

MINDS AT WORK

Increasing Brainpower Through Exercise

Written by Marcia Conner for Virgin Pulse

2015 PULSE PAPER





Many leaders view employee well-being as their employees' responsibility, not an enterprise priority. Companies focus on optimizing the flow of information and physical assets, not on the brainpower of those they employ.¹ Yet a large body of research shows that, without a consistent level of health, people's brainpower doesn't come to work with them each day—influencing their capacity for sound decision-making, executive function, memory, learning, and creativity.²

This report explains why it's time corporate leaders take an active interest in encouraging employees to exercise.

Focusing on cognitive performance addresses a root cause of productivity loss in the workplace. With an estimated 200 million knowledge workers in the U.S. alone, even a small increase in collective brainpower could dramatically increase an individual's capacity, their company's health, and the economy overall.³

Brainpower is already on your employees' minds. It's time for it to drive business decisions. With over two billion people worldwide dealing with brain-based health and productivity challenges, the resulting global economic burn is in the trillions. Among adults over age 50 in the U.S., "staying mentally sharp" outranks Social Security and physical health as the top priority and concern.⁴

Unlike expensive infrastructure solutions that won't be fully realized without additional attention, addressing the cognitive quandary is relatively inexpensive. Research shows that physical movement—even in small amounts, at a moderate pace—greatly expands brainpower.⁵ Short bursts of activity, like taking a brisk walk at lunch or opting for the stairs instead of the elevator several times a day, add up.

The question becomes: why aren't more of us creating company cultures where people can be physically active, on their own or in groups, so employees can be collectively wiser?

Few areas of focus are more important than making sure people can bring to work the brains they were hired for. It's time to make a shift and get started.

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Brainpower Changes Behavior

It's rare to meet someone who doesn't intuitively understand that exercise is important—yet that's not getting enough people out of their chairs. More data doesn't seem to help, either. So what might? Here's a compelling case study from an organization that may be like yours.

A study conducted by Leeds Metropolitan University of its white-collar workers revealed that job performance improved on the same day they exercised.⁶ The study followed 200 workers who did the exercise of their choice during the lunch hour. Some people took aerobics classes. Others lifted weights, participated in yoga, or played basketball.

Those who exercised experienced improved mood and performance, leading to better concentration, work-based relationships, and resilience to stress. Overall, they were more productive and felt better able to handle their workloads.

"The people who exercised went home feeling more satisfied with their day," said study author Jim McKenna, a professor of physical activity and health. "We were surprised. We weren't expecting this amount of effect."

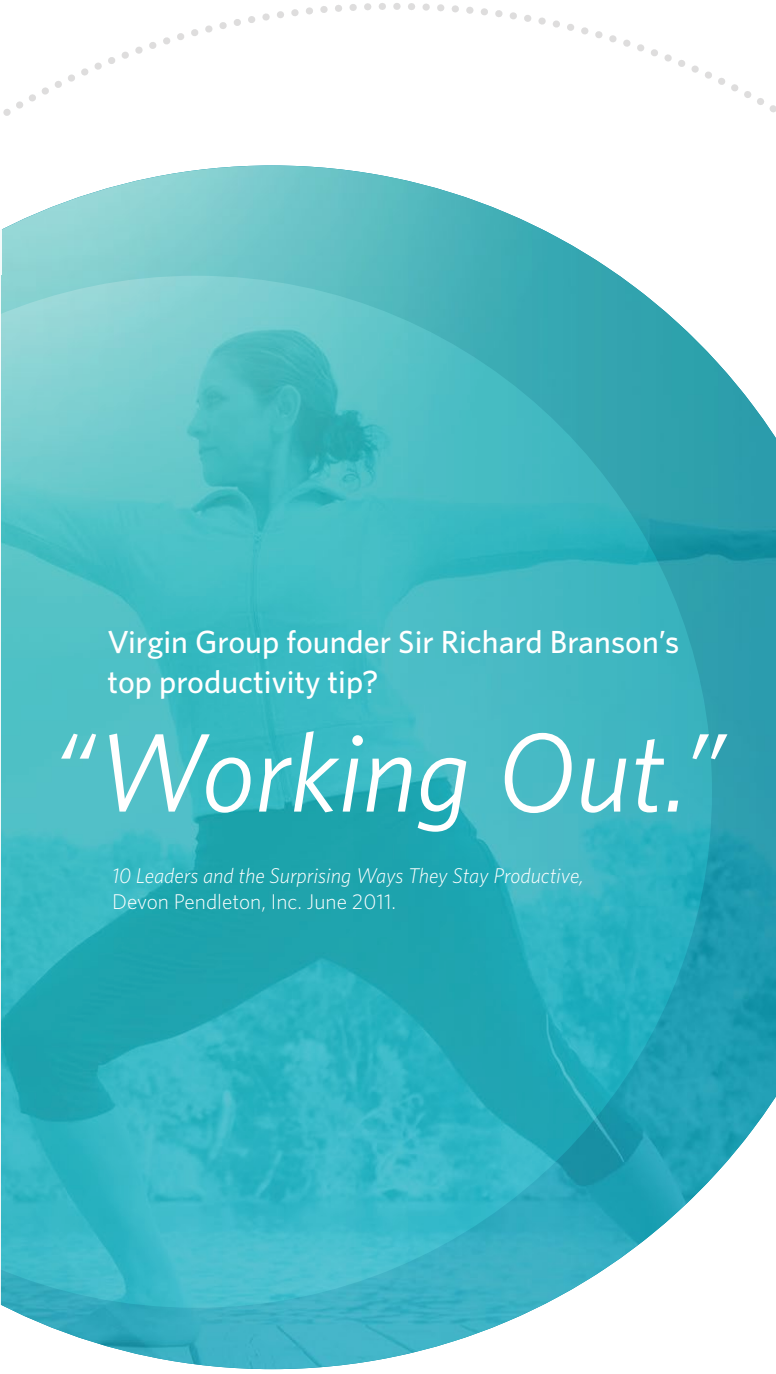
Although the study participants were regular exercisers and already felt they did a good job at work, many still saw an improvement with exercise. The type of exercise didn't seem to matter, either.

"We could find no difference according to length of exercise, duration, or intensity," McKenna said. "You got the effect no matter what you did."

Participants also rated their moods in the morning and afternoon. Exercise improved mood, a finding supported by other research, said McKenna.

"There's a very strong mood effect with exercise," he said, adding that physical activity can be both energizing and tranquilizing.

During focus group discussions, many of the participants said exercise seemed to help them deal better with the demands and pressures on the job.



Virgin Group founder Sir Richard Branson's top productivity tip?

"Working Out."

10 Leaders and the Surprising Ways They Stay Productive, Devon Pendleton, Inc. June 2011.

"After exercise, people adopted a more tolerant attitude to themselves and to their work," said McKenna. "They were more tolerant of their own shortcomings and to those of others."

They didn't lose their temper as much, for example, or yell at coworkers or slam the phone. Workers in the study also indicated they were less likely to suffer bouts of afternoon fatigue known as the "post-lunch dip" on days when they exercised.

**"It's the paradox of exercise," said McKenna.
"To get energy, you have to expend some."**

McKenna said his findings should give companies an additional incentive to offer workplace exercise programs, which may also help cut down on sick days and reduce health-care costs.⁷

In related research, a team from the University of Minnesota Carlson School of Management, lead by professor of work and organizations Avner Ben-Ner, studied 40 employees of a Twin Cities financial services company who used treadmills instead of office chairs while working.

The walkers were studied for one year, resulting a significantly favorable impact on both physical activity and work performance. After an initial decline as employees learned how to adjust to walking while working on their computers, talking on the telephone, and taking notes, there was a marked increase in worker productivity. Production measures were derived from employee and supervisor surveys of quantity of performance, quality of performance, and quality of interaction with co-workers.⁸

*"The physical state of our bodies can either **serve or subvert the quest to create genius.**"*

- Jonathan Fields
Founder, The Good Life Project

EXERCISE REVERSES BRAIN DECAY

AND AMPLIFIES BRAIN CELLS

Scientists used to believe that the brain didn't change structurally over a person's life span. That line of thinking changed dramatically in the 1990s, when researchers found convincing evidence that the human brain is capable of renewing itself (neurogenesis) and that exercise speeds up the process.⁹ While common sense says that the brain controls behavior, research now also shows that behavior could control and change the structure of our brains.¹⁰

The brain, like all muscles and organs, is tissue that declines with underuse and age. Exercise slows or reverses the brain's physical decay, provides a short-term oxygen boost, and maintains an efficient blood supply to the brain.¹¹ Exercise also pumps up existing brain cells, improves mood, aids in multitasking, blunts age-related memory loss, sharpens decision-making, and improves analysis skills.¹²

"Research has consistently shown that exercisers outperform couch potatoes in tests that measure long-term memory, reasoning, attention, problem-solving, and fluid intelligence. When combined with the health benefits exercise offers, "we have in our hands as close to a magic bullet for improving human health as exists in modern medicine. All we have to do is move," said John Medina, PhD, developmental molecular biologist and director of Seattle Pacific University's Brain Center for Applied Learning.¹³

Physical activity bathes neural tissue in oxygen-rich blood, increasing the production of chemicals that improve memory, attention, and problem solving.¹⁴

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- John Medina, PhD

Developmental Molecular Biologist & Director of Seattle Pacific University's Brain Center for Applied Learning

Aerobic exercise is great. Change is better.

While aerobic exercise brings the highest mental returns and intensive interval training the most oxygenation, there's no clear advantage of any one exercise over doing what you love and doing it consistently. Sustainability matters.

The best combination of exercise mixes what you enjoy with something new and challenging, because change combines physical and cognitive stretching.¹⁵

German scientists even found that bouncing or throwing a ball with alternating hands for 10 minutes increases attention and concentration in subsequent activities. They speculate that handling a ball primes the part of the brain that controls focus.¹⁶ Burning off stress through a game of

Frisbee in the courtyard, Ping-Pong in the break room, or even riding a bike between buildings can reduce muscle tension and boosting endorphins, getting blood pumping and making the brain function at its best.

In a Canadian study, older adults who lifted weights along with walking and balance exercises improved their decision-making abilities by nearly 13 percent in six months.¹⁷ Adding a balance and coordination challenge to standard strength moves—such as simultaneously raising the right arm and left leg—may magnify the benefit.

“Complex movements force your mind to work harder by engaging multiple parts of the brain,” said John Martin, Ph.D., professor of Neurobiology at New York's City College School of Biomedical Education.¹⁸

Work out regularly, several times a week over a few months.

Several months of moderate exercise can create new neurons, lift mood, hone memory, and sharpen thinking.¹⁹ Working out three or more times a week for 30 minutes to an hour seems to make the most significant difference.²⁰ Yet many of the **studies on the influence of exercise on brain boosting show people see an immediate result each time they work out.**²¹

The majority of benefits from exercising are due to the first 30 minutes of exercise, said Timothy Church, M.D.,

John S. McIlhenny endowed chair in health wisdom at the Pennington Biomedical Research Center in Baton Rouge.²² That 30-minute period prepares the body to deliver the maximum amount of oxygen that the heart and lungs can deliver to the muscles. That in turn leads to changes in the brain, including improvements in memory and motor skill. In contrast, when you sit for longer than about 17 minutes, blood begins to pool in your hamstrings and calf muscles, pulling needed oxygen and glucose from the brain.²³

Results last, but not forever.

Even when you stop exercising or become less active, new brain cells survive, although many other changes in the brain during exercise eventually return to their normal state.²⁴ In other words, your high school days on the junior varsity field hockey or football team help you today, but not nearly as much as if you took up activities like running or hot yoga—ones you would enjoy (and stick with) today.²⁵

Few studies have gone on to examine the cognitive benefits of exercise over longer periods of time. What is known is that aerobic training may increase levels of proteins that

enhance the brain's ability to send and receive information, said Theresa Liu-Ambrose, Ph.D., associate professor at the University of British Columbia. Exercise also increases the volume of the hippocampus, the part of the brain required for spatial navigation and consolidating information from short- and long-term memory. **Because hippocampal volume shrinks up to 2 percent annually in older adults, six months of aerobic training may reverse age-related loss by two years.**²⁶

Exercise doesn't need to be intense for a mental boost.

Although recent research shows that intense exercise is needed for the dramatic shifts in physical health, when it comes to the mind, movement is more generally defined.²⁷

Walking is especially good for your brain because it increases blood circulation, accelerating how fast oxygen and glucose reach your brain. Walking is not strenuous, so leg muscles don't take up extra oxygen and glucose like they do during other forms of exercise. As you walk,

you effectively oxygenate your brain. Maybe this is why walking can "clear your head" and help you think clearly.²⁸

Fast, intense workouts do have their benefits, though. A 2007 study found that exercisers who did two, three-minute sprints memorized new words 20 percent faster afterward than those who skipped the workout. **In a University of Pittsburgh study, the most aerobically fit had an average 7 percent larger hippocampus size than their inactive peers did.**

See specific improvements in memory, attention and speed.

A four-month study at the Duke University Medical Center tested four areas: memory, executive function, attention/concentration, and psychomotor speed. Compared to the control group, the **exercisers showed significant improvements in the higher mental processes of memory and in executive functions** that involve planning, organization, and the ability to mentally juggle different intellectual tasks at the same time.

"What we found so fascinating was that exercise had its beneficial effect in specific areas of cognitive function that are rooted in the frontal and prefrontal regions of the brain," said James Blumenthal, psychologist and study principal.²⁹

Planning and carrying out actions to achieve specific goals requires allocating attention and memory, goal setting, self-control and monitoring, making decisions, and the flexible use of strategies. Executive function appears more sensitive than other aspects of cognition to aerobic exercise.³⁰

How Exercise Changes the Brain

Neuroscientists have varying theories about how exercise prompts the brain to remodel itself, each involving interrelated biochemical processes. One popular hypothesis points to insulin-like growth factor 1 (IGF1), a protein that's circulated in the blood and is produced in greater amounts in response to exercise.³¹ IGF1 usually stops at the blood-brain barrier (the passage which prevents large molecules from entering into the brain). Exercise is thought to help IGF1 pass through the barrier, sparking neurogenesis and other changes in brain tissue.

Many other researchers now credit brain-derived neurotrophic factor (BDNF), for the beneficial mental impacts of exercise. BDNF is a protein produced in the brain and elsewhere in the body. Pumped out in greater supply during and after exercise, it's known to help neurons develop and thrive. Movement places demands on the brain, just as it does on muscle, and so the brain releases BDNF, which triggers the growth of cells to meet the increased mental demands of movement. But BDNF floods through the brain, not just through the parts engaged in movement. It also allows the brain to consolidate short-term memories into long-term ones.³²

There's bone morphogenetic protein (BMP) in the brain, which has been found to contribute to the control of stem cell division.³³ Your brain is packed with adult stem cells which, given the right impetus, divide and differentiate into either additional stem cells or young neurons. As we age, those stem cells tend to become less responsive. They don't divide as readily and can slump into a kind of cellular sleep. BMP acts as a sleep aid. The more active BMP and its various signals are in your brain, the more inactive your stem cells become and the less neurogenesis your brain undergoes. Your brain grows slower, less nimble, and (no matter what your chronological age) physiologically older. But exercise countermands some of the numbing effects of BMP.

Noggin, a beautifully named brain protein that acts as a BMP-signaling antagonist, increases as we exercise. The more Noggin in your brain, the less BMP activity and more stem cell division and neurogenesis in your brain.³⁴ Through a complex interplay with Noggin and BMP, **physical activity helps to ensure that neuronal stem cells stay lively and birth new brain cells.**

The brain is an energy-burning network of specially adapted cells that flourish as a result of the body's needs. It provides

the environment brain cells need to grow and function well. For challenges requiring stronger and more refined movement, brain circuitry forms to guide you. It seems like common sense that the brain wouldn't build without the body, or the body without the brain.

That's no longer conjecture. While we've been sitting at our desks, scientists have been assembling massive piles of evidence that say **the quickest, surest path to the health and well-being of the brain and body is movement or vigorous aerobic exercise.** While much of the direct link studies have been done in the last 10 years, in 1999 the science began mounting up.³⁵

Like muscles, individual brain cells get a type of physical workout during exercise. The brain has to work hard to keep muscles moving and all of the bodily systems in sync.³⁶ Scans have shown that metabolic activity in many parts of the brain surges during workouts.

Reenergized brain cells should be resistant to fatigue. Because bodily fatigue is partially mediated by signals from the brain, exercising your body could be training your brain to allow you to exercise more, simplifying the benefits. Revitalized brain cells also could reduce mental fatigue and sharpen your thinking, even when you're not exercising.

There's no medicine or other intervention that appears to be nearly as effective as exercise in maintaining or even bumping up a person's cognitive capabilities.³⁷

Exercise also dramatically alters how you feel. Even a small amount of activity can make an enormous difference in the functioning of the brain.³⁸

Vigorous exercise isn't necessary to protect your mind.³⁹ Even walking around the block makes a difference. The longest study of overall health, Harvard's Nurses Health Study, most recently completed at the end of 2013, showed that consistent changes in practices toward a more healthful approach on the job, like taking the stairs throughout the day rather than the elevator, makes a profound effect on health and brainpower.⁴⁰

THE BOTTOM LINE

The term “exercise” is an artifact of our industrialized, regimented, domesticated lives. If the brain is to take full advantage of what we now understand about the importance of movement, then you don't have to exercise, per-se. You've got to move. You've got to be nimble.⁴¹

You spend a lot of time and money on your workforce—be sure you're creating a healthy company culture as part of those investments. Focus on well-being as a productivity-booster. Energize your environment by leading the way.⁴² Drive cohesion and consistency in decision-making and overall business fitness by making exercise a priority.

The end result? A recharged, energetic workforce with the focus and brainpower you need them to have.

Virgin Pulse, part of Sir Richard Branson's famed Virgin Group, replenishes employees with tools that help them build better habits. With its award-winning, online platform, the company cultivates daily habits and sustainable behavior change that help people thrive at work and across all aspects of life. Unlike narrowly-focused employee health and engagement solutions, Virgin Pulse creates more meaningful habits and drives greater utilization across HR investments, delivering a better quality of life for employees and better health, increased productivity, and improved culture for employers. More than 250 industry leaders representing more than 2 million employees have selected Virgin Pulse's programs to replenish their people and ignite their business. Learn more at www.virginpulse.com.



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ABOUT THE AUTHOR

Marcia Conner (@marciamarcia) is a blank page systems architect, working with big-vision leaders, impact entrepreneurs, and Plan-B thinkers, ready to use their superpowers for good.

She is a SupportED Mentor, contributes to Fast Company, is a fellow at the Darden School of Business, collaborates with Common Health ACTION, and is an activist with Change Agents Worldwide. She is co-author of *The New Social Learning, revised edition: Connect, Collaborate, Work* (June 2015). Superpowers include moving mountains, fighting phoniness, and inspiring others to join her journey to level up the world. For more visit www.marciacconner.com

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RESOURCES

- 1 Enterprise brain-awareness is the focus of a series of 2013 reports from Gartner entitled "Maverick" Research: Living and Leading in the Brain-Aware Enterprise." Analysts Elise Olding and Jackie Fenn report 1) employee brainpower is squandered on a massive scale in most organizations. Many processes, job roles, teams and meetings, as well as much software, actually suboptimize available brainpower. 2) In the brain-aware enterprises of the future, employees will directly monitor and optimize their brain state, emotional responses and subconscious intuitions to improve their performance and relationships. 3) From pioneering CEOs to grassroots evangelists, leading organizations are already embracing the movement toward increased brain awareness within a corporate environment. <https://www.gartner.com/doc/2594818/maverick-research-living-leading-brainaware>
 - 2 Scientific data overwhelmingly suggests that exercise builds brain health, which leads to improved cognitive outcomes. Further, sedentary behavior causes brain impairment, deriving the brain of the neurochemistry that evolution developed to grow and keep brains healthy. Despite over 30 years of examining the statistical outcomes for people who exercise and 70 years with animals in labs, people who believe that sitting, facing forward demonstrates proper behavior sometimes still warn, "correlation is not cause." In other words, they assert that lack of movement at work, in the name of productivity, cannot be associated with mental performance. We aim to change that by describing both the hard data from decades of academic research and the well-written summaries from investigative journalists. In 2011, a team lead by J. Eric Ahlskog from the Department of Neurology at the Mayo Clinic, did an exhaustive survey of all research on the link between exercise and cognition. Prompted by some inconclusive work by the NIH, Ahlskog and his group undertook a comprehensive review of all the research they could find on the relationship between cognition and exercise. The search returned 1,603 published research papers in PubMed database using the keywords "cognition" and "exercise," a number that in itself gives us some idea how thoroughly this issue has been examined. In addition to writing up of what they learned from reading every report (for their own research on the link between Alzheimer's and vigorous exercise), some of the most comprehensive write ups related to this report include: "Exercise builds brain health: key roles of growth factor cascades and inflammation." CW Cotman, NC Berchtold, LA Christie. *Trends Neuroscience*. Sept 2007; 30(9):464-72. <http://dx.doi.org/10.1016/j.tins.2007.06.011> and "Associations between Physical Activity and Physical and Mental Health-A HUNT 3 Study" Gro F. Bertheussen, Pål R Romundstad, Tormod Landmark, Stein Kaasa, Ola Dale, Jorunn L. Helbostad. *Medicine & Science in Sports & Exercise*: July 2011 43(7): 1220-1228 <http://dx.doi.org/10.1249/MSS.0b013e318206c66e> <http://www.ncbi.nlm.nih.gov/pubmed/21131869> "How exercise influences the brain: a neuroscience perspective." Lukasz M. Konopka. *Croatian Medical Journal* 56.2 (2015): 169-171. PMC. <http://dx.doi.org/10.3325%2Fcmj.2015.56.169>
 - 3 While we've found no single source for the number of knowledge workers on the U.S., combining the workers from all the fields that the U.S. Labor Department reports on that would be considered "information workers" yields a number just over 200 million. In the past, this number was culled from just those who worked at desks, but in the last four decades, an increasing number of service and manual laborers are required to apply independent thinking and good judgment for most of their workday, leading to a broader number of workers. (For additional information see <http://www.bls.gov/oes/tables.htm>.) A report from McKinsey & Co. in 2013 said, "Physical labor and transactional tasks have been widely automated over the last three decades. Now advances in data analytics, low-cost computer power, machine learning, and interfaces that 'understand' humans are moving the automation frontier rapidly toward the world's more than 200 million knowledge workers." To further point that knowledge-workers benefit from sharper thinking skills, a 1999 IDC study found that Fortune 500 companies lost \$12 billion as a result of intellectual rework, substandard performance, and inability to find knowledge resources. The "knowledge deficit" captures the costs and inefficiencies that result primarily from intellectual rework, substandard performance, and inability to find knowledge resources (both information and experts).
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May 2007 reporting on research from a new study led by researchers at Columbia University provides the first evidence in humans that a structured exercise training program increases neurogenesis—the birth and development of new nerve cells—in a memory hub of the brain. Pereira, Ana C. et al. "An in Vivo Correlate of Exercise-Induced Neurogenesis in the Adult Dentate Gyrus." *Proceedings of the National Academy of Sciences of the United States of America*. 104.13 (2007): 5638-5643. PMC. Web. 6 May 2015. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1838482/>
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- "Trying to choose" a single best exercise is "like trying to condense the entire field" of exercise science, said Martin Gibala, the chairman of the department of kinesiology at McMaster University in Hamilton, Ontario."

RESOURCES

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- 27 The threshold for brain benefit seems to be raising your heart rate to 70 percent of maximum. For men, maximum heart rate is roughly 220 minus your age; then take 70 percent of that. For a 70-year-old man, the target heart rate during exercise would thus be 105 beats per minute. This assumes your physician has cleared you for that level of exercise; always talk to a doctor before starting a new exercise program. Moderate-intensity exercise includes brisk walking and swimming as well as anything else that gets your blood moving, including yard or housework. "Getting your heart rate up is something you can do just by walking fast," Dr. Ratey says. "You don't have to be running." Dr. John Ratey, associate clinical professor of psychiatry at Harvard Medical School and author of *Spark: The Revolutionary New Science of Exercise and the Brain*(2008). The secret? Regular exercise.
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