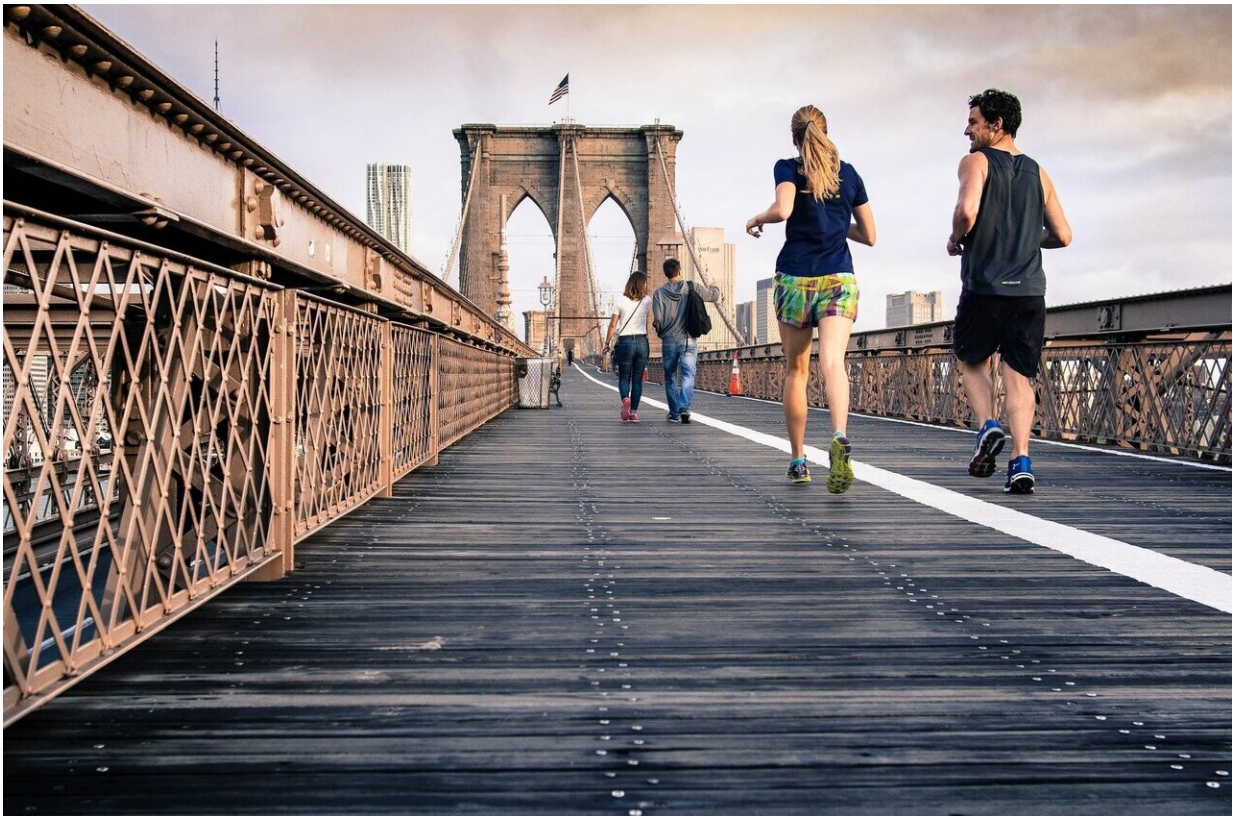


# Q&A: Evolutionary biologist discusses how exercise helps brain health

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Strip away all the modern technology, and the human body remains a fantastic endurance machine. Our bodies have evolved to reward endurance exercise with boosts to cognitive development and defense

against degenerative diseases. As public health emergencies emerge and impact the world, looking back on how our bodies evolved may reveal key insights into how to successfully prevent and treat disease.

Finding the links between brain and [physical health](#) motivates David Raichlen, professor of human and evolutionary biology at the USC Dornsife College of Letters, Arts and Sciences. His research into [human movement](#) spans a broad range of activities, from the long-term benefits of squatting and kneeling to how your body rewards strenuous [physical activity](#). We recently spoke with Raichlen about what inspires his research, and why he's grumpy when he doesn't work out.

## **Why did you choose to study evolutionary biology?**

I grew up in Los Angeles and ran cross country and competed in triathlons throughout high school. From an early age, I was really active in [aerobic exercise](#), and I was really interested in movement in general. So, when I started getting into human evolution, I was drawn to understanding human locomotion from a biomechanical perspective to try to understand the origins of human walking. Some interesting ideas were bubbling up about the importance of long distance running during [human evolution](#) as I got my Ph.D. [in 2004 at the University of Texas, Austin], and I was drawn to that because it melded my personal hobby of running with my academic life.

## **Why is fitness so important?**

At this point, I think most people know that physical activity is important for their health. The key question now is how do you get people to change their behavior? From an evolutionary perspective I'm focused on why physical activity makes some people feel good and that again comes from my experience. I wanted to figure out why I felt so

much better when I worked out and why I wasn't very pleasant on days that I didn't exercise.

## **Something like endorphins and the 'runner's high'?**

Exactly. Only what we found out was that it's also tied to a reward system in the body called the endocannabinoid system. It's like our body's endogenous form of marijuana. Over a series of projects, we looked at endocannabinoid signaling in humans, dogs and ferrets while they ran. It turns out that while ferrets—which don't generally engage in endurance activity—didn't show much activity, humans and dogs did, suggesting perhaps evolutionary processes at work. That led to further projects where we found that the endocannabinoid system may have developed to encourage and reduce pain during physical activity and may even play a role in the cognitive benefits of exercise.

## **What else have you learned about how exercise benefits humans?**

The whole point of our work at this point is taking our evolutionary history and applying it to the massive health problems we're dealing with today. Two million years ago, we evolved and adopted a hunting and gathering lifestyle which required our ancestors to start being much more physically active to forage. While we engaged in physically active foraging, we also were navigating and doing other cognitive tasks utilizing executive functions and memory—remembering where to find certain foods and making decisions while on the move, things like that. We think the evolution of these foraging behaviors linked high levels of physical activity with cognitive needs and may explain why physical activity is so good for brain health. So, the concurrent evolution of high physical activity and cognitive function became a fertile ground for us to start thinking about how we can actually enhance the impact of physical

activity on health today.

## **It sounds like the hardest part of exercise is taking the first step. How do you motivate people to exercise more?**

What predicts whether someone's going to remain engaged in an exercise program is whether it brings them enjoyment—much more than if they're doing it to lose weight or for a subjective reason, like they want to be healthy. An idea I think about a lot is how we can find ways to enhance people's enjoyment of exercise. Sometimes it's just trying different forms of exercise because not everyone likes to run or play tennis, for instance. Access is also an issue. Not everyone can ride a bike, or has access to other equipment or gyms, but if you find the kind of exercise that triggers those rewarding sensations then you're more likely to remain active over the long haul.

## **What are the best exercises for cognitive health?**

That is absolutely the question I get asked the most and unfortunately, it's a question I don't have a great answer for. In terms of the kind of activities available to people right now, there's not been a good comparative work. However, we've produced a game that you can play while you're on an exercise bike that's includes a maze and other cognitive challenges. We showed for that task, there was an enhanced effect of exercising while playing the game versus just exercising alone. There have also been meta-analyses that show that simultaneous exercise and gaming lead to better results than just exercise alone. Unfortunately, most of those games aren't available to the public right now.

## **You mentioned access—you have a few recent**

**publications with major implications to physically active people in highly polluted areas. Notably, increased exposure to car exhaust seems to mute or diminish the benefits of exercise for risks of developing cognitive diseases such as Alzheimer's and dementia. Any advice for people exercising in cities?**

These results were definitely an eye opener for us, especially living in Los Angeles. Our first piece of advice is to keep doing it. There's not great evidence that you should avoid exercise in the standard air quality we deal with most days. The benefits outweigh the risks. Certainly, it can be dangerous if there's wildfire smoke or an air quality emergency, but generally on an average day there's no reason to not exercise, even knowing that exposure might blunt some of the benefits. But I would recommend thinking about where you exercise. Stay away from areas of heavy car traffic or consider exercising indoors in a space with good air filtration.

Also, while there are personal choices that we can make, I think the bigger issue is that, as a community—especially in Los Angeles—cleaning up our air is a huge priority for improving the health of millions and millions of people. The benefits of exercise for our brains should not depend on where you live or what you have access to. We should work much harder to improve air quality so we can all get these great brain benefits from moving our bodies.

Provided by University of Southern California

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