

Welcome to the Cutting Edge Health Podcast with Jane Rogers, where we discuss science to help prevent cognitive decline.

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**[00:00:00] Jane Rogers:** I'm Jane Rogers. Welcome back to the Cutting Edge Health: Preventing Cognitive Decline podcast. I hate to tell you we need to add something else to our exercise regimen, but I think it may be smart. I just interviewed Chris Ring. He's a PhD from the University of Birmingham in England. He and his research colleagues have found out that if you add brain endurance training, either before you do your exercise or during it intermittently, like if you do weightlifting and in between your sets, you add brain endurance training with an app on your phone, that it really helps your cognition interestingly. It also helps you physically as well. I think you'll find what he has to say easy to apply, and I hope you get a lot out of it. I certainly did. My workout is going to change.

Dr. Ring, thank you so much for joining us for this podcast. I've been really excited about your research.

**[00:01:01] Dr. Chris Ring:** Well, thank you, Jane, for inviting me. It's a pleasure to come on and speak with you and share some information with your listeners.

**[00:01:11] Jane:** Wonderful. We're doing a first, at least for me, and that's interviewing someone who is in Tokyo. [chuckles]

**[00:01:17] Dr. Chris Ring:** [chuckles] Yes. It's a first for me. Well, I tell you, it's not the first time. It's the second time in Tokyo, but it's a great place to be.

**[00:01:25] Jane:** Oh, I bet it is. Usually, you hail from the University of Birmingham in England?

[00:01:29] Dr. Chris Ring: Yes, in England. That's right. Yes.

**[00:01:33] Jane:** When I read your research, and it got quite a bit of publicity, I was really excited because I love to work out. What you're saying your research is finding is you need to add a whole other component before your workout. You need to work your brain out first for 20 minutes and then go to the gym.

[00:01:49] Dr. Chris Ring: Yes.

**[00:01:49] Jane:** Can you tell me how you found this, how you designed your research, and pull it apart so it motivates all of us to do the brain stuff first?



[00:01:56] Dr. Chris Ring: Absolutely. For about the last 10 years or so, I have been spending a lot of my research and thinking time interested in the topic of mental fatigue and performance in the context of sport and exercise. The bottom line is that it's now very well established that if you are mentally fatigued, mental fatigue can be caused by a whole variety of everyday activities, not sleeping well, having demands at work, having demands for caring, a whole variety of demands.

What mental fatigue seems to do is it undermines performance, makes your exercise performance worse than you would expect. As a result of this large body of literature, it doesn't always happen but more often than not, that's what we find. Then the question becomes, what are you going to do about it? A number of groups around the world have come up with various countermeasures, and these things include simple things like adding rests and having breaks. Getting up and walking around, I guess, is one. These are fairly commonplace and fairly well-developed countermeasures. The only problem with them is that I'm not sure how long-lived they are and whether they will be able to support you in the long term.

What we have been doing-2016 was our first study inspired by the work of Professor Samuele Marcora, now at the University of Bologna-we started evaluating the benefits of brain endurance training. What brain endurance training is, it combines normal physical training with additional cognitive training. The initial idea behind it was, if you can make the training a little bit harder, then you're going to get more adaptations, brain adaptations, physical adaptations, and therefore, after doing this form of combination, cognitive plus physical training, you'll be able to perform better.

We've done a whole series of studies now in very high-level athletes, initially just looking at exercise performance and sports performance. Again, more often than not, brain endurance training can benefit the athletes. Almost by accident along the way, we would occasionally put in some measures of cognitive function as our outcomes. We only did it in a few studies. As I said, it was really quite accidental. What these studies showed was the brain endurance training, which was designed to help athletes to become better athletes, perform better, was also improving their cognitive performance.

We thought about this and I started a collaboration with Dr. Jesús and his supervisor at the University of Extremadura in Spain. They were also interested in this topic of mental fatigue and performance, again, mainly in sport. Then one day I was talking with Jesús, and we said, "Well, maybe we can do a little bit more and extend this to other groups." It just so happens that Jesús is also a padel tennis coach, and he was giving some padel lessons in his village. It just so happened that one of the people in his group was the local mayor, and she started asking, "Jesús, what do you do for a living?" He started explaining to her what he was up to. She said, "Well, is there anything that you can do for our local community?" They live in a small village, Torre de Miguel Sesmero, in Spain.

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Jesús and Thomas and myself put our heads together and thought, "Well, what can we do to apply these principles of brain endurance training to a non-sporting group?" We set about this project, and that's how it was born, almost like a chance conversation, giving a padel tennis lesson to the mayor of a little village. That's how the study was born. Then, with her support and the support of the local community, we recruited some older ladies, 65 years and above to this 12-week study, and all. We did some tests, assessed people beforehand, assessed them halfway through the eight-week intervention, and then assessed them at the end of the eight-week intervention. Then there was a washout period for four weeks where they didn't get any training at all and then we reassessed essentially at 12 weeks.

Because we had noticed that brain endurance training was benefiting not only physical performance, but also cognitive performance, we also included a few tests of cognition along with the physical tests. The physical tests that we use are very standard for assessing fitness in older adults. We asked people to see how far they could walk in six minutes, we asked them to see how many times they could sit up and stand from a chair, and we asked them how many times they could do a bicep curl using a small weight in their hand.

Those were the standard tests. What we found was that brain endurance training- which wasn't particularly onerous, really, it was before they did their physical training, which was a little bit of resistance exercise and a little bit of walking, 20 minutes, 25 minutes, 3 times a week. They did a 20-minute cognitive task to activate them and prime them really for the upcoming exercise resistance and endurance exercise that they were going to do. That was the training, and those were the physical tests. Then we also added in a couple of cognitive tests called the psychomotor vigilance task. What that is, is very simply, you're shown a screen and a stimulus, like a little circle appears on the screen, and you're asked to press it as quickly as you can. It's like a reaction time, speeded reaction time task. They do that for a couple of minutes.

Then the other task we did was we gave them something called the Stroop Color Word Test, which is a bit of a brain's task really. [chuckles] What it does is it presents you a series of words, of colors printed in different colored inks. It asks you to name the color of the ink. We've grown up since childhood, reading so you see a word and you read it.

The natural inclination is to read the word, but we're actually, in this rather confusing task by Dr. Ridley Stroop, we ask participants not to read the word, but instead to name the color. This assesses a classic cognitive function and one of the so-called executive functions, one of the higher-order functions that we call inhibition. Inhibition is around in our everyday lives. We assess inhibition, and then we also assess the earlier tasks, the psychomotor vigilance. We assess attention.

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What we find is that when we test people before the training, halfway through the training, and at the end of the training that the group who did the brain endurance training, this combination of cognitive plus physical training, they do better. There's two comparison groups. There's a group who just do physical training for eight weeks, and then there's a no-training control group who just remain sedentary for eight weeks. On most of the tasks, not all of the tasks, and on most of the occasions, but not all of the occasions, we find that the brain endurance training group outperform the other groups. We're very pleased that this little--

It was really a pilot study, to be honest. If a methodologist would get to this study, they'll say, "Well, there's not enough people." Fair enough, there's not a lot of people in the study. There's only eight ladies per group, but it's a start for us. The findings are very supportive of this idea that if you get people to engage and add a little bit of cognitive activity, cognitive training to their standard physical training, that you can get even better benefits. You can get benefits both for their physical performance and also for their cognitive performance. That's the study in a nutshell.

[00:10:04] Jane: Great. Are you going to go back and do it again with a larger cohort?

[00:10:07] Dr. Chris Ring: We have to do that, yes. We're trying to get some funding at the moment to extend this. These studies, they're not easy to run. They need some funding because you have to do lots of testing. There's the training involved. This study was eight weeks of training three times a week, so that's already 24 sessions. Then there's some testing sessions, and what have you. You're looking at lots of personnel hours to do the training. That's what we want to do. As I said, we're excited there's been some publicity around the study, and so we hope to get some funding for Jesús. He's just finished his PhD recently. He's currently a postdoc in Italy. He's trying to get fellowships to continue with this work.

It's not unique, in that there are some studies coming up now looking at the benefits of combining cognitive plus physical training. The only difference I would say with brain endurance training as a form of combined training is that it's a little bit more formalized. There are some studies that look at, for example, residents in care homes where they get them to do crosswords and Sudokus and puzzles like that, as well as a little bit of physical training. What we did, it's a little bit more formalized. We take classic cognitive tasks from the neuropsychological literature, and we get people to perform these.

The advantage of doing that is that you can standardize the task. You can tailor the task. You know what sort of cognitive load that you are giving people, whereas these other studies, they're probably more practical, to be honest, in that they're done in a setting of a care home or a residence. The tasks that we get people to perform, typically, they can perform on an iPhone, an iPad, or on a computer. They're just a little bit more demanding.

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I think the cognitive load is a little bit higher than, for example, doing a Sudoku or trying to solve those sorts of puzzles.

[00:11:58] Jane: Fascinating. If I want to do this, if I want to train my brain before I go to work out, where do I turn to get a high enough level brain workout to make a difference? Where do you advise people go?

[00:12:10] Dr. Chris Ring: Yes. Well, there are lots of apps available from your choice of app store, and some of them are free, some of them cost not very much. We use an app called Soma NPT, but that's designed for use by athletes, and military personnel use it. It's rather expensive just for regular people to use.

[00:12:32] Jane: You spell S-O-M-A, Soma?

[00:12:34] Dr. Chris Ring: S-O-M-A and NPT, yes. As I said, it's a bit expensive, that one.

[00:12:40] Jane: I looked into it. Yes, it is a bit expensive. I saw you use that in your study, and I went, "Ooh, it's a little high."

[00:12:46] Dr. Chris Ring: Yes, it is. The reason that we started using it was that when the pandemic arrived, all the labs were closed at the university, and probably worldwide, they were closed. We were doing studies originally using other software, but when the pandemic came, we realized that it wasn't business as usual. We wanted to carry on doing some research, and the students still had to get their degrees. We looked around and we started conversation with Grant Hayes, who's the CEO of Soma Technologies who produces Soma. That was the start of a collaboration. He gives us the app for doing research-

[00:13:25] Jane: Oh, excellent.

[00:13:26] Dr. Chris Ring: –but his income stream comes from athletes and coaches and the military, and racing drivers, and what have you, who don't blink at paying a little bit of money. For most people, it's a bit steep. There are plenty of cognitive tasks available on the app store for very little money or even for free, they're just not particularly standardized. Any of those would work perfectly well.

[00:13:50] Jane: Do some names come to mind, Chris?

[00:13:52] Dr. Chris Ring: Not off hand. As I said, if you type in for any of the classic cognitive tasks, and I can give you a list of the classic cognitive tasks. The PVT, for example, that one's there, the Stroop task, you can get the 2-back memory task. There's a whole range of different cognitive tasks. In our studies now, we tend to use tasks from

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executive function battery. We use tasks that look at inhibition, things like the Stroop task. We look at memory updating, things like the 2-back memory task.

[00:14:26] Jane: What's a 2-back memory test? What's that?

[00:14:28] Dr. Chris Ring: The 2-back is-- Oh, okay.

[00:14:30] Jane: Sorry. I don't know what that is. [laughs]

[00:14:32] Dr. Chris Ring: No, that's fine. Why would you? You wouldn't expect to, but what that is, it presents you a series of stimuli, let's say numbers. What you have to do is you have to keep track of the numbers you've been presented with, and you have to say whether the current number is a match with the number that was presented on the two screens before.

[00:14:58] Jane: 2-back. Ooh, okay.

[00:14:59] Dr. Chris Ring: Yes. In fact, you can change the difficulty of the task by changing the size of the N in the N-back. The simplest one is the 1-back. You just have to say whether the current stimulus is the same as the one previous. You can also make it harder by saying, is the current stimulus the one that you saw three screens back, so you can change the cognitive load, how much you have to retain this information in memory, and keep it current, like a running track of it.

**[00:15:29] Jane:** I was just thinking that sounds really hard.

[00:15:31] Dr. Chris Ring: I personally find the 3-back a little bit too challenging. [chuckles] It is hard. The 3-back gives me a bit of a headache, I think, but the 2-back I can manage, and the 1-back I can also manage. That's one, and then there are some tasks switching where you are doing one task, and then either the rules of the task change or the actual task changes, and you have to now do a second task. These three apex inhibition, updating, and switching are core cognitive operations, frontal cognitive operations, and they're involved in most purposeful activities and behaviors that we do as humans.

They're also involved in exercise regulation, and hence that's why we think that there's this link between doing brain endurance training with these sorts of tasks and causing adaptations by combining them with exercise. The cognitive loading, plus the physical demands of exercise, we believe, create greater adaptations. We think that this adaptation process, which is better with the combined training, allows people to then perform better at both subsequent tests of physical function, but also of cognitive function. Basically, you push the system to perform better.

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**[00:16:46] Jane:** You're doing 20 minutes of the brain. Then, how much are you doing of each?

**[00:16:51] Dr. Chris Ring:** The brain endurance training is flexible. In that particular study with the older ladies, we decided that we would keep it quite simple and we would give the 20 minutes of cognitive task and then about 45 minutes of exercise and do that three times a week. What we have is we have a whole variety of options for doing and integrating the combination of cognitive task and physical task. For example, the brain endurance training studies that we do in the context of resistance or weight training, what we do there is we have somebody do short cognitive tasks, then they'll do an exercise set. They'll do so many reps, then they'll do another cognitive task, and then they'll do another set, and then they'll do another short cognitive task.

The one with the older adults, we call that prior brain endurance training, because the cognitive task comes before. The one I've just described to you with the sets of exercise and then the sets of cognitive tasks, we call that intermixed brain endurance training because it interleaves or intermixes the two types of tasks. The great advantage of that is that people would be having a little rest anyway between exercise sets.

[00:18:12] Jane: You have to, yes.

**[00:18:13] Dr. Chris Ring:** Yes, you have to. Then, you just add a little bit of a cognitive task for three minutes before you get going again. It doesn't add too much to your overall training session, which is, obviously, more advantageous for people who are a bit time poor. People complain, "I don't want to be adding loads and loads of extra time with the cognitive training." We say, "Well, you'll be sitting around resting." While you are resting your body, you can be putting demands on your brain.

**[00:18:41] Jane:** Everybody at the gym, they get on their phones, they do a rep, and then they get on their phones and look at their email. Now you might as well be doing brain training and have the same results.

**[00:18:50] Dr. Chris Ring:** Yes. Well, interestingly, there is some literature suggesting that going on your phone and doing social media is a form of cognitive loading. It's just not very standardized, but that is, I guess, a form of brain endurance training where you're on your phone looking at social media, scrolling, and checking things out. Then you do your set, and then, as you say, while you're waiting, you do a little bit more. I don't know if that's beneficial compared to the cognitive tasks that we typically use, but it's definitely worth trying out–

[00:19:23] Jane: That's good.



[00:19:23] Dr. Chris Ring: -because if it creates a load, a cognitive load, then in principle it should create this benefit.

[00:19:29] Jane: Are you saying the intermittent has the same cognitive benefits as doing the preloading?

[00:19:34] Dr. Chris Ring: We've never formally compared the different forms of brain endurance training. We get the same sort of changes. Most of our studies now prefer to do the intermixed brain endurance training because it's just a little bit more flexible. For example, what we might do is give people, let's say, a 10-minute cognitive task before they start anything, and then after they complete each set of exercises at the gym, we then ask them to do another three-minute task or a five-minute task, or something, and then they do exercise. That integration seems to be guite well-received by people. They're quite happy to do that.

[00:20:10] Jane: When you go to the gym, that's what you're doing, you're doing that intermittent?

[00:20:13] Dr. Chris Ring: My form of exercise pleasure is I like to ride a bicycle. Much to my wife's disappointment, I don't currently go to the gym to do resistance, but we have got a weight room. It's one of my 2025 resolutions because, as we know, there's lots of benefits for doing resistance. I'm getting on a little bit these days, as well as doing my cycling and my swimming. I've decided I'm going to add a bit of resistance work as well.

[00:20:38] Jane: Good for you.

[00:20:39] Dr. Chris Ring: Yes. Thank you.

[00:20:40] Jane: Before you bike and swim, you're doing your preloading, you're doing cognitive work before those things?

[00:20:46] Dr. Chris Ring: Well, I am.

[00:20:47] Jane: Have you adopted this yourself, Chris?

[00:20:49] Dr. Chris Ring: There's naturalistic ways of creating mental fatigue. If you are engaged in cognitive work, which engages me for most of my work, at the end of the day, as well as being physically tired, you could argue that you'll get better training benefits if you then go and work out at the end of the day when you've had a hard day's work behind you than if you exercise when you are feeling fresh and sparkly early in the morning. I haven't actually compared that, but that's what I would predict. It might be better to actually wait till life wears you down a little bit and tires you out before you go to the gym or go for your bike ride, which is what I typically do. Yes.



[00:21:32] Jane: That's great. I can't think of anything else. You've explained this so well. Thank you. We have in this country something called BrainHQ that you have to pay for. I'll also go looking for free things, but BrainHQ seems to have a lot of these components. Have you worked with that software?

[00:21:49] Dr. Chris Ring: I'm not familiar with that software actually. There are lots of people working in this space, and I think there's lots of providers available. I think this idea of cognitive training is a very popular one. I think the idea now is, okay, let's just combine it. It seems a very unnatural thing to do to just say, "Oh, I'm just going to do cognitive training," or "I'm just going to do physical training." We were designed from--When we were kids, we would do everything. You would run and play and--

[00:22:13] Jane: Oh, yes, for hours.

[00:22:14] Dr. Chris Ring: It seems strange when you become adult, you now start to compartmentalize these demands. I think this idea of combination training is getting a lot of traction. I hope over the next few years people will try it out and see where it works and when it doesn't work, and what's the best way that it can work, and fit around people's schedules, and what have you. I think the years ahead are very promising for all of us.

[00:22:40] Jane: I'm really glad that your colleague stumbled on this with the mayor of his small town and had the skills and knew you and you guys could put together a study. It's very exciting. Thank you.

[00:22:50] Dr. Chris Ring: Thank you for inviting me. It's been very good to be able to share with you and your listeners.

[00:22:55] Jane: You're welcome.

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## [00:23:35] [END OF AUDIO]

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