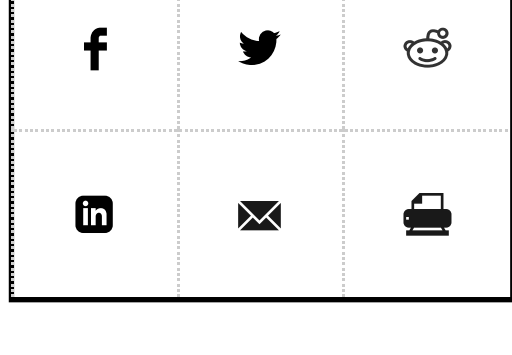


MIND

# Mind Control by Cell Phone

Electromagnetic signals from cell phones can change your brainwaves and behavior. But don't break out the aluminum foil head shield just yet.

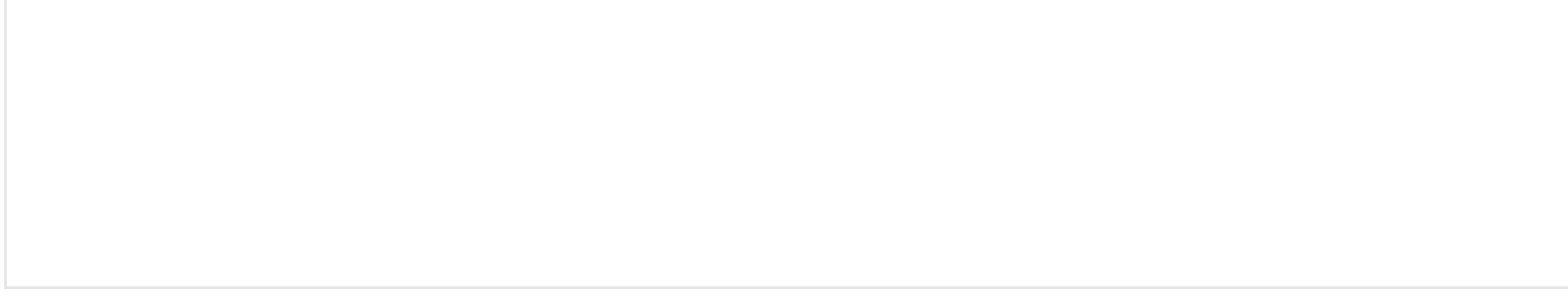
By R. Douglas Fields on May 7, 2008



Hospitals and airplanes ban the use of cell phones, because their electromagnetic transmissions can interfere with sensitive electrical devices. Could the brain also fall into that category? Of course, all our thoughts, sensations and actions arise from bioelectricity generated by neurons and transmitted through complex neural circuits inside our skull. Electrical signals between neurons generate electric fields that radiate out of brain tissue as electrical waves that can be picked up by electrodes touching a person's scalp. Measurements of such brainwaves in EEGs provide powerful insight into brain function and a valuable diagnostic tool for doctors. Indeed, so fundamental are brainwaves to the internal workings of the mind, they have become the ultimate, legal definition drawing the line between life and death.

Brainwaves change with a healthy person's conscious and unconscious mental activity and state of arousal. But scientists can do more with brainwaves than just listen in on the brain at work—they can selectively control brain function by transcranial magnetic stimulation (TMS). This technique uses powerful pulses of electromagnetic radiation beamed into a person's brain to jam or excite particular brain circuits.

Although a cell phone is much less powerful than TMS, the question still remains: Could the electrical signals coming from a phone affect certain brainwaves operating in resonance with cell phone transmission frequencies? After all, the caller's cerebral cortex is just centimeters away from radiation broadcast from the phone's antenna. Two studies provide some revealing news.



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The first, led by Rodney Croft, of the Brain Science Institute, Swinburne University of Technology in Melbourne, Australia, tested whether cell phone transmissions could alter a person's brainwaves. The researchers monitored the brainwaves of 120 healthy men and women while a Nokia 6110 cell phone—one of the most popular cell phones in the world—was strapped to their head. A computer controlled the phone's transmissions in a double-blind experimental design, which meant that neither the test subject nor researchers knew whether the cell phone was transmitting or idle while EEG data were collected. The data showed that when the cell phone was transmitting, the power of a characteristic brain-wave pattern called alpha waves in the person's brain was boosted significantly. The increased alpha wave activity was greatest in brain tissue directly beneath to the cell phone, strengthening the case that the phone was responsible for the observed effect.

## Alpha Waves of Brain

Alpha waves fluctuate at a rate of eight to 12 cycles per second (Hertz). These brainwaves reflect a person's state of arousal and attention. Alpha waves are generally regarded as an indicator of reduced mental effort, "cortical idling" or mind wandering. But this conventional view is perhaps an oversimplification. Croft, for example, argues that the alpha wave is really regulating the shift of attention between external and internal inputs. Alpha waves increase in power when a person shifts his or her consciousness of the external world to internal thoughts; they also are the key brainwave signatures of sleep.

## Cell Phone Insomnia

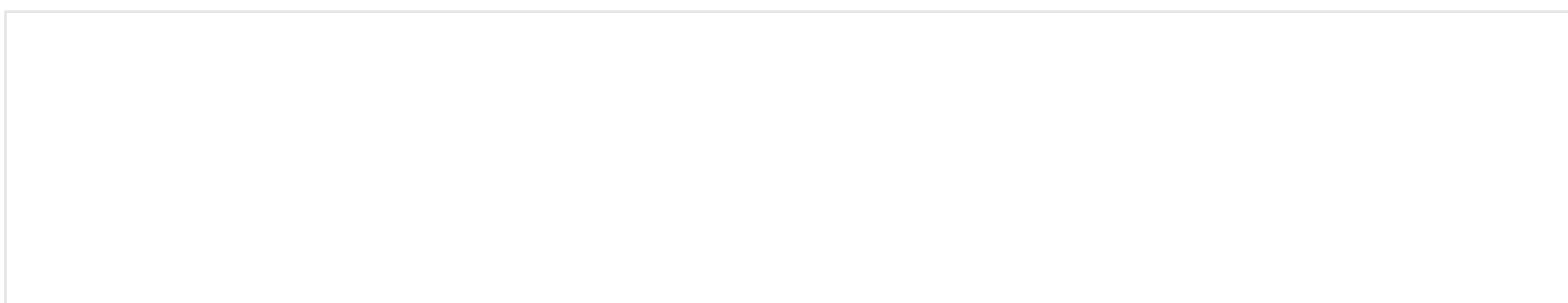
If cell phone signals boost a person's alpha waves, does this nudge them subliminally into an altered state of consciousness or have any effect at all on the workings of their mind that can be observed in a person's behavior? In the second study, James Horne and colleagues at the Loughborough University Sleep Research Centre in England devised an experiment to test this question. The result was surprising. Not only could the cell phone signals alter a person's behavior during the call, the effects of the disrupted brain-wave patterns continued long after the phone was switched off.

"This was a completely unexpected finding," Horne told me. "We didn't suspect any effect on EEG [after switching off the phone]. We were interested in studying the effect of mobile phone signals on sleep itself." But it quickly became obvious to Horne and colleagues in preparing for the sleep-research experiments that some of the test subjects had difficulty falling asleep.

Horne and his colleagues controlled a Nokia 6310e cell phone—another popular and basic phone—attached to the head of 10 healthy but sleep-deprived men in their sleep research lab. (Their sleep had been restricted to six hours the previous night.) The researchers then monitored the men's brainwaves by EEG while the phone was switched on and off by remote computer, and also switched between "standby," "listen" and "talk" modes of operation for 30 minute intervals on different nights. The experiment revealed that after the phone was switched to "talk" mode a different brain-wave pattern, called delta waves (in the range of one to four Hertz), remained dampened for nearly one hour after the phone was shut off. These brainwaves are the most reliable and sensitive marker of stage two sleep—approximately 50 percent of total sleep consists of this stage—and the subjects remained awake twice as long after the phone transmitting in talk mode was shut off. Although the test subjects had been sleep-deprived the night before, they could not fall asleep for nearly one hour after the phone had been operating without their knowledge.

Although this research shows that cell phone transmissions can affect a person's brainwaves with persistent effects on behavior, Horne does not feel there is any need for concern that cell phones are damaging. The arousal effects the researchers measured are equivalent to about half a cup of coffee, and many other factors in a person's surroundings will affect a night's sleep as much or more than cell phone transmissions.

"The significance of the research," he explained, is that although the cell phone power is low, "electromagnetic radiation can nevertheless have an effect on mental behavior when transmitting at the proper frequency." He finds this fact especially remarkable when considering that everyone is surrounded by electromagnetic clutter radiating from all kinds of electronic devices in our modern world. Cell phones in talk mode seem to be particularly well-tuned to frequencies that affect brainwave activity. "The results show sensitivity to low-level radiation to a subtle degree. These findings open the door by a crack for more research to follow. One only wonders if with different doses, durations, or other devices, would there be greater effects?"



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Croft of Swinburne emphasizes that there are no health worries from these new findings. "The exciting thing about this research is that it allows us to have a look at how you might modulate brain function and this [look] tells us something about how the brain works on a fundamental level." In other words, the importance of this work is in illuminating the fundamental workings of the brain—scientists can now splash away with their own self-generated electromagnetic waves and learn a great deal about how brainwaves respond and what they do.

Mind Matters is edited by Jonah Lehrer, the science writer behind the blog *The Frontal Cortex* and the book *Proust Was a Neuroscientist*.

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