Ultrasound waves applied to the brain can alter patients' moods

Stuart Hameroff, professor emeritus in the UA's departments of anesthesiology and psychology, is lead author on the first clinical study showing that transcranial ultrasound affects mood.

**Stuart Hameroff**
Ultrasound waves applied to particular parts of the brain have been found to be capable of altering a patient's mood. The research, conducted by a team from the University of Arizona, may one day lead to the development of non-drug-based interventions for conditions such as depression.

The research hinged on the fact that ultrasound vibrates in megahertz at around 10 million vibrations per second -- roughly the same rate that microtubules (protein structures in the brain linked to mood) resonate.
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Ultrasound is more widely used for imaging anatomical structures via a pulse echo, including foetuses in the womb, the heart, kidneys and other organs.

By JONAH Lehrer

The team, lead by Dr Stuart Hameroff, professor of the university's departments of anaesthesiology and psychology and director of the Centre for Consciousness Studies, became interested in the applications of ultrasound after reading a study of animals conducted by a colleague at Virginia Polytechnic Institute.

Having looked at the results, Hameroff decided to try the technique out on chronic pain patient volunteers, but not before he tried it on himself. He placed an ultrasound transducer against his head for 15 seconds, but initially felt no effect. "And then about a minute later I started to feel like I'd had a martini," he said.

Hameroff's elevated mood seemed to last for an hour or two, but he was aware that it could have been down to the placebo effect. To test the hypothesis further he launched a double blind clinical study -- eventually published in journal Brain Stimulation -- using chronic pain patients, in which neither doctor nor subject knew if the ultrasound machine had been switched on.

Patients who had been exposed to the ultrasound reported mood improvements for up to 40 minutes after treatment. Those not exposed to transcranial ultrasound reported no difference in mood.

The technique could be used as an alternative to transcranial magnetic stimulation to treat clinical depression. Ultrasound vibrations are undetectable when passing through the body, unlike magnetic waves, which patients can feel moving through their head.

Hameroff recruited two colleagues from the department of psychology -- Jay Sanguinetti and John Allen -- to refine the technique for use in depressed patients, initially using student volunteers.

They concluded that the treatment most likely to produce a positive mood change in patients was a 30-second blast at 2 megahertz. Those treated in this way reported "feeling lighter or happier, a little more attentive and a little
more focused" according to Sanguinetti. They have since conducted a double blind clinical trial to rule out the placebo effect, the results of which are being analysed.

Sanguinetti says that they think the mood uplift is happening because the ultrasound is "making the neurons a little bit more likely to fire in parts of the brain involved with mood".

The ultrasound acts on neuronal membranes and the aforementioned microtubules. "As microtubules are intimately involved in synaptic plasticity, and theoretically implicated in learning, memory and conscious experience, transcranial ultrasound may be useful in a variety of mental and neurological disorders including depression, traumatic and hypoxic brain injury, stroke, learning, Alzheimer's disease, psychiatric disorders, and altering states of consciousness," the study’s authors conclude.

The researchers are working with a hardware company called Neurotrek to develop a device that could target specific parts of the brain with ultrasound.