countries and you find further evidence that sex differences in variability are, well, variable. Luigi Guiso's cross-cultural *Science* study also found that, like the gender gap in mean scores, the ratio of males to females at the high end of performance is something that changes from country to country. While in the majority of the forty countries studied there were indeed more boys than girls at the 95th and 99th percentiles, in four countries the ratios were equal or even reversed. (These were Indonesia, the UK, Iceland, and Thailand.)[16] Two other large cross-cultural studies of math scores in teenagers have also found that although males are usually more variable, and outnumber girls at the top 5 percent of ability, this is not inevitably so: in some countries females are equally or more variable, or are as likely as boys to make it into the 95th percentile.[17]

Of course, scoring better than 95 or 99 percent of your school peers in mathematical ability is probably a baseline condition for eventually becoming a tenured Harvard professor of mathematics: like having hands, if you want to be a hairdresser. Top scorers on standardized math tests may be what one group of researchers, rather stingily, refers to as "the merely gifted."[18] But also changeable is the proportion of girls identified in what's called the Study of Mathematically Precocious Youth (SMPY), which gives the quantitative section of the Scholastic Aptitude Test (the SAT) to kids who, theoretically, are way too young to take it. Children who score at least 700 (on a 200 to 800 scale) are defined as "highly gifted." In the early 1980s, highly gifted boys identified by the SMPY outnumbered girls 13 to 1. By 2005, this ratio had plummeted to 2.8 to 1.[19] That's a big change.

Being highly gifted is, I imagine, rather nice, but at the risk of swelling the head of any research mathematicians in top-ranked institutions who happen to be reading this book, they need to

have made it onto the next rung of the giftedness ladder, and be "profoundly gifted." And here again—in this literally one-in-a-million category—there can be striking differences in female representation, depending on time, place, and cultural background. The International Mathematical Olympiad (IMO) is a nine-hour exam, taken by six-person teams sent from up to ninety-five countries. The length of the exam is off-putting enough, but the six problems within it are also so difficult that every year just a few students (or sometimes even none) get a perfect score. We tend not to hear that much about math competitions (perhaps in part because, let's be honest, live televised coverage of a nine-hour math exam would not make for compelling viewing). So it's probably worth pointing out that these competitions are not female-free zones. Girls are among those who achieve perfect scores. Girls, like US team member Sherry Gong, win medals for outstanding performance. Gong won a silver medal in the 2005 IMO and a gold medal in 2007. The girl can do math—and she's not alone. As the researchers point out, "numerous girls exist who possess truly profound ability in mathematical problem solving."[20]

But an equally important insight from their analysis is what a difference where you come from makes for your chances of being identified and nurtured as a math whiz. Between 1998 and 2008 *no* girls competed for Japan. But next door, seven girls competed for South Korea (which, by the way, ranks higher than Japan). A profoundly gifted young female mathematician in Slovakia has a five times greater chance of being included on the IMO team than her counterpart in the neighboring Czech Republic. (Again, Slovakia outperforms the Czech Republic. I say this not to be competitive, but merely to show that teams with more girls have not been scraping the bottom of the barrel.) The ratio of female members on IMO teams among the top 34 participating countries ranges from none at all, to 1 in 4 (in Serbia and Montenegro). This is not random fluctuation, but evidence of "socio-cultural, educational, or other environmental factors" at work.[21]

In fact, we can see this very clearly even within North America. Being underrepresented on the IMO team, or the Mathematical Olympiad Summer Program (MOSP), is not, as you might assume, a *girl* problem. It's more subtle and interesting than that. First of all, if you're Hispanic, African American, or Native American, it matters not whether you have two X chromosomes or one—you might as well give up now on any dreams of sweating for nine hours over some proofs. Then within girls, interesting patterns emerge. Asian American girls are *not* underrepresented, relative to their numbers in the population. But that doesn't mean that it's even simply a *white girl* problem. Non-Hispanic white girls born in North America are sorely underrepresented: there are about twenty times fewer of them on IMO teams than you'd expect based on their numbers in the population, and they virtually never attend the highly selective MOSP. But this isn't the case for non-Hispanic white girls who were born in Europe, immigrants from countries like Romania, Russia, and the Ukraine, who manage on the whole to keep their end up when it comes to participating in these prestigious competitions and programs. The success of this group of women continues into their careers. These women are *a hundred times more likely* to make it into the math faculty of Harvard, MIT, Princeton, Stanford, or University of California–Berkeley than their native-born white counterparts. They do every bit as well as white males, relative to their numbers in the population. As the researchers conclude:

> Taken together, these data indicate that the scarcity of USA and Canadian girl IMO participants is probably due, in significant part, to socio-cultural and other environmental factors, not race or gender *per se*. These factors likely inhibit native-born white and historically underrepresented minority girls with exceptional mathematical talent from being identified and nurtured to excel in mathematics. Assuming environmental factors inhibit most mathematically gifted girls being raised in most cultures in most countries at most times from pursuing mathematics to the best of their ability,

we estimate the *lower* bound on the percentage of children with IMO medal-level mathematical talent who are girls to be in the 12%–24% range [i.e., the levels seen in countries like Serbia and Montenegro]. . . . In a gender-neutral society, the real percentage could be significantly higher; however, we currently lack ways to measure it.[22]

That's a lot of squandered talent, and among boys, too. As the researchers acknowledge, the data they collected can't answer the question of whether females—in a perfectly gender-equal environment—could match (or, why not be bold, perhaps even surpass) males in math. But the gender gap is narrowing all the time, and shows that mathematical eminence is not fixed, or hardwired or intrinsic, but is instead responsive to cultural factors that affect the extent to which mathematical talent is identified and nurtured, or passed over, stifled, or suppressed in males and females.

And so this is all good news for Lawrence Summers, who said that he "would far prefer to believe something else" than the "unfortunate truth" that, in part, "differing variances" lie behind women's underrepresentation in science.[23] And for Pinker, too, who warned Summers' detractors that "[h]istory tells us that how much we want to believe a proposition is not a reliable guide as to whether it is true."[24] Evidence for the malleability of the gender gap in ability and achievement is there. And this is important because, as we learned in the first part of the book, it makes a difference what we believe about difference. Stanford University's psychologist Carol Dweck and her colleagues have discovered that what you believe about intellectual ability—whether you think it's a fixed gift, or an earned quality that can be developed—makes a difference to your behavior, persistence, and performance. Students who see ability as fixed—a gift—are more vulnerable to setbacks and difficulties. And stereotypes, as Dweck rightly points out, "are stories about gifts—about who has them and who doesn't."[25] Dweck and her colleagues have shown that when students are encouraged to see math ability as something that grows with effort—pointing out, for example, that the brain forges new connections and develops better ability every time they practice a task—grades improve and gender gaps diminish (relative to groups given control interventions).[26] The Greater Male Variability hypothesis, of course, endorses the view that very great intellectual ability is indeed a fixed trait, a gift bestowed almost exclusively on men. Add a little talk of women's insufficient white matter volumes, or their plump corpora callosa, and the ingredients for a self-fulfilling prophecy are all in place.

The sensitivity of the mind to neuroscientific claims about difference raises ethical concerns.[27] A recent study by University of Exeter psychologist Thomas Morton and his colleagues asked one group of participants to read the kind of passage that is the bread-and-butter of a certain type of popular gender science book. It presented essentialist theories—that gender difference in thinking and behavior are biological, stable, and immutable—as scientifically established facts. A second group read a similar article, but one in which the claims were presented as being under debate in the scientific community. The "fact" article led people to more strongly endorse biological theories of gender difference, to be more confident that society treats women fairly, and to feel less certain that the gender status quo is likely to change. It also left men rather more cavalier about discriminatory practices: compared with men who read the "debate" article, they agreed more with statements like, "If I would work in a company where my manager preferred hiring men to women, I would privately support him," and "If I were a manager in a company myself, I would believe that more often than not, promoting men is a better investment in the future of the company than promoting women." They also felt better about themselves—a small consolation indeed to women, I think you'll agree.

Interestingly, for men who tend to the view that sex discrimination is a thing of the past, the appeal of essentialist research is enhanced by evidence that the gender gap is closing, Morton and his colleagues also found. Participants were asked to rate research that investigated the genetic basis of sex differences in mouse brains, as well as claiming that similar factors may underlie psychological gender differences in humans. Beforehand they read an article, supposedly from a national newspaper, arguing either that gender inequality was stable, or closing. After reading about women's gains these men more readily agreed that "this type of research should continue, deserved more funding, was good for society, represented the facts about gender differences, and made a major contribution to understanding human nature."[28]

Taken together, Morton's findings suggest that women's gains will, in certain quarters, increase demand for essentialist research. As this research trickles back into society, people will turn away from social and structural explanations of gender difference. They will give up on the idea of further social change. And, to help the belief in the inevitability of inequality come true, workplace discrimination against women will increase.

It is, I think, time to raise the bar when it comes to the interpretation and communication of sex differences in the brain. How long, exactly, do we need to learn from the mistakes of the past?

As we've seen in this part of the book, speculating about sex differences from the frontiers of science is not a job for the faint-hearted who hate to get it wrong. So far, the items on that list of brain differences that are thought to explain the gender status quo have always, in the end, been crossed off.[29] But before this happens, speculation becomes elevated to the status of fact, especially in the hands of some popular writers. Once in the public domain these supposed facts about male and female brains become part of the culture, often lingering on well past their best-by dates. Here, they reinforce and legitimate the gender stereotypes that interact with our minds, helping to create the very gender inequalities that the neuroscientific claims seek to explain.[30]

PART 3

Recycling Gender