

Invited editorial

## **Freud and memory neurobiology**

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Recent experimental studies and clinical applications have brought about two gigantic contributions by Freud to the current knowledge on memory suppression and/or inhibition. Such inhibition or suppression is inherent to our nature. On the one hand, we need to avoid the access of many memories to consciousness because evoking them would be harmful or unbearable (fears, humiliations, etc.). On the other hand, we have to do it, because we should remember or learn other memories, and recent studies have indicated that our mnemonic systems, especially those of the hippocampus and prefrontal cortex, are quickly saturated.

One of the two Freudian contributions to be briefly discussed here is the discovery of repression, which is a key topic for psychoanalysis, due to its usefulness in daily life and due to its importance in pathology. A study by John D. Gabrieli et al. (2004), using functional magnetic resonance, demonstrated that when the brain excludes the expression of undesired memories from consciousness, there are: a) inhibition of evoking those memories (repression); b) activation of the anterolateral prefrontal cortex (involved in working memory); c) inhibition of hippocampus activity. The hippocampus is the “maestro” of the “orchestra” of cortical areas involved in evoking memories (see references in my book *A arte de esquecer* [The art of forgetting]<sup>1</sup>).

Another aspect of memory inhibition discussed by Freud is extinction, discovered by Pavlov in the early 20<sup>th</sup> century, but applied by Freud to the treatment of phobia since the 1920's using

different names. Extinction consists of the reassociation of a stimulus or group of stimuli or signals (for example, a conditioned stimulus: viewing an object that foretells a reward or a punishment) with another memory (for example, lack of reward or punishment). Pavlov's dogs associated the sound of a bell with food; so they learned to salivate in response to the bell, foretelling the subsequent presentation of a piece of meat. If, after a certain moment, the meat is no longer offered, the dog cancels the response to the bell: it stops salivating. It starts associating the bell with lack of food, instead of associating it with its presence. Freud observed, 80 years ago, that phobic individuals exposed to the object of their aversion, but without the fear associated with it (for example, an individual with phobia against spiders repetitively exposed to a dead spider, which does not offer any danger) lose their phobia. The treatment was Freud' incursion outside the psychoanalytic therapy, perhaps anticipating cognitive therapy.

Recent studies from many laboratories, especially ours (see reference in *A arte de esquecer*,<sup>1</sup> mentioned above), demonstrated which areas, and through which molecular mechanisms are activated at the moment aversive tasks are extinguished. Those areas are the corticomedial frontal cortex, basolateral amygdala, entorhinal cortex and especially the hippocampus. Neurochemical steps include the activation of glutamatergic N-methyl D-aspartate (NMDA) receptors, extracellularly activated protein kinases, cyclic adenosine monophosphate-dependent protein kinase, and above all, gene expression and protein synthesis in each structure. Extinction is a new learning that overlaps and replaces a previous one.

References on this topic can be searched by using the names Izquierdo I, McGaugh JL, Quirk GA, Davis M, Vianna MRM, Bevilaqua LRM or Cammarota M at the website Entrez PubMed (<http://www.ncbi.nlm.nih.gov/entrez>). Extinction started being used as the treatment of choice for posttraumatic stress; however, not by psychiatrists, but by followers of the cognitive therapy.

The increase in the time an individual is exposed to the "new" harmless stimulus (a dead spider, pictures of 9/11 followed by explanations about the fact that this is not happening at the present time, etc.) favors extinction and the occasional healing of posttraumatic stress.

If Freud were alive today, he would be proud to see that both processes so comprehensively studied by him, repression and extinction, already have great part of their mechanisms known (as he so eagerly wished) and are of great use in the treatment of horrible syndromes.

History walks through pathways whose start does not make it possible to predict neither the middle, nor the end. Freud, who hated Pavlov, used his technique and principle to perhaps inaugurate cognitive therapy. But, as Shakespeare said, "all's well that ends well." The application of extinction to therapy has saved millions of patients from the realm of horror. It does not matter that Freud preferred to call it "habituation," or that many modern American cognitivists call it "exposure" or "flooding."

That is the nature of geniuses. They discover or invent things that, years later, have unexpected applications. Mozart discovered the thrilling effect of using a trio of female singers and used it in "The Magic Flute." Ray Charles led that effect to perfection almost two centuries later. And he possibly never knew he was using something Mozartian.

## REFERENCE

1. Izquierdo I. A arte de esquecer. Rio de Janeiro: Vieira & Lent; 2004.