Science AMA Series: I'm David Moreau, a cognitive neuroscientist in Auckland, New Zealand. I do research on how the brain changes in response to different types of training, especially physical exercise, and I'm here today to talk about it. AMA!

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Abstract

Hi Reddit! I'm David Moreau and I'm a cognitive neuroscientist in the department of Psychology at the University of Auckland, New Zealand. My research focuses on the dynamics and plasticity of cognitive function, that is, how the brain changes and adapts to its environment. Before moving to Auckland in 2014, I've worked at Princeton University, New Jersey, where I developed, tested and validated the idea of combining physical and cognitive demands to elicit improvements in brain function. This type of intervention, blending brain training and physical exercise, allows preserving the ecological components of naturalistic activities, and has ramifications both for clinical (e.g. children with neurodevelopmental disorders, adults with dementia and patients in post-stroke recovery) and non-clinical populations. I'm here to answer questions about a recent paper my group published in the journal eLife (https://doi.org/10.7554/eLife.25062), where we showed that short, intense bursts of exercise can induce meaningful improvements in brain function, or queries related to anything in my area of expertise more broadly. I'll start answering questions at 3pm EST. AMA!

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REDDIT

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DAVID_MOREAU R/SCIENCE

Hi Reddit! I'm David Moreau and I'm a cognitive neuroscientist in the department of Psychology at the University of Auckland, New Zealand. My research focuses on the dynamics and plasticity of cognitive function, that is, how the brain changes and adapts to its environment. Before moving to Auckland in 2014, I've worked at Princeton University, New Jersey, where I developed, tested and validated the idea of combining physical and cognitive demands to elicit improvements in brain function. This type of intervention, blending brain training and physical exercise, allows preserving the ecological components of naturalistic activities, and has ramifications both for clinical (e.g. children with neurodevelopmental disorders, adults with dementia and patients in post-stroke recovery) and non-clinical populations.
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Hi Dr. Moreau! I understand that cognitive benefits are imparted with physical exercise. Are these benefits also then lost, if over the time the exercise routine is lost/becomes uneven?

tanyaj92

Hi tanyaj92, great question. Two things I'd like to mention here. First, there is a reason why (individual) baselines are just that, baselines—it is what individuals typically return to, after any kind on intervention has stopped. This is especially problematic when it comes to brain training exercises on the computer, because these typically have limited impact, and improvements tend not to last. With physical exercise, however, improvements are induced by a whole cascade of neurophysiological changes that take time to appear, but also tend to be sustained for a while after an exercise program ceases. This is a bit of a nuance on my first point, when it comes to physical exercise, but all in all, I think it is safe to say that benefits from any cognitive intervention are likely to fade over time. How quickly, however, is another question that many of us are interested in finding out. Hopefully more on that soon!

I have been diagnosed with Lewy Body Dementia. I'm 45 years old. I'm starting to lose my mind. Have you had any experience with my condition? I'm told there is nothing I can do except treat some of my symptoms. Normally they can treat you to help with hallucinations but mine aren't particularly scary and

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I'd rather not take the drugs. So as of right now I'm not taking anything. Is there anything you're doing in your study that could help me?

cwleveck

Hi cwleveck, thanks for joining us. Before I answer, I must acknowledge that I have not worked with LBD patients, and that my comments here may have to be taken with a bit of caution. At the moment, there is not enough research to properly assess the impact of exercise interventions on LBD, as discussed, for example, in this recent review. That being said, and provided you have been cleared by your physician, there are very few examples of moderate exercise harming patients, regardless of the medical conditions. This has to be assessed on a case-by-case basis, obviously, but it might be worth a try. Chances are, the impact of exercise on mood, general health, and sleep quality might bring about a positive dynamic that could be helpful.

Semi-seirous question here: does regular sex have a (permanent) effect on the brain?

vlosinssrigg

Hi vlosinssrigg, thanks for your question. First, and not to advise deliberately turning this into a workout, sexual intercourse is a form of physical activity, and as such can lead to the typical growth of neurons and connections one can observe after generic physical exercise. There is research out of the Gould lab at Princeton that shows that sexual experience promotes neurogenesis in rats (see here). More generally, sex is also accompanied by a cascade of chemical and physiological reactions, some of which have been shown to benefit brain function (see for example this paper).

Hi Dr. Moreau, What would you consider the minimum exercise regime to see cognitive improvement? And what is ideal to pair it with if your job isn't particularly mentally stimulating? (Hobby or crossword or puzzles, etc, etc?)

Lastly, is there a correlation between increased exercise and increased cognitive function and if so, how far does that correlation go?

Aquabullet

Hi Aquabullet, thanks for joining us on here. This is a difficult question, because it depends quite a bit on your individual baseline. If you are already exercising regularly, it might take a bit of effort to get additional improvements, and at some point physical exercise might not lead to new cognitive gains. This is because the association between physical exercise and cognitive function is not linear—the difference between not exercising at all and moderate physical activity can be quite substantial, while the difference between exercising daily or twice a day might not be noticeable on cognitive performance. This means that for people who rarely exercise, or not at all, starting some form of physical activity should be the first thing on their list if the intent is to improve cognition.

We (and others) have done a little bit of work on the idea of combining physical exercise with some form of mentally stimulating environment (e.g., here, rationale explained here). Basically, the idea is that although physical exercise is probably the most potent to bring about durable changes in the brain, it can be combined with cognitively challenging situations to maximize changes. The key: novelty, diversity, and complexity. Seek out new, stimulating experiences, don't be afraid to get out of your comfort zone, and try and improve constantly. The mindset probably matters more than the specific activity (e.g., learning a new language, picking up a new musical instrument, starting a new sport).

Finally, you ask about the association between increased exercise and cognitive function. It seems like

you are getting at the idea of dose-dependence—i.e., do cognitive improvements follow a trend that is directly related to the amount of exercise. This circles back to the first part of my answer, but let me know if I have left some of your questions unanswered!

For people who are paraplegic or otherwise missing the use of their limbs, does this seem to impede the effect by a great margin? What if someone else manipulates their limbs in the same manner as your non-impaired subjects (patients?)

Do you feel then that children (with conditions or in general) should be permitted more time per classroom day to have bursts where they can run around furiously to improve their learning?

Thank you for your work and your time (regardless if you answer any of these).

webbyducktales

Hi webbyducktales, thanks for posting. It is always good to remember that regardless of physical activity, we continue to produce new neurons across the lifespan, especially in a part of the brain that is very important for memory, the hippocampus. Exercise enhances this natural process, but new neurons still appear in sedentary individuals. I am not sure about passive manipulation of the limbs in the case of paraplegia, and don't know of any research that has addressed this question specifically.

Regarding your idea to allocate more time to move around in the classroom, I think that the way a typical school day is organized can definitely be difficult for children. Attention cannot be maintained for hours and hours, and yet school days are often designed with this expectation. Some would argue that it has been like this for decades, but I'm not sure that it is a good argument against seeking to improve school settings, or against improvement of any system for that matter. When it comes to scheduling bursts of exercise throughout the day, there is also a fine line between facilitating subsequent activities via exercise and excessive, disruptive breaks. This balance has to be worked out with the teachers and principals involved, and what works in one school, with a particular environment, might not translate well to a different school. In any case, there is also a cost in changing policies, and those changes have to be informed by well-designed, unbiased studies. Hopefully we are contributing, in a modest way, to the growing body of evidence on this very interesting question!

What is the effect of fasting on a normal and diseased brain?

azzazaz

Hi azzazaz, thanks for your questions. There is some evidence in the scientific literature that caloric restriction and intermittent fasting can help keep the brain healthy, even as we age (see for example this paper). Importantly, these effects are based on mechanisms that only partially overlap with those influenced by physical exercise, and therefore a combination of these approaches might be optimal. Again, as I've mentioned in my reply to another question, it is important to get the green light from your physician before changing substantially your diet or calorie intake, so as to make sure you are not harming your body in the process.

Hello, dr.Moreau. We know that one of the reasons why people enjoy working out is that brain releases certain chemicals. But there are also people who, no matter what, just hate it. Technically, their brains should also release similar chemicals, but they still do not enjoy it. Where comes the difference? Why does the level of enjoyment differ so much?

wannabe_engineer69

Hi wannabe_engineer69, thanks for your question. You've pinpointed a very important component, in any program intended to enhance brain function—motivation. When exercise is forced, the production of BDNF (a growth hormone that facilitates the creation of new neurons in the brain) is lowered, compared with voluntary exercise (see for example this study in the context of stroke recovery in animal models). It is therefore important to find an activity (particular sports, exercise at fitness centers, for example with music), or a type of effort (aerobic, resistance, etc.) that suits you. There is no magic bullet here—it is all about finding what works for you!

Does the improvement in decision making skills in one task affect the ability of a person to develop his/her decision making skills in another unrelated task?

A-Manual

Hi A-Manual, you've hit the nail on its head. The idea that training at something helps improve at something else is refer to, in the scientific literature, as transfer. Transfer from one task to the other. Now, there is quite a bit of evidence that training on a task tapping one ability will lead to improvements in another task tapping *the same* ability. This is referred to as *near* transfer. For example, working memory training, to enhance working memory. What remains difficult to find is training regimens that lead to *far* transfer, that is, improvements on another task tapping *a different* ability. For example, working memory training to enhance intelligence.

So, the short answer to your questions is that it might, in specific instances, and provided that the other task shares enough features with the training task.

Dr. Moreau, Do you think that the cognitive improvements from exercise decrease or increase as the brain's plasticity decreases? Thanks for your time.

The_Ozynandias

Hi The_Ozynandias -- great question. I'm not sure comparative studies have been conducted across the lifespan, but it seems plausible that exercise-induced plasticity matters to a greater extent when plasticity has decreased, naturally. In typical populations, these effects are usually confounded because younger individuals have a tendency to also move more, whereas older adults show more sedentary behaviors, on average. There might be interesting insight from animal studies that I'm not aware of, though.

What are some skills of a modern day cognitive neuroscientist that you wish you had spent more time on developing earlier in your career? Thank you for this AMA!

dopanephrine

Hi dopanephrine, thanks for your questions and your enthusiasm! I have spent quite a bit of time working on programming/math skills, and I think this has been extremely important in enabling me to do the work I do today. More of this, early on, would have been great, as there is only so much time you can dedicate to learning new skills once you are stuck in the day-to-day duties and requirements.

With this in mind, I'd like to emphasize how multidisciplinary the field of neuroscience has become; scientists have backgrounds in areas as diverse as psychology, engineering, computer science, math, physics, biology, exercise science and many more that I'm sure I'm forgetting. Bottom-line, regardless of your background, you have something to contribute to the field, and there is no one way to become part of it. Find how you can apply *your* specific expertise to answer questions in this field, and start

having fun!

It's interesting that more rigorous exercise can affect the brain - so many possibilities for helping people! I've read that something as basic as taking a short walk can increase attention, memory, promote creativity, etc. What are your thoughts on the value of integrating simple movements in the classroom (given that it may be difficult to regularly integrate the activities you used in your study)?

chocolateandbourbon

Hi chocolateandbourbon, thanks for dropping by, and for your interest in our work! You're right, walking does help increase cognitive abilities, but especially for people who tend to live sedentary lifestyles. If walking, or any other form of exercise, is already part of your life, these improvements (if any) are typically weaker.

I think our program could be part of a school schedule, given that it involves very basic movements (e.g., jumping jacks), video-based, that can be performed in the classroom. So we hope these qualify as simple movements that can be useful as such!

What is the difference between performing the same exercises and performing new exercises once a while? (in terms of the brain's response)

MasterAgent47

Hi MasterAgent47, thanks for posting. I have answered a similar question earlier, so I'll paste the previous answer here. If you feel like there is more to your question than this answer covers, feel free to let me know!

One quick rule of thumb: whenever starting a new activity, the demands appear very challenging at first, only to become more manageable as one practices more. We have reasons to believe that this challenging period is extremely beneficial to the brain, as it forces adapting to new demands, and coming up with novel solutions. Think of picking up a new sport, for example. Every single thing is challenging initially, but eventually some of these become automatic (e.g., basic motor control), to free up resources for other things (e.g., more elaborate coordination, focusing attention on the environment, etc.). As time passes, and with sustained practice, many of these challenges have been worked out already, and situations are less demanding cognitively. This is what expertise is all about. Interestingly, there might be a case for favoring new activities in which one is a novice, to force the brain to adapt to new demands, despite society's emphasis on mastery. Different dynamics, to achieve different goals.

Can overtraining lead to depression like symptoms? Is that what "burnout" is?

UncleDan2017

Hi UncleDan2017, thanks for posting. Just like a sedentary lifestyle is detrimental to maintaining a good health, so is overexercising -- if the body is not given enough time to recover, then potential improvements cannot materialize, and benefits might be limited. In addition, and when it comes to enhancing brain function and the creation of new neurons, there is little benefit in exercising further, passed a certain threshold, and time could be spent doing other challenging activities. As for burnout, it refers to a more general psychological state of emotional exhaustion that may or may not come from physical strain.

Kia ora Dr Moreau, thanks for doing this AMA.

How would you ideally want to see these exercise interventions delivered to the population through the healthcare system?

We currently have the Green Prescription programme to improve activity in patients with chronic disease, is that something that you think could be emulated to help patients suffering long-term cognitive impairments, or do you expect it would be more beneficial were it delivered to the wider population as an extensive campaign?

quel-dorei

Hi quel-dorei, thanks for your question. Ideally, we want our intervention to be available to schools, parents, or individuals, with the hope that they can then make a decision about implementation. Of course, it helps if implementation is encouraged, or validated by, higher institutions, but this is not a fundamental requirement for us. We are making the science and the tools available, so that eventually individuals can decide for themselves.

As an aside, thanks for the pointer -- I'll definitely look into the Green Prescription program, and what it entails.

What's the overall vision you're striving to achieve?

The_Glorious

Hi The_Glorious, thanks for your question. Because it's a bit general, I'll redirect you to some of the content that is available on the MovinCog Initiative website, which is at the core of the intervention reported in this paper. If there's anything else you'd like to know, please reach out!

Has your work included, or provided clues, as to the brain's changes from longer periods of high intensity exercise?

How did your tests quantitatively define exercise as high intensity?

FadeIntoReal

Hi FadeIntoReal, thanks for stopping by. A range of high intensity was defined based on individual resting heart rates at baseline, and monitored with activity trackers (see details here. We are currently testing other (longer) interventions, to see if sustained training can lead to larger improvements. So stay tuned!

Do you think alternating cardio and some sort of strength training (1 minute jumping-jacks, 1 minute squats, etc) could capitalize on the possibly different beneficial effects of aerobic exercise and resistance training?

While the number of students with learning disabilities was small, did you notice any particular benefit, or did they more or less overlap with the BDNF variant you mentioned?

Do you think that this kind of intervention would be useful in vulnerable populations in their late teens/early twenties by ameliorating possibly excessive synaptic pruning? (Or in some other way.)

Is it possible to see the training video?

--Allegra--

Hi --Allegra-- thanks for your questions. Because the mechanisms of improvements may be different, it could make sense to include a blend of different forms of exercise in your regular workout. This is particularly relevant since it is also the kind of workout that could bring about the biggest physiological gains, if one is targeting overall health and fitness.

In the study we reported here, we lacked the (statistical) power to look at the influence of HIT on students with learning disabilities, in comparison with typical children. However, we are doing this kind of work as I speak, so stay tuned for more on that! The same applies to disorders that may arise because of abnormal synaptic pruning--it is too early to tell, but we do hope this kind of regimen can make a difference.

The full script for the workout is available here.

Hello! Are there certain exercises you can reccomend that are better for increased cognitive elasticity? Are there types of exercise that are detrimental? Thank you :)

FeralChapstick

Hi FeralChapstick, thanks for your question. Traditionally, people have found that aerobic exercise, that is, exercise performed at moderate intensity (~50-80% of maximum) for long periods of time (at least 30-40min/session) are optimal to elicit cognitive improvements. However, recent work, including our own, shows that other types of exercise (e.g., HIT, strength training, complex motor training) can induce similar gains. There does not seem to be any form of exercise that systematically worsens brain function, documented in the scientific literature at this point (at the exception of overexercising, which can be detrimental to health overall). When it comes to make a personal decision about what type of exercise is right for you, it is also important to take into account personal preferences and motivation. Long-term commitment is key, so pick something, or multiple activities that you find appealing!

Curious: During the study, did you observe changes in mood after the participants engaged in high-intensity training? Wondering about this being used to treat depression in minors.

diana_sea

Great question, diana_sea. In this study, we did not find that HIT affected self-reported happiness differently from the control intervention. This measure, however, is coarse, so it would definitely be worth exploring this question more deeply in future studies. More generally, exercise has shown very positive effects on depression and its symptoms--see for example this summary.

I've noticed some miraculous improvements in a Parkinson's sufferer whose doctor sent him to our local juggling group. He's gone from not being able to hold a ball to a steady three ball fountain. Is there any research being done on the effects of juggling and other flow arts (poi, staff, hoop etc.) on neurodegenerative disorders? What is your take on it?

The_Dead_See

Hi The_Dead_See, thanks for your question. There are, indeed, some reported cases of Parkinson's patients whose symptoms appear to dramatically improve with an exercise program. Of course, we have a tendency in this case to focus on those cases, rather than the ones where no such recovery exist, and in this regard we might be slightly biased if that's all the evidence we look at. However, there are some trials out there that seem to argue convincingly for including exercise regimens in

Parkinson's treatment (e.g., here).

two questions : How can one tell that the condition of his mind has changed during given period of time ? I am afraid that every little thing I found about my mind working differently due to heavy stress, after an some kind of exhausting period of life (i.e. writing thesis) or even due to alcohol could be just pure imagination. What do cognitivists state about this kind of sensation of ones own brain. How can brain think of itself in a critical way ? Second question being, I'm currently thinking about joining research on msc deegree studies with neuroscientific research team. I found the subject extremally interesting through the years. What necessary abilities shoud a student posess to come as an viable asset to the team (currently being a chemist/biotechnologist I'm taking extensive courses in neurology human physiology and anatomy) Thanks for the answer.

mrkivi

Hi mrkivi, you're hinting at quite a few interesting points there. First, as I understand it you're alluding to the concept of randomized controlled trials. So, in our study, we randomly assigned our participants to either the HIT or the control group, and if you have enough participants in your study, this should approximately equate individual differences that are not related to the intervention. If done properly, such trial allows claims about the source of improvements, namely, the difference in interventions. We then use well-validated measures to assess cognitive improvements, from baseline to post-intervention.

For the second part of the question, I'll refer to an earlier answer I've posted on here, which I believe might be relevant. Hope this helps!

Hi dopanephrine, thanks for your questions and your enthusiasm! I have spent quite a bit of time working on programming/math skills, and I think this has been extremely important in enabling me to do the work I do today. More of this, early on, would have been great, as there is only so much time you can dedicate to learning new skills once you are stuck in the day-to-day duties and requirements. With this in mind, I'd like to emphasize how multidisciplinary the field of neuroscience has become; scientists have backgrounds in areas as diverse as psychology, engineering, computer science, math, physics, biology, exercise science and many more that I'm sure I'm forgetting. Bottom-line, regardless of your background, you have something to contribute to the field, and there is no one way to become part of it. Find how you can apply your specific expertise to answer questions in this field, and start having fun!

Hi, in your description you mention that the intervention "[preserves] the ecological components of naturalistic activities". What does that actually mean? It would be great if you could give some examples to help a non-neuroscientist (like me) understand? Thank you.

StuartRFKing

Hi StuartRFKing, thanks for your question. The idea of seeking naturalistic (or ecological) activities, to enhance cognitive function is to find activities that are already present in the world. For example, playing sports or musical instruments would qualify as ecological forms of stimulation for the brain. These are usually referred to in opposition to computerized forms of brain training, which are artificially constrained, by the game developers in this case. There is nothing magical about activities that already exist in the world, but these are often accompanied by features that make them particularly appealing when it comes to brain training; for example, the inherent complexity and diversity that they include, together with the motivational factors that are naturally associated with them. Finally, many of these also include a motor component, that is, some form of movement, which demands are especially interesting to challenge the brain.

If you're interested in reading further about this, we have explained this concept in more details in this paper. Hope this helps!

Reckon there's anything to double n-back working memory training? I'd love to have a better working memory for math stuff, but I can never decipher the current state of the literature on whether it actually works.

Also, have you found any positive effects on working memory from physical exercise?

HotGeorgeForeman

Hi HotGeorgeForeman, thanks for joining us. Unless your working memory really *is* the limiting factor in many of the tasks you perform every day (i.e., your working memory is so low it is impairing your ability to reason, think, etc.), chances are that n-back training might not be the best use of your time. More ecological, or naturalistic activities might be preferred in this case (see this paper for example). However, in some cases computerized training might be beneficial to target the specific abilities that are impaired, for example in the case of learning disorders (see the rationale for this idea here).

One quick rule of thumb: whenever starting a new activity, the demands appear very challenging at first, only to become more manageable as one practices more. We have reasons to believe that this challenging period is extremely beneficial to the brain, as it forces adapting to new demands, and coming up with novel solutions. Think of picking up a new sport, for example. Every single thing is challenging initially, but eventually some of these become automatic (e.g., basic motor control), to free up resources for other things (e.g., more elaborate coordination, focusing attention on the environment, etc.). As time passes, and with sustained practice, many of these challenges have been worked out already, and situations are less demanding cognitively. This is what expertise is all about. Interestingly, there might be a case for favoring new activities in which one is a novice, to force the brain to adapt to new demands, despite society's emphasis on mastery. Different dynamics, to achieve different goals.

There was an article about intensive exercise could cause heart disease and other problems. Is that a different degree of intense exercise or we need to choice what we want?

xipha

Hi xipha, thanks for posting. I assume you are referring to this NYT article, which discusses cases of spinning-induced rhabdomyolysis. You are absolutely right--it's all about moderation here. The workouts described in the NYT article are typically an hour long, all while being very intense. Obviously, this is not something one would want to get into at the onset of an exercise program. Our workout, on the other hand, was just 10min/day, including interleaved rest, without getting anywhere near the point of exhaustion. At you pointed out a very important factor in your question--motivation, and your ability to sustain it over time, is so important, it is worth finding out what works best for you.

I would be frightfully interested to see how the brain changes subsequent to martial arts training! Edit: spelling

AdmNaismith

Hi AdmNaismith, you might be interested in the work of Adele Diamond at UBC (see for example this review). She discusses the impact of martial arts on executive function, our ability to plan, decide what to do, and stay on task, among other things. We have also done some work on wrestling, which is not

martial arts per se but falls into the category of combat sports (see for example this paper). Bottom-line: these activities stimulate spatial ability, in ways that can facilitate spatial processing in other activities. All while having a good time!

Is the prefrontal cortex reponsable for chronoception

yunayomiko

Hi yunayomiko, thank you for your question. Chronoception, i.e. the sense of time, is the result of the interaction between many different parts of the brain, including the cerebellum, the basal ganglia, the cortex, the suprachiasmatic nucleus, especially involved in the regulation of circadian rhythms.

Is the brain the only organ to have named itself? Does the "liver" accept the name the brain has given it?

Mevil187

Great question, Mevil187. Since your brain asked it, however, and mine seems to want to answer it, I'm afraid this cannot be objective. My gut feeling is that this cannot be the only instance of self-labeling, but I don't know any other by heart.

Which is better for improving brain function? Weights or aerobic?

tigersharkwushen_

Hi tigersharkwushen_, traditionally, aerobic exercise has been lauded has the best way to enhance brain function. Lately, other forms of exercise have proven valid alternative. See also this previous thread:

Hi FeralChapstick, thanks for your question. Traditionally, people have found that aerobic exercise, that is, exercise performed at moderate intensity (~50-80% of maximum) for long periods of time (at least 30-40min/session) are optimal to elicit cognitive improvements. However, recent work, including our own, shows that other types of exercise (e.g., HIT, strength training, complex motor training) can induce similar gains. There does not seem to be any form of exercise that systematically worsens brain function, documented in the scientific literature at this point (at the exception of overexercising, which can be detrimental to health overall). When it comes to make a personal decision about what type of exercise is right for you, it is also important to take into account personal preferences and motivation. Long-term commitment is key, so pick something, or multiple activities that you find appealing!

Hi Dr. Moreau,

Let's say I want to program one weight lifting session, one HIT cardio session, and two 2-hour study periods a day. What would be the best way to schedule them to take advantage of the improvements in cognitive function the exercise provides?

Your paper looks like it focuses on longer term adaptions and cardio, but in the intro you mention research on resistance training and shorter term benefits from single sessions so I'm hoping you might have some advice.

Thanks!

Tarukar10

Hi Tarukar10, great, practical question! Two things to take into account here. First, exercise typically increases alertness, and in that regard it might be beneficial to implement an exercise session *before* studying. That's for the short-lived, acute improvements. Now, of course, exercise also triggers long-term improvements, which are more durable. For those, it matters little whether exercise is followed by a study session or vice-versa: new neurons and connections will take between a few days and a few weeks to emerge. Finally, individual biological rhythms also matter: if I know that I cannot pay much attention to studying material early in the afternoon, it might not make much sense to always schedule an intense study session around that time. Some form of exercise scheduled for that period of the day might be preferable.

Dr. Moreau,

Have you looked into the effects of brain training combined with low-level electrical stimulation (i.e. with something like the PoNS device)?

Also, why did you choose the cognitive tests that you did as outcome measures for cognitive improvement?

Thanks!

missthinks

Hi missthinks, thanks for dropping by. To answer your question, I have no personal experience with the PoNS or other similar devices. As for the cognitive tests we chose, those were thought to be good, standardized assessments of working memory and cognitive control, two abilities we suspected would respond to HIT.

Does the concept of embodied cognition affect your work at all?

GhostOfWindows95

Hi GhostOfWindows95, it does, to some extent. There are many different views of embodied cognition (there is even a paper that is titled pretty much just that), but regardless of one's perspective, our findings can be understood as part of the embodied cognition framework. More specifically, some of our results have suggested that involvement in sports and other motor activities elicit seeing the world in a "motor" way, where most people naturally process the same information differently (e.g., as visuospatial content). See for example this paper.