Chapter 14
The Consciousness of Reality

Abstract Finally, the human mind faces its own nature. By extending the information-theoretic paradigm, the informational nature of consciousness is uncovered. This gives rise to the very first formal description of consciousness. In attempts to bridge the chasm between the objective and subjective, scientists and philosophers have opened up to the unspeakable. The nature of consciousness, as has been suggested by ancient Eastern and shamanic traditions, is necessarily universal and primal. The notion of spirituality is creeping back into science. Moving towards a more empirical analysis, the enigma of intelligence is discussed, arising in decentralized systems and even in inanimate structures. Then, the surprising therapeutic effects of psychedelics is discovered, next to a myriad of transcendental planes of being, accessible to pure consciousness. Moreover, peer-reviewed studies are appearing in the physics literature describing mind-matter interactions in double-slit quantum experiments—a long suspected connection by many pioneers of quantum mechanics. As the cracks in the current edifice of science continually grow, the new information-theoretic paradigm is embraced. Beginning with an information ontology, a radical participatory ontology is hinted at. In essence, the human mind is witnessing the most radical paradigm shift in its own history. The well-served and previously glorious materialistic and reductionistic scientific worldview is yielding to a novel scientific conception of subjective consciousness and objective reality—and their unexpected intimate kinship.
Level of mathematical formality: low.

Consciousness is a truly puzzling phenomenon. For one, my own consciousness is the only element of existence I am personally aware of. Through the flow of subjective experiences I perceive an external reality and myself demarcated from it. I assume that other human minds—and to some extent non-human minds—experience a similar structure in this eternal moment of "now." Strangely however, the subjective itself is very hard to objectify. The totality of perception, including every memory, is notoriously unreliable and misleading (Chap. 11). How then, should one try to comprehend the fundamental nature of consciousness? Moreover, is the external world our senses are seemingly reporting to us about really "out there?"

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The latter question of how consciousness can acquire knowledge about the external world has a long history in philosophy. According to René Descartes and John Locke, a distinction needs to be introduced when thinking about material entities. In detail (Baggott 2009, p. 99):

> [P]hysical objects possess primary qualities such as extension in space, shape, motion, density, number, and so on, all underpinned by the concept of material substance. […] Secondary qualities such as color exist only in our minds and therefore cannot be said to be independently existing real qualities of physical objects.

This view is compatible with empiricism and rationalism (Chap. 9). However (Tarnas 1991, p. 335):

> Locke was followed by Bishop Berkeley, who pointed out that if the empiricist analysis of human knowledge is carried through rigorously, then it must be admitted that *all* qualities that the human mind registers, whether primary or secondary, are ultimately experienced as ideas in the mind, and there can be no conclusive inference whether or not some of those qualities "genuinely" represent or resemble an outside object.

Indeed (Baggott 2009, p. 100):

> Berkeley's logic is merciless but compelling. We can hold on to the idea of independently [of the mind] existing material substance, but at the cost of having to accept that we can ascribe no independently real properties to it, and can never hope to explain how this substance might give rise to the perceptions we have of it.

So, why do we appear to witness the same objective reality, if all things are intangible? For Berkeley it was clear (Tarnas 1991, p. 336):

> The reason that objectivity exists, that different individuals continually perceive a similar world, and that a reliable order inheres that world, is that the world and its order depend on a mind that transcends individual minds and is universal—namely, God's mind.

The next iteration in this line of reasoning came in the form of David Hume's skepticism (Tarnas 1991, p. 337):

> Like Berkeley, Hume could not accept Locke's views on representative perception, but neither could he accept Berkeley's identification of external objects with internal ideas, rooted ultimately in the mind of God.

He drove the critique of empiricism to its final extreme (Tarnas 1991, p. 339):

> [A] more disturbing consequence of Hume's critical analysis was its apparent undermining of empirical science itself, for the latter's logical foundation, induction, was now recognized as unjustifiable.
>
> […]
>
> If all human knowledge is based on empiricism, yet induction cannot be logically justified, then man can have no certain knowledge.

All is contingent. Hume's philosophy stimulated "Immanuel Kant to develop the central philosophical position of the era" (Tarnas 1991, p. 340). In effect, Hume awakened Kant from his "dogmatic slumber." The result was an existential blow (Tarnas 1991):

> In retrospect, the long-term consequences of both the Copernican and Kantian revolutions were fundamentally ambiguous, at once liberating and diminishing. Both revolutions awakened man to a new, more adventurous reality, yet both also radically displaced man—one from the center of the cosmos, the other from genuine cognition of that cosmos. [P. 348]
>
> […]
>
> In the wake of Kant's Copernican revolution, science, religion, and philosophy all had to find their own bases for affirmation, for none could claim a priori access to the universe's intrinsic nature. [P. 351]

In detail, Kant argued the following in his *Critique of Pure Reason* (Kant 1781). The *Transcendental Aesthetic* reads (translated by Meiklejohn 2003):

> From this investigation it will be found that there are two pure forms of sensuous intuition, as principles of knowledge a priori, namely, space and time. [§1]
>
> Space is nothing else than the form of all phenomena of the external sense, that is, the subjective condition of the sensibility, under which alone external intuition is possible. [§4]
>
> Time is nothing else than the form of the internal sense, that is, of the intuitions of self and of our internal state. [§7]
>
> […] if we take away the subject, or even only the subjective constitution of our senses in general, then not only the nature and relations of objects in space and time, but even space and time themselves disappear; and that these, as phenomena, cannot exist in themselves, but only in us. [§9]

In a nutshell (Tarnas 1991, p. 343f.):

> Space and time are thus not drawn from experience but are presupposed in experience. They are never observed as such, but they constitute that context within which all events observed. They cannot be known to exist in nature independently of the mind, but the world cannot be known by the mind without them.
>
> Space and time therefore cannot be said to be characteristic of the world in itself, for they are contributed in the act of human observation. They are grounded epistemologically in the nature of the mind, not ontologically in the nature of things.

A contemporary interpretation of this line of thought is provided by the philosopher Hilary Putnam. He pondered about the notion of brains in a vat (Putnam 1981):

> Here is a science fiction possibility discussed by philosophers: imagine that a human being (you can imagine this to be yourself) has been subjected to an operation by an evil scientist. The person's brain (your brain) has been removed from the body and placed in a vat of nutrients which keeps the brain alive. The nerve endings have been connected to a super-scientific computer which causes the person whose brain it is to have the illusion that everything is perfectly normal. There seem to be people, objects, the sky, etc; but really all the person (you) is experiencing is the result of electronic impulses travelling from the computer to the nerve endings. The computer is so clever that if the person tries to raise his hand, the feedback from the computer will cause him to "see" and "feel" the hand being raised. Moreover, by varying the program, the evil scientist can cause the victim to "experience" (or hallucinate) any situation or environment the evil scientist wishes. He can also obliterate the memory of the brain operation, so that the victim will seem to himself to have always been in this environment. It can even seem to the victim that he is sitting and reading these very words about the amusing but quite absurd supposition that there is an evil scientist who removes people's brains from their bodies and places them in a vat of nutrients which keep the brains alive.

The question now is (Baggott 2009, p. 105):

> So, could you be just a brain in a vat? If all your knowledge of the physical world around you is derived from your perceptions and your perceptions were being manipulated to give you the impression of reality, then how would you know otherwise?

Putnam tried to argue that the brain-in-a-vat scenario is impossible. His reasoning is based on the idea that brains are usually in causal connection with real objects in the real world, making the statement "I am a brain in a vat" a self-refuting proposition. Not everyone agrees (Baggott 2009, p. 115):

> This [the argument of causal connection and self-refutation] is, perhaps, a perfectly natural assumption. But it *is* an assumption.

Such musings about the nature of the objective world our subjective experiences seem to bear witness to—from Berkeley to Putnam—only represent the tip of the existential iceberg. Some other radical explanations for the content of my personal conscious perception in this very moment have been listed in the introductory part of Chap. 1. Needless to say, all of the alternative explanations of existence cannot be proven or disproven. To recapitulate:

E1 It is all just one big coincidence and happened by pure chance. We know the fundamental laws of nature and consciousness is simply the result of how the brain works. There is no mystery and that is all there is to say. [Materialism, scientific realism]

E2 A God created the universe. Perhaps 13.8 billion years ago or perhaps 6,000 years ago with fictitious properties making the universe appear older (or even 5 seconds ago, with false memories implanted in all human minds). [Creationism in Abrahamic religion]

E3 Reality is a vast and impermanent illusion (*anicca*) comprised of endless distractions and suffering. The quest of the mind is to cultivate a state of awareness, allowing the illusion to be seen for what it is. Then the enlightened mind can withdraw from the physical realm and enter a state of pure bliss. [Buddhism]

E4 Only the Self exists. Life is the endless play of the Self (*lila*) losing itself only to find itself again in a constant game of hide-and-seek. [Hinduism]

E5 Only pure consciousness exists. In endless cycles, it manifests itself as separate physical embodiments, allowing for an experiential context, only to merge in unity again and start afresh. [Spirituality, panpsychism]

E6 We are dreaming this life and will some day "wake up" to a richer reality which is unimaginably more lucid and coherent. Physical death marks the transition of consciousness from the dreaming state to a higher-dimensional reality or maybe a reality entirely outside the realm of space and time. [Esotericism variation]

E7 We live in the multiverse, the infinite set of all possible universes. As a consequence, we naturally find ourselves in that corner of it which allows for intelligent and sentient life. [String/M-theory, cosmology, many-worlds interpretation of quantum mechanics]

E8 Our physical three-dimensional universe is an illusion. It is a hologram that is isomorphic to the quantum information encoded on the surface of its boundary. [Holographic principle, AdS/CFT duality]

E9 We inhabit a simulation that has these features programmed. [Simulation hypothesis]

The human mind's scientific quest to comprehend the world and its own nature is detailed in Part I. The limits of the current materialistic and reductionistic scientific worldview are outlined in Part II. Then, Chap. 13 offers a novel scientific understanding of the world, based on an information ontology. Creationism is discussed in Sect. 12.2.2. Buddhism appeared in the context of mindfulness (Sects. 7.4.2.1, 9.3.5, and 11.1). The Hindu concept of *lila* is discussed below, as is the notion of panpsychism. Recall the words of the philosopher of the mind Thomas Metzinger, reminiscing about his experience of an episode of false awakening (Sect. 11.2.2):

> So, how do you know that you actually woke up this morning? Couldn't it be that everything you have experienced was only a dream?

Elements of string/M-theory are introduced in Sects. 4.3.2, 10.2.2, and 13.4.1.2, while the notion of the multiverse is discussed in Sect. 10.3.2.2. The holographic principle is introduced in Sect. 13.4.1. It is motivated by theoretical findings related to the novel information-theoretic paradigm outlined in Chap. 13. So too is the simulation hypothesis, which is explained in Sect. 13.4.2. In conclusion (Baggott 2009, p. 228):

> We must now come to terms with the fact that there is no hard evidence for this commonsense reality to be gained from anywhere in the entire history of human thought. There is simply nothing we can point to, hang our hats on and say *this is real*.

How should the human mind proceed from here? Should we simply concede that information is the fundamental nature of physical reality and that our minds are forever unknowable enigmas? In other words, subjectivity allows the objective to be grasped while remaining ethereal itself. This chapter argues that the human mind can take a final step in understanding itself. It is a small step within the informational ontology, but a huge step conceptually. Only the brave mind can reach the destination, as it requires a radical reassessment of all things believed to be true. For one, radical open-mindedness is asked for (Sect. 12.4.4). Indeed (deGrasse Tyson 2007, p. 305):

> One thing is for certain: the more profoundly baffled you have been in your life, the more open your mind becomes to new ideas.

In the words of an influential neuroscientist introduced in the next section (Koch 2012, p. 134f.):

> Let me end with a plea for humility. The cosmos is a strange place, and we still know little about it. It was only two decades ago that scientists discovered that a mere 4 percent of the mass-energy of the universe is the sort of material out of which stars, planets, trees, you, and I are fashioned. One-quarter is cold dark matter, and the rest is something bizarre called dark energy.[1] Cosmologists have no idea what dark energy is or what laws it obeys. [...] Our knowledge is but a fire lighting up the vast darkness around us, flickering in the wind. So, let us be open to alternative, rational explanations in the quest for the source of consciousness.

[1] Both concepts are introduced in Sect. 10.3.1.

Finally, the list of phenomena which are deemed impossible requires a re-evaluation. In essence, to understand itself, the human mind needs to entertain "crazy" ideas and break taboos. The Nobel laureate Francis Crick once gave the following advice (quoted in Bilger 2011):

> The dangerous man is the one who has only one idea, because then he'll fight and die for it. The way real science goes is that you come up with lots of ideas, and most of them will be wrong.

Only now, freed from prejudice and preconceived notions, can the information-theoretic paradigm shift become truly earth-shaking by encompassing the human mind.

14.1 Formalizing Consciousness: Integrated Information Theory

In Sect. 11.1, the history of the scientific study of consciousness is outlined. Notably, research on the topic was dormant until Crick, together with the now eminent neuroscientist Christof Koch, published an article called *Towards a Neurobiological Theory of Consciousness* (Crick and Koch 1990). Then, four years later, the young philosopher of the mind, David Chalmers, introduced the "hard problem of consciousness." Slowly, the notion of consciousness, a vague concept unworthy of any scientific attention, started to captivate scholars. However, it would take another 10 years before attempts were made at mathematizing consciousness—in an information-theoretic framework.

14.1.1 The Taboo of Subjectivity

It is an interesting observation that the human mind's most effective tool has only now been employed to analyze its own nature. The power of utilizing formal thought systems in decoding the workings of reality, thus unearthing knowledge, has been nearly exclusively applied to the external world. This is the essence of science's success: the human mind has the capability to encode aspects of the physical world as formal representations which inhabit an abstract world of their own and can be manipulated by the mind and decoded back into the physical world, yielding predictions. Knowledge generation is a result of acts of translation between the physical and abstract realms of existence. This process has been detailed in Chaps. 2 and 5, and applied in Chaps. 3, 4, 6, and 7. While discussing the nature of consciousness in Chap. 11, many philosophical ideas were presented, next to the neuroscientific knowledge gained about the workings of the brain—specifically, the flaws and shortcomings of consciousness. However, a formal approach has been lacking.

The nature of consciousness appeared to challenge the scientific worldview. Even the very notion of subjectivity has been banned from science. In the words of Koch (2012, p. 8):

> I also write in the face of a powerful professional edict against bringing in subjective, personal factors. This taboo is why scientific papers are penned in the desiccated third person: "It has been shown that…" Anything to avoid the implication that research is done by flesh-and-blood creatures […].

Science is understood as being concerned only with the tangible world, not the inner world of the subjective. Physicists inquire about the nature of objective reality without factoring in their own existence. This is also why philosophy is seen as essentially futile. A sentiment conveyed by a quote from the eminent theoretical physicist Freeman Dyson, found in Sect. 9.1.4:

> Compared with the giants of the past, they [contemporary philosophers] are a sorry bunch of dwarfs.

In essence, scientific materialism divided the world into two domains: the objective and the subjective. B. Alan Wallace is a scholar concerned with the nexus of science, philosophy, and religion—specifically also focusing on the relationship between science and Buddhism. In the book called *The Taboo of Subjectivity* he writes (Wallace 2000, p. 123):

> In the dualistic, mechanical philosophy that dominated the rise of modern science, nature was not only seen as devoid of consciousness but also was objectified to the point that it was divorced from perceptual experience altogether. The material objects that made up the world were believed to have certain primary qualities, such as size, shape and velocity; but they were inherently devoid of all secondary properties, such as color, smell, and sound, which were relative to perception. Thus, conscious experience was effectively removed from nature and, therefore, from the objective domain of science.
>
> As the scientific worldview developed, words that previously referred to constituents of human sensory experience were defined in purely objective terms. Sound became fluctuations in an objective medium such as air; smell became molecules adrift in the atmosphere; light became a form of electromagnetic energy; and color became specific frequencies of that energy. Science was concerned solely with these phenomena as they were thought to occur independently in nature. Adhering to the principles of scientific materialism, science came to be equipped with more and more sophisticated means of exploring objective physical processes; but there was no corresponding development of means to explore subjective cognitive processes. Thus, scientists simply redefined secondary properties—such as color, sound, and so on—in terms of the objective physical stimuli for the corresponding subjective experiences. In so doing, they shed increasing light on the nature of these physical phenomena, while shedding little or no light on the corresponding subjective perceptions. Thus, subjective experience was not explained; rather, it was overlooked through a purgative process of objective redefinitions.

Furthermore (Wallace 2000, p. 145):

> After four centuries of advances in scientific knowledge, more than a century of psychological research, and roughly a half century of progress in the neurosciences, even most advocates of scientism acknowledge that science has yet to give any intelligible account of the nature of consciousness. Nevertheless, the extent of our ignorance concerning consciousness is often

> overlooked. This ignorance is like a retinal blind spot in the scientific vision of the world, of which modern society seems largely unaware. In most books and articles on cosmogony, evolution, embryology, and psychology, consciousness is hardly mentioned; and when it is addressed, it tends to be presented not in terms of experiential qualia but in terms of brain functions and computer systems.

Koch succinctly captures the essence of this discrepancy (Koch 2012, p. 23):

> [A]stronomy can make testable statements about an event that took place 13.7 billion years ago [referring to NASA's Cosmic Background Explorer data]! Yet something as mundane as a toothache, right here and now, remains baffling.

14.1.2 The Mathematical Engine

In 2004, for the first time, consciousness was formalized. Now a quantitative theory began to emerge which could be potentially falsified. Koch observes (Koch 2012, p. 8):

> The endpoint of my quest [to understand consciousness] must be a theory that explains how and why the physical world is capable of generating phenomenal experience. Such a theory can't just be vague, airy-fairy, but must be concrete, quantifiable, and testable.

He has been collaborating on a mathematical theory of consciousness, based on information, first introduced by the neuroscientist and psychiatrist Giulio Tononi. In the publication with the title *An Information Integration Theory of Consciousness*, Tononi first outlined the thesis (Tononi 2004):

> This paper presents a theory about what consciousness is and how it can be measured. According to the theory, consciousness corresponds to the capacity of a system to integrate information. This claim is motivated by two key phenomenological properties of consciousness: differentiation—the availability of a very large number of conscious experiences; and integration—the unity of each such experience. The theory states that the quantity of consciousness available to a system can be measured as the Φ value of a complex of elements. Φ is the amount of causally effective information that can be integrated across the informational weakest link of a subset of elements. A complex is a subset of elements with $\Phi > 0$ that is not part of a subset of higher Φ.

Integrated information theory (IIT) has been developed further since then (Tononi 2008, 2011; Oizumi et al. 2014; Tononi et al. 2016).

IIT makes two assumptions. Conscious states are informationally rich and they are highly integrated. In general (Tononi et al. 2016):

> Integrated information theory starts from the essential properties of phenomenal experience, from which it derives the requirements for the physical substrate of consciousness.

To this end, IIT defines a set of axioms (Oizumi et al. 2014):

- Existence: Consciousness exists—it is an undeniable aspect of reality. Paraphrasing Descartes, "I experience therefore I am".

- Composition: Consciousness is compositional (structured): each experience consists of multiple aspects in various combinations. Within the same experience, one can see, for example, left and right, red and blue, a triangle and a square, a red triangle on the left, a blue square on the right, and so on.
- Information: Consciousness is informative: each experience differs in its particular way from other possible experiences. Thus, an experience of pure darkness is what it is by differing, in its particular way, from an immense number of other possible experiences. A small subset of these possible experiences includes, for example, all the frames of all possible movies.
- Integration: Consciousness is integrated: each experience is (strongly) irreducible to non-interdependent components. Thus, experiencing the word "SONO" written in the middle of a blank page is irreducible to an experience of the word "SO" at the right border of a half-page, plus an experience of the word "NO" on the left border of another half page—the experience is whole. Similarly, seeing a red triangle is irreducible to seeing a triangle but no red color, plus a red patch but no triangle.
- Exclusion: Consciousness is exclusive: each experience excludes all others—at any given time there is only one experience having its full content, rather than a superposition of multiple partial experiences; each experience has definite borders—certain things can be experienced and others cannot; each experience has a particular spatial and temporal grain—it flows at a particular speed, and it has a certain resolution such that some distinctions are possible and finer or coarser distinctions are not.

These axioms are then formalized into postulates relating to physical mechanisms, such as neurons or logic gates. The properties the configurations of mechanisms must satisfy, in order to generate experience, are analyzed. In a first step, the trivial postulates of the existence of mechanisms in some state and the composition of mechanisms into systems are stated. The postulates of information, integration, and exclusion apply both at the level of individual mechanisms and at the level of systems of mechanisms (Oizumi et al. 2014):

- Individual mechanisms:
  - Information: A mechanism can contribute to consciousness only if it specifies "differences that make a difference" within a system. That is, a mechanism in a state generates information only if it constrains the states of a system that can be its possible causes and effects—its *cause-effect repertoire*. The more selective the possible causes and effects, the higher the *cause-effect information* specified by the mechanism.
  - Integration: A mechanism can contribute to consciousness only if it specifies a cause-effect repertoire (information) that is *irreducible* to independent components. *Integration/irreducibility* φ is assessed by partitioning the mechanism and measuring what difference this makes to its cause-effect repertoire.
  - Exclusion: A mechanism can contribute to consciousness at most one cause-effect repertoire, the one having the maximum value of *integration/irreducibility* φ^{Max}. This is its *maximally irreducible* cause-effect repertoire (MICE, or *quale sensu stricto* (in the narrow sense of the word)). If the MICE exists, the mechanism constitutes a *concept*.
- Systems of mechanisms:
  - Information: A set of elements can be conscious only if its mechanisms specify a set of "differences that make a difference" to the set—i.e. a *conceptual structure*. A conceptual structure is a *constellation* of points in concept space, where each axis is a possible past/future state of the set of elements, and each point is a concept specifying differences that make a difference within the set. The higher the number of different

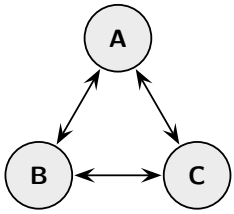

Fig. 14.1 Integrated information theory example. The network is comprised of a set of mechanisms A, B, and C, which are logic gates (e.g., OR, AND, XOR, …). The configuration is a candidate set for IIT analysis

concepts and their φ^{Max} value, the higher the *conceptual information* that specifies a particular constellation and distinguishes it from other possible constellations.

- Integration: A set of elements can be conscious only if its mechanisms specify a conceptual structure that is irreducible to non-interdependent components (strong integration). *Strong integration/irreducibility* Φ is assessed by partitioning the set of elements into subsets with unidirectional cuts.
- Exclusion: Of all overlapping sets of elements, only one set can be conscious—the one whose mechanisms specify a conceptual structure that is *maximally irreducible (MICS)* to independent components. A local maximum of integrated information Φ^{Max} (over elements, space, and time) is called a *complex*.

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Consider the fully connected network of three logic gates, seen in Fig. 14.1. Each mechanisms can be on (1) or off (0), allowing the whole system to be in one of eight (2^3) states at time t_0, defined by three bits: $ABC = \{000\}$, $ABC = \{100\}$, …, $ABC = \{111\}$. Let A be an OR gate, meaning that the inputs from B and C at t_0 will determine its state at t_1 accordingly. Specifically, $BC = \{11\}$, $BC = \{01\}$, and $BC = \{10\}$ results in $A = 1$. The simplest quantity to compute is the cause-effect information (cei) for the mechanism A in a specific state. Constrain A to be on: $A^c = 1$. The probability distribution of past states ABC^p that could have been potential causes of A^c is the cause repertoire $cr = p(ABC^p|A^c = 1)$. cr is an 8-dimensional vector labeled by the possible states of ABC, in the following order: {000}, {100}, {010}, {110}, {001}, {101}, {011}, and {111}. It is computed to be $cr = (0, 0, 1/6, 1/6, 1/6, 1/6, 1/6, 1/6)$ (Oizumi et al. 2014, Supplementary Methods). The amount of information that A^c specifies about the past is its cause information (ci). It is defined as the distance $\mathcal{D}$ between the cause repertoire cr and the unconstrained past repertoire $p^{uc}(ABC^p)$. Formally

$$ci(ABC^p|A^c = 1) = \mathcal{D}\left[p(ABC^p|A^c = 1),\, p^{uc}(ABC^p)\right]. \tag{14.1}$$

p^{uc} is given by a uniform distribution (i.e., all components are 1/8). Note that the utilized distance measure between the probability distributions is what is known as

the earth mover's distance. Other options are discussed in Tegmark (2016). Similarly to ci, the effect information (ei) can be computed for the future states ABC^f. This allows the cause-effect information to be determined

$$cei(ABC^{p,f}|A^c = 1) = \min\left[ci(ABC^p|A^c = 1), ei(ABC^f|A^c = 1)\right]. \quad (14.2)$$

Step by step, the integrated information φ, and the maximally irreducible cause-effect information φ^{Max}, can be derived for the mechanisms, yielding concepts. Moving to systems of concepts, the (conceptual) integrated information Φ is specified for constellations, i.e., conceptional structures. Finally, the maximal integrated information Φ^{Max} can be found, yielding a complex. There exists an online tool for performing example calculations.[2]

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Formally, integrated information Φ is a measure of the cause-effect power of a physical system. Intuitively, a system has a higher Φ the "richer" its interconnection structure is.[3] IIT posits that the larger Φ is, the more conscious the system is. In other words, a thermostat has incremental consciousness, while a room full of human minds does not have more consciousness than the individual minds.

With respect to the notion of information, IIT has the following to say (Tononi et al. 2016):

> Shannon information is observational and extrinsic—it is assessed from the extrinsic perspective of an observer and it quantifies how accurately input signals can be decoded from the output signals transmitted across a noisy channel. It is not compositional nor qualitative, and it does not require integration or exclusion.

Recall Claude Shannon's information theory, introducing the concept of binary digits, or bits, in Sect. 13.1.2. In contrast (Tononi et al. 2016):

> In IIT the information content of an experience is specified by the form of the associated conceptual structure (the quality of the integrated information) and quantified by Φ^{Max} (the quantity of integrated information). In IIT, information is causal and intrinsic: it is assessed from the intrinsic perspective of a system based on how its mechanisms and present state affect the probability of its own past and future states (cause-effect power). It is also compositional, in that different combinations of elements can simultaneously specify different probability distributions within the system. Moreover, it is qualitative, as it determines not only how much a system of mechanisms in a state constrains its past and future states, but also how it does so. Crucially, in IIT, information must be integrated. This means that if partitioning a system makes no difference to it, there is no system to begin with. Information in IIT is exclusive—only the maxima of integrated information are considered.

Thus, we are presented with the inner and outer aspects of information (Sect. 15.1).

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[2] See http://integratedinformationtheory.org/calculate.html.

[3] This is related to complex network theory, discussed in Sect. 6.3.

In summary, in the words of Koch (2014):

> Basically, Φ captures the quantity of consciousness. The quality of any one experience—the way in which red feels different from blue and a color is perceived differently from a tone—is conveyed by the informational geometry associated with Φ. The theory assigns to any one brain state a shape, a crystal, in a fantastically high-dimensional qualia space. This crystal is the system viewed from within. It is the voice in the head, the light inside the skull. It is everything you will ever know of the world. It is your only reality. It is the quiddity of experience. The dream of the lotus eater, the mindfulness of the meditating monk and the agony of the cancer patient all feel the way they do because of the shape of the distinct crystals in a space of a trillion dimensions—truly a beatific vision. The water of integrated information is turned into the wine of experience.

Qualia are subjective conscious experiences, like the greenness of green, see Chap. 11. Information geometry is a contemporary framework for scientific analysis and it unifies statistics with geometry. Specifically, it examines the geometrical structure of the manifolds of probability distributions (Amari and Nagaoka 2000). In essence, IIT offers a formal mapping of a system's causal power upon itself, quantified as integrated information, to geometric structures. Hence the phenomenology of a system can be seen as being isomorphic to the mathematical abstractions. The idea of mapping reality aspects onto higher-dimensional geometric shapes has also emerged in quantum gravity with the discovery of the amplituhedron (Sect. 10.4).

Books outlining the history and ideas of IIT include (Edelman and Tononi 2000; Tononi 2012; Koch 2012).

14.1.3 Putting It to the Test

In 2016, a study tested a complexity metric in the context of IIT (Casarotto et al. 2016). A threshold was derived, above which consciousness emerges. Patients may be misdiagnosed as being in a vegetative state due to their lack of expressing signs of consciousness, although they are experiencing the world. This can result from brain injury. Locked-in syndrome is the tragic condition in which a patient is completely paralyzed and unable to communicate while being fully conscious. Recall the devastating and inspiring story of Martin Pistorius recollected in Sect. 11.3.3. In the study, healthy subjects were measured as being conscious during:

- wakefulness;
- REM sleep;
- Ketamine anesthesia.

Note that Ketamine anesthesia and REM sleep are "conditions in which consciousness is present but is disconnected from the external environment" (Casarotto et al. 2016). Brain injured patients with the following conditions were determined to be conscious:

- locked-in syndrome;
- subcortical stroke;

- cortical stroke;
- other disorders of consciousness with a minimally conscious state.

In the contrast, no signs of consciousness in healthy subjects were found during:

- non-REM sleep;
- anesthesia (Midazolam, Xenon, and Propofol).

Older and more restricted research had reached similar conclusions (Casali et al. 2013; Sarasso et al. 2014, 2015). In another study, subjects were shown three films: a movie, a scrambled movie, and TV noise. Their neural responses were measured utilizing fMRI images. The researchers found that the meaningfulness of the stimulus was associated with higher information integration among cortical regions of the brain. This could be measured without any assumptions about the stimuli and how they are represented in the brain. See Boly et al. (2015).

Moreover (Tononi 2015):

> IIT provides a principled and parsimonious way to account for why certain brain regions appear to be essential for our consciousness while others do not. For example, widespread lesions of the cerebral cortex lead to loss of consciousness, and local lesions or stimulations of various cortical areas and tracts can affect its content (for example, the experience of color). A prominent feature of the cerebral cortex is that it is comprised of elements that are functionally specialized and at the same time can interact rapidly and effectively (when awake or dreaming). According to IIT, this is the kind of organization that can yield a comparatively high value of Φ^{Max}. On the other hand, lesions of the cerebellum do not affect our consciousness in any obvious way, although the cerebellum is massively interconnected with the cerebral cortex and has four times more neurons. This paradox can be explained by considering that the cerebellum is composed of small modules that process inputs and produce outputs largely independent of each other. As suggested by computer simulations, a system thus organized, even if each module is tightly connected with a complex of high Φ^{Max} (the cortical complex), will remain excluded from the conceptual structure of the latter, nor will it form a complex on its own (at best it would decompose into many mini-complexes each having low Φ^{Max}).

Then (Tononi 2015):

> It is well established that, after the complete section of the corpus callosum—the roughly 200 million fibers that connect the cortices of the two hemispheres—consciousness is split in two: there are two separate "flows" of experience,[4] one associated with the left hemisphere and one with the right one. An intriguing prediction of IIT is that, if the efficacy of the callosal fibers were reduced progressively, there would be a moment at which, for a minor change in the traffic of neural impulses across the callosum, experience would go from being a single one to suddenly splitting into two separate experiencing minds. The splitting of consciousness should be associated with the splitting of a single conceptual structure into two similar ones (when two maxima of integrated information supplant a single maximum). Under certain pathological conditions (for example, dissociative disorders such as hysterical blindness), and perhaps even under certain physiological conditions (say "autopilot" driving while having a phone conversation), such splits may also occur among cortical areas within the same hemisphere in the absence of an anatomical lesion. Again, IIT predicts that in such conditions there should be two local maxima of information integration, one corresponding to a "major" complex and one or more to "minor" complexes (Mudrik et al. 2014).

[4] See Sect. 11.3.3.

Finally (Tononi 2015):

> A counterintuitive prediction of IIT is that a system such as the cerebral cortex may be conscious even if it is nearly silent, because it would still be specifying a conceptual structure, though one composed purely of negative concepts. Such a silent state is perhaps approximated through certain meditative practices that aim at reaching "naked awareness" without content (Sullivan 1995).

Maybe the most outlandish prediction of IIT is that any sufficiently complex and integrated system "feels like something." Physical entities can possess interior mental aspects. Recall the discussion about animal consciousness in the introduction of Chap. 11. Now we are potentially faced with the dilemma of a conscious Internet or a conscious computational device. And what about black holes (Sect. 13.4.1.1)?

14.1.4 The Opposition

Tononi has received support from some notable scholars. In particular, the help of Koch and Chalmers. Another influential supporter is the cosmologist Max Tegmark. He was introduced in Sect. 13.4.3 with his mathematical universe hypothesis. Tegmark proposes the following in a recent publication called *Consciousness as a State of Matter* (Tegmark 2015):

> We examine the hypothesis that consciousness can be understood as a state of matter, "perceptronium", with distinctive information processing abilities. We explore four basic principles that may distinguish conscious matter from other physical systems such as solids, liquids and gases: the information, integration, independence and dynamics principles. [...] Our approach generalizes Giulio Tononi's integrated information framework for neural-network-based consciousness to arbitrary quantum systems, and we find interesting links to error-correcting codes, condensed matter criticality, and the Quantum Darwinism program, as well as an interesting connection between the emergence of consciousness and the emergence of time.

Naturally, not all agree. For instance, the quantum computer scientists Scott Aaronson. He was introduced in the last chapter, specifically in Sects. 13.2.1, 13.4.1.2, 13.4.2, and 13.4.1.4. In a blog post from May 21st, 2014, he argues that[5]:

> Yes, it might be a decent rule of thumb that, if you want to know which brain regions (for example) are associated with consciousness, you should start by looking for regions with lots of information integration. And yes, it's even possible, for all I know, that having a large Φ-value is one necessary condition among many for a physical system to be conscious. However, having a large Φ-value is certainly not a *sufficient* condition for consciousness, or even for the appearance of consciousness. As a consequence, Φ can't possibly capture the essence of what makes a physical system conscious, or even of what makes a system *look* conscious to external observers.

In detail, he observes:

[5] See https://www.scottaaronson.com/blog/?p=1799, retrieved August 15, 2018.

> [IIT] unavoidably predicts vast amounts of consciousness in physical systems that no sane person would regard as particularly "conscious" at all.
>
> […]
>
> I conjecture that approximating Φ is an NP-hard problem.[6]

Aaronson invokes the example of a two-dimensional grid (of logic gates) which would render Φ a function of its size.

One could shrug and wonder about the relevance of a blog post. However, Aaronson enjoys a high level of visibility. In the comments section of his posts we find active engagement of the likes of Koch, Tegmark, and Chalmers. A week after Aaronson's critique, on May 28th, Tononi sent him a 14-page rebuttal, titled *Why Scott Should Stare at a Blank Wall and Reconsider (or, the Conscious Grid)*.[7] There we can read:

- Scott's mathematical argument is right: certain systems whose structure and function are easy to describe from the extrinsic perspective of an observer, such as expander graphs performing parity checks, or worse, grids doing absolutely nothing, may in fact have a large value of PHI if they can be built to be large enough (again, they must be actual physical structures).
- Because of their extreme structural and functional "simplicity", they apparently fit Scott's "commonsense" intuition that they cannot possibly be conscious.
- However, Scott's "commonsense" intuition that such simple systems cannot possibly be conscious is wrong and should be revised.

Tononi explains and outlines other aspects of IIT with respect to the critique. Two days later Aaronson replied. He lists four arguments for IIT he believes Tononi provided and explains why he finds them unpersuasive. In the end, Aaronson concludes[8]:

> At this point, I fear we're at a philosophical impasse. Having learned that, according to IIT,
>
> 1. a square grid of XOR gates is conscious, and your experience of staring at a blank wall provides evidence for that,
> 2. by contrast, a linear array of XOR gates is not conscious, your experience of staring at a rope notwithstanding,
> 3. the human cerebellum is also not conscious (even though a grid of XOR gates is), and
> 4. unlike with the XOR gates, we don't need a theory to tell us the cerebellum is unconscious, but can simply accept it as "reasonably established" and "largely uncontroversial,"
>
> I personally feel completely safe in saying that this is not the theory of consciousness for me.

In November 2015, a two-day workshop on integrated information theory was held at New York University. The speakers included Tononi, Koch, Tegmark, Chalmers, and Aaronson as skeptic. The science writer John Horgan reports (Horgan 2015):

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[6] See Sect. 13.4.1.4.

[7] See http://integratedinformationtheory.org/download/conscious_grid.pdf, retrieved August 15, 2018.

[8] See https://www.scottaaronson.com/blog/?p=1823, retrieved August 15, 2018.

> Tononi shrugged off Aaronson's criticism. "We have to be prepared to be extremely surprised," he said. He also suggested that Aaronson had critiqued an outdated version of phi. IIT is "a work in progress," Tononi said.

In any case, IIT has and will continue to face criticism (Cerullo 2015). Also the philosopher John Searle had already chimed in and provoked this response (Koch and Tononi 2013). A recent overview of the evolution of IIT can be found in Moon and Pae (2018).

Yet again, the detailed technical discussions about theoretical concepts threaten to become postmodern narratives, where meaning, clarity, and understanding is at stake. Recall the Sokal hoax and the Bogdanov affair discussed in Sect. 9.1.4. Time will tell if IIT will survive and evolve through different embodiments of formal structures. For the moment, one must ask what is happening with grids in IIT[9]:

> To conclude, whether one like's grids or not, think highly of them or not, and no matter what your intuition tells you about their level of consciousness, you should begin to take them seriously, as it seems that our own experience of 2D space requires a grid to create it. True, even though we can try to approximate it by staring at a blank screen, we do not experience exactly "what it is like to be a single, isolated 2D grid", because we are made of multiple interconnected grids, and of many additional structures that extract categories out of grids. And yet, if we trust a theory that starts from phenomenology and is supported by empirical evidence more than unreliable and unsupported intuitions, our best inference should be that, if a 2D grid is large and well built, it could be quite conscious, though perhaps a bit boring and not that intelligent.

Maybe there exists a link to the holographic principle outlined in Sect. 13.4.1 or the geometric entities encountered in altered states of consciousness (discussed below in Sect. 14.3.2).

At the end of the day, IIT helped open Pandora's box of radical postulates about consciousness. Within the time-span of 28 years, it is today not only acceptable to talk about consciousness, but also about the notion of universal consciousness—a topic that would otherwise make many scientists recoil in utter disgust.

14.2 The Cosmic Nature of Consciousness

Now that the floodgates have been opened, the recalcitrant nature of consciousness can be viewed in a novel light. In a remarkable turn of events, the seemingly isolated phenomenon of consciousness reemerges within the structure of the cosmos itself.

[9] See http://integratedinformationtheory.org/download/conscious_grid.pdf, retrieved August 15, 2018.

14.2.1 Panpsychism: The Universality of Consciousness

The cognitive scientist Donald D. Hoffman argues that what we perceive of reality is nothing like reality itself (Sect. 11.2.1). In a Kantian twist, evolution maximizes evolutionary fitness and not veridical perceptions. Hoffman also holds other "crazy" ideas (Hoffman 2015):

> Perhaps reality is some vast, interacting network of conscious agents, simple and complex, that cause each other's conscious experiences. Actually, this isn't as crazy an idea as it seems, and I'm currently exploring it.

Chalmers is also thinking about such outlandish properties of reality (Chalmers 2014):

> In the time remaining, I want to explore two crazy ideas that I think may have some promise. The first crazy idea is that consciousness is fundamental. Physicists sometimes take some aspects of the universe as fundamental building blocks: space and time and mass. They postulate fundamental laws governing them, like the laws of gravity or of quantum mechanics. These fundamental properties and laws aren't explained in terms of anything more basic. Rather, they're taken as primitive, and you build up the world from there. Now sometimes, the list of fundamentals expands. In the 19th century, Maxwell figured out that you can't explain electromagnetic phenomena in terms of the existing fundamentals—space, time, mass, Newton's laws—so he postulated fundamental laws of electromagnetism and postulated electric charge as a fundamental element that those laws govern. I think that's the situation we're in with consciousness. If you can't explain consciousness in terms of the existing fundamentals—space, time, mass, charge—then as a matter of logic, you need to expand the list. The natural thing to do is to postulate consciousness itself as something fundamental, a fundamental building block of nature. This doesn't mean you suddenly can't do science with it. This opens up the way for you to do science with it. […]
>
> The second crazy idea is that consciousness might be universal. Every system might have some degree of consciousness. This view is sometimes called panpsychism: pan for all, psych for mind, every system is conscious, not just humans, dogs, mice, flies, but even Rob Knight's microbes,[10] elementary particles. Even a photon has some degree of consciousness. The idea is not that photons are intelligent or thinking. […] But the thought is maybe photons might have some element of raw, subjective feeling, some primitive precursor to consciousness.
>
> This may sound a bit kooky to you. I mean, why would anyone think such a crazy thing? Some motivation comes from the first crazy idea, that consciousness is fundamental. […] A deeper motivation comes from the idea that perhaps the most simple and powerful way to find fundamental laws connecting consciousness to physical processing is to link consciousness to information. Wherever there's information processing, there's consciousness. Complex information processing, like in a human, complex consciousness. Simple information processing, simple consciousness.
>
> A really exciting thing is [that] in recent years a neuroscientist, Giulio Tononi, has taken this kind of theory and developed it rigorously with a mathematical theory. […] Now, I don't know if this theory is right, but it's actually perhaps the leading theory right now in the science of consciousness, and it's been used to integrate a whole range of scientific data […].
>
> Another final motivation is that panpsychism might help us to integrate consciousness into the physical world. Physicists and philosophers have often observed that physics is curiously

[10] See, for instance, Knight's 2014 TED talk *How Microbes Make Us Who We Are*.

> abstract. It describes the structure of reality using a bunch of equations, but it doesn't tell us about the reality that underlies it. As Stephen Hawking puts it, what puts the fire into the equations?[11] Well, on the panpsychist view, you can leave the equations of physics as they are, but you can take them to be describing the flux of consciousness. That's what physics really is ultimately doing, describing the flux of consciousness. On this view, it's consciousness that puts the fire into the equations. On that view, consciousness doesn't dangle outside the physical world as some kind of extra. It's there right at its heart.

The notion of panpsychism is introduced in the *Stanford Encyclopedia of Philosophy* as follows (Goff et al. 2017):

> Panpsychism is the view that mentality is fundamental and ubiquitous in the natural world. The view has a long and venerable history in philosophical traditions of both East and West, and has recently enjoyed a revival in analytic philosophy. For its proponents panpsychism offers an attractive middle way between physicalism on the one hand and dualism on the other. The worry with dualism—the view that mind and matter are fundamentally different kinds of thing—is that it leaves us with a radically disunified picture of nature, and the deep difficulty of understanding how mind and brain interact. And whilst physicalism offers a simple and unified vision of the world, this is arguably at the cost of being unable to give a satisfactory account of the emergence of human and animal consciousness. Panpsychism, strange as it may sound on first hearing, promises a satisfying account of the human mind within a unified conception of nature.

More specifically, in the words of Koch (2014):

> Panpsychism is one of the oldest of all philosophical doctrines extant and was put forth by the ancient Greeks, in particular Thales of Miletus and Plato. Philosopher Baruch Spinoza and mathematician and universal genius Gottfried Wilhelm Leibniz, who laid down the intellectual foundations for the Age of Enlightenment, argued for panpsychism, as did philosopher Arthur Schopenhauer, father of American psychology William James, and Jesuit paleontologist Teilhard de Chardin. It declined in popularity with the rise of positivism in the 20th century.[12]

More personally, he adds (Koch 2014):

> As a natural scientist, I find a version of panpsychism modified for the 21st century to be the single most elegant and parsimonious explanation for the universe I find myself in.

For many, the notion of panpsychism sounds simply ludicrous—a metaphysical aberration. Even if some great thinkers in history have tinkered with panpsychism, today, we should know better. Indeed (Goff 2017, p. 170):

> The main objection one comes across to panpsychism is that it is "crazy" and "just obviously wrong." It is thought to be highly counterintuitive to suppose that there is something that it is like to be an electron, and this is taken to be a very strong reason to doubt the truth of panpsychism.

The philosopher Philip Goff retorts (Goff 2017, p. 170):

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[11] See Sect. 9.2.1.

[12] See Sect. 9.1.1.

> But the view that time slows down at high speeds, that particles have determinate position only when measured, that the Earth goes round the sun, or that we have a common ancestor with apes were (indeed, still are) also highly counterintuitive, and to many "just obviously wrong." And yet the counter-commonsensicality of these views gives us little or no reason to think them false. It is hard to see why the fact that most Westerners living today happen to be pre-theoretically inclined to think panpsychism false constitutes a reason to think that it is false.

The science writer Amanda Gefter also reminds us (Gefter 2012):

> [F]undamental physics has a long history of disregarding our common sense notions.

One could argue that, overall, the skepticism towards panpsychism is rooted in the prejudices of the prevailing materialistic and reductionistic scientific worldview. The renowned philosopher Thomas Nagel wrote a controversial book in 2012, where he attacked this worldview (Horgan 2013):

> Some scholars, notably philosopher Thomas Nagel, are so unimpressed with science that they are challenging its fundamental assumptions. In his new book *Mind and Cosmos: Why the Materialist Neo-Darwinian Conception of Nature Is Almost Certainly False*, Nagel contends that current scientific theories and methods can't account for the emergence of life in general and one bipedal, big-brained species in particular. To solve these problems, Nagel asserts, science needs "a major conceptual revolution," as radical as those precipitated by heliocentrism, evolution and relativity. Many pundits calling for such a revolution are peddling some sort of religious agenda, whether Christian or New Age. Nagel is an atheist, who cannot accept God as a final answer […].

In the words of Nagel (2012):

> Certainly the mind-body problem[13] is difficult enough that we should be suspicious of attempts to solve it with the concepts and methods developed to account for very different kinds of things. Instead, we should expect theoretical progress in this area to require a major conceptual revolution at least as radical as relativity theory, the introduction of electromagnetic fields into physics—or the original scientific revolution itself, which, because of its built-in restrictions, can't result in a "theory of everything,"[14] but must be seen as a stage on the way to a more general form of understanding. We ourselves are large-scale, complex instances of something both objectively physical from outside and subjectively mental from inside. Perhaps the basis for this identity pervades the world. [P. 42]
>
> Everything, living or not, is constituted from elements having a nature that is both physical and nonphysical—that is, capable of combining into mental wholes. So this reductive account can also be described as a form of panpsychism: all the elements of the physical world are also mental. [P. 57]

Nagel already started to write about panpsychism in 1979 (Nagel 1979). It may come as a surprise to some, that such seemingly unscientific views were also held by a few of the pioneers of modern theoretical physics. For instance, Dyson, who expressed his distaste for philosophy above, also observed in 1979 (quoted in Schooler et al. 2011, p. 169):

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[13] See Sect. 11.4.

[14] See Sect. 4.3.

> […] mind is already inherent in every electron, and the processes of human consciousness differ only in degree but not in kind from the processes of choice between quantum states we call "chance" when made by electrons.

So too the eminent physicist David Bohm, who contributed unorthodox ideas to quantum theory (Bohm 1980). He noted (quoted in Schooler et al. 2011, p. 169):

> [W]e have something that is mind-like already with the electron.

Unnoticed by the scientific mainstream, the specter of panpsychism has been haunting intellectually inquisitive—and open—minds for decades. In April 2014, the conference *Toward a Science of Consciousness*, in Tucson Arizona, celebrated its 20th anniversary.[15] Notably, at its first gathering, Chalmers presented the "hard problem of consciousness" (Sect. 11.1). Twenty years later, ideas related to panpsychism were discussed. Attempts at incorporating such a view into science—as panpsychist realism—were presented, especially related to relativity and quantum mechanics (Graubart 2014).

Panpsychism could indeed be the key finally concluding the information-theoretic paradigm shift initiated in the previous chapter (and brought to full fruit in Chap. 15). In conclusion (Goff 2017, p. 170f.):

> While in the mindset of thinking that physics is on its way to giving a complete picture of the fundamental nature of reality, panpsychism seems improbable as physics does not attribute experience to fundamental particles. But once we realize that physics leaves us completely in the dark about the deep nature of the entities it talks about, and indeed that the only thing we know for certain about the deep nature of the universe is that some of it is taken up with consciousness, things look very different. All we get from physics is this big black and white abstract structure, which we metaphysicians must somehow color in with concrete categorical nature. Assuming the falsity of substance dualism,[16] we know how to color in one bit of it: the brains of organisms are colored in with consciousness. How to color in the rest? The most elegant, simple, sensible option is to color in the rest of the world with the same pen.

Within the set of ideas related to panpsychism, one can find variations which too have found a place in the history of human thought. For instance, in Hinduism, the notion of *lila* (explanation E4 listed above and discussed in Sect. 15.2.2) is akin to the concept of pandeism. In detail (Mapson 2017, p. 5):

> Pandeism is a theological theory proposing that instead of the traditional notion of an external God-entity creating our Universe wholesale and then observing it from the outside, our Universe is more logically explained as the product of a Creator wholly becoming it, with principles in place from this becoming which allow its structure—including life within it—to arise organically within it as part of its experience. The history of this idea reaches back to the earliest etchings of human history.

Staying within this theist realm, in contrast (Russell 2004, p. 330):

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[15] See http://www.consciousness.arizona.edu/documents/FinalCCS_BOOKofAbstracts_2014-2.pdf.

[16] This is a variety of dualism, discussed in Sect. 11.1.

> The Greek view, that creation out of nothing is impossible, has recurred at intervals in Christian times, and has led to pantheism. Pantheism holds that God and the world are not distinct, and that everything in the world is part of God. This view is developed most fully in Spinoza, but is one to which almost all mystics are attracted. It has thus happened, throughout the Christian centuries, that mystics have had difficulty in remaining orthodox, since they find it hard to believe that the world is outside God.

Albert Einstein once remarked "I believe in Spinoza's God" (Sect. 9.2.1). Then (Culp 2017):

> "Panentheism" is a constructed word composed of the English equivalents of the Greek terms "pan", meaning all, "en", meaning in, and "theism" meaning God. Panentheism considers God and the world to be inter-related with the world being in God and God being in the world. It offers an increasingly popular alternative to both traditional theism and pantheism. Panentheism seeks to avoid either isolating God from the world as traditional theism often does or identifying God with the world as pantheism does. Traditional theistic systems emphasize the difference between God and the world while panentheism stresses God's active presence in the world and the world's influence upon God. Pantheism emphasizes God's presence in the world but panentheism maintains the identity and significance of the non-divine.

In summary, while pantheism equates the divine with the cosmos ("all is God"), panentheism allows for a distinction between the divine and the non-divine. Some have argued for a reconciliation of science and theism along these lines (Griffin 2014 p. 275):

> Crucial for a reconciliation between science and religion, and hence a "scientific worldview" that promotes religious pluralism, will be the acceptance—within both "religious" and "scientific" circles, of the type of naturalism and panentheism advocated in this book.

14.2.2 The Primacy of Consciousness

Chalmers mentioned the notion of consciousness being fundamental above. Some scholars have tried to conceptualize around this idea. For instance, the eminent philosopher of science and systems theorist Ervin Laszlo. In his book with the title *The Systems View of the World: A Holistic Vision for Our Time* (Laszlo 1996), Laszlo outlined a systems-based view of nature, based on over three decades of research. In essence, he advocated a complexity-oriented understanding of reality (see Chap. 6, especially Sect. 6.2). In 2006, Laszlo published *Science and the Reenchantment of the Cosmos* (Laszlo 2006). Peter Russell contributed an essay (Russell 2006, p. 144):

> Ervin Laszlo has proposed that the virtual energy field known as the quantum vacuum, or zero-point field,[17] corresponds to what Indian teachings have called Akasha, the source of everything that exists, and in which the memory of the cosmos is encoded. I would like to take his reasoning a step further and suggest that the nature of this ultimate source is consciousness itself, nothing more and nothing less.

[17] See Sect. 10.1, especially 10.1.1, and 10.1.2.

> Again we find this idea is not new. In the Upanishads, *Brahman*, the source of the cosmos (literally, "that from which everything grows"), is held to be equal to *Atman* ("that which shines"), the essence of consciousness. And in the opening lines of *The Dhammapada*, the Buddha declares that "All phenomena are preceded by mind, made by mind, and ruled by mind."
>
> Such a view, though widespread in many metaphysical systems, is completely foreign to the current scientific worldview. The world we see is so obviously material in nature; any suggestion that it might have more in common with mind is quickly rejected as having "no basis in reality." However, when we consider this alternative worldview more closely, it turns out that it is not in conflict with any of the findings of modern science only with its presuppositions. Furthermore, it leads to a picture of the cosmos that is even more enchanted.

Russell has degrees in theoretical physics, computer science, and experimental psychology, next to having studied meditation in India. He is the author of *The Awakening Earth: The Global Brain* (Russell 1982), predicting the Internet and its impact. Russell argues for the primacy of consciousness—mind is more fundamental than matter. Consciousness is the most fundamental essence of existence out of which comes the experience of material reality. This is the exact opposite of the materialistic scientific paradigm, where matter/energy and space/time is said to reside at the foundation of reality and consciousness emerges out of it. The problem with this is, however, that neither does this scientific worldview predict consciousness, nor can it explain it. Something appears to be missing. Others don't go as far as Russell, by placing consciousness at the center of the ontology, but give it the same status as the scientific fundamental properties of reality. Chalmers explained this stance above.

In the introduction to Chap. 11, the *Swiss Biennial on Science, Technics + Aesthetics* was mentioned, focusing on contemporary challenges in quantum physics, cosmology, and consciousness. In 2018, the topic of the conference was *The Enigma of Consciousness*. Speakers from different disciplines were presenting. Among them were Hoffman; Wallace; Horgan, who is well-known for his book *The End of Science* (Sect. 9.2.2); the theoretical physicist Marcelo Gleiser, known for his writing about truth and knowledge (Gleiser 2010, 2014); Bernardo Kastrup, who has a Ph.D. in computer engineering, is an entrepreneur, and writes about metaphysics and the philosophy of the mind; and the cosmologist Martin Rees. In former years, the mathematical physicists and cosmologist Roger Penrose presented his views on consciousness (Penrose 1989, 1994, 1997). Other speakers were scholars of anthropology and psychology. One specific topic gravitated around non-ordinary states of consciousness found in the Peruvian shamanic traditions, discussed below. Relating to the concept of primal consciousness, the notion of the ontological primitive was discussed. This describes the irreducible components of reality. Next to matter/energy and space/time it was agreed that consciousness should also be a potential candidate. The challenge this poses to the prevailing materialistic worldview was acknowledged. Wallace invited the audience to ponder the following. In our scientific quest to understand the universe and ourselves, we implicitly incorporate a Eurocentric perspective. Specifically, older truth-seeking traditions found in the East are discarded as being pre-scientific and thus invalid. Wallace argued that any inquiry into the nature of consciousness requires introspection, focus, and awareness. Meditators in the East have been cultivating mindfulness form millennia. In detail:

- Observing the process of origination, abiding, and dissolution of mental processes.
- Identifying mental afflictions, which can be described by the criterion that they disrupt the balance and equilibrium of the mind.
- Observing whether mental processes and states are stable or momentary, true sources of happiness or unsatisfying, personal or impersonal.

Could it be that these ancient truth-seekers have discovered aspects of consciousness, and thus reality, without the Western mind even knowing? Wallace reminds us:

- About 5,000 years ago the early Indian seekers (*śramaṇa*) developed stable and highly focused attention (*samādhi*).
- The Gautama Buddha explored states of consciousness and their objects in unprecedented ways (*vipaśyanā*) about 2,500 years ago. "The mind that is established in equipoise comes to know reality as it is" (*śamatha* and *vipaśyanā*).

In these ancient contemplative traditions consciousness is understood as primordial:

- The ultimate, luminous, empty ground-state of consciousness pervades all phenomena (*jñāna*).
- The non-dual, non-local, atemporal, absolute space of phenomena (*dharmadhātu*), gives rise to the emergence of configurations of space-time. Similarly, the energy of primordial consciousness (*jñāna-vayu*) allows for configurations of matter-energy to appear.

Essentially, Buddhism is "empirical," as every practitioner is invited by the Gautama Buddha to check the claims themselves. "Do not believe anything that you have not experience yourself!" is a foundational principle of the philosophy. Overall, topics related to the exploration of vast inner realities were discussed at the conference—relating to contemplative and shamanic traditions, next to psychedelic explorations. Kastrup outlined his skepticism of materialism. His books are titled *Why Materialism is Baloney* (Kastrup 2014) and *Brief Peeks Beyond* (Kastrup 2015). There we can read (Kastrup 2014, p. 215):

> Let us be honest: the fairytale of materialism has served a valid purpose during a more naïve and childish age, but has now far outlived its use fullness. We no longer live in the reality of the 19th century. The collective experiences of our modern humanity in the early 21st century demand a mature, adult worldview.

Horgan summarized his experiences at the conference in Horgan (2018).

14.2.3 The Taboo of Spirituality

The journey outlined in this chapter began with a formal theory of consciousness. Soon, however, the narrative left this scientific footing and explored the non-scientific realms of theism and spirituality. The term "religion" refers to a set of teachings and rituals laid out at the conception of any specific theist doctrine. Religions are geographically constrained and mostly conceived to be static worldviews. However,

religion represent the human mind's very first attempt at deciphering the universe it awoke to. Indeed, religion appears to be the matrix out of which the modern human mind—with its complex socio-cultural structures—would eventually emerge and conquer the cosmos (Harari 2015, p. 100ff.):

> In 1995 archaeologists began to excavate a site in south-east Turkey called Göbekli Tepe. In the oldest stratum they discovered no signs of a settlement, houses or daily activities. They did, however, find monumental pillared structures decorated with spectacular engravings. Each stone pillar weighed up to seven tons and reached a height of five metres. In a nearby quarry they found a half-chiselled pillar weighing fifty tons. Altogether, they uncovered more than ten monumental structures, the largest of them nearly thirty metres across.
>
> Archaeologists are familiar with such monumental structures from sites around the world—the best-known example is Stonehenge in Britain. Yet as they studied Göbekli Tepe, they discovered an amazing fact. Stonehenge dates to 2500 BC, and was built by a developed agricultural society. The structures at Göbekli Tepe are dated to about 9500 BC, and all available evidence indicates that they were built by hunter-gatherers. The archaeological community initially found it difficult to credit these findings, but one test after another confirmed both the early date of the structures and the pre-agricultural society of their builders. The capabilities of ancient foragers, and the complexity of their cultures, seem to be far more impressive than was previously suspected.
>
> Why would a foraging society build such structures? They had no obvious utilitarian purpose. They were neither mammoth slaughterhouses nor places to shelter from rain or hide from lions. That leaves us with the theory that they were built for some mysterious cultural purpose that archaeologists have a hard time deciphering. Whatever it was, the foragers thought it worth a huge amount of effort and time. The only way to build Göbekli Tepe was for thousands of foragers belonging to different bands and tribes to cooperate over an extended period of time. Only a sophisticated religious or ideological system could sustain such efforts.

Furthermore, the origins of domesticated wheat could be traced to a region about thirty kilometers from Göbekli Tepe. All of this suggest the unconventional view "that the temple may have been built first, and that a village later grew up around it" (Harari 2015, p. 102). Science and religion always appeared to be natural enemies (Sects. 5.3.1 and 12.2.2). However, some scientists can assimilate both aspects with ease (Sects. 12.4.4 and 15.3).

One can argue that religion mostly requires the submission of its believers to an external authority. Spirituality, in contrast, can be understood as the quest of finding a source of authority within one's own inner reality. Indeed, a strong definition of spirituality could be summed up as the conviction of the ontological reality of one's personal consciousness, reigning supreme over the objects which appearing within it. More generally, spirituality can be defined as (Walach et al. 2011, p. 6):

> [A]n experiential realisation of connectedness with a reality beyond the immediate goals of the individual. It gives rise to a holistic type of knowing that manifests cognitively, emotionally and motivationally. This is why it is termed "experience" in the sense of an inner experience of reality.

Within a scientific worldview, spirituality is mostly seen as being just as villainous as religiosity. Even the empathetic words of the physicist Carl Sagan, revered in the scientific community, have not changed much about this attitude (Sagan 1996, p. 29):

> Science is not only compatible with spirituality; it is a profound source of spirituality.

However, slowly the scientific taboos are beginning to tumble. The monograph called *Neuroscience, Consciousness and Spirituality* outlined an example of this (Walach et al. 2011, p. v):

> [The book] was born out of the vision to build bridges and get different disciplines to talk to each other. We have been observing these disciplines for quite a while, doing empirical research in the field of mindfulness meditation, conceptual, psychological and philosophical issues, as well as spirituality. We were struck by the lack of communication between different pockets of research cultures. We thought that neuroscience researchers could learn from philosophers and from those dealing with issues around spirituality and mystical experience, and vice versa. We felt that the philosophical discourse around the issue of what constitutes consciousness and how it can be explained would benefit from hard neuroscientific data on the one hand and from insights stemming from first-person experience on the other hand, as it is the currency of spiritual traditions.

The monograph contains essays from various scholars. One specifically outlines the following (Schooler et al. 2011, p. 157):

> Material reductionism—the prevailing metaphysical view that reality can be understood entirely in terms of non-conscious physical stuff—is at odds with the existence of experience, the flow of time,[18] and the privileged present. We propose an alternative scientifically-grounded metaphysical perspective that posits: (1) Consciousness represents a fundamental aspect of reality such that all material things enjoy some varying degree of consciousness (panpsychism); […] (3) both experience and the flow of time suggest the reality of a subjective realm of existence; […]. Although speculative, these conjectures illustrate the type of alternative metaphysics that may be able to accommodate scientific observations without abandoning the self-evident facts that experience exists and time flows.

However, the book's editors admit (Walach et al. 2011, p. v):

> Science within the comfort zone of unidisciplinarity is always nice and easy, and cosy, too. Stepping beyond is not only challenging, it is nothing short of madness and professional suicide. Yet, we felt it is necessary. Spirituality seems to be a necessary ingredient in the scientific debate. Talking about consciousness without taking into account exceptional experiences and personal accounts of conscious states that are beyond the ordinary is a bit like trying to do physics with the constraint of only studying crystal lattices. That won't yield a valid theory of matter. Neither will philosophising about consciousness without taking into account different aspects, especially extraordinary and even rare states of consciousness. Plasma states of matter are rare and not normally observed in our everyday world. Yet, they teach us a lot about matter. In the same sense, extraordinary states of consciousness as reported in the spiritual literature, by those practicing spiritual methods such as meditation, can teach us more about consciousness than thousands of discussions of what consciousness is like in a normal day in the supermarket.

The essence—or crux—of spirituality is its experiential dimension. If a person has experienced an episode so real, so intense, that ordinary events appear bland and inconsequential in comparison, it is hard to talk them out of it. Even knowing that by simply exposing my brain to a magnetic field can induce a mystical experience (Sect. 11.3.1) will in no way diminish the experiential reality of such an episode. The same is true for "hallucinations" experienced while the brain is flooded with psychoactive molecules, from psychedelics to empathogens or entactogens. Commonly,

[18] See Sect. 10.4.2.

a mystical experience—spontaneous or induced—will leave a mark on the psyche for years. The fascinating story of the neuroanatomist Jill Bolte Taylor was told in Sect. 11.3.3. While the left hemisphere of her brain was being damaged by a hemorrhage, she experienced the most profound mystical experience. Space ceased to exist as her consciousness united with all of existence. "I found Nirvana" (Bolte Taylor 2008). In his controversial end-of-science book of 1996, Horgan reports about a mystical experience in the epilogue. We can read (Horgan 2012, p. 261):

> Years ago, before I became a science writer, I had what I suppose could be called a mystical experience. A psychiatrist would probably call it a psychotic episode. Whatever. For what it's worth, here is what happened. Objectively, I was lying spread-eagled on a suburban lawn, insensible to my surroundings. Subjectively, I was hurtling through a dazzling, dark limbo toward what I was sure was the ultimate secret of life. Wave after wave of acute astonishment at the miraculousness of existence washed over me. At the same time, I was gripped by an overwhelming solipsism. I became convinced—or rather, I *knew*—that I was the only conscious being in the universe. There was no future, no past, no present other than what I imagined them to be. I was filled, initially, with a sense of limitless joy and power. Then, abruptly, I became convinced that if I abandoned myself further to this ecstasy, it might consume me. If I alone existed, who could bring me back from oblivion? Who could save me? With this realization my bliss turned into horror; I fled the same revelation I had so eagerly sought. I felt myself falling through a great darkness, and as I fell I dissolved into what seemed to be an infinity of selves. For months after I awoke from this nightmare, I was convinced that I had discovered the secret of existence: God's fear of his own Godhood, and of his own potential death, underlies everything. This conviction left me both exalted and terrified—and alienated from friends and family and all the ordinary things that make life worth living day to day. I had to work hard to put it behind me, to get on with my life. To an extent I succeeded.

Some years later Horgan published the book called *Rational Mysticism: Dispatches from the Border Between Science and Spirituality*. There he updates the reader as follows (Horgan 2003b, p. 4):

> In *The End of Science*, I alluded to a drug-induced episode that had been haunting me since 1981. I kept this section short, because I feared it might repel the scientifically oriented readers for whom my book was intended. The opposite reaction occurred. Many readers—including scientists, philosophers, and other supposed rationalists—wrote to tell me that they found the section on mysticism the most compelling part of the book. Readers related their own mystical episodes, some ecstatic, others disturbing. Like me, these readers seemed to be struggling to reconcile their mystical intuitions with their reason.

Finally, the neurosurgeon Eben Alexander reports his near-death experience during a coma in his book *Proof of Heaven* (Alexander 2012a). In a nutshell (Alexander 2012b):

> Yet in spite of the complete absence of neural activity in all but the deepest, most primitive portions of my brain, my identity—my sense of self—did not go dark. Instead, I underwent the most staggering experience of my life, my consciousness traveling to another level, or dimension, or world.

Alexander's book became a *New York Times* bestseller. He recalls a very remarkable experience (Alexander 2012a, back cover):

> Alexander's recovery is a medical miracle. But the real miracle of his story lies elsewhere. While his body lay in a coma, Alexander journeyed beyond this world and encountered an angelic being who guided him into the deepest realms of super-physical existence. There he met, and spoke with, the Divine source of the universe itself.

In more detail (Alexander 2012a, p. 47):

> My situation was, strangely enough, something akin to that of a fetus in a womb. The fetus floats in the womb with the silent partner of the placenta, which nourishes it and mediates its relationship to the everywhere present yet at the same time invisible mother. In this case, the "mother" was God, the Creator, the Source who is responsible for making the universe and all in it. This Being was so close that there seemed to be no distance at all between God and myself. Yet at the same time, I could sense the infinite vastness of the Creator, could see how completely minuscule I was by comparison.

Despite the commercial success of the book not everyone was convinced (Alexander 2012b):

> But I've also weathered considerable criticism—in large part from people who are appalled that I, a brain surgeon, could possibly make the claim that I experienced what I did.
>
> I can't say I'm surprised. As a scientist, I know that the consensus of my tribe is that the self is created through the electrochemical activity of the brain. For most neurosurgeons, and most doctors generally, the body produces the mind, and when the body stops functioning, the mind stops, just like a picture projected on a screen does if the projector is unplugged.
>
> So when I announced to the world that during my seven days of coma I not only remained fully conscious but journeyed to a stunning world of beauty and peace and unconditional love, I knew I was stirring up a very volatile pot.

Indeed, the *Esquire* reported critically about Alexander, questioning his credibility (Dittrich 2013):

> Before *Proof of Heaven* made Dr. Eben Alexander rich and famous as a "man of science" who'd experienced the afterlife, he was something else: a neurosurgeon with a troubled history and a man in need of reinvention.

Alexander retorts (quoted in Bercovici 2013):

> I stand by every word in this book and have made its message the purpose of my life. *Esquire's* cynical article distorts the facts of my 25-year career as a neurosurgeon and is a textbook example of how unsupported assertions and cherry-picked information can be assembled at the expense of the truth.

14.2.4 Non-Human Intelligence

After the excursion into the unscientific dimensions accompanying the enigma of consciousness, this section ends by returning to the terra firma of the objective realm. At this point, it is justified to contemplate the following. If consciousness really is a fundamental and/or universal phenomenon, then one would expect such characteristics also to be manifested in the cognitive capabilities of consciousness—specifically, in relation to the puzzle of intelligence.

Kevin Warwick is a scholar of cybernetics and robotics. In his book, called *QI: The Quest for Intelligence*, he writes (Warwick 2000):

> Intelligence is a term we all think we understand, but do we? What do we mean when we describe someone, some animal or even some thing as being intelligent? [P. 6]
>
> We are not only subjective in the way we view other human beings' intelligence, but also in our assessment of animal and machine intelligence. We have preconceived ideas, despite clear evidence to the contrary. For example, many people think that pigs are dirty, smelly animals and as a consequence not very intelligent. This is patently untrue—pigs are, when compared to other animals, of relative high intelligence. Likewise, many people think machines have no intelligence at all, that they get things done by following programs. This again is not true; some can learn and adapt, and such abilities are growing with every technological advancement made. [P. 14]

Before diving into the ocean of the many expressions of non-human intelligence, one fact should be recalled. In Sect. 11.3.3, two cases were reported, where seemingly normally functioning humans—expressing no obvious signs of intellectual disability—lacked most of what constitutes a brain. Such cases appear to break the expected correlation between cognition and neural complexity.

14.2.4.1 Collective Intelligence

Collective Intelligence is an abstract form of disembodied intelligence. It can be manifested without any individual cognitive capacity accompanying it. Many social insects can exhibit astonishing expressions of collective intelligence. In other words, each individual entity has very limited capacity for cognition, if any, but as a swarm the system functions as a single, intelligent superorganism. For instance, insect colonies that engineer air-conditioning capabilities or farm and milk other species (Sect. 12.4.1). In particular, the superorganism comprised of ants has been studied with great detail (Hölldobler and Wilson 2009). Indeed (O Shea-Wheller et al. 2015):

> Insect societies are complex systems, displaying emergent properties much greater than the sum of their individual parts. As such, the concept of these societies as single "superorganisms" is widely applied to describe their organisation and biology. […] Our findings lend support to the superorganism concept, as the whole society reacts much like a single organism would in response to attacks on different parts of its body.

Another fascinating aspect is collective decision-making. For instance, when colonies of honey bees choose among nectar sources (Seeley et al. 1991) or select new nest-sites (Britton et al. 2002). Collective decision-making has also been argued to underlie flocks of starlings while performing collective turns as a swarm. Essentially, swarm intelligence (Bonabeau et al. 1999) is another explicit manifestation of collective intelligence.

Within the study of complexity (Chap. 6), self-organization, structure formation, and emergence are often encountered phenomena. These can give rise to adaptive, resilient, and sustainable behavior. In other words: to collectively intelligent systems. A hallmark of such collective intelligence is a decentralized blueprint for the interactions of the system's components (Sect. 5.2.4). This key feature is mostly missing

in the collective system's we humans design (Chap. 7)—at least until very recently (Sect. 7.4.3).

In conclusion, intelligence can be divorced from electrochemical processes appearing in a biological neural network. This raises the question, what, then, the essence of this collective intelligence is? Where is it located? Analyzing a colony of ants does not reveal incremental units of intelligence distributed among the individual insects. Collective intelligence is an emergent phenomenon, suddenly appearing at a threshold where the whole is literally more than the sum of its parts. Moreover, what is the substrate for this intelligence? How does it come to be, how is it physically embodied, and how is it sustained? Perhaps it is encoded in the fabric of reality itself, as we today know that at the heart of complexity resides miraculous simplicity (Sect. 5.2.1 and Chap. 6).

14.2.4.2 Animal Intelligence

The question, if animals are intelligent, is a thorny one. The culturally normalized act of eating animals suddenly poses a potential ethical challenge. How intelligent must an animal be, before I refuse to consume its flesh? How much non-human suffering am I willing to induce for my subjective sensory pleasure?[19] This is a culturally charged topic (Harari 2015, p. 382):

> Around the time that *Homo sapiens* was elevated to divine status by humanist religions, farm animals stopped being viewed as living creatures that could feel pain and distress, and instead came to be treated as machines. Today these animals are often mass-produced in factory-like facilities, their bodies shaped in accordance with industrial needs. They pass their entire lives as cogs in a giant production line, and the length and quality of their existence is determined by the profits and losses of business corporations. [P. 382]
>
> The tragedy of industrial agriculture is that it takes great care of the objective needs of animals, while neglecting their subjective needs. [P. 385]

The dimensions of this ethical conflict are truly mind-boggling. Recall from the introduction to Chap. 11 that in 2016, approximately 65.8 billion chickens, 1.5 billion pigs, and 302 million cattle were slaughtered globally.

Anyone who ever had a pet knows for certain that animals are very intelligent and appear to have a rich inner life. Dogs and cats seem to also understand the inner life of humans—although cats often appear less interested. But not all. Oscar is a therapy cat living in a nursing and rehabilitation center. He is quite special (Dosa 2007):

> Since he was adopted by staff members as a kitten, Oscar the Cat has had an uncanny ability to predict when residents are about to die. Thus far, he has presided over the deaths of more than 25 residents […].

[19] Next to the issue of animal ethics, there exists mounting evidence that a well-planed plant-based diet leads to a healthier life (Lim et al. 2012; Orlich et al. 2013; Greger 2015) and that the ecological footprint of a diet heavy in meat and dair is alarming. See the discussion on anthropogenic environmental destruction in the Epilogue.

A book was written about his abilities (Dosa 2010). Another prominent feline is Bob. The street cat was adopted by the homeless heroin addict James Bowen and essentially helped him turn his life around. *A Street Cat Named Bob: And How He Saved My Life* appeared on the *New York Times* bestseller list and recounts this story (Bowen and Jenkins 2012).

Perhaps the most astonishing feat of animal intelligence is the comprehension of human language. For instance (Williams 2004):

> A border collie with a stellar vocabulary has accomplished a type of learning previously only seen in toddlers. The researchers say the finding indicates that even mammals distantly related to humans may have the rudiments of language learning.

Also birds appear to have a grasp on human language. Alex is perhaps the most famous parrot, studied by Irene Pepperberg at Harvard (Pepperberg 1999). She bought him in a pet-shop in 1977. On September 6, 2007, Alex is reported to have uttered the following last words to her before his death at the age of 31 (Philipkoski 2007):

> You be good. See you tomorrow. I love you.

Koko was a gorilla who achieved proficiency in conversing with signs. "Her total vocabulary now approximates that of human toddlers" (Fischer 1999, p. 27). Koko also adopted a kitten during her lifetime (Patterson and Cohn 1985). She taught the gorilla called Michael how to utilize sign language and thus communicate with her and humans (Fischer 1999).

Other signs of animal intelligence include tool use. Perhaps the ability of primates to make and utilize tools does not strike one as particularly extraordinary (Boesch and Boesch 1990). Tool use by birds may appear more exceptional (Emery 2006):

> Comparative psychologists interested in the evolution of intelligence have focused their attention on social primates, whereas birds tend to be used as models of associative learning. However, corvids and parrots, which have forebrains relatively the same size as apes, live in complex social groups and have a long developmental period before becoming independent, have demonstrated ape-like intelligence. […] In reviewing the evidence for avian intelligence, corvids and parrots appear to be cognitively superior to other birds and in many cases even apes. This suggests that complex cognition has evolved in species with very different brains through a process of convergent evolution rather than shared ancestry […].

It seems amazing, that an overall small avian brain could outperform a much larger primate brain. Especially, as birds lack arms, hands, and fingers. See also Lefebvre et al. (2002) for more on avian tool use and brains. Indeed, Sect. 11.3.2 baffled with the insight that pigeons are better equipped at intuitively grasping probabilities than humans. Then, octopuses (Sect. 11.3.2) are truly bizarre organisms (Courage 2013):

> If you want to study an alien intelligence, [philosopher] Godfrey-Smith says, "octopuses are the closest thing we have."

They are also very intelligent—perhaps even the earliest manifestations of intelligence. Albeit a very unusual one (Reynolds 2015):

> [T]he cognition of an octopus is decentralised and distributed throughout its body, allowing each tentacle to integrate with other systems as well as act independently. Octopuses are also capable of sophisticated, learned behaviour, much of which we'd consider to be a mark of consciousness in humans.

A deeper look at the lives and brains of octopuses is found in Godfrey-Smith (2016). Then, mirror self-recognition, the self-identification of the specular image, is known for apes, monkeys, dolphins, and elephants. It is believed to be associated with empathy and aiding behavior (de Waal et al. 2005). With respect to fairness (Brosnan 2013):

> Humans are not alone in responding negatively to differential treatment compared with a partner. This response is shared with other species and appears to be instrumental in successful cooperation.

Chimpanzee have far superior short-term memory than humans (Inoue and Matsuzawa 2007). Perhaps the most striking indication of the rich inner lives of animals is the capacity for play (Boyd 2004):

> Pleasure is nature's way of ensuring that creatures perform an activity, and animals and humans not only look as though they enjoy play but their brains release dopamine when they anticipate or take part in it. […] Play has been observed in many animal species, including all mammals in which it has been looked for, and especially in rats, canids (dogs and wolves), primates and cetaceans (dolphins and whales). Easily recognized by experts and non-experts alike, despite the difficulty of defining it, play has been much studied by biologists.

Today, with the ubiquity of recording devices and streaming platforms in the Internet, we can witness behaviors of animals which perhaps no researcher has ever been able to analyze. For instance, inter-species "friendship" among animals. The video-sharing website YouTube has many videos showing capybaras bonding with an array of different animals.

Again, all of this suggests that intelligence is not simply a function of complex neural connectivity, with the human brain eclipsing all animal brains. In detail (Brockman 2015a, p. 29):

> The bigger an animal's brain, the greater its intelligence. You may think the connection is obvious. […] In particular, you'll find the idea repeated in every modern textbook—that the brain size of different primate species is causally related to their social intelligence. I admit I'm partly responsible for this, having championed the idea back in the 1970's. Yet, for a good many years now, I've had a hunch that the idea is wrong.

In the final analysis, we appear to be confronted with the challenge of having to modify our cherished notion of superior anthropocentric thinking and intelligence. Somehow, intelligence is akin to "software" that can be run on different neural wetware—even on a distributed system of insects. We are, yet again, invited to formulate our understanding within an information-theoretic paradigm, embedded in a computational framework (Sects. 13.1.2 and 13.2.2). As an example, how is intelligence inherited? On the face of it, individual intelligence is encoded in the genes and unravels as the cognitive apparatus of the offspring develops. However, looking at animals constructing very complex and elaborate nest structures, the exact way

this knowledge propagates seems mystifying. The behavioral skill-set is physically encoded as information in the fertilized zygote's genes. It is then decoded and programs the young animal's developing brain to allow this instinctive knowledge to manifest. And so an animal constructs a physical structure it has never encountered before in its life. The more intricate the nests, the greater the potential computational complexity of the programming which was transmitted. For instance, this applies to the huge geometric circular structure the male pufferfish creates (Kawase et al. 2013), as it does to the intricate and ornamental nest the male bowerbird assembles (Borgia 1985).

We are also gently invited to reconsider what is deemed food and what represents creatures quipped with rich, subjective inner spaces of sentience, capable of great suffering. From such considerations a potential intrinsic moral right of a species could be derived, to not be subjected to factory-farming in enormous numbers. A simple exercise in empathy is to imagine being the other creature. This is obviously hard to imagine for non-human animals. Nagel wrote a much-noticed piece called *What Is It Like to Be a Bat?* (Nagel 1974), also relating to the philosophy of the mind (Sect. 11.1).

14.2.4.3 Plant Intelligence

Do we also face a potential ethical challenge by consuming plants? Alan Watts, a philosopher, psychonaut, mystic, and interpreter of Eastern philosophy, observes in his essay, titled *Murder in the Kitchen*, the following (Watts 1971 p. 23f.):

> I am simply amazed to find myself living on a ball of rock that swings around an immense spherical fire. I am more amazed that I am a maze—a complex wiggliness, an arabesque of tubes, filaments, cells, fibers, and films that are various kinds of palpitation in this stream of liquid energy. But what really gets me is that almost all the substance of this maze, aside from water, was once *other* living bodies—the bodies of animals and plants—and that I had to obtain it by murder. We are creatures rearranged, for biological existence continues only through the mutual slaughter and ingestion of its various species. I exist solely through membership in this perfectly weird arrangement of beings that flourish by chewing each other up.

Plants represent the only ubiquitous, terrestrial, biological interface to the sun, harnessing its energy by transforming solar radiation into life-sustaining chemical energy. Thus, the fundamental question is: Do plants feel pain and can they suffer? In Switzerland, the Federal Ethics Committee on Non-Human Biotechnology discussed the ethical status of plants in the 2008 report *The Dignity of Living Beings With Regard to Plants. Moral Consideration of Plants for Their Own Sake*.[20] The topics of ownership, instrumentalization, patenting, and genetic modification were discussed. Specifically:

> The Committee members unanimously consider an arbitrary harm caused to plants to be morally impermissible. This kind of treatment would include, e.g. decapitation of wild flowers at the roadside without rational reason.

[20] See http://www.ekah.admin.ch/en/topics/dignity-of-living-beings/.

However:

> A majority considers any action with or towards plants that serves the self-preservation of humans to be morally justified, as long as it is appropriate and follows the principle of precaution.

Other researchers disagree (as quoted in Koechlin 2009):

> [T]he discussion going on in Switzerland about the dignity of plants could lead us down to an absurd and dangerous path.

Plants lack a standard central nervous system able to process information and generate complex experiential inner landscapes. But this does not mean that plants are not intelligent. Intriguingly, there exists striking similarities between plant cells, especially in the roots, and neurons (Baluška 2010). Forests are sustained by vast underground networks, comprised of fungi and the roots of trees and plants, all existing in a symbiotic equilibrium transferring nutrients (Simard et al. 2012). More generally (Koechlin 2009):

> [M]any discoveries in recent years [have been made] that suggest a new "sensitive" picture of plants. It has, for instance, been revealed that plants are active in sensing numerous parameters from their environment, communicate extensively and actively; they interact with their surroundings. They can choose between different possibilities and change their behaviour accordingly. On the cellular level, similarities between animals and plants are far greater than previously assumed (communication with electrical action potentials, similar vesicle trafficking and signaling molecules, etc.). They have an innate immune system. At a rudimentary level, their roots can distinguish between self and non-self.

Plants can express a wide variety of intelligent behavior. The biologist Florianne Koechlin, member of the Federal Ethics Committee, explains the following about plants (quoted in Reissman 2016):

> [T]hey form memories, send warnings, attack predators, and pick up on signals from their environment. They communicate with other plants. They alter their behavior based on past experiences. […] When a caterpillar attacks a leaf, the [tomato] plant starts to produce leaf toxins and, at the same time, releases a cloud of fragrance to warn neighboring tomatoes, so they too can start with their defense […] not only [does] the tomato know that she is being attacked, but also exactly who is attacking her. If she is attacked by spider mites, she produces a fragrance cocktail that attracts predatory mites that eat spider mites, but if she is attacked by caterpillars, she produces a slightly different cocktail of fragrances to attract parasitic wasps. Tomato plants detect their predators through the taste of the insects' saliva.

Plants cry for help, ward off bugs, and save each other using molecular codes based on what are known as volatile organic compounds (Preston 2018). Finally (Pollan 2013):

> [T]he dodder vine, *Cuscuta europaea*, [is] a parasitic white vine that winds itself around the stalk of another plant and sucks nourishment from it. A dodder vine will "choose" among several potential hosts, assessing, by scent, which offers the best potential nourishment. Having selected a target, the vine then performs a kind of cost-benefit calculation before deciding exactly how many coils it should invest—the more nutrients in the victim, the more coils it deploys.

Slowly, the true extent of plant intelligence is being comprehended (Mancuso and Viola 2015; Trewavas 2016; Haskell 2017). Indeed (Calvo et al. 2017):

> Probably, 95% of plant biologists would reject any association of sentience with plant life. So did the authors of this article initially. But an investigation of older literature combined with present understanding led us to a more agnostic position [...].

Once again in the history of the Western mind, a cognitive blind spot resulted in myopia towards the surrounding wonders. The Sanskrit word *ahiṃsā* encapsulates the doctrine of non-violence and it applies to all living beings. For instance, the followers of the Indian religion of Jainism (Sect. 3.1) go out of their way so as not to even hurt insects. One of the central tenets of Buddhism is compassion—again, without an anthropocentric prejudice.

14.2.4.4 Non-sentient Intelligence

Remarkably, intelligence is an intangible phenomenon that can appear in very different biological configurations. However, in the discussion up to now, intelligence was incorporated in either complex organic matter—including plants—or in societies of insects with complex social structures. Can we find intelligence in other creatures?

Slime moulds are organisms that can live as single amoeba-like cells or can aggregate together to form multicellular structures. "Slime mould is effectively a supercell—a bunch of dumb cells that gather together to form a seemingly smart and mobile superorganism" (Collins 2015). Surprisingly, slime mould can solve mazes. Specifically, it can "find the minimum-length solution between two points in a labyrinth" (Nakagaki et al. 2000). "Slime moulds aren't just capable of learning, they can teach each other too" (Tennenhouse 2017).

Perhaps the biggest enigma related to intelligence is that it can latch onto non-organic matter. Even samarium nickelate oxide (SNO), a synthetic crystal, can mimic learning (Zuo et al. 2017). Indeed (Garisto 2017):

> It might be discomfiting that SNO—without a brain or even living cells—can learn. How special are we if a couple layers of atoms can learn, too? But then again, just because humans don't have a monopoly on learning doesn't mean we re not unique. We did discover SNO.

Indeed, the human mind unlocked unprecedented levels of non-organic information processing by engineering computers. Or perhaps the universe is guided by an invisible force driving it to ever higher levels of self-organized complexity and information processing—first organic, then mental, and finally digital (this raises the question of teleology, discussed in Sect. 15.2).

The fields of artificial intelligence (AI) and, specifically, machine learning, are currently exploding. Indeed, deep neural networks are being framed within an information-theoretic context, slowly shedding light on non-human learning mechanisms (Shwartz-Ziv and Tishby 2017):

> We demonstrated that the visualization of the layers in the *information plane* [related to the input and output variables of neural network layers] reveals many—so far unknown—details about the inner working of Deep Learning and Deep Neural Networks.

In 2016, a threshold was reached (Granter et al. 2017):

> In March of last year, Google's (Menlo Park, California) artificial intelligence (AI) computer program AlphaGo beat the best Go player in the world, 18-time champion Lee Se-dol, in a tournament, winning 4 of 5 games. At first glance this news would seem of little interest to […] anyone […]. After all, many will remember that IBM's (Armonk, New York) computer program Deep Blue beat Garry Kasparov—at the time the greatest chess player in the world—and that was 19 years ago. So, what's so significant about a computer winning another board game?
>
> The rules of the several-thousand-year-old game of Go are extremely simple. […] Despite the simplicity of its rules, Go is a mind-bogglingly complex game—far more complex than chess. A game of 150 moves (approximately average for a game of Go) can involve 10^{360} possible configurations, "more than there are atoms in the Universe." As complex as it is, chess is vastly less complex than Go, and chess is amenable to "brute force" algorithmic computer approaches for beating expert chess players like Kasparov. To beat Kasparov, Deep Blue analyzed possible moves and evaluated outcomes to decide the best move.
>
> Go's much higher complexity and intuitive nature prevents computer scientists from using brute force algorithmic approaches for competing against humans. For this reason, Go is often referred to as the "holy grail of AI research." To beat Se-dol, Google's AlphaGo program used artificial neural networks that simulate mammalian neural architecture to study millions of game positions from expert human-played Go games. But this exercise would, at least theoretically, only teach the computer to be on par with the best human players. To become better than the best humans, AlphaGo then played against itself millions of times, over and over again, learning and improving with each game—an exercise referred to as reinforcement learning. By playing itself and determining which moves lead to better outcomes, AlphaGo literally learns by teaching itself. And the unsettling thing is that we don't understand what AlphaGo is thinking. In an interview with *FiveThirtyEight*, one computer scientist commented, "It is a mystery to me why the program plays as well as it does." In the same article, an expert Go player said, "It makes moves that no human, including the team who made it, understands," and "AlphaGo is the creation of humans, but the way it plays is not." It is easy to see how some viewed AlphaGo's victory over Se-dol as a turning point in the history of humanity—we have created machines that truly think and, at least in some areas like Go, they are smarter, much smarter, than we are.

Metzinger points out the following (Metzinger 2009, p. 187):

> In thinking about artificial intelligence and artificial consciousness, many people assume there are only two kinds of information-processing systems: artificial ones and natural ones. This is false. In philosophers' jargon, the conceptual distinction between natural and artificial systems is neither *exhaustive* nor *exclusive*: that is, there could be intelligent and/or conscious systems that belong in neither category. With regard to another old-fashioned distinction—software versus hardware—we already have systems using biological hardware that can be controlled by artificial (that is, man-made) software, and we have artificial hardware that runs naturally evolved software.

Furthermore (Metzinger 2009):

> [L]et us call any system capable of generating a conscious self an *Ego Machine*. An Ego Machine does not have to be a living thing; it can be anything that possesses a conscious self-model. [P. 187]
>
> The first self-modeling machines have already appeared. Researchers in the field of artificial life began simulating the evolutionary process long ago, but now we have the academic discipline of "evolutionary robotics." Josh Bongard, of the Department of Computer Science

> at the University of Vermont, and his colleagues Victor Zykov and Hod Lipson have created an artificial starfish that gradually develops an explicit internal self-model. Their four-legged machine uses actuation-sensation relationships to infer indirectly its own structure and then uses this self- model to generate forward locomotion. When part of its leg is removed, the machine adapts its self-model and generates alternative gaits—it learns to limp. Unlike the phantom-limb patients […], it can restructure its body representation following the loss of a limb; thus, in a sense, it can learn. As its creators put it, it can "autonomously recover its own topology with little prior knowledge," by constantly optimizing the parameters of its resulting self-model. The starfish not only synthesizes an internal self-model but also uses it to generate intelligent behavior. [P. 189]

Lipson is featured in the 2018 documentary *Do You Trust this Computer?*[21] and recalls the following episode from a year earlier. He and his team were training an AI system for a live demonstration. Specifically, they were testing how the objects waved in front of the AI's camera were being recognized. On a side screen, the researchers could observe how certain neurons in the AI were responding to the stimuli. At 53 min and 37 s Lipson remarks:

> And suddenly we noticed that one of the neurons was tracking faces. It was tracking our faces as we were moving around. Now, the spooky thing about this is that we never trained the system to recognize human faces and yet, somehow, it learned to do that. Even though these robots are very simple, we can see that something else is going on there. It is not just programming.

The 2015 *Edge* annual question (Sect. 9.3) was: "What Do You Think about Machines that Think?" The psychologist Tania Lombrozo cautions: "Don't Be A Chauvinist About Thinking." Specifically, (Brockman 2015b, p, 337):

> Cultural psychologists have challenged the idea that Western adults provide a privileged population from which to study human thinking. Developmental psychologists have raised questions about whether and how preverbal infants can think. Comparative psychologists have long been interested in whether and how non-human animals can think. And philosophers, of course, have considered these questions along the way. Across these disciplines, one advance in how we think about thinking has come from recognizing and abandoning the idea that "thinking like I do" is the only way to think about thinking, or that "thinking like I do" is always the best or most valuable kind of thinking. In other words, we've benefited from scrutinizing the implicit assumptions that often slip into discussions of thinking, and from abandoning a particular kind of thinking chauvinism.
>
> With thinking machines, we face many of the very same issues, but the target of study has shifted from humans and other animals to machines of our own creation. […]. Recent advances in artificial intelligence are already compelling us to rethink some of our assumptions about thinking. They aren't just making us think differently and with different tools, but changing the way we think about thinking itself.

A potential future in which the human mind is faced with non-human and non-organic intelligence is unsettling to some and fascinating to others. The term (technological) singularity (Vinge 1993; Kurzweil 2005) encompasses this ambiguity. It is the hypothesis that one day, soon, artificial superintelligence will surpass human intelligence. Effectively, the human era will end. This challenge is analyzed by both

[21] See http://doyoutrustthiscomputer.org/.

Tegmark and the philosopher Nick Bostrom (introduced in Sect. 13.4.2 with his simulation hypothesis):

> If machine brains one day come to surpass human brains in general intelligence, the fate of our species would depend on the actions of powerful AI. [*Superintelligence* (Bostrom 2014, back cover)]
>
> We stand at the beginning of a new era. What was once science fiction is fast becoming reality, as AI transforms war, crime, justice, jobs and society—and, even, our very sense of what it means to be human. More than any other technology, AI has the potential to revolutionize our collective future […]. [*Life 3.0* (Tegmark 2017, blurb in dust jacket)]

The notion of posthumanism is invoked (Herbrechter 2013, p. 3):

> This could indeed be regarded as a preliminary definition of posthumanism: it is the cultural malaise or euphoria that is caused by the feeling that arises once you start taking the idea of "postanthropocentrism" seriously. To be able to think the "end of the human" without giving in to apocalyptic mysticism or to new forms of spirituality and transcendence—this would correspond to the attitude that the phrase "critical posthumanism" wishes to describe.

Tegmark founded *The Future of Life Institute*.[22] It is concerned with potential existential risks approaching humanity and its motto reads:

> Technology is giving life the potential to flourish like never before—or to self-destruct. Let's make a difference!

Advisors include the entrepreneur Elon Musk and, prior to his death, Stephen Hawking. In an open letter, signed by 3,978 AI/Robotics researchers and 22,541 others,[23] it is warned of the dangers of weaponizing AI. However, even without the existence of artificially-intelligent autonomous weapon systems, the following question stands out:

> How should true artificial superintelligent assess the role and utility of humanity, given its global political and religious ideological entrenchment (Chap. 12), its faulty economic and financial systems (Chap. 7) resulting in unimaginable inequity (Sect. 7.4.2.3), the tendency of the strong to exploit the weak, the globally prevailing cruel treatment of countless sentient beings, and the systematic destruction and pollution of the entire biosphere (Epilogue)?

At the moment, the challenges we face with respect to AI are similar to the general societal challenges. The current level and utilization of AI threatens democracy and increases inequality (O'Neil 2016). Moreover, if human online interactions are taken as a training set for AI, the results are unsavory. In 2016, Microsoft unleashed its chat bot Tay, supposed to mimic a 19-year-old US American girl, on social media. 24 hours later, the AI was shut down and Microsoft issued an apology[24]:

[22] See https://futureoflife.org/.

[23] See https://futureoflife.org/open-letter-autonomous-weapons/, retrieved August 21, 2018.

[24] See https://blogs.microsoft.com/blog/2016/03/25/learning-tays-introduction/.

> We are deeply sorry for the unintended offensive and hurtful tweets from Tay, which do not represent who we are or what we stand for, nor how we designed Tay.

In effect, mirroring the normal, daily behavior witnessed on social media, Tay quickly manifested abusive fascist, racist, and misogynist traits. We will never know how much this reveals about humanities dark side, thriving in anonymous online interactions, and how much is due to mischievous behavior—trolling.

In closing, intelligence is an emergent property of reality itself, being manifested in very different material and computational structures. It can be localized or distributed and it can be embodied within a conscious mind or not. Having said this, consciousness itself is still an enigma. Do any tools exists, which could help the human mind understand its own conscious nature?

14.3 Enhanced Consciousness: The Psychedelic Renaissance

Up to now, the enigma of consciousness was discussed with respect to three of its manifestations: sober waking consciousness, dreaming, and meditative states. However, since the dawning of the human mind it has been known that there exist radically different states of consciousness—often induced chemically. As these have been deemed harmful, most modern societies have banned any substances causing altered states of consciousness—with the exception of ethanol, nicotine, caffeine, and psychiatric medication. Yet again, a consequential blind spot emerges in the collective vision of humanity. However, slowly the prohibition of, and the stigma associated with, psychoactive substances is today being reevaluated—with profound potential for understanding consciousness and reality.

In 1980, the eminent psychiatrist Stanislav Grof observed (quoted in Carhart-Harris et al. 2014):

> [P]sychedelics, used responsibly and with proper caution, would be for psychiatry what the microscope is for biology and medicine or the telescope is for astronomy.

The influential writer Aldous Huxley is on record saying (in the 1958 BBC program *Monitor*[25]):

> I think it would be extremely good for almost anybody with fixed ideas and with a great certainty about what's what to take this thing [psychedelics] and to realize the world he's constructed is by no means the only world, that there are these extraordinary other types of universe.

Huxley famously documented his mescaline experience in the book *The Doors of Perception: And Heaven and Hell* (Huxley 1954)—the inspiration for the US American rock band's name, *The Doors*. LSD was a serendipitous discovery with great cultural ramifications. At first (Kaiser 2011, p. xxii):

[25] See https://www.bbc.co.uk/programmes/p015fs9b.

> The Central Intelligence Agency and the U.S. Army sponsored research on effects of LSD at government laboratories and reputable research universities throughout the 1940s and 1950s.

However (Kaiser 2011, p. xxi):

> The hippie counterculture sported […] a personal striving often facilitated by heavy use of psychedelic drugs. LSD, synthesized in a Swiss lab in the late 1930s, was first outlawed in the United States in 1966; possession of the drug was bumped up to a felony offense in 1968.

Indeed, the US Drug Enforcement Administration specifies[26]:

> Schedule I drugs, substances, or chemicals are defined as drugs with no currently accepted medical use and a high potential for abuse. Some examples of Schedule I drugs are: heroin, lysergic acid diethylamide (LSD), marijuana (cannabis), 3,4-methylenedioxymethamphetamine (ecstasy), methaqualone, and peyote.

The ethnobotanist and psychonaut Terence McKenna is doubtful of this explanation for banning psychedelics (Lin 2014):

> His assumption about psychedelics had always been that they were illegal "not because it troubles anyone that you have visions" but because "there is something about them that casts doubts on the validity of reality." This makes it difficult, McKenna observed, for societies—even democratic and especially "dominator" societies—to accept them, and we happen to live in a global "dominator" society.

The chemist Alexander Shulgin, who had synthesized and tested hundreds of new psychedelic substances, also observed (Shulgin and Shulgin 2017b, p. 385):

> Then: The earth is the center of the universe, and anyone who says otherwise is a heretic. Now: All drugs that can expand consciousness are without medical or social justification, and anyone who uses them is a criminal.

He was the most prolific psychedelic chemist in history (Horgan 2014b):

> Alexander "Sasha" Shulgin, I learned later, was a top-rank researcher for Dow Chemical in 1960 when he ingested a psychedelic compound—mescaline—for the first time. Shulgin found the experience so astonishing that he devoted the rest of his career to psychedelic chemistry.

Today, experts realize (Boseley and Glenza 2016):

> The global "war on drugs" has harmed public health, human rights and development. It's time for us to rethink our approach to global drug policies, and put scientific evidence and public health at the heart of drug policy discussions.

Surprisingly, medical experts call for global drug decriminalization. A panel of 22 medical experts called together by Johns Hopkins University advocate this stance in a publication in the leading medical journal, *The Lancet* (Frenk et al. 2010). Indeed (Tatera 2016a):

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[26] See https://www.dea.gov/drug-scheduling.

> [N]ot only is there ample research against the current prohibitionist drug approach, but there's support for decriminalization thanks to countries like Portugal and the Czech Republic which have already decriminalized all non-violent minor drug offenses. These countries have showed that in real-world settings, policies for drug decriminalization can have positive impacts on society.

In the early 1990s, Zurich was plagued by Europe's biggest open drug scene. Over decades, misery, suffering, and death became ever more visible in an otherwise affluent city. Evictions by the police resulted in relocation. In 1992, a pragmatic drug policy was enforced,[27] allowing for heroin distribution under medical attention. Despite certain political opposition against "the government supplying junkies with free heroin," the pioneering program was a success (Neue Zürcher Zeitung 2013). Having lived in Zurich since the early 1990s, the transformation is astonishing and the former conditions unimaginable.

In 2016, a landmark study was published in the prestigious journal *Proceedings of the National Academy of Sciences* (Carhart-Harris et al. 2016). For the first time, modern brain scanning techniques were applied to the brains of humans under the influence of LSD. The study was crowdfunded.[28] Senior researcher on the study, the neuropsychopharmacologist David Nutt, explained (quoted in Sample 2016):

> "This is to neuroscience what the Higgs boson was to particle physics," he said. "We didn't know how these profound effects were produced. It was too difficult to do. Scientists were either scared or couldn't be bothered to overcome the enormous hurdles to get this done."

Specifically (Reynolds 2016):

> [Lead author Robin] Carhart-Harris, from Imperial, said that the brain on LSD becomes more "integrated or unified" as the separateness between different brain functions (i.e. vision, movement, hearing) starts to dissolve.

The study concludes (Carhart-Harris et al. 2016):

> Results revealed marked changes in brain blood flow, electrical activity, and network communication patterns that correlated strongly with the drug's hallucinatory and other consciousness-altering properties. These results have implications for the neurobiology of consciousness and for potential applications of LSD in psychological research.

This line of research is being actively pursued (Atasoy et al. 2017):

> We found that LSD alters the energy and the power of individual harmonic brain states in a frequency-selective manner. Remarkably, this leads to an expansion of the repertoire of active brain states, suggestive of a general re-organization of brain dynamics given the non-random increase in co-activation across frequencies. Interestingly, the frequency distribution of the active repertoire of brain states under LSD closely follows power-laws[29] indicating a re-organization of the dynamics at the edge of criticality.

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[27] Bundesratssitzung, May 13, 1992.

[28] See https://crowd.science/campaigns/lsd/.

[29] See Sect. 6.4.1.

The psychiatrist Franz X. Vollenweider has been studying the effects of psilocybin, especially in the context of meditation, for over 20 years at the University of Zurich (Vollenweider et al. 1997). He is one of a few researchers in the world holding such a track record. However, a senior member of the Swiss People's Party (SVP)—a right-wing populist political party—opposes his research (Tagesanzeiger 2014, translation mine):

> Drugs haze perception and blur reality. One can also have mystical experiences by going to church.

Notwithstanding, psychedelics are experiencing a cultural renaissance—from their usage at transformational festivals (Leung 2010), like Burning Man, to Silicon Valley tech geeks microdosing LSD (Leonard 2015; Solon 2016; Hogan 2017). In Switzerland, a faction of the center-right, pro-business party FDP is discussing the legalization of all illegal drugs (Simonsen and Ballmer 2018).

14.3.1 Healing the Mind

Perhaps the most astonishing aspect of the increased research activity into psychedelic substances is their therapeutic effect. In stark contradiction to the definition of a Schedule I drug, an array of substances, formaly only utilized as recreational or party drugs, is showing very promising signs of healing capacity (McClelland 2017). Indeed (Wordsworth 2017):

> "Mental health for years has been inadequately addressed, partly because the tools we had on offer were hard to scale, and partly because some of the most powerful tools in brain health were stigmatised and turned into scheduled drugs, effectively halting any progress that could be made to prove their efficacy," says Khaliya [Khan], public health specialist and mental health advocate. "The drugs I am referring to are psychedelic compounds like Psyciliciban [sic], LSD, MDMA, Ayahausca and 5-MeO-DMT."
>
> "In the past few years, the research into these drugs, while primarily small scale studies, has had phenomenal success. [They] hold the promise that we might finally be able to not just treat, but actually heal the brain."

Specifically, successfully treating post-traumatic stress disorder (PTSD) patients with MDMA (Mithoefer et al. 2018), alleviating the symptoms in depressed patients with Ketamine (Berman et al. 2000), and reduced anxiety in terminally-ill patients utilizing LSD (Gasser et al. 2014). Moreover (Horgan 2010):

> [D]octors at schools like Harvard, Johns Hopkins, UCLA and NYU are testing the potential of psilocybin and other hallucinogens for treating depression, obsessive-compulsive disorder, post-traumatic stress disorder, alcoholism—and for inducing spiritual experiences.

Such chemical support comes at a crucial time (Wong 2017):

> [T]reatment for depression, the most common mental illness, came to be dominated by drugs called selective serotonin reuptake inhibitors (SSRIs)[…]. But recently, […] more and more studies suggest SSRIs aren't as effective as we thought. […]

> Last year, at the Psychedelic Science 2017 conference in Oakland, California, a group led by Michael Mithoefer at the Medical University of South Carolina presented results from trials in which 107 people with PTSD underwent a psychotherapy while under the influence of MDMA. A year or so after having the therapy, roughly 67 per cent of them no longer had PTSD […]. […] [T]he FDA was so impressed that it granted MDMA "breakthrough therapy" status, which will accelerate the path towards approval. If all goes well, it could be in use as soon as 2021. […]
>
> [A]fter the combined psilocybin-psychotherapy session, the amygdala[responsible for emotions] lit up. And again, this effect correlated with how well people did: the greater the response in the amygdala, the more their symptoms improved [in contrast to SSRIs dampening those responses].

Moreover (Tatera 2016b):

> Ketamine leads to [the] "most significant advance in mental health in more than half a century" […] "My life will always be divided into the time before that first infusion [of Ketamine] and the time after," [a sufferer of 25 years of depression] told the *Washington Post* […]. "That sense of suffering and pain draining away. I was bewildered by the absence of pain."

Johns Hopkins researchers report on a study with psilocybin (Medicine 2006):

> One third [of participants] said the experience was the single most spiritually significant of their lifetimes; and more than two-thirds rated it among their five most meaningful and spiritually significant. […] 79 percent of subjects reported moderately or greatly increased well-being or life satisfaction compared with those given a placebo at the same test session. A majority said their mood, attitudes and behaviors had changed for the better.

In 2016, a new psychedelic science group was formed at Yale (Gardner 2016):

> Psychedelic science is enjoying revival after nearly 50 years of dormancy in clinical research settings and clinical practice. Most psychedelic substances have been classified as "drugs of abuse" with no recognized medical value since the early 1970s, when research into their use was terminated.

Other psychedelic research group include MAPS[30] and ALIUS.[31]

What about all the negative effects of such drugs? In 2010, a study was published in *The Lancet*, analyzing the dangers of various drugs along two dimensions: harm to user and harm to others. A ranking by overall harm score (in parenthesis), revealed: alcohol (72), heroin (55), crack cocaine (54), methamphetamine (33), cocaine (27), tobacco (26), amphetamine (23), cannabis (20), GHB (19), Ketamine (15), ecstasy (9), LSD (7), and mushrooms (6) (Nutt et al. 2010). It is ironic, and troubling, that two legal substances are leading the ranking. Notably, alcohol scores disproportionately high in the measure of harm to others, while crack cocaine, heroin, and methamphetamine reach high scores for the harm to the user. The 2017 Global Drug Survey,[32] the world's largest drug survey with over 110,000 participants from over 50 countries, reported the following post-consumption emergency treatment

[30] See https://maps.org/

[31] See http://www.aliusresearch.org/.

[32] See https://www.globaldrugsurvey.com/.

seeking (percentages in parenthesis): methamphetamine (4.8), synthetic cannabis (3.2), alcohol (1.3), MDMA/ecstasy (1,2), amphetamine (1.1), cocaine (1.0), LSD (1.0), cannabis (0.6), and mushrooms (0.2). However, as most users of illegal substances can never be sure of the exact composition of the drugs purchased from the black market,[33] it is unclear how many of these emergency treatments were due to contaminated or entirely different chemical compounds. In terms of overall dependence scores—averaging physical and psychological dependence and factoring in pleasure—where 3.0 represents the maximum, one ranking is found to be: heroin (3.0), cocaine (2.39), nicotine (2.21), barbiturates (2.01), alcohol (1.93), cannabis (1.51), LSD (1.23), and ecstasy (1.13) (Nutt et al. 2007). Yet again, nicotine and alcohol emerge as very potent and addictive substances, while psychedelics appear benign.

In the late 1970s, the psychologist Bruce Alexander separated rats into cages and gave them a choice of two water bottles to drink from—one of them laced with morphine. The cages were either isolatory ones or stimulating ones with playing opportunities and fellow rats. The latter became known as "rat park." Alexander wanted to measure the effect of the environment on addiction rates. In isolation, rats tended to overdose and die, while in "rat park" the drugged water appeared uninteresting (Alexander et al. 1978). This highlights the importance of social connection in the context of addiction. Next to the details of a person's brain architecture, the integration within a healthy web of interpersonal relationships can determine the fate of a drug user. In general (Hari 2015):

> For 100 years now, we've been singing war songs about addicts. I think all along we should have been singing love songs to them, because the opposite of addiction is not sobriety. The opposite of addiction is connection.

In this context, incarcerating drug users appears as the worst possible solution to the problem. Moreover, the current rampaging opioid crisis in the US is perhaps indicative of the disintegration of the social fabric. However, in a potentially bright future, the healing powers of psychedelics can also be utilized to break the gridlock of political ideology and help cultivate empathy, understanding, and social connectivity—reducing the fear driving people to embrace fascist ideals (see also Sect. 11.3.1 for the neurophysiological role of fear in political ideology formation).

The stigma associated with psychedelics still runs deep. Simply the word "psychedelic" conjures up the image of a drug-crazed hippie in many minds. A better word is "psychotropic," alluding to the capacity to affect the mind or mental processes. The journalist and author Michael Pollan is currently on a quest to correct the misinformation associated with psychedelics. Indeed, he observes (quoted in Oaklander 2018):

> The biggest misconception people have about psychedelics is that these are drugs that make you crazy. We now have evidence that that does happen sometimes—but in many more cases, these are drugs that can make you sane.

[33] Since 2001, the municipality of Zurich has an information center related to drug use. Free of charge and protected by confidentiality, users can have their drugs chemically analyzed. A counseling interview is, however, required. See https://www.saferparty.ch/.

In his book, persuasively titled *How to Change Your Mind: What the New Science of Psychedelics Teaches Us about Consciousness, Dying, Addiction, Depression, and Transcendence* (Pollan 2018), Pollan presents a combination of science, history, medicine, and personal experiences related to this new frontier of understanding. The science writer Jennifer Ouellette devoted a chapter, called *Feed Your Head*, in her book *Me, Myself, and Why: Searching for the Science of Self* (Ouellette 2014) to the troubled history and bright future of psychedelics. Then, the *New York Times* best-seller *Stealing Fire: How Silicon Valley, the Navy SEALs, and Maverick Scientists are Revolutionizing the Way We Live and Work* (Kotler and Wheal 2017) chronicles the phenomena of human peak performance. Psychedelics play an important role and we meet Shulgin and his wife Ann. He has been called a "genius biochemist"—or, alternatively, "a dangerous criminal" by the US Drug Enforcement Agency—and was the first to resynthesize ecstasy,[34] next to over 200 psychoactive substances (Petridis 2014). The Shulgins tested, and diligently documented, all the psychedelic substances themselves, specifically phenethylamines (Shulgin and Shulgin 2017a) and tryptamines (Shulgin and Shulgin 2017b). The resulting two books are called *PiHKAL* and *TiHKAL*, acronyms for *Phenethylamines/Tryptamines I Have Known And Loved* and total 1,782 pages. It is a safe guess that their minds have experienced states of being few other human minds will ever know. They also "argued passionately for the rights of the individual to explore and map the limits of human consciousness without government interference" (Power 2014). Finally, the psychiatrist Rick Strassman writes in his book *DMT: The Spirit Molecule: A Doctor's Revolutionary Research into the Biology of Near-Death and Mystical Experiences* (Strassman 2001, p. xviii):

> It is so important for us to understand consciousness. It is just as important to place psychedelic drugs in general, and DMT in particular, into a personal and cultural matrix in which we do the most good, and the least harm. In such a wide-open area of inquiry, it is best that we reject no ideas until we actually disprove them. It is in the interest of enlarging the discussion about psychedelic drugs that I've written *DMT: The Spirit Molecule*.

14.3.2 DMT: Down the Rabbit Hole

DMT is a simple organic chemical found in many plants and some animals (Carbonaro and Gatch 2016). Specifically, it occurs as *N*, *N*-dimethyltryptamine, seen in Fig. 14.2, or as 5-methoxy-*N*, *N*-dimethyltryptamine (5-MeO-DMT). It is a psychedelic tryptamine (Shulgin and Shulgin 2017b) and probably the most powerful psychedelic substance known to the human mind. DMT is also produced by the human brain, although it is not clear where and for what function. Endogenous DMT is hypothesized to be synthesized in the pineal gland and related to dream states and near-death experiences (Strassman 2001). DMT has been utilized in Amazonian shamanic traditions as ayahuasca—a brew from two plants, drunk as a sacred

[34] MDMA had been synthesized but forgotten (Petridis 2014).

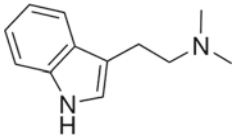

Fig. 14.2 The shape of DMT. The two-dimensional structure of *N*, *N*-dimethyltryptamine. Source: Wikimedia

medicine—since ages ago. Indeed, in these cultures the associated plants are understood as being connected to the origin of the world (Rätsch 1998, p. 9). In general (Horgan 2010):

> Why is DMT so fascinating? For starters, DMT is the only psychedelic known to occur naturally in the human body. In 1972, the Nobel laureate Julius Axelrod of the National Institutes of Health discovered DMT in human brain tissue, leading to speculation that the compound plays a role in psychosis. Research into that possibility—and into psychedelics in general—was abandoned because of the growing backlash against these compounds.
>
> In 1990, however, Rick Strassman, a psychiatrist at the University of New Mexico, obtained permission from federal authorities to inject DMT into human volunteers. Strassman, a Buddhist, suspected that endogenous DMT might contribute to mystical experiences. From 1990 to 1995, he supervised more than 400 DMT sessions involving 60 subjects at the University of New Mexico. Many subjects reported that they dissolved blissfully into a radiant light or sensed the presence of a powerful, god-like being.
>
> […]
>
> In *Antipodes of the Mind*[35] (Shanon 2002), the Israeli psychologist Benny Shanon, who has consumed ayahuasca more than 100 times, provides a gripping account of his own and others' visions. Shanon says the tea transformed him from a "devout atheist" into a spiritual believer awestruck by the mysteries of nature and the human mind. Yet Shanon, like Strassman, acknowledges that these hallucinogenic experiences pose risks. Quoting one ayahuasca shaman, Shanon warns that ayahuasca can also be "the worst of liars," leaving some users gripped by delusions.

DMT-induced visions can include—next to transcendental geometric shapes—robots, insects, and reptiles. McKenna coined the term "machine elves" for such apparently conscious entities inhabiting the psychedelic realm (McKenna 1993b, p. 114):

> We refer to the dynamic yet stable, apparently self-sustaining, non-three-dimensional spatiality into which the smoking of tryptamines conveys one. We especially refer to the apparently autonomous and intelligent, chaotically mercurial and mischievous machine elves encountered in the trance state, strange teachers whose marvelous singing makes intricate toys out of the air and out of their own continually transforming body geometries.

One may wonder about the possible implications of endogenous DMT release in the human brain. How much of mythology and how many reports of alien abduction could be the result of this?

Horgan reports his own experience (Horgan 2010):

[35] Horgan finds this one of the most compelling books on altered states he has ever read (Horgan 2003a), next to William James's *Varieties of Religious Experience* (James 1902), Huxley's *Doors of Perception* (Huxley 1954), and Shulgin's *PIHKAL* (Shulgin and Shulgin 2017a) and *TIHKAL* (Shulgin and Shulgin 2017b).

> I drank ayahuasca a decade ago while researching my book *Rational Mysticism* (Horgan 2003b). It tastes like stale beer dregs flavored with cigarette butts. After I threw up, I had a cosmic panic attack, in which I was menaced by malevolent, dayglo-hued polyhedra. I have no desire to repeat this experience.

In more detail, he explains (Horgan 2014a):

> The forms shifted, tumbled, quivered, danced with a kind of mischievous intelligence. They were showing off, trying to stagger me with ever-more-ostentatious displays of otherworldly beauty: Look at this! Okay, now check this out! […]
>
> All around me was a riot of color; the world dissolved into undifferentiated dayglo goo. A ten-foot pine tree at the bottom of the embankment quivered like a flame, fierce, fractal, exultant, discharging an unholy blue light. My head, too, sparked and crackled with electricity. Too much, I thought. I'm losing my mind. Too much. […]
>
> The colors became ever-more-dazzling, the shapes ever-more-complex, until there were no shapes and colors any more. They yielded to something deeper and more fundamental than shape, color, syntax, thought: the metaphysical principles underlying all things, the machine code of reality. […]
>
> I was seeing the future, long after humanity, and all of life, has vanished from the earth. The flame of consciousness has flickered out in the eternally expanding cosmos, and it has reverted to dumb, blind, painless, meaningless matter, as it must.

Others have probed the DMT realm with greater success and reported about its myriads of facets. For instance, the entomologist Adam Oliver Brown (Brown 2014):

> This is a form of purging in which the body is expelling this nasty bitter liquid in your stomach. But it's not just the physical purge, it's also a psychological one. Now, it seemed like there was a lot of vomiting going on. In retrospect, there wasn't. Because afterwards I looked in the bucket and there were only a few drops of spit […]. But at the time it really felt like there were these torrents of vomit coming out—and not to disgust you too much, for one, because it wasn't even vomit, it was snakes. So there were snakes oozing out of my nose and my mouth and this is quite literally what I was experiencing. […] It was very cathartic because these snakes felt like they were bringing demons up from inside and were cleansing my soul in the process. […]
>
> So not long after say 45 minutes into this, the first couple of layers of insect grids began to dissipate and I moved closer towards these bobbing pastel colored orbs of light, and managed to spend a little bit of time in that weird, strange cartoon kind of world until, all of a sudden, they came rushing at me, and I found myself blasted off into the universe on the back of some kind of fractal fireworks roller coaster. So I was traveling through the universe at light speed with the visuals becoming much, much more intense at this point, with colorful mandala's, the fractals opening and closing and spiraling around each other, like clockwork. So quickly I couldn't take it all in. And in fact at this point I was also physically being thrown around by the violent turbulence of the wild ride on this comet that I was traveling through the universe on. And again, I had to say to myself, this is so weird, because, rationally, I was able to recognize that there shouldn't be any lights. I'm in the dark in a hut in Peru. And why am I feeling like my body's being thrown around? So this was a really all-encompassing experience at this point and I have to admit, at this point, it was a little much for me and I started to panic, thinking "I don't like this anymore." I wanted to get off. But of course, you can't. You are on this ride until the very end. And at some point, I admitted that to myself and said, "Well we're just going to have to ride it out."
>
> But when that subsided we came down into this really thick, quiet, warm, emotionally laden place. It wasn't a room, it was like more of a zone and this zone was bordered by a big, red,

> velvety curtain. […] However, what did come next was truly astonishing to me. The curtain pulled back and revealed to me a scene—a forgotten scene—from my own childhood that was somewhat troubling emotionally. And I had forgotten about that scene probably since the very day it happened. But as soon as that curtain pulled back and I was witness to it again, I recognized it immediately as having been an important event in my life, that I somehow had repressed. And what was interesting about this is while I was re-experiencing this slightly traumatic scene from my childhood, I wasn't revisiting any of the emotional trauma associated with. It it was like I was a third party observer impartially and objectively being able to watch my life story and to be to determine why or how it was important to me becoming who I was as an individual. It was almost like I wasn't seeing what was happening, but I was being told why what I was seeing was important to how I became as an individual later on in my life. And so over the course of the next hour or so these curtains continued to part and presented me with these astonishingly vivid memories that I had forgotten about. […]
>
> So the point here folks is not a story about recreational drug tourism. It's about illustrating the potential for these chemicals to help us. To help us heal ourselves, our health, our psychology, and our societies.

A synthetic form of DMT can be smoked as a crystalline substance. After a sucession of tokes the effects set in, lasting about ten minutes in physical time. In comparison, an ayahuasca journey can last up to twelve hours. The effects include[36]:

> Immersion into very bizarre worlds, separation of mind and body, dissolution of ego, and a feeling of unity with the cosmos are the rule, near death experiences common.

There are countless personal reports of DMT-induced experiences posted online.[37] The magazine *Vice* interviewed people who had just smoked DMT (Barclay 2012):

> Within a few seconds of inhaling its thick, harsh smoke, one is taken to a place very different from what most contemporary Westerners refer to as reality. While there is a lot of debate regarding where that place exists (or if it exists, or if anything exists for that matter), it can be said with absolute certainty that DMT Town looks very cool. The passenger is immediately overwhelmed with exotic patterns, colors, textures, emotions, and other things that we don't yet have words for.
>
> "I felt what God was like. It was something that was smaller than anything. It's not made of anything—it is everything around the thing that it is and everything inside of it at the same time and it kind of moves about in a way that's not on the grid.
>
> "You're beyond consciousness—but you are consciousness—and you want nothing to tie you down to this physical realm."
>
> "Almost the strangest part is how quickly you come down. With acid it lingers for a day sometimes—the whole next day you feel weird. With this you pretty much feel normal almost immediately afterwards."

Another user reports[38]:

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[36] Take from https://de.know-drugs.ch/, retrieved August 24, 2018; translation mine.

[37] For instance https://www.reddit.com/r/DMT/, https://www.erowid.org/experiences/subs/exp_DMT.shtml, https://www.dmt-nexus.me/forum/default.aspx?g=topics&f=3, and https://www.dmt-nexus.me/forum/default.aspx?g=topics&f=71.

[38] See https://www.dmt-nexus.me/forum/default.aspx?g=posts&m=187288.

> Where I went I can't even fathom. The image zoomed out and it was revealed I was in a colossal grid of light, and I knew instantly that this was EVERYTHING. It's like zooming out from the planets, galaxies and beyond, further and further, until what you find is this. The grid. In the grid nothing makes sense, and everything makes sense. Words are meaningless.

And[39]:

> At this point I closed my eyes. I remember being frightened. I was met with a cartoonish place. It almost felt like some kind of a school of sorts, a mathematical place. Where bits of me were disintegrating, piece by piece, into this mathematical structure.

Finally, Pollan reports his experiences with 5-MeO-DMT in the smoked venom of the Sonoran Desert toad (Pollan 2018):

> "This is the Everest of psychedelics," she began, portentously, putting a steadying hand on my forearm. Olivia is in her early fifties, a management consultant with a couple of kids; I had vaguely known she was into Eastern religion but had no idea she was a psychonaut, too. "You need to be prepared." [P. 375]
>
> I have no memory of ever having exhaled, or of being lowered onto the mattress and covered with a blanket. All at once I felt a tremendous rush of energy fill my head accompanied by a punishing roar. I managed, barely, to squeeze out the words I had prepared, "trust" and "surrender." These words became my mantra, but they seemed utterly pathetic, wishful scraps of paper in the face of this category 5 mental storm. Terror seized me—and then, like one of those flimsy wooden houses erected on Bikini Atoll to be blown up in the nuclear tests, "I" was no more, blasted to a confetti cloud by an explosive force I could no longer locate in my head, because it had exploded that too, expanding to become all that there was. Whatever this was, it was not a hallucination. A hallucination implies a reality and a point of reference and an entity to have it. None of those things remained. [P. 378]
>
> Unfortunately, the terror didn't disappear with the extinction of my "I." Whatever allowed me to register this experience, the post-egoic awareness I'd first experienced on mushrooms, was now consumed in the flames of terror too. In fact every touchstone that tells us "I exists" was annihilated, and yet I remained conscious. "Is this what death feels like? Could this be it?" That was the thought, though there was no longer a thinker to have it. [P. 378f.]
>
> Here words fail. In truth, there were no flames, no blast, no thermonuclear storm; I'm grasping at metaphor in the hope of forming some stable and shareable concept of what was unfolding in my mind. In the event, there was no coherent thought, just pure and terrible sensation. Only afterward did I wonder if this was what the mystics call the *mysterium tremendum*, the blinding unendurable mystery (whether of God or some other Ultimate or Absolute) before which humans tremble in awe. Huxley described it as the fear "of being overwhelmed, of disintegrating under a pressure of reality greater than a mind, accustomed to living most of the time in a cosy world of symbols, could possibly bear." [P. 379]
>
> The other metaphor was the big bang, but the big bang run in reverse, from our familiar world all the way back to a point before there was anything, no time or space or matter, only the pure unbounded energy that was all there was then, before an imperfection, a ripple in its waveform, caused the universe of energy to fall into time, space, and matter. Rushing backward through fourteen billion years, I watched the dimensions of reality collapse one by one until there was nothing left, not even being. Only the all-consuming roar. It was just horrible. [P. 380f.]
>
> And then suddenly the devolution of everything into the nothingness of pure force reverses course. One by one, the elements of our universe begin to reconstitute themselves: the

[39] See https://erowid.org/experiences/exp.php?ID=111779.

> dimensions of time and space returned first, blessing my still-scattered confetti brain with the cozy coordinates of place; this is somewhere! And then I slipped back into my familiar "I" like an old pair of slippers and soon after felt something I recognized as my body begin to reassemble. The film of reality was now running in reverse, as if all the leaves that the thermonuclear blast had blown off the great tree of being and scattered to the four winds were suddenly to find their way back, fly up into the welcoming limbs of reality, and reattach. The order of things was being restored, me notably included. I was alive! [P. 381]
>
> I felt for the first time gratitude for the very fact of being, that there is anything whatsoever. Rather than being necessarily the case, this now seemed quite the miracle, and something I resolved never again to take for granted. Everybody gives thanks for "being alive," but who stops to offer thanks for the bare-bones gerund that comes before "alive"? I had just come from a place where being was no more and now vowed never to forget what a gift (and mystery) it is, that there is something rather than nothing.[40] [P. 382f.]

An interesting observation is that the human brain appears to have the final authority with respect to its own experience creation. Not always do psychedelics result in altered states of consciousness. I have been confronted with anecdotal evidence that the ingestion of LSD or ayahuasca left the consumer waiting in vain for the psychotropic effects. It seems as if, some days, the brain simply refuses to change gears. Also, there could exist a personal predisposition or affinity with respect to how drugs are experienced. This can perhaps explain why the avid psychonaut Watts surprisingly assesses DMT as "amusing but relatively uninteresting" (Watts 1971, p. 82).

It is truly astonishing that a single molecule, ubiquitous in nature, has the capacity to hijack our entire cognitive apparatus and "teleport" our consciousness into a realm transcending space and time, sometimes inhabited by alien entities of consciousness. What is also intriguing, is that these are entirely subjective experiences made by individual minds. One cannot share them. Any attempts at communicating their contents are severely restricted by our "normal" conceptuality, shaped during sober waking consciousness, thoroughly inadequate at capturing the reality of these transcendental realms of consciousness. Either a human mind has experienced such otherworldly states first-hand—harboring faint memories of the events ever after—or creative attempts at imagining the ineffable are made. Similarly to the abstract notions of infinity and zero, my mind can at best speculate about what it could mean to experience a non-material reality outside of space and time. However, people are attempting to contextualize the DMT realm (Kotler and Wheal 2017):

> [T]he Hyperspace Lexicon reflects a collective effort to codify and make sense of the utterly novel landscape of DMT (which aficionados refer to as "hyperspace"). The Lexicon is packed with neologisms that would have made James Joyce proud. Among many others, there's "*lumenorgastic*," for the orgasmic experience of white light; "*mangotanglement*," referring to the brightly colored fractal building blocks of DMT reality; and "*ontoseismic*," for the utter shattering of your worldview after glimpsing the DMT universe.

Psychonauts recount their observations of grids, mathematical structures, or the machine code of reality lurking behind the veils of physical reality, next to interacting with alien conscious entities. Within the prevailing materialistic and reductionistic

[40] See Sect. 8.1.2.

scientific worldview, such narratives are understood as being absurd. However, we have seen that this paradigm is currently crumbling (Chap. 10) and being replaced (Chap. 13), opening up the possibility of pragmatic and impartial explorations of these outer realms of existence. Furthermore, the various different pieces of understanding which could be brought back to the "normal" realm of reality that our minds inhabit, speak of the same architecture of these netherworlds. This can be seen by the similar "sacred geometries" expressed in different cultures. Indeed, how much of the awakening of the human mind has been influenced by certain chemical substances?

14.3.3 Cultural Roots

The human species is not the only one that knows about altered states of being and craves them. Within the animal kingdom, "getting high" is no rarity. For instance, early primates' ethanol consumption from fermented fruits (Carrigan et al. 2015); alcohol self-administration by elephants (Siegel and Brodie 1984); vervet monkeys on the Caribbean island of St. Kitts and their problems with alcohol (Palmour et al. 1997); the effects of catnip on most domestic cats; opium-eating wallabies (Williams 2010); jaguars consuming Yage vine, one of the ingredients of ayahuasca (Anderson 2013); and dolphins consuming the toxins of pufferfish (Nuwer 2013).

McKenna put forward the "stoned ape" theory of human evolution (McKenna 1993a). He argues that the key driver of Homo sapiens' remarkable explosion of cognitive capabilities was due to the influence of psilocybin mushrooms. As McKenna's thesis cannot be substantiated by much evidence, it has been ignored by the scientific community. However, as shamanic traditions emerged around the globe at the dawn of the modern human mind, it is perhaps not all too unreasonable to expect at least some cultural influence from the use of psychedelics. For instance, the anthropologist and ethnopharmacologist Christian Rätsch—who traveled the world to partake in a great number of psychedelic shamanic rituals of many indigenous people[41]—observed the following (Rätsch 1998, p. 635, translation mine):

> Indeed, it is quite possible that Santa Claus, who is always dressed in red and white garments and flies through the skies with his team of reindeer, is simply an anthropomorphized fly agaric mushroom or fly agaric shaman.

Perhaps only people who have themselves ventured into the psychedelic realm are open to such fantastic ideas.

In his book, called *A History of the World in 6 Glasses*, Tom Stanadage recounts the importance of certain psychoactive beverages since the dawn of humanity. In particular (Standage 2006, p. 134f.):

> This spirit of rational inquiry spread into the mainstream of Western thought over the next two centuries, culminating in the movement called the Enlightenment, as the empirical, skeptical approach adopted by scientists was applied to philosophy, politics, religion, and commerce. […]

[41] In an interview, he alleged that of all drugs, alcohol is the most dangerous (Mingels 2013).

> The diffusion of this new rationalism throughout Europe was mirrored by the spread of a new drink, coffee, that promoted sharpness and clarity of thought. It became the preferred drink of scientists, intellectuals, merchants, and clerks—today we would call them information workers—all of whom performed mental work sitting at desks rather than physical labor in the open. […]
>
> The impact of the introduction of coffee into Europe during the seventeenth century was particularly noticeable since the most common beverages of the time, even at breakfast, were weak "small beer" and wine. Both were far safer to drink than water, which was liable to be contaminated, particularly in squalid and crowded cities.

Perhaps even the computer revolution has some of its roots in psychedelics. In 2008, the programmer Dennis R. Wier made a confession. He was the chief architect for one of the biggest programming projects in 1975. Then (Wier 2008):

> At one point in the project I could not get an overall viewpoint for the operation of the entire system. It really was too much for my brain to keep all the subtle aspects and processing nuances clear so I could get a processing and design overview. After struggling with this problem for a few weeks, I decided to use a little acid to see if it would enable a breakthrough […]. […]
>
> While stimulated by the LSD I was able to get the entire system wholly in my mind at the same time. I spent some time mentally visualizing various aspects of the compiler, the language and the processing which would take place. I did discover three or four design inconsistencies while being stimulated by the effect of the LSD, and I made notes for later checking.
>
> After twenty-four hours when the effect of the LSD was completely gone, I went over my notes. I needed to have a measure of "faith" that the design changes suggested by my notes would produce the beneficial effects they seemed to imply […]. […]
>
> Once all the changes were made, I was able to successfully complete the programming of this huge system. […] Although the use of LSD was an important component of the success of the system, no one knew of its use except me.

Steve Jobs and other computer pioneers believed that LSD helped their creativity (Grossman 2011).

14.3.4 Plant Consciousness

At the 2018 *Swiss Biennial on Science, Technics + Aesthetics*,[42] Susana Bustos, a psychologist and scholar of Amerindian shamanic traditions, explained the concept of *Vegetalismo*. This is the process by which the shamans are said to gain their knowledge and power to cure diseases. This knowledge originates from the plants—specifically the transcendental states induced by ayahuasca. A central element is the *icaro*, a "song" of the plant which the shaman tries to get to resonate in the sick person, inducing healing (Bustos 2004; Callicott 2013). In effect, the plants are at

[42] Recall Chap. 11 and Sect. 14.2.2

the center of the Amerindian cosmology. Indeed, "Mother Ayahuasca" is reported as being the spiritual source of divine insights. In detail[43]:

> "Some people come away from drinking ayahuasca thinking it is a very real, living entity," says anthropologist Christine Holman of Arizona State University. "The people that believe in her believe that very strongly. They call her Mother Ayahuasca." But experienced ayahuasca-drinkers say only Mother Ayahuasca knows whether she will reveal her nurturing side or instead unleash terror.

In a therapeutic context (Labate and Cavnar 2013, p. 141):

> Patients and therapists alike emphasized that ayahuasca can function as an "inner mirror" that allows one to readily accept previously denied aspects of the psyche that are usually difficult to address in therapeutic contexts. […] However, it seems that confrontation stemming from within or from a perceived spiritual source, such as "Mother Ayahuasca," "Mother Earth" or "God" can be better received, integrated, and contained by patients […].

In detail (Kent 2010, p. 116):

> The extreme diets and psychedelic medicine catalyze spontaneous stress-based reorganization of neural identity structures, and the shamanic mythology creates the semantic frame through which the subject parses the transformational experience.

The author Claus von Bohlen explains the following[44]:

> South American shamans believe in "teacher plants". These are plants whose spirits will guide you and teach you, when you ingest the plant itself. That is of course a belief that is challenging from a Western scientific perspective. However, many people will say that they have gained new insights and perspectives from alterations in consciousness […].

Sitting in the Amazon rain-forest, engulfed by countless shades of green representing a myriad of botanical diversity, the following question seems natural[45]:

> I remember asking her [the shaman] how the indigenous peoples of the Amazon came by their knowledge of healing and medicinal plants, and particularly Ayahuasca, which requires two separate plants to be boiled together for a number of hours in order to have any effect. She looked at me as if I had asked a very foolish question, then she replied, "That's what the spirits teach us."

Indeed, if humans directly ingest the DMT-containing component of ayahuasca, nothing will happen. Monoamine oxidase inhibitors (MAOIs) are required to unleash the psychedelic effects. These are found in the other ingredient. If this knowledge was not received by otherworldly means, then one is faced with uncountable possible combinations of plant substances which would have to be tested by trial and error for their psychedelic effects.

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[43] See http://sciencenotes.ucsc.edu/2011/pages/ayahuasca/ayahuasca.html, retrieved August 27, 2018.

[44] See http://www.clausvonbohlen.com/post/155437462934/teacher-plants, retrieved August 27, 2018.

[45] See http://www.clausvonbohlen.com/post/155437462934/teacher-plants, retrieved August 27, 2018.

Why does such an abundance of chemicals exist in nature which can alter—and greatly enhance—the normal functioning of the sober waking state of the human mind? Why did this chemical affinity emerge? Some psychedelic substances are toxic, but others, like psilocybin, are not. DMT is even produced by the human brain. What is their function? Indeed, in the book *The Encyclopedia of Psychoactive Plants: Ethnopharmacology and Its Applications*, Rätsch describes a breathtaking array of psychoactive plants in a thousand page tour-de-force (Rätsch 2005). The human brain is immersed in a vast chemical landscape able to contest the primacy of sober waking reality. In contrast, a world in which no plant component has the power to modify human cognition could easily be imagined, where intoxication simply leads to unconsciousness. In detail, why do specific receptors in mammalian cells exist that recognize a plant-derived substance? As an example, the endocannabinoid system in the human brain is important for various physiological functions. It is surprising that the brain has a complex system of interacting chemicals related to cannabis (Pacher et al. 2006). Interestingly (Pacher et al. 2006):

> Marijuana, or cannabis, is the most widely used illicit drug in Western societies and also the one with the longest recorded history of human use.

The reality we perceive is a function not only of our neural hardwiring but crucially also of the chemical substances present in the brain. The evolutionary optimized state of sober waking consciousness is only one in a vast array of possibilities. Synthesized by plants, animals, and even the human brain, such chemicals can appear to give access to novel realms of reality.

Finally, the plant "consciousness" encountered in ayahuasca is currently also cultivating an emerging global environmental sensibility, a much needed antidote to the threatening environmental crises humanity is instigating (Hill 2016):

> Over the last 25 years or so ayahuasca has gone global, with many 1000s of people travelling to Peru and other South American countries to drink it, and expert healers—curanderos, shamans, ayahuasqueros, maestros—travelling abroad to hold ceremonies. […]
>
> "[Ayahuasca is] the conduit to a body of profoundly ancient genetic and evolutionary wisdom that has long abided in the cosmologies of the indigenous peoples of the Amazon who have guarded and protected this knowledge for millennia, who learned long ago that the human role is not to be the master of nature, but its stewards," [Dennis] McKenna wrote [the younger brother of Terence]. "Our destiny, if we are to survive, is to nurture nature and to learn from it how to nurture ourselves and our fellow beings. This is the lesson that we can learn from ayahuasca, if only we pay attention."

14.3.5 The Noumenon

For Kant, the human mind can ever only access the phenomenal world of the senses. Even space and time are categories of the mind and not features of true reality (see introduction to this chapter). The underlying reality, called the noumenon—

the thing-in-itself—can never be known. DMT users have reported of glimpsing the noumenon[46]:

> I felt like I was viewing the true nature of reality, but I was in some kind of limited room because I was only a human and didn't have the eyes to see or whatever.

People talk about notions like "the control room of reality" and "behind the veils of reality" when describing the DMT realm.

Taking a step back (Gallimore 2014):

> It is comforting to see the world around us as being somehow fixed, solid and, most importantly, real. But it only takes a lungful of *N*, *N*-dimethyltryptamine (DMT) to shatter this delusion. Whether the external world-in-itself, the noumenal world, is truly real is difficult to answer and, for the purposes of this discussion, it really doesn't matter. The only world we can ever experience is the phenomenal world—the world that appears to consciousness. As far as we know, the phenomenal world is never transcendent—it never reaches out and touches the noumenal world; it is always in the head. Thomas Metzinger (Metzinger 2009) expresses it clearly:
>
> > The global model of reality constructed by our brain is updated at such great speed and with such reliability that we generally do not experience it as a model. For us, phenomenal reality is not a simulational space constructed by our brains; in a direct and experientially untranscendable manner, it is the world we live in.
>
> For most people and for most of the time, this phenomenal world appears stable and predictable, but only because the brain has evolved to generate a stable and predictable model of the noumenal world. However, psychedelic drugs, such as DMT, LSD and psilocybin, among others, not only show us that the phenomenal world can become fluid, unpredictable and novel, but that it can be annihilated in an instant and replaced with a world altogether stranger than anything we can imagine. It is tempting to regard such perceptual aberrations as just that—"tricks of the mind", hallucinations, illusions or, if we want to appear especially smart, "false perceptions". But such a self-assured attitude is hard to justify, as deciding what is true and what is false about our perceptions is far from trivial.
>
> […]
>
> It is all too easy to assume that consensus reality is a privileged model of reality, the truest model, the real thing. But, as we have seen, it is actually just a tiny subspace within a much broader reality topology available to the brain's extraordinary information-generating machinery and, with the aid of a select number of natural and synthetic psychedelic drugs, this entire topology may become accessible and open to exploration.

Most people who have journeyed to the DMT realm argue that what they have experienced is just as real as experiences made during the sober waking state—if not much more so. As mentioned, it is tempting to disregard such experiences as hallucinations—nothing more, nothing less. However, this raises philosophical questions. Recall that neuroscientists are quite clear: Our perception of reality is a hallucination tethered by a bit of sensory input (Sect. 11.2.1). What I experience through sober waking consciousness is an elaborate virtual reality rendering in my brain. The nature of this hallucination can be modulated by the chemical composition

[46] See https://www.dmt-nexus.me/forum/default.aspx?g=posts&t=39663, retrieved August 27, 2018.

of the brain. Crucially, the DMT produced by my own body has the potential to intrinsically and naturally modify the contents of my consciousness—by "teleporting" my mind to the DMT realm. Indeed, simply by shutting down the left hemisphere of the human brain appears to induce travels of the mind, allowing consciousness to access a "place" of peace and euphoria (recall Bolte Taylor's experiences in Sect. 11.3.3). How can I then be certain that the fidelity and truth content of the one hallucination is superior to the other? What epistemic guarantee do I have that would allow me to negate the reality of the DMT realm? How can I exclude the possibility that reality is indeed "queerer than we can suppose" (Sect. 12.4.4) and everything I have ever known about is metaphorically restricted to a tiny isolated island in a vast archipelago of transcendental existence?

Moreover, we are faced with the startling possibility of otherworldly knowledge generation. Next to the amazing mechanisms of knowledge generation utilizing formal thought systems (Chaps. 2 and 5), these transcendental sources of information represent an orthogonal approach to understanding. Medicine men in shamanic traditions have been utilizing otherworldly knowledge for healing purposes for millennia (Luna and White 2006, p. vii):

> Any attempt to understand Amerindian cosmology, spirituality, and artistic manifestations must include a knowledge of shamanism in addition to the central importance given to the ritual use of psychotropic plants, including tobacco and coca, perhaps the oldest of all the psychoactive plants of the Americas, dating at lest 6,000 BCE.

Roland Loomis, also known as Fakir Musafar, was a US American performance artist and a pioneer of the modern primitive movement. He was known for extreme body modifications, including tattooing, body piercing, scarification, and flesh hook suspension. Loomis personally explored many rituals and built, for instance, a bed of nails and a bed of blades on which he would lay. "After an hour of surrender to the blades, I drift off and forget where I am" (Musafar 2005, p. 46). "After an hour, I trance out and feel like I am floating about 30 cm above the wicked spikes. I am warm and comfortable. I have visions and inner travels" (Musafar 2005, p. 50). His book, called *Spirit and Flesh*, opens with: "The images in this book may disturb you" (Musafar 2005, p. 8). He recounts a journey of his consciousness, initiated by extreme physical tourment, and the obtaining of otherworldly knowledge (Musafar 2005, p. 83):

> Because I made permanent holes in my breasts in 1975, I was able to experience Native American body rituals […]. Because I had suspended from them several times, I was no longer afraid to let go and hang freely from these two piercings. […] *Mandan O-Kee-Pa* suspension [a complex ceremony of the Mandan Native American tribe] were done in a darkened lodge. It was a rite of passage for young men and a way for elder medicine men the leave their bodies and reconnect with the powers beyond earth. I was now the elder medicine man. I left my body and met the Great Mystery, my own White Light, face-to-face. We had a telepathic conversation in that timeless place that is not a place. I received the answers to many mysteries that had puzzled me for years.

The seasoned psychonaut Rätsch explains in an interview (Mingels 2013, translation mine):

> *Rätsch:* You probably believe that the [LSD] visions are projections of the brain?
>
> *Reporter:* Of course.
>
> *Rätsch:* This is a stupendous error. The other [psychedelic] reality is always there. Namely, inherent in our world. Some physicists even say that there are infinitely many simultaneously existing universes.
>
> *Reporter:* But you say you were a jaguar [during an LSD experience], which is clearly a projection of the brain! Or are you really claiming that now you also exist as a jaguar?
>
> *Rätsch:* Not in this reality. Not now, not here in this kitchen in my apartment. We cannot access the jaguar-reality at the moment. Unless we would take some LSD.

In summary (Kent 2010, p. 158):

> Spirit contact is a central part of many psychedelic practices. While the autonomy of spirit entities is a subject for endless metaphysical debate, the reports of seeing spirits under the influence of psychedelics are common enough to make some generalizations. First, psychedelic entities are anthropomorphic interfaces through which psychedelic information is generated or transmitted. Second, formal spirit types represent idealized versions of specific information matrices: cellular, insect, plant, animal, ancestral, mythic, alien, pagan, machine, cosmic, and so on, and each type of spirit reveals different insights into the ordered nature of life and the universe. Third, psychedelic spirits are tricksters; they often speak in riddles, communicate in visual rebus and pantomime, and typically never give a straight answer to inquiries. From an information standpoint it does not matter if the spirits are real or delusion, the information they generate is real and can be analyzed from a formal perspective.

Metzinger asked, "How do you know that you actually woke up this morning?" (Sect. 11.2.2). Perhaps the more accurate, and pressing, question is "How do you know that you are not 'high' right now?"

14.4 A Participatory Ontology

In Chap. 13, specifically Sect. 13.4, the case for an information ontology was made. At the intersection of theoretical physics and theoretical computer science a new paradigm is emerging, replacing the current materialistic and reductionistic scientific worldview. In this novel understanding, information is the ethereal building block of reality. The very real possibility that our universe is a hologram, or even a simulation, was discussed. In this chapter, the idea that information has an inner aspect was introduced, giving rise to the subjective world emerging in minds. In this paradigm, consciousness is understood as primal and distributed. Indeed, panpsychism offers a solution, albeit an unexpected one, to the age old challenge of unifying the subjective with the objective (Sect. 11.1). It was also discovered that intelligence is an emergent phenomenon which can attach itself even to non-living matter (Sect. 14.2.4). Finally, psychonauts have been speaking of transcendental realms of existence since the beginning of time—planes of reality which can be accessed by disembodied consciousness. We find ourselves being conscious actors on a vast, intricate, and multifaceted stage of reality, comprising countless ineffable otherworldly realms.

However, what if we are in fact not actors at all, but creators? What if we inhabit a reality with a participatory ontology?

The eminent physicist John Wheeler[47] was instrumental in initiating the information-theoretic paradigm shift (Sect. 13.2). In the same sentence where he introduces this outlandish idea—it from bit—he also outlines the notion of metaphysical participation. He explains these notions as follows (Wheeler 1990):

> [I]n short, that all things physical are information-theoretic in origin and this is a participatory universe.

In more detail (Horgan 2011):

> Wheeler once explained this concept to me by comparing a scientist to someone playing the "surprise version" of the old game 20 Questions. In this variant, the Guesser leaves the room while the rest of the group—or so the excluded person thinks—agrees on some person, place or thing. The Guesser then re-enters the room and tries to guess the group's secret with a series of questions that can only be answered with a yes or a no.
>
> But the group has decided to play a trick on the Guesser. The first person to be queried will only think of something *after* the Guesser asks his question. Each subsequent person will do the same, making sure that his or her response is consistent with all previous questions. "The word wasn't in the room when I came in even though I thought it was," Wheeler noted. In the same way, physical reality exists in an indeterminate limbo before we pose our questions. "Not until you start asking a question, do you get something." We live in a "participatory universe," Wheeler suggested, which emerges from the interplay of consciousness and physical reality, the subjective and objective realms.

As a consequence (Heaven 2015):

> For Wheeler, this meant the universe couldn't really exist in any physical sense—even in the past—until we measure it. And what we do in the present affects what happened in the past—in principle, all the way back to the origins of the universe. If he is right, then to all intents and purposes the universe didn't exist until we and other conscious entities started observing it.

Remarkably, Wheeler's delayed choice experiment (Wheeler 1978)—where a choice made now by an observer can change or edit the past of a photon—has been experimentally confirmed and published in the prestigious journal *Science* (Jacques et al. 2007):

> Our realization of Wheeler's delayed choice Gedanken Experiment demonstrates beyond any doubt that the behavior of the photon in the interferometer depends on the choice of the observable which is measured, even when that choice is made at a position and a time such that it is separated from the entrance of the photon in the interferometer by a space-like interval [i.e., by a separation where events cannot affect each other].

The philosopher of science, Paul Feyerabend, harbor a similar intuition with respect to the participatory nature of the universe (Feyerabend 2008, p. 270):

> What we find when living, experimenting, doing research is therefore not a single scenario called "the world" or "being" or "reality" but a variety of responses, each of them constituting a special (and not always well-defined) reality for those who have called it forth. This is relativism because the type of reality encountered depends on the approach taken.

[47] "[O]ne of the most influential scientists of the twentieth century" (Barrow et al. 2004, back cover).

Indeed, the notion of a participatory reality is also found in Kant's philosophy. In summary (Tarnas 1991):

> The a priori forms and categories serve as absolute conditions of experience. They are not read out of experience, but read into it. They are a priori, yet empirically applicable and applicable only empirically, not metaphysically. For the only world that man knows is the empirical world of phenomena, of "appearances," and that world exists only to the extent that man participates in its construction. We can know things only relative to ourselves. Knowledge is restricted to the sensible effects of things on us, and these appearances or phenomena are, as it were, predigested. Contrary to the usual assumption, the mind never experiences what is "out there" apart from the mind in some clear, undistorted mirroring of objective "reality." Rather, "reality" for man is necessarily one of his own making, and the world in itself must remain something one can only think about, never know. [P. 344f.]
>
> In terms of scientific knowledge, the world could not be said to exist complete in itself with intelligible forms that man could empirically reveal if only he would clear his mind of preconceptions and improve his senses by experiment. Rather, the world that man perceived and judged was formed in the very act of his perception and judgment. Mind was not passive but creative, actively structuring. [P. 347]

This astute and eloquent summary of Kant's ideas was given by the historian Richard Tarnas. In his bestseller, called *The Passion of the Western Mind: Understanding the Ideas That Have Shaped Our World View*, he analyzes the thinking of the last two and a half millennia. His powerful and penetrating analysis immerses the reader in the epic journey of the human mind grappling with reality and its own existence. In the chapter, called *The Postmodern Mind*, Tarnas observes (Tarnas 1991, p. 396):

> Reality is not a solid, self-contained given but a fluid, unfolding process, an "open universe," continually affected and molded by one's actions and beliefs. […]. Reality is in some sense constructed by the mind, not simply perceived by it, and many such constructions are possible, none necessarily sovereign.

He outlines his conclusions in the epilogue, where he empathetically and persuasively argues for a participatory epistemology (Tarnas 1991, p. 396):

> The consensus is decisive: The world is in some essential sense a construct. Human knowledge is radically interpretive. There are no perspective-independent facts. Every act of perception and cognition is contingent, mediated, situated, contextual, theory-soaked. Human language cannot establish its ground in an independent reality. Meaning is rendered by the mind and cannot be assumed to inhere in the object, in the world beyond the mind, for that world can never be contacted without having already been saturated by the mind's own nature. That world cannot even be justifiably postulated. Radical uncertainty prevails, for in the end what one knows and experiences is to an indeterminate extent a projection. [P. 418f.]
>
> The new conception fully acknowledged the validity of Kant's critical insight, that all human knowledge of the world is in some sense determined by subjective principles; but instead of considering these principles as belonging ultimately to the separate human subject, and therefore not grounded in the world independent of human cognition, this participatory conception held that these subjective principles are in fact an expression of the world's own being, and that the human mind is ultimately the organ of the world's own process of self-revelation. In this view, the essential reality of nature is not separate, self-contained, and complete in itself, so that the human mind can examine it "objectively" and register it from without. Rather, nature's unfolding truth emerges only with the active participation of the human mind. Nature's reality is not merely phenomenal, nor is it independent and objective;

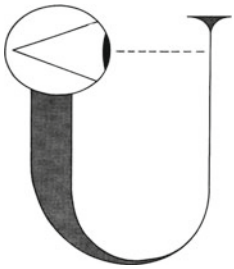

Fig. 14.3 A participatory universe. Wheeler's illustration of the notion, taken from Wheeler (1980), Fig. 22.13

> rather, it is something that comes into being through the very act of human cognition. Nature becomes intelligible to itself through the human mind. [P. 434]
>
> I believe there is only one plausible answer to this riddle [related to the philosophy of science, genuine knowledge, Popper, Kuhn and Feyerabend], and it is an answer suggested by the participatory epistemological framework outlined above: namely, that the bold conjectures and myths that the human mind produces in its quest for knowledge ultimately come from something far deeper than a purely human source. They come from the wellspring of nature itself, from the universal unconscious that is bringing forth through the human mind and human imagination its own gradually unfolding reality. In this view, the theory of a Copernicus, a Newton, or an Einstein is not simply due to the luck of a stranger; rather, it reflects the human mind's radical kinship with the cosmos. It reflects the human mind's pivotal role as vehicle of the universe's unfolding meaning. In this view, neither the postmodern skeptic nor the perennialist philosopher is correct in their shared opinion that the modern scientific paradigm is ultimately without any cosmic foundation. For that paradigm is itself part of a larger evolutionary process. [P. 436f.]

Within the information-theoretic paradigm, the jump from a participatory epistemology to a participatory ontology is perhaps only a small one. Wheeler once mused (quoted in Horgan 1997, p. 84):

> At the heart of everything is a question, not an answer. When we peer down into the deepest recesses of matter or at the farthest edge of the universe, we see, finally, our own puzzled faces looking back at us.

By thinking the idea of an information-theoretic reality to its radical conclusion, he realized (paraphrased in Gefter 2014):

> The universe has created an observer and now, in an act of quantum measurement, the observer looks back and creates the universe. Wheeler scribbled a caption beneath the drawing: "The universe as a self-excited system."

The drawing is depicted in Fig. 14.3. We all are the universe observing itself. This conclusion has not escaped others. Recall from the Preface the insight of Sagan:

> We are a way for the cosmos to know itself.

Also, the musings of Watts:

> Through our eyes, the universe is perceiving itself. Through our ears, the universe is listening to its harmonies. We are the witnesses through which the universe becomes conscious of its glory, of its magnificence.

In the words of an entirely different paradigm (Harvey 2005):

> [A]nimism is a sophisticated way of both being in the world and of knowing of the world; it is a relational epistemology and a relational ontology.

In the final analysis, panpsychism offers the conscious fabric from which the universe is tailored.

14.4.1 The Quantum Observer

The reason physicists wade out into the murky waters of metaphysics is driven by quantum mechanics (Sects. 4.3.4 and 10.3.2). The emergence of an observer has vexed the physics community since the discover of the quantum realm of reality in 1901. Indeed (Rosenblum and Kuttner 2011, p. back cover):

> In trying to understand the atom, physicists built quantum mechanics, the most successful theory in science and the basis of one-third of our economy. They found, to their embarrassment, that within their theory, physics encounters consciousness.

This goes to the heart of Cartesian dualism: the inexplicable schism between the physical body and an ethereal mind (Sect. 11.1). In summary (Stapp 2009):

> Yet, in stark contrast to classical mechanics, in which the physically described aspect is matter-like, the physically described aspect of quantum mechanics is mind-like! *Thus both parts of the quantum Cartesian duality are ontologically mind-like.*
>
> In short, orthodox quantum mechanics is Cartesian dualistic at the pragmatic/*operational level*, but mentalistic on the *ontological* level.
>
> This conclusion that nature is fundamentally mind-like is hardly new. But it arises here not from some deep philosophical analysis, or religious insight, but directly from an examination of the causal structure of our basic scientific theory.

Henry Stapp was a collaborator of Wolfgang Pauli, Werner Heisenberg, and Wheeler. He is known for the development of the axiomatic S-matrix theory (Stapp 1971). Stapp probably was the first US American physicist to popularize Bell's theorem in the early 1970s (Stapp 1975), then still obscure, and thus bring the issue of entanglement to attention (Sect. 10.3.2.1). He has also been working on the connection between quantum mechanics and consciousness for decades. In his book *Mindful Universe: Quantum Mechanics and the Participating Observer* he summarizes his research (Stapp 2011). In essence (Stapp 2011, p. 160):

> Quantum mechanics is a causal structure that joins the epistemological and ontological aspects of nature together in a rationally coherent dynamical reality. Knowledge and the acquisition of knowledge become integral parts of the process of creating the evolving universe! The acquisition of knowledge does not simply reveal what is physically fixed and settled; it is part of the process that creates the reality that we know.

Again, we are confronted with a participatory role of consciousness. Stapp also criticizes the philosopher Daniel Dennett, famous for "explaining consciousness away" (Sect. 11.1). Specifically (Stapp 2011, p. 2):

> But the now-falsified classical conception of the world still exerts a blinding effect. For example, Daniel Dennett (1994, p. 237) says that his own thinking rests on the idea that "a brain was always going to do what it was caused to do by current, local, mechanical circumstances". But by making that judgment he tied his thinking to the physical half of Cartesian dualism, or its child, classical physics, and thus was forced in his book *Consciousness Explained* (Dennett 1991) to leave consciousness out, as he himself admits, and tries to justify, at the end of the book. By effectively restricting himself to the classical approximation, which squeezes the effects of consciousness out of the more accurate consciousness-dependent quantum dynamics, Dennett cuts himself off from any possibility of validly explaining the physical efficacy of our conscious efforts.

To the point (Stapp 2011, p. 9):

> The most radical change wrought by this switch to quantum mechanics is the injection directly into the dynamics *of certain choices made by human beings about how they will act*. Human actions enter, of course, also in classical physics. But the two cases are fundamentally different. In the classical case the way a person acts is fully determined in principle by the physically described aspects of reality alone. But in the quantum case there is *an essential gap in physical causation*. This gap is generated by Heisenberg's uncertainty principle, which opens up, at the level of human actions, a range of alternative possible behaviors between which the physically described aspects of theory are in principle unable to choose or decide. But this loss-in-principle of causal definiteness, associated with a loss of knowable-in-principle physically describable information, opens the way, logically, to an input into the dynamics of another kind of possible causes, which are eminently knowable, both in principle and in practice, namely our conscious choices about how we will act.

Stapp also sees an information-theoretic relevance (Stapp 2014, p. 148):

> By virtue of this filling of the causal gap, the most important demand of intuition—namely that one's conscious efforts have the capacity to affect one's own bodily actions—is beautifully met by the quantum ontology. And in this age of computers, and information, and flashing pixels there is nothing counterintuitive about the ontological idea that nature is built—not out of ponderous classically conceived matter but—out of events, and out of informational waves and signals that create tendencies for these events to occur.

Wheeler's thinking was also influential for a modern alternative interpretation of quantum mechanics (Sect. 10.3.2.2), called quantum Bayesianism, or QBism (Fuchs et al. 2014). Bayesian probabilities are understood as subjective degrees of belief about a system (see Sect. 11.3.2 for Bayesian inference). In QBism, the quantum wave function's probabilities are interpreted as Bayesian probabilities. One of the founders of QBism admits (Fuchs 2017, p. 113):

> John Archibald Wheeler's writings were a tremendous influence on the point of view on quantum mechanics we now call QBism […].

In more detail (Gefter 2015):

> QBism, on the other hand, treats the wave function as a description of a single observer's subjective knowledge. It resolves all of the quantum paradoxes, but at the not insignificant cost of anything we might call "reality." Then again, maybe that's what quantum mechanics has been trying to tell us all along—that a single objective reality is an illusion.

QBism also gives rise to a participatory realism (Fuchs 2017). The science writer and author Amanda Gefter takes the criticism of a single universe shared by multiple observers a step further. In her 2012 FQXi essay *Cosmic Solipsism* she elaborates[48]:

> I argue that the basic assumption of a single universe shared by multiple observers is wrong. Synthesizing the implications of black hole radiation, horizon complementarity, dark energy, observations of the cosmic microwave background and quantum logic, I argue that moving toward a true theory of quantum gravity will require us to give up the notion that we all share the same universe. Instead, each observer has their own universe, which constitutes a complete and singular reality.
>
> […]
>
> This cosmic solipsism turns on all of our common sense notions about the world; then again, fundamental physics has a long history of disregarding our common sense notions.
>
> […]
>
> John Wheeler famously asked, "Why the quantum?" I suspect that the answer is something like this: because each observer has their own universe, and we can never speak about more than one at a time.

14.4.2 Psi: Measuring the Transcendental

If anything written in this chapter and the last is true, then one should expect some experimental support. Specifically, an influence of the mind on physical reality seems a pertinent area of research. Alas, any suggestion of a direct connection between subjective consciousness and objective reality conjures up the final taboo of the supernatural. Parapsychology is the study of paranormal and psychic phenomena, refereed to as psi research in the following. There probably exists no other topic that triggers as much disdain, animosity, and contempt in scientists, philosophers, and theologians alike. Psi research is an off-limits subject matter obviously unworthy of any serious attention, as it has allegedly been debunked ages ago. Furthermore, it is seen as a threat to the prevailing materialistic and reductionistic scientific paradigm, which confidently dictates what is possible and not. For instance, scholars can propose the following speculative traits of reality, without fearing any professional backlash or public ridicule: reality is (up to) eleven-dimensional (Sect. 10.2.2), where the additional dimensions conveniently curl up and become undetectable; there exists a mirror world of supersymmetric particles (Sect. 4.3.2); the universe is a hologram (Sect. 13.4.1); we live in the multiverse, an infinite collection of parallel universes (Sect. 10.3.2.2); causality is an illusion (Sect. 10.3.2.2); time is an illusion (Sect. 10.4.2); consciousness is an illusion (Sect. 11.1); free will is an illusion (Sect. 11.4.1); and panpsychism. However, exclaiming that the subjective could potentially have a direct influence on the objective is professional suicide.[49] Of course, it does not help that history is fraught with charlatans and fraudsters preying on the gullible and uninformed.

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[48] See https://fqxi.org/community/forum/topic/1512, retrieved August 28, 2018.

[49] Recall that even the study of consciousness held the same status until 1990 (Sect. 11.1).

The investigation of psi phenomena has not always been stigmatized. The psychiatrist Carl Jung famously introduced the notion of synchronicity (Jung 1952). This is the idea that events can be related, even if there exists no causal relationship. In essence, consciousness has the power to meaningfully arrange physical reality. In the words of Tarnas (2006, p. 50):

> Jung first described the remarkable phenomenon he named synchronicity in a seminar as early as 1928. He continued his investigations for more than twenty years before at last attempting a full formulation in the early 1950s. He presented his influential, still-evolving analysis of synchronicity in the final paper he gave at the *Eranos* conferences, and immediately followed this with a long monograph. Developed in part through discussions with physicists, particularly Einstein and Wolfgang Pauli, the principle of synchronicity bore parallels to certain discoveries in relativity theory and quantum mechanics. Yet because of its psychological dimension, Jung's concept possessed a special relevance for the schism in the modern world view between the meaning-seeking human subject and the meaning-voided objective world.

Pauli was one of the pioneers of quantum mechanics. He is also known for an "effect" named after him. The theoretical physicist George Gamow once wrote the following about Pauli (Gamow 1985, p. 63f.):

> He is famous in physics on three counts:
>
> 1. The *Pauli Principle*, which he preferred to call The Exclusion Principle.
> 2. The *Pauli Neutrino*, which he conceived of in the early twenties and which for three decades escaped experimental detection.
> 3. The *Pauli Effect*, a mysterious phenomenon which is not, and probably never will, be understood on a purely materialistic basis.
>
> It is well known that theoretical physicists cannot handle experimental equipment; it breaks whenever they touch it. Pauli was such a good theoretical physicist that something usually broke in the lab whenever he merely stepped across the threshold. […] You may believe this anecdote [involving the collapse of a complicated apparatus for the study of atomic phenomena] or not, but there are many other observations concerning the reality of the Pauli Effect!

Indeed, the Nobel laureate Otto Stern forbid Pauli from entering his laboratory (Mallonee 2016).

The physicist and historian David Kaiser meticulously researched the history of quantum mechanics in his book *How the Hippies Saved Physics: Science, Counterculture, and the Quantum Revival* (Kaiser 2011). Sections 4.3.4 and 10.3.2.1 contain important information provided by Kaiser. He traced the origins of the study of quantum information, the revival of research into the foundations of quantum physics, and the popularization of Bell's theorem and entanglement to a group of hippies, calling themselves the *Fundamental Fysiks Group*. However, their "contributions lie buried still, overlooked and forgotten in physicists' collective consciousness" (Kaiser 2011, p. xvii). Perhaps the reason is all too obvious (Kaiser 2011, p. xvii):

> Indeed, from today's vantage point it may seem shocking that anything of lasting value could have come from the hothouse of psychedelic drugs, transcendental meditation, consciousness expansion, psychic mind-reading, and spiritualist séances in which several members dabbled with such evident glee. History can be funny that way.

Stapp, himself not a hippie, was a charter member of the group (Kaiser 2011, p. 101). His experiences with psi research is also recounted (Kaiser 2011, p. 254ff.). He was approached in the early 1990s by a physicist-turned-parapsychologist. Skeptical but open minded, Stapp, agreed to an experiment. To his great surprise, there was a statistically significant trend in the data, which should have been random. Kaiser, then an undergraduate at Berkeley, remembers discussing these results with Stapp. A formal approach aimed at this "causal anomaly" yielded the following (Kaiser 2011, p. 256):

> Stapp realized that the modified equations could account for effects like those in the recent parapsychology experiment while still reproducing the usual, well-tested behavior of atoms predicted by ordinary quantum theory.

He proceeded to write an article and submitted it to a physics journal in 1993. Stapp received a letter from the journal's editor, asking him to shift the emphasis from psi phenomena to theoretical physics. After complying, another letter arrived, asking him to remove all details of the experiment. Stapp, amused and aggravated, agreed and the paper was published (Stapp 1994). However (Kaiser 2011, p. 257f.):

> Getting the paper into print proved to be only half the battle. Six months after his paper appeared, the editor-in-chief for all divisions of the *Physical Review*—the senior editor for the entire American Physical Society, who had not been involved with Stapp's submission—sent Stapp a long and agitated letter chastising Stapp's work and regretting that the paper had ever been accepted. He granted that Stapp and others were "legitimately interested in such matters as human intervention in experiment, or, even, of the nature of thought and its relation to physical reality. But, the editor continued, at the present time such ideas belong to the world of philosophy, not to the world of physics." Stapp's gravest offense, as the editor saw it, was lending credibility to parapsychologists claims.

However, in the end, "the statistical effect had entirely washed out" (Kaiser 2011, p. 258) leaving Stapp most likely in a state of puzzlement.

Today, only a few brave scientists exist who openly admit to researching psi. The biochemist Rupert Sheldrake proposed the concept of morphic resonance—a kind of information field or collective memory—to account for phenomena like collective intelligence next to psi phenomena (Sheldrake 1988). He claims that dogs[50] telepathically know when their owners are coming home (Sheldrake 1999) and that humans can sense when they are being stared at Sheldrake (2005). For this, he offers experimental evidence. In 2008, Sheldrake was invited to give a Google Tech Talk.[51] In the Q and A session, around 1 h, 27 min, and 14 s, he recalls the following anecdote:

> [T]he people who are really skeptical have such a strong belief that they know in advance the evidence must be wrong. You say if you believe it's impossible, then if I come along and say, "Here are results that shows it's possible," either it proves I'm a fool—I've done the experiments so badly or incompetently; I've got false positive results and haven't been smart enough to see it—or I'm a fraud. I'm trying to deceive you and the world. And so, the instant reaction is one of hostility and accusing people of being fools or frauds. Richard Dawkins,

[50] Oscar, the death-sensing cat, was introduced above, in Sect. 14.2.4.2.

[51] It was uploaded to Google's YouTube channel on September 2, 2008, called *The Extended Mind: Recent Experimental Evidence*. See https://www.youtube.com/watch?v=JnA8GUtXpXY.

> who's a very smart man and is, in this area, not very smart at all. He's a very bigoted skeptic, and he came to interview me for his most recent TV series in Britain.
>
> […]
>
> I said I only agree to take part if it's a genuine scientific discussion about evidence and if he's really open to discussing the evidence, otherwise, there's no point. […] They gave me a written assurance that this was the case. So, I agreed to meet him and he came to see me.
>
> […]
>
> And he started off by saying, "I dare say we agree about quite a number of things, Rupert," he said, "But let me tell you what worries me about you." And I said, "Okay, what worries you about me." And he said, "What worries me about you is you're prepared to believe almost anything and science should be base on the minimum number of beliefs." So, I said, "Well, okay. Well, let me tell you what worries me about you." I said, "You come across as prejudiced and bigoted and I think you give science a bad name." So, we didn't get very far with that conversation.
>
> […]
>
> Then I said, "Well, look, okay. Why don't we get down to the evidence and actually discuss the evidence, which is why we've met." He said, "I didn't want to talk about the evidence." And I said, "Well, why not?" And he said, "There isn't time."

Dean Radin is one of an estimated 50 doctorate-level scientists engaging in full-time psi research (Radin 2006, p. 7). In 2008, he also gave a Google Tech Talk.[52] Radin has held appointments at Princeton University, Edinburgh University, University Nevada, and Las Vegas.[53] He believes that scientific inquiry should not be restricted by a taboo, i.e., by preconceived ideas of what is possible or not. The scientific consensus that consciousness cannot possibly have a direct influence on physical reality is seen by him as prime example of such a taboo. Indeed, he claims that many people have experienced such phenomena—which they only communicate in private. He has written three books on the subject, where he presents empirical evidence (Radin 1997, 2006, 2013). For instance, in a skeptical publication on telepathy, called *Finding and Correcting Flawed Research Literatures*, the authors report (Delgado-Romero and Howard 2005):

> After eight studies, we had an overall hit rate of 32% (which agrees with the positive meta-analyses) and, in fact, our hit rate was also statistically significant.

Faced with having reproduced the phenomenon, they continue (Delgado-Romero and Howard 2005):

> So, for the moment, even the evidence against humans possessing psychic powers is precariously close to demonstrating humans do have psychic powers.

Then they run another experiment, using an ad hoc and untested method[54] and received a significant negative result. In conclusion (Delgado-Romero and Howard 2005):

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[52] It was upload to Google's YouTube channel on January 18, 2008, called *"Science and the Taboo of Psi" with Dean Radin*. See https://www.youtube.com/watch?v=qw_O9Qiwqew.

[53] See the introduction to his Google Tech Talk.

[54] According to Radin, Google Tech Talk, approximately at 28 minutes and 04 seconds.

> Due to this last data set, we do not believe that humans possess telepathic powers. Further, the approximately 32% correct figure obtained in an enormous number of psi studies remains perplexing.

Radin elaborates (Radin 2006, p. 120):

> From 1974 through 2004 a total of 88 ganzfeld experiments […] in 3,145 trials were conducted. The combined hit rate was 32% as compared to the chance-expected 25%. This 7% above-chance effect is associated with odds against chance of 29,000,000,000,000,000,000 (29 quintillion) to 1.

In 1995, the *American Institutes for Research* performed a review of remote viewing for the CIA (Mumford et al. 1995).[55] In conclusion (Mumford et al. 1995):

> In evaluating the various laboratory studies conducted to date, the reviewers reached the following conclusions:
>
> - A statistically significant laboratory effort has been demonstrated in the sense that hits occur more often than chance.
> - It is unclear whether the observed effects can unambiguously be attributed to the paranormal ability of the remote viewers as opposed to characteristics of the judges or of the target or some other characteristic of the methods used. […]
> - Evidence has not been provided that clearly demonstrates that the causes of hits are due to the operation of paranormal phenomena; the laboratory experiments have not identified the origins or nature of the remote viewing phenomenon, if, indeed, it exists at all.

The statistician Jessica Utts writes in her review (Mumford et al. 1995):

> Using the standards applied to any other area of science, it is concluded that psychic functioning has been well established. The statistical results of the studies examined are far beyond what is expected by chance. Arguments that these results could be due to methodological flaws in the experiments are soundly refuted. Effects of similar magnitude to those found in government sponsored research at SRI [Stanford Research Institute] and SAIC [Science Applications International Corporation] have been replicated at a number of laboratories across the world. Such consistency cannot be readily explained by claims of flaws or fraud.

Another reviewer, the psychologist Ray Hyman, observes (Mumford et al. 1995):

> We agree that the effect sizes reported in the SAIC experiments are too large and consistent to be dismissed as statistical flukes.

A meta-analysis on dream extrasensory perception (ESP), considering 37 studies from 1966–2002, find a median effect size of 0.255, indicating an overall medium sized effect. The study concludes (Sherwood and Roe 2003):

> We hope that this review will help re-awaken interest in this neglected but promising paradigm.

In a study, where two isolated people were requested to think about each other, the EEG data showed a statistically significant correlation of brain activity, unnoticed

[55] See also https://www.cia.gov/library/readingroom/docs/CIA-RDP96-00791R000200180006-4.pdf.

by the subjects themselves. This was done with 13 couples (Radin 2004). Then there exists a wealth of academic research that is published in journals committed to studying fringe science or in proceedings of parapsychological conventions. For instance, a study showing that when two isolated people are asked to think of each other and the "sender" is stimulated by a light flash, the "receiver's" brain shows corresponding activity (Kittenis et al. 2004). Similarly, another study selected one couple out of 30 and, again, asked the participants to focus their attention. When the "sender" received a visual stimulus, neural activity was reported in the "receivers" fMRI data of the visual cortex (Standish et al. 2003). Precognition has been reported in Bierman and Scholte (2002). A result relating precognition to electrophysiological aspects of the heart has been published in a peer-reviewed medial journal (McCraty et al. 2004). More recent research in more established journals include telepathy (Tressoldi et al. 2011), ESP (Storm et al. 2010), and precognition (Radin 2011; Mossbridge et al. 2012). More publications can be found on Radin's webpage.[56]

Another line of research analyzes random number generators. In essence, the notion that the human mind can change the performance characteristics of computers is researched. This was performed at the Princeton Engineering Anomalies Research (PEAR) laboratory. In detail (Van Bakel 1995):

> Nearly a hundred volunteers have conducted 212 million REG [random event generator] trials during the 15 years of the lab's existence, and the research shows a tiny but statistically significant result that is not attributable to chance. […]
>
> The effects that the volunteers accomplish are very small, but amazing. "The operators are roughly altering one bit in 1,000," explains Michael Ibison, a British mathematical physicist who has come to work for a year at PEAR after stints at Siemens, IBM, and Agfa. […]
>
> You don't have to be in the same room as the REG to get results. Or, for that matter, in the same city, state, or country. Volunteers as far away as Hungary, Kenya, Brazil, and India have shown they can influence Princeton's REG as if they were sitting 3 feet away. […] The effects generated by two people with an emotional attachment were much larger than those produced by an "unattached" pair of operators.[…]
>
> Skeptics have examined the lab's instruments, its data-processing software, its protocols. […] Other scientists have, by and large, been able to replicate PEAR's experiments—just as PEAR's own work builds on other academically sound research.

PEAR closed in February 2007. Efforts to reproduce and validate their claims have been unsuccessful or inconclusive. The Global Consciousness Project[57] is a psi experiment which begun in 1998. The project monitors a network of geographically distributed random number generators in order to detect anomalous output which correlates with global events of emotional importance. For instance (Radin 2006, p. 203):

> On September 11, 2001, the curve deviated wildly as compared to all the other days we examined. As it happened, this curve peaked nearly two hours before a hijacked jet crashed into World Trade Tower 1 in New York City at 8:46 a.m. EDT, and it dropped to its lowest point around 2 p.m., roughly eight hours later. […]. The huge drop in this curve within an eight-hour period was the single largest drop for any day in the year 2001.

[56] See http://www.deanradin.org/.

[57] See http://www.global-mind.org/.

In response to these claims (May and Spottiswoode 2001):

> We also provide verification of a separate analysis posted by Dr. Dean Radin, but we differ markedly with regard to the posted conclusions. Using Radin's analysis, we do not find significant evidence that the GCP [Global Consciousness Project] network's EGG's [the collection of random number generators] responded to the New York City attacks in real time. Radin's computation of 6000:1 odds against chance during the events are accounted for by a not-unexpected local deviation that occurred approximately 3 hours before the attacks. We conclude that the network random number generators produced data consistent with mean chance expectation during the worst single day tragedy in American history.

Perhaps the most compelling, and reproducible, psi effects appear in studies of human consciousness interacting with experimental quantum devices. For instance, a study appearing in the *Center for Open Science's*[58] *Open Science Framework*[59] in 2017 (last updated in March 2018), reports (Guerrer 2017):

> Motivated by a series of reported experiments and their controversial results, the present work investigated if volunteers could causally affect an optical double-slit system through mental efforts alone. […] The four pre-registered experiments combined resulted in a statistically null difference between the data collected in intention and relax conditions. A post hoc combination of the formal experiments' scores using sign independent statistics, however, provided statistically significant results favoring the existence of anomalous interactions between conscious agents and a physical system. Further studies are warranted to formally test the post hoc hypothesis.

Other, related research, was previously published in peer-reviewed scientific journals, demonstrating the robustness and reproducibility of these double-slit quantum experiments (Radin et al. 2012, 2015, 2016). Earlier experiments had been done using interferometers (Radin 2008). *The Global Consciousness App*[60] is an attempt to bring psi research to your smart-phone.

The controversy surrounding psi research is deep-rooted. The situation is very similar to the political entrenchment discussed in Chap. 12, especially related to open-mindedness (Sect. 12.4.4). In essence (Van Bakel 1995):

> Unfortunately, many of our critics basically say: "This is the kind of nonsense I wouldn't believe even if it were real." They're people who have made up their minds that this is all hogwash, without having studied the data.

In 1986, an article appeared in the prestigious science journal *Nature* summarizing (Marks 1986):

> Parascience has so far failed to produce a single repeatable finding and, until it does, will continue to be viewed as an incoherent collection of belief systems steeped in fantasy, illusion and error.

However, the journal also has a somewhat troubled history with the subject. In 1974, it prominently published a psi study by the physicist Russell Targ and the engineer Harold Puthoff, offering compelling evidence of a subject's psi powers (Targ and Puthoff 1974). It was later found out that the subject was the illusionist Uri Geller. The physicist Jack Sarfatti, a leading member of the *Fundamental Fysiks Group*, was

[58] A non-profit collaborative science research project. See https://cos.io/.

[59] See https://osf.io/.

[60] See http://www.consciousness-app.com/.

at first impressed by Geller's apparent psi capabilities. However, after the magician James Randi was able to demonstrate similar feats as the ones performed by Geller to him, Sarfatti exclaimed (quoted in Kaiser 2011, p. 82):

> I do not think that Geller can be of any serious interest to scientists who are currently investigating paraphysical phenomena.

Moreover (Kaiser 2011, p. 98):

> He [Randi] dedicated an entire chapter of his popular book on "delusions" to the SRI [Stanford Research Institute] psi lab's exploits, calling Puthoff and Targ "the Laurel and Hardy of psi." Thirty pages detailed what Randi considered to be Puthoff's and Targ's crimes against scientific method, statistical reasoning, and common sense.

At the end of the day, the following can be concluded. There appear to be effects happening which require an extension of the current scientific worldview. These effects are mostly very small and hard to reproduce. Nonetheless, the claims that psi is ruled out by what we know about the workings of nature is based on a belief—a belief inspired by science, but nevertheless a belief. The implicit ontology that is invoked with such claims is based on a materialistic and reductionistic scientific worldview. However, as more and more cracks appear in this specific edifice of science—and an entirely new information-theoretic and participatory ontology seems to be emerging—the certainty and justifiability associated with these assertions can only be upheld on ideological grounds. Certainty is an elusive notion (Sect. 8.1.1, Chap. 9, Sects. 10.4, 11.2.1, 11.3, and 14.3.5). Then it is perhaps not really intellectually honest to categorically exclude that reality is "queerer than we can suppose" (Sect. 12.4.4). In stark contrast (Ribur Rinpoche 1999, p. 56):

> In Tibetan the word for "existence" is "sipa", which also means "possible". In existence, anything is possible, anything can happen.

Finally, every paradigm is afflicted by blind spots. Currently, this relates to the taboo of subjectivity (Sect. 14.1.1) and spirituality (Sect. 14.2.3), the pointless nature of psychedelics (Sect. 14.3), the unnoticed insights gained by ancient Eastern truth-seekers and shamans (Sects. 14.2.2 and 14.3.4), the possibility of gaining knowledge through unorthodox channels (Sects. 14.3.5 and 14.3.4), and the ridiculous idea of psi phenomena. Moreover, astute scholars have suspected from the very beginning that quantum physics should be understood in the context of establishing a link between consciousness and the cosmos. The cosmologist and psi skeptic Sean Carroll reminds us (Carroll 2016):

> The trash heap of history is populated by scientists claiming to know more than they really do, or predicting that they will know almost everything any day now.

And as a result, the emergence of important knowledge has been deferred. The tragic story of Ignaz Semmelweis comes to mind. He claimed that simply washing hands could significantly reduce mortality in obstetrical clinics. He presented empirical evidence to substantiate his claim (Semmelweis 1861). Alas, his insights were ridiculed and rejected by his peers. He turned to alcohol and suffered from mental breakdowns. It did not help his cause that he wrote angry, bitter, and accusing letters to professors refusing to accept his ideas. See Obenchain (2016).

Conclusion

The question "Could there be something we don't yet know about ourselves and the universe, the knowledge of which could change everything?" is beginning to be answered. In the last chapter, an information-theoretic ontology was outlined. Guided by cutting-edge theoretical physics and theoretical computer science an unlikely foundation of the world was glimpsed: the fabric of objective reality is woven out of threads of information. Intriguingly, the notion of information is also understood as being central to the subjective and recalcitrant phenomena of consciousness. Information possesses an inner dimension giving rise to experiences. A truly outlandish world emerges, where consciousness is part of the cosmic fabric. Now, a participatory ontology arises, where the ultimate taboo within the current materialistic and reductionistic scientific worldview is being broken by exposing a mind-matter relationship—or more succinctly: mind over matter. Only very few great scientific minds ever had the courage to uttered such heresies. Slowly the blind spots within the current scientific paradigm are being exposed. Previously demonized substances are rediscovered in a therapeutic context and the experiences they are able to relay speak of a multiverse. However, one comprised of transcendental universes beyond space, time, and matter, accessible to pure consciousness. In the recent peer-reviewed physics literature one can find multiple double-slit quantum experiments, showing reproducible hints of a direct mind-matter connection. A feature some of the great pioneers of quantum mechanics had always suspected. Finally, intelligence can be a decentralized and non-sentient phenomena, latching onto various configurations of matter. Given these newly emerging surprising insights it is perhaps not all too puzzling that the prevailing scientific paradigm failed to uncover this ultimate nature of reality and the human mind, as outlined in Part II. In contrast, this knowledge some ancient Eastern truth-seekers and shamanic traditions appear to have had access to for a long time.

In a strange twist of events, the human mind was first dethroned and banished from the center of creation only to reawaken in the fabric of existence. These new advances in understanding have been criticized as neo-geocentrism (Horgan 2016). However, perhaps the most common, pervasive, and overlooked manifestation of geocentrism relates to our sober waking state of consciousness. We take this mode of subjective experience as the defining and default one. By ignoring all other states of consciousness—induced by meditation, trance, chemicals, pain, brain trauma, sleep, or spontaneously—we are placing our so-perceived reality at the core of existence, denying the possibility of vast and rich alternate realms of reality, only accessible by silencing the sober waking mind. Moreover, in a peculiar turn of events, we indeed do appear to be at the center of the universe. Humanities most advanced experimental and theoretical cosmological proficiency has resulted in two truly puzzling observations: the "axis of evil" and the "coincidence problem" (Sect. 10.3.1). In essence, given the entire context of the universe, "right here" and "right now" appear to be very special coordinates. In the words of the cosmologist Lawrence M. Krauss (Krauss 2006):

> But when you look at CMB [cosmic microwave background] map, you also see that the structure that is observed, is in fact, in a weird way, correlated with the plane of the earth around the sun. Is this Copernicus coming back to haunt us? That's crazy. We're looking out at the whole universe. There's no way there should be a correlation of structure with our motion of the earth around the sun—the plane of the earth around the sun—the ecliptic. That would say we are truly the center of the universe.

Yet another such enigma is the way the universe "conspired" to give rise to this very moment in time—including sentient and inquisitive minds inhabiting a neural network based on organic matter—through a series of breathtaking coincidences (Sect. 8.1.3). Is the universe perhaps more than a cold, pointless, callous, cruel, and cynical place? Is it being driven by an innate ordering force ever higher levels of computation resulting in emergent complexity? Is each human mind an author of its own "Book of Nature?"

In a final synthesis, the next chapter unifies the information-theoretic and participatory ontologies. The entelechy of existence emerges, containing all the rhizomes of reality comprising the transcendental multiverse.

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