Imagination, Art and Reality

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I must admit, I am somewhat of a contrarian. One of the greatest motivations for me is to refute some dominant idea. At worst, a contrarian could be considered someone who cares not about ideas themselves, but only their cultural dominance. I prefer to consider this proclivity as providing a valuable service: by being critical of the dominant, I provide greater balance and diversity in the world of thought. As an artist, I believe my role in cultural production is the exploration of what art is and what it could be. Art is, at least partially, a process of articulating and transforming what art is.

This text is an articulation of the key themes that structure and inform my art-as-research (Busch, 2009) practice: (1) the framing of art as exploratory, rather than expressive, (2) an explicit articulation of knowledge-making at the intersection of science and art, and (3) an emphasis on processes of representation and meaning—how a representation holds content—which is considered philosophically and cognitively. These themes have been developed through art productions, collaborations and discussions, and are informed by readings in philosophy, cultural theory, psychology and neurobiology. The influence of these themes expand beyond the artistic practice itself, permeating my life and worldview. This text is but a snapshot in the life of these ideas; they are continually refined as my practice develops. This text could be considered a signpost marking a shift of emphasis from artist to artist-theorist. This shift leads this text to emphasize the ideas that inform my work more than the work itself, or perhaps this text is an art object in itself.

I hope this text, just like my artworks, begs more questions than it provides answers. I strive to challenge us all to question the dominance of particular systems knowledge and what they say about ourselves and our culture. In this text, I endeavour to express my state of thought, as it currently stands, as genuinely as possible. I do so without the constraints and need for validation emphasized in academia, even without acceptance in contemporary or electronic media art. Whether you accept these notions or not, my only hope is that they stand to enrich your perspective, either in agreement or opposition.

Art as Exploration

I am not very interested in art objects in themselves. The significance of objects, as arrangements of material or energy, is not in their form, but in their meaning. Objects are important for how they structure and constrain human behaviour; they provide a site of negotiation where objects' utility and users', readers' or viewers' interpretations of the objects differ from those intended by the designer, writer or artist. The objects of art are articulations, demonstrations, realizations and

documentation of the process of art-making. In earlier writing (Bogart, 2008), I described the effect of an artwork on a viewer as a "perturbation", borrowed from creativity researcher Liane Gabora (2000). I consider the viewer's mind as a pool of experiences and knowledge. The sensory experience of an artwork, or any other object, is like a pebble being dropped into that pool. It is not that the artwork produces a message that is received by the viewer, but that an artwork participates in a cascade of activations that extend far beyond the pebble's initial impact. Our minds are not still pools; they are constantly active with some neurons firing due to external stimuli, and others firing due to internal activation. When we consider representation in art, we are actually considering how the experience of a shared world, mediated by a shared culture, can allow one person to produce an object (artwork, symbols, etc.) that causes a somewhat predictable set of affordances, associations or interpretations in the user, reader or viewer. This predictability depends on the shared cultural knowledge which itself is dependent on the stability and constraint provided by a shared physical world in which we live; without a shared world, there could be no grounded meaning.

When an artist manifests their will in material or energy, they become a viewer and are similarly perturbed by the object-in-progress. The artistic idea is no longer a thought in their mind, but a sensory reality before them. The tension between what the artist expected, and what occurred facilitates an optimization process where differences between intention and reality are reduced. The resulting optimization informs future choices made by the artist. The artist continuously makes choices and evaluates those choices in what I describe as the realization→interpretation loop (Bogart, 2008, Chapter 6). The interpretation of a work is a key aspect of artistic production, and thus the viewer and the artist are engaged in very similar processes of finding meaning in objects through the cascade of activations augmented by the object's presence.

I consider artistic practice a continuum between expression and exploration. Expression is an emphasis on arranging material or energy to elicit particular patterns of perturbation in the minds of the viewers for the purpose of communicating particular notions. Exploration is an examination of the relation between idea, culture and objects in the shared physical world; the focus is on the mechanisms of interaction between the world and ourselves that leads to perception, recognition, representation and even simulation. My practice emphatically emphasizes the exploration side of this continuum. This interest leads my practice to a strong emphasis on systems, causality and the rigorous scientific processes that produce rich and deep meaning about the physical world, and ourselves. These interests are currently manifest in the contextualization of my work in technology (in particular approaches to artificial intelligence, machine learning and machine creativity) and brain science (in particular cognitive, psychological and neurobiological conceptions of mind and brain).

Science and Art

There is a complex and long historical relationship between arts and sciences that is out of the scope of this text. Instead, I aim to provide a set of conceptions that have helped me carve out a space between the two in my current practice. Arts and sciences are practices that construct culturally relevant representations that function as tools exploited in our attempt to make sense of the world and ourselves. In arts, these representations are often artworks themselves, be they music, sculpture, dance, or even ideas or complex information patterns contained in a computer. Often these artworks make reference to the history of art, the world, or simply to pure sensual experiences. In sciences, these representations are the figures, texts and mathematical models used to describe the object of study. The *object of study* may be physical or conceptual and may refer to a process or even an experience. It is not the media that defines these disciplines, as both artists and scientists exploit any available media in the service of their practice. The artist may be just as capable of writing a text as a scientist, while a scientist may be just as capable of drawing a figure. An artwork can be described by a set of equations just as an image can describe a neurobiological theory.

The difference between arts and sciences is more a question of emphasis than a hard distinction. The strict parlance and methods used in sciences are used to constrain the number of possible interpretations that can be read into a scientific work (model or theory). Science favors causal, rational and objective ways of thinking. If a scientist is to embark on a purely theoretical work then the purpose is to inspire future empirical study to support or refute that theory. The primary value of scientific research is in the power of the model or theory to explain or predict the structure or behavior of the object of study. The process of validation is the mechanism by which we can evaluate the results of scientific research. The predictive power of a theory / model is determined by creating experiments that compare measurements of the model with measurements of the actual object of study. The results of these experiments are then used to transform the theory / model. This transformation can be as harsh as to abandon the theory entirely,[1] or as benign as to simply refine it. What is important to note here is that the empirical work done in scientific research is situated in a context of knowledge and theory that is constantly refined and tested, just as in the realization→ interpretation loop described above.

There is a clear definition of the object of study in science because such strictness is required for the explanation and prediction of the object's properties. These definitions constrain the creative process of designing experiments. It has been noted by Kuhn (1962) that revolutionary discoveries in science are, by definition, at odds with the dominant knowledge of the day. These may even involve a change of the definition of the object of study—constructing a novel perspective. It is my belief that by encouraging more broad conceptions and definitions of the objects of study, we inspire more broadly ranging empirical work—pushing research into less

explored territories. Thus, we can consider two processes in play in scientific research: (a) validating—the rational and objective process of testing implications and predictive power of theories and (b) theorizing—the creative and generative process of developing theories and alternative definitions meant to inspire future empirical work.

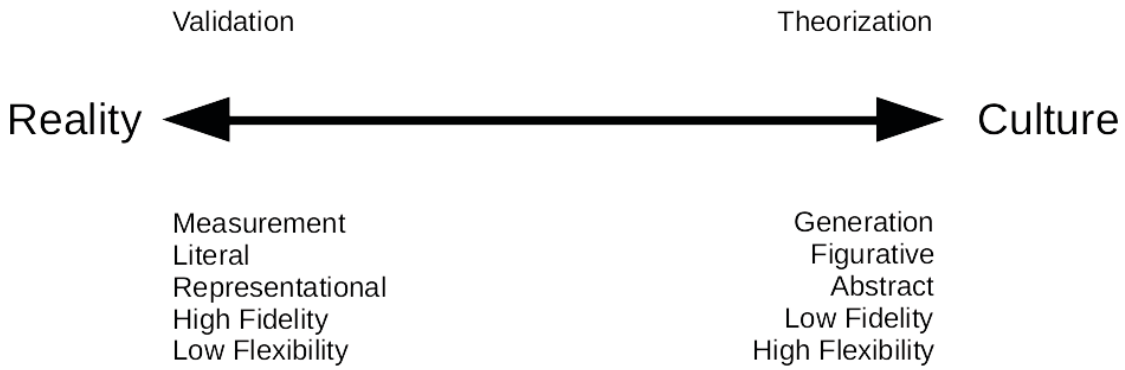

Figure 1: Continuum between Validation and Theorization

In representational arts, the object of study is quite clear, it is that which the artwork is a representation of. The artwork itself is analogous to the scientific theory produced in a context of existing knowledge and theory. Artists validate continuously as the artwork is constructed. Each time an artist considers the relationship between the realization and interpretation of the work, she is engaged in a process of validation. As in science, there is much latitude as to what could constitute an appropriate object of study. Representational arts then are most closely aligned with the scientific process of validating a representation against reality.

In nonrepresentational arts, things become quite a bit more muddy. The object of artistic study could be any experience or idea. Being nonrepresentational, the object of study is anything except for a physical object out in the shared world. In the natural sciences, the object of study is physical because knowledge can only be objectively validated against physical properties that can be independently measured. Indeed, the notion of a nonrepresentational natural science is nonsensical because the purpose of natural science is the description, explanation and prediction of reality. Non-representational arts engage in theorizing in order to encourage novel perspectives and present alternative interpretations of reality that are meant to inspire future artworks and ideas.

In the case of natural sciences, validating and theorizing are rarely considered in isolation because the predictive and explanatory power of scientific theories are determined by empirical study. In the case of arts, representational and nonrepresentational modes could be considered almost independent disciplines. All this assumes that representational arts and scientific objectivity both have a privileged perspective on reality. In the arts, it is trivial to imagine an

artwork that is simultaneously representational and nonrepresentational. A single image could have differing degrees of realism where one part is clearly representational and another slides into abstraction as to become totally ambiguous. I think of representational and nonrepresentational arts as being two sides of a continuum, as pictured in figure 1. On one end of the continuum we have validation where we strictly match the representation with external reality such that the representation encapsulates the essence of the object of study. On the other end we have theorizing where representations refer to other cultural representations (stories, histories, ideas) and strict validation is not possible because the representation is increasingly abstracted from that which is represented. This describes a continuum of abstraction where validating involves a decreasing amount of abstraction and theorizing involves an increasing amount. As abstraction increases—and we lose the ability to validate against reality—we increasingly consider the form of the abstraction itself. In art, we concern ourselves with formal properties such as composition, colour, line, et cetera. This formal evaluation is not limited to arts but also surfaces in the evaluation of science where aesthetics impact mathematical models and Occam's razor is concerned with the elegance of a theory.

Imagine a prehistoric artist drawing in charcoal on a cave wall with the intention of representing a human figure. Either another human is present to serve as a model, or the artist works from memory. The task of translating the sight, or memory, of a figure into a charcoal representation is extremely complex because of the lack of fidelity of the media (charcoal on rock), and thus the artist must make many compromises in the representation. Only the strongest and most essential features of the figure are manifest in the drawing because fine details are lost in the irregularity of the rock surface. While the drawing is validated against reality, the properties of the media itself interfere with the fidelity of the representation. The stability of the media and the object of study leads to stability in the representations.

Over many repetitions and ongoing cultural emphasis, the figure that roughly resembles a human being becomes a signifier for a human, and future drawings no longer need to be validated against reality. The drawing increasingly refers to a human in general, and not a human in particular. The repetition of drawing and redrawing the figure over time begins a process of optimization—where the symbolic value is retained through shared use while the form itself continues to evolve. It could eventually transform so significantly that it bares no resemblance to the original cave drawing. The form could even be distorted to the point of being nonrepresentational where it lends itself to any number of contradictory interpretations. At this point, the representation becomes a total abstraction—a form whose representational content is ambiguous.

The point here is twofold: (1) there is a continuum of increasing abstraction between validating and theorizing, and (2) that the process of validation is mediated. The utility of an abstract representation is in its lack of resemblance to reality because it allows the greatest flexibility in

its use. If all representations were highly accurate they would have little practical value because the representation would be just as awkward as reality. Imagine carrying around a life-size sculpture of a dear friend, presented every time you wanted to refer to that individual. As we allow increasing transformations of the representation (e.g. from a life-size sculpture to a photograph) their fidelity decreases, but their flexibility increases. We end up with total abstractions such as the words on this very page whose utility is nearly infinite because of the ease with which they can be deployed, which is a direct result of their lack of resemblance to reality. The symbolic meaning of abstract representations then depends on their context. Without an understanding of context, it would be nearly impossible to narrow the field of possible interpretations to that which the author or artist intended. Thus, with increasing abstraction representations gain flexibility, descriptive power, and greater context dependence.

Let us return to natural science. When we speak of the validation of a theory—by comparing what the theory indicates with reality—we are required to make measurements of the world. The eyes and perceptual abilities of the representational painter provide an analogous apparatus for the measurement of the object of study. Measurements are, by their nature, probes. These subsets of the world are abstractions from the very start because (1) they are extracted from their contexts in reality and (2) because the media (the measuring device) interferes with the representation, i.e. a measurement has a limited granularity at which point differences are no longer measurable. A scientific theory can only be validated insofar as the measurement apparatus used in the experiments allow. Theorization, as the use of abstraction in generating representations and models of the world, is intrinsic to cognition.

Cognition

When sighted and hearing infants learn the labels that represent objects out in the world, they are learning an association between the sound of the word and the objects the infant can visually perceive and recognize. On the first presentation of the object and the word, an infant could be associating any number of visually present objects with the word. It is through the ongoing presentation of the word and the object in different contexts, and the infant's shared attention with her caregiver, that a specific association can be made.

Let us return to the pool analogy introduced earlier in this text. We can consider both the audible word "dog" and the visual appearance of the dog as two pebbles simultaneously falling into the pool. Many parts of the mind can be simultaneously activated, even when we are only consciously aware of a small subset of that activation. Unlike a pool, some parts of the mind are more connected than others, and thus the activation propagates unevenly. The ripples are not concentric circles, but complex asymmetrical waves.

When we learn correlations between words (e.g. “dog”) and objects (e.g. dog) we are making it easier for the pebble’s energy (activation) to pass from one part of the pool to another. Our minds are able to constrain and reinforce certain connections in certain contexts, both consciously and unconsciously. We can attend by directing the pebble’s activation in differing directions. We cannot limit our conception of perception to a simple causal interaction between the pebble and the pool because perception cannot be reduced to the sensory processing of the eye. Perception is a perturbation of the viewer: a consideration of sensory experience (pebble) in the context of all the activations (the state of the whole pool).

Numerous psychological experiments (e.g. Davenport and Potter, 2004; Yi et al., 2008; Diekhof et al., 2011) have confirmed that our intention and expectations have great influence on our perception of the world—particularly in cases when sensory information is ambiguous (e.g. Meeter & Olivers, 2006). Perception is not the inactive reception of information from the world, but an act that directs activation in the mind. We may interpret the same object as one thing in one context, and another thing in another context (Oliva and Torralba, 2007). This is because the context changes the activity of the pool, and therefore changes how subsequent activation is propagated within it. Many of our expectations are implicitly learned, and thus the patterns of propagation are modulated by unconscious processes.

When we recollect an image in our minds, the same part of our brains are activated as when we initially experienced the stimulus (Graham et al., 2010). Remembering is like arranging the pool of our minds in a particular state that resembles the state in which we stored the memory. When we remember, imagine or dream, a specific part of the pool is put into a particular state. We can consider memories and mental images as the result of instructions that specify how to arrange a particular part of a pool to resemble the memory or image. To extend the pool analogy, the surface of the pool is concerned with sensory (input) and motor (output) information, while the water beneath the surface contains the instructions and mechanisms that are able to constrain and manipulate the activity of the water's surface. The instructions are simulators organized in hierarchies, and the memories are simulations manifest in the state of activation of the pool’s surface. The state of a particular part of the surface (simulation) is a function of the simulator immediately below it. These hierarchies of simulators extend deep into the pool and those closest to the surface are the most concrete and correspond to the validating end of the continuum described above. As we delve deeper into the pool, these simulators are increasingly abstract, leading to the theorizing end of the continuum. The deeper the simulator, the greater the influence over larger regions of the water’s surface. The simulators change the activity of the pool’s surface to emphasize particular associations over others and constrain the propagation of activation from external stimuli.

Let us put this in the context of a concrete example: A person sees a familiar dog on their way to a meeting for which they are late. The sensory impression of that dog causes a pebble to activate the pool. Previous experience of this dog leads to the activation of a simulator that corresponds to this particular dog. Activation propagates more deeply into the pool, recruiting increasingly abstract simulators, including those for this particular breed, dogs in general, and extending all the way down to the simulator that has learned the concept of an animate object. The activation of these simulators prime the pool with potentially relevant information. The result is that the surface will process some information more quickly because it is primed and expected to occur, including the dog's name, the feeling of his fur, a wet nose and an image of the last time the person saw this particular dog. The fact that the person is late for a meeting is not forgotten; this strong task-oriented drive is still modulating the pool. This modulation emphasizes the motor actions required to get to the meeting over the primed motor actions to pet the dog. After the person has finished the meeting, she walks back along the same route. She walks past the location where the dog was seen earlier and begins mind-wandering. This sensory context causes an activation in the pool's surface, resulting in the activation of a simulator for that location in space, which recruits the simulator for that particular dog because it was recently experienced. She proceeds to pet the dog in her imagination, which is manifest in the recruitment of a number of simulators including the motor movements of petting the dog, the sensation of the fur, and so on, these aspects of imagery are experienced but do not lead to changes in the surface of the pool.

Our perceptions are the result of simulators in our minds interacting with external sensory information in the construction of mental images. When we recognize an object out in the world it is not a pebble simply causing a cascade of activations. *Perception requires an interaction between the sensation and the simulation such that they reinforce each other*. Perceptual experiences are then not reducible to either the state of the pool or the sensory stimulus alone; perception is a necessary collaboration between the sensory context and the agent. When we are exposed to an ambiguous stimulus, our simulators use the available sensory information and fill in details not seen by our eyes.

This process resembles the process of both artistic and natural scientific enquiry. Our sensory organs and technologies provide probing measurements of the physical world which lead to theories (ideas, concepts, correlations and artworks) that are then refined through an ongoing process of continuous measurement and simulation. Theories constrain the impact of measurement and sensation, changing what aspects of the world deserve emphasis. Simultaneously, measurement and sensation serve to support and ground theories in reality. The notion that making artistic forms is an act of cognition was noted by the early pioneer of computer and generative art, Harold Cohen (1979), who stated:

> An image is a reference to some aspect of the world which contains within its own structure and in terms of its own structure a reference to the act of cognition which generated it. It must say, not that the world is like this, but that it was recognized to have been like this by the image-maker, who leaves behind this record: not of the world, but of the act.

Just as an image is a record of an act of recognition so can a system. The set of ideas described in this text outline the conceptual foundation of my practise. The understanding of cognition and epistemological position described here is the ground from which a series of artworks, collectively titled *Dreaming Machines,* arise.

A Machine That Dreams

A Machine That Dreams is the title of the art-as-research project that constitutes my doctoral work and the context in which *Dreaming Machines* are produced. The interest in dreaming came about as a result of my previous enquiry into machine creativity (Bogart, 2008). This examination of machine autonomy and creativity is manifest in the series of artworks titled *Context Machines* (Bogart and Pasquier, 2013), that all use generative processes to transform raw material collected from their environment into novel representations.

The idea of a machine that is more than a sum of its parts could be considered the central tenant of my art-as-research practice. *A Machine That Dreams* is not only an enquiry into the limits of our machines (Wilson, 1995), but also in those representational processes we use to make sense of the world and ourselves. It is easy enough to consider a causal notion of meaning, where external stimulus drives mechanistic processes that result in the "illusions" of agency and consciousness that pervade our experiences. These conceptions beg the question whether there is any difference between the causal processes in play in geology or fluid dynamics and those that constitute life.

In machine creativity, it is common to think of a dualistic process of generation and evaluation. Some generator is able to create nearly limitless variations in ideas and form, but most of that variation will have no social or functional value. A secondary process intentionally drives, constrains and filters the results of these generative processes—selecting only those with the potential to become socially acceptable or functional. My interest in dreams arose from a dissatisfaction with thinking about creativity in this way. Dreams contain great variation and flexibility, and yet present a somewhat cohesive world still containing characters, locations and social interactions. Dreams are creative because they generate novelty contextualized in the concerns and experience of the dreamer. Thanks to Freud and Jung, it is common to think of dreams as reflecting meaningful insights into ourselves, insights of which we may not be consciously aware. Dreams sit at the very interesting intersection of simulation and reality,

where they are known to contain elements learned from waking experience, and at the same time are capable of generating impossible juxtapositions.

The default state of mind is generative, rather than reactive. We imagine the world, not in purely subjective isolation, but in the context of the very real sensory information that we receive from it. We don't create the world but we do complete it, read into it, and transform it. Our simulations of reality are not copies, they are ongoing collaborations between ourselves (explicit and implicit, conscious and unconscious) and the world. Our dreams show the flexibility of our systems of imagination (simulation), and I think could be key in understanding embodied cognition.

I am not interested in the content of dreams, but rather the mechanisms that generate that content. This interest in mechanism is what lead me to neurobiological conceptions of dreaming. At first it was the notion of agency that interested me. Since being exposed to Merleau-Ponty's phenomenology (1968), I've been attempting to resolve the notion that we are nothing but cascades of mechanistic causal processes with our experience of volition, consciousness and agency. While I concede that none of these things is quite the same as we experience them, that does not mean that there is no causal role of consciousness in the world.

Figure 2: Frame from *Dreaming Machine #3* work-in-progress generated from test footage.

A Machine That Dreams began as an attempt to take the mechanistic conception of mind as far as I could take it. The hope is that the productions of the *Dreaming Machines* are a surprise to myself. The systems, of which *Dreaming Machine #3* is the prime an example, are framed as site-specific generative installations. They capture sensory information from out in the world, as

seen by a live camera, and use it as raw material in constructive image-making processes that resemble perceptual, dream and mind wandering imagery. The *Dreaming Machine* perceives the visual context by:

1. breaking frames into uniformly colored regions,
2. comparing the color of each of those regions to all previously seen regions,
3. recognizing regions seen in the current frame as particular objects that persist over time,
4. learning the context in which objects are likely to appear and in what order (prediction), and
5. constructing mental images by representing each recognized region with an aggregate of similar regions 'seen' at differing times.

The dreams and mind wanderings generated by the artwork exploit that which has been learned during perception. Rather than mental images being visualizations of the current sensory information, dreams and mind wanderings are the exploitation of contextual learning that allow the artwork to predict which objects are likely to appear. Dream and mind wandering imagery is produced by

1. considering the most recent perceptual state (the set of previously recognized objects),
2. generating a prediction of what objects are likely to be present at the next moment,
3. constructing mental images by visualizing each predicted object by its corresponding aggregate, and
4. replacing the most recent perceptual state with the current predicted state and repeating from #2, resulting in a feedback loop of predictions leading to a sequence of mental images.

In perception, dreaming and mind wandering, the visualizations from aggregate sensory information (a screen-grab of which is pictured in Figure 2) are presented on a display located in the same site as the live camera. Image sequences are not perfect mirror reflections of the external world, but simulations produced by the system's attempt to make sense of and predict the complexity of reality. The processes of simulation (dreaming, perception and mind wandering) are modelled after our contemporary scientific understanding of ourselves. They enact cognitive processes in the generation of image sequences. As I locate the artwork in these enacted processes themselves, the images produced are merely an entrypoint to the work; Images are only the surface of a pool of veiled mechanisms.

The *Dreaming Machines* conceptually fold in on themselves: Our minds make sense of the world and we generate our own internal structures that reflect our knowledge of it. Then the scientists, philosophers and artists among us, take this process as an object of study and generate representations, studies and models that attempt to make sense of how we make sense of the world. Then there are those like myself who build simulations—systems of representation that

dynamically act. They are representations, but representations that participate in the causal flow of the world. These simulations, of which the *Dreaming Machines* are an example, take the abstraction an additional step further and enact the knowledge encoded in the models that inform it. When these systems are presented as artworks, the loop is completed. While the system is being perturbed by our presence, we are being perturbed by its presence, mirroring Merleau-Ponty's (1968) sense that each subject and object is implicated in the construction of the other. We attempt to glean meaning from the images produced by the system, while those very images are the result of the system attempting to glean meaning from us. When we gaze into the machine, we see ourselves reflected back. We don't see ourselves only in the images in which we recognize ourselves, but also in the system's mechanism: We see a system that manifests those neurobiological conceptions of mind, perception and dreaming that we use to understand ourselves—even if we don't recognize it.

My motivation is not to produce a model validated by scientific standards, but to facilitate, inspire and enrich the discussion around those systems of knowledge through which we know ourselves and how they are constructed. Just as our simulations of the world are tools that have utility in the context of our experience, so too are the models produced in sciences and the artworks produced by artists. Perhaps they don't actually tell us all that much about the world itself, perhaps their true value is in how they stand as records of our own processes of making sense of the world. When we peer out into the complexity of the world and we recognize, we are recognizing as mediated by our concepts, by our simulations that tell us what we should expect to see. What we perceive is as much us as it is the reality beyond us. When we peer into the depths of space and into the microcosm of the infinitesimal, we are looking into ourselves—into those very processes that allow us to make sense of anything, those processes that make us who we are.

Notes

[1] We must keep in mind that failed experiments also have significant value in contributing to theory development.

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