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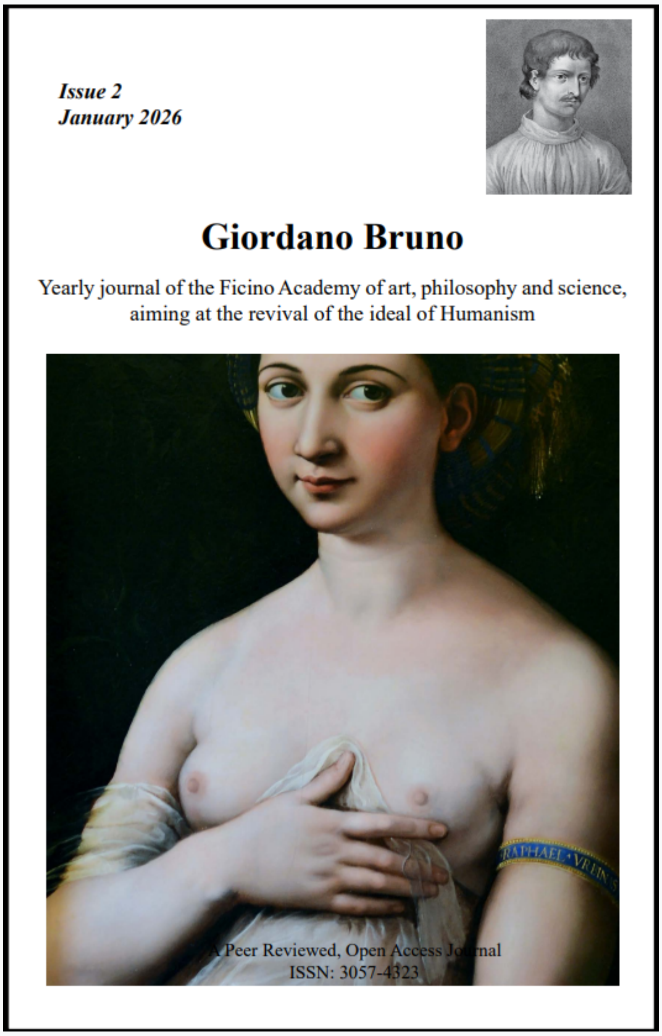

Art and Science Reimagined: Bridging the Epistemological Gap

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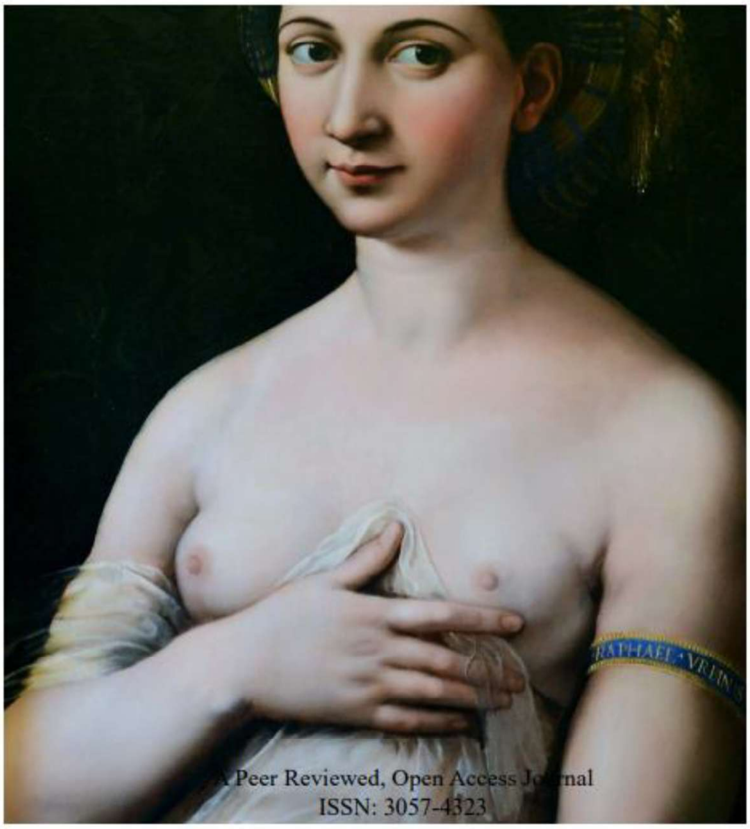

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Art and Science Reimagined: Bridging the Epistemological Gap

Angeliki Antoniou

Department of Archival, Library & Information Studies, University of West Attica

Email: angelant@uniwa.gr

Abstract

Was Da Vinci a great artist, or a great scientist and engineer? Why did he combine two domains, art and science, that today feel separate and completely unrelated? Was it due to a lack of scientific advancement that allowed him the space to explore science alongside the arts, or was it an internal drive that made him believe the two were inseparable? This article envisions the future of science by considering elements such as the prevalence of technology, the rise of artificial intelligence, and the evolving role of humans in the years to come. It is argued that the future of science depends on its integration with the arts, a synergy that fosters innovation and creativity while enabling individuals to achieve a more holistic intellectual development.

Keywords: epistemology, digital humanism, Uomo Universale, future of science

1. The end of the Renaissance Man?

In a world where Artificial Intelligence (AI) may soon take over most forms of human activity, one is left to wonder what the future of science will be. In fact, numerous AI experts predict a 50% probability that AI will outperform humans in every task by 2047, implying huge consequences for personal and societal well-being (Grace et al., 2025). In addition, reports from educational institutions like Stanford expect AI models to autonomously form research hypotheses and critically evaluate scientific findings. Researchers have already developed "Virtual Scientists", AI-powered virtual labs where agents collaborate to solve complex problems. Given these advancements, will there be a place for human activity in the scientific domain, and if so, what form is it likely to take?

The roots of the separation between art and science can be found in the Age of Enlightenment, a period dominated by the analytical-rational model of science (Snow, 1959). During this era, science entered a phase defined by what we can call a clinical approach, where rigorous methodologies mandated the formulation of research hypotheses followed by the collection and processing of data to either reject or fail to reject the initial hypotheses. Science advanced through this "trial and error" paradigm.

Furthermore, rationalism allowed science to break free from prejudice and obscurantism, progressing instead through "irrefutable" scientific data that respected the laws of physics and served as the primary source of scientific progress. Consequently, during the Enlightenment, an absolute commitment to science through rigorous methodologies enabled it to evolve and break free from the prejudices of the past. Simultaneously, the historical context, which drove rapid scientific and industrial advancements, demanded increasing specialization to further accelerate and intensify this progress.

The Enlightenment gave rise to a culture of "useful knowledge" by bridging the gap between natural philosophy and the practical arts. This narrowed the distance between scientists and craftsmen, facilitating the transformation of theory into innovation. The existence of an "open knowledge network" and the application of the experimental method allowed information to circulate rapidly and become accessible for productive purposes. Rationalism and a belief in progress supplanted old prejudices, establishing economic growth as a conscious social objective (Mokyr, 2002).

Consequently, in the name of progress and the liberation from a dark past, science was not only separated from the arts but also fragmented into distinct fields and domains, such as the "soft" and "hard" sciences. The necessity for vertical knowledge and specialization imposed this division for practical reasons; it allowed humans to better direct their relatively limited cognitive capacities within a single lifetime (Jones 2009). By focusing on a specific area, individuals could achieve a deep understanding, enabling them to push the boundaries of that field further.

This idea, the end of the Renaissance Man, an *Uomo Universale* who possessed a global breadth of knowledge, has its roots as far back as the 1600s. By that time, the volume of knowledge already produced had grown so vast that it was practically impossible for a single individual to achieve a deep and thorough mastery across multiple fields of study (Blair, 2010).

One of the most well-known and influential books of the 18th century is that of Adam Smith, in which he analyses how specialization and the division of labour are essential prerequisites for growth and productivity. Consequently, when an individual focuses on a single field, they become significantly more effective compared to someone who lacks a clear orientation in their (scientific) work (Smith, 1776). Therefore, from the 18th century onwards, an artist was an artist, and a scientist was a scientist, and the paths of the two rarely crossed.

2. Leonardo's legacy

After three centuries of human focus on specialization, we can now identify several significant issues that have emerged. As individuals focus on small fragments of knowledge, they seem to have lost the ability to grasp the "big picture" (Jones, 2009). Consequently, innovation is becoming increasingly difficult, which is already leading to serious consequences in fields such as medicine. Imagine a physician who specializes only in one specific organ while ignoring how a particular treatment might affect the rest of the body. Furthermore, specialists often struggle with "out-of-the-box" creative problem-solving because their minds are trained to follow specific, narrow pathways (Dane, 2010). Additionally, modern societies face systemic challenges that cannot be addressed by a single scientific field alone. Specialized approaches often target only isolated aspects of these systemic issues, leaving them unable to address the problem as a whole (Rittel & Webber, 1973). Finally, overspecialization hinders the "cross-pollination" of ideas, sabotaging potential breakthroughs that often arise from unexpected and accidental interdisciplinary encounters (Epstein, 2019).

To address the issue of overspecialization and its negative consequences, interdisciplinarity has been proposed as a potential solution, suggesting that individuals from different backgrounds could collaborate to solve complex problems. However, can true interdisciplinarity actually be achieved? According to Snow (1959), individuals from different scientific domains effectively "speak" different languages (a Tower of Babel); their specialized training often prevents them from understanding one another or working together seamlessly on a given problem. Consequently, what usually occurs is that researchers continue to work in disciplinary silos, attempting to "stitch" their results together only after the work is completed.

Attempting to coordinate an interdisciplinary scientific project often leads to a proliferation of meetings aimed at ensuring all participants are "on the same page," which significantly increases the overall cost of research (Cummings & Kiesler, 2005). Furthermore, there are structural problems inherent in the current organization of scientific activity; there are very few forums where genuine interdisciplinary work can be published (Jacobs & Frickel, 2009). Additionally, research by Bromham et al. (2016) indicates that interdisciplinary funding proposals have lower success rates compared to specialized ones.

Consequently, while interdisciplinarity appeared to be an ideal solution in theory, its true implementation has proven profoundly challenging. However, in the era of Artificial Intelligence, these constraints may no longer apply. Unlike human cognition, AI is not bound by the same temporal or capacity restrictions; it can operate seamlessly across disparate scientific domains, effectively functioning as a "digital polymath" that bridges the gaps, handling vast amounts of knowledge. Can this allow humans to revive the Renaissance polymath?

Historically, the ideal of the polymath is most known by the life and works of people like Aristotle (who worked on biology, zoology, metaphysics, ethics, aesthetics, theatre, music, rhetoric, linguistics and politics), Goethe (apart from a great writer, he also focused on botany, anatomy and physics), as well as Leonardo Da

Vinci (who was a great artist, an anatomist, an engineer, an inventor, a cartographer, a geologist, a palaeontologist, an optic and physics researcher, a botanist, a musician, a set designer, and a hydrologist). What today seems unthinkable, it was the ideal of the Renaissance.

Let us, therefore, reflect upon the trajectory of human intellect in the 21st century, where Artificial Intelligence will enable us to manage vast repositories of knowledge, clearing the path to redefine the polymath for a new era. Consequently, as we are no longer required to exhaust our cognitive resources on mastering hyper-specialized knowledge, is it perhaps time to contemplate new domains of action?

3. An airplane made of butter

Alan Dix, a prominent figure in Human-Computer Interaction (HCI), has famously argued that "bad ideas" are essential to the creative process. His perspective is that in a world governed by optimization and "good design" rules, we often get stuck in local maxima, small peaks of efficiency that prevent us from seeing much larger opportunities. He argues that pressure to produce "good" ideas immediately stifles innovation. A bad idea could function as a stepping stone, containing an element of a revolutionary concept that a "safe" idea would never reveal. By understanding why a bad idea is bad, designers become more aware of hidden assumptions that might limit creativity. In addition, producing bad ideas for design promotes a culture that allows wild ideas to emerge and fosters fluid brainstorming (Dix et al., 2006).

Dix introduces the "flawed idea" as a means for designers and scientists to think outside the box, thereby boosting innovation and creativity. This novel scientific embrace of the unexpected and the unthinkable aligns closely with artistic movements such as Surrealism, a realm where an airplane made of butter makes perfect sense.

It appears that the essential elements of both the arts and sciences are imagination, natural curiosity, and the ability to observe in depth. While these concepts are naturally inherent in the arts, they are equally fundamental to scientific inquiry. Popper (1959) underscores the importance of imagination in scientific thinking, arguing that it is crucial for moving beyond the obvious and the expected. To achieve breakthroughs, scientists must "see" beyond the raw data and proceed with a creative leap of the mind. Furthermore, curiosity is biologically embedded in the human brain, closely linked to the learning and problem-solving processes essential to scientific efforts (Gruber et al., 2014).

Much like artists, prominent scientists train themselves in the art of observation, seeking to identify patterns that most would otherwise overlook (Daston & Galison, 2007). This rigorous observation of human life and activity is central to both the social sciences and the Realist movement in art. Similarly, profound powers of observation are essential to movements like Naturalism, where photographic precision is employed to depict the raw elements of the natural world. Furthermore, science transcends mere observation, requiring researchers to interpret the phenomena they witness. This mirrors artistic schools such as Impressionism, where artists move beyond literal observation to interpret the world around them through their own perception and light. Consequently, it appears that both scientists and artists require similar training and possess fundamentally comparable skill sets.

4. Dancing big data

Why would someone choose to "dance" big data instead of simply analysing it? Is this a "bad" idea that, following Dix's rationale, could transform into a brilliant one? Columbia University certainly suggests so. In the article *"An Engineer Tap-Dances His Way to Tackling Big Data,"* it is described how an engineering student utilized dance to internalize the mathematical modelling of massive datasets. Art, in this context, is used to help individuals comprehend complex scientific concepts, providing them with unconventional tools to navigate them. Furthermore, artistic techniques are increasingly employed to visualize complex scientific data in fields such as genetics, astrophysics, and mathematics.

Bridging the gap between art and science, a work by Charitos et al. (2019) utilized urban data, such as air quality and noise levels, to transform raw information into a cohesive artistic experience. These data were presented to the public as a multisensory, immersive installation, making abstract environmental metrics tangible. Similarly, Holmquist and Skog (2003) utilize the term "informative art" to describe information visualization efforts where artistic principles are employed to represent diverse datasets.

This shift explains the emergence of STEAM (Science, Technology, Engineering, Arts, and Mathematics) as an evolution of the traditional STEM model, arising from a societal realisation that the arts are indispensable to innovation. Consequently, educational programs have been developed to train students across these integrated fields, viewing them as essential for professional success in the 21st century (Yakman, 2008; Maeda, 2013). Research indicates that students trained in STEAM demonstrate improved problem-solving skills and spatial reasoning, alongside significantly increased motivation levels (Root-Bernstein & Root-Bernstein, 2011).

Furthermore, the arts are profoundly influenced by scientific advancements, a relationship clearly demonstrated by the emergence of Bioart. This field allows us to experience the natural world in unprecedented ways; for instance, the work of Tarun Nayar translates the bio-electrical pulses of mushrooms into audible music. Similarly, in her project *Stranger Visions*, Heather Dewey-Hagborg creates realistic 3D portraits of individuals based on DNA extracted from discarded items, such as cigarette butts found on the street. These examples illustrate how scientific methodology can be repurposed to create provocative and meaningful artistic narratives.

5. Is Epidaurus a theatre?

Most people identify Epidaurus in Greece primarily as a famous ancient theatre. However, it was originally a renowned centre of healing in antiquity, attracting people from across Greece and the Roman Empire who sought treatment for various health conditions. Why, then, is a massive theatre situated at the heart of a medical centre? This configuration exists because ancient wisdom did not separate the arts from the sciences as rigidly as we do today. What we now explore as "alternative" medicinal practices, such as art therapy, were standard protocols in the ancient Greek world. In Epidaurus, the theatre was utilized as a vital therapeutic tool, with drama and performance serving as essential components of the holistic healing process (Gesler, 1993).

Recent scientific developments in psychology, medicine, and neuroscience demonstrate the vital importance of the arts for human well-being and their profound role in therapeutic practice. Significant improvements have been observed in both cognitive and affective functioning when artistic interventions are utilized to treat various conditions. These include neurodegenerative diseases such as dementia (McDermott et al., 2013), mental health challenges (Stuckey & Nobel, 2010), chronic pain (Fancourt & Finn, 2019), and cardiovascular conditions, among others (Mandel et al., 2007).

In fact, the arts provide multifaceted benefits for both clinical patients and healthy individuals. Music has been shown to enhance brain functioning and increase neuroplasticity (Olszewska et al., 2021), while simultaneously improving emotional responses (Sloboda & O'Neill, 2001), memory function (Musliu et al., 2017), and motor control (Altenmüller et al., 2006). Similarly, painting and the visual arts strengthen the prefrontal cortex, thereby improving decision-making and focus (Bolwerk et al., 2014) while significantly reducing stress levels (Kaimal et al., 2016). Finally, dance, beyond the obvious physical benefits of movement, increases hippocampal volume, which consequently enhances memory and spatial navigation (Teixeira-Machado et al., 2019). Thus, the arts can be effectively coupled with the sciences for the wellbeing of humans.

6. Complexity and ethics

Hopefully, it has been established that the arts provide multifaceted benefits for both individuals and society when coupled with scientific disciplines. Training scientists in the arts allows for the management of complexity, as artistic practice enhances intuition and encourages a holistic approach to problem-solving. For instance, can the arts empower us to address "wicked problems" such as climate change, social cohesion, and pandemics? When complexity renders these issues difficult for the human brain to comprehend, art downscales these phenomena into tangible, sensory experiences. For example, allowing the public to witness Arctic ice melting in urban spaces helps them internalize the abstract reality of climate change (e.g., Eliasson's *Ice Watch*). Such artistic works raise public awareness and catalyse engagement (Roosen et al., 2018). Furthermore, the visualization power of the arts helps people recognise patterns in their own behaviour and understand how those actions directly impact the global climate.

Finally, artists serve as a society's conscious voice. Art provides a mirror that allows us to reflect on our collective actions, both our triumphs and our failures. Artists often cultivate a sense of moral vigilance, transforming artistic expression into a profound political act. In a world where technology forces us to rethink ethics and reconsider the boundaries of morality, art becomes an indispensable tool for fostering empathy and introspection. Ultimately, the future of both society and science lies not in the mere collection of data, but in its innovative synthesis, an endeavour that is, at its core, an artistic act.

Thus, it is argued here that human society is moving beyond the era of rigid separation and specialisation. As the prevalence of technology, and specifically AI, allows for the management of vast amounts of data, humans are left with the opportunity to rediscover and redefine the boundaries of science and art, effectively redefining their own existence. The ideal of the *Uomo Universale* is now more relevant than ever, evolving into a new archetype: the digital polymath.

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