

---

# Addiction to cell phones: are there neurophysiological mechanisms involved?

---

Maria Paz de la Puente<sup>1</sup>, Afonso Balmori<sup>2</sup>

Published in *Proyecto*, Vol. 61: pp. 8-12, March 2007

Acknowledgments: Claudio Gómez Perretta and Paqui Bonet  
Translation from Spanish: Patricia Garcia

*At first glance we could consider the addiction to cell phones as belonging to those addictions that are substance-free, also called psychological addictions. Yet, unlike these, cell phones emit microwaves that reach the brain, making investigators wonder if there could be a physiological base for such addictions.*

*The following article gives a brief overview of the studies made that analyze the effects that these radiation produce and that bring us closer to the possible addictive effect, similar to those provoked by conventional drugs. In them, the authors dare to sound the alarm of the abuse that young people, whose brains are still in the process of maturing, could be prey to the risks derived from their improper use, and consider that there should be specific education of the responsible use of cell phones.*

---

Investigation about addictions to new technologies and especially about the abuse of cell phones is scarce, due in part to its great complexity and to the novelty of this social phenomenon. There are frequent difficulties in distinguishing between normal use of a substance or a modern technology, and the abuse of, or addiction to it. In general, one decides if such abuse or dependence exists, firstly by the intensity and frequency of use, secondly and more objectively by the amount of money invested in it, and thirdly by the level of interference that this process has on family, social and work relationships of each individual involved. In this manner, the interference, or significant restriction in the integral development of the individual would co-react with the level of compulsion or the partial or total control of its use, as a common trait described in any implicit activity would reflect in limiting the freedom or dependence of the individual.

Furthermore, when we speak of addiction, we are referring to the existence of compulsive behavior or of behaviors that aren't controlled by the individual, and that distance them from their normal actions. The methods most commonly used to classify and diagnose mental and behavioral disorders (DSM 4, CIE 10) coincide in considering 'substance dependency' as a group of behavioral, cognitive and physiological phenomenon that develop after the continuous use of a substance that typically include: an intense desire to consume the drug, difficulties in controlling its consumption, persistence in this consumption in spite of the harmful consequences, prioritizing consumption of the drug above other activities and obligations, increased tolerance and sometimes signs of physical abstinence. Other concepts, such as amount of use (occasional, frequent), abuse and addiction complicate and qualify the diagnosis.

---

1 Psychologist, Director of Aldaba Foundation – Project Man (an organisation working with drug addicts; helping them to overcome their addictions.)

2 Biologist investigator of the effects of radio frequencies on living organisms.

## News and polls

With increasing frequency the media brings up news about 'addiction' to cell phones. Studies based on polls and observations made in different countries reach the same conclusion: young people in particular have become inseparable from their cell phones. According to the latest studies, one of every three teens admit to being 'hooked' by their cell phones.

The conclusions of a study elaborated by the office of Defense of the Minor of the Community of Madrid in the year 2004, by the organization 'Protégeles' (Protect them), based on a poll taken of children and adolescents between 11 and 17, are that 'Separated from their cell phone, the syndrome is a confirmed and measured reality, not an exaggeration. 38 percent of those young people from Madrid were said to feel 'upset', 'overwhelmed' or that they 'felt awful' if they couldn't use their cell phone, normally as a result of punishment or fault with the phone. According to the specialists, the abuse of the use of cell phones could be typified as *'a disorder of addiction that has to be stopped as soon as possible'* (Paniagua, 2005).

The Consejería de Sanidad de la Comunidad de Madrid (Social Security Office in Madrid) through its anti-drug agency, has recently introduced, within its program of preventing drug addiction destined for schools of this region, a pilot project entitled, *'Preventing addictions to New Technologies'*.

A study by the University of Navarra affirms that young people between 15 and 19 admit being addicted to their cell phones (Naval et al., 2004)

Another study developed far from Spain, in South Korea, demonstrates that the youth of that country suffer dependency on technology, and that 30% suffer from confusion and transitory depression when they can't use their cell phone.

Last but not least, British scientists have decided that more and more people are getting addicted to their cell phones, causing stress and irritability (BBC, 2006).

Dr David Sheffield, from the University of Staffordshire, has found behavioral problems related to the use of cell phone among the 106 individuals studied. About 16% of those interviewed had a behavioral problem due to the use of cell phones. The results demonstrated that when there is a reduction in the use of cell phones, there is a lowering of blood pressure.

## Similarities with the conventional addictive process

Although the accepted international classifications that are habitually used in clinical psychology consider addictions and those disorders of the control of impulses as independent entities, they have many similarities between them, as a matter of fact, many authors consider obsessive gambling as a substance-free addiction. (Tirapu et al., 2004)

It may at first glance seem complicated to speak of a cell phone addict as we speak of a drug addict, but if we stop to analyze this situation, it is not difficult to establish similarities between them.

Comparing those that use the cell phone with moderation, the 'addicts' present a permanent state of vigilance or alert, focused on whatever signal that may come from the phone, which in turn provokes the almost compulsive and uncontrolled necessity of checking the cell phone constantly, independently of what they're doing.

It almost seems as if they need to dedicate more and more time to it (tolerance perhaps), and this instrument begins to occupy a very special place in their lives. Recent studies have also shown that those 'addicts' that stop using their cell phones show a syndrome of withdrawal that is both physical and psychological. This syndrome is characterized by

observable symptoms of anguish, anxiety, nervousness, irritability etc. These manifestations disappear once the 'addict' can use their phone again. The 'addict' also seems to have problems of insecurity, low self-esteem, difficulties in establishing inter-personal relationships, isolation and other emotional factors. We have begun to see actual cases of people who look for rehabilitation for cell phone addiction in drug treatment centers (Bononato, 2003).

## Neurophysiological bases for addiction

Looking at this problem through the psychobiological perspective, different investigations have been based, since several years ago, on the neurophysiological base of addictions in general. (Snyder, 1996). They want to determine which neurotransmitter intervenes, and in which parts of the brain they act, when a person presents a disorder because of the use of addictive substances. Dopamine seems to be the most active, although it's not the only one. Although each drug possesses its own mechanism of action, all of them intervene to a greater or lesser measure on a neuronal reward circuit known as the mesolimbic dopaminergic system, that favors, by means of pleasurable sensations, adaptive behaviors. Those systems of reward are located in the primitive part of the brain, where the processes of survival are inaccessible to the conscious or voluntary mind. We know that several natural substances and activities touch this system, and that show properties of positive reward (food, drink, sexual behavior etc.). The opiate receptors in the mammalian brain especially are concentrated mainly in this limbic system which regulates, among other things, emotional behavior. Because of this, the need to consume is produced in apparent absence of conscious, rational behavior, hence the difficulty of leaving the vicious cycle of drug abuse. The drugs that are abused have in common the ability to serve as a positive reinforcement, and of controlling behavior in a way that is similar to the natural positive reinforcement. The difference lies in that the natural reinforcement normally enters this system of reward through the senses, while drugs stimulate this circuit directly. The drugs that are being used create a false signal in the brain that indicate that a beneficial adaptive has arrived. This cerebral signal then produces an increase in the frequency of consumption, putting to one side the adaptive behavior. (Tirapu et al., 2004)

## The effects of cell phone radiation on the brain

As mentioned above, addiction to cell phones could be counted among those considered substance-free, or psychological addictions; perhaps we could include compulsive gambling, compulsive use of video games, or the Internet. Psychological addictions don't have chemical substances in them, but there is a degree of dependency and a certain amount of loss of control by the one who has it. (Echeburúa and Fernandez-Montalvo, 2002) And yet, in contrast to these, cell phones emit microwaves, high electromagnetic-modulated radiation also known as radio-frequencies, that interfere in important bodily systems (nervous, reproductive, endocrine, immunological) as well as in the processes and structures characteristic of living organisms, brain waves, the blood-brain barrier, the pineal gland, and DNA (Salford, 2003; Kramarenko, 2003; Navarro et al., 2003; Reflex, 2004; Balmori, 2004).

Dependency or addiction to cell phones could have a physiological base, due to the interruptions that the microwaves provoke in the neurotransmitters in the neural synapses of the reward system of the brain. These effects are still under investigation and it is too soon to understand the neurophysiological basis of cell phone addiction.

In this brief review we will analyze the reported effects that this radiation has on neurotransmitters and post-synaptic receptors that could help us understand the possibly addictive effect similar to that produced by conventional drugs.

Henry Lai, the American scientist, of the Bioelectromagnetics Research Laboratory of the University of Washington, discovered that microwaves increase the activity of brain endorphins or endogenous opioids (the biological basis of addiction to opium and its derivatives as well as alcohol) in similar ways to morphine. Even Dr Lai (in a personal communication) commented how Russian doctors used microwaves with patients with 'cravings' for heroin, although with inconclusive results. There could also be a suggested existence of an opiate-like action, similar to actual opiates and alcohol, as being partly responsible of its pleasurable 'craving' and of the positive reinforcement observed in cell phone addicts. In another study by the same author, the effects of radio-frequencies on the hippocampus were blocked by a pre-treatment in rats with opiate antagonists, naloxone and naltrexone, which suggests that radio frequencies activate endogenous opioids in the brain (Lai et al., 1989a). He also found that the receptors for benzodiazepine (BDZ) related to anxiety responses and stress in animals, were activated after being exposed to radio frequencies, probably related to the reinforcement of those euphoric properties of opiates. (Braestrup et al., 1979; Lai et al., 1992b; Walker and Ettenberg, 2001). Besides, during the same conditions of irradiation, different regions of the brain can have different sensitivity or vulnerability to radio frequencies and provoke different responses (Lai et al., 1991), but it seems that the long-term effects depend on the length of exposure (Lai, 1997). In this way and in general, the effects of radio frequencies on addiction imply several biological processes that are similar to other agents, such as certain psychoactive drugs: alcohol, opiates and benzodiazepines (Lai, 1999).

Physiology professor W Ross Adey, recently deceased from the University of California explained that the union of neurotransmitters GABA, Acetylcholine and Glutamate (closely related with the reward system) to its specific receptor, is sensitive to weak modulated microwave fields (a characteristic found in cell phone radiation) (Adey, 2003).

## A Working Hypothesis, Conclusions and Recommendations

Bearing these discoveries in mind, it is plausible to deduce that the morbidity relating to the use of cell phones could have a neurophysiological basis in common with some conventional drugs, through acting on neurotransmitters – like the response to electromagnetic exposure described above – and having similar effects on the cerebral reward circuit.

In this way, it could not really be considered an addiction 'without substance'; we could take this idea further, considering its own behavior 'per se' because it shares mechanisms similar to conventional drug addiction. Lastly, the radiation emitted by the cell phone would be a positive reinforcer that not only acts through conventional sensory channels but also through the reward circuit, acting directly through microwaves on the brain.

We find all the requirements of DSM4 in the street, in the polls as well as in laboratory studies that show certain effects that radiation in the brain could justify the addictive behavior. So then, what are we waiting for to take steps with the general public and especially with young people, who comprise the most vulnerable section of the population? We must teach people to be autonomous, with a sense of judgment, capable of choosing and of using responsibly those means that are available, but in order to do this, we must inform and educate. We are facing new phenomena in which there are hidden risks (purposely hidden?) with negative consequences for everybody's health. Young people, once again, are in the most vulnerable age range. Clearly they are also big consumers – in this case of cell phones – but since their brains and bodies are still maturing and developing, this shows how unwise the risks are of undue use of cell phones.

While the scientific view progresses and becomes more clear, it is urgent (under the precautionary principle) that adults be informed, have a hands-on attitude and be capable of incorporating facts that can help us educate (or re-educate) especially the young in the responsible use of the cell phone.

## Bibliography

- Adey WR (2003), 'Electromagnetic fields, the modulation of brain tissue functions – A possible paradigm shift in biology'. In Smith B, Adelman G (eds): *International Encyclopedia of Neuroscience*. New York
- Balmori A (2004), 'Posibles efectos de las ondas electromagnéticas utilizadas en la telefonía inalámbrica sobre los seres vivos'. *Ardeola*, 51: 477-490
- BBC World Service, 14 de septiembre de 2006: La adicción al teléfono móvil.
- Bononato L (2003), *Adicciones y nuevas tecnologías. Informe Inédito*. Asociación Proyecto Hombre
- Braestrup C, Neilsen M, Neilsen EB, Lyon M (1979), 'Benzodiazepine receptors in the brain as affected by different experimental stresses: the changes are small and not unidirectional'. *Psychopharmacology*, 65: 273-277
- Echeburúa E, Fernández-Montalvo J (2002), 'Juego patológico y adicciones sin drogas: tratamiento'. *Revista Proyecto Hombre*, 44: 13-16
- Kramarenko AV, Tan U (2003), 'Effects of high-frequency electromagnetic fields on human EEG: a brain mapping study'. *Int. J. Neurosci.*, 113: 1007-1019
- Lai H, Carino MA, Horita A, Guy AW (1989a), 'Low-level microwave irradiation and central cholinergic systems'. *Pharmac. Biochem. Behav.*, 33: 131-138
- Lai H, Carino MA, Horita A, Guy AW (1989b), 'Acute low-level microwave exposure and central cholinergic activity: a dose-response study'. *Bioelectromagnetics*, 10: 203-209
- Lai H, Carino MA, Horita A, Guy AW (1992a), 'Opioid receptor subtypes that mediate a microwave-induced decrease in central cholinergic activity in the rat'. *Bioelectromagnetics*, 13:237-246
- Lai H, Carino MA, Horita A, Guy AW (1992b), 'Single vs repeated microwave exposure: effects on benzodiazepine receptors in the brain of the rat'. *Bioelectromagnetics*, 13:57-66
- Lai H (1997). 'Neurological Effects of Radiofrequency Electromagnetic Radiation Relating to Wireless Communication Technology'. Conference: *Mobile Phones-Is there a Health Risk?*, September 16-17, 1997. Brussels, Belgium
- Lai H (1999), *Memory and Behavior*. 'The Biological Effects, Health Consequences and Standards for Pulsed Radiofrequency Field', Sicily, Italy
- Naval C, Ch. Sádaba y J Brigué (2004), *Impacto de las TIC (Tecnologías de la Información y Comunicación) en las relaciones sociales de los jóvenes navarros*. Universidad de Navarra
- Navarro EA, Segura J, Portolés M, Gómez Perretta C (2003), 'The microwave syndrome: A preliminary study in Spain'. *Electromagnetic Biol. Med.*, 22: 161-169
- Paniagua A (2005), El 38% de los niños sienten ansiedad si no llevan su móvil. *El Norte de Castilla* (Vida y Ocio, 25 de mayo de 2005) Colpisa
- Reflex (2004), <http://www.verum-foundation.de/cgi-bin/content.cgi?id=euprojekte01>
- Salford LG, Brun AE, Eberhardt JL, Malmgren L, Persson BR (2003), 'Nerve Cell Damage in Mammalian Brain after Exposure to Microwaves from GSM Mobile Phones'. *Environmental Health Perspectives*, 111:881- 893
- Snyder SH (1996), *Drogas y cerebro*. Biblioteca Scientific American. 240 pp. Barcelona
- Tirapu J, Landa N, Lorea I (2004), *Cerebro y adicción*. Gobierno de Navarra

Walker BM, Ettenberg A (2001), 'Benzodiazepine modulation of opiate reward'. *Exp Clin Psychopharmacol.*, 9: 191-7.