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Transcranial magnetic stimulation (TMS)

sync2brain: using magnetic waves to combat depression

In cases where standard therapies for mental illnesses such as depression prove ineffective, transcranial magnetic stimulation (TMS) offers a promising alternative. This method uses magnetic pulses to stimulate specific regions of the brain. The Tübingen-based company sync2brain has developed a system called 'bossdevice' that leverages EEG measurements to tailor this stimulation to each patient's unique brain wave patterns, something that may significantly enhance the therapy's effectiveness.



Dr. Ramona Samba, CEO of sync2brain.
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In conditions like depression, the brain's balance is disrupted, impacting not only key neurotransmitters such as serotonin, dopamine and norepinephrine but also altering activity in areas including the prefrontal cortex and amygdala, which are crucial for emotional processing. This imbalance leads to excessive focus on negative information, amplifying depressive symptoms and making it challenging for those affected to escape this cycle without assistance. While medication and psychotherapy are often effective, there is a growing range of non-invasive alternatives that offer support without the need for pharmaceuticals.

One such approach is transcranial magnetic stimulation (TMS), which uses magnetic fields to target specific brain regions in order to relieve symptoms of depression. "We see TMS as highly promising because studies have consistently shown it to be safe and effective," says Dr. Ramona Samba, managing director of the Tübingen-based start-up sync2brain. "Demand for effective treatments is high, but options remain limited." In response, sync2brain developed the bossdevice, a system aimed at making TMS more tailored and precise by customising stimulation to each patient's unique brainwave patterns. While TMS has traditionally been applied in a standardised way, this personalised approach could make it much more effective and pave the way for more effective treatments for depression and other neurological conditions.

Brain stimulation against depression reinvented

Since the 1930s, it has been known that targeted brain stimulation can help treat mental illness. Early methods relied on electrical stimulation and were introduced in treatments from the 1940s onwards.[1)] However, electroshock therapy is still stigmatised despite modern brain stimulation techniques having evolved significantly from the intense movie portrayals of the kind seen in 'One Flew Over the Cuckoo's Nest'. Today, non-invasive and painless brain stimulation methods such as electroconvulsive therapy (ECT, performed under anaesthesia), transcranial direct current stimulation (tDCS) and transcranial magnetic stimulation (TMS) offer advanced options. These therapies are generally considered when talk therapy or medication prove ineffective or unsuitable.

When it comes to non-invasive brain stimulation techniques, transcranial magnetic stimulation (TMS) is recognised as one of



sync2brain's personalised TMS approach tailors magnetic stimulation precisely to the patient's own brainwave patterns, measured in real-time. Pictured here: The technical setup with founder Christoph Zrenner, a team member and the bossdevice RESEARCH system.
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the safest, with minimal side effects. TMS targets specific brain areas using magnetic fields, avoiding the need for electrical currents. No anaesthesia is required, and patients can typically carry on with their day immediately after asession. Treatment usually spans three to six weeks, with sessions lasting about an hour each day. Studies show that TMS has a strong antidepressant effect, with mild side effects such as brief headaches or minor discomfort that quickly resolve. Unlike electroconvulsive therapy, TMS carries a very low risk of inducing seizures. [2)] "We currently see TMS as the most promising alternative to conventional therapies for depression and neurological disorders," says Dr. Samba. "That's why we've chosen to focus on it."

Numerous studies on transcranial magnetic stimulation are currently underway

Transcranial magnetic stimulation (TMS) has shown promising results, yet several questions remain. Originally developed in the 1980s and 1990s, TMS was first approved for depression treatment in the USA in 2008.[1)] It has been recommended in Germany's National Disease Management Guideline (Nationale VersorgungsLeitlinie, NVL) on Unipolar Depression since 2015.[2)] Despite this progress, ongoing studies continue to examine areas such as potential long-term side effects and how best to optimise treatment protocols for maximum effectiveness.

"There are several strategies for improving the effectiveness of TMS," explains Dr. Samba. "While some researchers focus on targeting specific brain regions, our approach is to precisely time the stimulation to align with each patient's unique brain wave patterns." The bossdevice system developed by sync2brain integrates TMS with real-time EEG brain wave monitoring. During treatment, patients wear a cap with electrodes that capture their brain's electrical signals in real-time. Specialised software then analyses this data to calculate the optimal moment for each magnetic pulse. "Think of brain waves as oscillating with peaks and troughs," Dr. Samba explains. "We aim to time the stimulation precisely when the brain is most receptive, which can substantially enhance the effectiveness of TMS."

Major need for treatments for neuronal diseases

It's no coincidence that sync2brain was founded by Dr. Christoph Zrenner, a neuroscientist, and his partner Dr. Brigitte Zrenner, a psychiatrist, given the significant challenges faced in psychiatric care today. There is massive demand for effective treatment: in Germany alone, 5.3 million people aged 18 to 79 experience depression annually, according to the German Depression Aid Foundation - and this figure excludes children, adolescents and adults over 80. [3)]

TMS has potential far beyond treating depression. Studies indicate that magnetic stimulation can also help alleviate symptoms of anxiety disorders, obsessive-compulsive disorders and chronic pain. Additionally, manufacturers are currently exploring TMS as a supportive therapy in stroke rehabilitation.

sync2brain is currently undertaking a randomised controlled trial (RCT) registered with the Federal Institute for Drugs and Medical Devices (BfarM) to obtain more information on the effectiveness of TMS in stroke rehabilitation. The company is also involved in five clinical trials at the Centre for Addiction and Mental Health (CAMH) in Toronto, which are, amongst other



Dr. Ramona Samba with part of her sync2brain team.
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things, investigating the effectiveness of personalised TMS compared to conventional TMS therapies. Dr. Samba is optimistic that advances such as enhanced personalisation and increased efficacy will position TMS as a viable alternative to traditional therapeutic methods. "Currently, our bossdevice is only available for research purposes," notes Dr. Samba. "However, we plan to introduce it as an approved medical device in 2025, which would make it available for use in clinics and medical practices."

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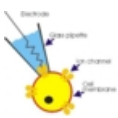
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