

Consciousness and Universal Axiology

Might some possible world be best? What would such a world be like? A new theory of consciousness suggests an answer.

1. The value dispute

The belief that our world exists because of its value has been called the *axiarchic view* (Parfit 1998a:25-26). The idea descends from Plato, who advanced its *optimalist* version: The world came into being just because it is the “greatest and best, most beautiful and most perfect ... being alone of its kind!” *Timaeus* 92C (Kalkavage, tr.). The opposing *value neutral* position descends from the Greek atomists: Some quasi-random or stochastic process produced the world; value had nothing to do with it. We can usefully distinguish this *value dispute* from two related questions, the problem of evil and the more recent *fine-tuning argument*.

Instead of saying that the world is so bad that it cannot plausibly have a value-oriented cause – a premise of the problem of evil – the *axiarchic view* says the world is so good only such a cause is plausible. Given this inverse relationship, a successful defense against the problem of evil (*e.g.*, a successful free will defense) would not necessarily resolve the world’s axiological status: It might only make a value-oriented cause a live possibility.

The *fine-tuning argument* rests on the discovery that most possible “settings” of our physical laws and initial conditions would be inconsistent with the emergence of life; yet our world’s actual laws and conditions make life possible. This led Paul Davies (1983:24) to suggest that “somebody has fine-tuned nature’s numbers to make the Universe....” Physicists have since noted many coincidences between the laws and conditions that life needs and those that our world has, but one of these can stand for the rest. Assuming that key physical values were

independently and randomly set, Lee Smolin (1997:324-326) calculates the odds against long-lived stars to be a staggering 10^{229} to 1. "Luck will certainly not do here," he concludes (*ibid* 23), "we need some rational explanation of how something this unlikely turned out to be the case."

The fine-tuning argument neither assesses the world's value nor explains its existence. It only suggests that some non-random "Selector" (Parfit 1998b), naturalistic or otherwise, must have caused our world to be as it is. But even this conclusion is doubtful, for no Selector may be needed. The *Weak Anthropic Principle* (WAP) tautologically states that any world we observe must be one that lets us exist at the time we observe it. Since we are alive, any world we observe must support life. Writers often link the WAP to another claim: We inhabit an effectively limitless multiverse consisting of vastly many, randomly-generated worlds. Since so many worlds exist, some must be habitable; that we inhabit one of those is unsurprising.

Against this modern version of the atomist position, the axiarchic view insists that only our world's exceptional value can explain its existence. For this claim to be plausible, a) some quality that a world could possess would have to create intrinsic value; b) some definable world or worlds would need to be optimal in its support for this value-creating quality, and c) our world and a definable optimal world would need to resemble each other so closely as to be indistinguishable. Without such a close resemblance the claim would be untestable: Many possible worlds are likely to have some value, so the discovery that our world has value would not necessarily mean that it exists for that reason. This paper addresses only the preconditions for an axiarchic argument, items a) and b) above. For reasons that will soon be apparent, we begin with Leibniz.

2. Leibnizian optimalism

Plato's world was an orderly plenum: filled with copies of every Form, arranged in perfect order, and strikingly beautiful. Yet though western theism inherited much from Plato and though it also teaches that the world is "very good" (Genesis 1:31), its theologians have mostly held that ours is *not* the best possible world. Aquinas (1271:P1Q25A5) explained that this is not God's fault: No matter what substances God would have created, God's power would always permit the creation of better ones, for "the divine goodness is an end exceeding beyond all proportion things created." God could not create the "best" of possible worlds, any more than God could create a man who was also in all respects a horse.

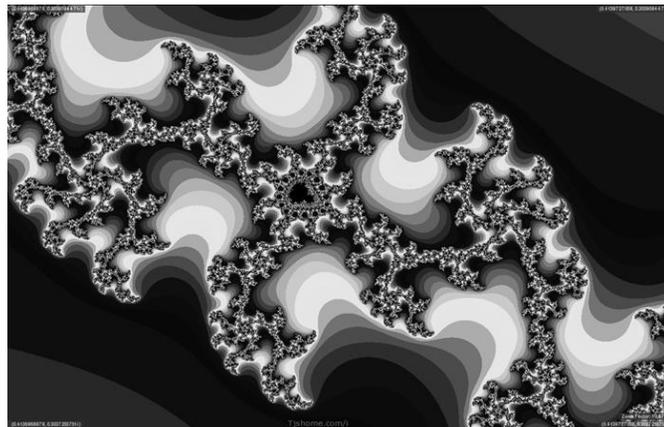
Leibniz rejected this argument: "[I]f there were no best among all possible worlds," he wrote, "God would not have created one." 1714: § 8. He did not insist that the best world – the one that we inhabit – would be the happiest or the most virtuous. Instead, he wrote that "God ... has chosen the most perfect ... the one which is at the same time the simplest in hypotheses and the richest in phenomena, as might be the case with a geometric line whose construction was easy but whose properties and effects were extremely remarkable and of great significance" (1989:39). God "has chosen the best possible plan in producing the universe, a plan which combines the greatest variety together with the greatest order ... with the greatest effect produced by the simplest means" (Rescher 1991:195).

This best of worlds features a greater "quantity of reality" than the alternatives. See Griffin 2013:50-51. But for Leibniz this reality or "perfection" is not (1973:146) "located in matter alone, that is, in something filling time and space, whose quantity would in any way have been the same; rather it is to be located in form or variety. So it follows that matter is not everywhere alike, but is rendered dissimilar by its forms; otherwise it would not obtain as much

variety as it can.” In short, the best of worlds exists most fully because it is “richest” in differentiated structure.

However structural richness alone is not enough. The “hypotheses” that generate and govern the optimal world – its physical laws and initial conditions – also have to be few, simple, and uniform (collectively “simple”). The Mandelbrot set (see Fig. 1) shows how simple laws can produce great structural richness. Indeed, a certain degree of simplicity may be essential for that purpose. See Wolfram 2002:22-50.

Figure 1



A small region of the Mandelbrot set, a complex fractal created by a simple rule.

Simple laws make it possible to “find[] a place for as many things as can be put together: if [God] made use of other [more or more complex] laws, it would be like trying to make a building with round stones, which make us lose more space than they occupy” (Leibniz 1970:211). Numerous diverse phenomena cannot be “put together” in a way that lets them interact to form more complex structures unless their world is lawful. And Leibniz was the first to note that lawfulness demands simplicity:

[L]et us suppose for example that someone jots down a quantity of points upon a sheet of paper helter-skelter.... [I]t is possible to find a geometrical line whose

concept shall be uniform and constant, that is in accordance with a certain formula and which ... shall pass through all of those points ... in the same order in which the hand jotted them down.... But when the formula is very complex, that which conforms to it passes for irregular. Leibniz 1989:39.

In other words, no line can be “helter-skelter” in the eyes of an all-knowing being: Some sufficiently complicated algorithm will always govern its movement. But no observer can see a line as orderly unless a rule can be framed that predicts its changes of direction. And no observer can frame such a rule or even know that one exists unless it can be derived from available information. In the case of Leibniz’s line, this can only be its prior changes in direction; in the case of a world it can only be changes observed in the world. Thus, no self-contained physical system (*e.g.* no world) can be lawful – orderly in itself – unless its laws can be derived from information it contains. In reaching this conclusion, Gregory Chaitin (2003:3) writes, Leibniz explained “what it means to say that Nature is lawful and what are the conditions for empirical science to be possible.” For, as physicist Herman Weyl explains (*ibid*), “the notion of law becomes empty when an arbitrary complication is permitted....” These are statements of what it means for a world to be lawful, but Leibniz said the best of worlds would go beyond this requirement. It would (1710 § 208) be *optimally* rich and simple, “the most productive in relation to the simplicity of its ways and means.”

Leibniz’s account of the best of worlds drew on Aquinas’ (1270:XLIV) quasi-Platonic dictum: “[T]he best thing in creation is the perfection of the universe which consists in the orderly variety of things.” But Leibniz recast this idea in fundamental ways. His idea of phenomenal richness did not celebrate a fixed set of substances; it required as many different

“distinctly thinkable” (1973:146) structures as possible. He said, in effect, that Earth’s stable of brown, black, and palomino horses – some big and fast, others slow and small – created more reality than if all the planet’s horses had platonically “perfect” conformations. The notion of a Form for mud had discomfited Plato, but Leibniz held that even mud added to a world’s richness: “Every bit of matter can be conceived as a garden full of plants or as a pond full of fish. But every branch of the plant, every member of the animal, every drop of its bodily fluids is again such a garden or such a pond” (1714 § 67).

Plato prioritized being over becoming, but Leibniz (Strickland 2006:129) held that a constantly changing world would contain “more kinds or forms of perfection [than a static one], even though they may be equal in degree.” To the argument that change must either be for the worse or imply a present lack he replied (*ibid* 130), “[T]he best may be changed into another which neither yields to it nor surpasses it.” Plato saw his world’s arrangement of Forms as orderly; for Leibniz “order” demanded simple laws that govern change.

Leibniz gave two reasons for thinking that optimum richness (being) and simplicity (order) would maximize value. The first descended from Plato and paralleled Aquinas’ claim that “good and being are the same really” (1271:P1Q5A1). Leibniz (2006:85) put it this way: The best possible world is the one “through which the most essence [being] and the most perfection is obtained that it is possible to obtain together....” This formulation demands a rich and orderly world but places rational beings in the role of the mirrors at Versailles: The palace was not built for us alone but we multiply its beauty by reflecting and refracting it, each from our own, unique perspective. “If God had no rational creatures in the world, he would still have

the same harmony, but simply without an echo, and the same beauty but simply without reflection and refraction or multiplication” (Strickland 2006:106).

Our enjoyment of the world’s beauty also adds to its value. This enjoyment derives from the world’s simplicity and richness: “Variety delights, but only when it is reduced to a unity, symmetrical, connected. Agreement delights, but only when it is new, surprising, unexpected...” (Rutherford 1995:13). The optimal combination creates “a cosmos, full of ornament ... made in such a way that it gives the greatest satisfaction to an intelligent being” (1973:146). On this second argument, the world has value because it is experienced.

Figure 2



A small region of Earth’s biosphere

3. Optimalism and its critics

Optimalism’s opponents fall into two camps: those who deny that any world could be optimal and those who gleefully show why this world is not.

Following Aquinas’s lead, Plantinga (1977:61) argues that no possible world can maximize happiness (or any other value): “[F]or any world you mention, replete with dancing girls and deliriously happy sentient creatures, there [could be] an even better world, containing

even more dancing girls and deliriously happy sentient creatures.” Like the words “highest possible number” the words “best possible world” describe a notion that cannot logically exist.

However this objection only applies to certain “best world” claims: those in which the best of worlds must have or be “the most” of some one source of value, with no reference to any other. It does not apply when two or more criteria or sources of value are in tension with one another. In this case we cannot maximize one or another; we must instead utilize an optimization process. If lions cannot be made stronger and antelope fleeter *at the same time and in the same place* – perhaps because fleeter antelope would deprive lions of a meal – we need to balance these goals. In such cases, the optimal result is not typically obtained by maximizing one input but rather by seeking the best compromise, the best way of arranging or blending the relevant factors. See Strickland 2005.

On Leibniz’s approach, finding the best possible world would require optimization. As Nicholas Rescher (2013:27) explains, “a striking feature of Leibniz’s criterion of world perfection that the two operative factors are *opposed* to one another and pull in opposite directions. Rescher (28) calls this Leibniz’s “*conflict-admitting two-factor criterion*” of optimality, and emphasizes its difference from claims that the best of worlds would maximize some single factor.¹ If optimality lies at a juncture of two or more conflicting requirements (in this case, simple laws and rich phenomena) adding more of either could not improve an optimal world; it could only make things worse. Plantinga’s “no best world” objection does not apply to this claim or to any other that is focused on finding a best combination rather than on piling up more and more.

¹ Emphasis in all quotations is in the original.

William Mann (1991:250-77) offers a different objection: No possible world can be best because worlds can be good in different and incommensurable ways. In one a girl might choose to become an opera singer, bringing joy to millions; in another she might work in a hospice, serving the poor. Mann argues that Opera world is not better than Hospice world, nor is it worse, nor are they equal in value. They are simply incomparable. Mann does not say that every possible world is incommensurable with every alternative. He envisions an Opera-plus-*Tosca* world in which his heroine gives one more performance of *Tosca* and argues that this world and Opera world would be comparable: Opera-plus-*Tosca* world would be better. But when we try to compare Opera-plus-*Tosca* world with Hospice world we are no better off than we were before. This leads him to say that possible worlds come in clusters, with comparison possible in each cluster, but that “[n]ot even an omniscient being can rank two worlds from different clusters, for there is nothing on which to base the ranking.” *Ibid* 271. To see how Leibnizian optimality fares against this objection we need to place it in a modern context.

As a description of our actual world, Leibniz’s account was perspicacious. Nobelist Murray Gell-Mann writes (1994:99-100), “[I]n an astonishing variety of contexts, apparently complex structures or behaviors emerge from systems characterized by very simple rules.” Physicist Seth Lloyd (2007:176) agrees: “Although the basic laws of physics are comparatively simple in form, they give rise, because they are computationally universal, to systems of enormous complexity.” Reviewing a series of such comments, Rescher concludes (2013:139) that leading scientists have “found their way back into a Leibnizian state of mind; simplicity, fertility and lawful order are now, once again, at the fore of scientific theory.”

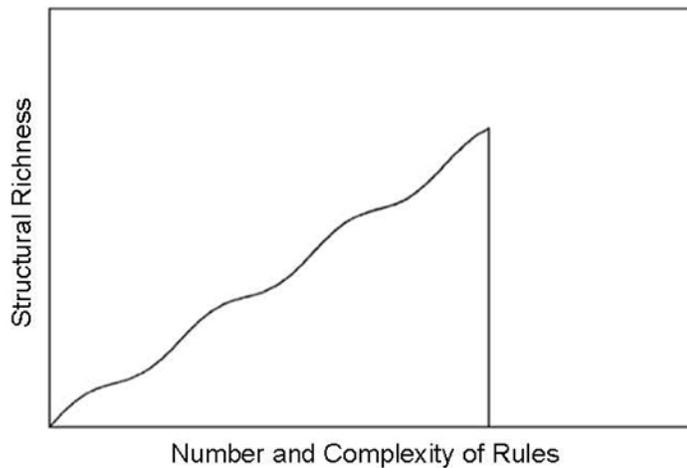
This new “state of mind” is grounded in empirical knowledge, but also in the information theoretic character of Leibniz’s thought. Physicists increasingly see the world in informational and computational terms. Seth Lloyd (2007:3) writes, “The universe is made of bits [binary digits]. Every molecule, atom, and elementary particle registers bits of information. Every interaction between those pieces of the universe processes that information by altering those bits.” Leibniz’s simplicity and richness criteria address the information content of phenomena and the laws that govern them. Each criterion is quantifiable. Simplicity is standardly measured as *Kolmogorov-Smirnov-Chaitin (K-S-C) complexity*, while *the variety of the system* (or just *variety*) measures structural richness in a way that distinguishes it from both repetitive order (as in a crystal) and chaotic disorder (as in a hot gas). K-S-C complexity is defined as the length in bits of the shortest computer program that completely replicates or describes the measured item. Variety defines structural richness by the relation of its elemental components with respect to each other. “It measures, in a certain sense, how unique, one from another, the different parts of the system are.” Barbour and Smolin 1992:3; see also Barbour 2003. Because of their information theoretic character, these measures have the same meaning in all possible worlds.

Since Leibniz’s claim balances two opposing features Mann’s objection applies to it, but not in the way his example depicts. If the same physical laws governed Opera world and Hospice world, those two worlds *would be* commensurable on the simplest/richest standard: The one that, over its history, was richest in phenomena would be the higher value world. However, if the laws of physics differed between these worlds, the commensurability problem would return. If world A were slightly richer than world B but B had slightly simpler laws, how

could we say which was better? Leibniz (1973:108) thought that only one could be best and that God would choose that one, but he could not specify which it would be: “[F]or how can I know and how can I show you infinities and compare them?” Looked at from *our* perspective rather than God’s his richest/simplest claim falls to Mann’s objection, for it offers no standard by which to discern which world is highest in the hierarchy of possibilities.

Physicist Max Tegmark (1998:7) depicts the problem graphically. Figure 3, derived from one he drew after investigating structure in many fields of mathematics,² depicts the conflict between the simplicity of a world’s rules and its structural richness. As the wavy, ascending line suggests, more and more complex rules are needed to generate greater richness *up to a point*. But after that line reaches a peak richness declines; overly complicated rules wipe out more of it than they create.

Figure 3



² I have relabeled the axes for clarity only. The term “rules” refers to a world’s laws and initial conditions.

Figure 3 accords with Leibniz's claim that richness requires somewhat simple rules (for it drops precipitously to the right of the peak) *and* with his belief that simplicity is in tension with structural richness (for the two are in tension to the left), so it graphically depicts the impossibility of determining optimality on his claim. If optimality requires a balancing of simplicity and richness the best possible world must lie somewhere left of the peak. (If the optimal world were *at* the peak simplicity could play no countervailing role. In that case, Plantinga's objection would prevail.) However, nothing in Leibniz's writings tells us *where* it would lie. The true desideratum of Leibniz's system, "perfection" or "value," is never precisely defined, and the naked words "best" or "most perfect" do not tell us how to combine the simplicity and richness criteria. Each point on the ascending line is, in its own way, as good a candidate for optimality as all the others. In this sense, they represent worlds of incommensurable value.

Finally, we reach the objection most often raised against Leibniz. Voltaire savaged the German polymath not on any logical ground but on his conception of value. Rather than denying that any best world could exist, Voltaire asked how our world could be best, no matter what standard of value Leibniz had in mind. In essence, Voltaire showed that we cannot use the word "best" to mean whatever we wish. A world can only be optimal, indeed it can only be good, if it meets some humanly plausible standard of value.

Leibniz's arguments were inadequate to this attack. By the mid-18th Century, the Platonic view that had always linked the world's profusion of being with God's goodness and love had given way to a more anthropocentric understanding of value. See Hick 1966:77. And the claim that natural beauty appeals to rational minds, while no doubt true, has always been

“far away from the everyday concerns of most human beings.” Ekeland 2007:42. In the marketplace of ideas Voltaire’s argument prevailed, and it still stands as a caution to anyone who claims that a certain sort of world would be best: A persuasive axiarchic claim needs to be grounded in a *compelling* understanding of value, one not easily derided. This paper will advance consciousness as that source of value and a world’s openness to it as the measure of its value, but first we need to ask what consciousness is and where it might come from.

4. Consciousness as integrated information

The question of how we come to be conscious remains in dispute. The question concerns *phenomenal consciousness*, which exists whenever there is something “it is like” (Nagel 1974) to be an entity.³ Phenomenal consciousness (hereafter just “consciousness”) presents as a succession of *qualia* (*sing.* quale). Any subjective sensation – a pain in the toe, an image in a dream – is either a quale or an element of one. So the question can be restated this way: How do we and other animals come to have qualia?⁴

An adequate theory of consciousness must resolve two problems: First, matter and conscious perception seem quite different. Leibniz (1714 § 17) wrote, “In imagining that there is a machine whose construction would enable it to think, to sense, and to have perception, one could conceive it enlarged while retaining the same proportions, so that one could enter into it, just like into a windmill. Supposing this, one should, when visiting within it, find only parts pushing one another, and never anything by which to explain a perception.” This thought

³ Van Gulick (2014: §9) briefly describes theories of phenomenal consciousness now on offer. Boly *et al.* (2013) focus on those with scientific currency.

⁴ The Cambridge Declaration on Consciousness (Low, *et al.* 2012) affirms that consciousness is widespread in the animal kingdom. See also Sneddon 2014 and van Swinderen 2005.

experiment asks how a causal link between matter and consciousness could possibly work. Even today there is no agreed answer.

Second, perceptions are singular and coherent; they are, in Leibniz's words (1714 § 1), "without parts." When you see a red rose or a yellow pear you do not see the red and then the rose or the pear and then the yellow. Nor do you see their colors and shapes on different internal screens, as if they were field reports from distinct locations. You see only an integrated image. But eyes, ears, and brains are – like mills – divisible mechanisms. How can interacting parts create *unified* perceptions?

Neuroscientist Giulio Tononi offers a theory that, if it is right, would answer both questions. His *integrated information theory* (IIT) says that consciousness requires a physical apparatus but is not reducible to it. Consciousness is a fundamental property of nature that manifests locally whenever a certain type of apparatus (a *complex*) produces *integrated information*. Integrated information (Tononi 2010: 300) is

associated with every causal mechanism capable of choosing among alternatives.... [I]ntegrated information is high if a system's mechanism can generate a large amount of information *and* this information is integrated. High information means that a system's causal mechanisms can specify precisely which out of a large repertoire of potential states could have caused its current state. High integration means that the information generated by the system as a whole is much higher than the information generated by its parts taken independently.

Information in IIT is any reduction in the uncertainty as to which of a system's possible prior states caused its present state. Unlike Shannon information, it is "an intrinsic, observer-independent property" of the system. *Ibid* 301. Shannon information assumes the existence of a (presumably conscious) sender and receiver outside the system being studied; information as defined in IIT does not. Like Shannon information, however, it is measured in bits. Integrated information, represented as Φ (*phi*), is "the amount [in bits] of information generated by a complex of elements above and beyond the information generated by its parts." Tononi 2008: 216. For an apparatus to be a complex there must be no way to break it into parts that, separately or together, would generate as much information as the whole.

Two thought experiments illustrate this theory. First, place a photodiode in front of a screen that can be made light or dark. The diode consists of a sensor that produces current in response to light and a detector that switches on and off when the current exceeds or falls below a threshold. You also sit facing the screen.

The first problem of consciousness reduces to this: when you distinguish between the screen being on or off, you have the subjective experience of seeing light or dark. The photodiode can also distinguish between the screen being on or off, but presumably it does not have a subjective experience of light and dark. What is the key difference between you and the photodiode? *Ibid* 217.

For IIT, the difference involves the number of possible states available to the system. The photodiode can only process one bit of information, turning an output on or off. Since it has no internal context it can distinguish only an undifferentiated "this" from a nearly identical "that." Its range of experience is irreducibly small. By contrast, we have experience of vastly

many events and causal relationships, so we can compare the dark or lighted screen with all of this past experience. When “we see ‘light’ in full consciousness ... we simultaneously specify that things are ... light as opposed to dark, that whatever we are discriminating is not colored (in any particular color), does not have a shape (any particular one), is visual as opposed to auditory or olfactory, sensory as opposed to thought-like, and so on.” *Ibid* 218.

Different systems have different capacities for such distinctions and associations. On IIT, “[e]ven simple matter has a modicum of Φ . Protons and neutrons consist of a triad of quarks that are never observed in isolation. They constitute an infinitesimal integrated system.” Koch 2012:132. Helen Keller, blind and deaf from birth, recalled a time of limited consciousness: “Before my teacher came to me, I did not know that I am. I lived in a world that was a no-world. I cannot hope to describe adequately that unconscious, yet conscious time of nothingness.... Since I had no power of thought, I did not compare one mental state with another.”⁵ She began to emerge from this “unconscious, yet conscious time of nothingness” only when her teacher taught her to associate water’s wetness with the word “water” traced on her arm.

A typical life experience endows a person with a vast repertoire of possible brain states, capable of representing an equally vast range of possible distinctions. In combination, these let us identify a lighted screen or another perception for the thing it is. The brain’s actual and possible states – both those that represent features a stimulus has and those that represent features it lacks – contribute to the quale it engenders.

⁵ Quoted in Rothblatt (2014:14) from a speech Keller gave in 1908.

Information is essential to consciousness, but insufficient. A digital camera is a collection of photodiodes, each signaling “on” or “off,” “1” or “0,” at every snap of the shutter. A camera with a sensor chip consisting of a million diodes is capable of distinguishing among $2^{1,000,000}$ alternative states; yet, for IIT, the camera is not conscious at all. Tononi (2008: 218-19) explains the difference.

From the point of view of an external observer, the camera may be considered as a single system with a repertoire of $2^{1,000,000}$ states. In reality, however, the chip is not an integrated entity: Since its 1 million photodiodes have no way to interact, each photodiode performs its own local discrimination between a low and a high current completely independent of what every other photodiode might be doing.... [T]here is no intrinsic point of view associated with the camera chip as a whole.

The “difference” reported by each diode makes no difference to the others. By contrast, our cerebral cortex is highly interconnected, capable of storing and combining information from many diverse sources. The “difference” reported by each neuron makes a difference to many others. Integration is then the second requisite of consciousness: “[T]o generate consciousness, a physical system must be able to discriminate among a large repertoire of states (information) *and* it must be unified; that is, it should be doing so as a single system, one that is not decomposable into a collection of causally independent parts (integration).” *Ibid* 219. It “must [220] be connected in such a way that information is generated by causal interactions *among* rather than *within* its parts.” That is why a mere

collection of data – a camera or a hard disk – lacks any semblance of consciousness, while the taste of a madeleine can generate a procession of human reflections.

In IIT each quale is a mathematical shape. “The many mechanisms of a complex, in various combinations, specify repertoires of states they can distinguish within the complex...: Each repertoire is integrated information – each an irreducible concept. Together, they form a shape [an n-dimensional polytope] in qualia space.” Tononi (2012:216). A larger repertoire of possible states produces polytopes of greater complexity, in more dimensions, equating to more detailed, more “perceptive” perceptions. The information content of each polytope (its Φ) is the quantum of consciousness the complex is generating at that moment. The shape of each polytope is the quality of that consciousness. Its representation of qualia as shapes, albeit in qualia space, helps IIT to bridge the conceptual gap between qualia and brain structure.

A complex always produces more information than its parts, and this “extra” holistic information can effect downward causation on the organism to which it belongs. In a high $\langle\Phi\rangle$ (average Φ) complex this extra information can (Tononi 2010:310) guide complex behaviors.

[A]n organism with a brain generating high $\langle\Phi\rangle$ in an environment rich in long-range spatial and temporal correlations, can respond to environmental situations with highly context-sensitive actions. In this way it can be far more flexible than an organism equipped with a set of informationally separated processors, each of which has limited scope and understanding of the situation it finds itself in.

In a causally rich environment, the power of conscious understanding to effect downward causation would be an asset in the Darwinian struggle, which would in turn sharpen this asset. Like other empirical claims made by IIT (see section 5 below) the claim that

consciousness is most valuable when “long-range temporal and spatial correlations” are important has empirical support. van Gaal, *et al.* 2012.

In summary: IIT agrees with Chalmers’ (1996:305) claim that “Experience is information from the inside; physics is information from the outside.” It adds that, for any experience beyond the most basic, “inside” means inside a complex. Rolf Landauer (1996:188) offers a universal principle: “Information ... is always tied to a physical representation.” IIT posits a similar link between information and consciousness, one that, like Landauer’s, does not depend on the laws of physics peculiar to our universe. And with Douglas Hofstadter (1999:P-4), IIT claims that “the key [to consciousness] is not the *stuff* out of which brains are made, but the *patterns* that can come to exist inside the stuff of a brain.” Its claim that consciousness is *substrate independent* has an important implication: If patterns alone create consciousness they must do so regardless of the physical laws that bring them into existence. One set of physical laws might be better than another at supporting the evolution of complexes, but qualia-level consciousness in all possible worlds arises from, and only from, the integrated information that complexes produce. Concepts like simplicity and richness are meaningful in all possible worlds because they are information theoretic. IIT also rests on purely information theoretic relationships and is therefore, if true, equally universal.

5. IIT and its critics

Until very recently, investigators of consciousness could not even agree about what the problems were or what facts were relevant to them. And despite recent progress, the question of what consciousness is still has no agreed answer. Neuroscientist Christof Koch (2012:121) explains that only a *prescriptive* theory can clarify this confusion. To be prescriptive a theory

must give the necessary and sufficient conditions for consciousness to occur. It “must quantify consciousness, linking specific facets of neuroanatomy and physiology to qualia, and explain [for example] why consciousness wanes during anesthesia and sleep.” *Ibid.*

For Koch, only IIT or some theory much like it can do this. IIT (130) “not only specifies the amount of consciousness, Φ , associated with each state of the system. It also captures the unique quality of that experience,” explaining why one quale is unlike another. In both ways it goes beyond merely descriptive theories, those that claim consciousness occurs in certain brain regions or under certain neural conditions without explaining why it occurs in these regions or conditions and no others.

To date, IIT accords with experience. The most tightly networked region of the human brain, the corticothalamic complex, is essential to our consciousness while less interconnected regions (*e.g.*, the cerebellum) are not. IIT also explains why our consciousness diminishes in predictable ways when parts of the former region are removed or their interconnections are lost. As the theory predicts, this diminution comes in chunks. Severing the corpus callosum, the bridge between the hemispheres of the brain creates two distinct consciousnesses where there was one before. This comports with the theory’s prediction that two independently conscious complexes will merge into a single consciousness when integrated. When subjects are in more conscious states more brain regions participate in the response to a magnetic stimulus, comporting with IIT’s claim that integration and consciousness are linked. Casali *et al.* 2013.⁶ A review article (Boly *et al.* 2013:10) concludes that “TMS-EMG studies ... have indeed

⁶ Tononi (2015 § 5) discusses these and other confirming results.

suggested that consciousness should necessarily require both neuronal activity integration and differentiation.” “Typically, high conscious levels are associated with an increased range of conscious contents.” *Ibid* 2. The authors note that, following Tononi, theorists now offer other “approximations of measures of information integration.” *Ibid* 10. But the differences among these formalisms are immaterial to our topic, so IIT will stand as proxy for them all.

Some critics deride IIT’s claim that a photodiode can create a single bit of consciousness. However, Φ is a digital quantity. Much as the relations among zeroes and ones in an electronic medium define a bar of digital music or the relations among physical atoms define a physical structure, the relations among binary events define a quale. The fact that one such event, creating one bit of consciousness, is not already a quale does not count against the theory. Other critiques rest on misunderstandings,⁷ or even highlight the theory’s strengths. Anthony Peressini’s criticism is of the latter sort. He agrees (2013:24) that IIT provides “a philosophically defensible and potentially ground breaking empirical framework for investigating the qualitative properties of experience,” but he goes on to argue that it is not a complete theory of consciousness. It offers a way to mathematize qualia – by describing them as polytopes in qualia space – but it does not explain why we experience anything, why there is “something it is like” to be conscious.

Peressini seems to think that a complete theory would offer an intervening mechanism between events in the physical world and conscious experience. He faults IIT for not providing one. But this critique assumes that some theory of consciousness *could* provide such a

⁷ Searle (2013) conflates information as defined in IIT with Shannon information. Cerullo (2011) conflates the quantity of Φ with its quality.

mechanism while Leibniz's thought experiment suggests that this is impossible. Chalmers (1996) agrees, arguing the point at length. If physical events can nevertheless instantiate experience, it must be because they are experience already. The only current theory that explains how this might work is IIT, which treats conscious experience as being already "information from the inside," removing any need for a further link between it and physics ("information from the outside").

This parsimony makes IIT a potentially universal theory. Whatever mechanism another theory tried to fit "between" events and experience would likely differ in different worlds. A theory of consciousness that required a linking mechanism would therefore differ from world to world. But IIT is not like that. Because it depends directly on the twofold nature of information, IIT would, if true, apply in all possible worlds.

6. Consciousness as a value-creating feature

Might consciousness be the value-creating feature the axiarchic view needs to get off the ground? We can begin to answer that question by asking what intrinsically valuable goods a world could offer its inhabitants. William Frankena (1988:87) suggests these among others: health and strength; happiness; knowledge of various kinds; beauty, harmony, and proportion; mutual affection, love, and friendship; freedom, self-expression, and adventure. They and the others he lists have this in common: Each is a form of conscious experience. Indeed, "it is the *experience* of them that is good in itself" (*ibid* 92).

Writers have long argued that conscious experience is the only intrinsic value. Epicurus taught, "Not what we have but what we enjoy constitutes our abundance." Neuroscientist

Sam Harris (2014:186) agrees: “Everything we do is for the sake of altering consciousness.”

When Rupert Brooke recalls:

White plates and cups, clean-gleaming,
Ringed with blue lines; and feathery faery dust;
Wet roofs beneath the lamplight; the strong crust of
Friendly bread; and many-tasting food...

or when, in *The Sound of Music*, Maria sings about

Raindrops on roses and whiskers on kittens
Bright copper kettles and warm woolen mittens

they are not celebrating the *noumena* of bread or mittens but their phenomenal experience of them.⁸ In mutual affection, love, and friendship, we value our experience of another person and wish to alter her consciousness by making her happy. Without conscious experience, none of this value could exist.

Consciousness is no value-neutral sea in which waves and troughs of value and disvalue appear. We value our capacity for experience as much or more than we value any specific experience. Thomas Nagel (1979:2) writes, “There are elements which, if added to one’s experience, make life better; there are other elements which, if added to one’s experience, make life worse. But what remains when these are set aside is not merely neutral: it is emphatically positive.... The additional positive weight is added by experience itself, rather than by any of its contents.” The billions of dollars we spend each year to keep severely ill patients

⁸ Psychologist Nicholas Humphrey (2011:80-124) quotes these and many other lines that celebrate conscious experience. The Brooke poem is “The Great Lover.”

alive reveal our preference for conscious experience, even when it is painful, over permanent unconsciousness.

Consciousness is not restricted to humans; other animals enjoy it as well. Their experiences have value to them (negative or positive) just as ours do to us. Non-human animals may not foresee the absence of consciousness that death will bring, but no one who has ever thrown a stick to a dog can doubt that they enjoy their present conscious existence. Ethologist Marc Bekoff (2007:19) writes that animal joy “is the purest and most contagious of joys....” Some animals enjoy richer experiences than others, but a capacity for feeling goes far down. See Bateson, *et al.* (2011) (evidence of depression in bees).

Experience creates both value and disvalue, but the balance is plainly positive. Even proponents of the problem of evil proponents rarely dispute this point. (David Benatar (2006) is one of the few who denies this, arguing that pain and suffering more than offset the value of coming into conscious existence. But his arguments are flawed, culturally bound, and attribute no value to consciousness when its contents are painful. See, *e.g.*, Cabrera (2011) and McLean (2014).) On the other hand, if something created more net value than consciousness it might better serve as our value-creating feature. Life and intelligence have been proposed for this role, but neither fills the bill.

On IIT, consciousness is a fundamental property of nature; its basic characteristics, like unity and immediacy, are universal. The same cannot be said of life. Indeed, one objection to making life our measure of value is that the word “life” has no generally accepted meaning. Exobiologist Chris McKay (2004:302) writes, “[W]ith only one example of life—life on Earth—it is not all that surprising that we do not have a fundamental understanding of what life is. We

don't know which features of Earth life are essential and which are just accidents of history.” Even on Earth the line between living and non-living entities is blurry: Is a virus alive? What about a computer virus? When it comes to comparing worlds with differing laws of physics the definition problem is vastly worse. With no universal definition of life how could we say where it might exist and where it might not? Moreover, life has no quantitative measure. Do we count cells, organisms, or species? By contrast, IIT measures Φ in bits, which are the same in all possible worlds. We therefore know that, *in principle*, the support that worlds provide to consciousness could be placed on a single scale.

Even if we had a definition of life, it would still be only a special configuration of atoms. Why should a “lifelike” configuration be more valuable than any other? Is an ant more valuable than the Mona Lisa? We cannot say that all kinds of life are equally valuable: Even within the kind that exists on Earth a carrot cannot compare with an elephant. The most plausible standard for comparison, the one most consistent with our intuition of value, is the degree to which each lifeform is conscious. Some religious traditions make this explicit. Jains, for example, follow the precept of *ahimsa*, which requires reverence for life but demands more respect for beings they classify as “five-sensed” (birds and mammals) than for “two-” or “three-sensed” animals like insects or worms, or “single-sensed” creatures like microbes. Dundas 2002:161. In essence, *ahimsa* demands more respect for more conscious creatures. This is a plausible standard, but adopting it would suggest that what we really value is consciousness and life is only a proxy for it.

Intelligence is another possible measure of value, but making it our value-creating feature seems anthropocentric, a rightly ridiculed viewpoint. On IIT, making consciousness our

value-creating feature avoids anthropocentrism; for consciousness exists far more broadly than intelligence, not only in animals but primitively in photodiodes and subatomic particles. In any event, we do not behave as if intelligence had intrinsic value. We value our own intelligence mainly because it lets us access experiences we otherwise could not have. It can do this either directly (*e.g.* by letting us see a beautiful solution to a chess problem) or indirectly (*e.g.* by helping us to make money for a vacation). But absent consciousness or its simulacrum, we place no particular value on intelligence *per se*: Few would dispose of a pet just to obtain a more capable model, but we routinely do that with computers.⁹

Finally, consciousness is not a monochromatic substance; it is an ever-changing mosaic. As multifarious structures change and interact, so do the complexes observing them. Qualia are assessments of these changes, each different from all the others. Crucially, every conscious being (complex) views the world from a unique perspective; this means that, as Leibniz saw (1714 § 57), each one adds something new. No law of diminishing returns applies here, as might well be the case with life or intelligence. A single world can, in effect, contain as many unique “worlds” as it contains complexes.

7. C-optimality

We can define a “world” as an informationally isolated, causally interconnected region of spacetime. Many worlds may exist or just one; our universe may or may not be “everything that is.” Because we cannot measure the total consciousness in a world we cannot predicate a testable claim on such a measurement. However, if a world looked to be capable of producing

⁹ Contrast our indifferent attitude to most computers with the fact that even simple simulations of consciousness, as in the Tamagotchi game, can engage our emotions.

as much or more total Φ and at least as varied a set of qualia as any identifiable, self-consistent alternative it would be or be among the best of worlds. We can call such a world *c-optimal*. Our ability to distinguish among worlds on this basis may evolve over time, so a world that looks to be c-optimal now may not later, but that is how progress in science occurs. On this definition, ties are possible: Two or more worlds could be so similar in their support for consciousness as to be indistinguishable in that respect.

This definition of c-optimality focuses on a world's capacity for consciousness. The fact that conscious beings (*e.g.* conscious angels) might be added to a world by hand (by a divine Being) or by stipulation (by a philosopher) neither undercuts nor sustains a world's c-optimality, since such additions might occur in almost any world. Moreover, such additions cannot reliably produce net improvement, in a world's total consciousness or anything else. See Rescher 2013:146-169.

While a number of possible worlds might be c-optimal, all would share certain characteristics. We can develop a preliminary list of these by reconceiving the information theoretic conditions (**C**) for consciousness that IIT imposes as requirements (**R**) of c-optimality. It may be that no possible world can meet every requirement fully (indeed, we should expect that result), but no world can be regarded as c-optimal if its non-maximization of a requirement cannot be not amply justified.

C1: The "raw material" of consciousness, non-Shannon information, is recorded causation.

R1: Recorded causation can only reliably come to exist in a law-governed world, so *a c-optimal world must be lawful*. A "lawful" world is one where the laws of nature can be derived

from information present within the world: that is, one that comports with the Leibniz/Chaitin/Weyl simplicity requirement. (This requirement further vitiates the claim that consciousness might be added by hand or by stipulation.)

C2: Qualia (as opposed to bits of consciousness) occur only in complexes and these are highly structured entities.

R2: In a lawful world, structures can only arise through lawful processes, so *the laws of a c-optimal world must optimally facilitate the evolution of complex structures.*

C3: Complexes are integrated structures; their substructures must communicate.

R3: *The laws of a c-optimal world must optimally facilitate communication.*

C4: Consciousness requires preservation of recorded (past) experience (**R1**).

R4: There can be no needless impediment to the preservation of recorded experience (information). Thus, *the laws of a c-optimal world must optimally conserve information.*

C5: To be conscious, complexes must be able to differentiate experiences and to learn from them. This they will not be able to do unless events are somewhat predictable.

R5: *The world's laws must be few and simple enough in their effects to permit evolving creatures to learn from experience.*

C6: IIT puts no ceiling on the growth of consciousness.

R6: Since consciousness requires learning from experience and the optimal learning process would be unconstrained, *a c-optimal world must be as vast, rich, and long-lasting as any world can be.*

As to **R6**, in the science of complex systems “the complexity of the organism has to match the complexity of the environment at all scales in order to increase the likelihood of

survival.” Bar-Yam 2004:67. And “the presence of a more complex brain, with stronger hierarchical connectivity, likely correlates with both the presence of more complex cognitive processes and with potentially higher levels of consciousness.” Boly *et al.* 2013:9. Selection pressures of all kinds could affect the widest possible range of structures only in a vast, vastly rich, and long-lasting world.

The resemblance between the world these requirements describe and Leibniz’s best of worlds is apparent. **R1**, **R3**, and **R5** (and likely **R4**)¹⁰ press toward simplicity, while **R2** and **R6** press toward richness. The result is Leibnizian, but here each component of that result exists for a specific reason. This may make it possible to find their optimal intersection(s).

8. Objections

Making a world’s support for consciousness the measure of its value overcomes standard objections to the possibility of world optimality and answers Voltaire’s argument that no suffering world can be optimal.

Plantinga’s objection

On IIT it is not the case that given any possible world another could enjoy more consciousness. C-optimality can be attained only by optimizing potentially countervailing requirements. As with Leibniz’s claim, this process cannot give rise to a topless tower in which every world could always be improved. While we may never know which possible world would

¹⁰ In a world that preserves information events would be computationally reversible; that is, it would be possible in principle to retrodict the world’s former state from its present state. Most possible rules of change do not allow this. Wolfram (2002:436) examined 256 of the simplest rules by which one row of cells generates another. He found 6 to be reversible (knowing row 3 lets us retrodict row 2, etc.), about 2.3%. But out of about 7.6 trillion slightly more complex rules, only 1,806 were reversible, ~100 millionths of 2.3%.

be the absolute best at promoting consciousness, our ignorance on this point is not at all the same as the claim that no world logically could be.

Mann's objection

If support for consciousness is our sole measure of world value there can be no alternative measures that might make diverse worlds incommensurably good. Some possible world could stand at the highest point on this scale. The fact that more than one possible world might, from our point of view, look to be equally potent at promoting consciousness does not make them incommensurable in Mann's sense; it simply makes us ignorant of their relative scalar value.

Voltaire's argument

Conscious experience can be horrific, unpleasant, or boring. Must not a search for axiological optimality take the pains and pleasures of alternate worlds into account along with the consciousness each might offer? Consider possible worlds A and B. World A has slightly more consciousness but vastly more creaturely pain than world B. It seems therefore to be *less* valuable than B, which has slightly less consciousness but vastly less pain. This suggests that consciousness cannot be the only measure of a world's value. But this conclusion misses critical points.

First, for reasons explained above, even painful experience is mostly felt to be better than none at all. Only world A's *disproportionately* greater suffering makes it seem worse than world B. Absent the condition that A has only "slightly" more consciousness but "vastly" more suffering than B we would likely not intuit that B is better. For example, if a more conscious

world experienced only *proportionately* more suffering than a less conscious one we would not believe it had less value.

To prove that a c-optimal world could not suffer disproportionately more than a less conscious alternative may be impossible, but the notion nevertheless seems self-contradictory. First, pain limits consciousness: When we stub a toe our thoughts focus on our toe. This suggests that a world of pain would not be optimal on consciousness. Second, a world that includes vastly many complexes, each enjoying vastly many unique qualia, would need to be lush and fertile, qualities we do not associate with pain and suffering. Such a world would also have a vast range and number of unique structures, and these would change and evolve at all possible scales. Rules that prevented some structures from forming (because in some cases they could be harmful) would necessarily be complex and diminish the range of possible qualia. By contrast, more diverse phenomena would allow more “inquisitive play” (Wemelsfelder 2005:82), which all sentient beings require. A c-optimal world would closely resemble Leibniz’s best of worlds, so his argument from beauty can be deployed here as well: a c-optimal world’s vastness, diversity and beauty would heighten the consciousness of all who experience it.

Perhaps most importantly, consciousness is causal on IIT. Awareness of suffering often leads to its alleviation. Steven Pinker (2013: 690) argues that the “expanding circle” of empathy and the neutral, rational view he calls the “perspective of eternity” have tended to expand and gain credence over time. These heightened and broadened perspectives have often reduced both human and non-human animal suffering, and would likely grow most quickly in a c-optimal world. (The metaphors of “heightened” or “broadened” consciousness are appropriate here because the states of mind Pinker credits for diminishing violence are more information-rich

than more parochial ones. Empathy, for example, involves brain regions not active in its absence. Amodio & Frith (2006.) Exploring the world, acting to relieve suffering, and creating new forms of experience are also antidotes to boredom. Since these activities demand conscious choices they are more likely to occur in a more conscious world.

In the end, the objection that more consciousness would not create more value is plausible only if something else is better than consciousness. Yet no one could experience that “something else” without consciousness, making this a doubtful claim.

A c-optimal world is possible and would be best. Some requirements for c-optimality have been specified and these facially resemble the physical conditions that we observe. In a slight modification of the WAP, we could only become conscious in a world that supports consciousness, so this coincidence may be an observation effect. Or our world might indeed be c-optimal. The question of which explanation is true must be left for another time.

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