POST-NORMAL SCIENCE

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In the current times of a pandemic and of new lexicons as the "new normal", the expression "post-normal science" can evoke the effects of the epidemic situation in science.

However, the concept of post-normal science was developed in the previous century (FUNTOWICZ AND RAVETZ, 1990), motivated by disasters such as the explosion of Chernobyl or of the Challenger space shuttle, both paradigmatic of catastrophic risk management. According to this concept, a scientific domain can be considered to be in a post-normal state when uncertainty is very large, cultural values are at stake, societal risks are high, and decisions are urgent. Considering this definition, climate science is an obvious example of a post-normal science (BRAY and VON STORCH, 1999), and the COVID pandemic in 2020 highlighted post-normality in many other areas.

Modern science follows principles summarised by the sociologist Robert Merton (MERTON, 1973) in the acronym CUDOS of Communalism (common property of scientific discoveries, promoting collective collaboration), Universalism (using universal and impersonal criteria, regardless of gender, race, religion), Disinterestedness (actions motivated by the common scientific good and not by personal gain) and Organized skepticism (impartial critical scrutiny, peer review). As a human cultural activity, science cannot be entirely objective but still strives diligently for objectivity and nurtures self-correcting mechanisms. A scientific fact is not understood as an absolute truth, but rather as the most plausible explanation, taking into account the observations and scientific theories considered valid. As such, it can be replaced by an alternative explanation in face of new data or new knowledge. A fact is not scientific, even if expressed by a scientifically educated individual or a professional scientist, if the scientific method is not followed, for example when alternative explanations are not considered, or when an explanation is chosen just because it agrees with a specific school of thought. Although these are well established and widely accepted principles of scientific practice, their application is put to the test in post-normal conditions.

The social pressure to which scientific practice is subject under post-normal situations affects the scientific process itself and its results. In post-normal conditions, the predisposition to choose topics considered socially relevant is inevitable, and explanations consistent with the dominant social view preferred. For example, considering climate, the usefulness of science to either achieve the objectives of the Paris Agreement or to postpone profound economic changes becomes the main focus, rather than the soundness of the science that informs those decisions. The usefulness of science, and its consistency with cultural and political preferences, becomes more important than its solidity in terms of methodological rigor (for example, consistency with Merton norms). Paradoxically, the usefulness of science to inform decision-making processes becomes then significantly reduced, since it no longer has the distance, focus and impartiality that are precisely its strength.

In order to maintain the undeniable usefulness of science to society, particularly in understanding complex phenomena, even in emergency and high-risk situations, as in the case of climate change, science should insist on the methodological rigor that is its strength. Education of younger generations of scientists on the fundamental principles of rigorous scientific inquiry is crucial (RAVETZ, 2019), and more emphasis should be given to science education than to apparently less useful subjects, such as philosophy or the history of science. For those who do not deal directly with scientific issues, it is even more difficult to comprehend the distinctive character of the scientific method, resulting sometimes in the overestimation of the power of science and in what

it can effectively contribute to society, and at other times to the underestimation and discredit of scientific results. This polarization is exacerbated in post-normal situations, when science is seen as either meeting or failing societal expectations, irrespective of science's validity.
Science should remain within its domain of competence, which is inevitably very limited in terms of the scope of the reality it describes. In post-normal conditions, science tends to lean towards politics, as the political utility of scientific conclusions becomes more important than its scientific soundness, and politics tends to lean towards science, as political decisions are presented as being based on univocal and non-uncertain scientific knowledge. This bending should be corrected. Science should focus on its hard core of competence, recognising that scientists have very deep knowledge but a narrow focus, and politics on promoting open and inclusive decision-making processes, based on science, but taking into account its uncertainties and unavoidable restricted domain. When leaving the territory of science to enter public or policy-making spheres, it is important to humbly recognize that scientific knowledge is very focused and therefore limited, providing only one component of all the knowledge that is necessary to deal with complex problems such as climate change. The definition of public policies and the response to complex societal challenges must therefore involve not only scientists in the field of natural sciences, but also specialists from other areas, including social sciences, as well as stakeholders from different domains and sectors of society, all respecting limitations and forces of each other for a more constructive and democratic decision-making process.

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