

# ART ↔ SCIENCE RELATIONALITIES

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As science moves away from single disciplines into research that combines multiple scientific fields, we seek to discuss the possibilities of a multi-perspective approach reminiscent of Stenger's *ecology of practices* where science and the arts provide differing perspectives that can be brought into dynamic relationality.

Research and practice that explore relationships between art and science have been around for a very long time. As a subgenre of the artworld, these works and related questions are currently showing a renewal of interest. Are we simply experiencing a transient period when the frontiers between disciplines become more porous and allow for a better mutual comprehension or are we experiencing a real game-changing scenario similar to one of these paradigm shifts described by the epistemologist Thomas Kuhn?

Although initially suggesting the presentation of a taxonomy of the different relations between the Art(s) and Science(s), we have realized in our discussions that such an undertaking would call for a vast study, much broader than what we can actually address here. Nevertheless we will try to articulate a series of operative relations and explore their qualities— this is what we have termed *relationalities*. We have immediately found that each of us represent a quite different understanding of these relationalities and works of art that arise as examples of this juncture. Thus this paper will be an embodiment and synthesis of a dynamic dialogical process, sometimes synthesizing and sometimes pointing to difference. In general both of us see a difference between the practice of Science and Art. If we here adopt a position that does not take for granted that art and science are simply *two different names for the same practice, approach or activity* as sometimes claimed by the proponents of Art-Science bridging, we also believe that these domains of inquiry, seen quite separately by default, can sometimes be brought together when a conviction is established that the disparate pieces can be merged in the service of a new practice.

There has been a certain dose of play in our approach. We both believe this component is common to both art and science. Aspects of creativity are also central to both but are manifested in very different ways in general as part of their practices e.g. in science creativity might become manifest in how one approaches or frames a research problem. This work should be considered a stepping stone toward a more systematic undertaking. We have ended-up here with an initial collection of relationalities between Art and Science that one might call variations on a theme. We seek to let these entries talk and negotiate between each other, exemplifying a dialog between shots from different angles or perspectives. Drawing on Stengers' *ecology of practices*, [1] one might see here an ecology of co-existing relationalities. We typographically coined Art ↔ Science to encompass a wide range of possible relations.

Art (=∃∩≠≤≅) Science?

Having in mind a target rubric Art ↔ Science, we posit a series of overarching concerns explored under this label. A seminal book outlying one period of works is the late Stephen Wilson's Information Arts and

related website. [2] Here Wilson provides a unique set of categories that comfortably intersect with ours below:

- the development of new forms of artificial intelligence and computational practices;
- the exploration of robotics;
- the creation of intelligent environments;
- the exploration of consciousness studies;
- the study of science as it relates to understandings of the body;
- the development of new forms of interface and sensing modalities;
- the creation of new experience focusing on phenomenology, interactivity and intra-activity;
- the exploration of new materials born of scientific inquiry;
- the abstraction of particular material practices in the service of art and architectural production — e.g. biological processes, physics, and nanotechnological processes;
- the exploration of new technologies for artistic purposes — e.g. locative media, virtual reality, augmented reality, etc.;
- the use of game strategies;
- language games / mathematical games and instantiations of knowledge/concepts through play;
- the employment of media archeology / variantology and its relations as art content;
- the mining of the history and philosophy of science as subject matter;
- the exploration of databases and/or data mining;
- the employment of visualization strategies and/or the abstractions thereof;
- the use of telematic and locative potentials;
- the interest in emergence, generative strategies and dynamic/non-fixed works of art;
- works of social and cultural critical reflection focusing on scientific issues;
- political reflection critiquing scientific research;
- creativity and innovation arising out of scientific inquiry.

Each of these categories can easily be populated with a group of examples. A question that naturally emerges is whether we encompass more or less any form of Art in general, in terms of Art  $\leftrightarrow$  Science practice or not. Our short answer is no: when art is informed by science by using its materials, technologies and paradigms it expands the possibilities of creation (e.g. using new materials created by physicists or scientific concepts) and simultaneously becomes tinged with what we might call a scientific *color*.

Our question actually bifurcates: (1) can a given work be of art and of science at the same time - Seaman believes yes, where Perriquet is much more circumspect; (2) can 'any' work be described as an Art  $\leftrightarrow$  Science work - we would both say no. The physicist and philosopher Lévy-Leblond raised an interesting negative voice and argued in a recent essay [3] that the artistic approach and the scientific approach are different in nature and do not consist of a single genre, that this separation is constitutive of each field and condition of its reception. This has also been a debate between us. While Roger Malina, one of the most outspoken contemporary proponents of Art  $\leftrightarrow$  Science bridgings, published a recent rebuttal to Lévy-Leblond's text, [4] Jacques Mandelbrojt, co-editor of the Leonardo Journal, also remarked that it offers "*a point of view different from that which usually prevails in Leonardo, and it can make [the readers] find their own path by comparing those two points of view.*" [5]

We agree with the idea that neither art is a part of science in general, nor science a subset of art, nor science and art are two names for the same activity. But we adopt a softer position, considering that some works may be of art and science at the same time. Seaman defends the idea that, properly contextualized, "*science = proto-conceptual art*" while Perriquet would perceive a mix of genres only in specific

works (but appreciates the hidden and subtle recursivity of Seaman's artistic equation). Seaman's collaborative book with the scientist Otto Rössler, *Neosentience | The Benevolence Engine*, [6] exemplifies this equation. Seaman calls this approach Recombinant Informatics, exploring a multi-perspective approach to knowledge production. A methodology to investigate the meanings of a mixed-genre work, can be taken up by observing it through artistic glasses as well as through scientific lens (additionally works can also be addressed from other disciplines e.g. the humanities). Wearing these alternating lens provides differing perspectives, resulting in different discourses on the same object or experience.

Works of art-science collaboration may end up in differing output arenas, where the scientist might publish about what they take away from an art-science collaboration in a journal or book chapter, the artist may manifest the result in an exhibition, installation or other form. Concretely, daily scientific productions are mainly publications, addressed to colleagues, and subject to peer-review, whereas artworks are intended for an audience that is not usually made up of artists alone. Framing a work as Art and Science at the same time implies some specificities, such as targeting a public (this is not the usual goal of scientific research) or questioning tacit scientific standard that we may roughly gather under the banner of objectivity. An artist has a right for raising a much more subjective voice: by claiming "*this is an artwork*", his work becomes indeed an artwork, as per trans-substantiation. There is no similar option in science. Non-orthodox researchers such as Wilhelm Reich or Emile Benveniste, among many others, were excluded from the scientific community at their time for non-conformity with the constitutive rules of science. This inclusion / exclusion framework is a bit caricatural: Art also sets tacit rules for the cooperation of its members, and objectivity in science is a complex and widely discussed concept, having a History and assumably different meanings in hard and soft sciences. This example, however, outlines just one variable in the tricky *equation* the community possibly emerging at the intersection would have to solve.

Science ⇄ Art ⇄ Science ⇄ Art ⇄ Science ⇄ Art

Art seems non-linear in its historical progressions. Scientific knowledge, in comparison, is cumulative, there is a notion of progress that is not so pregnant in art. This point could be discussed, though: one cannot address the question of randomness in art after the drippings of Pollock or the question of the unconscious after the works of the surrealists as if nothing was already done. Whether we call it progress or not is a subtle debate, but at least an artist knows that he/she does not start from scratch. History plays an important role in art, in appearance maybe more so than in science. A physicist, a mathematician or a biologist may be trained only with recent formulations of physics, math or biology and have only a reduced knowledge of the History of his discipline (we imagine that the revolutionary figures, in contrast, always know the History of their science). Art and Science practices must contend with this perhaps subtle difference between art and science in terms of progression.

Certainly science has a different epistemological background related to its concrete functioning – the study of knowledge and its methodologies for justifying its belief. We can explore this from multiple perspectives in the writings of Bachelard, Latour, Kuhn, Feyerabend, Popper and Stengers.[7] We here orient our focus on the work of Kuhn, whom we find illuminating for our concern (a critical discussion on the relative positions of the former epistemologists is beyond the scope of this paper). When arguing that science does not explicitly articulate its rules but functions instead according to *paradigms*, Kuhn offers a conceptual apparatus for ongoing change. We might compare this to the notion of the avant-garde in the arts. Normal science, says Kuhn "*does and must continually strive to bring theory and fact*

*into closer agreement, and that activity can easily be seen as testing or as a search for confirmation or falsification."* [8]

Where science must uphold strong standards of truth - here labeled falsifiability (Popper's concept) - art is more open in its strategies and relation to the truth. The famous quote "*art is the lie that tells the truth*" from Picasso, illuminates the complexity and perhaps polarity to that of science in terms of the relations that art explores in the domain of practice. Art has this potential to extend the traditional boundaries of Truth and we provide the hypothesis that there is a similar expansion of logical truth which is at stake when in mathematics one thinks of a visual demonstration of elementary geometry or a computational proof in number theory. This conception and the subsequent debate or controversy it stimulates could be compared to the contemporary understanding of what an artwork is, after Duchamp. Witness here Duchamp's ideas surrounding a *playful physics*. [9] While a painting includes the viewer's gaze in its definition, a contemporary proof (as many contemporary artworks) may include the viewer's cognitive faculties within its boundaries. Interestingly, Hans Diebner who has also worked and written exploring art and science relationality, has defined a new approach to scientific inquiry he calls Performative Science. [10] His work explores in part complex systems and suggests that certain results are time-based and not repeatable. He is deeply interested in a proto-hermeneutics. This is an example where the performative notion relevant to the arts functions in the service of scientific inquiry.

( Art → Science ) & ( Art ← Science )

Scientific knowledge is traditionally organized hierarchically: is it inherent to its nature? For example, in mathematics, it is hard to start teaching to a student what the cohomology of finite groups is, if he/she does not even know what a group is in the mathematical sense. It may simply be difficult to understand the need for the invention of such a structure without a prior manipulation of different kinds of simple operations in various contexts (multiplication on numbers, rotations in geometry, etc.).

Bourbaki, a collective pseudonym standing for a group of mathematicians of the 20th century, wrote a series of books presenting an exposition of modern advanced mathematics. With the goal of founding all of mathematics on set theory, the group strove for rigor and generality. Each volume starts with an introductory explanation: "*The method of exposition we have chosen is axiomatic, and normally proceeds from the general to the particular.*" [11] and also, with a possible coefficient of irony (ranging from zero to one, up to the reader's beliefs), "*In principle, it requires no particular knowledge of mathematics on the readers' part, but only a certain familiarity with mathematical reasoning and a certain capacity for abstract thought.*" There exists a propensity to organize scientific knowledge hierarchically. Yet, it is interesting to think about how Science might gain from Art at this level: finding a different way to organize and access its knowledge, as well as a means to stimulate insight and new knowledge production through the potentials of association and juxtaposition.

In exploring the relationality of language used in the service of Art ↔ Science Relationalities, language should be understood in the broadest sense: there is an intimate relation between a given language and its potential expressiveness. The limits of language, for Wittgenstein as discussed in the *Tractatus*, [12] indicate and set the limits of thought, or the limits of a particular world circumscribed by these thoughts. Mathematicians often use words as simple as group, field, action, natural transformation, etc. to name high level abstract algebraic objects: what is at play here is the complexity of the concepts this language embodies (Deleuze and Guattari would rather speak about *functions* in science and leave *concepts* to the philosophers, *affects* and *percepts* to the artists). [13] In general, scientific language seeks

to be precise and monovalent. Language supporting the arts moves from the clarity of art historical and formal definitions to the poetic, having obscure, and polyvalent potentials. The word may also function as part of an image as both an aesthetic object and a linguistic signifier, superimposing signifying domains. In terms of Art ↔ Science collaboration, certain goals related to the construction of a bridging language may be undertaken. Simplifications have always existed in general-public magazines of science or in lectures intended for a wide audience, but the close interaction with scientists offered to artists in residency in scientific laboratories may lead them to function at times as bridges with a wider or different non-scientific audience; these lucky artists may in return inform their own practice by methodologies imported from science while at the same time illuminate science with an unusual light spot.

## Art % Science

Embodying both approaches, Leonardo Da Vinci has become an icon in Art ↔ Science rhetorics because he has been known as a major character for his unequalled contribution both to the sciences and the arts of the Renaissance. A focus on Leonardo's work confirms that History is an important factor in the study of Art ↔ Science bridgings. Leonardo lived a long time before the modern and contemporary conception of science, now concerned with falsifiability and reproducibility of experiments, ie. at a time when the operational concept of objectivity was not yet normalized by an advanced meta-discourse on scientific practice, combined with the intensification of scientific and technological productions. It is interesting to think how an artist like Leonardo functions today in relation to our contemporary conception of the image: *"Another unusual feature in Leonardo's writings is the relationship between word and picture in the notebooks. [...] Leonardo gave absolute precedence to the illustration over the written word in his teaching method. Hence, in his notebooks, the drawing does not illustrate the text; rather, the text serves to explain the picture. In formulating his own principle of graphic representations — which he called *dimostrazione* (demonstrations) — Leonardo's work was a precursor of modern scientific illustration."* [14]

We understand and believe that Leonardo's work, rather than being a mere discovery of illustration in science, may have been precursory to scientific visualization as we conceive today: the art of gaining insight into a problem by visual means. Taking data visualization as an example, we realize this form of practice can fall within the Art ↔ Science spectrum of relationalities where one may either work on an abstraction of data visualization with the intention of creating a work of art or may draw on art and design concepts to make a more effective display of scientific informations. Visualization not only relaxes the mind from getting lost in too much abstraction, but helps shape a given problem along particular lines of thought, that, when cognitively dismantled into understandable units by the viewer's eyes and brain, provides what Leonardo called *dimostrazione*. It's worth remarking that science might sometimes still call this methodology a demonstration, keeping the dual and ambiguous meaning of *concrete representation* and *logical proof*.

The intrusion of such methodologies from outside of science, reminds (and provides an example to) the strong encounter of Art and Science claimed by Malina, who states: *"[...] the history of science does not follow a logical path of increasing completeness. Instead the history of science is punctuated by the introduction into the scientific methods of ideas and methods from outside of science. The scientific method itself evolves. Facts, theories and methods which would not have been considered scientific a hundred years ago, are now mainstream science. ... I argue that one of the reasons for encouraging the interac-*

tion of art and science is to facilitate the migration of ideas and methods from outside of science into science. I call this the 'strong case' for art-science interaction." [15] One can imagine a dual strong interaction where the intrusion of methodologies from outside of art also transforms artistic practices.

## Art ☆ Science

Having reached the conclusion we find ourselves just at the beginning of a vast study. We certainly hope that we have in part reflected the plurality of practices involved here and started to articulate a multi-perspective approach which allows for a circle that encompasses many foci and multiple points of view. At some point this appears to be a paradoxical undertaking, and probably we are pulling out the rug beneath the very footing that we are currently bootstrapping, by embracing this multiplicity of perspectives. But each person involved in Art ↔ Science practices positions *themselves* differently and our remote goal is to embrace these inner and outer diversities.

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