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Complex Systems: Thoughts on the Causes of Nature

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

Short Communication

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ABSTRACT

This short note presents a dialectic that discusses certain limits that are assumed to be intrinsic according to the work of author Robert (1978). Work of Serge Robert relates to the study of logic, epistemology and sciences cognitive. We therefore suggest the idea that there is a hidden and omnipresent variable that stirs up the expression of unpredicted phenomena in a complex and determined system given the error calculation. The future and epistemological implications are discussed.

Keywords: Epistemology; adaptation; complex systems; variability.

1. INTRODUCTION

According to authors [1] the heuristic significance offered by the paradigm of non-linear complex systems is high. Along these lines, authors [1] have mentioned that: "Certain psychological variables can be considered in an ecological context as the resultant of complex systems subject to uncontrollable and unpredictable impacts. Each value produced comes from a process of self-organization at time *t*. For this reason, a separate study of the constituents of the system will not in any way lead to an understanding of the comprehensive

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functioning of the system. The spirit cannot be reduced to separate mechanisms without taking into account the mutual influences and their coordination. In this sense, several specific psychological functions work in parallel in order to generate a superior structure able to bring forth a product that can be understood by everyone." There is a massive volume of literature in the field of complex systems (see [2]; for a complete review; see also [3-4]).

If we are to believe certain author [5], the principle of parsimony of hypotheses is "a simplifying representation" of the world of living things which is in contrast with complexity. In light of what has just been stated, we think that this principle pleads in favor of a *refined* hypothesis. In other words, it is a plausible representation of nature until proof of the opposite. As a reminder, the principle of parsimony referred to as *Occam's razor* (W. of Occam, 14th century) can be summarized with a simple statement: *"Pluralitas non est ponenda sine necessitate"* (i.e. entities should not be multiplied unnecessarily). In this case, the approach used by the researcher involves translating concepts and constructs that are generally very complex into the simplest possible hypotheses.

Beyond this, we can add that a researcher should never be satisfied with one method, one appropriate experiment or one statistic regardless of its power, in determining the significance of an object of Nature. This is one of the divisions that the Sciences face in general, and this is true for the Humanities and Nature as well. The paradigm of complex systems is based on the idea by which a system is composed of a large number of distinct but interconnected elements. For this reason, the probable outcomes are exponential while the relationship between the uncertainty and the organization is broadly fleshed out.

This brings us to the insistent issue of entropy in the soft sciences. It is generally accepted in the hard sciences where it reflects (in particular) in thermodynamics for example, the irreversibility of a system. The transformation of heat into mechanical energy is intrinsically limited, because the conversions always operate from hot to cold.

In thermodynamics, we accept the existence of a *quantity* called *entropy* which is specific to the state of the system. The entropy of the system can only increase due to the wealth of probable events that directly or indirectly impact a resultant. Consequently, there is a process of self-organization at time *t*. Here, the infinite multiplication of the hypotheses (called "H") is a temptation which all researchers face, despite the fact that the base postulates (called "A") are within a vectorial space that is finite. Whence the necessity, as we believe, to unify – not to say reconcile – the orientations of the complexity with those of the principle of parsimony of hypotheses. This is the point of view defended in this research note. The challenge to be taken up is a substantial one because it requires an in-depth remodeling, both in terms of the epistemology of the sciences, and the methodologies to be implemented to support a coherent paradigm. In this case, the nomothetic construction depends on the elimination of duplicate hypotheses in favor of the one that is both true and acceptable, reasonable, to justify what seems plausible in the occurrence of an event and/or a behavior, keeping in mind that both of them are subject to the laws of Nature. Research aims at bringing probable answers until proof of the opposite.

In this way, the explanation of a fact remains furtive only when it is presented within a multiplication of hypotheses, without necessity, to the detriment of those that are both true and sufficient to explain this fact.

Although we accept the paradigm of the complex system as a plausible representation of a situation, the evaluation of the variances remains problematic, because an infinity of causes

and events leads to an infinity of outcomes, each one as probable as the others. Logically, the ways to reach the same result are multiple.

It appears, from the standpoint of the *philosophical doubt* introduced by Pinel (see the dictionary of the medical sciences, C. L. F. Panckoucke (under the direction of), Paris: C.L.F. Panckoucke, 10 (Dise-Eau), pp. 239-242.), that such variability is clearly an advantage, especially for the anchoring of the research problematic, for the hypotheses that address it accompanied by appropriate experiments, but what about the principle of the parsimony of hypotheses?

Starting from this postulate, the originality of our reasoning is based on a simple idea: there exists an infinite set of hypotheses leading to a finite set of solutions or outcomes by virtue of the principle of the theory of the explanation of the causes of the things of Nature - or epistemology of the things of Nature. The paradigm defended is presented in the following section.

2. REGARDING NATURE

Work of the author [6] relates to the study of logic, epistemology and sciences cognitive. This work concerns the study of the logic and the philosophy of sciences of nature. Its research relates to the designs on the nature of human rationality and their effects on social operation.

In the idea of Robert [6], deductive reasoning follows several rules, the most important of which are *modus ponens* (if *a* then *b*) and *modus tollens*. In the equation of Robert, according to the logic of *modus tollens,* the verification of a hypothesis strictly follows the mathematical expression:

$$(H + A) \rightarrow e^*$$
$$e^* \rightarrow (H + A)$$

In this expression, H represents the hypothesis, A the postulates and e* the resultant (observed fact). This is where *modus ponens* (if *a* then *b*) comes in. We can represent it in the following manner:

The founding rule of deduction is read in the following manner:

- If *a* is true.
- And if *a* is true then *b* is also true.
- Then *b* is true.

For practical examples : see [7-8-9-10-11]

The founding rule of the abduction is illustrated as follows:

- If *b* is true
- And if *a* is true then *b* is also
- Then *a* is true.

According to [12]: “Abduction or, as it is also often called, Inference to the Best Explanation is a type of inference that assigns special status to explanatory considerations. Most

philosophers agree that this type of inference is frequently employed, in some form or other, both in everyday and in scientific reasoning. However, the exact form as well as the normative status of abduction is still matters of controversy. This entry contrasts abduction with other types of inference; points at prominent uses of it, both in and outside philosophy; considers various more or less precise statements of it; discusses its normative status; and highlights possible connections between abduction and Bayesian confirmation theory".

For the author (op.cit. [12], and see [13-14-15] for a complete historical review):

"Abduction is normally thought of as being one of three major types of inference, the other two being deduction and induction. The distinction between deduction, on the one hand, and induction and abduction, on the other hand, corresponds to the distinction between necessary and non-necessary inferences. In deductive inferences, what is inferred is necessarily true if the premises from which it is inferred are true; that is, the truth of the premises guarantees the truth of the conclusion. A familiar type of example is inferences instantiating the schema

All As are Bs.
a is an A.
Hence, *a* is a B.

But not all inferences are of this variety. Consider, for instance, the inference of "John is rich" from "John lives in Chelsea" and "Most people living in Chelsea are rich." Here, the truth of the first sentence is not guaranteed (but only made likely) by the joint truth of the second and third sentences. Differently put, it is not necessarily the case that if the premises are true, then so is the conclusion: it is logically compatible with the truth of the premises that John is a member of the minority of non-rich inhabitants of Chelsea. The case is similar regarding your inference to the conclusion that Tim and Harry are friends again on the basis of the information that they have been seen jogging together. Perhaps Tim and Harry are former business partners who still had some financial matters to discuss, however much they would have liked to avoid this, and decided to combine this with their daily exercise; this is compatible with their being firmly decided never to make up."

Presentation of the illustration of the reasoning (source: http://www.les-mathematiques.net)
In deduction we state that:

"All men are mortal, Socrates is a man, therefore Socrates is mortal."
In abduction we state that:
"All men are mortal, Socrates is mortal, therefore Socrates is a man."
Also, in induction, we state that:
"All men whom I know are mortal, therefore all men are mortal."

It is about a logical demonstration of the principles.

Modus tollens and *modus ponens* imply that if e* is not observed, then H and/or A cannot be true because the deduction and the abduction are violated.

On this level, if e* is false, it is impossible to know whether we must reject H or A or H and A. However, we do not exclude the idea that the contamination of an unverified or parasite variable can distort the research paradigm. A complex system will always generate outcomes that exceed the predicted range of outcomes of even the most well-encoded

model, regardless of size and intricacy of the model. From a probabilistic standpoint, we can accept that the multiplication of the paradigms can reduce the probability of the appearance of an element not predicted in the model. For these reasons, we expect an effect of narrowing or proximity of the expression of the data of e* (i.e. the resultant or the observed fact + uncertainly calculation) around a central trend index once the estimation of the error of measurement or error calculation has been done.

However, probabilistic logic also shows that in the strictest experimental conditions, for the observed facts there is always a fluctuation which is not expected in the model, once the error of measurement has been introduced in the equation of the model. As a reminder, the error of measurement (or error calculation) is called Delta (Δ) by convention.

With no surprise, we can say that there is a set of techniques that exist for the purpose of estimating the error produced on a numerical result. This error is equivalent to the uncertainties or errors made on the measurements that lead to the observed result. The total error is the product of the sources of error such as: the accuracy of the measurement of uncertainty (Δ1); statistical dispersion (Δ2); and systematic error (Δ3).

The sources of error are defined as follows:

- ✓ Δ1: refers to the distances separating the graduations of the analog devices. This is mostly present in the hard sciences
- ✓ Δ2: corresponds to the external disturbing phenomena that very slightly influence the experimental conditions (we speak of the principle of quantum uncertainty) when the experiment is repeated x times;
- ✓ Δ3: refers to the very slight difference or statistical dispersion that results from a sampling error for example.

The total error is thus expressed in the following manner:

$$\Delta = \Delta 1 + \Delta 2 + \Delta 3$$

These elements lead me to think that the equation of the author [6] is incomplete. The theory that we propose is underpinned by an approach that is assumed to be *contemporary* but which by virtue of Nature, we believe, is already obsolete. This theory is based on the simple idea that the combination of conditions *a* and *b* allows for the expression of a law, i.e. that all of the regular and observed facts in the presence of *a* and *b* lead to the expression of phenomena not predicted in a complex and determined model given the error calculation (Δ). Logically, this idea implies that the researcher's approach is constantly in *motion*.

Beyond the discourse and predictions promised by the *motion*, it is essential to think about the processes, influences, and resistances that will hinder the evolution of subjects, groups, and organizations. From a scientific standpoint, this issue is obviously not new.

However, in the reasoning that we are presenting, we accept the existence of a hidden variable which is paradoxically omnipresent in the sequence of verification of a hypothesis.

The theory that we are presenting has the following form:

$$(H \times A) + k \rightarrow e^{*\alpha}$$
$$-e^{*\alpha} \rightarrow -(H \times A) + k$$

The terms are the same as those presented previously, i.e.:

H: represents the hypothesis;
A: represents the postulates;
e*: represents the resultant (variation of the fact observed given Δ).

The mathematical expression of the author [6] which is presented above, and after modification, sets forth the hypothesis that the resultant (e*) is the product of H (hypothesis) multiplied by A (the postulates). In this case, the base postulates are contained in a finite system. The presence of a constant *k* not provided for in the deductive reasoning - itself associated with a constant or squaring (small *α*) - expresses a condition of equivalence in the left term ((H x A) + *k*) which predicts the set of variations that is illustrated using the values of the right term ($e^{*\alpha}$).

Thus, in a *deductive* approach which, as a reminder, is based on the idea that the researcher first establishes a hypothesis, logically infers a research protocol for the purpose of materializing it (the hypothesis), proving it, then deriving new models and more complete theories from it, the presence of a constant small *α* is expressed as follows (rules of deduction and abduction):

The founding rule of the deduction after modification is read in the following manner:

- If *a* squared by small *α* is true;
- And if a^{α} is true then *b* squared by small *α* is also;
- Then *b* is true only in the presence of the squaring of small *α*.

The rule of the abduction after modification is illustrated as follows:

- If *b* squared by small *α* is true;
- And if a^{α} is true then *b* squared by small *α* is also;
- Then *a* is true only in the presence of the squaring of small *α*.

Thus, the product of a set of resultants (facts observed given Δ) is in a universe between -∞ and +∞ because the presence of the constant small *α* expresses the squaring of a set of phenomena (deductive reasoning), of which the base components are located in a universe of hypotheses and postulates which, in the presence of the constant *k*, has no limits. Consequently, the product of e* (the resultant i.e. the variation of the fact observed given Δ) can be simplified as follows:

$$e^{*\alpha} = (H+ A) * (H + A)$$

$$e^{*\alpha} = (H + A)^2 + k$$

An explanation of the causes of the things of Nature

3. CONCLUSION

At the end of this analysis, our wish was to submit to the sagacity of the reader a paradigm on which a *refined* hypothesis is based. We have just done this. Contrary to the preceding,

does this mean that the principle defended following the example of the theory on which a *refined* hypothesis is based forms a coherent model?

However, the idea presented does not always seem to be satisfactory. We see at least two reasons for this:

First, there was no consideration of the fact that a resultant is not a fact in and of itself, but merely a plausible representation of e* at some point. Also, it seems to me that the static nature of the approach suggests that it is far from being able to predict the outcomes of a multitude of events that emerges from new properties in a system that oscillates between equilibrium and non-equilibrium. The theory and the idea of the *refined* hypothesis that stems from it must therefore be covered by a deepening for the purpose, not just of being scientifically refuted, but also to be in line with the simple idea that the elegance of a theory lies in the simplicity of the terms that compose it.

Beyond this, it seems that another fundamental issue must be raised. This involves the methodology and the epistemology that illustrate the approach and its limits. This pressing issue must guide the researcher, and it is already a subject of debate [16].

On the methodological level, reliable metrological instruments must be available for this. Consequently, researchers are constantly caught in a dogmatic strait jacket, a doctrine from which they must resolutely break free if they want to reach the ultimate goal which is the universality of knowledge and thus the understanding of the things of Nature, the emancipation of the human species and the quest for happiness and the Truth.

Thus, the introduction of nomothetic research must involve the invariance of the paradigmatic structure, which itself lies in the capitalization of knowledge. It is no surprise that the observable goes through the prism of personal experience and the subjectivity of the investigator. It therefore seems that the fruit of research work most often makes a contribution to the knowledge of an object, without however prejudging the veracity of the proven models and the approach needed to validate them. This is one of the fundamental limits of all research approaches.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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