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Navigating the Convergence: Science, Belief and the Quest for Truth

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ABSTRACT: This article aims to discuss certain aspects of the relationship between science, truth, and beliefs, focusing primarily on the scientific activity of the biological and medical sciences and their connection to the notions of truth and belief. The relationship with religions will not be addressed. Science uses specific methods to acquire knowledge, and philosophers have analyzed how this scientific knowledge was acquired, trying to specify the approaches and establish some general rules. Some radical theorists have challenged the value of the scientific method, despite the undeniable success of science. Although it is rational, science is not free from belief, which can have a positive or negative impact on the acquisition of scientific knowledge and on the idea of human nature.

KEYWORDS: science, truth, belief, knowledge, methods

Introduction

This article explores the interplay between science, truth, and belief, with a particular emphasis on the domain of biological and medical sciences and their connection to the concepts of truth and belief. It omits the discussion on religion's relationship with science. The piece delves into the specific methodologies employed in science for knowledge acquisition, highlighting the philosophical scrutiny of these processes aimed at delineating their characteristics and formulating overarching principles. It also addresses the critique by some radical theorists who question the efficacy of the scientific method, notwithstanding the numerous triumphs attributed to scientific inquiry. The discourse extends to the intrinsic presence of belief within the rational framework of science, examining its dual role in both facilitating and impeding the pursuit of scientific knowledge and shaping our understanding of human nature (Rotaru 2016, 29-43).

Long before the scientific revolution 500 years ago, science and beliefs played major roles in our societies. Belief systems emerged when humanity lacked the conceptual tools to explain natural phenomena like the movements of the sun and moon, lightning, thunder, or the emergence of life. In search of explanations, people turned to what was most immediate: belief and the supernatural. British biologist and ethologist Richard Dawkins (Dawkins 1993, 256) viewed belief in the supernatural as a mental virus, while others, like French sociologist Émile Durkheim (Durkheim 1912, 300), saw religious belief as a societal structure that acts as a cohesive factor (Dawkins 1993, 13-27).

Religion, as one of the most organized belief systems, significantly influenced science. The example of Michel Servetus (Servetus 2006, 416), a French theologian and physician of Spanish origin, highlights this interaction. In his theological book "Christianismi Restitutio," he discussed the Trinity and Jesus Christ, and proposed the concept of pulmonary circulation to explain how the vital spirit enters the body. This blending of theology and science became less common over time, with figures like William Harvey (Harvey 1628, 262), who established the laws of blood circulation, not referring to such theological concepts in his 1628 work "De Motu Cordis." Science gradually distanced itself from religious influence but remained intertwined with non-religious beliefs.

This article will explore aspects of the relationship between science, truth, and belief(s), focusing on their impact outside the religious context (which involves faith). We will discuss both the positive and negative effects of beliefs on the acquisition of scientific knowledge and the concept of human nature. Additionally, a critique of relativism in the sciences and its repercussions on societal dynamics will be provided.

The Nature of Scientific Activity

This article will focus solely on the natural sciences, particularly biological and medical sciences, where scientific activity is predominantly associated with experimentation. In biological and medical sciences, scientific activity primarily operates through two methods: inductive inference and deductive inference. Inductive inference involves analyzing systematically collected data from experimental setups to formulate hypotheses and concepts, which can then be tested. In contrast, deductive inference starts with hypotheses that are subsequently tested through experimentation.

Causal inference is a key method of inductive inference in experimentation, establishing a causal link between observed facts in an experimental setup using the method of differences. This method was described by philosopher and logician John Stuart Mill, who stated that if an event occurs under certain conditions and does not under others, with all conditions being identical except one, the differing condition is the cause or an essential part of the cause of the observed phenomenon. Simplified, if an experimental system's behavior changes due to a single condition, that change is attributed to that condition. Identifying one distinct factor between two situations implies its causal significance for the event (Mill 1996, 634).

Causal inference requires reinforcement through additional conditions or criteria. The two compared situations must be homogeneous, with the potentially causal agent or mechanism present in one and absent in the other, ensuring no other interfering factors are present during the experiment. Causal inference is a crucial discovery strategy in biology and medicine, enabling, for example, the extrapolation of potential causal connections between molecular alterations and observed phenotypes. It must be supported by other experimental approaches.

Deductive inference from hypotheses is common in sciences other than biomedicine, where a general theory exists from which hypotheses can be derived, such as in physics. In biology, there are no theories akin to relativity or quantum mechanics, but there is a collection of observations and assertions from which hypotheses can be deduced.

Inductive and deductive inferences are closely linked, with inductive inference generating hypotheses that can then be tested deductively. This creates a "chicken-and-egg" situation, leading to debate about the initial driving force. Followers of philosopher Karl Popper believe in the primacy of deductivism over induction, arguing that cognitive processes require presuppositions to analyze generated data. In Popper's deductivist approach, the falsification criterion is key to knowledge acquisition, positing that a hypothesis is closer to "truth" if it can be falsified but remains unfalsified. The limitations of this approach will be discussed later.

The error statistical approach in science evaluates the likelihood of a hypothesis successfully passing tests without assigning probabilities to the hypotheses themselves. Specifically, it examines the probability that a null hypothesis, suggesting no event occurrence, successfully passes a test. A high probability for the null hypothesis may indicate the observed event is not due to the considered causal link. Two types of errors can occur: Type I, rejecting a true null hypothesis, leading to the acceptance of a false alternative hypothesis, and Type II, rejecting a false alternative hypothesis, leading to the acceptance of a true null hypothesis. This approach shares similarities with the falsification criterion, where a theory appears more robust if it has a significant risk of being falsified but ultimately is not.

The inference to the best explanation (IBE) or abduction is particularly useful in biology, bridging the gap between purely causal inductive inference and mechanistic explanations that involve concepts like topology, structure, and feedback mechanisms.

The concept of a "network of cumulative evidence," originating from psychology, emphasizes the convergence of evidence from various methods and approaches to validate a hypothesis or theory, especially relevant in biological and medical sciences. It is crucial that the evidence comes from independent, diverse, and multiple methods, with experimental data potentially supplemented by observational data, which can be incorporated into the cumulative evidence network.

Researchers aim to understand the world and derive useful tools for its evolution, striving to "know the world as it is." This objective is challenged by two perspectives: the ultra-realist view, which neglects the influence of cognitive processes on knowledge acquisition, and the idealist view, which emphasizes that our understanding is shaped by our cognitive apparatus, leading to a perception-bound "average world." Both views have limitations—the ultra-realist view struggles with the complexities of quantum physics, while the idealist view risks subjectivism and relativism. The role of language in science also influences research focus and methodologies, as demonstrated by the naming and initial understanding of biological entities like (*vascular endothelial growth factor*) VEGF (Leung 1989, 1306-1309).

The distinction between "mechanism" and "pathway" in scientific models reflects different levels of analyses and understanding, highlighting the evolving nature of scientific knowledge. Despite the debate, it is recognized that human cognition and the development of tools and interfaces for exploring the world suggest a dynamic interaction between our cognitive faculties and reality, supporting a worldview aligned with ongoing scientific and technological progress (Ross 2018, 551-572).

The beliefs we have discussed are distinct from those derived from cultural heritage, which are tied to myths that humanity has amassed over centuries. These myths often have a "religious" aspect and are found within ideological systems that can sometimes lead to detrimental outcomes. A notable example is the Lyssenko affair, where adherence to communist doctrine led to the rejection of Darwinism and genetics, stifling the progress of genetics and molecular biology (Joravsky 1970, 472).

Myths have been a significant part of human creation, likely emerging alongside the cognitive evolution of Homo sapiens. They serve a social function, providing meaning to the lives of those who believe in them. While myths may not convey factual truths, they can reflect deep-seated existential concerns and reveal profound psychological archetypes, such as those identified by Jung (1970, 680), including personas, heroes, and dragons, similar to characters in Grimm's fairy tales. According to philosopher Kurt Hübner (Hübner 1985, 465), mythological truth remains relevant today, offering a worldview that parallels scientific understanding. Myths, therefore, while not factually accurate, can represent a form of "metaphorical truth" or moral values, which are distinct from empirical truths that can be scientifically tested (Tacey 2015, 285).

The critical philosophical tradition and science

The critical philosophical tradition, started by Scottish philosopher David Hume and German philosopher Emmanuel Kant, spread in the 20th century with the logical empiricism of the Vienna Circle (Rudolf Carnap, Otto Neurath, etc.), (Ayer 1982, 283) and later with Popper (2002, 442), Imre Lakatos, Thomas S. Kuhn, and Paul Feyerabend (Thornton 2017, 3; Musgrave 2016, 457-491; Preston 2016, 79-86). These schools of thought are characterized by their philosophical analysis of the foundations of the sciences and the robustness of the methods used. While Rudolf Carnap developed an inductive logic as a general methodology for the sciences, Karl Popper championed the deductive method as central to science and introduced falsification as a demarcation criterion. Building upon Popper's work, Kuhn and Lakatos critically analyzed their mentor's thoughts. Kuhn perceived scientific progress not as a steady accumulation of knowledge but as a jagged advancement, introducing the concepts of normal science, paradigm, and scientific revolution. Normal science refers to the activities conducted within an exploratory framework set by a pre-existing paradigm. Over time, anomalies that do not fit the existing theory accumulate, leading to a crisis and eventually a scientific revolution, which births a new paradigm for normal science to operate within. Kuhn's concept is relativistic, not ranking the knowledge of one era over another. He suggests that the explanatory value of knowledge is equal across all eras, each corresponding to the evolution of science at a particular time. Kuhn's examples mainly come from physics, but are applicable across all sciences (Kuhn 1996, 212)?

Considering examples from biology, an area Kuhn was less familiar with, such as the circulatory system, raises questions. Can we equate Galenic theory with Harvey's circulatory theory? Certainly not, as Galenic theory was dismantled through experimentation, and Harvey's theory became the foundation of all cardiovascular biology and physiology. It transcends the status of a theory because it is no longer falsifiable, becoming a foundation from which testable theories and hypotheses derive (Harvey 1628, 262).

The question remains: Can we foresee the circulatory theory ever being disproven? And how do we recognize when a theory becomes such a foundational cornerstone?

We refer to a theory as STHD (Solid Theoretical Hard Data) when it has an almost zero probability of being refuted, whether in the near or distant future. This probability is assessed by examining all past occurrences of a property f(x) affecting the object x. As mentioned earlier, STHD can encompass sub-theories and hypotheses. Using the circulatory system as an example again, the demonstration of vertebrates' circulatory system leads to various sub-theories and hypotheses, such as the postulate of a cellular system linking venous and arterial circulation, or the mechanisms involved in transporting oxygen, nutrients, or cells to tissues, and so on.

Regarding the transportation of elements from the bloodstream to the tissues, two theories emerged in the 19th century: the "corpuscular" theory and the "humoral" theory.) English physiologist John Hughes Bennett proposed the humoral theory, which suggested that only the non-cellular part of the blood played a role and could be transported through the vascular wall. Conversely, English physician William Addison proposed a corpuscular theory where solid (corpuscular/cellular) elements could be transported through the vascular wall. These theories were tested, and immunologist Julius Cohnheim demonstrated that cells could indeed traverse the vascular wall (Bikfalvi 2018, 192).

Criticism of relativism

Feyerabend, in his book "Against Method" and other writings, goes beyond Kuhn's ideas. He argues that there is no single method for conducting science, encapsulated by his phrase "anything goes," suggesting that all systems for acquiring knowledge are equivalent. Feyerabend was a complex thinker, and his critique was mainly aimed at those philosophers of science who attempt to establish fixed rules for scientific activity (Feyerabend 2010, 336). While he was critical of both rationalists and relativists, his philosophical anarchism, applied broadly to scientific activity, is considered extremely dangerous by some as it blurs the distinction between truth and falsehood, leading to relativism.

Extending this concept beyond science to societal spheres could lead to resolving differences through power dynamics rather than through the rational exchange of ideas in pursuit of consensus. English philosopher and mathematician Bertrand Russell saw such positions as a justification for fascism (Russell 1936, 225), arguing that the doctrines of modern irrationalists favor will over thought and feeling, intuition over observation and inductive reasoning, and glorify power. The constructivism and relativism of sociologist of science Bruno Latour are similar in vein. In his article regarding Ramses II and the Koch bacillus, he controversially claims that Ramses II could not have died from tuberculosis because before its discovery by Robert Koch (Latour 1998, 112), the bacillus did not have a real existence, illustrating a confusion between identity and concept. Similarly, this line of thinking would suggest that the evolution of species only started when the concept of evolution was formulated, a perspective that conflates the discovery of a concept with the origin of the phenomenon it describes.

Yuval Noah Harari's book "Sapiens," which has achieved undeniable international success, serves as another example of relativism. One of the central theses of the book is that myths are essential to human evolution, positing that it is the creation of myths that defines humanity. Harari extends the concept of myth to include any cognitive construction that represents a real or fictional situation. He equates a highway map with a myth about deities rewarding or punishing us, arguing that while neither are 'real' in the sense of representing tangible objects, they are still profoundly different. For the highway map, belief (or trust in the map) is based on evidence that can be tested (since alternative routes exist), while in the case of deities, evidence is absent. Harari dismisses the concept of truth and how it can be cognitively acquired through experience. This aligns with Feyerabend's "anything goes" stance, which reduces reason to just another tool for understanding the world (Harari 2015, 512).

David Krakauer of the Santa Fe Institute in the United States has a distinct perspective on cognitive evolution. He introduces the concepts of complementary cognitive artifacts (CCA) and competitive cognitive artifacts (CCA), which he considers to be extremely interesting notions. World maps, writing, and mathematics are examples of such artifacts. These artifacts have the potential to alter cognitive structure as they are internalized and do not require a physical medium to function. In this scenario, the artifacts are complementary. Conversely, if the removal of these artifacts results in reduced performance, then they are deemed competitive (Mayo 1996, 509).

Safeguarding against the impacts of relativism on the concept of human nature and within the social domain

Harari extends his relativist discourse to morality, portraying humanism as an additional religion with its myths and a clergy of rationalist philosophers. However, he overlooks that humanism, since Erasmus, has developed as a movement independent of religious dogmas, combining the "golden rule" with a rational outlook. Morality has been built on altruism, empathy, sympathy, and cooperation, which are rooted in "shared intentionality" unique to humans as shown by Tomasello (2016, 2008). For instance, chimpanzees and other great apes collaborate with peers in various contexts for mutual benefit, forming coalitions and alliances for group defense where everyone's participation is in their collective interest. In humans, young children establish social bonds in their early years, showing an awareness of their mutual interdependence. Despite their natural selfishness in many scenarios, they often prioritize collective goals over personal ones, collaborating, empathizing, assisting others, and sharing resources. They also start to assess others based on cooperative behaviors, leading to more selective assistance and sharing later on.

According to primatologist Frans de Waal (2013, 385), the "veneer theory" posits that only education and culture provide a moral framework for humans, suggesting that humans are inherently monstrous and need to be educated and moralized. However, this is incorrect. The notion that morality comes from "within" has been previously articulated by Adam Smith (Smith 2002, 358) in his book "The Theory of Moral Sentiments," and more recently by Frans de Waal (De Waal 2013, 385) and Steven Pinker in "The Blank Slate" (Pinker 2019, 528).

Yuval Noah Harari is criticized for simply echoing the ideas of Counter-Enlightenment theorists, a notion introduced by Isaiah Berlin. This perspective, highlighted in Berlin's chapter "The Counter-Enlightenment," discusses how 18th-century philosopher Giambattista Vico viewed myths not as false realities needing rational correction, as the Enlightenment thinkers believed, but as authentic worldviews. Myths and ancient poetry represent truths as valid as those found in Greek philosophy, Roman law, or modern enlightened culture, offering a unique voice from a distant past. Each culture, through its collective experience, contributes its own authentic means of expression to the human developmental spectrum (Isaiah 1973, 24).

The Counter-Enlightenment gave rise to postmodernism through an unnatural transformation, with a reactionary and traditionalist component aimed at saving and protecting faith from Enlightenment critiques. Interestingly, these ideas were adopted by philosophers from Marxist backgrounds and incorporated into the postmodern framework. The concept of the decolonization of science, and particularly the "Science must fall" movement from South Africa, serve as striking examples of the disastrous societal consequences of relativistic ideas (Lipton 2004, 232). Regardless of political affiliation, irrationality is indeed blind (Nordling 2018, 159–162).

Conclusion

The article offers a comprehensive exploration of the complex interplay between reason, science, and belief, shedding light on how these domains intersect and influence one another in the pursuit of knowledge and truth. It critically examines the methodologies and assumptions underlying scientific inquiry, emphasizing the importance of maintaining a critical perspective on the role of beliefs within the scientific process. The discussion navigates through the historical and philosophical contexts that have shaped the current scientific paradigm, highlighting the challenges and controversies that arise when empirical evidence intersects with deeply held beliefs.

The article further delves into the philosophical underpinnings of scientific theories, the evolution of scientific thought, and the impact of cognitive and cultural factors on scientific discovery (Rotaru 2023, 62-79). It underscores the necessity of a multidisciplinary approach that incorporates insights from philosophy, sociology, and psychology to fully understand the dynamics of scientific knowledge production. Moreover, the article addresses the implications of scientific beliefs on societal values and decision-making, illustrating the potential for science to both empower and constrain societal progress. It advocates for a balanced approach that recognizes the contributions of science to human advancement while remaining vigilant to the limitations and biases inherent in scientific practices.

Ultimately, the article calls for an ongoing dialogue between scientists, philosophers (Rotaru 2005, 34-38), and the broader public to foster a more nuanced and reflective engagement with the complexities of the scientific endeavor. It champions the idea of science as a dynamic and evolving process, one that is enriched by diverse perspectives and open to questioning and revision in the pursuit of a deeper understanding of the natural.

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