Spacious Theories of Object Relativity & Objective Reality

Book Review for
Seven Brief Lessons on Physics
by Carlo Rovelli
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Bio

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When we talk about the big bang or the fabric of space, what we are doing is not a continuation of the free and fantastic stories that humans have told nightly around campfires for hundreds of thousands of years. It is the continuation of something else: of the glaze of those same men in the first light of day looking at tracks left by antelope in the dust of the savannah - scrutinizing and deducting from the details of reality in order to pursue something that we can't see directly but can follow traces of. In the awareness that we can always be wrong, and therefore ready at any moment to change direction if a new track appears; but knowing also that if we are good enough we will get it right and will find what we are seeking. This is the nature of science.

The confusion between these two diverse activities - inventing stories and following traces in order to find something - is the origin of the incomprehension and distrust of science shown by a significant part of our contemporary culture. The separation is a subtle one: the antelope hunted at dawn is not far removed from the antelope deity in that night's storytelling. The border is porous. Myths nourish science, and science nourishes myth. But the value of knowledge remains. (Rovelli, 2016, pp. 68-69)

The following is an Arts-based Book Review of Carlo Rovelli's book, (2016) Seven Brief Lessons on Physics and incorporates original artworks by me, the book reviewer. The first two physical-digital illustrations (Figures 1-2) were inspired by Seven Brief Lessons on Physics, among other books, for the introduction to a Master's Thesis written at the European Graduate School, Arts Health and Society Division, in 2020. This article concludes with the harvesting of an Expressive Arts Academic Consultation session that was informed by this work of Carlo Rovelli, among many other great creative thinkers in physics.
Figure 1. Art by Carmiella Salzberg Zorzi
Figure 2. Art by Carmiella Salzberg Zorzi
Carlo Rovelli’s book is an accessible, short, and poetic doorway into the surprising findings and theories of physics for curious art-based researchers and Expressive Arts professionals who have an appreciation for math and science without a zest for solving equations or remembering many complex terms. To understand how scientists have arrived at and move forward from within modern theories of physics, and what their imaginative implications are, *Seven Brief Lessons on Physics* provides a poetic history of how the research of physics has evolved over time, as well as simple thought experiments that drive home the wild conclusions to which these findings and theories lead. Expressive Arts (EXA) facilitators may find this book especially meaningful as they guide others through creative processes without a clear map into and out of the realms of imagination. When in the process of the abstraction of the arts, this book helps ground the imagination to the limits and potentials of the predictable-yet-unpredictably-ever-strange underlying structures of physics upon which our shared reality is structured.

Rovelli’s insights about the liminality of time, the relativity of each individual’s unique experience, and how scientific research can salutogenically decenter ourselves to form fascinating new relationships with others in physical spaces are what particularly ignites my sensibilities as an art-based researcher and Expressive Arts professional. My relationships with time while in art-based research settings repeatedly reveal surprising, even shocking, insights into the relativity of time, perspective, and even the experience of a mutual relationship. In an art-based research experience/EXA session, insights can emerge out of co-creative simultaneous inter-actions at a near-far distance, in parallel-unparallel processes that we enact as separate yet interconnected beings. There is no way to track time unless one can observe the change of multiple objects when they are in relation to one another. Thus, without relationships, there is not time. As Rovelli emphasizes, physicists no longer use the terms *true or absolute* to describe time but instead describe individual times told by separate clocks/entities as their own proper time. Through illuminating simple thought experiments, especially those of Einstein, Rovelli unravels insights into the nature of time and space. These thought experiments invite endless new entry points for imaginative inquiries about physics scenarios that can be incorporated into EXA-based research in a myriad of fields.

The following are questions that emerged for me as an artist researcher/EXA professional in response to this book: What can be learned by engaging the multiplicity of our individual and collective times while co-creatively inter-acting through artistic embodiment? How can art-based research serve to support those who are in pursuit of a “Theory of Everything” of mathematical understanding which bridges the gaps between quantum mechanics and classical physics? How can we explore the liminality or solidity of physical-metaphysical realities which exist as yet-imperceivable ‘objects’ between the ‘particle and wave’ duality? Since we now know through quantum mechanics that the ‘inanimate’ components of reality respond to us based on how we observe/interact with them, what new interactive techniques can we explore to enable surprising science fiction-esque scenarios? How can EXA-inspired art-based research serve to attune us to nature’s musicality of real and imagined object formation, deconstruction, reconstrustion, materialization, dematerialization, rematerialization, and lastly otherwise fascinating co-creative evolution?

I invite the reader to join me in exploring Rovelli’s work through the following EXA session with a physics student to consider how each issue that faces us, be it environmental, humanitarian, technological, extraterrestrial, or intergalactic has vital relevance to our *experiences with* physics.
Figure 3. Expressive Arts Academic consultation session with undergraduate physics student, H (shared with permission) 2020. Photo by Carmiella Salzberg Zorzi

Figure 4. Notes by Carmiella Salzberg Zorzi
In the mystifying village of Saas- Fee in 2020, I was lucky to encounter a young physics student from the University of Zürich who was open to doing an EXA Academic Consultation session with me. I will call him H. H told me he was studying the mathematics of real and imaginary numbers, which I felt would be a fascinating subject to explore through Expressive Arts. My session with H was the only one during the time of my master’s degree that I conducted in person rather than online. I began the session by having H teach me a bit about the relationship between real and imaginary numbers from what he had learned so far in his course. He drew the following graphs while he spoke (Figure 3), and I took my own notes (Figure 4) about what he said. H was learning what the ‘meaning’ of an imaginary number is in mathematics and why it is useful. I decided that that should be the question around which the session would be centered.

I led H through a sensitization process by beginning with jumping and shaking while watching how the objects in the room moved in relation to one another as he moved, mainly on the vertical axis of his body in space. I then asked him to stop and hold his hands over his eyes as I read a writing piece I had prepared about how within the darkness of his closed eyes, the only proof he had of a world outside of his own mind were the phenomena of his physical sensations: touch, sound, taste. Yet in the dark of his closed eyes, what proof did he have otherwise that these sensorial phenomena weren’t scrambled in that moment? That he may physically be entirely other, otherwise… We then shifted into an artistic exploration of a ‘graph’ of real and imaginary numbers. I suggested that H draw onto the graph with either (a) a marker to signify real, or with (b) paint to signify imaginary. I meanwhile, as the EXA Academic Consultant, drew particles/objects around the graph in marker and/or paint which he could interact with or avoid. The following image emerged (Figure 5).

Figure 5. Artistic exploration between Carmiella Salzberg Zorzi and H
I observed that H began the activity by only drawing and painting on the axis lines; I was very curious as to why. He then painted a red line that moved around my little green object in the top left quadrant, followed by a green bridge between the axes in both paint and marker. Next, he drew a web which connected each of my particles, first in marker and then in paint. H then enacted a beautiful phenomenological metaphor when his brush eventually ran out of paint; he continued his strokes around the paper without a permanent mark being made.

H told me that he started by staying on the axes because he felt that was the only place where imaginary and real numbers could feasibly coexist mathematically. He said that he then saw in one of my particles that I had used both marker and paint, and it made him curious to consider how everything in between the axes could be both imaginary and real. He then moved into connecting all of the particles, perhaps to mean that “everything is connected”. He painted and drew a large dot over the intersection of the x and y axis to consider what the “origin” is, wondering what “null” really means—how it could be the source of everything.

I shared with H how I was intrigued by the moment his strokes became mark-less, when he smiled as his hand lilted across the page enjoying that neither marker nor paint marked their memory…. how to me, in this moment, he was alluding to another level of imagination: enacting an interactive movement with the brush and paper which was real and remembered by both of us in our imaginations but invisible now and thus nonexistent to anyone else who looks at the work we made. I then, in our Expressive Arts Academic Consultation session, suggested that we co-create a responsive poem with the title, In the Nodes Where Imaginary and Real Meet. Figure 6 is an image of that poem, with my words in purple and H’s in green.

![In the Nodes where Imaginary and Real Meet](image)

In the Nodes where Imaginary and Real Meet

Everything is uncertain and clear too,

The bridge between must be neither or both, or other
   But is there a bridge?
   Or is it a border?
   What if it is all one?
   Then how can we see each other?
   And that lamp over there
   And the monster with seven glowing hairy eyes
   Immagination.
   Seems like the real world is just a subset of the imaginary world
   So what is the purpose of graphing imaginary
   and real numbers?
   To expand your possibilities - The "real" feels so small compared to the "imaginary".

Figure 6. Co-created responsive poem by H and Carmiella Salzberg Zorzi
We discussed the part of the poem where H wrote that the real world was a “subset” of the imaginary. I didn’t understand what he meant when he wrote it, so I used his words to create an abstract fraction, where “sub” went under the setting. I then associated “setting” with the word “sitting”; and finally I felt compelled to make a further abstracted fraction where the dividing line became the water waves around a submarine. For me, this drawing denoted a submersion into the subconscious where the line between imaginary and real is completely fluid. H reflected that he didn’t understand what I meant when I wrote/drew this, because he had used the mathematical word “subset” to describe a concept of mathematical logic. He said that a “subset” is something which is contained by a larger set but not in reverse, such as “if it rains the streets are wet, but if the streets are wet then it is not necessarily because there was rain.” He said that, mathematically, real numbers are a subset of imaginary numbers, and not the other way around.

I responded by asking, “So without the imaginary, there is no real?” He responded with a question about imagination in general, wondering whether one can imagine something that doesn’t have some direct link to their actual experience. He pointed to the line in the poem where I described a monster with glowing hairy eyes saying, “Sure, we have never seen such a monster, but we have seen glowing things, hair, and eyes, so our imagination can just mash together those images”. I responded that I wondered if this was a limitation of verbal description. I asked what would have happened if I had used the English alphabet to write gibberish words or had drawn gibberish letters—would that tap into imagination devoid of real influences? From there we were inspired to discuss how we have learned that our spoken languages do not accurately describe subatomic phenomena because there are no equivalents of it in the macroscopic realm. Our harvest concluded with crystallizing how, on or off a mathematical graph, it is immensely challenging to determine the boundaries between imaginary and real.

Through the evolution of my master’s thesis research with the help of Rovelli’s work alongside EXA consultations like this one with H, I developed new perspectives on the terms relationship and interaction. I have come to see relationship as inextricable from interaction but not the other way around. In other words, interaction is a subset of relationship. I define ‘interaction’ as the juncture when separate entities meet and affect one another through their presence, while ‘relationship’ describes the connection between entities even when they are not in immediate contact. Relationship thus describes an immaterial quality of object dynamics that interaction does not. Thus, I arrive at a new understanding, upon reflection of my original session with H. My essential harvest, my personal meaning-making and takeaway from our session is this:

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\text{Interaction} = \text{Real subset} \quad \text{Relationship} = \text{Imaginary}
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Through harvesting this EXA session, I have deepened my insight and passion that utilizing Expressive Arts in relationship to scientific research serves to salutogenically decenter and transform the ways we interact and/or form relationships with others. Rovelli’s work provided me with clear terminology and the possibility to think through and utilize simple thought experiments with H and explore the boundary between real and imaginary objects. The junction of EXA, art-based research, and physics helps us imagine a wildly fascinating range of potential realities for ‘objects’ in known and unknown-yet physics.
Figure 7. Evolving Research by Carmiella Salzberg Zorzi
The artwork Figure 7 is an excerpt from my evolving PhD research, which shows the continued inspiration I endlessly draw from *Seven Brief Lessons on Physics*.

As one of the founders of Loop Quantum Gravity Theory, Carlo Rovelli, has become a bestselling author in the field of physics internationally. Originally from Italy,

…the essays in ‘Seven Brief Lessons on Physics’ arrive like shots of espresso, which you can consume the way the Italians do, quickly and while standing up… His book politely suggests that anyone who is not interested in modern physics cannot be an entirely serious human being… as Mr. Rovelli puts it, ‘space is granular, time does not exist, and things are nowhere.’ This information shouldn’t be estranging, he writes. It should jump-start curiosity. (Garner, 2016, n.p.)

Carlo Rovelli is now, as the director of the quantum gravity group at the Centre de Physique Theorique of Aix-Marseille University in Provence, undoubtedly continuing his enduring work, and his powerfully, sensitively, and sensibly aesthetic probing into the natures of *Dasein*. I recommend this book and all of his books to all humans and entities who are entirely serious about being a human or otherwise physics-bound being.

References

