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Towards sustainable conservation science in cultural heritage: bridging the gap between contemporary conservation theory and the philosophy of science in approaches to authenticity questions

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As contemporary artists' practices evolve to incorporate ever-newer forms and approaches, conservators are encountering challenges not met before, that influence the development of sustainable and green treatment methods and materials. Many challenges stem from how we understand and articulate authenticity and cultural heritage. In approaching authenticity, the conservation field seeks to rely on reliable knowledge, supplied by science that has been playing an ever more critical role in conservation and technical art history. While conservation science techniques are relatively well-known to conservators, the foundational ethos of the scientific inquiry that distinguishes science from other intellectual pursuits needs to be clarified. Exploration of the foundational ethos of science and the philosophy of science has lacked in conservation, which creates communication problems for stakeholders with different backgrounds: curators, conservators, art historians, and scientists, who operate in different realms, but need to produce knowledge across disciplines and collectively. To bridge this knowledge gap in authenticity questions, the authors take the perspective of the philosophy of science and discuss what makes the scientific inquiry distinct from other intellectual pursuits in the context of conservation. As a workable solution for cultural heritage, the authors propose adopting a concept of scientific attitude as a science demarcation criterion, introduced by Lee McIntyre. The new demarcation criterion, based on values rather than methodology, offers a sustainable approach to defining the role of present-day science in cultural heritage and building sustainable connections with diverse frameworks of knowledge used in conservation and authenticity questions.

KEYWORDS

sustainability, authenticity, philosophy of science, cognition, cultural heritage, conservation

Challenges in articulating authenticity in art conservation

The twenty-five-hundred-year-old Zeno's Arrow paradox, a thought experiment proposed by the ancient Greek philosopher Zeno of Elea, states that an arrow in flight is at rest at any given moment, and motion is impossible. To the present day, Zeno's paradox does not have a logical resolution, as we experience motion and arrows do fly. Zeno argues that at each instant, the arrow occupies a fixed space equal to its length. If we depart from a notion, that time is composed of instants (or "nows"), and the arrow is motionless at each one, the arrow cannot be moving at all. The paradox cannot be definitively solved as it challenges our intuitive understanding of infinitely divisible (discrete) space and time. The true problem here is not the motion, but how we understand and articulate space and time on which the understanding and explanation of motion depends. Calculus and the theory of limits provide a framework to handle infinitely small intervals and sums, allowing one to articulate the continuous motion of the arrow and its eventual arrival at the target, even though it passes through an infinite number of points on its way. In essence, while the paradox may seem puzzling on an intuitive level, mathematical and scientific theories have provided tools to comprehend and work with such concepts, providing solutions within the framework of these theories.

The same challenge applies to the articulation of authenticity in art. As contemporary artists' practices evolve to incorporate ever-newer forms and approaches, conservators and conservation scientists are dealing with challenges not met before. Most seem to stem from how we understand and articulate authenticity, but in reality, they stem from how we understand the work of art, the artist's intent, and the role of the beholder, the interaction on which the notion of authenticity depends. Despite being a frequently discussed topic in conservation theory and a hallmark of any treatment, authenticity continues to be used as a nebulous term, a phenomenon without an accepted conceptual reference frame or framework, similar to the standard model in physics.

Arguably, the core difficulty of developing such models is rooted in the nature of the work of art and the authenticity inquiry, where the knowledge must be produced and processed across diverse disciplines and collectively. For communication, it is essential first to define the realm of inquiry, as different disciplines tend to articulate the same phenomena in equally correct, incommensurable ways. For example, if a cat falls from a couch, a physicist may ask, "How fast," while a biologist might ask, "What does it feel?" and the answer from physics would be meaningless in biology. This simplification seems self-evident, but in practice, it creates a great deal of confusion in authenticity questions that include both the material fabric of the artwork, subjective human experiences, and social constructs, such as shared beliefs on artwork's values, meaning, and purpose, and defining clearly the realm of inquiry is paramount. In approaching authenticity questions, the conservation and technical art history field tends to be scientific, and conservation science is an established and practiced field, trained at the university level, with its institutes, journals, and dissemination sources.

Because of its epistemic authority, scientific evidence is highly desirable by multiple stakeholders in collection management and care, tasked with responsibility for the conservation, condition, and display of the artworks. The clarity over the realm of inquiry is critical where stakeholders with different backgrounds and mindsets: conservators, art historians, and scientists, need to collaborate and produce knowledge across disciplines and collectively. To quote W. Oddy: "However wonderful the discoveries of the conservation scientists are, if they fail to communicate them to the conservators, they have wasted their time" (Oddy 1997:76). However, while conservation science methods and techniques are frequently discussed in professional meetings and taught at the university level, the foundational ethos of science is not. Two major ICCROM conferences (Bologna 1998; Rome 2013) were organized to define conservation science's role, but the foundational ethos of science was not discussed at all (ICCROM 2000; ICCROM 2015). Without a discourse over the disciplinary matrix of science, it is challenging to clarify to diverse stakeholders in the field how science works, what it does, why its claims are justified (Elliott 2022), and how it could be applied to authenticity questions.

Is science a correct tool of inquiry for the authenticity of art questions?

In most general terms, authenticity refers to the true identity of the artwork or other cultural heritage object. Since the term authenticity was coined by Walter Benjamin in 1935, articulation has remained undefined, and in the context of identity and change, the debates of Ancient Greek philosophers over the identity of the ship of Theseus. This paradox explores whether an object (a ship) with all its components replaced preserves its identity. The traditional paradigm, where authenticity has been intrinsically linked with the material fabric of the artwork and documented history, has shifted towards individual subjective experiences since the Nara Document of Authenticity (Nara 1995), which resonated with J. Dewey's concepts (Dewey 1934), where he departs from the notion of an artwork as a physical object, and compares it to an active process, a language, using triangulation between the speaker (the artist and his intent), the thing said (the art product) and the audience (observer). Dewey ideas echoed in N. Goodman's concept shifting the question from "What is art?" to "When is art?" (Goodman 1978:57), and the work of art is instead "a working of art" rooted within subjective non-repeatable experience, a concept that was influential in C. Brandi's theory (Brandi 1963:32) and in contemporary art conservation theory. The updated 2019 decision-making model for the conservation of contemporary art defines authenticity as "the degree to which an individual or group regards a physical assemblage, event, or experience as a manifestation of the work of art it purports to be at a particular point in time" (Giebeler, Heydenreich, and Sartorius 2019). It appears that authenticity is not an innate quality of artwork but is instead a set of shared or individual beliefs on values, purpose, and meaning. This raises the question of whether science, which does not answer the questions on values or purpose in principle, is a correct tool for such an inquiry.

A look into the rational foundational of science and the philosophy of science

At their foundation, scientific approaches to authentication, for instance, conservation science imaging and analysis, which we use in conservation, are based on a philosophical approach, which makes it different from other intellectual pursuits. It requires faithfulness to

facts, freedom from values, and the absence of personal bias, and the results should be observable, repeatable, and measurable. This poses fundamental limitations in approaching conscious experiences, such as seeing, hearing, feeling, and thinking: all essential in the enactment of contemporary works of art. As noted earlier, it is critical to define the realm of inquiry when approaching authenticity questions, and when using scientific knowledge, it is essential first to understand what is so special about science as a way of knowing. For this, integrating the philosophy of science with conservation theory would foster the building of missing explanatory bridges between science, conservation theory, and authenticity questions. Over the 20th century, the philosophy of science has been a significant field of study that aims to provide a logical, rational reconstruction of the process of science and is concerned with the very definition of what science is, what scientists should try to accomplish, and how science operates both in theory and in practice. At a fundamental level, the definition of science seems simple: a focused, systematic, and organized way to reveal nature and know the world. However, the actual rational foundation of science is incredibly complicated, and it has been a subject of lengthy discussions during the 20th century, known as the "demarcation problem," and debates going back to Aristotle's attempt to differentiate between knowledge and opinion. One of the most common misconceptions is that science follows a distinctive "scientific method" methodology. The "method" frequently depicted in science textbooks as 5-6 steps: *observe* > *hypothesize* > *predict* > *test* > *analyze results* > *revise hypothesis and start again*, is an oversimplification, which does not correspond to the history of scientific discoveries, and perhaps the only thing that disagreeing science philosophers agree upon is that such a "scientific method" does not really exist (McIntyre 2019:9). Overall, the 20th-century philosophy of science has struggled to produce diverse models to define science by specific methodology, such as logical positivism, social constructivism, Popperian demarcationism, etc., The models were largely incompatible and succeeded mainly by leaving something behind, which meant only a partial description of science.

For example, logical positivists, who strongly influenced the present-day ethos of natural sciences and were perhaps the most important school from the early 20th century until the 60 s–70 s, claimed that at the foundation of scientific methodology, there was an empirical verifiability of meaning. If nothing could connect a statement to empirical experience, it had no meaning at all. The insistence on the verification of everything turned out to be an impossible mission, especially when the inquiry was related to subjective human experiences in psychology, sociology, or economics, and the school came to an end when logical positivists realized that some of their statements could not pass their verification tests (Jylhä et al., 2023). In contrast to logical positivists, Karl Popper sought a solution to the demarcation through his falsifiability approach. He disagreed with the existence of a "scientific method" in principle and claimed that scientific truths are not those that have been proved to be true but those that could not be proved wrong. All scientific truths must remain disprovable or falsifiable in principle. Theories that could not be falsified, such as astrology or creationism, were pseudoscience. Falsification worked well for physics but was too simplistic for sciences that relied on human experiences and explanatory hypotheses, such as sociology, economics, etc. The further a discipline was from physics; the less progress can be explained by falsifications. An alternative was proposed by Thomas Kuhn, who felt that although Popper was correct to abandon the idea of the scientific method, one should probably also give up on the idea that there is any distinctive methodological difference between science and nonscience. He considered that the distinctive feature of science is solving puzzles and evolving thought-revolving paradigm shifts. Under normal circumstances, what he called normal science works under an established set of rules for solving day-to-day "puzzles," which guaranteed the solution. He called this process a "mopping up." However, with time and more experimental data, anomalies tend to accumulate. First, they are ignored, denied, or corrected. However, over time there are too many to be ignored. This leads to a crisis in science when the dominant paradigm does not work anymore. It can last for decades until the new paradigm starts to emerge, solves the discrepancies, and the science goes back to day-to-day "puzzle solving" and "mopping up." In contrast to the above approaches, Paul Feyerabend, known for his anarchist "anything goes" views on the ethos of science, claimed that every scientist is free to invent their concept and defend it. There are no universal rules for scientific discoveries. According to Feyerabend, major discoveries, such as Copernicus' revolution, were virtually impossible had the scientists followed the established paradigm.

From distinct methodology to distinct values: scientific attitude as a demarcation criterion

As noted earlier, based on unique methodology, these and other science and nonscience demarcation models allowed for only a partial description. Methodology-based approaches failed, as the practice once again showed that scientists do not follow the steps prescribed to them by science philosophers (McIntyre 2019:47). This, however, does not mean that there is nothing special about the privileged epistemic status of science. Perhaps, as proposed by Lee McIntyre, what is unique about science is the attitude and values to which scientists adhere in their research, not the methodology. He proposed using the concept of scientific attitude as a new demarcation criterion based on two simple aspects: care for empirical evidence a) and willingness to change its theory in the face of new empirical evidence b). McIntyre notes that what matters for the inquiry to be scientific is not whether the claim is falsifiable but whether scientists seek to falsify it. The scientific attitude approach offers a flexible matrix for science in technical art history and conservation and allows to clearly articulate the problems and the realm of inquiry, which questions could be answered with science, which require other intellectual pursuits, and which, as typically happens in practice, require input from diverse frameworks of knowledge (Martini et al., 2022; Todd et al., 2022). For example, scientific inquiry relies on empirical evidence, which must be independent of an individual observer. However, how to investigate the experiential authenticity of a work of art or working of art, according to Goodman, which is inherently subjective? The empirical evidence-based approach, central to scientific inquiry, poses fundamental limitations investigating all subjective experiences, in Cartesian terms summed up as qualia: seeing, hearing, feeling: all essential in perceiving and experiencing a

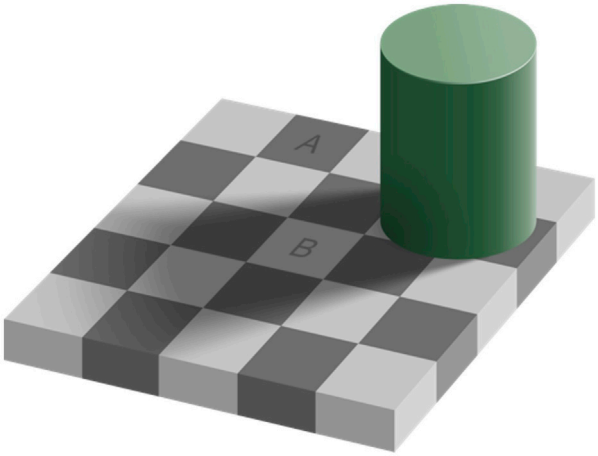

FIGURE 1
Adelson checker shadow illusion. Image: Wikimedia, under a CC-BY 2.0 license.

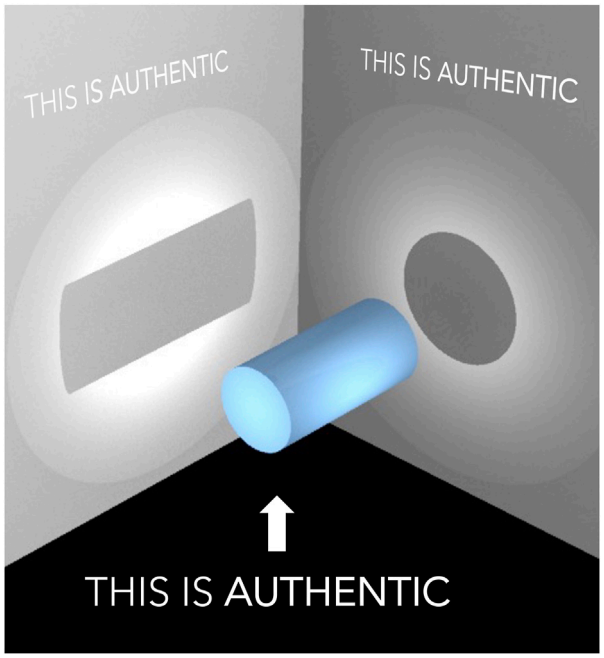

FIGURE 2
Authenticity illusion.

work of art. As in the previous example with the cat, there can be incommensurable findings and discrepancies between empirical scientific data and what is actually experienced by the observer. This challenge goes back to Aristotle's struggle to differentiate knowledge and opinion (Miller 2013) and in quantum physics to Bohr and Einstein's debate on the nature of reality depending on who is looking (Bohr 1935), to the present-day physics findings that *alternative facts* may exist in the physical realm (Proietti et al., 2019), which is fundamentally influenced by life (Lanza 2020).

An excellent example of a discrepancy between scientific data and subjective experience could be the sound paradox of Laurel and Yanni. Around half of the people will hear the same sound as Laurel and others as Yanni (Pressnitzer et al., 2018). The same applies to optical illusions, such as the Adelson checker shadow illusion, where the A and B areas are of equal luminance (measured using colorimetry) but humans experience them differently (Adelson 1993: 2042-4). And if this analogy is used for the color assessment in paintings, which color is the authentic one? (Figure 1). In cognitive science, it is well acknowledged that sounds, like colors, are experiences and exist in the human mind only. However, if they cannot be measured empirically, which one—the measured or the experienced—is authentic? Perhaps, the answer will always remain in the eye of the beholder (Figure 2) (Schwan et al., 2020). This resonates with Martin Kemp's approach, where he emphasized the separation of scientific and art historical approaches to authenticity questions as two distinct ways of knowing, which characterize the artwork in incommensurable ways (Kemp 2013:8).

Conclusion and discussion

In summary, contemporary conservation theory faces new challenges relating to the undefined role of scientific inquiry in questions of authenticity, which may be linked to establishing authorship and making decisions on treatment choices and preservation strategies. From the perspective of the philosophy of science, scientific truths are NOT those that have been proven to be true, but those that could not be proved to be wrong, and all scientific truths must remain falsifiable, according to Karl Popper. Thomas Kuhn denied that science is approaching any truth, and in Popper's words, "the game of science is without end." Notably, science cannot answer questions about subjective experiences, values, meaning, and beliefs, which it might illuminate but does not aim to answer. In practice, the decisions related to authenticity are made based on the combination of consistent factors from diverse frameworks of knowledge and involve multiple stakeholders: art historians, conservators, and scientists. To fully exploit the potential of science, it is indispensable to understand the foundational ethos of science. Integrating the philosophy of science into conservation theory and training conservators and technical art historians would create explanatory bridges and foster understanding. The McIntyre concept of scientific attitude offers a flexible value-based demarcation approach for conservation, much needed to address the real-world authenticity questions that cannot be answered solely on the material level and require non-scientific inquiry to approach questions that cannot be approached through science. In practice, this combination is frequently implemented in technical art history studies, where scientific methods and the conservator's or art historian's "eye judgment" and expertise determine the authenticity of the artworks in question, combining diverse modes and languages of inquiry. While we intuitively use both scientific and non-scientific frameworks of knowledge in synergy, articulating the foundation ethos and the realm of inquiry, using the philosophy of science will bridge the gap between complementary ways of knowing in science and humanities, making us more comfortable with the discomfort of uncertainties and limitations, unavoidable in the real world.

Data availability statement

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

Author contributions

TM: Conceptualization, Writing–original draft, Writing–review and editing. NO: Conceptualization, Writing–review and editing, Writing–original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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