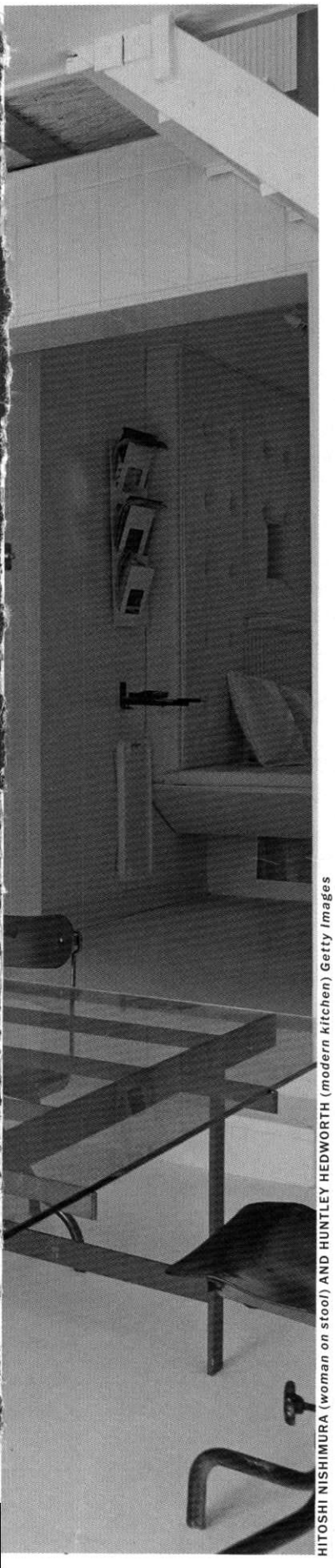


HITOSHI NISHIMURA (*woman on stool*) AND HUNTLEY HEDWORTH (*modern kitchen*) *Getty Images*

Depressingly Easy

We nuke prepared dishes rather than growing our own food and machine-wash ready-made clothes rather than sewing and scrubbing. Such conveniences may be contributing to rising rates of depression by depriving our brains of their hard-earned rewards By Kelly Lambert

For several decades, the multibillion-dollar antidepressant industry has pointed to imbalances in the neurochemical serotonin as the cause of depression. But research has yet to find convincing evidence that serotonin imbalances represent the indisputable cause of depression, and despite the unprecedented number of pharmacological treatment options available today, depression rates are higher than ever.

If Big Pharma does not have a cure for depression, shouldn't we pursue a fresh approach to this vexing problem? Could there be a nonpharmacological treatment strategy that would bring relief to the increasing number of people struggling with this mood disorder, for instance? What do we know about how to preserve good mental health? Is it possible to maintain a sense of control over our increasingly stressful daily lives, so that we can refocus our attention on more meaningful psychological endeavors, such as the challenging issues of problem solving and planning for our futures?

Is there something about how we live today that's actually toxic to our mental health? Were earlier generations somehow less susceptible to depressive symptoms? If so, what can we learn from how they lived that will help us rebuild our resilience and emotional well-being? To build a new, more integrated theory of depression, I have searched the literature for possible evolutionary triggers of emotional responses, reevaluated what we know about how the brain functions in both healthy and unhealthy ways, and identified pivotal lifestyle factors that might be affecting our society adversely.

Did we lose something vital when we started

I began thinking about the impact our contemporary lifestyle has on our mental health more than 10 years ago, after attending a lecture by Martin Seligman, a psychologist and the pioneering creator of the Positive Psychology movement, who was then president of the American Psychological Association. Seligman described two studies conducted in the 1970s in which people in different age groups were questioned about bouts of depression they had experienced during their lifetimes. The researchers then compared the responses of different generations.

The result should be a no-brainer, I thought at the time. Of course, older people would report more bouts of depression. After all, they had lived through the Great Depression and two world wars and suffered far more hardships and loss just by virtue of having lived longer. How could their mental anguish compare with the shorter (so far), easier and much less traumatic lives of a younger generation?

To my surprise, the exact opposite was true. Seligman reported that younger people were much more likely to have experienced depression. In fact, one study found that those born in the middle third of the 20th century were 10 times more likely to suffer from major depression than those born in the first third of the century were. These findings were later corroborated in a second study.

What is behind this startling disparity? For one thing, earlier generations did far more physical work than we do today. I was reminded of just how much our daily lives have changed six years ago, while reading a bedtime story to my younger daughter, who was three at the time. Skylar had chosen *Little House on the Prairie* for that evening—one of my childhood favorites.

Yesterday and Today

Over the years as I've read to my daughters I've often used the time to think through my to-do list for the next day. This bit of cognitive multitasking was a piece of cake with books such as *Goodnight Moon,* which I had read countless times when my girls were younger. "Goodnight room".... I need to update that section in Wednesday's lecture. "Goodnight moon".... and remember to take the chicken breasts out of the freezer. "Goodnight cow jumping over the moon".... I have to finish those analyses of the rat brains in the lab tomorrow. "Goodnight light".... I need to sign that permission slip for my older daughter Lara's field trip.

But that night the story about life on the prairie somehow drew me in. I found the demanding lives of Ma and Pa Ingalls so compelling that I actually had to pay attention! Laura Ingalls Wilder, their daughter, described in detail how the family planted, harvested and hunted down all their food throughout the year. That made my trips to the supermarket and merely reading the heating instructions for much of the food I "prepared" seem, well, lame.

I had always complained about doing laundry, but my efforts paled in comparison to those of Ma Ingalls. She had to scrub every garment on a washboard and then hang the clothes out to dry. And she had made all the garments with her own hands! Bathing my daughters did not require collecting rainwater or drawing water from a well; I merely had to turn on a faucet. The Ingalls family had to make most of the things I simply purchased, including toys, candles, soap, honey and butter. *Little House* crashed this working mom's self-pity party that evening. My life is a walk in the park compared with the lifestyles of a century earlier, I realized.

Clearly, I'm not suggesting that we go back to churning butter and tanning hides. But I do think we have to examine whether our cushy, digitally driven contemporary lifestyles—replete with SUVs, DVDs, laptops, cell phones and, yes, microwave ovens—may be at the root of the soaring

FAST FACTS

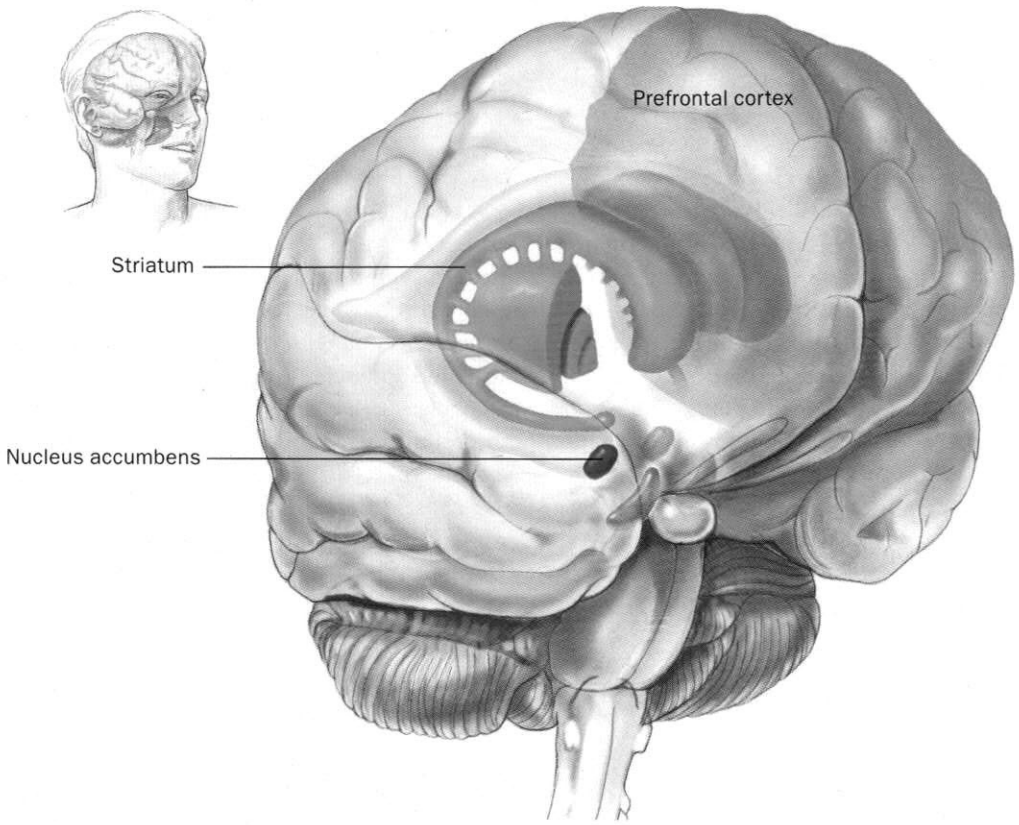
The Mental Perils of Ease

1» Rates of depression have risen in recent decades, at the same time that people are enjoying time-saving conveniences such as microwave ovens, e-mail, prepared meals, and machines for washing clothes and mowing lawns.

2» People of earlier generations, whose lives were characterized by greater efforts just to survive, paradoxically, were mentally healthier. Human ancestors also evolved in conditions where hard physical work was necessary to thrive.

3» By denying our brains the rewards that come from anticipating and executing complex tasks with our hands, the author argues, we undercut our mental well-being.

pushing buttons instead of plowing fields?



The nucleus accumbens, the brain's pleasure center, forms a critical interface between the motor system, or striatum, and the prefrontal cortex, which controls thought processes.

rates of depression in people born in the latter part of the 20th century. Did we lose something vital to our mental health when we started pushing buttons instead of plowing fields? From a neuroanatomical point of view, I believe the answer is an emphatic yes.

Will Work for Pleasure

Our brains are programmed to derive a deep sense of satisfaction and pleasure when our physical effort produces something tangible, visible and—this fact is extremely important—meaningful in gaining the resources necessary for survival. In fact, our brains have been hardwired for this type of meaningful action since our ancestors were dressed in pelts. After all, nature needed a way to keep the earliest humans from becoming "cave potatoes." Hanging out all day didn't put freshly caught game on the campfire or help maintain a safe place to live.

I call this emotional payoff "effort-driven rewards." There are other important benefits to this type of effort beyond a greater sense of psychological well-being. We also experience an increased perception of control over our environment, more positive emotions and, perhaps most critical, enhanced resilience against mental illnesses such as depression.

Think about effort-driven rewards as a clever evolutionary tool, a way to motivate early humans to maintain the physical activity needed to obtain the resources to live—to find food, protect themselves from the elements and procreate to continue the species. Effort-driven rewards don't come just from physical effort, however. They also involve complex movement coupled with intricate thought processes. Imagine thousands of years ago, when our ancestors were tracking a pack of wild boars through a forest or across a plain. Because these animals are such vicious fighters, a successful strategy typically involved the coordinated efforts of a few hunters, requiring effective social communication and support. They needed to be wily as they chased their game or lured their prey into a trap that they had built. All their efforts were fueled by anticipation. In fact, anticipating something pleasurable creates more activity in the pleasure center of the brain than actually achieving the goal does. Once they caught their prey, our hunters were suffused with a sense of accomplishment and satisfaction as they skinned the animal before dinner.

TERESE WINSLOW

Our hands play a crucial role when it comes to effort-driven rewards. From an evolutionary perspective, it is easy to see why they have always been so critical to our survival: they allow us to gain control of our environment. In fact, an essential premise of the proposed effort-driven-rewards theory is that movement—and especially hand movements that lead to desired outcomes—plays a key role in both preventing the onset of and building resilience against depression and other emotional disorders. Furthermore, we are predisposed to preferring hand movements that our ancestors needed for survival—those necessary for nurturing, cleaning, cooking, grooming, building shelter and farming.

But these days we shop at Whole Foods and drive Hummers. What does all this history have to do with our modern lives and depression? Our brains are generally the same size and have all the same parts and chemical composition as those of the earliest humans. Even though our lifestyles have changed radically, we have retained the innate need for achieving effort-driven rewards.

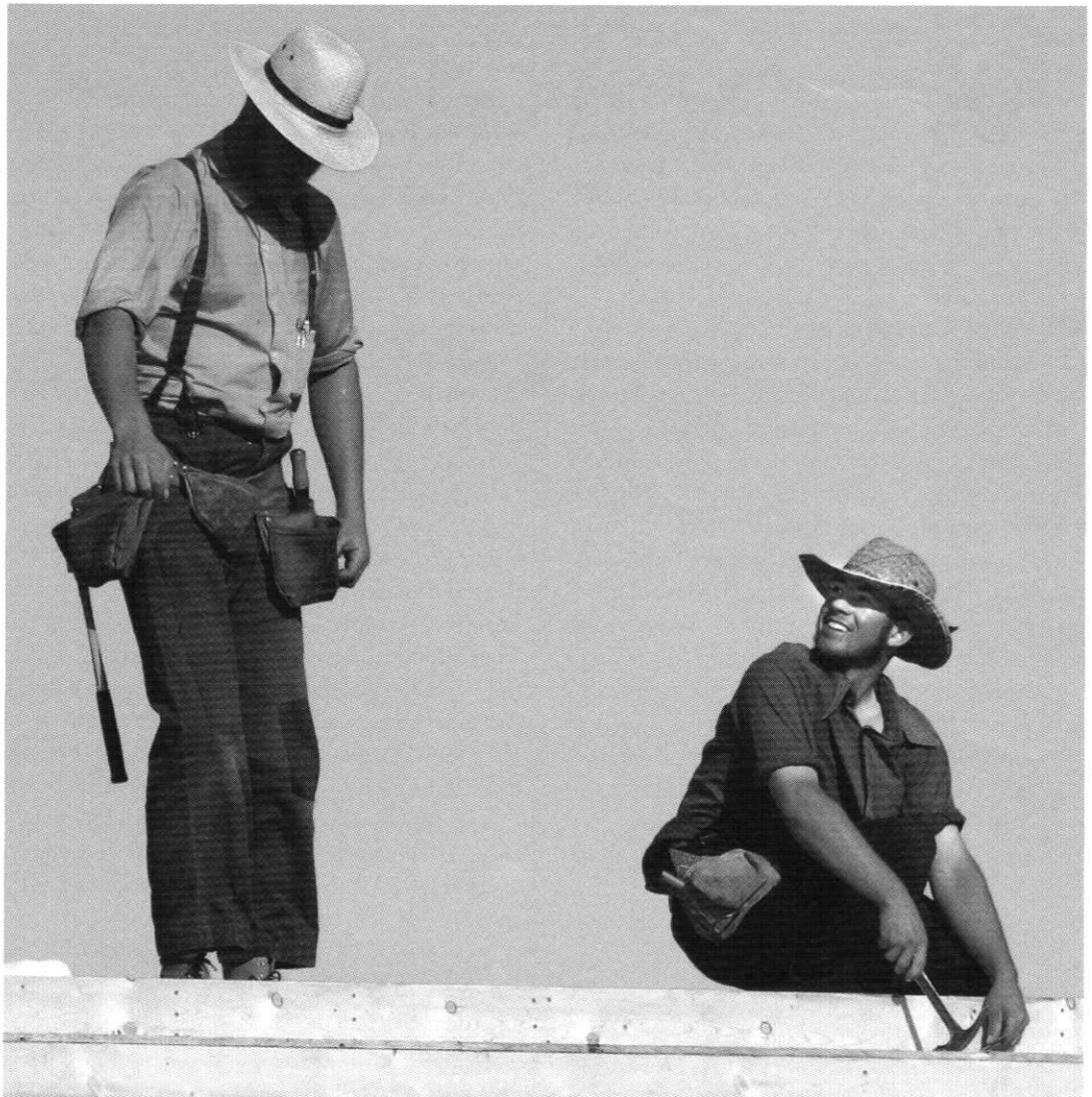
Is it okay that we have systematically removed physical effort—and all the complexity of movement and thought processes that it implies—from effort-driven rewards? Is contemporary society actually robbing us of certain forms of pleasure so fundamental to our mental health?

How Our Brains Reward Effort

As I looked for the possible evolutionary triggers of depression, I also began to reexamine the primary symptoms. Over the past few decades researchers have identified certain areas of the brain associated with some of these symptoms. But could I match every single one—including loss of pleasure, feelings of worthlessness, slowed motor abilities and difficulty concentrating—to a specific part of the brain? And, significantly, were those different brain areas interconnected or linked in some clearly identifiable way?

A natural place to start was the nucleus accumbens. This peanut-size structure is known as

The more the effort-driven-rewards system is



Hard work with hands is a likely factor in keeping the rate of depression in Amish communities far lower than it is in the rest of the U.S.

KEN GIGLIOTTI *AP Photo/CP, Winnipeg Free Press*

"Working rats" that had to search for hidden cereal learned to be persistent (*left*), which helped them solve new challenges; in contrast, "trust fund rats," which did not have to work for treats, gave up more easily (*right*).

the pleasure, or reward, center of the brain, and it keeps us engaged in behaviors that are important to our survival, including eating and having sex. It plays a crucial role in how the brain functions, as it determines how to respond to environmental stimuli such as a piece of chocolate cake or that handsome guy at the bar.

An integrating center of the brain, it receives inputs and outputs from many neural areas. But for our purposes, I am focusing on its intimate connection to three other primary areas. The accumbens is positioned in proximity to the brain's motor system, or striatum, which controls our movements, and the limbic system, a collection of structures involved in emotion and learning. Essentially, the accumbens is a critical interface between our emotions and our actions. The closely linked motor and emotional systems also extend to the prefrontal cortex, which controls our thought processes, including problem solving, planning and decision making.

It is this accumbens-striatal-cortical network—the crucial system that connects movement, emotion and thinking—that I call the effort-driven-rewards circuit. It is the proposed neuroanatomical network underlying the symptoms associated with depression. In fact, it is possible to correlate every symptom of depression with a brain part on this circuit. Loss of pleasure? The nucleus accumbens. Sluggishness and slow motor responses? The striatum. Negative feelings? The limbic system. Poor concentration? The prefrontal cortex.

As if to impart renewed energy to our behavior, the motor structures that control our movements are intimately connected to the reward center—where we register pleasure—and to the cortical area of our brain that controls higher thought processes. Because of the interconnectivity of the brain areas that control movement, emotion and thinking, doing activities that involve a number of these components fully engages the effort-driven-rewards circuit.

In fact, the more the effort-driven-rewards circuit is kept activated and humming, the greater the sense of psychological well-being that results. It is as if an electric current is coursing through the network. When it is buzzing at top capacity—when, for example, installing that new light fixture requires both hands—the cells in those areas of the brain are turned on and secreting neurochemicals, such as dopamine and serotonin, which are involved in generating positive emotions. Neural connections are strengthened and reinforced. Perhaps most important, this kind of meaningful action—that is, effort-driven rewards—likely stimulates neurogenesis, the production of new brain cells. Neurogenesis is believed to be an important factor in recovering from depression.

humming, the greater the sense of well-being.

Our hands play a crucial role. They occupy most of the real estate of the motor cortex, located in the higher cortex (the brain's outer covering). In fact, our hands are so important that moving them activates larger areas of the brain's complex cortex than does moving much larger parts of our bodies, such as our backs or even our legs.

MOLLY HYER

(The Author)

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Knitting a sweater or cropping images into shape for a scrapbook project can alleviate stress and engage the brain in ways that benefit mental health.

JUPITERIMAGES

Doing activities you find meaningful boosts

As I continued to delve into the scientific research on depression, I found myself thinking more and more about the role of hands-on work and effort-driven rewards in our mental lives. Could adding simple tasks to our daily repertoire of activities help maintain emotional resilience? For the answer, there was just one place to go—back to the laboratory.

The Trust Fund Rats

Because the rat brain has all the same parts as the human brain (it is just smaller and less complex), rodent models are a great starting place for mental health research. Could the rats tell me if there was anything to the connection between depression and physical effort?

Two undergraduate students, Kelly Tu and Ashley Everette, helped me design a study to test my theory. We put four mounds of cage bedding in the testing apparatus and buried a Froot Loop—a culinary favorite among my laboratory rodents—in each mound. We trained the rats to search the mounds for the treat, and each day we changed the positions of the mounds randomly. The animals soon learned that each new mound had a Froot Loop, so once they retrieved one prize they moved on to the next mound. I designed this task to mimic "harvesting"—picking fruit, vegetables or, in this case, Froot Loops from the "fields."

Within a few days the rats immediately approached the mounds and started digging for their prized cereal pieces. We trained these rats every day for five weeks so they would have ample opportunities to make associations between their physical effort and desired rewards.

Our control group consisted of rats that we also placed in this novel environment every day. But regardless of the physical effort they exerted, they received their Froot Loop rewards in a lump sum in the corner of the apparatus. My students enjoyed calling these rats the "trust fund rats" and the digging rats the "working rats."

In the next phase, we developed a puzzle that the rats had to learn to solve. We wanted to assess whether the worker rats or the trust fund rats were more persistent in problem solving. We put a Froot Loop in a plastic cat-toy ball, a novel toy stimulus that would be mildly threatening to the animals because it had a bell in it. We made certain that the coveted cereal piece would not fit through the openings. That meant that no matter how clever or bold the rat was, it would not be able to retrieve the reward in the test's three-minute time frame. Of course, the rats would not know this factor, so we could assess the amount of time they spent trying to get the treat. The task involved boldness and persistence—characteristics that serve us all well during challenging times.

To make this task official, Craig Kinsley, my colleague from the University of Richmond who collaborated on this project, suggested we call it the "novel manipulandum task." This sounded much more impressive than the "cat-toy test."

What did we find? Although we made sure that both groups had equivalent levels of "emotionality," or anxiety, before training began, we observed remarkable differences in how the animals approached the challenge task. The worker rats picked up the ball in their mouths and slung their heads from side to side, tossing the ball

across the cage. They also tried to stick their tiny paws through the openings to obtain the reward. Although the trust funders were just as motivated to retrieve the Froot Loop (both groups were on the same food-restriction regime) and used similar strategies, they were not nearly as persistent.

In fact, the worker rats spent approximately 60 percent more time trying to obtain the Froot Loop reward and made 30 percent more attempts to do so than the control group did. In their own way, the worker rats were telling us that their prior training sessions had made them more confident that they could overcome the challenge and retrieve the reward.

As I considered these findings, I was reminded of the widely reported study conducted several decades ago by Seligman and his colleague, psychologist Steven F. Maier of the University of Colorado at Boulder. In this famous experiment, dogs gave up responding and problem solving after they realized they could not escape from cages in which they received mild shocks. The researchers referred to this effort-consequence disconnect as "learned helplessness." Could our findings, then, be called "learned persistence"?

Clearly, we had empirical evidence of the adaptive value of effort-based rewards. The simple behavior of digging in mounds of bedding for cereal rewards had given the rats the motivation and confidence to persevere on a completely different challenging task.

The Lifestyle-Depression Link

Even though our nervous systems have the same anatomical makeup and chemical composition as those of our ancestors—or even people who lived a mere century ago—we are clearly using our brains and our hands differently. The percentage of farmers in the workforce was 38 percent at the start of the 20th century but less than 3 percent at its end. Today many more of us are knowledge workers than physical laborers. There have been vast increases in service-related jobs, from 31 percent of the workforce in 1900 to 78 percent of all workers in 1999.

Of course, you may feel a sense of accomplishment when you zip through your cognitive to-do list. The pleasure derived from just intellectualizing a problem is rewarding because it activates the prefrontal cortex. But effort-driven rewards activate the problem-solving prefrontal cortex plus the movement-controlling striatum and the reward/motivation center known as the accumbens, leaving you with a fuller brain experience that prepares you for life's next challenge. The decreased brain activation associated with increasingly effortless-driven rewards may, over time, diminish your perception of control over your environment and increase your vulnerability to mental illnesses such as depression.

What can we do to protect ourselves against the onset or tenacious persistence of depression? Poring over a scrapbook project or knitting a sweater may distract you from the stress in your life and engage your brain in intense ways that are beneficial to your mental health. Going out to the park or gym to exercise, especially if you perceive the activity as meaningful, can also boost important, emotionally relevant neurochemicals such as serotonin and endorphins. Such activities may alter the brain in more meaningful ways than any dose of a single drug could accomplish. Why? Because they are performed within the context of your life. When you are faced with a challenge and embark on the dynamic process of deciding on an effective strategy, implementing the plan and observing the final desirable outcome, your brain takes note of these situations so that it can access similar response strategies in the future.

important, emotionally relevant neurochemicals.

Just as a gymnast needs to complete simple muscle repetitions before she can learn complex routines, we need ongoing, positive experience with simple effort-driven rewards to execute the complex mental gymnastics that enrich our mental lives. Anything that lets us see a clear connection between effort and consequence—and that helps us feel in control of a challenging situation—is a kind of mental vitamin that helps build resilience and provides a buffer against depression. M

(Further Reading)

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- **Learned Optimism: How to Change Your Mind and Your Life.** Martin E. P. Seligman. Pocket Books, 1992.
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