

## **A Consciência da Dor: alterações induzidas por Dor Crônica nos mecanismos neurobiológicos de aprendizagem, atenção e recompensa**

### **Results:**

The studies performed in grant 84/04 "THE CONSCIOUSNESS OF PAIN" led to significant advances in our understanding of the neurobiological mechanisms that induce cognitive alterations under chronic pain conditions. Our studies have introduced for the first time the use of complex cognitive tasks in animal models of chronic pain. The relevance of our studies is notorious not only from the quality of the scientific publications in which we have reported our results, but also from the impact that these studies have achieved in the Pain Research scientific community as inferred by the many invitations to present our results in international meetings.

Specifically, in this Project we have:

- 1 – developed for the first time a cognitive task for emotional decision making under ambiguity – the Rodent Gambling Task – that is sensitive to prefrontal and amygdalar functioning just like is observed in the human brain;
- 2 – demonstrated that prefrontal executive function assessed in our decision-making task is impaired in chronic pain animals, and that this pain-induced impairment is as severe as after a prefrontal lesion;
- 3 – demonstrated that chronic pain changes the neurochemical balance of dopamine and serotonin in the prefrontal cortex, amygdala, hippocampus, and ventral striatum;
- 4 – demonstrated that chronic pain impairs working memory without affecting performance dependent on long-term memory.
- 5 – demonstrated that chronic pain impairs attentional processing, without affecting choice impulsivity as some authors had previously suggested;
- 6 – developed a novel software for acquisition of behavioral animal data and control of experimental arenas that was freely available for download by the neuroscience community.

### **Published Works:**

#### **Book Chapters:**

2. Lima D (2007) Ascending Pathways: Anatomy and Physiology. In: The Senses: A Comprehensive Reference. Basbaum, A. et al., editors, pp. 477-526, Elsevier, London
1. Galhardo V (2006) Dynamics of thalamic responses to noxious stimuli. In Encyclopedic Reference of Pain Willis, W.D. & Schmidt, R.F., eds. Springer-Verlag, New York.

#### **Full Papers:**

10. Pais-Vieira M, Aguiar P, Lima D, Galhardo V (2009) Orbitofrontal single-cell activity encodes the behavioral shift from risk aversion to risk proneness in a rodent task of decision under uncertainty (*submitted to Journal of Neuroscience*)

9. Pais-Vieira M, Mendes-Pinto M, Lima D, Galhardo V (2009) Chronic pain affects memory acquisition but not memory-dependent performance in monoarthritic rats (*submitted to European Journal of Pain*).
8. Ji G, Sun H, Fu Y, Li Z, Galhardo V, Neugebauer V (2009) Cognitive impairment in pain through amygdalo-prefrontal cortical interactions (*submitted to Nature Neuroscience*).
7. Pais-Vieira M, Lima D & Galhardo V (2009) Sustained attention deficits in rats with chronic inflammatory pain. *Neuroscience Letters*, 463: 98-102.
6. Pais-Vieira M, Mendes-Pinto MM, Lima D & Galhardo V (2009) Cognitive impairment of prefrontal-dependent decision-making in rats after the onset of chronic pain. *Neuroscience*, 161: 671-679.
5. Neugebauer V, Galhardo V, Maione S, Mackey SC (2009) Forebrain Pain Mechanisms. *Brain Research Reviews*, 60: 226-242.
4. Aguiar, P., Mendonça, L., & Galhardo V. (2007) OpenControl: A free opensource software for video tracking and automated control of behavioral mazes. *Journal of Neuroscience Methods*, 166: 66-72.
3. Pais-Vieira M, Lima D, Galhardo V (2007) Orbitofrontal cortex lesions disrupt risk assessment in a novel serial decision-making task for rats. *Neuroscience*, 145: 225-231.
2. Bi GQ et al (2006) Recent advances in basic neurosciences and brain disease: from synapses to behavior. *Molecular Pain*, 2: 38-51.
1. Monteiro, C., Lima D & Galhardo V (2006) Switching-on and -off of bistable spontaneous discharges in rat spinal deep dorsal horn neurons. *Neuroscience Letters*, 398(3): 258-63.

**These results were also presented orally in 20 invited seminars and symposiums at national and international meetings, and in 18 communications in abstract form.**

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