

ESSAY

**Building Alien Worlds—
The Neuropsychological and Evolutionary Implications
of the Astonishing Psychoactive Effects of
N,N-Dimethyltryptamine (DMT)**

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Abstract—Arguably the most remarkable property of the human brain is its ability to construct the world that appears to consciousness. The brain is capable of building worlds during waking life, but also in the complete absence of extrinsic sensory data, entirely from intrinsic thalamocortical activity, as during dreaming. DMT, an extraordinary psychedelic, perturbs brain activity such that indescribably bizarre and apparently alien worlds are built. This property of DMT continues to defy explanation. However, by regarding this unique molecule as equivalent to serotonin, an endogenous neuromodulator with a long-standing relationship with the brain, DMT's effects may be explained. Serotonin has evolved to hold the brain's thalamocortical system in a state in which the consensus world is built. When serotonin is replaced by DMT, the thalamocortical system shifts into an equivalent state, but one in which an apparently alien world is built. This suggests that DMT may be an ancestral neuromodulator, at one time secreted endogenously in psychedelic concentrations—a function apparently now lost. However, DMT maintains a number of unique pharmacological characteristics and a peculiar affinity with the human brain that supports this model. Thus, the modern practice of ingesting exogenous DMT may be the reconstitution of an ancestral function.

Friends, right here and now, one quantum away, there is raging a universe of active intelligence that is transhuman, hyperdimensional, and extremely alien.

—Terence McKenna

Introduction

N,N-dimethyltryptamine, DMT, is a truly exceptional hallucinogen. When smoked or injected in a purified or synthetic form, its effects on consciousness are more profound, shocking, and compelling than any other known psychedelic—the 'DMT flash'. Within seconds of inhaling,

DMT propels the user to an unimaginably bizarre alternate reality, an alien world. And yet, DMT is not an obscure compound, cooked up in the lab of a creative underground chemist, but a ubiquitous natural molecule found in countless plant species and with a long history of human use. Although much has been written on DMT and its effects, this unique drug continues to defy explanation. It is straightforward to assume that the DMT flash is *mere hallucination*, but very few have taken the time to consider, in detail, what this would entail from a neurobiological and neuropsychological standpoint and thus whether this explanation holds water—this paper aims to do just that.

The administration of exogenous DMT is traditionally associated with indigenous Amazonian people, who consume a bitter decoction of at least two types of plant material, known as ayahuasca (Luke 2011). This brew necessarily contains a DMT-containing plant, such as *Psychotria viridis*, together with one containing harmala alkaloids, such as *Banisteriopsis caapi*. These latter alkaloids act as monoamine oxidase (MAO) inhibitors, preventing the DMT being destroyed in the gastrointestinal tract and thus rendering it orally active. This practice can be traced back several thousand years (McKenna 1999). The consumption of relatively pure DMT, extracted and purified from plant material or synthesized chemically, is very much a modern practice. In fact, DMT was identified as psychoactive only in 1956, synthesized and self-administered by Hungarian psychiatrist Stephen Szàra (Szàra 1989). Notable psychedelic pioneers Timothy Leary and Ralph Metzner experimented with, injected, and smoked DMT throughout the 1960s, and a 1966 article by Leary (1966) caught the attention of many in the psychedelic counterculture (Meyer 1994). The late Terence McKenna, the highly articulate ‘bard’ of the psychedelic community, regarded DMT as the most powerful and authentic psychedelic experience one could have—“this isn’t a drug, this is *magic!*” (McKenna 1991). During his lectures he regularly described, in eloquent detail, his experiences after smoking DMT and can probably be credited with popularizing this form of DMT use. Smoking DMT remains the most common mode of administration, producing an extremely intense, but short-lasting experience, both quantitatively and qualitatively different from that of ayahuasca and other oral DMT preparations. This article will focus on smoked or injected DMT, rather than its oral preparations, as the effects of ayahuasca are unlikely to be consistently the result of the action of DMT alone—the harmala alkaloids are known to be psychoactive and no doubt contribute to the experience. Other alkaloids from the many admixture plants that are utilized in the range of different ayahuasca recipes may also color the effects. Whereas the ayahuasca experience builds gradually, as the DMT is slowly absorbed

into the bloodstream, smoking DMT is like “being fired out the muzzle of an atomic cannon with neon-byzantine barrelling” (Leary 1966). Further, as well as allowing DMT to be orally active, MAO inhibition also elevates serotonin levels in the brain, competing with DMT for receptor sites and probably attenuating its effects (Mishor, McKenna, and Callaway 2011). As such, it would be unwise to draw conclusions about the effects of DMT by relying on the effects of ayahuasca. We are most concerned here with the effect of DMT rapidly flooding the brain and overwhelming the user—this is the effect known as the ‘DMT flash’.

This discussion will analyze the DMT flash in terms of what is currently known about perception and the way the brain represents the world that appears to consciousness. It will also justify the position that the DMT flash cannot be explained using the paradigms of modern brain science or pharmacology and cannot be regarded as a dream state. Thus, it may be unwise for science to casually explain away this molecule as simply another naturally occurring psychedelic drug. The DMT molecule, together with the effects it produces in humans, may have profound implications for our understanding of consciousness and the nature of reality itself. The Hard Problem of Consciousness (Chalmers 1995) is as hard as ever, despite the best efforts of scientific endeavor; there is, as yet, no satisfactory explanation for a sense of self or a satisfactory explanation for why we are conscious at all. Faced with apparently unshakeable problems in explaining our conscious world, each and every tool that might help elevate our understanding of it ought to be grasped firmly and resolutely. Cherished paradigms regarding the nature of reality and our place in it may need to be dismantled if we are to progress beyond the confines of materialist dogma. Psychedelic drugs, DMT in particular, may well light the way.

DMT is set apart from the other classical psychedelics, such as LSD and psilocybin, with regard to the effects it so reliably produces at sufficient dosages. DMT is capable of transporting the user, within seconds, to what appears to be a fully autonomous alternate reality (Strassman, Wojtowicz, Luna, & Frecska 2008). This reality is commonly inhabited, even infested, with a variety of entities that often communicate with the user. The point at which many scientists, philosophers, and lay psychonauts diverge is on the question of whether these worlds are real, autonomous realities, or simply products of a hallucinatory state of mind. However, this distinction between reality and hallucination begins to blur when we appreciate that ‘consensus reality’, the world we all live in, is constructed and represented by the brain and that the experience of a ‘world out there’ is an illusion. The suggestion here is not to trivialize consensus reality—the brain’s ability to construct a world of such beauty and complexity is remarkable; a world

that enables us to survive and flourish in whatever is ‘out there’. At the same time, the brain is capable of building worlds undreamed of, worlds of such astonishing beauty and complexity that words fail to adequately describe them. This paper will attempt an explanation for DMT’s unique and remarkable psychopharmacological properties and, hopefully, stimulate further discussion within the scientific community.

Building Worlds from Information

Before discussing the nature of the DMT flash, it is important to clarify exactly which aspects of the conscious experience of a world this paper is attempting to explain and which it is not. Restricting the discussion to the ‘consensus world’ initially, it seems reasonable to suggest that any conscious experience of a world has three requirements—the external world-in-itself, the neural representation of the external world, and subjective consciousness itself (whether or not these are aspects of the same process remains unclear) (Koch 2004). Of course, in explaining hallucinatory phenomena and dreams, we may need to remove the requirement for an external world-in-itself in some circumstances—this issue will be dealt with as it arises, but the three components serve as a useful guide.

It is an intuitive and natural error to equate the world that *appears* before us to the actual world-in-itself. To do this is to confuse the *phenomenon*, the world as experienced, with the *noumenon*, the world-in-itself. This is also the mistake that leads to confusion with regard to the worlds perceived under the influence of DMT, as will be discussed. Whatever the nature of the external world-in-itself, we have no access to it (Metzinger 2009). This also applies to any worlds seen under the influence of a psychedelic drug, such as DMT. What we do have access to, however, is the representation of the external world built by the brain’s information-generating machinery (Koch 2004).

This brings us to the second component—the neural representation of the world. This paper will make the well-supported assumption that if a world appears to consciousness, it must have an informational representation in the brain. This provides no explanation as to how this informational representation is related to the subjective conscious experience, but it does predict that removal of the brain’s ability to generate an informational representation of any feature of the world will preclude that feature of the world from becoming part of the conscious experience of the world. Indeed, this is found to be correct. For example, a lesion in the part of the cortex that represents color will result in that feature of the world disappearing; the world becomes devoid of color (Spillmann, Laskowski, Lange, Kasper, & Schmidt 2000). One doesn’t have to assume that the brain *generates* the conscious

experience of color, but that color must have a representation in the brain in order to become part of conscious experience. This applies to any and all observable features of the world. All worlds that appear to consciousness have an informational structure that has a neural representation in the brain.

Subjective consciousness itself is more difficult to explain and forms the basis of the Hard Problem of Consciousness, as described by Chalmers (1995). In fact, it remains a matter of debate as to whether consciousness is a product of brain function—a monist position—or whether consciousness and the brain somehow interact and yet remain distinct—a dualist position. While the majority of modern neuroscientists might favor the former position, this paper is agnostic on this issue and, as will become clear, it isn't necessary to adopt a stance on this in order to explain the effects of DMT and psychedelic drugs on brain function. In fact, in attempting to explain how DMT can cause such dramatic shifts in consciousness, such that completely novel worlds appear, this paper will limit itself to the more tractable problem of explaining how the brain is able to represent the informational structure of the worlds that appear to consciousness. Having examined how the consensus world is represented by the brain, we can then examine the DMT flash as an alien world constructed analogously. This is a sensible approach because, just as with the consensus world, even if the alien worlds that appear under the influence of DMT have a true external reality, we have no access to this reality directly. However, as with the consensus world, the DMT alien worlds must have a neural representation in the brain that is accessible to us. Having explained how the brain can represent alien worlds under DMT, we will be better equipped to deal with issues of veridicality and autonomy, i.e. whether or not the DMT world is 'real'. This will also avoid the potentially confusing idea that DMT must somehow 'transport' the user to another world, while also avoiding the intellectually facile conclusion that it's 'mere hallucination', which tells us nothing of its nature.

In order to build worlds (or representations of worlds if preferred) under any circumstance, the brain uses information. The information is encoded by patterns of activity within neurons and the multitude of connections between them; sequences of action potentials that oscillate and reverberate throughout the cerebral cortex (Kumar, Rotter, & Aertsen 2010, Stemmler & Koch 1999). Of course, the world doesn't appear to us as information; it appears as a glorious chorus of objects, colors, textures, smells, and sounds. The brain's ability to create such an exquisite, full-color, three-dimensional representation of the world is remarkable, but we must not forget that this exists only within the brain.

The key to understanding the world-building capabilities of the brain

lies in the cerebral cortex. The human cortex is a folded 2–4 mm sheet of about 50 billion neurons among 500 billion supporting cells (Fitzgerald, Gruener, & Mtui 2012). The ability to build worlds lies in the extraordinarily complex connectivity of neurons within the cortex. The two principles that the brain employs to create a unified world are functional segregation and integration. Functional segregation refers to the manner in which specific areas of the cortex are responsible for specific functions (Nelson et al. 2010). In order to illustrate this clearly, we will focus on the visual system. Humans are primarily visual creatures, devoting a large proportion of the cortex to this particular sensory modality, and the DMT flash is a characteristically visual experience. However, this discussion can be extended to the other senses that contribute to the overall appearance of a world. To generate a visual scene, different areas of the cortex have specific roles in representing different features of the world. There are specialized regions devoted to orientation, direction of motion, color, and form, for example. The primary visual cortex (denoted V1) sits at the back of the brain, in the occipital lobe. It is this region that receives visual information from the external world first, from the retina via the thalamus (discussed later). V1 is generally responsible for basic visual features, containing ‘simple’ neurons that are tuned to respond to certain line orientations and spatial frequencies as well as more ‘complex’ neurons that respond only when a line is moving in a specific direction, for example (Snowden, Thompson, & Troscianko 2006). The visual association cortex contains areas that are specialized to represent specific features of the world, such as geometric shapes, colors, and depth perception. Farther downstream, in the temporal lobes, are areas that are specialized for the recognition of certain types of objects, such as faces or animals.

To illustrate, we can imagine a highly simplified brain, containing only a handful of functionally segregated areas (Figure 1). It should be clear how this brain would build a very simple world containing a single object—a smooth red square moving from left to right, for example. In a real human brain, the mechanism is analogous—different functionally segregated areas of the cortex are responsible for mapping the basic features, such as the edges, contours, and their orientations, as well as the overall form of the object and its color, texture, and movement. All of these individual characteristics, each represented by a specific functional region of the cortex, when combined represent a “moving red square” (see Figure 1), which is itself a pattern of activation in the cortex. In reality, of course, the situation is far more complex, but the basic principle is hopefully clear. Complex objects can be represented by specific patterns of activation of functionally specific areas of the cortex (Tsunoda, Yamane, Nishizaki, &

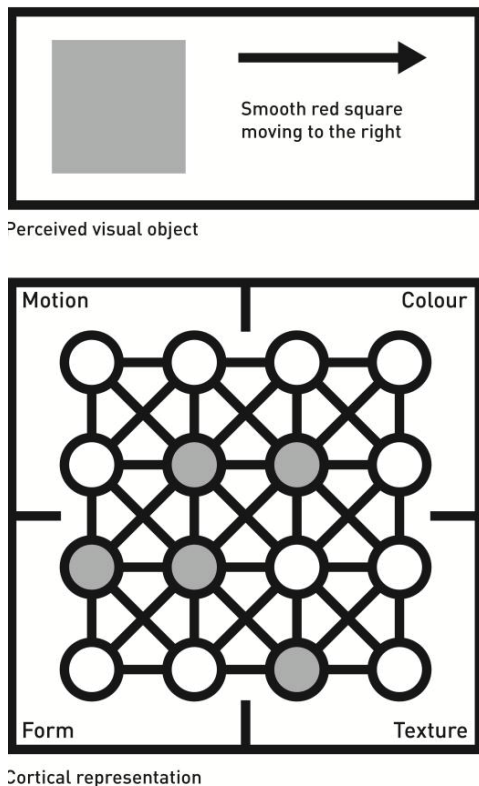


Figure 1. Functional specialization in the visual cortices.

Tanifuji 2001), and, overall, the informational structure of the world that appears in consciousness is represented by an extraordinarily complex cortical activation pattern.

This functional segregation is exemplified in individuals who suffer focal damage to specific regions of the cortex, often due to stroke. For example, damage to an area of the occipital lobe, V5, responsible for the processing of motion, can result in a disorder called akinetopsia or motion-blindness. Individuals with this rare condition see the world as a series of still images and have no perception of motion (Schenk, Norbert, Jochen, & Josef 2000). Likewise, when those areas responsible for representing color are damaged, a monochrome world is the result.

Another example, this time from the auditory system, demonstrates how the brain uses functionally segregated areas of the cortex to represent

sounds. A natural sound normally consists of a number of different frequency waves that combine to form a complex sound wave structure. Specific regions of the auditory cortex are sensitive to specific frequencies of sound. Each frequency component of a complex sound activates its own frequency-specific region of the auditory cortex; these individual activations are then combined to represent the sound heard. This mechanism can be extrapolated across the senses and other functional areas of the cortex to explain how the brain is capable of representing worlds with limitless features and characteristics with such apparent ease.

Of course, the functional segregation in the cortex is much finer than the gross distinctions between sound and vision and even color, form, texture, etc. Another way to think about functional segregation is simply to imagine that the billions of cortical areas are able to generate an almost limitless number of different activation patterns, each pattern representing a single conscious moment in the world (Figure 2). Each pattern is informative as it rules out the countless other possible patterns. This is possible precisely because of the vast number of cortical columns available to contribute to the activation pattern. If there were no functional segregation, and thus all columns were functionally identical, then the brain would have only two patterns available—all areas active or inactive. This would be more analogous to a lightbulb, “on” or “off”—a simple two-state device. The cortex can perhaps be imagined as a board containing billions of lightbulbs, each capable of being switched not only on or off, but also dimmed to varying degrees. It is the pattern of lighting that constitutes the informative brain state or built world.

To understand this process of world-building more deeply, we must look deeper into the cortex. The cortex comprises six layers of neurons—layer I is the outermost, layer VI the deepest. Thus, the functionally specialized areas of cortex are, in fact, three-dimensional columns. These cortical columns are considered the basic unit of functional segregation within the cortex (Hirsch & Martinez 2006). We can thus regard the cortex as a 3D mosaic of cortical columns, specific combinations of which can represent complex visual scenes, soundscapes, and, naturally, complete worlds. While functional segregation allows us to understand how the brain represents the multitude features of the world, in order to produce a unified conscious experience of a world these features must be bound together in some way. In the simple “moving red square” example, the features of movement and redness are somehow bound to the shape despite being processed at separate regions of the cortex. This issue is known as the ‘binding problem’. It is a problem because there is no known supraordinate cortical area where features represented at disparate regions of the cortex

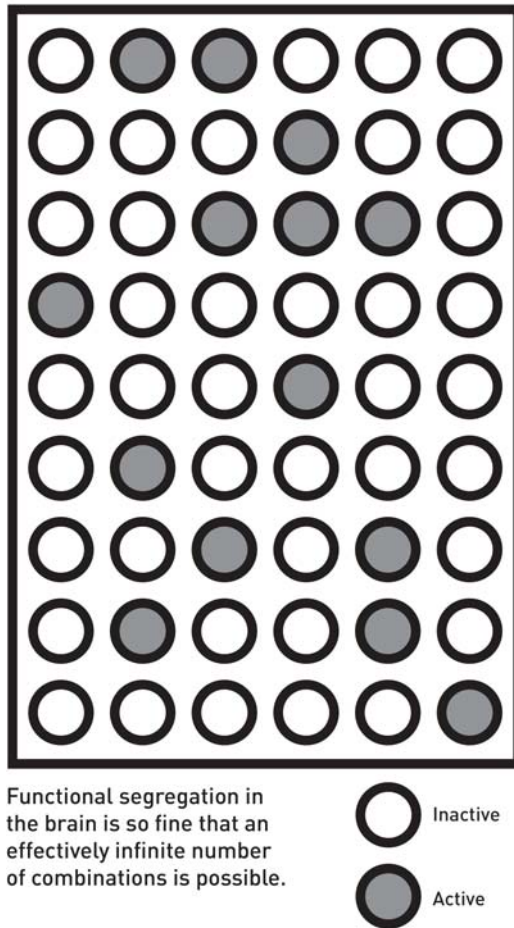


Figure 2. Pattern of activation of functionally segregated areas of the cortex.

are bound together. Although the issue of binding remains an open question in neuroscience, most researchers agree the solution lies in the manner in which the functionally segregated areas of the cortex are massively interconnected. Rather than a mosaic of independent cortical columns, the neurons of different functional areas have dense reciprocal connections that allow strong and rapid interactions (Edelman 2000). This allows the individual cortical columns to be integrated to form a cohesive whole. The world that appears is thus both highly differentiated (informative) and highly integrated (unified).

To understand this more thoroughly, which will be necessary if we are to relate it to the action of psychedelic drugs, such as DMT, we need to consider the role of the thalamus, a key subcortical structure sitting in the center of the brain. The thalamus is commonly seen as a relay station through which all sensory information, barring olfactory, must pass on its way to the cortex (Sherman and Guillery 2002). This is correct but is only part of the story. Each functionally specific area of the cortex, and thus each cortical column, is reciprocally connected to a corresponding region of the thalamus, forming a thalamocortical loop (see Figure 3). In fact, the thalamus has been described as a ‘miniature map’ or seventh layer of the cortex (Ward 2011). Thus, rather than ‘cortical column’, it would be more representative to use the term ‘thalamocortical column’. When the thalamocortical column is activated, the neural activity is observed on an EEG as an oscillating electrical potential. It is now thought that synchronized oscillations, particularly those in the gamma range (~40 Hz), may represent the manner in which information is integrated across the brain (Joliot, Ribary, & Llinas 1994, Engel & Singer 2001). For example, if a moving object is presented as a stimulus to an awake animal, it has been shown that distant regions of the cortex, each with a different functional role in processing the sensory information, begin to display synchronized gamma oscillations as long as the object is present (Gray & Singer 1989). Gamma oscillations enable disparate neuronal populations to synchronize, transiently enhancing their functional connections (Wang 2010).

As well as being part of a functionally specific thalamocortical loop, non-specific thalamic neurons project to regions of the cortex other than to their corresponding specific functional areas. This provides a means by which the functionally differentiated thalamocortical columns can be unified (Figure 3). Thus, while being functionally segregated, the cortex is integrated by means of the highly interconnected structure of the thalamocortical system. When a specific set of thalamocortical columns is activated, their gamma oscillations self-organize and synchronize, resulting in a transient neuronal assembly (Tononi, Edelman, & Sporns 1998)—a ‘thalamocortical state’. The activity of a large number of thalamocortical columns can be integrated within a few hundred milliseconds in order to generate a unified thalamocortical state (Tononi & Edelman 2000) that represents the world. *The world that appears within each conscious moment is represented by a differentiated pattern of activity spread across many different regions of the cortex and unified through the thalamocortical system.* It is conceivable that the information is contained within the specific thalamocortical columns, but bound together by the non-specific thalamocortical circuits (Llinas & Ribary 1993). The world that appears at each conscious moment is unique,

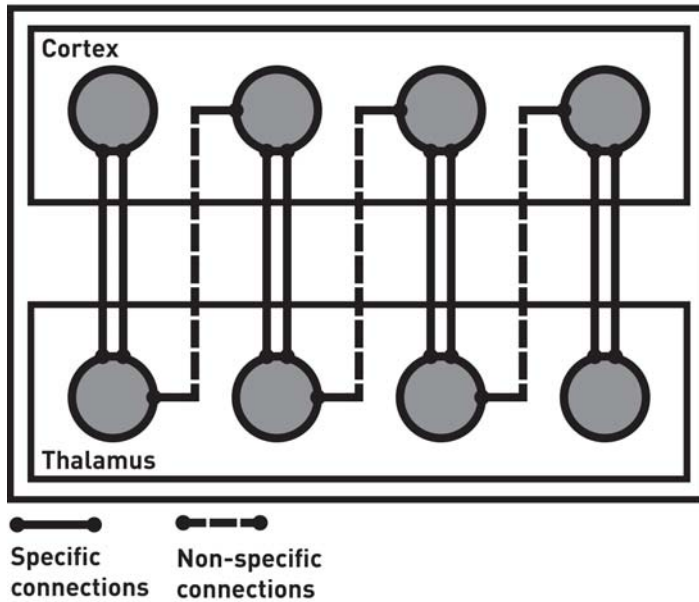


Figure 3. Specific and non-specific connections between the cortex and the thalamus.

with each *thalamocortical state* (i.e. a specific pattern of activation of the thalamocortical system) ruling out literally countless other thalamocortical states. This applies to all conscious moments, whether during waking, dreaming, or a psychedelic experience.

Conscious awareness of a world appears to be a default state of the brain (Llinas & Pare 1991) and can be fully independent of incoming sensory data, as exemplified by dreaming. During REM sleep, the brain is perfectly capable of building completely realistic worlds, with all sensory modalities intact, despite having no access to the external world. In fact, even during waking, sensory stimuli contribute far less to the information used to build the world than might be expected (Edelman 2000). To understand what this means, we need to distinguish between two types of information in the brain. Information generated entirely within the brain, through the differentiated and integrated activity of the thalamocortical system, as discussed, is *intrinsic* information. Information that enters from outside, through the senses, is *extrinsic* information. It is a combination of these two types of information that the brain uses to build worlds. However, it is not simply a case of extrinsic sensory information *adding* to intrinsic

information. Rather, patterns of sensory data amplify or “awaken” (Sporns 2011) existing intrinsic activity within the brain (Edelman 2000), and very little additional information is provided by sensory data (Tononi, Edelman, & Sporns 1998). To put it another way, *extrinsic sensory data is ‘matched’ to ongoing intrinsic activity*, which it amplifies (Tononi, Sporns, & Edelman 1996). The intrinsic activity thus represents a repertoire of thalamocortical states that provide the context for any incoming sensory data. In fact, even in the complete absence of extrinsic sensory data, the intrinsic thalamocortical activity remains perfectly capable of building complete worlds. Of course, this is dreaming, which will be discussed in detail later. However, suffice to say that the principal difference between the waking consensus world and the dream world is the manner in which the former is modulated by extrinsic sensory data. Sensory information *constrains* conscious perception (Behrendt 2003), and the conscious awareness of a world is an intrinsic functional state of the brain that is modulated, but not created, by sensory input (Llinas, Ribary, Contreras, & Pedroarena 1998). Naturally, this begs the question as to why the intrinsic activity of the thalamocortical system tends to build the consensus world as a default and thus why extrinsic sensory data can be so effectively ‘matched’ to ongoing intrinsic activity. This suggests that extrinsic sensory data somehow shaped the thalamocortical system, i.e. that the brain used sensory data from the external world to *learn* to build a representation of it.

Learning to Build the World

In order to explain the intrinsic activity of the thalamocortical system, how it is shaped and how this represents the consensus world, we need to consider two types of connectivity in the brain, structural and functional (Figure 4). Structural connectivity refers to the physical synaptic coupling of neurons and thus can be considered the anatomical connections or ‘wiring’ of the thalamocortical system. The circuits and networks of neurons are relatively stable and static at short time scales, on the order of seconds to minutes. However, they are plastic at longer time scales (hours to days), as connections are strengthened or weakened (Sporns 2011). Functional connectivity is the temporal correlation of distributed thalamocortical columns and is highly dynamic, often changing on a millisecond time scale, modulated by extrinsic sensory data, as well as ongoing intrinsic activity. As a simplification, functional connectivity can be regarded as those transient synchronous activations of the thalamocortical columns of a thalamocortical state. As the thalamocortical system shifts from state to state, some functional connections remain, while others dissolve and new ones are formed. For example, when engaged in a listening task, neuroimaging has demonstrated

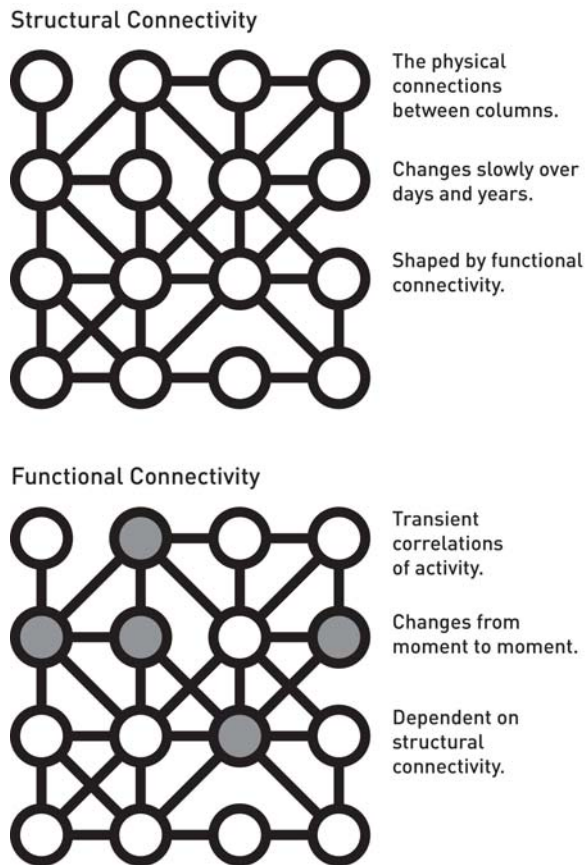


Figure 4. Differences between structural and functional connectivity in the thalamocortical system.

increased functional connectivity between the areas of the brain associated with speech (Broca's area) and the comprehension of the spoken word (Wernicke's area) (Hampson, Peterson, Skudlarski, Gatenby, & Gore 2002). Functional connectivity is obviously limited by the structural connectivity scaffold, and as this scaffold develops and changes so does the repertoire of functional connections and thus the thalamocortical states that can be adopted; structural connectivity 'molds' functional connectivity. However, quite conversely, through a number of use-dependent mechanisms, synaptic (structural) connections are strengthened as they are used (i.e. by functional connectivity). Thus, structural connectivity shapes functional connectivity and functional connectivity, with use, shapes structural connectivity—this

is a mutualistic relationship (Sporns 2011). It is the structural and functional connectivity that determines the intrinsic thalamocortical activity that is so central in representing the world. In fact, when we descend into deep dreamless sleep, the connectivity of the thalamocortical system breaks down (Massimini et al. 2005) and the brain stops building worlds. However, as soon as we begin dreaming, the connectivity returns and appears similar to waking connectivity (Massimini et al. 2010). This makes sense, as the worlds built during waking are of the same nature as those built during dreaming. The dramatic changes in connectivity that occur as consciousness shifts between states demonstrate just how dynamic the system of connectivity is.

At birth, the brain is not pre-wired, ready to receive and process the multitude of sensory signals in a manner analogous to a computer. In order to survive and flourish in the consensus world, the brain “must either inherit or create criteria that enable it to partition the world into perceptual categories according to its adaptive needs” (Edelman 1993). During evolution, development, and experience, sensory information sampled from the environment activates specific neuronal populations, and, consequently, the connections between them become strengthened or weakened—the structural and functional connections, and thus the intrinsic thalamocortical activity, are gradually molded by extrinsic sensory data (Figure 5). Eventually, the intrinsic thalamocortical activity and the patterns of sensory data from the external world become more and more closely ‘matched’ (Tononi, Sporns, & Edelman 1996). At no point does the world built by the brain *become* the external world, and we must not forget that the world that appears is still built by the brain. However, at the same time, the data from the external world is essential to the development of the consensus-world-building capabilities of the brain. Once the structural and functional connectivity has been developed, and continues to develop and change throughout life and across the span of evolutionary time, it becomes absolutely critical in determining how the brain interprets and categorizes sensory information and thus builds the consensus world. The richness of the dream world seems a startling validation of this model, as the brain becomes capable of building worlds in the total absence of extrinsic sensory data, entirely from the intrinsic information generated by the activity of the thalamocortical connectivity molded by evolution, development, and experience.

The worlds that appear in dreams are not mere suggestions or two-dimensional sketches of the consensus waking world, but full-color 3D representations that seem indistinguishable from it. Indeed, the dream state, like the waking state, is characterized by synchronized gamma oscillations and activation of sensory-modality specific areas of the cortex (Llinas &

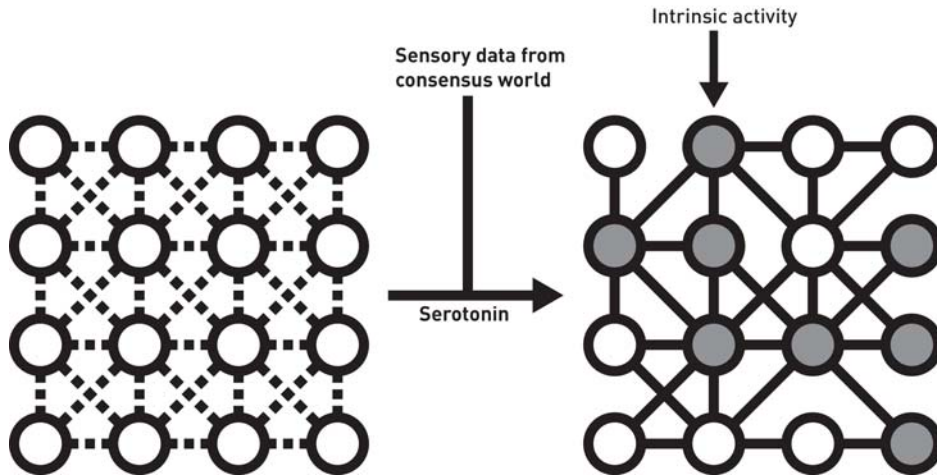


Figure 5. The structural and functional connectivity of the thalamocortical system develops under the modulation of serotonin and subject to sensory data input from the consensus world. Eventually, the intrinsic activity of the system builds the consensus world as a default state. Only strong/characteristic connectivity is shown on the right diagram.

Pare 1991). It seems the brain builds worlds in exactly the same way during dreaming as it does during waking—and why wouldn't it? Indeed, it is the only way the brain is able to build the worlds that appear to us. As pointed out earlier, the primary difference between waking and dreaming is the manner in which the waking world is modulated by extrinsic information. During waking, the formation of coherent oscillatory assemblies (i.e. thalamocortical states) is modulated by incoming sensory information. During dreaming, however, the individual is disconnected from the external environment (although the reason for this remains subject to debate, see Nir & Tononi 2010). The primary sensory areas of the cortex, which normally receive the incoming information before passing it on to higher cortical areas for further processing, also become inactive, as does the prefrontal cortex (Braun et al. 1998). The higher sensory areas of the cortex remain active in building the dream world, using the repertoire of intrinsic thalamocortical states developed during waking life. As the dynamic sequence of thalamocortical states is not constrained by incoming sensory data, however, the dream world can become bizarre, often impossible. Faces of family members become simultaneously associated with distant friends or the family dog, while the scene shifts inexplicably from the front garden

to the inside of an aircraft. Unfortunately, loss of normal critical function means that such ridiculousness is rarely recognized for what it is, unless you happen to be a lucid dreamer.

As explained earlier, the worlds that immerse the DMT user must have a neural representation in the brain if they are perceived. The question that must be answered is whether the DMT world is constructed entirely from intrinsic information, like the dream world, or whether it is modulated by an extrinsic component, as with consensus reality. The former explanation would be favored from an orthodox standpoint and would regard the DMT flash as an elaborate hallucination. The latter must endow DMT with the ability to chemically manipulate the brain to receive sensory information to which it normally has no access. This idea might be favored by those believing DMT capable of transporting the user to an alternate reality. However, both of these explanations have inherent problems that will be addressed later. Rick Strassman (2010) distinguishes between two alternate explanations of the DMT flash. The first is that the DMT experience is generated by the brain. The alternative is that DMT changes the receiving capabilities of the brain such that it can receive sensory data from a normally unseen reality. These explanations, however, are not actually independent, as even if the latter explanation is correct, the brain would still be required to build a neural representation of the worlds observed.

Before discussing DMT specifically, it will be useful to examine how other classical psychedelics, such as LSD and psilocybin, alter brain function and thus produce their effects. These models of hallucinogenesis can then be mapped onto the exceptionally bizarre effects of DMT.

The Mechanism of Action of the Classical Psychedelics

Although more than 100 natural neurotransmitters have been identified that modulate brain function, serotonin seems to be the most important with respect to the action of psychedelics. Serotonin (5-hydroxytryptamine) in the brain is secreted principally by the Raphe nuclei, a cluster of neurons in the brainstem (Fitzgerald, Gruener, & Mtui 2012). This small piece of tissue is responsible for production of serotonin for the entire brain, and neuronal efferents from the Raphe nuclei project to almost every area of the cortex. Serotonin falls into the category of neuromodulator, its function to alter the way that neurons fire on a global scale, with the entire cortical volume within reach of this molecule (Miner, Schroeter, Blakeley, & Sesack 2000). Although serotonin has numerous roles in the cortex, this discussion will focus on its action at cortical pyramidal cells and their associated inhibitory interneurons. The former are the major excitatory neurons that form the cortical component of the thalamocortical loop (Figure 6). There are seven

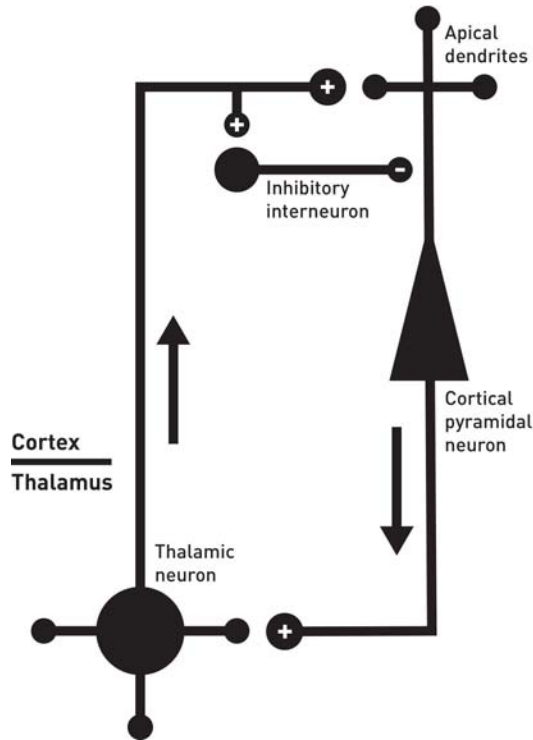


Figure 6. Simplified structure of a thalamocortical loop.

recognized classes of serotonin (5HT) receptor, 5HT1 to 5HT7. There are three subtypes of the 5HT1 receptor (5HT1A, 5HT1B, and 5HT1D) and likewise of the 5HT2 receptor (5HT2A, 5HT2B, and 5HT2C). With respect to the action of psychedelics, it is the 5HT2A receptor that has received the most attention and has long been regarded as the major locus for their effects (Nichols 2004). It has been shown that the potency of a psychedelic drug is strongly correlated with its affinity for 5HT2 receptor subtypes (Glennon, Titeler, & McKenney 1984). Crucially, Vollenweider has demonstrated that specific blockade of this receptor with a 5HT2A antagonist abolishes the activity of psilocybin in humans (Vollenweider et al. 1998). 5HT2A receptors are abundant on the apical dendrites of cortical pyramidal cells and their activation has a depolarizing effect on the neuron, making it more likely that the neuron will fire (Araneda & Andrade 1991). This is in contrast to the 5HT1A receptor, present alongside the 5HT2A receptor, which has a hyperpolarizing effect. These two receptor subtypes thus appear to antagonize each other—the balance of 5HT1A and

5HT2A stimulation sets the excitability of the neuron and, by extension, the entire cortex. 5HT1A and 5HT2A receptors also work antagonistically in regulating gamma oscillations in thalamocortical loops, with 5HT2A receptors promoting them and 5HT1A receptors inhibiting them (Puig, Watakabe, Ushimaru, Yamamori, & Kawaguchi 2010). This simple model is rendered less straightforward by the presence of inhibitory interneurons that are closely associated with the excitatory pyramidal neurons. It is the fast-spiking GABAergic interneurons that are thought to generate the gamma oscillations that are central in synchronizing the thalamocortical columns (Cardin et al. 2009). These interneurons also express 5HT2A receptors and are stimulated by 5HT2A agonists, including LSD (Marek & Aghajanian 1996). In addition, a subpopulation of layer IV interneurons ensures that gamma oscillations don't spread unrestricted across the cortex, helping to sculpt the pattern of thalamocortical column activation (Llinas, Urbano, Leznik, Ramirez, & van Marle 2005). It is clear how a balance of 5HT1A vs. 5HT2A activation, on both pyramidal cells and interneurons, may be necessary to maintain the tightly organized and regulated thalamocortical activation patterns and thus maintain the informational integrity of the thalamocortical states; this is essential for a stable representation of a world.

Under normal circumstances, it is serotonin that occupies and activates both receptor subtypes (Nichols 2004), setting this 5HT1A–5HT2A balance. The classical hallucinogens are primarily selective 5HT2A partial agonists, with little activity at the 5HT1A receptor. This appears to disrupt the balance and results in a more fluid and less predictable world. More specifically, the balance is tipped in favor of depolarization of pyramidal cells and promotion of gamma oscillations in thalamocortical loops. This has two primary effects: Firstly, the cortex becomes more sensitive to incoming sensory data; secondly, highly coherent thalamocortical gamma oscillations (Destexhe, Contreras, & Steriade 1999) are promoted, potentially even in the absence of incoming sensory data. Normally, the context within which incoming sensory data is interpreted is determined by spontaneous intrinsic activity in the thalamocortical system (McCormick 1995, Shu, Hasenstaub, & McCormick 2003, Destexhe, Hughes, Rudolph, & Crunelli 2007), itself an expression of the structural and functional connectivity established during evolution, development, and experience. This development, of course, took place on a background of serotonin modulation, which set the balance of 5HT1A–5HT2A activation. This is a key point that we will return to. The psychedelic-induced 5HT2A-weighting makes it more likely that pyramidal cells will enter into synchronized gamma oscillations. Further, as this effect is widespread over the cortex, such gamma oscillations are likely to spread more freely across the thalamocortical system, recruiting

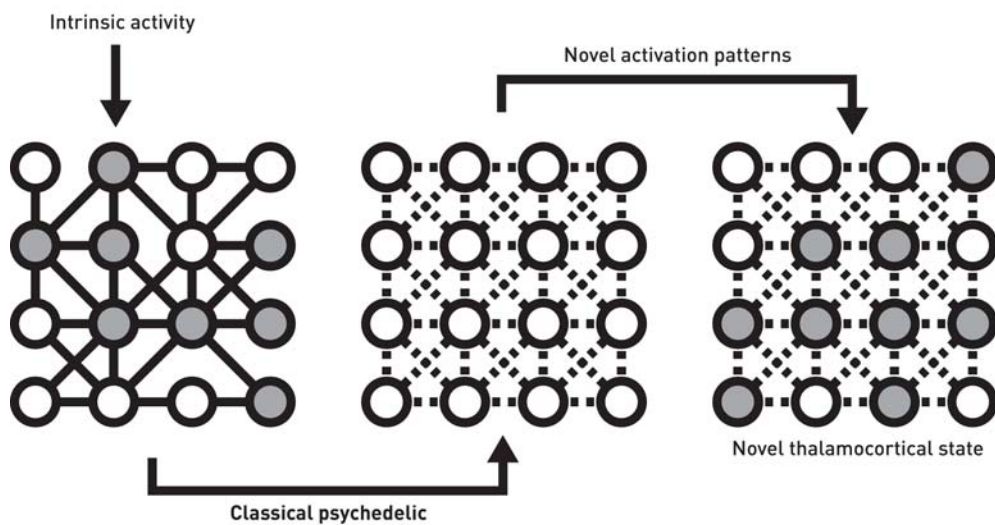


Figure 7. Classical psychedelics depolarize cortical pyramidal neurons and promote synchronized gamma oscillations, facilitating the appearance of novel activation patterns in the thalamocortical system.

areas of the cortex without the tight restraint normally held by serotonin. One can envisage, for example, how information could be spread from one sensory modality to another, generating synaesthesia effects (Aghajanian 2009). Illusions, or misinterpretations of sensory information, can be explained as underconstrained novel reinterpretations of such information. Fully immersive hallucinations of entities, landscapes, and complete worlds can be regarded as stable thalamocortical states that don't have any relationship to incoming sensory data, at least not of the usual kind. Most psychedelic effects, whether visual, auditory, or multisensory, can be regarded as novel thalamocortical activation patterns resulting from the disruption of the 5HT1A–5HT2A balance (Figure 7). The thalamocortical system's connectivities have been selected by development, experience, and evolution—thus the consensus world that appears is predictable and stable, as the appropriate connectivities and activation patterns are well-established. Psychedelics override this by making a much larger repertoire of thalamocortical columns and combinations accessible to the dynamic and shifting thalamocortical states. Thus, unfamiliar connections, illusions, distortions, and hallucinations are facilitated. The principle is analogous to Goekoop and Looijestijn's (2011) network model of the

hallucinations seen in psychotic disorders. The established connectivities of the thalamocortical system create ‘attractor’ states that the system tends to adopt. These attractors constitute the thalamocortical state repertoire and explain why, even in the absence of sensory data (e.g., during dreaming), the thalamocortical system tends to represent the consensus world as a default. However, in schizophrenia for example, the regulation of these attractor states is somehow compromised (possibly by a reduction in regulation by the frontal cortex), and “false-positive” attractor states can be adopted—these are experienced as hallucinations (Goekoop & Looijestijn 2011). The 5HT1A–5HT2A model discussed here suggests that psychedelic drugs are able to induce the formation of novel attractor states in an analogous manner, generating their novel perceptual effects.

This explanation of how psychedelic drugs work is, of course, a highly simplified model of the true picture. Early neuroimaging studies with psilocybin seemed to support the assumption that psychedelic drugs would lead to an increase in cortical activity, in accordance with the 5HT2A receptor’s depolarizing effect on pyramidal neurons (Vollenweider et al. 1997). However, a more recent functional imaging study failed to demonstrate such an increase in neural activity in any specific cortical area and, in fact, saw an overall decrease in cortical activity (Carhart-Harris et al. 2012). This is not particularly surprising—the presence of 5HT2A receptors on the inhibitory interneurons that terminate on cortical pyramidal neurons makes it difficult to predict the overall effect of a 5HT2A active psychedelic agent on the overall level of cortical activity—the effect of hallucinogens is more of a perturbation of functional relationships between thalamocortical columns, rather than a simple activation effect. This discussion has also omitted the effects of hallucinogens on glutamatergic transmission, the thalamic reticular nucleus, locus ceruleus, or the Raphe nucleus itself, all of which may contribute to their effects on brain function (for a full discussion of these aspects, see Nichols 2004 and Nichols & Chemel 2011). Potentially relevant to the action of DMT, in particular, are the “mysterious trace amine” receptors (Burchett & Hicks 2006). The function of these receptors is yet to be fully elucidated, but they are thought to be activated by a range of amines present in very low concentrations in the brain (hence “trace amines”) and may have a role in regulating synaptic transmission. Based on the discovery that DMT is active at these receptors, Wallach (2009) suggests that they might have a role in DMT’s unique perceptual effects. It remains to be seen whether this can be substantiated.

In summary, the crux of this model of psychedelic drug action is that, by their activity at 5HT2A receptors, classical hallucinogens seem to increase the repertoire of states available to the thalamocortical system and shift the

world that appears to consciousness from being stable and predictable to being fluid, unpredictable, and novel. Before attempting to apply this model to DMT, we need to examine the phenomenology of the DMT flash in more detail.

The Phenomenology of the DMT Flash

Rick Strassman's groundbreaking research into the effects of DMT in human volunteers (Strassman 1996) remains the only major study of its kind, the official aim being to obtain human pharmacological data on the drug. However, the study also generated a large number of carefully recorded "trip reports"—far more interesting. Together with hundreds of trip reports posted online at such outstanding sites as Erowid.org, it is possible to identify commonalities across a multitude of experiences and draw general conclusions as to the nature of the DMT world users find themselves fired into.

A number of published studies have attempted a detailed systematic analysis of the phenomenology of DMT, the most notable example being by Shanon (2002), although this focused on its traditional use in oral preparations, namely ayahuasca. Cott and Rock (2008) carried out a small study involving only 19 DMT users, but were able to delineate common themes that characterize the DMT experience:

1. Hallucination—visual, physical, auditory;
2. Entering other realities, sometimes including having contact with other sentient beings, which were described as true or real experiences rather than hallucinations;
3. Lucidity;
4. Affective distortions;
5. Ineffability;
6. Extreme intensity;
7. Spirituality, learning, or being taught about truths of the universe/self;
8. Distortion in sense of time, space, self;
9. Sense of familiarity (Cott & Rock, 2008).

The user typically rushes through a number of stages, before 'breaking through' into the characteristic alien worlds, which are the focus of this discussion. The accounts of Strassman's volunteers and posters on Erowid.org who achieved this breakthrough, while varied, follow a number of recurring themes:

- Merry-go-rounds, fairgrounds, clowns/jesters, circuses;
- Mischievous or playful elves/dwarves/imps;
- Insectoid and reptilian creatures, aliens;
- Futuristic hypertechnological buildings and cities;
- Complex machinery, hyper-advanced technology;
- Being observed and/or experimented upon;
- Unknown places apparently on Earth.

A number of these features are common in ‘trip reports’ by users and, notably, unique to DMT. Users typically describe the DMT world as being more real than ordinary waking reality, even after the experience has ended. The lucidity of the experience is also striking—the lack of haziness or stoning allows the user to experience the effects as if in an ordinary waking state.

Perhaps the most interesting of the recurrent themes, recounted by a significant proportion of users, is the experience of apparently hyperadvanced technological societies, with highly intelligent entities occupying futuristic cities and unearthly landscapes, manipulating complex machinery.

Often the entities appear as mischievous or playful ‘elves’ that vie for the attention of the user:

It was generally like a wacky toy factory. Gadgets, widgets, twirling machines, stair-step pattern, Escher-like “space” and tunnels and chutes. The beings would seem to go “look!” and I felt I was supposed to look. (Erowid Experience 11258)

The elves were dancing in and out of the multidimensional visible language matrix, ‘waving’ their ‘arms’ and ‘limbs/hands/fingers?’ and ‘smiling’ or ‘laughing’. (Erowid Experience 1859)

One of the DMT beings, tall, thin, and golem-like, grasped my head and turned it back to see. (Erowid Experience 131)

Once I entered a room to see what looked like little elves working hard . . . I was watching these little guys work very hard on a bench, and they were building something. (Cott & Rock 2008, Respondent #16)

They are elves/not-elves. They don’t appear, they kind of ooze out of the woodwork seductively and before you know it they’re there—the whole realm is infested with these creatures like nothing else you could ever imagine. (Erowid Experience 1841)

Terence McKenna's recollections of his meetings with the elves are legendary.

*Trying to describe them isn't easy. On one level I call them self-transforming machine elves; half machine, half elf. They are also like self-dribbling jewelled basketballs, about half that volume, and they move very quickly and change. And they are, somehow, awaiting. When you burst into this space, there's a cheer! Pink Floyd has a song, **The Gnomes Have Learned a New Way to Say Hooray**. (McKenna 1993)*

You burst into this space and they're saying, "How wonderful that you're here! You come so rarely! We're so delighted to see you!" (Terence McKenna, unknown audio recording)

This riotous welcome from the elves that many DMT users experience is uncanny:

They kept saying welcome back and words like: the big winner, he has returned, welcome to the end and the beginning, you are The One! As I looked around the room I felt the sense of some huge celebration upon my entry to this place. Bells were ringing, lights flashing . . . (Erowid Experience 1839)

Damn if Terence McKenna wasn't right-on-the-nose about these crazy elves. As this realization washed over me the elves burst into uproarious laughter. They were laughing themselves silly, giggling, rolling across the ceiling, and holding their stomachs. (Erowid Experience 1843)

The new geometry began to unfold layer after layer of laughing, giggling, incredibly lively beings . . . greeting me with enthusiastic cheers . . . the countless wonderful, hilarious, animated self-transforming liquid light energy creatures vied for my attention. . . . They actually all start waving and saying "goodbye [sic]" and "Time to go, nice seeing you, Love you . . ." (Erowid Experience 85120)

The peculiar sense of familiarity, despite the thoroughly alien nature of the experience, is also typical:

"You've done this before. Remember?" echoes in my head. Yes I have done this before. I've been here before! I have come home. An overwhelming sensation of Deja-Vu overcomes me. (Erowid Experience 76492)

Sometimes, the entities actively attempt to communicate with the individual:

“There were creatures and machinery . . . there was a female who, when I felt I was dying, appeared and reassured me. . . . Something green appeared in front of me, rotating, doing things. She was showing me, it seemed, how to use this thing, which resembled a computer terminal. I believe she wanted me to try to communicate with her through that device, but I couldn’t figure it out.” (Strassman, Wojtowicz, Luna, & Frecska 2008)

Sometimes, the entities are described as being ‘insectoid’:

There were insectlike intelligences everywhere, in a hypertechnological space. . . . There was another one helping me. . . . It was very intelligent. It wasn’t at all humanoid. It wasn’t a bee, but it seemed like one. (Strassman, Wojtowicz, Luna, & Frecska 2008)

I was in a very large waiting room, observed by the insect-thing and others like it. . . . They have an agenda. It’s like walking into a different neighbourhood. You’re not really sure what the culture is. (Strassman, Wojtowicz, Luna, & Frecska 2008)

She was a monstrous machine, somewhat insectoid in that she seemed to be spawning all the reality around her. . . (Erowid Experience 74820)

Sometimes, the entities appear as highly intelligent ‘alien’ creatures that inhabit advanced technological domains:

A space station below me and to my right. Presences were guiding me to a platform. I was also aware of many entities inside the space station—automatons, android-like creatures that looked like a cross between crash-test dummies and Empire troops for Star Wars, except they were living beings, not robots. . . . They were doing some kind of routine technological work, and paid little attention to me. (Strassman, Wojtowicz, Luna, & Frecska 2008)

There were these beings that seemed to inhabit this place, that seemed to come off as vastly more intelligent and vastly more capable. (Erowid Experience 52797)

They are . . . the word is ‘machine-like’. The whole thing bodes of high alien technology. . . More fractal machine entities. They are getting bigger, more complex, they join with one another, they break apart, they dance, they sing. THEY SING! (Erowid Experience 76492)

While elves, aliens, and insectoid entities appear regularly, they are by no means the only type of entity met in the DMT realm—angels, demons, monsters, chimeras, and animals, among others, also are reported (Shanon 2002), although some of these are more typical of ayahuasca. Sometimes, the entity isn’t identifiable by form, but manifests as an overwhelming presence that seems extraordinarily powerful (Strassman 2001).

While Strassman suggests that the commonalities among experiences suggest that the “DMT world” is a fully autonomous alternate reality (Strassman, personal communication, January 2012), others disagree (Ayes 2001). It cannot be ignored that Strassman’s study was carried out in a hospital environment and that this may well have colored the experience for many of his volunteers. One author suggests that the aliens and their hypertechnological abodes are simply psychological representations of the physicians and the clinical environment and to suggest otherwise is “just plain silly” (Ayes 2001). At first glance, this might seem reasonable, especially if the reports of Strassman’s volunteers are the only ones considered. However, there is no explanation as to why the physicians would appear as aliens rather than humans, and when accounts of hypertechnological alien entities are noticed throughout the online trip report literature, this position becomes less persuasive. We will return to this central issue later.

Whether or not the worlds that appear under the influence of DMT are autonomous realities or elaborate hallucinations, it is undisputed that DMT is capable of rapidly hurling the user into exquisitely convincing and extremely unusual environments, often inhabited by apparently intelligent entities; these worlds often seem inexplicably familiar, with the user remaining fully of sound mind despite the astonishment. It is remarkable that DMT users remain confident of the veridicality of the DMT world even after the effects have subsided, and yet very few individuals wake from a dream and refuse to accept that a dream is all it was. The totally immersive nature of the experience has been equated with dreaming, which is itself an immersive and convincingly real experience, despite being devoid of extrinsic information (as far as is known) and a model example of the brain’s ability to build worlds purely from intrinsic data. But can the DMT flash really be equated with dreaming?

Is the DMT World a Dream World?

In attempting to explain the sophisticated imagery of the DMT flash, it seems ostensibly reasonable to suggest that DMT might be the ‘dream molecule’, released during REM sleep and generating dreams. As discussed earlier, the neural activity that constitutes the waking state is fundamentally equivalent to that of the dream state. The key difference is that the dream world is not modulated by extrinsic sensory information. Assuming that the DMT world is also entirely lacking an extrinsic component, it makes a certain amount of sense to equate it with the dream world. This would regard the DMT world as a highly elaborate hallucination. Always a source of interesting and novel ideas, it is possible that this idea can be traced back to the musings of Terence McKenna—he has certainly discussed this idea on a number of occasions. The first formal proposal was by Callaway (1988), who suggested that dream sleep begins when psychedelic tryptamine production by the pineal gland increases above an undefined threshold. There is, however, no empirical evidence that DMT is secreted by brain structures during dreaming or, in fact, in psychedelic concentrations at any time. In an attempt to secure evidence for the ‘transmethylation hypothesis’ of schizophrenia (Osmond & Smythies 1952, Smythies 1984), which suggests that the disease may be the result of the endogenous production of psychotomimetic amines (such as DMT), at least 69 published studies between 1955 and 2010 have looked for DMT and/or its metabolites in the bodily fluids of psychiatric patients and controls (Barker, McIlhenny, & Strassman 2012). While DMT was detected in the urine, plasma, and cerebrospinal fluid of schizophrenic patients, levels were generally erratic and not consistently different from those seen in healthy controls (Wyatt, Mandel, Ahn, Walker, & VandenHeuvel 1973, Oon, Murray, Brockington, Rodnight, & Birley 1975, Murray & Oon 1976, Corbett, Christian, Morin, Benington, & Smythies 1978).

Pertinently, one study examined urinary levels of DMT over three eight-hour periods throughout the day and night (Oon, Murray, Rodnight, Murphy, & Birley 1977). While levels fluctuated, there was no diurnal pattern with a peak during the early hours, as would be predicted by the ‘dream molecule’ hypothesis. Aside from the lack of physiological evidence for DMT as a ‘dream molecule’, does this hypothesis even make sense in light of the phenomenology of the DMT flash?

Dreaming is an almost universal experience, one familiar and taken for granted by most. However, dreaming is itself a highly psychedelic experience—a fully immersive world that appears as real as the waking world and, yet, a world that is built entirely from intrinsic information. While modern scientific techniques have described many of the

physiological and neurological features of the dream state, such as rapid eye movements (REM) coupled with high cortical activity as measured by EEG (Desseilles, Dang-Vu, Sterpenich, & Schwartz 2011), dreaming will always remain a fundamentally private experience. As with the DMT flash, “subjective reports offer the primary portal to the qualities of lived experience” (Kahan & LaBerge 2011). These reports are used to map the structure and content of the dream world in the same way they are used to map the DMT world (Schneider & Domhoff 2009). Studies largely support the ‘continuity hypothesis’ of dreaming—that dreaming is continuous with waking (Schredl & Hofmann 2003). Events and activities in the dream world tend to reflect waking life, even down to the proportion of time spent in mundane activities, such as talking on the telephone or watching TV (Schredl & Hofmann 2003). Similarly, the characters who appear in dreams are also from waking life—friends, family members, animals, etc. (Schneider & Domhoff 2009). Further, contrary to commonly held beliefs, all sensory modalities are typically intact during dreaming, although the dominance of any specific sense often varies (Kahan & LaBerge 2011). There are a number of well-known themes that are often associated with the dreaming—being pursued or attacked, falling from a height, losing teeth, or appearing naked in public. However, these themes tend to be less frequent than is commonly believed and by no means do they typify the dream state (Maggiolini, Cagnin, Crippa, Persico, & Rizzi 2010). The symbolic significance of such themes is beyond the scope of this discussion, and has for a long time been a subject ripe for speculation by psychologists.

Overall, the phenomenology of dreaming suggests that, given the neural freedom to build worlds without extrinsic sensory modulation, the brain tends to build worlds that appear remarkably similar to waking reality. This is unsurprising, of course, as the constraints of sensory input experienced during waking life select the neuronal connectivities that define this reality and determine the intrinsic thalamocortical activity that builds the dream world during sleep. In other words, as far as we are aware, your own personal waking world is the only type of world your brain knows how to build.

It ought to be clear by this point, having examined the phenomenology of both and despite speculation that DMT is a ‘dream molecule’, that the DMT world is utterly incomparable to the dream world. While it is possible to identify some minor similarities—entoptic hallucinations that often occur during the descent into sleep (Mavromatis 1987, referenced in Luke, Zychowicz, Richterova, Tjurina, & Polonnikova 2012) might be compared to similar hallucinations seen during the early stages of the DMT flash—the immersive stages of the DMT flash are, unlike the dream world, completely unrelated to consensus reality. It seems reasonable to state that

the dream world differs from the waking world in the manner in which the intrinsic thalamocortical activity is modulated by extrinsic sensory data—for the waking world, this modulation is central; for the dream world, this modulation is effectively nil. Both worlds, however, are of the same character and result from the same thalamocortical activity. This leaves us no closer to an explanation of the DMT flash, but it does enable us to rule out the equating of the DMT flash with dreaming. Given these observations, it seems all the more remarkable that the brain is capable of building such alien worlds, exemplified by those of the DMT flash, at all. If the DMT world does appear entirely as a result of intrinsic thalamocortical activity, then this begs the question as to how the brain ‘learned’ to build these bizarre worlds. This problem would be resolved if, as Strassman and others have suggested, DMT does indeed allow access to an alternate reality and, thus, that the DMT flash has an extrinsic component.

Is There an Extrinsic Component to the DMT Flash?

Individuals have very individual dreams, the contents and themes of which are influenced by very personal factors, such as experiences in waking life, fears, and desires, physiologically expressed by the intrinsic activity of the thalamocortical system, as discussed earlier. The content of an individual’s dreams are thus reasonably explicable in terms of these factors. Dreams are normally representations of waking reality in their gross form. While dreams can seem strange, illogical, even quite bizarre when recounted from the bedside, few dreams resemble anything close to the DMT flash. While the worlds experienced under the influence of DMT undoubtedly vary between individuals, there is a striking correspondence between reports describing the nature of these worlds, particularly at higher dosages. Above an undetermined threshold, DMT reliably induces or facilitates the thalamocortical system’s adoption of completely unfamiliar and yet highly regular activation patterns, such that apparently alien worlds are built. These worlds are not nebulous and hazy suggestions of another reality, or chaotic maelstroms of confusion. They are unmistakable and apparently real alternate realities experienced with absolute sober clarity. It is difficult to generate a simple explanation as to why DMT ought to have this capability. While it is relatively straightforward, as has been discussed, to explain how stable and completely immersive hallucinations could be generated under the influence of a psychedelic drug, there is no obvious explanation as to why these hallucinations would exhibit such characteristic and striking similarities across users and yet bear so little relationship to consensus reality. As has been explained, the brain learns to build a consensus world throughout the course of evolution, development,

and experience. The thalamocortical connectivities so developed enable the brain to build worlds in the total absence of sensory input—these dream worlds are directly analogous to consensus reality. However, when the brain is perturbed by the action of a very simple molecule, DMT, it automatically begins building unimaginable alien worlds of crystalline clarity; worlds that users typically describe as being as or more real than the consensus world. At high enough dosages and unlike with the other classical psychedelics, the experience often appears to have little dependence on set or setting, with the experience seeming to overwhelm and transcend individual psychological idiosyncrasies, expectations, or mood. These alien worlds don't appear to be characteristic to the individual user, but characteristically similar *across* users and characteristically 'other' or 'alien'. [The term 'alien' is used very deliberately, here and throughout this discussion. The idea is not to conjure up images of grey beings arriving in flying discs, but to reflect the thoroughly 'other' nature of the DMT world and its inhabitants, while avoiding unhelpfully loaded terms such as 'spirit' or 'astral'.]

The regular and repeated appearance of thoroughly non-human entities—elves, pixies, dwarves, and goblins (Luke 2011), as well as intelligent insectoids and other alien creatures—is also difficult to explain. Luke (2008) describes the similarities between certain entities met in the DMT world with deities, demons, and other strange discarnate beings that appear in the mythology and folklore of many religious and spiritual traditions. Also, elves, pixies, and related 'little people' are an integral and well-known part of Celtic folklore (Evans-Wentz 1911), and it is tempting to surmise that they might somehow be related to similar beings met in the DMT realms and perhaps even have a common origin (see Hancock 2005 for a detailed discussion). It is all too easy to dismiss the DMT entities as simply being the activation of widely held unconscious imagery, but this is unsatisfactory. Although the DMT user might grasp for the closest familiar archetype in attempting to describe the entities—elves, pixies, insects, etc.—this is often just an attempt to render into common language creatures almost beyond description and far stranger than any being met in Celtic folklore or between the pages of a science fiction novel. Strassman's volunteers typically rejected the suggestion that the experience was a product of unconscious mental content or dreamlike imagery (Strassman, Wojtowicz, Luna, & Frecska 2008), and it is this fact, among others, that persuades Strassman of the reality of these worlds. Even if the DMT entities could be explained as such, it is hard to explain why DMT seems unique in its ability to unearth them. The model described later may offer such an explanation.

Struggling to explain the alien worlds visited under DMT, it might

be time to consider what many scientists might consider unthinkable; that the DMT worlds built by the brain are modulated by extrinsic data from outside the brain, analogous to the manner in which the consensus world is modulated by sensory input from the outside world. This would explain the striking parallels and similarities among users and is in line with the many individuals convinced of DMT's ability to transport the user to an alternate reality. However, this idea begs the question as to the form such an external modulation could take—how does the brain receive data from an alternate reality? Speculators have suggested that DMT somehow 'tunes' the brain to receive "channel DMT" (Hancock 2005, Strassman 2001); the idea being that the brain is capable of receiving sensory input from different realities depending on precise neurochemically defined states, in the same way a radio receives data from different radio stations depending on its tuning. This is an intuitively appealing idea. However, there is no suggestion as to how this tuning would occur to allow the brain access to this alternate data field. Ede Frecska (2008) speculates that DMT allows access to a 'non-local' realm, where the entities reside. Clearly, these types of ideas need to be explored further. While this type of 'tuning' idea is attractive, it is only a hint of a hypothesis and makes no attempt to explain the neurological mechanisms that might be involved. Further, there is no explanation as to why DMT, a ubiquitous natural metabolite, ought to possess this extraordinary ability to 'tune' the brain to 'alien worlds'. Later, a preliminary model to explain the action and effects of DMT will be proposed, without adopting the facile position that DMT is simply another psychedelic drug that produces highly visual hallucinations. The phenomenology of the DMT flash clearly deserves a deeper and more considered explanation. Before attempting this, it would be useful to question whether DMT ought to be regarded more correctly as an exogenous drug or an endogenous metabolite with a true neural function in the human brain. If we are to conclude the latter, then the nature of the DMT flash might be more explicable.

Is DMT an Endogenous Neuromodulator?

The idea that DMT is an endogenous neurochemical, produced naturally by the brain and with a true neural function, is not new (Christian, Harrison, Quayle, Pagel, & Monti 1977). However, authors have consistently attempted to dissociate its psychedelic effects from any purported endogenous physiological role in the brain.

Jacob and Presti (2005), for example, make the case for an anxiolytic role for DMT, based on low-dose effects of DMT in Strassman's volunteers. Strassman noted that, at sub-psychedelic dosages (0.05 mg/kg IV), DMT produced a relaxed and comfortable psychological state. It is somewhat

confusing that, despite DMT's unique and extremely dramatic psychedelic effects, these effects seem to be considered secondary to whatever proposed role that DMT could have as an endogenous neurochemical. This is a very strange position to adopt. It would be truly astounding if an endogenous neurochemical, with a primary anxiolytic role in the brain, produced the astonishing phenomenology of DMT at higher non-physiological concentrations, purely as a secondary effect. DMT doesn't produce 'confusion' or 'delirium' or even a 'psychotic break'; DMT catapults the psyche into bizarre alien realities. Surely, it makes more sense to suggest that any anxiolytic effect of DMT, at low concentrations, is secondary to its primary effect—fully immersive hallucinogenesis. Wallach (2009) proposes a perceptual role for DMT, suggesting that waking reality is a 'tightly regulated psychedelic experience', facilitated by endogenous DMT release—full-blown psychedelic effects occur when this regulation is 'loosened'. This proposal isn't fully explored, but at least avoids completely sidelining DMT's psychedelic effects. Strassman has been bolder than most academics in proposing that DMT's psychedelic effects are its primary functional role in the brain. He suggests that DMT facilitates the exit of the soul from the body at the point of death. While this is an intriguing piece of speculation, Strassman has certainly left the scientific arena by this point and sits squarely within metaphysical territory (this is not a criticism, but an observation). As such, it is difficult to comment further, and the reader is directed to Strassman's excellent book *DMT: The Spirit Molecule* (2001) for further insight. However, it is at least possible in principle, although practically implausible, to measure DMT concentration in the brain at the point of death. Whether or not Strassman is correct, DMT certainly possesses a number of characteristics that suggest it is either an endogenous neurochemical or one with a curious affinity with the human brain and psyche.

Aside from the profoundly alien and inexplicable phenomenology of the DMT experience, the molecule itself is exceptional among psychedelics, both in terms of its structure and pharmacology. DMT is most closely related to the neuromodulator serotonin, both being derived from tryptamine, which is itself derived by decarboxylation of the essential amino acid tryptophan. Serotonin is 5-hydroxytryptamine—the 5-position on the indole ring of tryptamine is hydroxylated (Figure 8). DMT is equally straightforward to derive from tryptamine—the primary amine position is simply methylated twice. The result, from a chemical perspective, is the simplest psychedelic tryptamine; the molecule contains little chemical functionality of any note. In fact, the masking of the primary amine by the dimethyl group renders a structure that could reasonably be regarded

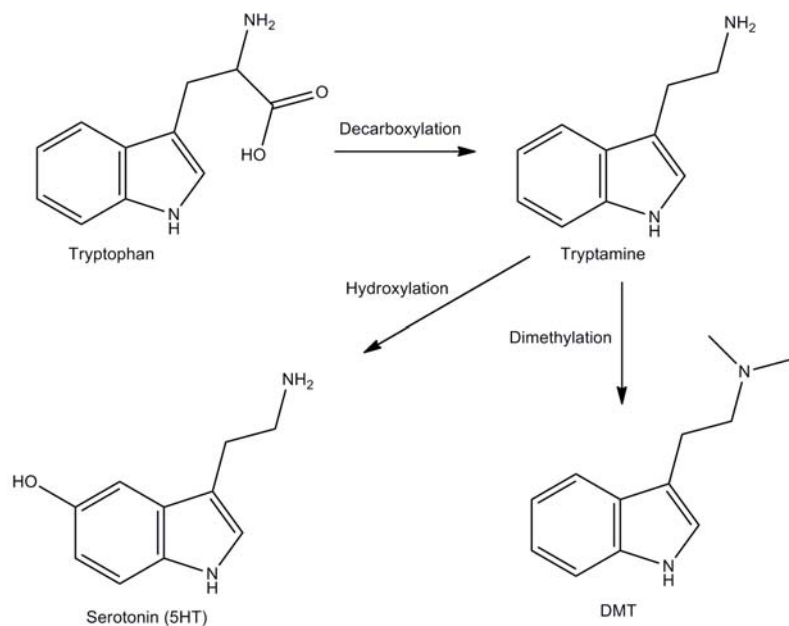


Figure 8. Biosynthesis of serotonin and DMT from tryptophan.

as the simplest possible tryptamine, simpler than tryptamine itself—it has been shown that dimethylation of the primary amine prevents the nitrogen interacting with the 5HT_{2A} receptor (Ebersole, Visiers, Weinstein, & Sealfon 2003). It appears, pharmacologically, to be a rather blunt instrument. And yet, despite this, it also happens to be the most incomprehensibly powerful natural psychedelic drug known. When DMT enters the human brain, its behavior is also unlike any other psychedelic molecule. The DMT trip is characteristically brief, oft noted as mercifully so, owing to the intensity of the experience. The molecule is metabolized and cleared from the brain within minutes, far more rapidly than with other tryptamine psychedelics. When DMT enters the bloodstream, it rapidly moves from the bloodstream into the tissues; most importantly, of course, the brain (Yritia et al. 2002). While it hasn't been demonstrated that DMT is actively transported across the blood–brain barrier, a number of studies have shown the active and selective accumulation of DMT into rat and dog brain (Sangiah, Gomez, & Domino 1979, Takahashi et al. 1985, Yanai et al. 1986). It is possible that a similar mechanism exists in humans, which would explain why it is so rapidly sequestered from the bloodstream after administration and capable

of reaching psychedelic concentrations in the brain within seconds. Cozzi et al. (2009) have shown that DMT is a transport substrate for both the serotonin transporter and monoamine vesicular transporter. It is thus possible that DMT may be actively transported into presynaptic terminals and packaged into synaptic vesicles for synaptic release. It is apparently non-toxic with no known direct adverse effects and is unique among the classical psychedelics in its inability to generate tolerance in users with repeated use (Strassman, Qualls, & Berg 1996). All of these characteristics would be expected for an endogenous neurotransmitter and are not possessed by other classical psychedelics.

It has now been established that the primary site of action of the classical hallucinogens within the brain is the 5HT_{2A} receptor. Indeed, it has been shown that the effects of psilocybin can be blocked by a specific 5HT_{2A} antagonist. As discussed earlier, it can be explained using current understanding of brain function how many of the effects of the classical hallucinogens can be produced by activation of this receptor. Of course, the complete picture is certainly richer and more complex, with other receptors and pathways no doubt being involved in generating the full spectrum of effects of hallucinogens. Owing largely to the work of the Shulgins (Shulgin & Shulgin 1997), we now have limited psychopharmacological data on more than 100 novel tryptamine analogues. Other studies have established their individual receptor binding profiles (Ray 2010). DMT isn't striking or even notable in terms of its affinity for any particular set of receptors; its affinity for the 5HT_{2A} receptor, in particular, lies between that of psilocin and LSD (Ray 2010). From a standard pharmacological perspective, one can make the assumption that DMT generates its remarkable effects because of the highly specific and individual manner in which it binds to a number of receptors and/or the manner in which it activates the receptors it binds, certainly including the 5HT_{2A} receptor. DMT's highly individual and specific receptor binding signature produces a unique perturbation of brain function—one can compare this to how a key is able to open a lock by shifting a specific set of pins in a precise manner within the barrel. If such a precise profile of receptor interactions were not necessary to produce DMT's effects, then one could make the reasonable assumption that a number of other known tryptamines would exhibit comparable effects to DMT, just as a number of mescaline or LSD derivatives exhibit similar effects to their parent molecules. But this is not the case; the effects of DMT are unique to DMT itself. Of itself, this is not a particularly remarkable observation, as all drugs are in some way unique. Sasha Shulgin's peerless work has shown that minor structural changes can have dramatic effects on the psychopharmacology of a molecule. But what *is* remarkable about

DMT is that it sits at the bottom of the list of classical psychedelics in terms of molecular complexity, uniquely possesses a number of characteristics that suggest it is an endogenous neuromodulator, *and* produces some of the most unimaginably profound alterations of consciousness of any naturally occurring drug, firing users into an apparently alien reality. All of the classical psychedelics activate the 5HT_{2A} receptor and yet only DMT reliably facilitates access to characteristic alien worlds. It would be a truly startling coincidence if DMT, the simplest tryptamine possible with little chemical functionality, the most widely distributed in nature and a natural human metabolite, just happens to be the only one capable of perturbing brain chemistry in such a finely tuned manner so as to produce apparent transport to alien worlds—all by chance and without any functional significance. And yet, this is exactly what we are faced with. It is difficult to reconcile these characteristics of DMT and its effects on consciousness with the assumption that DMT is merely an exogenous psychedelic drug and that any psychedelic effects are incidental and unrelated to its neural function. The nature of DMT and its effects might be better understood if, rather than as an exogenous drug, we begin to regard DMT as a neuromodulator with a *long-standing relationship with the human brain*.

Neural Development of World-Building Modes

The functional connectivity patterns of the thalamocortical system of an adult human brain result from three processes working on very different temporal scales—evolution, development, and experience. As discussed, these connectivity patterns are established by the sampling of sensory data from the external world. Eventually, the brain becomes capable of building the consensus world and is able to do so in the presence or absence of sensory data, i.e. waking or dreaming. This is because the selected thalamocortical connectivities generate intrinsic activity that represents the consensus world as a default state. Sensory data (i.e. extrinsic information) can modulate the intrinsic activity of the thalamocortical system only by being ‘matched’ to this ongoing activity and amplifying it. It is of central importance that the development of this connectivity takes place in the presence of serotonin, which modulates the ‘tone’ of the cortical pyramidal and inhibitory interneurons, tuning their excitability by activation of 5HT_{1A} and 5HT_{2A} receptors. As such, the intrinsic activity that builds the consensus world is most reliably expressed in the presence of serotonin. When the normal serotonergic tone is disrupted by a molecule with 5HT_{2A} selectivity, the thalamocortical patterns of activation are no longer tightly constrained and a variety of unpredictable psychedelic effects result. However, when serotonin is displaced by DMT, something very different seems to happen;

the thalamocortical system does not begin to behave unpredictably and with variable effects, but instead begins to behave *as if its structural and functional connectivity and thus intrinsic activity had developed in the presence of DMT and subject to the extrinsic sensory input of a completely different reality*. The thalamocortical states that are generated under DMT modulation are highly regular and highly specific—we know this because the worlds that appear are highly regular and highly specific to DMT. This is difficult to explain unless the brain contains more than one parallel ‘set’ of thalamocortical connectivities—one that developed under the modulation of serotonin (the ‘consensus set’) and one that developed under the modulation of DMT (the ‘alien set’). As such, the set that is expressed depends upon which neuromodulator is present; when serotonin is present, the consensus set is expressed and thus the consensus world appears. When DMT is present, the parallel ‘alien set’ is expressed and the alien world appears. This is a key idea, illustrated in Figure 9, and is worth explaining in more detail.

As explained earlier, the thalamocortical system can be thought of as a 3D mosaic of thalamocortical columns, differentiated but integrated as a unified whole. This system possesses a practically infinite potential for different thalamocortical states, expressed by the structural and functional connectivity and patterns of activation of the thalamocortical columns. However, as specific functional connectivities and activation patterns are developed, as a result of extrinsic sensory data sampled from the consensus world, this potentiality becomes molded to a ‘consensus set’ of connectivities and patterns that represent consensus reality. The integrity and stability of this system depends on a multitude of finely balanced and complex functional interactions among the neurons of the thalamocortical system. The development of these interactions, while driven by extrinsic sensory data, occurred in the presence of serotonin, which acted to tune the excitability of the pyramidal cells and their associated interneurons by its balance of activity at 5HT1A and 5HT2A receptors. As a result, these interactions can be reliably expressed only in the presence of serotonin as only then will the cells be appropriately excitable. When the balance of 5HT1A/5HT2A activation is altered by the presence of a psychedelic drug, the ‘consensus set’ of finely tuned functional interactions breaks down. Consequently, the thalamocortical system becomes ‘re-potentiated’ and capable of adopting a larger repertoire of states. This is experienced as a psychedelic state, but is maintained only as long as the drug is present—as soon as it is cleared from the brain, the ‘consensus set’ re-establishes itself and the user ‘comes down’ from the experience. It is a relatively straightforward conceptual leap to now explain how DMT enables the brain to ‘shift’ into

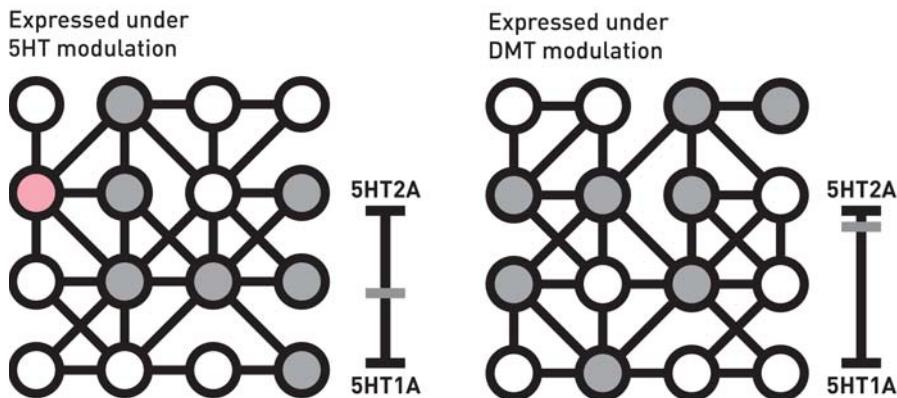


Figure 9. The connectivities of both the consensus and alien worlds exist in parallel. However, specific patterns of connectivity are expressed only in the presence of either 5HT or DMT, depending on which was present when they developed. The patterns expressed determine the intrinsic activity of the thalamocortical system and thus which world is built.

an alien world-building mode. The presence of any molecule that shifts the 5HT1A/5HT2A balance in favor of 5HT2A will result in a temporary breakdown of the ‘consensus set’ of thalamocortical connectivities and re-potentialize the thalamocortical system. This would include DMT, of course. Now, one can imagine that if extrinsic data from an alternate reality (the nature of which is unimportant here) was received when DMT was present, a new set of functional connectivities and activation patterns would begin to develop in exactly the same way that the ‘consensus set’ developed in the presence of serotonin (Figure 10). Further, exactly as with serotonin, this would need to happen repeatedly over an extended period of time (i.e. evolutionary time). Eventually, the thalamocortical system would develop the ability to build the ‘alien world’ in the same way it builds the ‘consensus world’ and thus possess two completely independent and parallel world-building modes. Which mode is expressed (i.e. whether the intrinsic thalamocortical activity constructs the consensus world or the alien world) and thus which world is seen, depends only upon which molecule is present—serotonin or DMT. Conceptually, at least, there would be no issue in the brain accommodating such parallel patterns of functional connectivity, as there is massive redundancy in neural connections, and the majority of neural connections are not functionally expressed at any one time (Edelman 1993). In fact, there are far more ‘potential synapses’ (points of close contact between dendrites and axons) than functional ones (Stepanyants

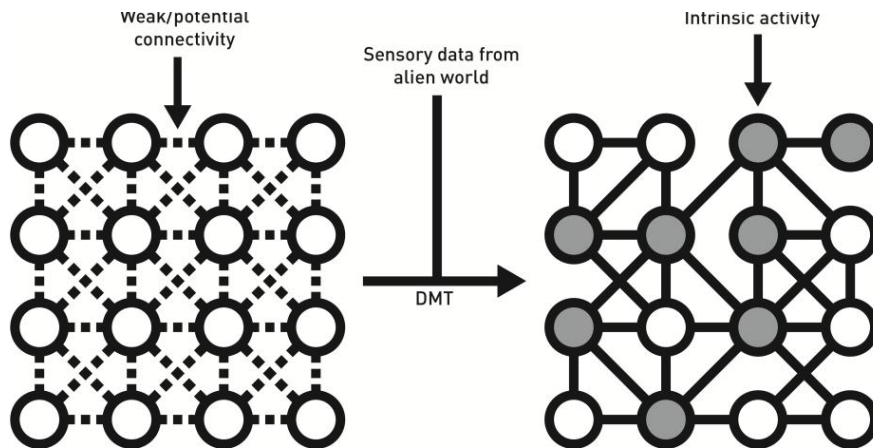


Figure 10. The structural and functional connectivity of the thalamocortical system develops under the modulation of DMT and subject to sensory data input from the alien world. Eventually, the intrinsic activity of the system builds the alien world as a default state, but only in the presence of DMT. Only strong/characteristic connectivity is shown on the diagram on the right.

and Chklovskii 2005). This explanation resolves the question as to why DMT is unique in its ability to transport the user to these characteristic alien worlds. Its uniqueness is simply a consequence of the fact that it was the neuromodulator present when the thalamocortical connectivities of the alien world were developed. As such, the intrinsic activity that generates the appearance of the alien world can be expressed only in its presence, in exactly the same way that the consensus world appears in the presence of serotonin. This also provides a neurological mechanism for the suggestion that DMT ‘tunes’ the brain to receive sensory data from another reality. As discussed earlier, extrinsic sensory information adds very little new information to the brain, but is, rather, ‘matched’ to ongoing intrinsic activity, which it amplifies. Thus, *sensory data from the DMT reality can only be received only when it matches ongoing intrinsic activity within the brain’s thalamocortical system. DMT, by replacing serotonin in the cortex, acts to shift the thalamocortical system into generating the appropriate intrinsic activity.* A structurally unremarkable neuromodulator thus has the most remarkable effects. In fact, this model would predict that DMT is the only molecule capable of shifting the thalamocortical system into a state in which it constructs these characteristic alien worlds. However, this model

also requires that, like serotonin, DMT be present in the brain repeatedly over a span of time on an evolutionary scale. It is intriguing that such an idea might suggest that DMT may well be an endogenous neuromodulator with a very long-standing relationship with the brain. This is precisely the conclusion that was tentatively drawn earlier, based on its unique chemical and pharmacological characteristics. However, DMT has never been detected in psychedelic concentrations in the brain, so there must be more to the story. The following model, while highly speculative, may explain the unique characteristics of DMT, its interaction with the human brain, and its psychedelic effects better than any current model that regards DMT as an exogenous psychedelic drug in the same category as other classical psychedelics.

DMT as an Ancestral Neuromodulator

So far, it has been suggested that the characteristics of DMT and its interaction with the brain are indicative of an endogenous molecule. Also, the psychedelic effects of DMT, fully immersive hallucinogenesis during which the consensus world is completely replaced with an apparently ‘alien’ world, might be explained if DMT was the major neuromodulator present when a parallel set of thalamocortical connectivities were developed. Both of these ideas would make sense if DMT is an *ancestral neuromodulator*, i.e. a neuromodulator that, at some point in our evolutionary past, was secreted in psychedelic concentrations by the brain. However, most of this functional capacity has subsequently been lost and the DMT that is currently present in the brain is possibly vestigial and might not have a significant modern function. So, in this ancestral period, the brain would have produced both serotonin and DMT, although probably not at the same time. The evolution of the consensus world-building capabilities of the brain took place under the modulation of serotonin, and was driven by the extrinsic sensory data from the consensus world. However, periodically, the brain was able to switch from primarily serotonin secretion to DMT secretion. This switch made the brain more sensitive and receptive to sensory data from the alternate reality, the ‘alien world’. This is because DMT’s 5HT1A and 5HT2A binding signature facilitated intrinsic thalamocortical activity that more closely matched the extrinsic sensory data from that particular reality. Over time, the intrinsic activity of the thalamocortical system and the alien reality became more and more closely ‘matched’ (i.e. the same mechanism by which the brain developed its consensus-world-building capabilities, except that DMT, rather than serotonin, was present). Thus, the thalamocortical system developed an ability to build the ‘consensus world’ when serotonin was present and the ‘alien world’

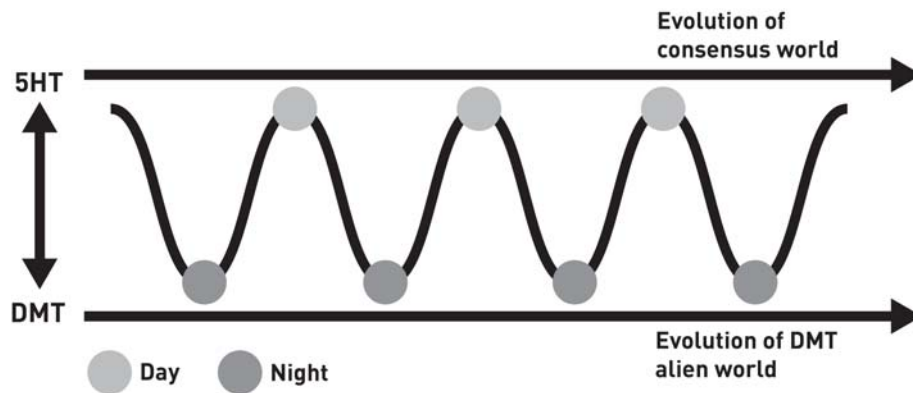


Figure 11. Parallel neural evolution of two separate world-building modes of the thalamocortical system.

when DMT was present. Now it is possible that the brain cycled between serotonin and DMT secretion, possibly with a diurnal rhythm. For example, serotonin could be secreted during waking and thus during interaction with the consensus world. As such, evolution of the brain's consensus world-building ability would occur during waking hours. However, during (REM) sleep, DMT would be secreted. As such, evolution of the brain's 'alien world'-building capabilities would take place during the night. In other words, the brain underwent a *parallel neural evolution*, in which two entirely separate world-building capabilities were developed (Figure 11). Perhaps, however, in order to cement the human species more firmly in the consensus world, the DMT secreting ability of the brain was gradually lost and only serotonin remained. As a consequence, all knowledge of the other reality was eventually forgotten. It is possible that dreaming is a vestigial function from the time when DMT was secreted during sleep. Modern dreaming is not known to have any specific adaptive function (Flanagan 2000), despite speculation as to its possible role in human life. Originally, dreaming would represent the period during maximal DMT secretion and when the individual would interact with the alien world. Now, however, this period has been replaced by modern dreaming, in which the brain maintains the thalamocortical activity that developed under serotonin, with models of the consensus world being built. However, serotonin secretion still cycles between waking and dreaming, with secretion dropping off during REM sleep (McCarley 2007), although this is no longer accompanied by a ramping up of DMT secretion. It is possible that modern dreaming has

additional advantages for survival in the consensus world, which may have helped select for the loss of the DMT secretion function, but this is unclear.

So, rather than the administration of an exogenous drug, smoking DMT could be regarded as reconstitution of an ancestral function. There is no reason to assume that the current repertoire of neuromodulators used by the human brain represents all that have ever been used. This may mean that those looking for a modern function for the small quantities of DMT currently secreted by the brain could be misguided—the function may well be in the past. Why this function was lost is unclear, as is the site of production/secretion in the brain. However, the idea that the human brain has actually regressed functionally in the last ~100,000 years is increasingly attracting attention (Gynn & Wright 2008). It is notable that Gynn and Wright make the case for a decline in pineal function, caused by changes in human's ancestral diet, as an explanation for many modern human 'left brain' characteristics. Although they focus on the pineal gland's role in the production of melatonin, a hormone associated with the diurnal wake–sleep cycle, it is striking that the pineal has been proposed as a possible site of endogenous DMT synthesis (Strassman, Wojtowicz, Luna, & Frecska 2008). Further, the pineal gland's primarily nocturnal activity, secreting melatonin only during darkness, accords with the ancestral neuromodulator proposal. In fact, it is possible that there has been either a contraction of pineal function or a functional reassignment, its role shifting from DMT secretion to melatonin secretion—melatonin is itself a tryptamine (specifically, N-acetyl-5-methoxytryptamine). Luke, Zychowicz, Richterova, Tjurina, and Polonnikova (2012) have explored the idea that the cycle of DMT and melatonin secretion by the pineal might still be correlated and related to precognitive dreams. Although nobody has ever measured DMT levels in the brain directly, it seems likely that any DMT secretion is sub-psychedelic; otherwise, dreams ought to resemble the DMT flash. The pineal has, since ancient times, been regarded as a connection between the material and spiritual worlds (López-Muñoz, Molina, Rubio, & Alamo 2011). Perhaps there is an element of truth in these ostensibly primitive ideas. Certainly, this needs to be explored further and will no doubt be the subject of future discussions.

Seriously proposing that the brain is capable of receiving extrinsic data from an alternate alien reality is certainly bold. However, this discussion has deliberately avoided defining the nature of the external world and certainly shies away from defining the nature of any alien world. A true external alien reality, the nature of which is difficult to comprehend, isn't necessarily a requisite within the ancestral neuromodulator model of DMT. Jung proposed that fragments of the psyche buried in the unconscious might carry on a completely separate existence from the conscious ego. These

autonomous psychic complexes form a miniature, self-contained psyche and are, perhaps, even capable of a consciousness of their own (Jacobi 1959). If confronted, these complexes would appear entirely alien, with qualities of outside objects or persons. It is conceivable that, rather than receiving extrinsic data from an external alien reality, the parallel thalamocortical repertoire explored and developed during elevated DMT secretion in sleep may in fact represent the informational structure of these autonomous psychic complexes. Rather than learning to build a representation of an alien reality external to the brain, the brain in fact may have learned to build a conscious representation of deep unconscious structures. Laughlin (1996) argues that Jung's constellation of human archetypes that constitute the collective consciousness are neurognostic structures (neural structures present from birth that produce the experience of the foetus and infant) that are both inheritable and subject to evolution. It ought to be clear that these neural structures are analogous to, if not identifiable with, the thalamocortical connectivities discussed at length in this paper. Clearly, if ancestral DMT secretion facilitated the development of a parallel set of inheritable neurognostic structures (thalamocortical connectivities), whether or not involving data input from a true external alien reality, these may form an autonomous fragment of the collective unconscious (a *universal autonomous psychic complex*) that can be expressed only when DMT levels in the brain are reconstituted (i.e. by smoking or injection of exogenous DMT). This would explain the phenomenal commonalities reported by DMT users, while also explaining why DMT alone seems capable of evoking these characteristic alien worlds. One can at least speculate that this universal psychic complex might evolve somewhat independently and, perhaps, far more rapidly than other parts of the collective unconscious and the conscious ego. Would this explain why the worlds and their occupants experienced under DMT often appear extremely intelligent and hypertechnological? This requires a far more detailed examination than can be presented here, but it is certainly an interesting idea.

To summarize, the ancestral neuromodulator model provides an explanation for a number of features of the DMT molecule, its interaction with the brain, and psychological effects:

1. Simple structure—as an ancestral neuromodulator, it would be predicted that the molecule be structurally unsophisticated and readily biosynthesized from natural precursors, as is serotonin. In fact, it could be argued that DMT is the least sophisticated derivative of tryptophan, after tryptamine itself, and may well pre-date serotonin in the brain.

2. Unique ability to transport the user to the highly characteristic DMT reality—as evolution of the brain’s ability to build the alien world progressed in DMT’s presence, it would be expected to be unique in its ability to facilitate access to that reality, in the same way serotonin specifically allows access to the consensus world.
3. Active transport into the brain, packaging into synaptic vesicles, and rapid metabolism—all would be predicted for an endogenous neuromodulator, albeit one from the distant past.
4. Highly specific action—the lucidity of the experience enables the user to experience the DMT world in almost the same manner as the consensus world, with little stoning or other psychological distortions. This would be expected if DMT’s role in the brain has evolved to facilitate this reality shift without causing additional physiological perturbations.
5. Total replacement of consensus reality with the alien reality—in the presence of DMT, the thalamocortical system has evolved to shift into the functional state to build/receive the alien reality. As such, the transition would be expected to be rapid and complete, assuming dosage is sufficient.
6. Inter-user commonalities and corroboration—users often seem to go to the same world.
7. Sense of familiarity—many users note that, despite being extremely bizarre, the DMT reality seems strangely familiar. This might be expected if DMT is an ancestral neuromodulator and humans have a long history of access to this alien world, although consciously forgotten.
8. The welcome cheers of the elves—a number of users note how the entities seem to be expecting them and welcome them ‘home’.
9. The vestigial sub-psychedelic secretion of DMT by the brain—DMT remains detectable in bodily fluids, although this may no longer be physiologically significant at current levels.

Overall, serotonin and DMT can be regarded as equivalent—each shifts the thalamocortical system into building a very specific world. Serotonin is a powerful psychedelic neuromodulator that locks the brain into building the consensus world, as the thalamocortical connectivity patterns expressed are those developed under the modulation of serotonin. It is not being suggested that serotonin is the only significant neuromodulator in this regard, but ultimately the world that appears is determined by the chemistry in the brain—change the chemistry and change the world. When the concentration of DMT rises in the brain, either because of endogenous

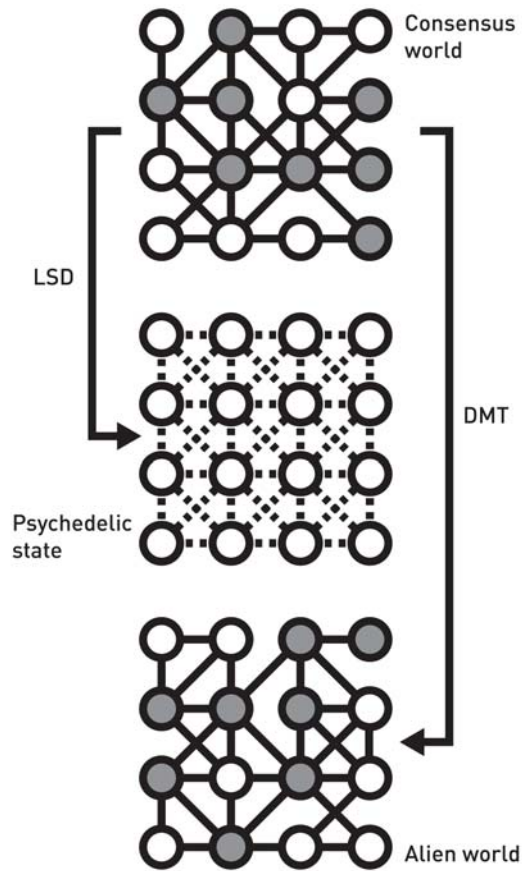


Figure 12. The shifting between world-building modes induced by DMT is very different from the psychedelic state induced by classical psychedelics such as LSD.

secretion or exogenous administration, the thalamocortical connectivities expressed are no longer those of the consensus world; they are of a different world, a bizarre and apparently alien world (Figure 12). Whether or not this state is *currently* modulated by extrinsic sensory data is unclear, and any mechanism for this remains to be discovered. However, it is logical to assume that, if the brain is currently capable of receiving extrinsic data from an alien reality, then it must have evolved to do so. The modern human brain doesn't appear to have been dropped to earth, ready to receive sensory data from this world—it evolved to do so. Thus, if the brain did not evolve to

also receive data from another reality, then there is absolutely no reason why it ought to be capable of doing so, if indeed it does possess this capability. The ‘DMT as ancestral neuromodulator’ model provides an explanation for how this could have been achieved. Whether the alien worlds seen with DMT are real external realities or realms within the collective unconscious, the implication is that they may not be so alien after all, but a deep, long-forgotten part of us, carried around in our heads, waiting to be rediscovered and explored.

Summary and Conclusion

The paradigm of modern materialist neuroscience fails to provide a straightforward explanation for DMT’s remarkable effect on human consciousness. Our current understanding of the action of hallucinogens appears sufficient to explain many of the effects of classic psychedelics, but DMT seems exceptional and is more difficult to account for. This simple molecule has an extraordinary ability to rapidly fire the user into an unimaginably strange alien reality and then return them within a few minutes, shocked and shaken but unharmed. The worlds DMT users find themselves in are completely unlike the dream world, bear no apparent relationship to consensus reality, and yet possess commonalities that are difficult to explain, unless they are modulated by an extrinsic sensory component of an unknown nature or are expressions of autonomous structures within the collective unconscious. The brain’s thalamocortical system learned to construct consensus reality throughout evolution, development, and experience, and it seems likely that it must have also learned to construct alien worlds that appear when DMT floods the brain—this suggests that this simple tryptamine has a long-standing relationship with the brain; a conclusion supported by a number of pharmacological peculiarities unique to DMT. Of course, DMT itself contains none of the information that constitutes the experience—no alien landscapes, no entities, no hidden worlds. However, DMT may allow the expression of intrinsic thalamocortical activation patterns that developed in a world that is not so much alien, but from which we have become alienated, allowing us a brief but astonishing glimpse at a long-forgotten hyperdimensional heritage. Thanks to the curiosity of a small, but growing, number of individuals, this heritage is now being rediscovered and explored. Surely, this can only be a good thing. DMT may be one of the most powerful tools for understanding consciousness and the nature of reality bestowed on the human species and ought to be treated as such. As Terence McKenna was so keen to point out, “DMT is not a secret; it is *the* secret.” Perhaps he was right.

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