



Making Music with Muscles

Thomas Fritz, Leader of the Music Evoked Brain Plasticity Research Group at the **Max Planck Institute for Human Cognitive and Brain Sciences** in Leipzig, knows how to make people happy and fearless – essentially as a kind of welcome side-effect. He conducts experiments using exercise machines with which you can create music. The experience of exercising with this equipment and simultaneously creating unique sounds not only reduces bodily exhaustion, it also puts the user in a good mood and lowers their anxiety and pain levels – effects that give rise to a range of therapeutic applications.

TEXT **STEFANIE REINBERGER**

Slaves used to sing on the cotton plantations of North America, as did convicts in quarries. Mariners belted out shanties at the top of their lungs to counter the wind and waves. Even today, soldiers sing cadence calls while marching, for extra motivation. And scientists from the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig use exercise machines to produce energizing rhythms and melodies. In search of a name for this new – and at first glance surprising – activity, they coined the label “Jymmin” – a cross between “jamming” and “gym.”

Music makes physical exertion easier. That’s why work songs have a long-standing tradition. It was previously assumed that singing songs while working serves to establish a regular beat that synchronizes the workflow and possibly also distracts the workers from the strenuousness of their labor. Yet Thomas Fritz, Leader of the Music Evoked Brain Plasticity Research Group

at the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig, and professor for empirical music research at the Institute for Psychoacoustics and Electronic Music in Ghent, has arrived at a different conclusion. His studies with exercise machines that create music show that making music while doing a physical workout does in fact reduce the physical strain – at least with regard to strength training.

MAKING MUSIC IS SPORTIER THAN LISTENING TO MUSIC

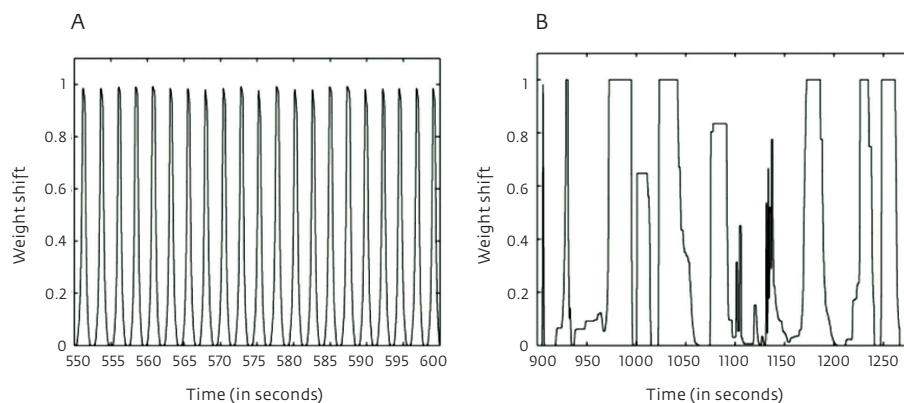
The experiment set up by the scientists in Leipzig involved 36 participants doing sports. None of them were musicians and none of them were professional athletes, in order to eliminate side-effects that could potentially distort the results. The first group of participants trained using conventional exercise machines – a stepper, a lat pull-down bar designed to strengthen the broad back muscle (latissimus) and an

ab trainer – while listening to music, as in any normal gym. The second group, however, was allowed to use the Jymmin machines, meaning they made the music themselves.

The surprising result: Even though both groups completed the same exercise routine, the Jymmin group reported feeling a significantly lower level of physical exertion than the group using standard fitness equipment. Furthermore, physiological measurements of oxygen consumption and muscle tension showed that, during the Jymmin workout, muscles worked more efficiently and were also less tense. Fritz and his colleagues published this discovery in 2013 in the *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (PNAS)*, an American science journal.

When Thomas Fritz is asked how he came up with the idea of constructing fitness machines that produce music, he laughs and says: “That’s a long story. Are you sure you want to hear it?” And then he gets talking. He recounts

Inside the “gym” of the Max Planck Institute in Leipzig: While an assistant shows the participant how to correctly use the ab trainer, Tom Fritz prepares the computer that will record and visualize the movement patterns that result from the Jymmin composition program.



Stereotypical movement patterns that originate during conventional strength training result in even spikes in the graph depicting weight shift over time (diagram A), while movement that depends on music leads to a less stereotypical and physiologically more meaningful motor behavior with a greater degree of holding movements, creating an irregular line graph (diagram B).

his university studies in biology and his neuroscientific research. Around 15 years ago, while writing his university diploma thesis, he was already working at the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig, where he focused on the link between music and emotions – a topic that would continue to fascinate him throughout his career. “Basically, the first time I looked into how music triggers emotions was during my years at the university, when I had a part-time job composing my own live electronic music in the chill-out zones of clubs in Frankfurt and the surrounding region, often for ten or twelve hours at a stretch.” He says this is when he observed how different sound parameters affected the mood of the party-goers.

However, the inspiration for Fritz’ Jymmin machines came to him upon his return from an ethnomusicological

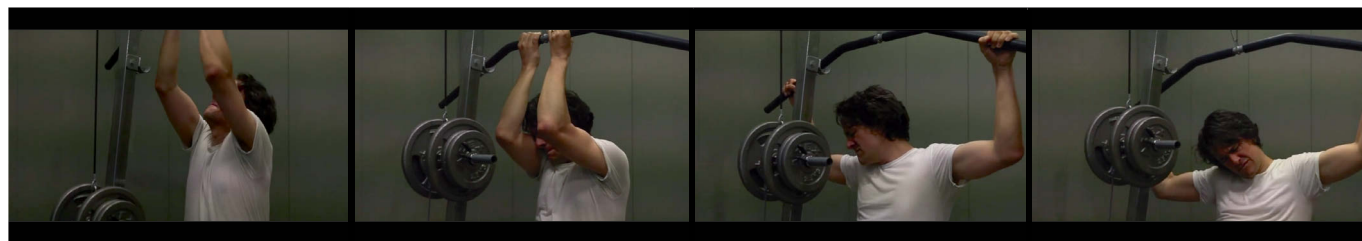
research trip to the Mandara Mountains in northern Cameroon. As part of his doctoral thesis, the scientist studied how people who have never been exposed to Western music perceive it when they hear it for the first time. “In the beginning, nobody wanted to participate in my study, of course; after all, I was a stranger,” Fritz remembers. “So instead, I took part in the music rituals of the Mafa.” The Mafa, a particular ethnic group from northern Cameroon, form groups to play music using special flutes. Playing these instruments, Fritz reports, requires considerable physical effort, essentially a form of controlled hyperventilation that ultimately leads to a trance-like, euphoric state.

“I wanted people in our cultural sphere to be able to experience this same sense of euphoria,” Tom Fritz explains. That’s why he went in search of a method that would be more widely ac-

cepted in our part of the world – and that didn’t require hyperventilation. “That shouldn’t be underestimated. You’d always need a doctor present during the activity, just in case,” he says. The scientist consequently began experimenting with exercise machines. He retrofitted standard fitness equipment so that it plays music when used – sometimes the music plays faster, sometimes slower, it swells and then subsides again, sometimes sequences are played to the end, other times they are cut up into staccato-like fragments. As a result, the person using the machine creates his or her own sounds and therefore feels, subjectively, like he or she is making music in a very expressive manner.

The Max Planck scientist produced the first prototypes of this equipment himself. “I basically always had a workshop wherever I went, and at that time I shared a studio with installation artist

Unlike conventional workouts, Jymmin systematically makes people subjectively feel positive sensations. There is a strong reciprocal effect between physical exercise and musical expression; the movements are indeed perceived as being arousing and beautiful.





Tom Fritz uses magnetic resonance images to study which regions of the brain are influenced by Jymmin in the form of physiological changes. During the experiment, the participants listened to recordings of the music they themselves had composed.

Carlo Crovato, who had great ideas regarding the mechanical aspects,” says Fritz. The third member of this team of tinkerers was brain researcher John-Dylan Haynes, who today conducts research at the Bernstein Center for Computational Neuroscience in Berlin. Heeding the advice of the Max Planck Society, the three inventors applied for a patent. In the summer of 2014, Fritz put three of his sporty music machines on display at the German Hygiene Museum in Dresden as part of an exhibition called *Exploring the Now*. Of course visitors (15,000 in six weeks) were explicitly encouraged to try out the Jymmin equipment – much to their delight.

This story may sound a bit like Gyro Gearloose or a typical wacky inventor. Tom Fritz is accustomed to such reactions: “It might seem a bit strange, and when you see people making music with fitness equipment, that will likely take you by surprise at first,” he admits. “But as soon as you sit on one of these

machines yourself, it feels as if this is exactly what music was made for.” It therefore comes as no surprise that the neuroscientist regularly uses his machines himself, as you can tell by his physique. “It’s great for zoning out and relaxing the mind,” he believes. Besides, the musical exercise machines have since become much more than merely the tinker project of a brilliant mind. The researcher began systematically studying the Jymmin effect. Fritz found out that Jymmin is not only less strenuous than exercise routines using conventional fitness machines – it also makes you happy.

EUPHORIA EXPERIENCE SIMILAR TO A TRANCE

Similar to the experiment on physical exertion, Fritz had his participants split up into two groups and do a workout. One group listened to music as they exercised, while the other group com-

posed their own sounds. After the training session, all of the participants were asked about their experience. It turned out that the composer group was in a significantly better mood, and what’s more, their mood remained positive for a longer period of time: The participants still felt happy during the second round of training, despite the fact that they were now only passively listening to the music. Moreover, further studies have shown that social interaction – a group of people can jointly create sounds using different Jymmin machines – further heightens the positive experience.

This brings Fritz another step closer to his goal of recreating the experiences he shared with the Mafa in Cameroon, but this time using Western methods – and under controlled conditions. “The link between strenuous physical labor and music originated long ago in the history of civilization. It is quite possibly as old as humanity itself,” says Fritz. “Thanks to the Jymmin machines, sci-



What feelings does the same piece of music evoke in people from different cultural backgrounds? The field work that Tom Fritz conducted among the Mafa ethnic tribe in Cameroon several years ago was the starting point of his research into musical trance techniques that later inspired him to invent Jymmin.

entists will now, for the first time ever, be able to study this phenomenon in a laboratory. What we're doing here is what you might call a form of archeological psychology."

TREATING DEPRESSION AND ADDICTION WITH JYMMIN

Yet the neuroscientist believes Jymmin is more than just a great way to gain new historical-cultural and psychological insights: "Jymmin harbors vast potential for new clinical applications. The mood-lifting effect could possibly even become a useful element of depression therapy," Fritz believes.

Drug addicts undergoing treatment and rehabilitation could also benefit from the musical workout, as a further study carried out by the Leipzig-based scientists shows. "We were a bit concerned before conducting our experi-

ment at the drug rehabilitation clinic, because some of the participants came to us straight after undergoing withdrawal. And whether patients with elevated levels of aggression should be doing strength training at all is a controversial issue, because the workout can potentially aggravate their aggressive behavior," the researcher explains. "We also weren't sure if the whole thing would backfire, because the euphorogenic effect could perhaps trigger a craving for substance abuse." His worries were unfounded: According to the psychological questionnaire the participants filled out afterwards, the craving sensations were, in fact, reduced after the workout. Moreover, the mood of the participants lifted, their sense of self-efficacy increased and they became more willing to be socially interactive – a key step in the drug rehabilitation process. The participants

even felt that same positive effect of the workout one week later, when they participated in another experiment and this time merely listened to the music they had previously produced using the Jymmin machines.

The researchers in Leipzig are continually identifying new applications for their musical sports equipment. No wonder therapy centers have started showing an interest in this peculiar invention. A study that is currently underway has indicated, for example, that patients suffering from pain could also strongly benefit during rehabilitation. Jymmin reduces the participants' pain sensitivity during exercise, which is crucial to most rehabilitation therapies, as many patients from very different backgrounds feel pain when doing therapeutic exercises. Furthermore, Jymmin appears to reduce anxiety in people suffering from chronic pain. The levels of

» When you watch people doing a Jymmin workout, you will be pretty surprised at first. But as soon as you try it out for yourself, it feels as if this is exactly what music was made for.«

anxiety are often significantly elevated in these types of patients, as they are in patients who suffer from Alzheimer's or who are recovering from a stroke. "By reducing the amount of anxiety these people feel, it could be possible to substantially improve their quality of life," says Fritz. And there's more: Anxiety and depression significantly enhance an individual's risk of suffering (another) stroke, which in turn is detrimental to their mood and quality of life, increasing the stroke risk. Jymmin, the scientist believes, could help patients break out of this vicious cycle.

UNDERLYING MECHANISMS REMAIN UNCLEAR

It almost appears as if Fritz and his colleagues have discovered some type of panacea. So far, however, no one is able to say with certainty which mechanisms underlie Jymmin's ability to influence mood levels, addictive behavior and pain. The Music Evoked Brain Plasticity Research Group has set itself the task of finding an answer to this pressing question. Hormones and endorphins could play a role, Fritz suspects. And recently, the first immunological studies carried out showed that the number of monocytes – special white blood cells and key players in the body's immune system – increased considerably one hour after the Jymmin workout. This would indicate that the musical workout bolsters the body's own defenses.

Furthermore, the scientists from Leipzig have initiated a first series of studies involving imaging technology, because one thing is certain: the brain plays an important role in the Jymmin effect. It has been common knowledge for quite some time that music and movement are closely linked in our thinking organ – a relationship research-

ers call auditory-motor mapping. Someone who knows how to play the piano, for example, would need only to listen to a recording of a piano concert in order for the motor cortex regions responsible for hand and finger movements to be activated. The brain is essentially playing along in spirit, even when the person is not actually moving their fingers. In the case of professional musicians, the activation of the respective regions in the brain is virtually identical when playing and when listening to music. Yet a similar effect can even be observed in people who don't actively make music. Studies conducted by Tom Fritz several years ago using magnetic resonance imaging showed that, in participants who were listening to pleasant music, regions of what is known as the Rolandic operculum were active – a region that represents the larynx and vocal cords, among others. This means that the brain possibly "vocalized and sang along" in spirit.

Fritz hopes to be able to use his Jymmin machines to recreate this effect. First of all, he believes that the feedback loop linking movement and music reinforces the training effect. The move-

ment patterns are essentially etched deeper into the brain. And secondly, due to the fact that this leads to stronger mapping, you could assume that the patients – basically between the actual workout sessions – feel the same therapeutic benefits just by passively listening to their own Jymmin compositions. With the help of modern imaging technology, Fritz aims to find out if his hypothesis will prove true.

The way the Leipzig-based researcher sees it, his research into the Jymmin effects are still in the very early stages. He hopes to gain further fundamental insights by using Jymmin machines as part of a longer course of treatment. Can regular workouts be used as a preventive medical measure to counter the development of depression-related symptoms, for example? In search of answers to questions such as this, starting in January 2016, Fritz plans to set up a workout space where anyone who is interested will have the opportunity to regularly take part in Jymmin training sessions. That means even more energizing beats will be created in Leipzig – in the name of science and for treatment methods of the future. ◀

TO THE POINT

- For centuries it has been common knowledge that music in the form of work songs makes physical labor feel less strenuous. Now, with the help of music produced using specially equipped exercise machines, scientists are able to prove that music does in fact reduce perceived exhaustion. This new type of strength training is called "Jymmin."
- Jymmin significantly lifts a person's mood, and this effect can be further enhanced by means of interaction when creating the sounds. The training can be used for therapeutic purposes: drug addicts in rehabilitation experience euphorogenic effects without the cravings, and in chronic pain patients, Jymmin reduces anxiety after exercise. Some of these effects are even detectable when the patients passively listen to music they composed in a previous workout session.
- Magnetic resonance images of the brains of participants show that brain regions that are responsible for the larynx and vocal cords are active while they are listening to music, meaning the brain is possibly "singing along."