

[Home](#) > [Journal](#) > [Social Sciences & Humanities](#) > [PSYCH](#)[Indexing](#) [View Papers](#) [Aims & Scope](#) [Editorial Board](#) [Guideline](#) [Article Processing Charges](#)[PSYCH](#) > Vol.1 No.3, August 2010

OPEN ACCESS

## Is a Divergent Central Serotonergic Activity Responsible for Either Despair or Learning Behavior in Intact Wistar or Sprague-Dawley CD Rats, Respectively? A Concomitant Behavioral and Electrochemical Analysis

PDF (Size: 613KB) PP. 209-219 DOI: 10.4236/psych.2010.13028

### Author(s)

Francesco Crespi

### ABSTRACT

Behavioral observations combined with electrochemical analysis have been performed in Wistar or Sprague-Dawley CD rats in the attempt to clarify earlier controversial behavioral reports. In particular, these rats were submitted to FST and to repeated Forced Swimming (rFS, during 4 days). In parallel, voltammetric in vivo analysis of serotonin (5-HT) levels in platelet-rich plasma (PRP) collected daily from these animals was also performed as it is known that peripheral 5-HT levels monitored in rat PRP mirror cerebral 5-HT contents. Thus, combined behavioral-voltammetric studies allow deducing changes of central 5-HT levels that could be correlated to FST or rFS, with the advantage of non invasive analysis of central neurotransmitter activities in intact behaving animals. In particular, combined behavioral-voltammetric results suggest that "behavioral despair" is the process interesting Wistar rats when submitted to FST or rFS while "learning to be immobile" is the process involving Sprague-Dawley CD rats.

### KEYWORDS

Rat Strains, Behavior, Electrochemistry, Fluoxetine, Serotonin, Platelets

### Cite this paper

Crespi, F. (2010). Is a Divergent Central Serotonergic Activity Responsible for Either Despair or Learning Behavior in Intact Wistar or Sprague-Dawley CD Rats, Respectively? A Concomitant Behavioral and Electrochemical Analysis. *Psychology*, 1, 209-219. doi: 10.4236/psych.2010.13028.

### References

- [1] R. D. Porsolt, M. Le Pichon and M. Jalfre, "Depression: A New Animal Model Sensitive to Anti Depressant Treatments," *Nature*, Vol. 266, No. 5604, 1977, pp. 730-732.
- [2] F. Borsini and A. Meli, "Is the Forced Swimming Test a Suitable Model for Revealing Antidepressant Activity?" *Psychopharmacology*, Vol. 94, No. 2, 1988, pp. 147-160.
- [3] T. J. Connor, P. Kelliher, Y. Shen, A. Harkin, J. P. Kelly and B. E. Leonard, "Effect of Subchronic Antidepressant Treatments on Behavioral, Neurochemical, and Endocrine Changes in the Forced-Swim Test," *Pharmacology Biochemistry and Behavior*, Vol. 65, No. 4, 2000, pp. 591-597.
- [4] M. J. Detke and I. Lucki, "Detection of Serotonergic and Noradrenergic Antidepressants in the Rat Forced Swimming Test: The Effect of Water Depth," *Behavioural Brain Research*, Vol. 73, No. 1-2, 1996, pp. 43-46.
- [5] R. D. Porsolt, A. Bertin, N. Blavet, M. Deniel and M. Jalfre, "Immobility Induced by Forced Swimming in Rats: Effects of Agents which Modify Central Catecholamine and Serotonin Activity," *European Journal of Pharmacology*, Vol. 57, No. 2-3, 1979, pp. 201-210.
- [6] M. J. Detke, M. Rickels and I. Lucki, "Active Behaviors in the Rat Forced Swimming Test Differentially Produced by Serotonergic and Noradrenergic Antidepressants," *Psychopharmacology*, Vol. 121, No. 1, 1995, pp. 66-72.

- [Open Special Issues](#)
- [Published Special Issues](#)
- [Special Issues Guideline](#)

[PSYCH Subscription](#)[Most popular papers in PSYCH](#)[About PSYCH News](#)[Frequently Asked Questions](#)[Recommend to Peers](#)[Recommend to Library](#)[Contact Us](#)

Downloads: 247,435

Visits: 545,838

[Sponsors >>](#)

- [7] S. E. Hemby, I. Lucki, G. Gatto, A. Singh, C. Thornley, J. Matasi, N. Kong, J. E. Smith, H. M. L. Davies and S. I. Dworkin, " Potential Antidepressant Effects of Novel Tropane Compounds, Selective for Serotonin or Dopamine Transporters," *Journal of Pharmacology and Experimental Therapeutics*, Vol. 282, No. 2, 1997, pp. 727-733.
- [8] L. G. Kirby and I. Lucki, " Interaction between the Forced Swimming Test and Fluoxetine Treatment on Extracellular 5-Hydroxytryptamine and 5-Hydroxyindoleacetic Acid in the Rat," *Journal of Pharmacology and Experimental Therapeutics*, Vol. 282, No. 2, 1997, pp. 967-976.
- [9] M. E. Page, M. J. Detke, G. Kirby and I. Lucki, " Serotonergic Mediation of the Effects of Fluoxetine, but not Desipramine, in the Rat Forced Swimming Test," *Psychopharmacology*, Vol. 147, No. 2, 1999, pp. 162-167.
- [10] J. P. Reneric and I. Lucki, " Antidepressant Behavioral Effects by Dual Inhibition of Monoamine Reuptake in the Rat Forced Swimming Test," *Psychopharmacology*, Vol. 136, No. 2, 1998, pp. 190-197.
- [11] C. Lopez-Rubalcava and I. Lucki, " Strain Differences in the Behavioral Effects of Antidepressant Drugs in the Rat Forced Swimming Test," *Neuropsychopharmacology*, Vol. 22, No. 2, 2000, pp. 191-199.
- [12] T. Skrebuhova, L. Allikmets and V. Matto, " Effect of Anxiogenic Drugs in Rat Forced Swimming Test," *Methods & Findings in Experimental & Clinical Pharmacology*, Vol. 21, No. 3, 1999, pp. 173-178.
- [13] J. De Vry, S. Maurel, R. Schreiber, R. de Beun and K. R. Jentsch, " Comparison of Hypericum Extracts with Imipramine and Fluoxetine in Animal Models of Depression and Alcoholism," *European Neuropsychopharmacology*, Vol. 9, No. 6, 1999, pp. 461-468.
- [14] G. Griebel, C. Cohen, G. Perrault and D. J. Sanger, " Behavioral Effects of Acute and Chronic Fluoxetine in Wistar-Kyoto Rats," *Physiology & Behavior*, Vol. 67, No. 3, 1999, pp. 315-320.
- [15] J. F. Cryan, M. E. Page and I. Lucki, " Differential Behavioral Effects of the Antidepressants Reboxetine, Fluoxetine, and Moclobemide in a Modified Forced Swim Test Following Chronic Treatment," *Psychopharmacology (Berl)*, Vol. 182, No. 3, 2005, pp. 335-339.
- [16] S. Dal-Zotto, O. Marti and A. Armario, " Influence of Single or Repeated Experience of Rats with Forced Swimming on Behavioral and Physiological Responses to the Stressor," *Behavioural Brain Research*, Vol. 114, No. 1-2, 2000, pp. 175-181.
- [17] L. G. Kirby and I. Lucki, " The Effect of Repeated Exposure to Forced Swimming on Extracellular Levels of 5-Hydroxytryptamine in the Rat," *Stress*, Vol. 2, No. 4, 1998, pp. 251-263.
- [18] A. Parra, C. Vinader-Caerols, S. Monleon and V. M. Simons, " Learned Immobility is also Involved in Forced Swimming Test in Mice," *Psicothema*, Vol. 11, No. 2, 1999, pp. 239-246.
- [19] Y. Lamberty and A. J. Gower, " Cholinergic Modulation of Spatial Learning in Mice in a Morris-Type Water Maze," *Archives Internationales de Pharmacodynamie et de Therapie*, Vol. 309, 1991, pp. 5-19.
- [20] G. Richter-Levin and M. Segal, " The Effect of Serotonin Depletion and Raphe Grafts on Hippocampal Electrophysiology and Behavior," *Journal of Neuroscience*, Vol. 11, No. 6, 1991, pp. 1585-1596.
- [21] J. M. De Pablo, A. Parra, S. Segovia and A. Guillamon, " Learned Immobility Explains the Behavior of Rats in the Forced Swimming Test," *Physiology & Behavior*, Vol. 46, No. 2, 1989, pp. 229-237.
- [22] A. J. Martos, C. Vinader-Caerols, S. Monleon, M. C. Arenas and A. Parra, " Effect of Physostigmine and Nicotine on Learned Immobility in the Forced Swimming Test," *Psicothema*, Vol. 11, No. 3, 1999, pp. 631-639.
- [23] E. H. Cook, K. E. Fletcher, M. Wainwright, N. Marks, S. Y. Yan and B. L. Leventhal, " Primary Structure of the Human Platelet Serotonin 5-HT<sub>2A</sub> Receptor: Identity with Frontal Cortex Serotonin 5-HT<sub>2A</sub> Receptor," *Journal of Neurochemistry*, Vol. 63, No. 2, 1994, pp. 465-469.
- [24] C. R. Pfeffer, P. A. McBride, G. M. Anderson, T. Kakuma, L. Fensterheim and V. Khait, " Peripheral Serotonin Measures in Prepubertal Psychiatric Inpatients and Normal Children: Association with Suicidal Behavior and its Risk Factors," *Biological Psychiatry*, Vol. 44, No. 7, 1988, pp. 568-577.
- [25] S. D. Mendelson, " The Current Status of the Platelet 5-HT<sub>2A</sub> Receptor in Depression," *Journal of*

- [26] J. M. Sneddon, " Blood Platelets as a Model for Mono- amine Containing Neurones," *Progress in Neurobiology*, Vol. 1, No. 2, 1973, pp. 151-198.
- [27] S. M. Stahl, " The Human Blood Platelet: A Diagnostic and Research Tool for the Study of Biogenic Amines in Psychiatric and Neurologic Disorders," *Archives of Gen- eral Psychiatry*, Vol. 34, No. 5, 1977, pp. 509-516.
- [28] M. Bianchi, C. Moser, C. Lazzarini, E. Vecchiato and F. Crespi, " Forced Swimming Test and Fluoxetine Treat- ment: In Vivo Evidence that Peripheral 5-HT in Rat Platelet-Rich Plasma Mirrors Cerebral Extracellular 5-HT Levels, whilst 5-HT in Isolated Platelets Mirrors Neu- ronal 5-HT Changes," *Experimental Brain Research*, Vol. 143, No. 2, 2002, pp. 191-197.
- [29] F. Congestri, F. Formenti, V. Sonntag and F. Crespi, " The Selective D3 Receptor Antagonist SB- 277011-A Potenti- ates the Effect of Cocaine on Extracellular Dopamine in the Nucleus Accumbens: A Dual Core-Shell Voltammetry Study in Anesthetized Rats," *Sensors*, Vol. 8, No. 11, 2008, pp. 6936-6951.
- [30] F. Crespi, " In Vivo Voltammetry with Micro-Biosensors for Analysis of Neurotransmitter Release and Metabo- lism," *Journal of Neuroscience Methods*, Vol. 34, No. 1-3, 1990, pp. 53-65.
- [31] F. Crespi, K. F. Martin and C. A. Marsden, " Measurement of Extracellular Basal Levels of Serotonin in Vivo Using Nafion-Coated Carbon Fibre Electrodes Combined with Differential Pulse Voltammetry," *Neuroscience*, Vol. 27, No. 3, 1988, pp. 885-896.
- [32] J.-M. Zen, I.-L. Chen and Y. Shih, " Voltammetric Deter- mination of Serotonin in Human Blood Using a Chemi- cally Modified Electrode," *Analytica Chimica Acta*, Vol. 369, No. 1-2, 1998, pp. 103-108.
- [33] F. Crespi, " In Vivo Voltammetry and Concomitant Elec- trophysiology at a Single Biosensor to Analyse Ischaemia, Depression and Drug Dependence," *Journal of Neuro- science Methods*, Vol. 119, No. 2, 2002, pp. 173-184.
- [34] F. Crespi and M. Jouvett, " Differential Pulse Voltammetry Parallel Peak 3 Changes with Vigilance States in Raphe Dorsalis and Raphe Magnus of Chronic Freely Moving Rats and Evidence for 5HT Contribution to this Peak after Monoamine Oxidase Inhibitors," *Brain Research*, Vol. 272, No. 2, 1983, pp. 263-268.
- [35] A. Louilot, A. Serrano and M. D' Angelo, " A Novel Car- bon Fiber Implantation Assembly for Cerebral Voltam- metric Measurements in Freely Moving Rats," *Physiology & Behavior*, Vol. 41, No. 3, 1987, pp. 227-231.
- [36] S. L. Handley and J. W. McBlane, " Opposite Effects of Fluoxetine in Two Animal Models of Anxiety," *British Journal of Pharmacology*, Vol. 107S, 1997, p. 446.
- [37] M. L. Rao, B. Hawellek, A. Papassotiropoulos, A. Deister and C. Frahnert, " Upregulation of the Platelet Serotonin2A Receptor and Low Blood Serotonin in Suicidal Psychiat- ric Patients," *Neuropsychobiology*, Vol. 38, No. 2, 1998, pp. 84-89.
- [38] F. Crespi, " Apamin Increases 5-HT Cell Firing in Raphe Dorsalis and Extracellular 5-HT Levels in Amygdala: A Concomitant in Vivo Study in Anesthetized Rats," *Brain Research*, Vol. 1281, 2009, pp. 35-46.
- [39] K. F. Martin, C. A. Marsden and F. Crespi. " In Vivo Electrochemistry with Carbon Fibre Electrodes: Princi- ples and Application to Neuropharmacology," *Trends in Analytical Chemistry*, Vol. 7, No. 9, 1988, pp. 334-339.
- [40] J. A. Stamford, F. Crespi and C. A. Marsden, " In Vivo Voltammetric Methods for Monitoring Monoamine Re- lease and Metabolism," *Monitoring Neuronal Activity, a Practical Approach*, Oxford University Press, Oxford, 1992, pp. 113-145.
- [41] T. Self and F. Crespi, " Electron Microscopic and Volt- ammetric Analysis of Carbon Fibre Electrode Pretreat- ments," *Journal of Materials Science: Materials in Medi- cine*, Vol. 3, No. 6, 1992, pp. 418-425.
- [42] F. Crespi and Z. L. Rossetti, " Pulse of Nitric Oxide Re- lease in Response to Activation of N-Methyl-D- Aspartate Receptors in the Rat Striatum: Rapid Desensitisation, In- hibition by Receptor Antagonists and Potentiation by Glycine," *Journal of Pharmacology and Experimental Therapeutics*, Vol. 309, No. 2, 2004, pp. 462-468.

- [43] F. Crespi, T. Sharp, N. Maidment and C. A. Marsden, "Differential Pulse Voltammetry in Vivo—Evidence that Uric Acid Contributes to the Indole Oxidation Peak," *Neuroscience Letters*, Vol. 43, No. 2-3, 1983, pp. 203-207.
- [44] F. Crespi, T. Sharp, N. Maidment and C. A. Marsden, "Differential Pulse Voltammetry: Simultaneous in Vivo Measurement of Ascorbic Acid, Catechols and 5-Hydroxyindoles in the Rat Striatum Using a Single Carbon Fibre Electrode," *Brain Research*, Vol. 322, No. 1, 1984, pp. 135-138.
- [45] F. Crespi, P. Keane and M. Morre, "Does Concomitant Analysis of Extracellular DOPAC and 5HIAA with a Single Carbon Fibre Electrode Enable the Detection of Striatal Dopamine-Serotonin Interaction?" *Journal of Neurochemistry*, 1985, Vol. 44, pp. 109-112.
- [46] F. Borsini, "Role of the Serotonergic System in the Forced Swimming Test," *Neuroscience & Biobehavioral Reviews*, Vol. 19, No. 3, 1995, pp. 377-395.
- [47] W. F. Boyer and J. P. Feighner, "Side Effects of the Selective Serotonin Re-Uptake Inhibitors," In: J. P. Feighner and W. F. Boyer, Ed., *Selective Serotonin Re-Uptake Inhibitors. Perspectives in Psychiatry 1*, Wiley Press, New York, 1991, pp. 133-152.
- [48] P. Chopin and M. Briley, "Animal Models of Anxiety: The Effect of Compounds that Modify 5-HT Neurotransmission," *Trends in Pharmacological Sciences*, Vol. 8, No. 10, 1987, pp. 383-388.
- [49] F. Borsini, A. Lecci, A. Sessarego, R. Frassine and A. Meli, "Discovery of Antidepressant Activity by Forced Swimming Test may Depend on Pre-Exposure of Rats to a Stressful Situation," *Psychopharmacology*, Vol. 97, No. 2, 1989, pp. 183-188.
- [50] C. Barja-Fidalgo, J. A. Guimaraes and C. R. Carlini, "The Secretory Effect of Canatoxin on Rat Brain Synaptosomes Involves A Lipoygenase-Mediated Pathway," *Brazilian Journal of Medical and Biological Research*, Vol. 21, No. 3, 1988, pp. 549-552.
- [51] R. M. Lyons and J. O. Shaw, "Interaction of Ca<sup>2+</sup> and Protein Phosphorylation in the Rabbit Platelet Release Reaction," *Journal of Clinical Investigation*, Vol. 65, No. 2, 1980, pp. 242-255.
- [52] H. C. Buhot, S. Martin and L. Segu, "Role of Serotonin in Memory Impairment," *Annals of Medicine*, Vol. 32, No. 3, 2000, pp. 210-221.
- [53] W. J. McEntee and T. H. Crook, "Serotonin, Memory, and the Aging Brain," *Psychopharmacology*, Vol. 103, No. 2, 1991, pp. 143-149.
- [54] I. Gonzalez-Burgos, M. I. Perez-Vega, A. R. Del Angel-Meza and A. Feria-Velasco, "Effect of Tryptophan Restriction on Short-Term Memory," *Physiology & Behavior*, Vol. 63, No. 2, 1998, pp. 165-169.
- [55] G. T. Shishkina, T. S. Kalinina and N. N. Dygalo, "Serotonergic Changes Produced by Repeated Exposure to Forced Swimming: Correlation with Behavior," *Annals of the New York Academy of*