

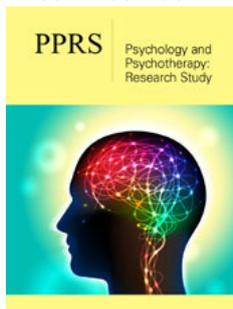
Chaos and Creativity

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Opinion

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The internal structure in the functioning of complex natural and social adaptive systems lies between order and chaos. We are facing ourselves a new epistemology of science where the Newton's and Laplace's mechanistic model is no longer sufficient to account for everything known, as the uncertainty principle in quantum physics or the functioning of many natural and social systems as chaotic systems. Scientific psychology, however, during its century and a half of life, has almost always sought a mechanistic explanation of its object of study, based on a principle of linear causality. As Abraham and Gilgen say in their book *Chaos theory in Psychology*, in psychology we deal with complexity by trying to reduce or neutralize aspects of it [1]. This has happened in the two great paradigms. In Behaviorism, with the search for an efficient causality and an analysis of behavior in terms of functional relationships between stimuli and responses, removing from its study any vestige of the mental and reducing the scientific explanation of the psychological subject to universal laws of learning[2].

For its part, Cognitive Psychology, in its most reductionist vision of the dominant computer metaphor in the 1960s and 1970s, reproduced the mechanistic model, although referring to the mental, where the human subject is an information processor, unconditioned with respect to its complex context of motives, emotions, personal traits or social conditions [3]. But in the beginning, the father of scientific psychology, Wilhem Wundt, had refined the object of scientific psychology by entrusting it with the study of the simplest and most mechanical mental processes of perception or memory, the «mental atoms». But all these historical attempts to mechanize the study of psychology were left behind and in today's more complex psychology and with greater ecological value there are complex systems that a deterministic psychology cannot allow, such as creativity.

We are talking about the most complex and unpredictable dimension of human behavior. That which is defined in terms of a way of thinking that gives rise to ideas-embodied in devices, sculptures, sonnets, symphonies, philosophical or scientific theories, advertising spots that are original and valued by a context. We speak of unpredictability because creativity is unpredictable, or more specifically, the creative product. If it could be predicted, it would stop being creative. How to predict the revolution of the artistic vanguards? the Gioconda or the theory of relativity? According to the distinction between Big Creativity, (the products that have transcended and go down in history) and little Creativity (the creativity of everyday life), it is evident that Big Creativity is completely unpredictable. We are talking about a surprising product: an effective surprise, in Bruner's terms; in whatever context [3-9].

It is a new way of organizing the domain with new rules that are not derived from the previous ones; we speak, in extreme Big Creativity, of a new paradigm in terms of Kuhn or even of a new discipline. The transcendence of Darwinian theory was such that it not only changed the paradigm of natural history of its time, but also affected many other disciplines -anthropology, geology, paleontology and psychology- but, above all, it modified the perception that, from then, the human being has of himself, according to Gruber in his valuable book *Darwin on man: A psychological study of scientific creativity*. However, there is a prediction in the little Creativity; I can risk saying that the canapés that my friend X is going to offer me at

the party on Saturday will be creative, because she always surprises us with her culinary creativity. It is «the people who always surprise us», the creative people, who make it possible for us to speak of creativity in behavior as a stable and, to a certain extent, predictable condition [8-9]. As we are going to see, we are beginning to know the rules that intervene in human creativity, although the extreme sensitivity to the initial conditions - that little butterfly flapping its wings in Brazil that unleashes a cyclone in Texas - will continue conditioning the unpredictability of creative behavior as in any chaotic system. We are beginning, however, to know the rules that allow us to speak of a scientific discipline of creativity.

We cannot predict Big Creativity, because, that something is diagnosed as Big Creativity does not depend on the author but on the field. As Csikszentmihalyi has said, creativity is found in the dialectic of three systems: individual or creative person, domain or discipline, and field or group of experts who decide on the discipline. But the recognition of the field, which will determine that a product becomes part of a discipline, can come long after the death of the individual. Who would pay €200 million for a Van Gogh painting in his time? Who considered him a genius in life? However, for the purposes of psychological scientific study of it, Big Creativity and little Creativity are the same. And that is the reason for a science of creativity. But the romantic vision has always denied it, to safeguard the mystery of genius, as if bringing it to light would destroy it. But even when the possibility of predicting masterpieces is closed to us, that does not condemn the study of creativity to the mythology [5,10,11]. The value of science is not to predict but to explain. «Science is not prophecy,» says Boden. The important thing in science is not to know what will happen but to know how things happen.

The complexity of the initial conditions is extreme. On the other hand, we are still ignorant of many principles involved in creative work in particular contexts. We know that the skills of creativity, that is, the heuristics that intervene in creative thinking -flexibility in thought, the use of analogies, the ability to detect problems-, are combined with domain skills -the specific intelligences of the field where the creator works; according with componential models of creativity such as Theresa Amabile's, Gardner's or Kaufman. For my part, in my book *Psychology of creativity* I have tried to systematize this set of rules and starting conditions in what I have called the 7 components of creativity [12]:

1. «Infrastructure» skills (intelligences of the field)
2. Knowledge (mastery of the discipline)
3. Skills (the creative thinking heuristics)
4. 10 years or more of intensive initial work
5. Personal characteristics of openness, independence, risk acceptance and self-efficacy.
6. Intrinsic motivation
7. And... a little luck!

It is clear that all these components are present in those people who have made some important contribution to the culture, in any area. I can say that these 7 elements are necessary, but what I cannot say is the way in which the contribution of each of them takes place in each creative product. Perhaps one day some model of chaos theory can help us in this mission. There is an element whose contribution no one disputes: chance. But, nevertheless, we must not identify this chance with randomness. In other words, it is a relatively «domesticated chance». We are talking, for example, about the chance of being born into a professional, free-thinking family, something that is shown, with great frequency, in the families of Nobel Prize winners. Families that feed the child's motivation towards a certain area and that facilitate favorable conditions for it.

We are talking about the luck of being in the right place at the right time; like, for example, Florence of the Quattrocento or Paris of the beginning of the 20th century. But even this chance was sought... It is no coincidence that Picasso worked in Paris. The right moment is also the crisis of a paradigm that turns into revolutionary and big-creative contributions that in a period of normal science would not turn their author into a genius. We also talk about the chance of having someone by your side in the hard work periods in which the creator is involved in a far-reaching project. It is what Howard Gardner, in his 7 case studies on great creators of the modern era, has called: cognitive and affective support at the time of advancement.

We are also talking about chance in many random discoveries. What has been called «serendipity», like the title Roberts's book. Let us cite the case of Fleming, the most paradigmatic. It was chance that staphylococci culture became contaminated with that fungus, but what was not chance -and that is why I speak of domesticated chance- was that Fleming noticed what had happened with that plate and knew how to interpret it. Would we have penicillin if that accident had occurred in the laboratory of another bacteriologist? As Pasteur said «luck favors only the prepared mind». It is no accident that only truly creative people know how to take advantage of these serendipities. Chance plays an important role, but it is impossible to explain creativity in terms of chance. For me it is the seventh ingredient and it only counts when the other 6 are present.

I want to end with an analogy between biological evolution and cultural evolution understood as the accumulation of the products of human creativity. In biological progress, random variations combine with the principles of natural selection to explain the evolution of life: Chance and Necessity as the title of Monod's book. In the case of cultural evolution, the evolutionary theory of creativity proposed by Campbell, in an analogy with Darwinian theory, combines the principles of blind variation: the appearance of new ideas in the fields of science, technology, arts... and selective retention: the criterion of need established by the relevant fields; according with Csikszentmihaly, that will decide on the products that have to become Big Creativity. Such products are «memes»-in Dawkins's terms-or units of cultural information to be transmitted through the generations. As we can see, there are many implications

of chaos theory for the explanation of human creativity, but in an epistemological sense, I would emphasize that this is the area where psychology has most clearly had to go beyond the limits of that mechanistic determinism imported from physics.

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