

# Advocacy for a Cognitive Approach to Electrohypersensitivity Syndrome

Electrohypersensitivity syndrome may have little to do with actual exposure to electromagnetic radiation. It instead may be better understood as a phobia explained by anxiety disorder mechanisms.

SÉBASTIEN POINT

Development of communication technologies (such as mobile phones and other wireless devices) has been followed in the past twenty years with appearance of a new self-assessed, so-called electrohypersensitivity (EHS) syndrome, which some people—including some medical doctors—attribute to permanent exposure to domestic, low levels of electromagnetic radiation. EHS syndrome is not the only potential concern raised by people worried about electromagnetic radiation; effects on cognition, sleep, and tumor initiation or growth have been pointed out—without convincing scientific evidence or satisfying proposals regarding potential biological mechanisms. But until now, EHS (also often called electromagnetic hypersensitivity) syndrome seems to have been about the supposed health effects of exposure to electromagnetic radiation. Some studies (Hallberg and Oberfeld 2006; Eltiti et al. 2007; Schröttner and Leitgeb 2008) tried to count EHS-affected people, which is a difficult task because of the lack of a medical description of EHS syndrome. Results of these studies are shown in Figure 1. A continuous increasing trend is observed in EHS self-diagnoses between 1985 and 2005, although the latest studies suggest a decrease.

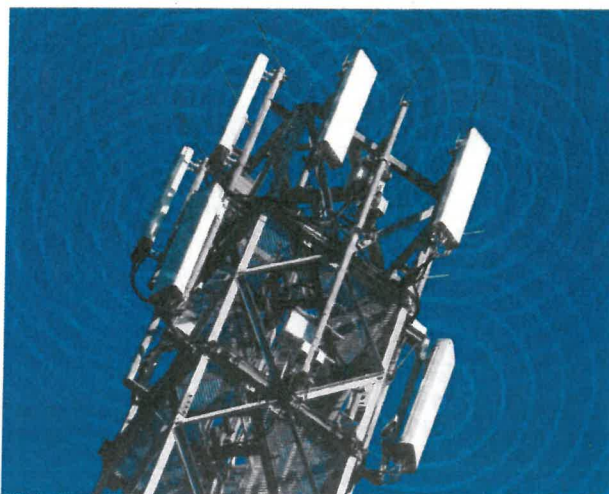
In the face of numerous claims regarding adverse health effects of electromagnetic radiation in general—and EHS syndrome in particular—the French Agency for Food, Environmental, and Occupational Health & Safety (ANSES) emphasized in its 2018 report the need for taking care of people suffering from EHS syndrome, although it did not recognize the causal relationship between electromagnetic radiation and EHS syndrome (ANSES 2018). In parallel, for some years, an increasing number of court decisions have recognized the right of individuals suffering from EHS syndrome to refuse wireless technologies for medical reasons, and some judges

have *decided* a causal relationship between electromagnetic radiation and EHS syndrome. Mass media are also interested in the problem, and it is easy to find numerous online testimonials of people suffering from EHS syndrome.

Scientists have tried to clarify the nature of this EHS syndrome and to verify the reality of the alleged relationship with exposure to electromagnetic radiation. In this article, I will summarize results produced by provocation studies and share my view that the etiology of the EHS syndrome is not



Figure 1: Percentage of EHS individuals in the population as measured in different European countries between 1985 and 2008 (adapted from Bellayer 2016).



related to real exposure to electromagnetic radiation. Instead, a phobia-like disorder should be investigated as a possible explanation of EHS syndrome.

### Provocation Studies

Biological effects of electromagnetic radiation are taken into account by normative standards based on International Commission on Non-Ionizing Radiation Protection (ICNIRP) statements (ICNIRP 1998). Normative exposure limits aim to protect people from high doses of electromagnetic radiation, which can result in electrical or thermal effects (or both) depending on radiation frequency. Indeed, induced currents or temperature elevation are the only proven biological adverse effects associated with acute exposure to electromagnetic radiation (Perrin and Souques 2012). In Europe, directive 2013/35/EU has been created to protect workers from exposure to conditions able to generate such effects. However, EHS syndrome is claimed to appear when people are exposed to *low levels* of electromagnetic radiation.

## Mass media are also interested in the problem, and it is easy to find numerous online testimonials of people suffering from electrohypersensitivity syndrome.

A provocation study or trial is a form of medical clinical trial frequently used in this field. Participants are exposed to a substance or device claimed to provoke a response or to a sham substance or device that should provoke no response. Several provocation studies have been conducted in an attempt to reveal a potential relationship between exposure to electromagnetic radiation at low levels and EHS syndrome. The premise is quite simple: as EHS people claim to suffer from various symptoms when they are exposed to electromagnetic radiation, experiments should be able to examine the phenomenon by comparing the level of discomfort of EHS people depending on exposure conditions measured against a control population. Such studies must deal with a potential low-dose effect—what makes experiments sensitive to confusing variables. Thus, to be usable, such experiments must at least be single-blinded and if possible double-blinded, randomized, and counterbalanced.

Several authors have tried to create such experiments. One full and relevant analysis of these provocation studies has been made by E. van Rongen and colleagues (2009), who conclude that in provocation studies a causal relation between electromagnetic radiation exposure and symptoms “has not been demonstrated, suggesting that psychological factors such

as conscious expectation of effect may play an important role in this condition.” This conclusion is shared by Renáta Szemerszky and colleagues (2010), who studied the role of the nocebo effect in physical symptoms reported at a frequency of 50 hertz. They found a considerable nocebo effect and noted the formation of “a vicious circle of psychosocial factors, such as enhanced perception of risk and expectations, self-monitoring, somatization and somatosensory amplification, casualization, and misattribution.”

### A Cognitive Approach

On the one hand, provocation studies failed to determine a causal relationship with exposure to low levels of electromagnetic radiation, and there is no serious candidate for a biological mechanism. On the other hand, results of some studies show a significant number of people claiming to suffer from EHS syndrome. These contradictory observations call for a new pathway for investigations. As suggested by some authors, one possible etiology is psychological. I suggest a cognitive mechanism for explaining EHS syndrome as a potential form of phobia in which confirmation bias could have a central role. A view of my mechanism proposal is shown in Figure 2. The rationale and hypothesis used for building it are discussed below.

### Biological Vulnerability

Anxious symptomatology has been described as under the influence of some genetic factors (Jardine et al. 1984; Kendler et al. 1992; Andrews 1996). Studying etiology of social phobia, Ronald M. Rapee and Richard G. Heimberg (1997) suggested that genetic factors may explain preferential allocation of attention toward danger. The role of the biological factor has been integrated in many models of anxiety, including the Jones and Barlow biopsychosocial model of post-trauma stress (Jones and Barlow 1992) and the Clark model of panic (Clark 1986). In this latest model, people suffering from panic disorders are excessively sensitive to some normal or pathological body perceptions, which they consider as a catastrophic threat and which can trigger a panic attack. The biological manifestation of this panic attack can amplify the perception of the threat. Some recent results have shown that this biological vulnerability to anxiety disorders, including depression and post-trauma stress, could be related to the volume of hippocampi (Campbell and MacQueen 2004; Bremner et al. 1995). The widely accepted theory of anxiety by Jeffrey A. Gray and Neil McNaughton (2003) also points out the main role of hippocampi in anxious behaviors. But some studies suggest that hippocampal volume evolution is not a result of anxiety, trauma, or depression but would be, to the contrary, a causative factor (Gilbertson et al. 2002). Biological vulnerability and preferential allocation of one's attention to threat is accepted as one of the bases for the development of anxiety disorders. To consider EHS syndrome as a form of phobia, one has to make the fundamental hypothesis that EHS individuals carry, prior to the appearance of symptoms, this type of biological vulnerability.

**Alleged Exposure as Neutral Stimulus and Mental Representation of Health Disorders**

Anxiety troubles are often associated with a neutral stimulus, as understood in a Pavlovian approach. If EHS syndrome is a phobia, alleged exposure to electromagnetic radiation could play the role of neutral stimulus. From my perspective, several cues support this assumption.

As demonstrated by provocation studies, people, including those claiming an EHS syndrome, are not able to detect electromagnetic radiation at domestic, low levels. As low-level radiofrequency electromagnetic radiation is neither visible nor detectable, exposure can be inferred only on the basis of cues such as the proximity of mobile phones or antennas. Yet some research has shown a strong relationship between the loss of perceived control and anxiety troubles (Gallagher et al. 2014). Exposure to electromagnetic radiation could be a neutral stimulus powered by the feeling that the person has no control over this exposure.

News media are more and more focused on potential effects of electromagnetic radiation, especially with the current deployment of 5G technology. This media treatment could encourage people to focus on mobile phones, antennas, or radiofrequency emitters existing in their environment and on physical perceptions when these people encounter or use them. Such a hypothesis is supported by recent results, especially those of Anne-Kathrin Bräshser and colleagues (2017), who showed that worrisome information on health effects of

wifi increases discomfort during sham exposure; it also increases sensitivity to tactile stimuli. In their studies, Michael Witthöft and G. James Rubin (2013) concluded that “media reports about the adverse effects of supposedly hazardous substances can increase the likelihood of experiencing symptoms following sham exposure and developing an apparent sensitivity to it.”

**Symptoms of Anxiety**

Symptoms claimed by EHS individuals are various and nonspecific. According to Marjukka Hagström and colleagues (2013), the most common symptoms are “stress” (60.3 percent), “sleeping disorders” (59.3 percent), and “fatigue” (57.2 percent). These symptoms are compatible with anxiety disorders, which can affect organs, glands, and the nervous system. In a cognitive approach, instead of considering anxiety (and all associated potential symptoms) as a collateral consequence of any real electrosensitivity, all these symptoms could be considered as existing prior to the appearance of the EHS syndrome (as a result of a biological vulnerability) and being recently associated with neutral stimulus (the alleged exposure to electromagnetic radiation).

**Feedback Mechanism**

It has been shown that reducing or avoiding electromagnetic radiation can help individuals suffering from EHS syndrome recover a better level of comfort (Hagström et al. 2013). Such avoidance behaviors and immediate well-being

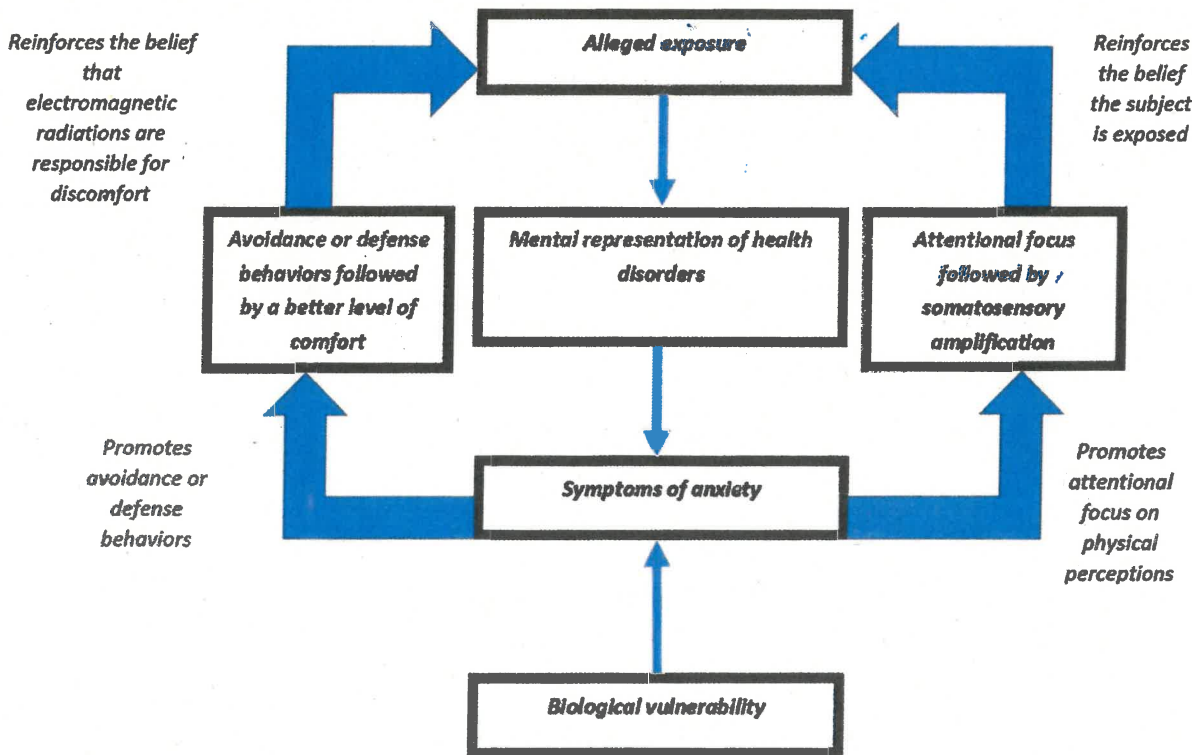


Figure 2: Possible theoretical model of EHS syndrome considered as an anxiety disorder.

gain are typically observed in anxiety or panic disorders; alternatively, for the case of EHS individuals, some counter-phobic objects can be purchased, such as anti-radiation chips applied to mobile phones to allegedly reduce their emission level. Following such avoidance or defense behaviors, decreasing discomfort could act as a confirmation that the source of discomfort was related to electromagnetic radiation. This would possibly reinforce the belief of EHS individuals in adverse health effects of electromagnetic radiation.

It is also well accepted that anxious individuals do allocate their attention to threat (Dalglish and Watts 1990), which could be an evolutionary strategy to protect the organism (Ohman 1996). Considering EHS syndrome as an anxiety disorder, this attentional focus on physical perceptions, related to the belief that the subject is exposed and that this exposure can result in adverse health effects, could amplify and reinforce the belief in a real threat.

The feedback mechanism I explored here (reinforcement of belief by attentional focus on symptoms and good results of avoidance strategy) could make the EHS individuals enter a loop of fear whose main engine is confirmation bias.

## Conclusion

Science has failed to show a causal relationship between real exposure to electromagnetic radiation and EHS syndrome. There is, however, a growing accumulation of evidence that EHS syndrome is related to psychological factors. I have proposed that EHS syndrome could be a form of phobia explained by mechanisms occurring in other anxiety disorders. Biological vulnerability to anxiety—existing prior to the appearance of EHS syndrome—would cause people to confound symptoms of anxiety with a biological effect of electromagnetic radiation. Alleged exposure to electromagnetic radiation would play the role of neutral stimulus. Finally, confirmation bias—based on attentional focus and avoidance strategies—would push people still deeper in their belief.

Researchers should now stop (or at least reduce their efforts) trying to find a less-and-less plausible link between EHS syndrome and electromagnetic radiation and instead concentrate their work on understanding more accurately the mechanisms pushing people to the wrong belief that domestic, low levels of electromagnetic radiation are deleterious. Researchers should find a way to help these people by decreasing anxiety and discomfort through adapted cognitive behavioral therapy techniques. ■

## References

Andrews, G. 1996. Comorbidity in neurotic disorders: The similarities are more important than the differences. In R.M. Rapee (ed.), *Current Controversies in the Anxiety Disorders*. New York: The Guilford Press, 3–20.

ANSES. 2018. Hypersensibilité électromagnétique ou intolérance environnementale idiopathique attribuée aux champs électromagnétiques. Avis de l'Anses Rapport d'expertise collective- édition scientifique.

Bellayer, J. 2016. Vivons-nous les prémices d'une catastrophe sanitaire? Book-e-Book, Coll. Une chandelle dans les ténèbres.

Bräscher A.K., K. Raymaekers, O. Van den Bergh, et al. 2017. Are media reports able to cause somatic symptoms attributed to wifi radiation? An experimental test of the negative expectation hypothesis. *Environmental Research* 156: 265–71.

Bremner J.D., P. Randall, T.M. Scott, et al. 1995. MRI-based measurement

of hippocampal volume in patients with combat-related posttraumatic stress disorder. *American Journal of Psychiatry* 152(7): 973–981.

Campbell, S., and G. MacQueen. 2004. The role of the hippocampus in the pathophysiology of major depression. *Journal of Psychiatry & Neuroscience* 29(6): 417–426.

Clark, D.M. 1986. A cognitive approach to panic. *Behaviour Research and Therapy* 24(4): 461–470.

Dalglish T., and F.N. Watts. 1990. Biases of attention and memory in disorders of anxiety and depression. *Clinical Psychology Review* 10: 589–604.

Eltiti, S., D. Wallace, K. Zougkou, et al. 2007. Development and evaluation of the electromagnetic hypersensitivity questionnaire. *Bioelectromagnetics* 28(2): 137–151.

Gallagher, M.W., K.H. Bentley, and D.H. Barlow. 2014. Perceived control and vulnerability to anxiety disorders: A meta-analytic review. *Cognitive Therapy Research* 38(6): 571–584.

Gilbertson, M.W., M.E. Shenton, and A. Ciszewski, et al. 2002. Smaller hippocampal volume predicts pathologic vulnerability to psychological trauma. *Nature Neuroscience* 5(11): 1242–7.

Gray, J.A., and N. McNaughton. 2003. *The Neuropsychology of Anxiety: An Enquiry into the Functions of the Septo-Hippocampal System*, Second Edition. Oxford University Press.

Hagström, M., J. Auranen, and R. Ekman. 2013. Electromagnetic hypersensitive Finns: Symptoms, perceived sources and treatments, a questionnaire study. *Pathophysiology* 20(2): 117–122.

Hallberg, O., and G. Oberfeld. 2006. Will we all become electrosensitive? *Electromagnetic Biology and Medicine* 25: 189–191.

ICNIRP. 1998. ICNIRP guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). *Health Physics* 74(4): 494–522.

Jardine, R., N.G. Martin, and A.S. Henderson. 1984. Genetic covariation between neuroticism and the symptoms of anxiety and depression. *Genetics Epidemiology* 1(2): 89–107.

Jones, J.C., and D.H. Barlow. 1992. A new model of posttraumatic stress disorder: Implications for the future. In P.A. Saigh (ed.), *Posttraumatic Stress Disorder*. New York: Macmillan, 147–165.

Kendler, K.S., M.C. Neale, R.C. Kessler, et al. 1992. The genetic epidemiology of phobias in women. The interrelationship of agoraphobia, social phobia, situational phobia, and simple phobia. *Archives of General Psychiatry* 49(4): 273–281.

Ohman, A. 1996. Preferential preattentive processing of threat in anxiety: Preparedness and attentional biases. In R.M. Rapee, *Current Controversies in the Anxiety Disorders*. New York: The Guilford Press, 253–290.

Perrin, A., and M. Souques. 2012. *Electromagnetic Fields, Environment and Health*. Berlin, Germany: Springer.

Rapee, R.M., and R.G. Heimberg. 1997. A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy* 35(8): 741–756.

Schröttner, J., and N. Leitgeb. 2008. Sensitivity to electricity—temporal changes in Austria. *BMC Public Health* 8(310).

Szemerszky, R., F. Köteles, R. Lih, et al. 2010. Polluted places or polluted minds? An experimental sham-exposure study on background psychological factors of symptom formation in “idiopathic environmental intolerance attributed to electromagnetic fields.” *International Journal of Hygiene and Environmental Health* 213(5): 387–94.

Van Rongen, E., R. Crof, J. Juutilainen, et al. 2009. Effect of radiofrequency electromagnetic fields on the human nervous system. *Journal of Toxicology and Environmental Health Part B*, 12: 572–597.

Witthöft, M., and G.J. Rubin. 2013. Are media warnings about the adverse health effects of modern life self-fulfilling? An experimental study on idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF). *Journal of Psychosomatic Research* 74(3): 206–12.



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