

Praise Be to Jaak Panksepp

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A few days ago, on April 18, we were surprised by the news that neuroscientist Dr. Jaak Panksepp had passed away. Dr. Panksepp in his last days was Professor of the Integrative Physiology & Neuroscience at Washington State University and Emeritus Professor of the Department of Psychology at Bowling Green State University.

Talking about the importance of his legacy is both simple and unbelievably difficult. But it is just a superficial contradiction. It is simple because his work had an immense and undeniable impact. It is difficult, because it has brought about so many transformations in so many areas that everything that can be mentioned will never be enough. Also, in his work there is plenty of subtleties with great implications. Little is left out of the impact of his work, not only scientifically, but also as part of the Human *Weltanschauung* from the philosophical point of view.

A short, but insightful, biography of Panksepp has been compiled by Robin Stock, so there are no innovations to be made in this topic:

"Jaak Panksepp was born on June 5, 1943 in Tartu, Estonia. He and his family fled to the United States when the Soviets began to take over his country. Panksepp earned his B.S. in Psychology in 1965 from the University of Pittsburgh in Pennsylvania. In 1967, I earned his M.S. and in 1969 his Ph.D. both in Physiological Psychology at the University of Massachusetts in Amherst, Massachusetts. His graduate thesis focused on electrical stimulation and lesions of the brain and the corresponding behavioral effects. His thesis, "The Neural Basis of Aggression in the Albino Rat," focused on the behavioral consequences of incentive shifts, effects of drug on self-stimulation and aggression, and behavioral analysis on positive and aversive electrical stimulation of the brain. Panksepp completed a postdoc in 1971 at the University of Sussex in Brighton, England, where he studied the role of medial hypothalamic lesions, insulin, and protein synthesis inhibition in feeding behavior. At the Worcester Foundation in Shrewsbury, Massachusetts, I completed another postdoc in 1972 in sleep physiology."

So, Dr. Panksepp lived his life as a good and honest man and it could sustain an interesting and captivating poetry of daily life, but what is truly amazing is his work.

The general lines of his work emphasized that Emotions seem to be the most fundamental of the hard-wired neural circuits in the visceral-limbic brain that facilitate diverse and adaptive behavioral and physiological responses to major classes of

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environmental challenges. Presumably these circuits developed early in the mammalian brain evolution, and the underlying control mechanisms remain similar in humans. This would suggest that theoretically guided studies of the animal brain can reveal how primitive emotions are organized in the human brain. Let Panksepp himself explain:

"[...] conversely, granted this cross-species heritage, it is arguable that human introspective access to emotional states may provide direct information concerning operations of emotive circuits and thus be a primary source of hypotheses for animal brain research. In this article the possibility that emotions are elaborated by transhypothalamic executive (command) circuits that concurrently activate related behavior patterns is assessed. Current neurobehavioral evidence indicates that there are at least four executive circuits of this type—those which elaborate central states of expectancy, rage, fear, and panic. The manner in which learning and psychiatric disorders may arise from activities of such circuits is also discussed" [1].

The four (at least) executive circuits quoted above later became 7, as we can see above. The manner in which learning and psychiatric disorders may arise from activities of such circuits is also very extensively discussed across his work. With this in mind, one can easily understand that if this assumption is true, animal brain research will reveal the basis and the general architecture of emotions in the human brain.

Based on this, Panksepp described seven primary processes. Each one of them is in charge of a particular kind of possible environmental challenges and his repertoire of adaptive behavior. Each one of these seven sets is genetically provided with emotional systems of mammalian brains. Also, the author stressed that all these systems are subcortically localized, so it is not possible to investigate with modern brain imagery.

This seven basic emotions or emotion systems consist of the seven "neuronal process" [2]:

1. SEEKING/Enthusiasm;
2. RAGE/Anger;
3. FEAR/Anxiety;
4. sexual LUST/Passion;
5. maternal CARE/Nurturance;
6. PANIC separation/distress, Grief; and
7. PLAY/Social Joy.

How the author himself stressed several times across his work, most of these systems figure heavily in social bonding, and social bonds are very important to mammals. We can add to this that there is very strong evidence linking the high encephalization and complexity of social life in primates, like us, humans [3].

Based on these seven systems Panksepp presented a methodology for the study and comprehension of several kinds of pathologies. In *Current Topics in Behavioral Neuroscience* [2], for instance, he and his team describe depression as a "sustained overactivity of the separation-distress PANIC system reflecting severed social bonds and the excessive "psychological pain" of loneliness that, if sustained, can lead to a downward cascade known as psychological despair, and (ii) The despair phase that follows the PANIC response, which is characterized by abnormally low activity of the SEEKING, the so-called brain reward networks, leading to a motivational states that characterize depression. To understand why depression feels so bad, we must understand the neural mechanisms that mediate such social feelings."

From this, always relating the function of the systems of primary emotions, both in the evolutionary sense, as an anatomical and biomolecular point of view, we have the solid foundation for a branching of studies in several areas. This can be viewed in titles of some of his most recent works, such as "Positive Emotional Learning Induces Resilience to Depression: A Role for NMDA Receptor-mediated Synaptic Plasticity" [2], where we can see the remarkable approach of complex behaviors, personal experiences and changes at a cellular-molecular level. Here we can see the remarkable advance that his conceptions and results have brought to the understanding of what Tinbergen called "proximal causes" [4]. Considering emotions as primary tools shared by all mammals, we have that they play their part in a bottom-up pathway, favoring a class of behaviors that have proven most suitable in the evolutionary past of this genre. This has major implications in the frame where research and conceptions and theoretical approach give shape to the "making hypothesis" process, even in questions about the mind-body theme.

No one can overrate this issue as far as "bottom-up" and "top-down" questions are concerned. This means that the center of control of the action or system activation starts in the body feelings or come from encephalic regions. We can appreciate this in a special paper called "Integrating bottom-up internalist views of emotional feelings with top-down externalist views: Might brain affective changes constitute reward and punishment effects within animal brains?" [5].

Again, the implications are immense. It is enough to see the title of one of his last books: "Social Behavior from Rodents to Humans" [6], where one of the chapters is justly called "The Psycho-Neurology of Cross-Species Affective/Social Neuroscience: Understanding Animal Affective States as a Guide to Development of Novel Psychiatric Treatments".

In an attempt to situate its impact of Panksepp on a short comment, a synthesis was necessary, which implies some simplification, but, even at this risk, we can understand the importance of his scientific work, both from the point of view of research, as well as the philosophical point of view, and the resulting interaction between the two.

The human and biological sciences, in their efforts to understand the human being or even to define it, always lead to the question of emotions. Panksepp with his affective neuroscience model could situate the role of the basic emotions in the behavior, bringing these questions to the methods of the natural sciences and allowing it to be studied at the laboratory. This effort brought other consequences, enabling the consolidation of the knowledge of the human being as "a being" of nature. By a strange aberration of these methodological difficulties quite often left aside, the Human being stood apart from nature, as in a solitary solipsism.

Panksepp "animated" us (give us a "anima" a "natural soul", his results and methodological approach allowed the human being to be animal, in a absolutely good and new way to consider these questions); in a profoundly existential sense, he had returned us to Nature. The opposite also applies: his work had "humanized" the "other animals", and both us "animals" and "human" became closer and very near, indeed.

Starting from the work of pioneer giants such as Konrad Lorenz, Nicholas Tinbergen, among others (and therefore the development of an epistemology based on an evolutionary understanding), this knowledge made possible the emergence and development of neuroscience and a scientific analysis of emotional behavior, bringing the human being more consistently close to the Animal Kingdom; it also began to be analyzed in an extremely proficient way under the paradigms of causality and from an empirical point of view.

With his researches and discoveries on the neural systems generating of emotions, he has shed immense light on this field, which allowed for an approach that aligned the behavior of several species and their function, and brought together several fields of research and several other areas of knowledge, such as Psychology, Biology, Anthropology, Psychoanalysis, and several works like those of John Bowlby. Let us see, for example,

this statement by Panksepp, "the attachment system begins in the midbrain periaqueductal gray, very close to the area that produces physical pain responses, suggesting that it may have originated from the pain circuits ", from this observation we can better understand how certain types of environment can be harmful to health.

We can state that Panksepp's book, "Affective Neuroscience: The Foundations of Human and Animal Emotions", Oxford University Press [7], will be one of the most important contributions to the understanding of the biology of emotions since Darwin's "The Expression of the Emotions in Man and Animals". We should also quote other books of his own, "The Archeology of Mind: Neuroevolutionary Origins of Human Emotion" [5]; "The Textbook of Biological Psychiatry", (2004); "Emotions and Psychopathology", (1988); "Handbook of the Hypothalamus: Behavioral Studies, Physiology and Anatomy of the Hypothalamus" (in 4 volumes) and many others. It helped us to understand emotions as a tangible part of our existence and not as a mere abstraction, almost unreal, as tended to consider the science of the century XIX until almost the end of the XX.

The fact that emotion would have adaptive value was already in Darwin's texts (1872: The Expression of the Emotions in Man and Animals). But with Panksepp's work, it reached a degree of clarity and a high level of comprehensiveness that made possible the explanation and punctual understanding of each class of behavior, going to its anatomo-functional and neurochemical description. As we can see in this passage of Vuilleumier: "emotional processes not only serve to record the value of sensory events, but also to elicit adaptive responses and modify perception" [8].

In short, after his work some changes were made possible:

1. Definitely consider emotion as a field of scientific research, independent of the logical-philosophical difficulties to handle the subject;

2. To bring the emotional life of the human being closer to that of other species, making it possible for a whole field of research on a more substantial basis to be able to theoretically relate the results of comparative research with other animals and with humans;
3. To understand the human being integrated into and within Nature, leaving the "obscured area" in which this animal was segregated with difference and differentiated from the whole biological kingdom;
4. It made possible the systematic study of the different classes of behaviors linked to their purpose, in relation to both the proximal and final causes, in the concept of Tinbergen, opening a wide field of research, both basic and clinical;
5. Finally, Panksepp, teaches us that our emotions and our ties, what moves us and drives us, our goals, are not superior or so different from those of other animals ... we are as fragile and sweet as little lab rats, laughing and joking, while trying to make bonds, escape pain, seek pleasure ... While opening the field and paving the way for understanding complex behaviors, by situating the problem of emotion for understanding the brain, it builds a solid foundation for the researches on conscience.

According to a very quick research on Google Scholar, we could see this remarkable result: Panksepp published 648 works, including books and periodicals, and obtained 43,337 citations, which proves that he has been the great and generous writer when sharing such wide knowledge.

Only one thing comforts us in this loss: the infinite beauty of an existence that is complete, leaving behind the very meaning of 'yes, it was worth coming!'

With gratitude, we say farewell to this great scientist!

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