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Understanding Different Brains

Notice the title of this chapter. It sounds so distant and clinical, as if we are talking about someone else's brains. But you and I know it's not the brains of "those" students out there; it's the brains of your own students and maybe even your own children. The reason I used a sort of impersonal format is because, just for a moment, I'd like you to consider the generic three-pound mass on top of your shoulders. Just for a moment, think of the misbehaving or underperforming brain as a mystery to solve instead of as a problem. This chapter puts critical pieces of the puzzle together for you. You may be surprised what has been learned recently about the human brain, behavior, and academic achievement.

THE MYTH OF THE HEALTHY OR "TYPICAL" BRAIN

Intuition tells teachers to use differentiation strategies with their students. If you were to scan the actual structure of the human brain, what would you discover? At the Department of Neurology in the David Geffen School of Medicine at UCLA, neuroscientists have been collecting brain data from around the world as well as using their own state-of-the-art scans. They have scanned the healthy, "normal" human brain throughout the human lifespan using structural and functional brain imaging data. As part of the

International Consortium for Brain Mapping (ICBM), these scientists have developed a set of "normal" criteria for subject inclusion. The idea was to discover what the typical brain looks like. Naturally, they needed the associated exclusion criteria, too.

Over several years, almost 2,000 subjects responded to public advertisements for "those with no health problems." Each of the consortium sites (e.g., UCLA) ensured that every subject was prescreened by (1) a detailed telephone interview, (2) in-person history gathering, and (3) physical examination. This procedure was designed to exclude those who were not likely to have healthy, typical brains. For example, those with a history of head trauma, high blood pressure, violence, and long-term medication usage or drug abuse were excluded from the study.

Let's find out how common it is to have a healthy brain. Of those who responded to the advertisement and considered themselves to be normal, only 32 percent passed the telephone screening process. Of those who qualified for the in-person health history and physical examination, only 52 percent passed these screening procedures. Now we can do the math: only 11 percent of those individuals who believed they were healthy and normal even qualified for imaging. The study concludes by saying, "The majority of individuals who consider themselves normal by self-report are found not to be so" (Mazziotta et al., 2009, p. 914).

What does this tell you about people who are known to have problems, differences, or disabilities? The study suggests reexamining the inclusion of qualifications of subjects in brain imaging studies, the criteria used to select them, and the conclusions that can be drawn from them (Mazziotta et al., 2009). By the way, the study was published in a peer-reviewed scientific journal by pioneers in the brain-imaging field, including John Mazziotta and Arthur Toga. The take-home message from this study is that differences are the norm, not the exception!

Understanding What Runs the Brain

We start with the premise that all brains are unique. Now we acknowledge that children's brains are influenced by a host of factors. They include (but are not limited to) exposure to toxins, genetics, relationships, socioeconomic status, siblings, maternal education, maternal drug abuse, and what mom did during pregnancy. First, different factors have a different influence at different ages. How much your mother (or primary caregiver) lavishes attention on you matters more from birth to age 3 than from, for example, 13 to 15 years old. Peers, on the other hand, mean more to a teenager than they do to a 2-year-old. Teens want social status more than kids do at age 5. Second, at every age there are factors that exacerbate others and cause outcomes to deteriorate. If you don't have friends at age 12 but you excel at sports, you may avoid depression. If you don't get a quality childcare experience but your childhood included a wide range of engaging, age-appropriate activities, you may have no disadvantage.

The point here is that your brain develops depending on the aggregate of factors over time. One event (unless it is a significant trauma) is less likely to change the developing brain, but many do over time.

What Matters Most to the Developing Brain

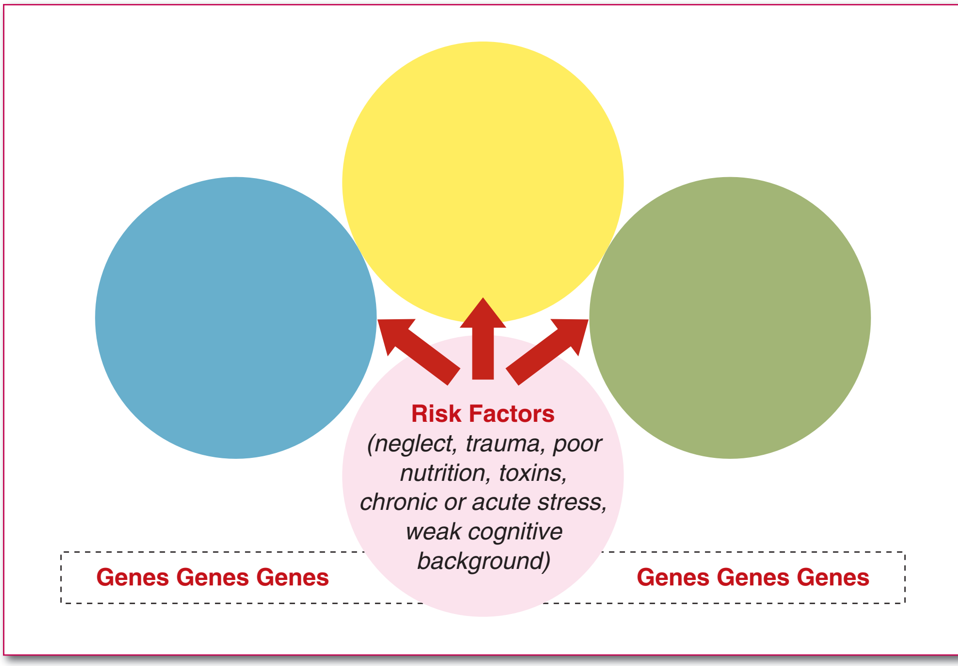
The primary underlying factor beneath everyday experiences that is the foundation for academics, socialization, and achievement is genetics. Genetics contributes to about 30–50 percent of life's outcomes. But genes are not our destiny. Yes, they code for eye, hair, and skin color; a narrow selection of diseases; and various other qualities. But genes are only part of the equation. The two largest parts of the equation are interactions between genes and the environment and everyday experiences. You have undoubtedly heard of the importance of both genetic and environmental factors. The old nature-versus-nurture debates used to pit environmental factors against genes. That's outdated and oversimplified.

Humans share over 99 percent of the same genes. Yet within any two humans (think of your students), the precise identical shared genes may be expressed in one and not in another. Gene expression is the capacity of the environment to influence genetic messages via an "on/off" switch that tells genes to make proteins (or not). Genetic expression is much of the reason that family members of even identical twins can share the same DNA and yet still have a very different personality. In fact, most of the personality differences within a family or ethnicity (with both shared genes and culture) are a result of gene expression. This is a huge source of differentiation among humans. What activates the switching is a wide array of factors. You'll be introduced to them later, but they include social conditions, exercise, new learning, stress, and environments.

So what does all this mean in the context of our discussion of how to understand the brain? It means that genes are just part of the equation. The expression "the apple doesn't fall far from the tree" is outdated, wrong, and damaging. Sometimes apples do fall far from the tree. For example, a pair of identical conjoined twins, joined at the brain at birth, lived the first 29 years of their life attached, experiencing every one of life's moments together—sleeping, eating, learning, illness, and so on. Their genes and experiences would suggest that these two people would be alike. Yet they had two very different personalities. Genes are not our destiny. And that means other factors will influence how your students turn out. The question is: Can you apply positive factors purposely and quickly so that your students will have a fighting chance to succeed in life?

Keep in mind that all brains develop with an everyday working platform. In healthy learners, both emotionally and academically this platform supports the behaviors that lead to good grades and social skills. But in students who struggle, their platform is overwhelmed by risk factors (see Figure 1.1), which are built on genetic scaffolding and exacerbated by adverse life experiences. The aggregate of risk factors for those with academic or social impairment can be small or huge. On a behavioral level, it could range from mild attention deficit hyperactivity disorder to severe conduct disorder. On the academic level, it could vary from a child with treatable dyslexia to one with severe autism. We've all seen how risk factors can be dominant in a child's life. An example would be a child with significant learning delays; the brain's platform for school success is compromised.

Figure 1.1 An Impaired Operating System



Risk Factors Can Seem Overwhelming

In a perfect world, all children would arrive at school with workable academic and social operating systems, ready to be fine-tuned by a positive school experience. Unfortunately, not all children have a malleable yet undamaged operating system (i.e., the brain's way of getting through the experience at hand) that is ready for school. That's what this book is all about. When children have been exposed to adverse life experiences without the coping skills to survive or thrive, their operating system or the capacity to build it may be compromised. What might compromise the healthy development of a child's operating system for successful school behaviors or academics? Here are some factors:

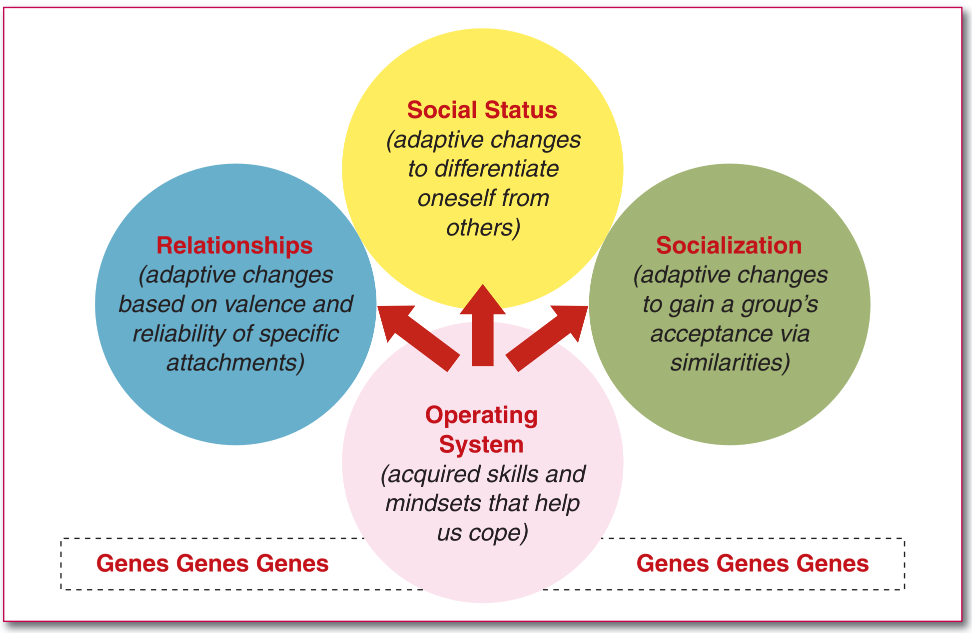
- exposure to neglect or abuse
- parents who are divorced or separated

- exposure to toxins (e.g., lead, pesticides)
- insufficient exposure to complex language
- head injury
- prenatal exposure to alcohol
- chronic or acute stress
- lack of healthy exploratory play
- chronic inner ear infections

Now, using the platform in Figure 1.1, the genetic factors would still be the underpinnings, but the primary driver in student performance would be risk (versus success) factors. That may not be fair, but it's the reality. In addition, a student's operating system may simply be underdeveloped through neglect or ignorance. Some parents may not know what it takes to raise children or get them "school ready." There's nothing hardwired in parents that tell them to do the right things in raising a child, aside from being protective. Outside of that protectiveness, many environmental factors come into play. The stronger the operating system, the greater a student's capacity to overcome severe adversity (risk factors).

We each have many operating systems, each of which contains various subskills for a different situation. We might show an operating system graphically like this:

Figure 1.2 Our Platform Is an Operating System



A bit later on, we'll fill in the other circles. For now, what actually is the operating system? It is a brain system comprising subsystems that are context dependent. For example, you have a survival-oriented operating system that lets you focus in an emergency on the fewest possible variables from one moment to the next and exclude trivia (e.g., a sore toe, an e-mail to answer, the fact that you are mad at your sister). This particular operating system is not in effect all the time unless you live in extreme conditions such as a war zone, abuse, or severe poverty. You have other overlapping operating systems, including a social one and a professional one, that you use more often. Even children have various operating systems, but theirs are quite raw and undeveloped depending on their age and life experiences.

This academic operating system is not inclusive of everything kids need in life. Our brains develop other operating systems for socialization, survival, jobs, and a host of other behaviorally relevant needs. The academic operating system does not include love, sacrifice, duty, fairness, humor, kindness, and a host of other values. But to succeed in school, a champion's mind set, hope, attentional skills, memory, processing, and sequencing skills are must-haves. These are highly leveragable, critically needed skill sets. The good news is that these subsystems (e.g., attention) that comprise the aggregate operating system can be taught!

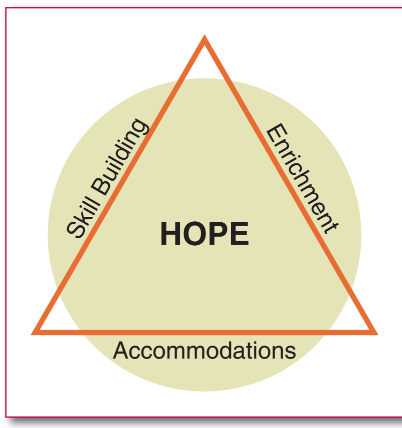
Students are not stuck the way they are. Their success is dependent on their operating system, and it can be upgraded. For example, physical activity can increase a student's production of new brain cells (Pereira et al., 2007), and this is highly correlated with learning, mood, and memory. Playing chess can increase reading (Margulies, 1991) and math (Cage & Smith, 2000) capabilities by increasing attention, motivation, processing, and sequencing skills. Using certain computer-aided instructional programs can, in just weeks, increase attention and improve working memory (Kerns, McInerney, & Wilde, 2001; Westerberg & Klingberg, 2007), both of which are significant upgrades to a student's operating system. Students are not stuck with poor attention span. Instead of demanding more attention in class, you can train students in how to build it.

In addition, many arts can improve attentional and cognitive skills (Posner, Rothbart, Sheese, & Kieras, 2008). Arts can also upgrade the system by teaching sequencing and processing skills. To put it bluntly, building capacity to learn (i.e., upgrading the operating system) is much more important than adding more content, and for many reasons. One of them is that you get more return on your time investment. If you fail to plan an upgrade for the skills your students need in order to learn and process academic information, you are planning to fail.

You can mitigate many risk factors with a strong operating system. Without improvements in their processing capacity, students' achievement will stagnate. An old Commodore 64 computer had so little processing power that no matter how fast you typed or how much content you had, it still tended to overwhelm the system. Raising standards and having high expectations is admirable. But wishing and hoping something dramatic will happen is not enough. You've got to enable and build the brain's operating system to make progress happen. Whatever you did in the past that worked, it upgraded students' operating systems. Every successful school intervention for kids from low-income neighborhoods features a variation on the theme of rebuilding the operating system. This system works on the principle of using the fewest processes that matter most to the learning process. If you simply try to cram more content into the same brain without upgrading the operating system, students will get bored, become frustrated, and fail. Good interventions build effective systems. Each day, our brains adapt to our experiences, and this newly changing brain influences us. There's a chicken-and-egg effect happening: we change our brains, and our changed brains then change us.

In a school situation, the operating system comprises two of the four parts of the big picture: hope and the skills needed. To this we add the final pieces: accommodations and enrichment. We now have a "sea of hope" for students (see Figure 1.3).

Figure 1.3 A Sea of Hope



While being hopeful and building skills, we must also balance students' needs for accommodations and enrichment. When educators use accommodations appropriately, they help level the playing field. Enrichment overcomes many problems and challenges in the brain because of the brain's capacity to change for the better. Enrichment has been shown to overcome the effects of learning delays, memory loss, attachment disorders, fetal alcoholism, and drug abuse. When we bring together skill building, enrichment, accommodations, and hope, we get a powerful plan that accelerates the chances for success.

With each of the challenges discussed in this book comes a different balance of what's needed to maximize change in the brain. In some cases, hope is most critical. In others, skill building will solve most of the issues. Each chapter offers a practical plan to use for student success, and each plan includes many suggestions that you can use immediately. The theme of the suggestions is building students' operating systems. Without that focus, students will not have a good chance to succeed. You are about to embark on a wonderful journey to change your students' brains.