Imagination is the Madwoman of the House

Georges M. Halpern, MD, DSc

with Yves P. Huin

In the October 07, 2020 of *Facts so Romantic in Biology* of Nautil.us, Alice Fleerackers offers an essay: *It Pays to Be a Space Case*, musing on the power of mind wandering.

She supports her own promenades with a few relevant quotes from elders: *"Mind wandering is the opposite of control: It's free," she explains from her home in Norway. "In some situations, it is important to be able to control your mind and to focus on the task at hand, but that does not mean that mind wandering is in itself a negative thing. We just don't recognize the situations where mind wandering is useful."* (Ylva Østby, from Oslo, Norway)), and "*In my opinion, there is far too much emphasis on the value of being in the here and now, [Mind wandering is] where all of the creativity of our species comes from.*" (Jonny Smallwood, from Queen's University))

Still, a growing body of evidence suggests Østby and Smallwood may be on to something. These studies find that mind wandering can play an important role in planning for the future and solving challenging problems, for example. Some psychologists have even found that it can help solidify memories, much like sleep does.

"Indeed, many of history's most revered artists and inventors had daily routines that incorporated periods of mental rest. Yoko Ono lit matches when stressed, watching the flames slowly burn into darkness. Frida Kahlo spent hours in her garden, drawing inspiration from the bright plants around her. James Joyce lay in bed "*smothered in his own thoughts*" for a full hour each morning, letting ideas come and go. Charles Darwin would declare at noon, "*I've done a good day's work,"* and spend the rest of the day taking long walks, napping, and answering letters", Fleerackers hammers down.

I think she is right (for me!).

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According to Wikipedia, "**Imagination** is the ability to produce and simulate novel objects, sensations, and ideas in the mind without any immediate input of the senses. It is also described as the forming of experiences in one's mind, which can be re-creations of past experiences such as vivid memories with imagined changes, or they can be completely invented and possibly fantastic scenes. Imagination helps make knowledge applicable in solving problems and is fundamental to integrating experience and the learning process. A basic training for imagination is listening to storytelling (narrative), in which the exactness of the chosen words is the fundamental factor to "*evoke worlds*".

Imagination is a cognitive process used in mental functioning and sometimes used in conjunction with psychological imagery. It is considered as such because it involves thinking about possibilities. The cognate term of mental imagery may be used in psychology for denoting the process of reviving in the mind recollections of objects formerly given in sense perception. Since this use of the term conflicts with that of ordinary language, some psychologists have preferred to describe this process as "*imaging*" or "*imagery*" or to speak of it as "*reproductive*" as opposed to "*productive*" or "*constructive*" imagination. Constructive imagination is further divided into active imagination driven by the prefrontal cortex (PFC) and spontaneous PFC-independent imagination such as REM-sleep dreaming, daydreaming, hallucinations, and spontaneous insight. The active types of imagination include integration of modifiers, and mental rotation. Imagined images, both novel and recalled, are seen with the "*mind's eye*".

Imagination, however, is not considered to be exclusively a cognitive activity because it is also linked to the body and place, particularly that it also involves setting up relationships with materials and people, precluding the sense that imagination is locked away in the head."

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On October 16, 2020, Aeon Essays posted a remarkable, comprehensive essay co-authored by Michael Levin, Vannevar Bush and Distinguished Professor of Biology at Tufts University in Massachusetts, and Daniel C. Dennett, also at Tufts University, whose contribution seems to be overwhelming. Its title is "*Cognition All The Way Down.*"

Wikipedia has a long entry (cited here and edited) on Daniel Clement Dennett III (born March 28, 1942) who is an American philosopher, writer, and cognitive scientist whose research centers on the philosophy of mind, philosophy of science, and philosophy of biology, particularly as those fields relate to evolutionary biology and cognitive science.

As of 2017, he is the co-director of the Center for Cognitive Studies and the Austin B. Fletcher Professor of Philosophy at Tufts University. Dennett is an atheist and secularist, a member of the Secular Coalition for America advisory board, and a member of the Committee for Skeptical Inquiry, as well as an outspoken supporter of the Brights movement. Dennett is referred to as one of the "*Four Horsemen of New Atheism*", along with Richard Dawkins, Sam Harris, and the late Christopher Hitchens.

Dennett is a member of the editorial board for *The Rutherford Journal*.

Dennett spent part of his childhood in Lebanon, where, during World War II, his father was a covert counter-intelligence agent with the Office of Strategic Services posing as a cultural attaché to the American Embassy in Beirut. When he was five, his mother took him back to Massachusetts after his father died in an unexplained plane crash. When Dennett was six years old, he suffered a significant injury from being dropped on his head by his mother. This resulted in a severe traumatic subdural hematoma causing significantly lower functionality in the right brain hemisphere. Dennett's sister is the investigative journalist Charlotte Dennett. Dennett says that he was first introduced to the notion of philosophy while attending summer camp at age 11, when a camp counselor said to him, "*You know what you are, Daniel? You're a philosopher*."

Dennett in 2008 – © Wikipedia

Dennett graduated from Phillips Exeter Academy in 1959 and spent one year at Wesleyan University before receiving his Bachelor of Arts in philosophy at Harvard

University in 1963. At Harvard University he was a student of W. V. Quine. In 1965, he received his Doctor of Philosophy in philosophy at the University of Oxford, where he studied under Gilbert Ryle and was a member of Hertford College. His dissertation was entitled *The Mind and the Brain: Introspective Description in the Light of Neurological Findings; Intentionality*.

Dennett describes himself as *"an autodidact—or, more properly, the beneficiary of hundreds of hours of informal tutorials on all the fields that interest me, from some of the world's leading scientists".*

He is the recipient of a Fulbright Fellowship, two Guggenheim Fellowships, and a Fellowship at the Center for Advanced Study in the Behavioral Sciences. He is a Fellow of the Committee for Skeptical Inquiry and a Humanist Laureate of the International Academy of Humanism. He was named 2004 Humanist of the Year by the American Humanist Association. In 2006, Dennett received the Golden Plate Award of the American Academy of Achievement.

In February 2010, he was named to the *Freedom from Religion Foundation's* Honorary Board of distinguished achievers.

In 2012, he was awarded the Erasmus Prize, an annual award for a person who has made an exceptional contribution to European culture, society or social science, "*for his ability to translate the cultural significance of science and technology to a broad audience*."

In 2018, he was awarded an honorary degree by Radboud University, located in Nijmegen, Netherlands, for his contributions to and influence on cross-disciplinary science.

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Now back to the Essay *“Cognition All the Way Down,”* subtitled *“Biology’s next great horizon is to understand cells, tissues and organisms as agents with agendas (even if unthinking ones).”*

It is dense, multifaceted and covers (too?) many critical areas of interest. Hereunder I offer you a few selected paragraphs (many *verbatim*), and some summarized or edited for clarity:

“Biologists like to think of themselves as properly scientific behaviorists, explaining and predicting the ways that proteins, organelles, cells, plants, animals and whole biota behave under various conditions, thanks to the smaller parts of which they are composed. They identify causal mechanisms that reliably execute various functions such as copying DNA, attacking antigens, photosynthesizing, discerning temperature gradients, capturing prey, finding their way back to their nests and so forth, but they don't think that this acknowledgment of functions implicates them in any discredited teleology or imputation of reasons and purposes or understanding to the cells and other parts of the mechanisms they investigate.

"We think that this commendable scientific caution has gone too far, putting biologists into a straitjacket that prevents them from exploring the most promising hypotheses, just as behaviorism prevented psychologists from seeing how their subjects' measurable behavior could be interpreted as effects of hopes, beliefs, plans, fears, intentions, distractions and so forth. The witty philosopher Sidney Morgenbesser once asked B F Skinner: 'You think we shouldn't anthropomorphize people?'– and we're saying that biologists should chill out and see the virtues of anthropomorphizing all sorts of living things. After all, isn't biology really a kind of reverse engineering of all the parts and processes of living things? Ever since the cybernetics advances of the 1940s and '50s, engineers have had a robust, practical science of mechanisms with purpose and goal-directedness – without mysticism. We suggest that biologists catch up.

"Now, we agree that attributing purpose to objects profligately is a mistake; Isaac Newton's laws are great for predicting the path of a ball placed at the top of a hill, but they're useless for understanding what a mouse at the top of a hill will do. So, the other way to make a mistake is to fail to attribute goal-directedness to a system that has it; this kind of teleophobia significantly holds back the ability to predict and control complex systems because it prevents discovery of their most efficient internal controls or pressure points. We reject a simplistic essentialism where humans have 'real' goals, and everything else has only metaphorical 'as if' goals. Recent advances in basal cognition and related sciences are showing us how to move past this kind of all-or-nothing thinking about the human animal – naturalizing human capacities and swapping a naive binary distinction for a continuum of how much agency any system has.

"Thanks to Charles Darwin, biology doesn't ever have to invoke an *'intelligent designer'* who created all those mechanisms. Evolution by natural selection has done – and is still doing – all that refining and focusing and differentiating work. We're all just physical mechanisms made of physical mechanisms obeying the laws of physics and chemistry. But there is a profound difference between the ingenious mechanisms designed by human intelligent designers – clocks and motors and computers, for instance – and the mechanisms designed and assembled by natural selection

"The great progress has been mainly on drilling down to the molecular level, but the higher levels are actually not that well-off. We are still pretty poor at controlling anatomical structure or knowing how to get it back on track in cancer – this is why we don't have a real regenerative medicine yet. We know how to specify individual cell fates from stem cells, but we're still far from being able to make complex organs on demand. The few situations where we can make them are those in which we've learned to communicate with the cell swarm – providing a simple trigger, such as the bioelectric pattern that says '*build an eye here'*, and then letting the intelligence of the cell group do the hard work and stop when the organ is done.

"Thinking of parts of organisms as agents, detecting opportunities and trying to accomplish missions is risky, but the payoff in insight can be large. Suppose you interfere with a cell or cell assembly during development, moving it or cutting it off from its usual neighbors, to see if it can recover and perform its normal role. Does it know where it is? Does it try to find its neighbors, or perform its usual task wherever it has now landed, or does it find some other work to do? The more adaptive the agent is to your interference, the more competence it demonstrates. When it '*makes a mistake'*, what mistake does it make? Can you '*trick*' it into acting too early or too late? Such experiments at the tissue and organ level are the counterparts of the thousands of experiments in cognitive science that induce bizarre illusions or distortions or local blindness by inducing pathology, which provide clues about how the '*magic'* is accomplished, but only if you keep track of what the agents know and want.

'Here's another simple way to think about the problem. Once the individual early cells – stem cells, for instance – are born, they apparently take care of their own further development, shaping both themselves and their local environments without any further instruction from their parents. They become rather autonomous, unlike the mindless gears and pistons in an intelligently designed engine. They find their way. What could possibly explain this? Something like a trail of breadcrumbs? Yes, in some cases, but the cells have to be smart enough to detect and follow them. We might hope for some relatively simple physical explanation.

"It has become standard practice to describe such phenomena with the help of anthropomorphic, intentional idioms: when we click the mouse, we tell the cursor to grab the thing on the screen, and as we move the mouse we move the thing on the screen until we signal to the cursor to drop the thing by clicking the mouse again. This talk of signaling and information-processing is now clearly demystified thanks to computers – no mysterious psychic powers here! – and this has been correctly seen to license use of such information talk everywhere in biology. Detectors and signals and feedback loops and decision-making processes are uncontroversial physical building blocks in biology today, just as they are in computers. But there is a difference that needs to be appreciated, since failure to recognize it is blocking the imagination of theorists. In a phrase that will need careful unpacking, individual cells are not just building *blocks*, like the basic parts of a ratchet or pump; they have extra competences that turn them into (unthinking) agents that, thanks to information they have on board, can assist in their own assembly into larger structures, and in other large-scale projects that they needn't understand.

"We members of *Homo sapiens* tend to take the gifts of engineering for granted. For thousands of years, our ancestors prospected for physical regularities that they could exploit by designing structures that could perform specific functions reliably. What makes a good rope, good glue, a good fire-igniter? The humble nut-and-bolt fastener is an elegantly designed exploitation of leverage, flexibility, tensile strength and friction, evolving over 2,000 years, and significantly refined in the past two centuries. Evolution by natural selection has been engaged in the same prospecting at the molecular level for billions of years, and among its discoveries are thousands of molecular tools for cells to use for specific jobs. Among those tools are antennas or hooks with which to exploit the laws of physics and computation.

"Yet there seems to be a fundamental problem here. Evolution runs on the principle of selfishness. How could complex living systems implement group goals toward which their cellular subunits would work? How can such cooperation ever arise from the actions of selfish reproducing agents? Consider the thinking tool that has been used to analyze this conundrum for decades – the Prisoner's Dilemma (PD) – as set out in Daniel Dennett's book "*Darwin's Dangerous Idea*" (1995):

> The best-known example in game theory is the Prisoner's Dilemma, a simple two-person 'game' [in which] you and another person have been imprisoned pending trial (on a trumped-up charge, let's say), and the prosecutor offers each of you, separately, the same deal: if you both hang tough, neither confessing nor implicating the other, you will each get a short sentence (the state's evidence is not that strong); if you confess and implicate the other and he hangs tough, you go scot free and he gets life in prison; if you both confess-and-implicate, you both get medium-length sentences. Of course, if you hang tough and the other person confesses, he goes free and you get life. What should you do?
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> If you both could hang tough, this would be much better for the two of you than if you both confess, so couldn't you just promise each other to hang tough? (In the standard jargon of the Prisoner's Dilemma, the hang-tough option is called *cooperating*.) You could promise, but you would each then feel the temptation – whether or not you acted on it – to *defect*, since then you would go scot-free, leaving the *sucker*, sad to say, in deep trouble. Since the game is symmetrical, the other person will be just as tempted, of course, to make a sucker of you by defecting. Can you risk life in prison on the other person's keeping his promise? Probably safer to defect, isn't it? That way, you definitely avoid the worst outcome of all, and might even go free. Of course, the other fellow will figure this out, too, so he'll probably play it safe and defect as well, in which case you *must* defect to avoid calamity – unless you are so saintly that you don't mind spending your life in prison to save a promise-breaker! – so you'll both wind up with medium-length sentences. If only you could overcome this reasoning and cooperate!

"Specifically, let's think about spatialized PD, with a grid of agents (cells) and each one plays PD against its neighbors. The traditional way to think about this is that the number of agents is fixed – they are permanently distinct, and the only thing that varies and evolves is the policy that each one uses to decide to cooperate or defect against its neighbors. But imagine that evolution discovers a special protein – a

Connexin – that allows two neighboring cells to directly connect their internal milieus via a kind of tunnel through which small molecules can go. Evolution's discovery of this kind of protein allows the system to take advantage of a remarkable dynamic.

'When two cells connect their innards, this ensures that nutrients, information signals, poisons, etc. are rapidly and equally shared. Crucially, this merging implements a kind of immediate '*karma*': whatever happens to one side of the compound agent, good or bad, rapidly affects the other side. Under these conditions, one side can't fool the other or ignore its messages, and it's absolutely maladaptive for one side to do anything bad to the other because they now share the slings and fortunes of life. Perfect cooperation is ensured by the impossibility of cheating and erasure of boundaries between the agents. The key here is that cooperation doesn't require any decrease of selfishness. The agents are just as 100 per cent selfish as before; agents always look out for Number One, but the boundaries of Number One, the self that they defend at all costs, have radically expanded – perhaps to an entire tissue or organ scale.

'This physiological networking fundamentally erases the boundaries between smaller agents, forming a kind of super-agent in which the individual identity of the original ones is very hard to maintain. Of course, these boundaries aren't anatomical, they're physiological or functional – they demarcate computational compartments inside of which data flow freely, with massive implications from a game-theory perspective. Information (memory) is now shared by the collective – indeed, that is a prime reason for connecting to your neighbor: you inherit, for free, the benefit of their learning and past history for which they already paid in metabolic effort.

'The other amazing thing that happens when cells connect their internal signaling networks is that the physiological setpoints that serve as primitive goals in cellular homeostatic loops, and the measurement processes that detect deviations from the correct range, are both scaled up. In large cell collectives, these are scaled massively in both space (to a tissue- or organ-scale) and time (larger memory and anticipation capabilities, because the combined network of many cells has hugely more computational capacity than the sum of individual cells' abilities). This means that their goals – the physicochemical states that serve as attractors in their state space – are also scaled up from the tiny, physiological homeostatic goals of single cells to the much larger, anatomical homeostasis of regeneration and development, which can achieve the correct target morphology from all kinds of weird starting configurations, and despite noise and massive external perturbations along the way. It is this system that later became coopted to the even larger and faster goal-directed activity of brains, as ancient electrical synapses (Connexin-based gap junctions) evolved into modern chemical synapses, and cells (which were using physiological signaling to orchestrate morphogenesis) became speed-optimized lanky neurons.

'The cooperation problem and the problem of the origin of unified minds embodied in a swarm (of cells, of ants, etc.) are highly related. The key dynamic that evolution discovered is a special kind of communication allowing privileged access of agents to the same information pool, which in turn made it possible to scale selves. This kickstarted the continuum of increasing agency. This even has medical implications: preventing this physiological communication within the body – by shutting down gap junctions or simply inserting pieces of plastic between tissues – initiates cancer, a localized reversion to an ancient, unicellular state in which the boundary of the self is just the surface of a single cell and the rest of the body is just 'environment' from its perspective, to be exploited selfishly. And we now know that artificially forcing cells back into bioelectrical connection with their neighbors can normalize such cancer cells, pushing them back into the collective goal of tissue upkeep and maintenance.

"An important implication of this view is that cooperation is less about genetic relatedness and much more about physiological interoperability. As long as the hardware is good enough to enable physiological communication of this type, the exact details aren't nearly as important as the multiscale homeostatic dynamics ensured by the laws of physics and computation. For example, unlike us humans, whose children never inherit mutations occurring in our bodies during our lifetime, planarian flatworms often reproduce by fission and regeneration. This means that they have somatic inheritance – every mutation that doesn't kill the stem cell is propagated into the next generations as the stem cell reproduces to help fill in the missing half of the worm. Their genomes bear the evidence of this accumulation of junk over 400 million years – they are a total mess. We still don't have a proper genome assembly for *Dugesia japonica*, and the worms are mixoploid – they don't even all have the same number of chromosomes! And yet, planaria are champion regenerators, making exactly the same anatomy every time they are cut – 100 per cent fidelity, despite the mess of a genome. This is what computer scientists call hardware independence – within a wide tolerance, the same worm-building software can run on very different molecular hardware because the software is extremely robust and directed to build the same large-scale outcome whatever it takes (in terms of telling the diverse cells what to do to get there).

"How do the *right* cells *figure out* whom they should trust as a life partner? We don't see every cell partnering up with every other cell that is its neighbor. So, the Prisoner's Dilemma still seems to raise its head. Is there some sort of trial-and-error Darwinian process that homes in on the best gap junctions to commit to? How can the individual cells tell which way to turn? At the cellular level, most cells can couple with most other cells. What determines how this happens is the physiological software, which determines whether gap junctions between any two cells are open or not. Remarkably, the physiological software isn't 'hardwired' or even 'firmware'; these gap junctions have – like synapses – a memory and are affected by prior states of the cells.

"This is a reasonable mechanistic story, but then isn't all the talk of memory, decision-making, preferences and goal-driven behavior just anthropomorphism? Many will want to maintain that real cognition is what brains do, and what happens in biochemistry only seems like it's doing similar things. We propose an inversion of this familiar idea; the point is not to anthropomorphize morphogenesis – the point is to naturalize cognition. There is nothing magic that humans (or other smart animals) do that doesn't have a phylogenetic history. Taking evolution seriously means asking what cognition looked like all the way back. Modern data in the field of basal cognition makes it impossible to maintain an artificial dichotomy of '*real*' and '*as-if*' cognition. There is one continuum along which all living systems (and many nonliving ones) can be placed, with respect to how much thinking they can do.

"The central point about cognitive systems, no matter their material implementation (including animals, cells, synthetic life forms, AI, and possible alien life) is what they know how to detect, represent as memories, anticipate, decide among and – crucially – attempt to affect. Call this the system's cognitive horizon. One way to categorize and compare cognitive systems, whether artificial or evolved, simple or complex, is by mapping the size and shape of the goals it can support (represent and work toward). Each agent's mind comprises a kind of shape in a virtual space of possible past and future events. The spatial extent of this shape is determined by how far away the agent can sense and exert actions – does it know, and act to control, events within 1 cm distance, or meters, or miles away? The temporal dimension is set by how far back it can remember, and how far forward it can anticipate – can it work towards things that will happen minutes from now, days from now, or decades from now?

"Humans, of course, have very large cognitive horizons, sometimes working hard for things that will happen long after they are gone, in places far away. Worms work only for very local, immediate goals. Other agents, natural and artificial, can be anywhere in between. This way of plotting any system's cognitive horizon is a kind of space-time diagram analogous to the ways in which relativistic physics represents an observer's light cone – fundamental limits on what any observer can interact with, via influence or information. It's all about goals: single cells' homeostatic goals are roughly the size of one cell, and have limited memory and anticipation capacity. Tissues, organs, brains, animals and swarms (like anthills) form various kinds of minds that can represent, remember and reach for bigger goals. This conceptual scheme enables us to look past irrelevant details of the materials or backstory of their construction, and to focus on what's important for being a cognitive agent with some degree of sophistication: the scale of its goals. Agents can combine into networks, scaling their tiny, local goals into more grandiose ones belonging to a larger, unified self. And of course, any cognitive agent can be made up of smaller agents, each with their own limits on the size and complexity of what they're working towards.

"From this perspective, we can visualize the tiny cognitive contribution of a single cell to the cognitive projects and talents of a lone human scout exploring new territory, but also to the scout's tribe, which provided much education and support, thanks to language, and eventually to a team of scientists and other thinkers who pool their knowhow to explore, thanks to new tools, the whole cosmos and even the abstract spaces of mathematics, poetry and music. Instead of treating human '*genius*' as a sort of black box made of magical smart stuff, we can reinterpret it as an explosive expansion of the bag of mechanical-but-cognitive tricks discovered by natural selection over billions of years. By distributing the intelligence over time –

aeons of evolution, and years of learning and development, and milliseconds of computation – and space – not just smart brains and smart neurons but smart tissues and cells and proofreading enzymes and ribosomes – the mysteries of life can be unified in a single breathtaking vision."

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Jeremy England is senior director in artificial intelligence at GlaxoSmithKline, principal research scientist at Georgia Tech, and the former Thomas D. and Virginia W. Cabot career development associate professor of physics at MIT. In the October 21, 2020 issue of Nautil.us he published an essay on "*Why Physics Can't Tell Us What Life IS*" subtitled "*The origin of life can't be explained by first principles.*"

Again, I urge you to read the complete essay by clicking on the link in the References section.

Jeremy England – © Facebook

Jeremy England starts by being axiomatic:

> "There is just something obviously reasonable about the following notion: If all life is built from atoms that obey precise equations we know—which seems to be true—then the existence of life might just be some downstream

> consequence of these laws that we haven't yet gotten around to calculating."

He then develops -critically- his idea(s), and I'm quoting (and summarizing) his approach:

> "Physics is an approach to science that roots itself in the measurement of particular quantities: distance, mass, duration, charge, temperature, and the like. Whether we are talking about making empirical observations or developing theories to make predictions, the language of physics is inherently metrical and mathematical. The phenomena of physics are always expressed in terms of how one set of measurable numbers behaves when other sets of measurable numbers are held fixed or varied. This is why the genius of Newton's Second Law, F = ma, was not merely that it proposed a successful equation relating force (F), mass (m), and acceleration (a), but rather that it realized that these were all quantities in the world that could be independently measured and compared in order to discover such a general relationship.
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> "This is not how the science of biology works. It is true that doing excellent research in biology involves trafficking in numbers, especially these days: For example, statistical methods help one gain confidence in trends discovered through repeated observations (such as a significant but small increase in the rate of cell death when a drug is introduced). Nonetheless, there is nothing fundamentally quantitative about the scientific study of life. Instead, biology takes the categories of living and nonliving things for granted as a starting point, and then uses the scientific method to investigate what is predictable about the behavior and qualities of life. Biologists did not have to go around convincing humanity that the world actually divides into things that are alive and things that are not; instead, in much the same way that it is quite popular across the length and breadth of human language to coin terms for commonplace things like stars, rivers, and trees, the difference between being alive and not being alive gets denoted with vocabulary.
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> "In short, biology could not have been invented without the preexisting concept of life to inspire it, and all it needed to get going was for someone to realize that there were things to be discovered by reasoning scientifically about things that were alive. This means, though, that biology most certainly is not founded on mathematics in the way that physics is. Discovering that plants

> need sunlight to grow, or that fish will suffocate when taken out of water, requires no quantification of anything whatsoever. Of course, we could learn more by measuring how much sunlight the plant got, or timing how long it takes for the fish-out-of-water to expire. But the basic empirical law in biological terms only concerns itself with what conditions will enable or prevent thriving, and what it means to thrive comes from our qualitative and holistic judgment of what it looks like to succeed at being alive. If we are honest with ourselves, the ability to make this judgment was not taught to us by scientists but comes from a more common kind of knowledge: We are alive ourselves, and constantly mete out life and death to bugs and flowers in our surroundings. Science may help us to discover new ways to make things live or die, but only once we tell the scientists how to use those words. We did not know any physics when we invented the word "life," and it would be strange if physics only now began suddenly to start dictating to us what the word means."

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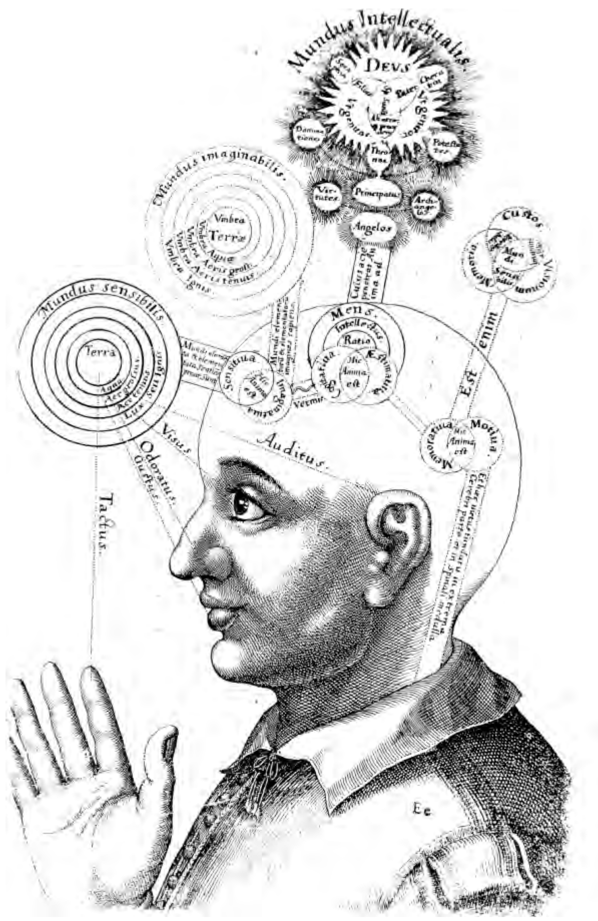
"Ever since Charles Darwin published On the Origin of Species in 1859, evolution has been the grand unifying theory of biology. Yet one of our most important biological traits, consciousness, is rarely studied in the context of evolution. Theories of consciousness come from religion, from philosophy, from cognitive science, but not so much from evolutionary biology. Maybe that's why so few theories have been able to tackle basic questions such as: What is the adaptive value of consciousness? When did it evolve and what animals have it?" asks Michael Graziano, Professor of Psychology and Neuroscience at Princeton University in an article titled *"This Theory Explains How Consciousness Evolved"* published on June 6, 2016 in The Atlantic.

He then explains and develops:

> "The Attention Schema Theory (AST), developed over the past five years, may be able to answer those questions. The theory suggests that consciousness arises as a solution to one of the most fundamental problems facing any nervous system: Too much information constantly flows in to be fully processed. The brain evolved increasingly sophisticated mechanisms for

deeply processing a few select signals at the expense of others, and in the AST, consciousness is the ultimate result of that evolutionary sequence. If the theory is right—and that has yet to be determined—then consciousness evolved gradually over the past half billion years and is present in a range of vertebrate species.



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“With the evolution of reptiles around 350 to 300 million years ago, a new brain structure began to emerge – the wulst. Birds inherited a wulst from their reptile ancestors. Mammals did too, but our version is usually called the cerebral cortex and has expanded enormously. It’s by far the largest structure in the human brain. Sometimes you hear people refer to the reptilian brain as the brute, automatic part that’s left over when you strip away the cortex, but this is not correct. The cortex has its origin in the reptilian wulst, and reptiles are probably smarter than we give them credit for.

The cortex is like an upgraded tectum. We still have a tectum buried under the cortex and it performs the same functions as in fish and amphibians. If you hear a sudden sound or see a movement in the corner of your eye, your tectum directs your gaze toward it quickly and accurately. The cortex also takes in sensory signals and coordinates movement, but it has a more flexible repertoire. Depending on context, you might look toward, look away, make a sound, do a dance, or simply store the sensory event in memory in case the information is useful for the future.

“The most important difference between the cortex and the tectum may be the kind of attention they control. The tectum is the master of overt attention—pointing the sensory apparatus toward anything important. The cortex ups the ante with something called covert attention. You don’t need to look directly at something to covertly attend to it. Even if you’ve turned your back on an object, your cortex can still focus its processing resources on it. Scientists sometimes compare covert attention to a spotlight. (The analogy was first suggested by Francis Crick, the geneticist.) Your cortex can shift covert attention from the text in front of you to a nearby person, to the sounds in your backyard, to a thought or a memory. Covert attention is the virtual movement of deep processing from one item to another.

“The cortex needs to control that virtual movement, and therefore like any efficient controller it needs an internal model. Unlike the tectum, which models concrete objects like the eyes and the head, the cortex must model something much more abstract. According to the AST, it does so by constructing an attention schema—a constantly updated set of information that describes what covert attention is doing moment-by-moment and what its consequences are.

“Maybe partly because of language and culture, humans have a hair-trigger tendency to attribute consciousness to everything around us. We attribute consciousness to characters in a story, puppets and dolls, storms, rivers, empty spaces, ghosts and gods. Justin Barrett called it the Hyperactive Agency Detection Device, or HADD. One speculation is that it’s better to be safe than sorry. If the wind rustles the grass and you misinterpret it as a lion, no harm done. But if you fail to detect an actual lion, you’re taken out of the gene pool.

> To me, however, the HADD goes way beyond detecting predators. It's a consequence of our hyper-social nature. Evolution turned up the amplitude on our tendency to model others and now we're supremely attuned to each other's mind states. It gives us our adaptive edge. The inevitable side effect is the detection of false positives, or ghosts.
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> "And so, the evolutionary story brings us up to date, to human consciousness—something we ascribe to ourselves, to others, and to a rich spirit world of ghosts and gods in the empty spaces around us. The AST covers a lot of ground, from simple nervous systems to simulations of self and others. It provides a general framework for understanding consciousness, its many adaptive uses, and its gradual and continuing evolution."

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The Academy of International Medical Studies or AIMS *(see link in the References section)* is a tour operator that caters to medical doctors and dentists by offering trips and visits of interesting countries/places, with a short list of meetings with colleagues, hospitals, special medical museums or unique ancient pharmacies. The global expenses involved can be tax-deductible.

I started collaborating with AIMS in 1991, scouting my contacts in the countries that were on their expanding list for professional encounters, and suggesting foods, dishes or wines that would attract the members. I also served as "Academic Leader" ironing out problems or bureaucratic obstacles; and I also enjoyed giving short lectures followed by long, animated discussions.

That's why AIMS contacted me in December 2005 to lead a group of physicians on a 2-week cruise in Antarctica mid-January 2006. I accepted with enthusiasm! The ship was MV *Corinthian II (see link in the References section)* and we boarded in Ushuaia, at the tip of South America.

The AIMS group was small and friendly, but the overall tour operator (with the majority of passengers) had a surprise for us: a special guest-lecturer, Brian Greene -with his wife, Tracy Day. His Wikipedia entry is amazing: *(see link in the References section)*, and his lectures on board the ship were riveting, opening new horizons (for me). Brian and Tracy were permanent guests at the captain's table -while I had to join the AIMS physicians. We corresponded by email after the cruise, and then -as expected- our lives diverged. But I was hooked on reading his books, most importantly his latest one: *Until the End of Time*: *Mind, Matter, and Our Search for Meaning in an Evolving Universe* (Borzoi Books, Alfred A. Knopf).

Brian Greene - © Elena Seibert

On March 4, 2020, Dennis Overbye published, in the New York Times, an excellent review of Brian's book; I am excerpting a few paragraphs of Overbye's review (with slight editing) that are relevant to this essay:

> "For Greene this impulse has taken the form of a lifetime devotion to mathematics and physics, of the search for laws and truths that transcend time and place. "*The enchantment of a mathematical proof might be that it stands forever,*" he writes.
>
> "If he dies, the work lives on as part of the body of science and knowledge. But as a cosmologist, he knows this is an illusion: "*As our trek across time will make*

> *clear, life is likely transient, and all understanding that arose with its emergence will almost certainly dissolve with its conclusion. Nothing is permanent. Nothing is absolute*."
>
> "Depressing. But in a Starbucks one day, he says, he had a realization, a sort of conversion to gratitude. Life and thought might occupy only a minute oasis in cosmic time, but, he writes, "*If you take that in fully, envisioning a future bereft of stars and planets and things that think, your regard for our era can appreciate toward reverence*." Or maybe, he jokes, he was just losing his mind.
>
> "Why do humans tell stories? Was there an evolutionary advantage to be gained from taking time out from the hunt to sit around the campfire and gab — a bonding experience? Is the shared imagination a way to practice navigating unknown territory, or a guide for living your life?
>
> "In the end it is up to us to make of this what we will. We can contemplate eternity, Greene concludes, "*and even though we can reach for eternity, apparently we cannot touch eternity*."

Heather Berlin, Ph.D., MPH is a cognitive neuroscientist and assistant professor of psychiatry at the Icahn School of Medicine at Mount Sinai, who (re)published in the October 14, 2020 issue of Nautil.us an essay titled *The Neurology of Flow States.* Hereunder are a few paragraphs that could complement Brian Greene's book:

> "Many people describe being "enchanted" or "transfixed" when watching a live performance or viewing their favorite work of art. For example, when exploring the European paintings section of the Metropolitan Museum of Art, I enter into a kind of dissociated, transcendent state, which many people report experiencing. All of our cares and worries disappear, and time seems to stand still or fade away as we become lost in the world of the story, or work of art, or the virtuosity of the performer. This loss of time-awareness mirrors the process occurring in the brains of the performers or artists while they create.
>
> "During what psychologists call "flow states," where one is completely immersed and absorbed in a mental or physical act, people often report an altered sense of time, place, and self. It's a transportive and pleasurable experience that people seek to achieve, and that neuroscience is now seeking to understand. A great example of flow state is found in many improvised art

forms, from music to acting to comedy to poetry, also known as "spontaneous creativity." Improvisation is a highly complex form of creative behavior that justly inspires our awe and admiration. The ability to improvise requires cognitive flexibility, divergent thinking and discipline-specific skills, and it improves with training.

"And during musical improvisation, in jazz or freestyle rap, studies show a distinctive increase in medial prefrontal cortex activation. The medial prefrontal cortex (mPFC) is a brain area known to be involved in intentional, internally generated self-expression and the pursuit of goal-oriented behaviors. This makes sense, since improvised performance requires you to come up with new material in a rapid stream and deploy it just as quickly for a listening or watching audience. The other aspect to this pattern is a decrease in lateral orbitofrontal cortex and dorsolateral prefrontal cortex activation (DLPFC). The lateral orbitofrontal cortex (OFC) and dorsolateral prefrontal cortex are brain areas involved in conscious self-monitoring, effortful problem solving, focused attention, and evaluation and regulation of goal-directed or planned behaviors. These lateral areas assess whether behaviors conform to social norms and exert inhibitory control over inappropriate or maladaptive behavior. But as any skilled performer will tell you, inhibitions are the enemy of improvisation.

"Future research could explore whether this pattern of brain activity is in fact a neural signature of improvisation that occurs across all art forms, for instance during painting, theater, comedy, and dance improvisation, or whether the signature is unique to the musical and verbal forms it has been found in so far. When the lateral PFC regions—where our sense of agency is created after ongoing actions take place—decrease in activation, a performer's moment-to-moment decisions and actions may feel as if they are occurring outside of time and without conscious intention, as if they are "coming from somewhere else." This is consistent with the sentiment many artists express that their creative process is being directed by a "muse" or outside agent.

"The sense of time passing, producing its changes and progressions, is a capacity our brains evolved for adaptive reasons. How long have I been sleeping? How soon do the kids need to eat? How fast will I have to walk to make it home before dark? Keeping track of time is something we do instinctively, and our instincts have recently been supplemented by cultural inventions such as clocks and calendars, which train our brains to map its instincts onto scales and increments. However, we have also evolved the ability to turn off this constant timekeeping, in moments of artistic rapture or contemplation, and that adaptive sense of timelessness gives our lives much of its beauty and meaning. How we choose to spend our time, which remains our most limited and valuable resource, is one of the greatest gifts, and responsibilities, we are given."

The Actor as a Messenger to Imagination

Paul Giamatti as Hamlet in Yale Repertory Theatre's production of 2013 - © Joan Marcus

On March 23, 2021, AEON/Psyche published a superb Essay/Dialog: **Phantasia**, co-authored by Paul Giamatti, a film and television actor and Stephen T. Asma, a professor of philosophy at the Columbia College Chicago and a member of the Public Theologies of Technology and Presence program at the Institute of Buddhist Studies in Berkeley, California. It is a wonderful and timely update and complement to our subject. Here it is:

"Imagination is a powerful tool, a sixth sense, a weapon. We must be careful how we use it, in life as on stage or screen.

When I performed in the play "The Iceman Cometh" (1946) by Eugene O'Neill, I played a character who stands up near the end and pours his heart out on stage. My character was almost like a messenger in a Greek tragedy but, instead of describing some nightmarish battle, he had to recount the horror of his own failures and the regrets of his life. It was an intense, emotionally draining experience, and I had to do it night after night. Each night I wondered if I could do it again, but somehow the energy of the room, the other actors and the story itself helped me to dial in some deep emotional frequency from my own history. It feels like you're a shaman because you kind of lose yourself and channel something. And that activates deep emotions in the audience, too. So, there's a weird connection – I'm losing myself, and the audience is losing themselves. Then we come down together, having shared something powerful. - Paul Giamatti.

Like other artists, the actor is a kind of shaman. If the audience is lucky, we go with this emotional magician to other worlds and other versions of ourselves. Our enchantment or immersion into another world is not just theoretical, but sensory and emotional. How do actor and audience achieve this shared mysterious transportation is shared ritual draws upon a kind of sixth sense, the imagination. The actor's imagination has gone into emotional territories of intense feeling before us. Now they guide us like a psychopomp into those emotional territories by recreating them in front of us.

Aristotle called this imaginative power *phantasia*. We might mistakenly think that phantasia is just for artists and entertainers, a rare and special talent, but it's actually a cognitive faculty that functions in all human beings. The actor might guide us, but it's our own imagination that enables us to immerse fully into the story. If we activate our power of phantasia, we voluntarily summon up the real emotions we see on stage: fear, anxiety, rage, love and more. In waking life, we see this voluntary phantasia at work but, for many of us, the richest experience of phantasia comes in sleep, when the involuntary imagination awakes in the form of dreams.

In *The Descent of Man* (1871), Charles Darwin writes:

> The *Imagination* is one of the highest prerogatives of man. By this faculty he unites, independently of the will, former images and ideas, and thus creates brilliant and novel results ... *Dreaming* gives us the best notion of this power; as Jean Paul [Richter] ... says, 'The dream is an involuntary art of poetry.'

The dreaming brain isn't aware that the monster chasing us is unreal. During REM sleep, your body is turned off by the temporary paralysis of sleep atonia, but your limbic brain is running hot. In waking life, the limbic system is responsible for many of the basic mammalian survival aspects of our existence: emotions, attention and focus, and is deeply involved in the fight-or-flight response to danger. The dreaming brain isn't just faking a battle but actually fighting one in our neuroendocrine axis. That's why we sometimes wake up sweating with our heart racing. The involuntary imagination of dreaming creates an episode of emotional reality – not sham emotions. The same is true in the theater, the movie, the novel. We're really stirred by the St Crispin's Day speech in William Shakespeare's *Henry V*, really terrified by Edgar Allan Poe's short story *The Pit and the Pendulum* (1842), and really haunted by Andrei Tarkovsky's film *Stalker* (1979).

The intensity of these emotions is not just felt by the audience. For an actor, embodying a scene with another actor – who reveals, say, a deep vulnerability from losing a child – can mean that a scripted fiction enacted by two strangers on a stage actually bonds the actors themselves in real intimacy long after the play or film is over. Like in a dream, the limbic mind experiences art as real. An actor or writer embodies the deepest traumas and joys of life so the audience can experience them vicariously. Acting (and other collective artistic work) can be a kind of mainlining of intimacy, and the audience partakes of this intimacy too.

There's a lot of subtle embodied communication going on. There's an intense awareness between the actors themselves, and between the audience and actors – especially in theatre. The most obvious feedback happens in comedies of course, because you can hear the laughs or the lack of them. But much more subtle stuff is happening too. Once, when I was playing Hamlet, there was an early scene with the Player King. His prop beard was slowly falling off his face – unbeknown to him – just as I was saying a line about beards. And there was this amazing energy in the whole place from the collective recognition that we were all playing in a play, but also a play that knows it's a play.

And sometimes when something goes wrong on stage – like a mistake, or a prop thing – it actually brings in a fresh energy by breaking the normal patterns, and everyone becomes more present in the room.

At other times, the emotional awareness is more intimate. Once I was playing the husband opposite the actor Kathryn Hahn in a scene where another character is inadvertently saying something insulting to her, and she doesn't know what to say in response, and I'm trying to sort of cover it over, and then we just share this quiet moment together as we listen to the other character continue talking. They shot the scene many times, but then after one particular take we both looked at each other and said: 'Wow, I really felt that one.' And I think the authenticity of these kinds of connections can shine through to observers. For example, I think that was the take the director eventually used as well. - Paul Giamatti

To prepare a role, the actor must function as an empathy sponge: they work to ingest and ingurgitate all the social nuances of power, vulnerability, hope and despair. This is a sensory osmosis – the actor must cultivate this like a sixth-sense organ. It happens 'in the dark' of the mind so to speak, beneath the radar of conscious thinking.

Nor does this rely on direct observations of human behavior alone. According to the extended mind theory, humans offload much of who they are into the environment. The philosophers David Chalmers and Andy Clark argue that our minds don't reside exclusively in our brains or bodies but extend out into the physical environment (in diaries, maps, calculators and now smartphones, etc.). Consequently, you can learn a great deal about someone by spending time in their home – not deducing facts like Sherlock Holmes, but absorbing subtle understandings of character, taste, temperament and life history. When an actor prepares to play a historical figure, he might find deep insights in the environs, the clothing and so on. A small detail can turn the key and open up a real 'visitation' from the past.

When I played President John Adams in the 2008 miniseries for HBO, I studied many historical records, but the key that helped me find his character was an amazing compilation of his health complaints. Someone had culled all his letters for any references to his health, and produced this giant record of elaborate and hypochondriacal health complaints. The man was a wreck with digestive problems, toothaches, headaches, bowel troubles and more. After manic periods of high energy, *he would 'take to his bed' for a couple of weeks. In reading all this, I began to see how to play the everyday John Adams.* - Paul Giamatti

This capacity to get inside the emotional landscape of another person draws on a deep, evolutionary cognitive ability, a way of absorbing or reading what the psychologist James J. Gibson called 'affordances'. Gibson's affordances can be understood as all the things that surround an organism in their environment, with potential to be understood, grasped and exploited. An affordance is relational: it depends on the ecological relationship between the animal and its lifeworld, rather than having an objective value. A freshly baked baguette is to a baker a proud symbol of her art; to the hungry child, it's a meal; to the assistant at the boulangerie, an object to be arranged in the window. An affordance has meaning depending where you stand, and much of our grasp of affordances runs beneath conscious analysis. For social mammals, including humans, many of the affordances in our environment are social in nature, and thus we spend a huge amount of perceptual energy in processing signals of behavior, demeanor and emotion from our fellows, much of which never surfaces to our conscious mind.

"A chimpanzee, for example, sees the posture of the new guy as dominant – the dominance and subordinance exist in the real-time relationship between the two animals' bodies and behaviors. The chimp doesn't need to reason about the relationship, because the perception itself contains a great deal of information and prediction about status, disposition, character and possible behaviors. Stage actors 'read the room' in a similar way to our primate cousins reading their social world of dominance. A lifetime of subconsciously reading rooms (reading people) gives artists a rich palette of insights, feelings and behaviors. Unlike other animals, humans use phantasia to expand these affordances and create alternative behaviors – alternative realities – in the real-time present, as well as in the future. We take social affordances from our existing lifeworlds and spin new worlds out of them. at is the power of phantasia, but also, as we will see, its danger.

"Some people think that the imagination is just a frivolous fantasy-making ability. For Plato, the imagination produces only illusion, which distracts from reality, itself apprehended by reason. The artist is concerned with producing images, which are merely shadows, reflecting, like a mirror, the surface of things, while Truth lies beyond the sensory world. In the *Republic*, Plato places imagery and art low on the ladder of knowledge and metaphysics, although ironically, he tells us this in an imaginary allegory of the cave story.

By contrast, Aristotle saw imagination as a necessary ingredient to knowledge. Memory is a repository of images and events, but imagination (phantasia) calls up, unites and combines those memories into tools for judgment and decision-making. Imagination constructs alternative scenarios from the raw data of empirical senses, and then our rational faculties can evaluate them and use them to make moral choices, or predict social behaviors, or even build better scientific theories. For Aristotle, phantasia (which comes from the Greek word for 'light'), is as important to knowledge as light is to seeing. Although Aristotle was careful to distinguish phantasia from the ordinary five senses, because it can occur without any stimulus from outside, we could understand phantasia as a kind of sixth sense, shared by humans and many animals, a way to know the world, to which humans return in dreams. Here, Aristotle is thinking of imagination as something like the involuntary process; the associational mashups of dreams, the subconscious tracking of affordances, the conditioned memories we use to evaluate and make sense of our experience. When we bring this process under executive control – that is, when we harness it to our waking, speculative and creative mind – we transform the involuntary imagination to voluntary, and this 'phantasia 2.0' is unique to humans. Perhaps a chimpanzee might dream of a hippo it once saw, but only a Walt Disney can bring the hippo to mind whenever he wants, dress it in a tutu in his mind's eye, draw it, animate it dancing, and release it as a film called… *Fantasia* (1940).

Contemporary science of the mind sides with Aristotle, not Plato. Phantasia is adaptive and helps us know others and ourselves better. Art is not just great for therapeutic emotional management and catharsis, but also produces knowledge, generating new ways of understanding and manipulating the world. Contemporary neurocognitive theory argues that the mind is a 'prediction processor'. It builds mental models of the world, and tests predictions, always updating the model to reduce future errors. These cognitive processes are not possible without the imaginative faculty. Imagination helps us create possible futures (new architecture, medical breakthroughs, new political possibilities) but also helps us model other minds.

When art is good – when the acting and the script are on point, or a character in a novel is nuanced – the audience actually learns more about human behavior than real-life observation provides. This is because the interior of the character is articulated in art, whereas it remains submerged in real social interaction.

We are, then, running a constant 'simulator' in our own minds, whether we're consciously aware of it or not. Because of this involuntary sixth sense, we seem to know things without having figured them out. The dark processing (reading affordances, absorbing impressions from the extended minds around us, involuntarily combining narratives in headspace, and just simulating things) serves up 'reality' to us without revealing its hand in the construction. The mind is always incubating an alternative or supplemental reality. Our experience is always imagination-laden. Yet the vivid, and often unconscious, nature of this cognitive process isn't always enriching. If imagination is an involuntary creative act of cognition before downstream rationality uses it, it can also be dangerous.

Without properly understanding imagination's role in cognition, our views can present themselves to us as straightforward, accurate assessments of the world. People who disagree with us seem just 'irrational' (bad at weighing evidence and logic) or crazy. But once we take account of the imaginative layer of mind (the filtering and modelling we do between the raw data and the reasoned conclusions or beliefs), we see that the world itself really is different for the atheist as opposed to the Christian; the Republican as opposed to the Democrat; the rationalist versus the QAnon devotee.

The legal scholars Cass R. Sunstein and Adrian Vermeule argue that conspiracy theories arise when people suffer from a 'crippled' knowledge base because they have 'limited' informational sources. If you watch *only* one news network or get your 'facts' from a crank website or radio show with no peer review, then you're going to be highly susceptible to conspiracy and this will likely be exacerbated if you received limited school instruction in logic and critical thinking in your formal education. Thus, the answer to conspiracy theories is more education and more rational weighing of information sources.

Conspiracy theories aren't, however, just the result of alternative 'information sources' or limited information – we're all awash in information. Rather, a potent conspiracy is a narrative arc in which the believer is a heroic character. Phantasia is a potent ingredient here. The persuasiveness of imagination consists in its embodied quality – the conspiratorial mind *feels* and *sees* itself as a protagonist in a drama. A dramatic story such as the QAnon theory is reinforced by a charismatic leader (politician/actor/ clergy/celebrity), creating a phantasia layer that *feels* real, just as the dream f*eels* real to the limbic system and the movie feels real to the audience member.

No wonder then that conspiracy theorists like to dress up. The conspiracy-minded Trump supporters who smashed into the Capitol Building in Washington, DC in January 2021 included half-naked 'Ur-Americans' with painted faces and buffalo headdresses, carrying signs that said 'Q Sent Me'. A charismatic leader is like the shaman/actor on stage. They have 'gone before' into the embodied belief, they evoke the emotions, they involve the watcher/audience so intensely that everybody gets deeply invested. The insurrectionists in their dress-up costumes at the Capitol are less like actors and more like fully immersed audience members. Insurrection was a kind of malevolent cosplay convention in which superfans who had intensely internalized the narratives themselves took over the stage, only the 'convention' in this case was at the Capitol. Obviously, this makes them no less dangerous, because their guns are not props, and mob violence is wildly contagious.

Our phantasia is not just 'in our heads' but actually extended and distributed into our environment. Just as the actor changes into costume and transforms into a new persona, so too the jingoist drapes himself in flags and paraphernalia becoming a new persona – one that feels righteous and empowered, in this case, to do violence. There is 'magic' in the accoutrement. Anthropologists and social psychologists have long recognized the unique dynamics in ritual adornment and behavior. Ritualized collective imaginings help to produce what the French sociologist Émile Durkheim in 1912 called 'collective effervescence' – a feeling state or force that excites individuals and unifies them into a group. It's a similar phenomenon in political crowds, religious ceremonies, music concerts and theatre experiences.

In our current climate of partisan paranoia, we've all ramped up imaginative demonization of the other. This leaves us vulnerable to dark imaginings. The Chinese American philosophical geographer Yi-Fu Tuan states it plainly in his book *Landscapes of Fear* (2013): 'If we had less imagination, we would feel more secure.' Yes, there are real threats and enemies out there, but not as many as our active imagination produces. Alas, we can't stop fantasticating if it's the root of human cognition, and we wouldn't want to give it up if we could. But can we turn that awesome power of imagination toward humanizing ourselves and others?

Imagination recruits our natural empathy system and can amplify it. We see fear or joy in another person's face, and we catch it like an emotional contagion. The actor has made a career of this natural human ability to recreate another's feelings and perspectives within one's self. Properly cultivated, this emotional mimicry can become ethical care, and art and artists play a crucial role in this cultivation.

I have played some sinister characters doing some ethically dubious things in dark storylines. I'm not someone who thinks art must be 'moral' per se. A lot of art with really overt moral pretensions is usually pretty bad art. Having said that, we could be making better use of the imagination, making genuinely smart and nuanced characters. A lot of contemporary entertainment seems to me to have lazy renderings of characters. Here's a kind of shorthand going on: a character beats up someone in one scene, then kisses his mom in the next to show complexity and ambiguity, but it all feels too simple and easy sometimes.

There's a lot of contempt and cynicism in contemporary entertainment. The characters are contemptuous and cynical, and the impulses creating the characters are too. And there's contempt for the audience: just give them crud. That's always been a problem; I sound like an old-man moral scold. I'm all for the occasional mindless, nihilistic narrative, but the imagination is a hugely powerful tool and therefore weapon: if you're gonna go morally dark or ambiguous, you're gonna lacerate people, you better know why you are. You better be damn good at what you do, like Herman Melville good. It's oddly easy to crank out something risky and edgy, we all think we know what that is, but most of it doesn't really risk anything important, make real critiques of injustice or power. For sure: there's really good stuff out there. But a lot of it's weak, masquerading, performing its importance.

It's really difficult to be 'true' as in 'authentic'. Believe me, I know, I'm shooting for it myself and frequently missing the mark. It's difficult to show how real friendships form or end, how real grief is processed, real horror and pain are inflicted and borne, so on.

You gotta be careful with the imagination. It matters how it's wielded. There's a lot of opportunity for critique but hope too. - Paul Giamatti

Acting is like a 'laboratory of identity' because the actor gets to try on many different selves. Some of them are sinister and some saintly, with all points in between. The movie industry and the arts generally are also large-scale laboratories of identity for audiences. Such power carries some responsibility. But all of us have this power of phantasia – in fact we can't escape it – so it's on all of us to be better actors and even directors of our stories, individual and shared."

Uncertainty

Brian Greene, in his book, also reminds us that if Newtonian Physics *seem* to rule the *world as we experience it*, quantum physics are underneath everything. And *the very act of observing disturbs the system* (Werner Heisenberg).

Werner Karl Heisenberg – © Wikipedia

Indeed, so far in this Essay I have been quoting the *scientific* (= Newtonian) approach to Imagination. But every atom of our living body -including our brain- is subjected primarily to the laws of quantum physics, discovered by Werner Heisenberg.

Werner Karl Heisenberg (5 December 1901 – 1 February 1976) was a German theoretical physicist and one of the key pioneers of quantum mechanics. He published his work in 1925 in a breakthrough paper. In the subsequent series of papers with Max Born and Pascual Jordan, during the same year, the matrix formulation of quantum mechanics was substantially elaborated.

He is mostly known for the **Heisenberg uncertainty principle**, which he published in 1927. Heisenberg was awarded the 1932 Nobel Prize in Physics "*for the creation of quantum mechanics*".

The development of quantum mechanics, and the apparent contradictory implications in regard to what is "*real*" had profound philosophical implications, including what scientific observations truly mean. In contrast to Albert Einstein and Louis de Broglie, who were realists who believed that particles had an objectively true momentum and position at all times (even if both could not be measured), Heisenberg was an anti-realist, arguing that direct knowledge of what is "*real*" was beyond the scope of science.

Writing in his book *The Physicist's Conception of Nature,* Heisenberg argued that ultimately, we only can speak of the *knowledge* (numbers in tables) which describe something about particles, but we can never have any "*true*" access to the particles themselves:

"We can no longer speak of the behavior of the particle independently of the process of observation. As a final consequence, the natural laws formulated mathematically in quantum theory no longer deal with the elementary particles themselves but with our knowledge of them. Nor is it any longer possible to ask whether or not these particles exist in space and time objectively ... When we speak of the picture of nature in the exact science of our age, we do not mean a picture of nature so much as a picture of our relationships with nature. ... Science no longer confronts nature as an objective observer but sees itself as an actor in this interplay between man and nature. The scientific method of analyzing, explaining and classifying has become conscious of its limitations, which arise out of the fact that by its intervention science alters and refashions the object of investigation. In other words, method and object can no longer be separated."

Heisenberg admired Eastern philosophy and saw parallels between it and quantum mechanics, describing himself as in "*complete agreement*" with the book *"The Tao of Physics."* Heisenberg even went as far to state that after conversations with Rabindranath Tagore about Indian philosophy "*some of the ideas that seemed so crazy suddenly made much more sense*".

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So, here we are, back to ancient wisdom, Indian, Chinese with Laozi and the *Dàodé Jing,* or Socrates (470-399 BCE): "ἔοικα γοῦν τούτου γε σμικρῷ τινι αὐτῷ τούτῳ σοφώτερος εἶναι, ὅτι ἃ μὴ οἶδα οὐδὲ οἴομαι εἰδέναι" or "*I seem, then, in just this little thing to be wiser than this man at any rate, that what I do not know I do not think I know either"* often abbreviated in: "***the only thing I know is that I know nothing."***

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