Neuro-diversity and the Fundamental Complexity of Consciousness

Chelsea Demanche

MA by Research

University of York

Philosophy

November 2023

ABSTRACT

This project is an analysis on the system complexities of neurophysiological and cognitive structures associated with conscious states. A comparison of neurotypical and neuro-divergent systems is presented to demonstrate the underlying complexities that maintain neural functioning through atypical neuro-cortical patterns. The aim of this project is to challenge philosophical and neuro-correlates of consciousness (NCCs) theories that view consciousness as a mental-physical property by defining consciousness as an element of neuro-complexity that cultivates neuro-physical and cortical functioning.

Philosophical and NCCs theories disregard the notion of neurodivergence, such as Attention-Deficit-Hyperactive-Disorder, that develop atypical methods in neural communication and stimuli integration that can be interpreted as an impaired state of consciousness. For a theory of consciousness to incorporate neuro-divergency requires a reevaluation in neuro-cortical functioning to define consciousness as a complex element *that sustains the nervous system.* This will follow with a discussion on the relationship between neuro-divergency and neuro-complexity using ADHD as an example of divergent interconnectivity, or chaotic activity, in high-level/low-level cortical functioning and its correlation with consciousness. Incorporating neuro-divergency into a theory of consciousness will change how we view brain function and its role with consciousness. The goal of this thesis is to define consciousness as a fundamental property of neuro-complexity that cultivates the development of CNS/PNS through neuro-divergency.

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for a degree or other qualification at this University or elsewhere. All sources are acknowledged as references.

TABLE OF CONTENTS

Section 1

Medical & Psychological Definitions of Consciousness

This section will focus on differential aspects of neuro-cognitive functioning in the brain and its effects on conscious states. The neuro-cognitive relation with consciousness involves the use of medical and psychological definitions of conscious states to establish a foundation towards redefining the function and purpose for consciousness within neuro-cognitive structures. Medical professionals define a conscious state as a psychological state that involves the potential to observe and identify external-internal stimuli from a first-person perspective of mental events. Examples of conscious states include emotions, perception, and thoughts. A conscious state is a physical and mental state supported by higher-level cognitive processes in the prefrontal cortex that exhibit characteristics of *sensory-driven responses* to external stimuli. This helps to determine a patient's level of coherence and to identify their state of consciousness following physical trauma to the brain, illness, or from drug/alcohol induced impairment that has altered the patient's ability to interact and directly communicate with others.

The psychological interpretation of consciousness is generalized as a reflective state involving a sensory-driven individuation process generated by the prefrontal cortex to coordinate a subject-object differentiation between the person and their environment. Individuation is a development of intentionality or goal-directed behavior towards stimuli, thoughts, and emotions that arise from a person's interaction with the environment. Psychological consciousness functions as a mediative state associated with subjectivity and

intentionality to attain a desired goal within the objective world. An impaired state of consciousness, or psychiatric unconsciousness, pertains to psychological maladaptive defense mechanisms that resist or protect against emotional stress. Maladaptive mechanisms, such as dissociation (repression of threatening or distressful thoughts) and detachment (emotional disconnection), cause varying levels of impairment ranging from mild emotional numbness to one's surroundings and experiences to severe detachment with depersonalization, identity fragmentation, and derealization. Medically, a person displaying mild or a severe dissociative state would be experiencing an impaired state of consciousness even though psychologically, emotional defense mechanisms are unconscious applications as they disengage the person from rational thought while incorporating irrational processes.

Contrary to physical trauma impairment, which disrupts coherent interactions and communication with the environment, psychiatric unconsciousness is like an emotional coma that protects against mental distress. Behaviors stemming from this unconscious state are driven by thoughts and mental images from past experiences triggering a non-sensory driven anxiety response initiated by the thalamus and amygdala through the peripheral nervous system (brain and spinal cord processes of sensory/non-sensory driven stimuli). The thalamus processes non-sensory "danger" or "threat" nerve signal messages from the peripheral nervous system and bypasses the prefrontal cortex to directly engage the amygdala in the temporal lobe activating the "fight or flight" stress response. Once activated, the fight or flight stress response overrides the cognitive functions in the prefrontal cortex leading to an "unconscious" state of behavior centered on the survival aspects of the brain. The sensory-driven individuation process that occurs during a conscious state is reorientated towards a "survival

mode" in which the fight or flight stress response becomes the brain's managing system during a state of psychiatric unconsciousness. In other words, psychiatric unconsciousness is a state of autonomic (involuntary) consciousness controlled by peripheral nervous system communication through the thalamus and amygdala. Individuation under automatic consciousness is not directly supported by prefrontal cortex as higher-level cognitive functions are used to reinforce defense mechanisms against mental-emotional distress. A person under a state of autonomic consciousness will thus reflect a dissociated and detached state of mind but not necessarily incoherent or unaware of their surroundings. Rather, they are experiencing an increase of cognitive awareness towards perceived danger triggering the autonomic response process from the peripheral nervous system. The person is not unconscious but disengaged from voluntary consciousness.

The medical and psychological definitions of consciousness share similarities in relation to a person's level of coherency and direct communication with the prefrontal cortex that reflects the engagement of higher-level cognitive processes in response to stimuli. However, disconnected communication with the prefrontal cortex is marked by patterns of unconscious processes that appear to produce incoherent and irrational responses towards external stimuli. Although a medical unconscious state is caused by temporary or permanent impairment in cognitive functioning caused by physical brain trauma, psychiatric unconsciousness is triggered by a fight or flight stress response from the thalamus and amygdala that overrides input from the prefrontal cortex. This leads to a dissociated and detached state of mind centered on emotional survival marked by irrational behavior and responses to perceived threats. A state of autonomic consciousness is a disconnection from voluntary control over cognitive functions.

The medical and psychological definitions of a conscious state thus describe the behavioral and emotional responses under voluntary cognitive control through the prefrontal cortex. Responses stemming from an unconscious state are aspects of an autonomic-involuntary cognitive system that can assume "control" over voluntary functioning during an activated fight or flight stress response. Both descriptions define the functioning properties of consciousness as a voluntary cognitive response to stimuli with the assumption that physical or emotional impairment is a loss of voluntary cognitive control that leads to an unconscious state of mind.

If physical or emotional impairment to voluntary cognitive control gives rise to states of unconsciousness, does this imply that those with Attention-Deficit-Hyperactivity Disorder (ADHD) experience varying states of consciousness and unconsciousness? In the DSM-5-TR, ADHD is listed under "Neurodevelopmental Disorders" which are characterized by the presence of impaired functioning to "personal, social, academic, or occupational functioning"[1] (36) in relation to persistent patterns of inattentiveness and hyperactivity. As a neurodevelopmental disorder, ADHD should thus be caused by abnormal brain development despite not having a specific gene or genetic combination identified as a cause for ADHD. Brain scans reveal anatomical differences in children with ADHD. However, the reasons for this deviation in brain structure cannot be determined. Those who have behavioral traits stemming from inattentiveness and hyperactivity also appear to display poor cognitive control. An individual with ADHD is often easily distracted, forgetful, "does not seem to listen when spoken to," struggles to follow directions, fidgety/cannot sit still, and interruptive. Since ADHD is classified

[1] *Diagnostic and Statistical Manual of Mental Disorders*, *Fifth Edition, Text Revision* (DSM-5-TR), 2022, 35.

as a neurodevelopmental brain disorder, the display of poor cognitive control could be correlated with varying states of physical and emotional unconsciousness. Furthermore, the emotional aspects of ADHD are connected to social anxiety, depression, rejection sensitivity, and low self-esteem which can escalate into the emotional disassociation-disconnection that accompanies psychiatric unconsciousness.

As a person with ADHD, my inattentiveness and hyperactivity are not necessarily signs of poor cognitive control (even though it can feel like that) but rather a consequence of an overstimulated and overwhelmed cognitive state that struggles to regulate sensory/non-sensory stimuli. I have full control of my voluntary cognitive abilities but struggle to organize input from sensory/non-sensory stimuli which I experience as watching 20 TV screens displaying different images, words, and sounds at high volume all at once. My attempts to organize the information coming from these TV screens while focusing on a task is perceived by others as not listening, distracted, and forgetful. If a task is under stimulating, I appear bored and fidgety as I am trying to minimize the mental pain emitting from an overwhelmed brain. How others perceive inattentive and hyperactive behavior in ADHD is thus contradictive to how I experience it as I am not struggling to think or understand information but with organizing the information. Distracted or not listening is not a sign of an unconscious state caused by cognitive impairment; instead, it is a state of consciousness reflecting overwhelmed voluntary and involuntary cognitive functioning creating a conglomeration of voluntary-involuntary responses in which the brain utilizes somatic and autonomic neural processing with cognitive functions to combine sensory/non-sensory information into responses. Task-related responses are, however, determined by how many TV screens are on mute. The ability to combine cognition

with somatic and autonomic neural processing gives rise to deviation in brain function seen in ADHD as the combined cognitive process activates parts of the brain not normally used in task-related responses.

Neural deviation is an increase in cognition and stimuli information that causes the appearance and behavior of poor cognitive control. It does not affect brain development or functioning but increases functioning in processing information. If neural deviation causes an increase in stimuli information and cognitive functioning, it contradicts the notion that cognitive impairment leads to states of unconsciousness as it relates to sensory-driven responses and individuation towards external stimuli in which increased cognitive functioning should lead to an increased state of consciousness. I am not experiencing abnormal brain functioning or states of unconsciousness but divergent brain functioning that simultaneously processes both sensory/non-sensory driven stimuli information—or a 20-unmuted-TV screens state of consciousness. Divergency in neural processing is thus a matter of misunderstanding its neuro-cognitive functioning and its correlation with consciousness. For the neural divergence characteristic of ADHD, conscious states are determined not by a level of cognitive control over stimuli information but by the role of consciousness in normal and divergent brain functioning.

Philosophical & Neural Correlates of Consciousness

The notion of voluntary cognitive control that forms the basis for medical and psychological consciousness as involuntary cognitive control involves autonomic neural mechanisms that lead to states of unconsciousness marked by incoherent or irrational responses towards stimuli. Distinguishing a conscious state from unconsciousness through coherent and rational responses fails to explain how autonomic neuro-cortical activity is

"unconscious" even though it is another form of cognitive functioning. Do involuntary cognitive functions "turn off" consciousness? What "turns on" consciousness? Does a person with ADHD experience various states of consciousness depending on their engagement with an activity? At which point does consciousness arise during neural and cognitive processes? Is consciousness carried by neurons as stimuli and activated during cognitive processing? If consciousness is a product of neural-cognitive development, what is the function of a conscious state within the neural network in which all neural synapses and oscillations transfer stimuli information through cognitive processes? Attempts to define consciousness by its causal effects inhibits our knowledge and ability to understand its underlying involvement to our sense of awareness. Philosophical theories of consciousness should thus explore the integrated nature of neurophysiology, brain structures, and cognition.

'Weak' & 'Strong' Panpsychism

Philosophical theories of consciousness often define consciousness by its functional mental-physical properties in response to stimuli. According to the panpsychism theory of consciousness, mind and consciousness are fundamental elements of reality and intrinsic structures of matter that constitutes for phenomenal causal events. David Skrbina defines panpsychism as the "notion that all things possess some degree of mind, consciousness, or subjectivity."[2] This correlates panpsychism with the extended mind argument in which the mind and consciousness are not directly associated with neurophysiological properties but

[2] David Skrbina, "Panpsychism Reconsidered: A Historical and Philosophical Overview" (103-114) The Routledge Handbook of Panpsychism, Edited by William E. Seager, Routledge, 52 Vanderbilt Avenue, New York, NY, (2020): 103

embodies various physical forms to interact and influence other objects. In other words, the extended mind argument proposes that the cognitive abilities we assume are neurophysiological can exist in non-neurophysiological forms that allows all physical things to interact and influence other forms in the world.

Panpsychism correlated with the extended mind argument views mind and consciousness as extended mechanisms of physical properties in which mental properties can be expressed in various ways. Every phenomenal object possesses “what it’s like” or “mental-like” properties to generate a field of experience that encompasses all phenomenal objects. Phenomenal objects thus include animal and plant life, atmospheric elements, or anything that composes the natural universe. The mind in panpsychism is therefore a manifestation mechanism that externalizes an object’s physical property or essence. As consciousness is associated with mental and physical experiences, panpsychism views consciousness as a phenomenal manifestation of a physical entity’s mental-like and physical properties to create that object’s field of experience. Consciousness therefore helps create observable structures that constitutes physical reality by way of mental-like properties. Mind and consciousness are thus fundamental material attributes of the natural world.

Although the panpsychism theory suggests that all phenomenal objects possess mental-like properties, or the ability to manifest phenomenal structures, the ‘strong’ form of panpsychism claims that all physical objects are nothing but forms of consciousness or experiential phenomenal properties. The ‘weak’ form of panpsychism, however, differs by its assertion that all physical objects possess mental-like properties to manifest experiential phenomena but not all phenomenal properties possess experiential elements. In other words,

our knowledge of physical phenomena is determined by the "extrinsic, functional, and structural"[3] attributes of physical phenomena, not by the intrinsic behavior that *produces* the phenomena. Freya Mathews describes this as a "*mind-in-nature*" that expresses the internal mechanisms of an object's causal properties and dispositions that are not "a part of the extensional order of nature…or accessible to ordinary empirical [methods]"[4] of observation. Atmospheric phenomena are an example of *mind-in-nature* that produces various forms of weather with significant impact on terrestrial and oceanic activity. We can empirically observe and understand atmospheric phenomena, however, our knowledge remains at an empirical level. If an atmospheric event, such as a thunderstorm, requires specific conditions to occur but later produces tornadic activity as a secondary event, we can assume that a thunderstorm is the primary causal power to generate tornadoes. As "causal powers cannot be [objectively classified] as they are not empirically manifest),"[5] we cannot directly observe the underlying physical properties between these two events. Tornadic activity in thunderstorms requires strong atmospheric instability through the mixing of ground level warm moist air with cooler aloft dry air. However, tornadoes also require a strong vertical wind shear (wind speed/direction) to create an updraft rotation to generate a funnel cloud. Once a tornado reaches the ground, its strength and longevity depend on persistent rotation of warm updraft air. All severe thunderstorms have potential to develop tornadic activity but non-supercell

[3] Skrbina, "Panpsychism Reconsidered: A Historical and Philosophical Overview," 113.

[4] Freya Mathews, "Living Cosmos Panpsychism" (131-141) The Routledge Handbook of Panpsychism, Edited by William E. Seager, Routledge, 52 Vanderbilt Avenue, New York, NY, (2020): 133.

[5] Mathews, "Living Cosmos Panpsychism," 134.

severe thunderstorms lack strong vertical wind shear (non-supercell wind shear is horizontal) to increase rotation. The specific conditions for tornadic development therefore make tornadoes a rare meteorological event except for the southern and midwestern regions of the U.S. Without an understanding of these intrinsic atmospheric properties associated with tornadic activity we might assume that any intense thunderstorm can manifest a tornado. Furthermore, we would still be unaware of the intrinsic atmospheric properties without the use of Doppler radar technology. The intentional manifestation properties of any phenomenal object/element therefore function as mental-like processes to generate the natural and empirical forces of the material world. Mental properties in panpsychism thus refers to any phenomenal object/element with the capacity to manifest fields of experiences into the world. The role of consciousness in panpsychism does however involves a dimension of subjectivity that constitutes our phenomenal experience of reality.

The 'weak' form of panpsychism theory argues that all phenomenal objects/elements possess various forms of mental-like properties, but it does not proclaim that all phenomenal elements that possess mental-like properties also possess experiential consciousness. Phenomenal objects that express experiential consciousness, such as an animal or human, demonstrate an "outward appearance of an inner field of subjectivity"[6] in which the animal or human can distinguish a separation between themselves and their field of experience. This separation cultivates a personified sense of awareness towards other phenomenal manifestations. Personified awareness gives rise to meaningful interactions that recreates

[6] Mathews, "Living Cosmos Panpsychism," 138.

reality into an active state to influence an organism's behavior to be receptive towards this active reality. Receptivity will thus generate behaviors to reflect the subjective experiences of reality. Phenomenal manifestations are therefore physical objects of action potential directed towards physical entities with experiential qualities that which gives rise to personified field experiences. Personification is thus an embodiment of experiences as properties of subjectivity that provide a meaningful connection between individual entities and experiential phenomena.

Meaningful interactions associated with subjective properties have potential to recreate experiences. For weak panpsychism, this dimension of subjectivity correlates with consciousness as a fundamental function to sensory-driven individuation indicating "the basic condition of things mattering—of things having relevance, significance, and value."[7] Meaningful sensory-based individuation and consciousness is a preliminary process that constitutes a self-realizing system and functions to expand itself through external expressions of its intentional properties. This individuation process further promotes a motive for self-realizing systems to strengthen mental-like properties and increase experiential phenomena by communicating and engaging with other systems. Communication further develops categorical organization of mental-like properties and experiential phenomena to "become the basis for thought and language"[8] that develop the cognitive modalities correlated with consciousness. Weak form panpsychism therefore distinguishes mental-like properties from phenomenal consciousness as all physical objects possess mental-like intentional properties with the capacity to cause experiential phenomena. However, as some intentional properties are hidden and cannot be

[7] Mathews, "Living Cosmos Panpsychism," 137.
[8] Mathews, "Living Cosmos Panpsychism," 139.

directly experienced, not all physical objects are fully experiential entities. Therefore, not all physical objects are forms of experiential phenomena but possess the potential to *cause* experiential phenomena. This indicates that all physical entities have different forms of mental-like properties that manifest phenomenal reality but hidden elements cannot become direct experiential phenomena. Experiential phenomena can only occur if a physical organism possesses or develops the ability to directly experience hidden phenomenal elements. Therefore, the notion of consciousness as an intrinsic phenomenal element of reality can only exist if all physical entities can experience all forms of phenomena.

If all physical phenomena possess mental-like properties but not all mental manifestations are directly experiential then physical phenomena do not all possess consciousness. In other words, if consciousness is an intrinsic and experiential mental-like property of reality but accessible only to certain receptive physical entities then consciousness cannot contribute to reality without a form of universal subjective awareness. Subjectivity is thus a personified sense of awareness and embodiment towards experiential phenomena that manifests reality. The development of consciousness through mental-like properties with sensory-driven individuation culminates into a subjective reality in which "some first individual organism suddenly 'felt' the world or experienced reality."[9] The experience of reality is therefore the ability to recognize and distinguish differential elements between physical entities and their experiential properties. Consciousness, in accordance to weak panpsychism, is an emergent quality of all physical entities that possess mental-like properties and formulates

[9] Skrbina, "Panpsychism Reconsidered: A Historical and Philosophical Overview," 105.

all experiential phenomena within the realm of subjectivity. A physical organism can experience phenomenal consciousness only if it possesses mental-like and subjective properties. Phenomenal consciousness occurs if a physical organism experiences subjective individuation through self-realization and communication with other self-realizing entities. Communication development provides categorical organization of mental-like properties and experiential phenomena that further contribute to phenomenal properties associated with consciousness.

The mental-like and subjective properties of consciousness thus correlate with the notion that phenomenal consciousness is an emergent property of mental and cognitive processes. To avoid the hard problem of consciousness (how non-physical elements supervene on physical properties), panpsychism argues that all physical properties possess mental and conscious-like properties. Consciousness does not supervene upon the physical as it already exists within the intrinsic structure of physical properties. For every cell and molecule down to subatomic particles there are particles of consciousness that help constitute a physical object. Thus, according to 'strong' panpsychism, all physical elements are nothing but mental and conscious-like qualities in which conscious-like experiences exists as a by-product of interaction with other physical entities like a chemical reaction between one or more chemical substances to create the same or a new substance. We all experience consciousness because it is a natural element that can change or multiply if joined with other forms. Although weak panpsychism differs by stating all physical elements possess mental-conscious like qualities, phenomenal consciousness only occurs if all intrinsic physical properties experience subjective individuation. Consciousness therefore exists as a physical and phenomenal element but not all physical entities experience phenomenal consciousness but the potential to develop ability.

Consciousness as a physical and phenomenal emergent property of mental and cognitive processes suggests that there are dual functioning properties to consciousness. The mental and cognitive aspects of consciousness manifest physical and experiential phenomena while providing experiential capabilities from other entities. The panpsychism view of consciousness explains the possibility for different forms of consciousness based on the mental-like properties in physical organisms but does not explain as to how mental-like properties corresponds with consciousness in physical organism. Is consciousness necessary to generate experiential phenomena or is consciousness necessary for phenomena to be experienced? If consciousness is composed of smaller subatomic conscious particles, does this include smaller or lesser structures of mental-like properties that converge conscious particles into a singular and unified state of consciousness? In regards to ADHD, the mental-like properties that panpsychism defines as the primary mechanisms to experience consciousness avoids the precondition for voluntary cognitive control that disregards the importance of involuntary cognitive functioning in maintaining neuro-cortical activity and conscious functioning.

Although I agree that consciousness is fundamental to reality, I disagree that consciousness exists in various physical forms and manifests into the world through mental-like properties. This approach maintains the requisites to uphold conscious activity within a mental-physical duality constructed upon a neuro-cognitive system controlled by the prefrontal cortex. This further includes phenomenal consciousness as a secondary property of consciousness as it emphasizes subjective individuation (a higher-level cognitive function) towards phenomenal properties. My approach to consciousness as a fundamental element in neuro-cortical processing is to specify consciousness as a functioning attribute of intrinsic biocomplexity that

cultivates and sustains neural communication and integration. The relationship between consciousness and cognitive functions is that of an emergent manifestation process to modify sensory stimuli into cognitive components. In other words, the neuro-cognitive properties of the brain—including phenomenal experiences—are physical manifestations of consciousness responding to stimuli.

Illusional Consciousness

The illusion argument views phenomenal consciousness as an illusional state that occurs as a mental by-product of introspection. The strong and weak versions of illusionism both posit the experiences of physical properties as distinct but argue its existence is deceptive. Weak illusionism asserts that phenomenal experiences are qualitative but not intrinsic properties. Strong illusionism, however, "denies that the [phenomenal] properties [associated] with introspection are qualitative: it is an illusion to think there are phenomenal properties at all."[10] The purpose for phenomenal consciousness is to create unified subjective experiences that we assume are real functioning properties related to consciousness. Our ability to physically observe the qualitative sensory properties of physical objects, such as the color, texture, or weight of an object, are based on how our neural systems receive and process sensory properties which we modify with cognitive attributes that manifest into stimuli information. For example, the structures of the human eye allow us to see objects by reflecting light off an object through the cornea and retina that photoreceptor nerves receive by transforming light signals into electrical impulses for neuro-cortical structures in the brain to process and modify

[10] Keith Frankish, "Illusionism as a Theory of Consciousness" *Journal of Consciousness Studies*, *23*(11-12), 11–39, (2016): 4.

as sensory information. Once the brain receives electrical impulses from photoreceptor nerve signals, the transient oscillation between neuro-cortical mechanisms creates a *quasi-phenomenal* property that is a "non-phenomenal physical property [which] introspection [tends] to misrepresent as phenomenal."[11] The moment neuro-cognitive functions register sensory qualities allows us to experience the sensory properties that accompanies neural properties. In other words, the qualitative attributes of physical objects are partially produced by neural properties that trigger cognitive responses to insert our subjective interpretations of a neurological event. The phenomenal qualities of sensory experiences are thus not intrinsic attributes of physical objects but an inherent element of neuro-cognitive processes that influence the neuro-cortical process of sensory stimuli.

Although weak illusionism interprets *quasi-phenomenal* properties as qualitative attributes that we experience as phenomenal properties of sensory stimuli, for example, some physical effects can be felt as painful if the physical state involves bodily damage, but our subjective interpretations we identify as actual physical phenomena are illusory. Strong illusionism, however, argues that all phenomenal properties, including painful experiences, are illusory. We interpret phenomenal properties to be *distinct physical aspects of conscious experiences* as they co-occur with neuro-cortical processes and provide additional characteristic features to neural responses that would otherwise be a complex neural-sensory reflex reaction to stimuli. Frankish paraphrases Daniel Dennett's analogy of phenomenal conscious properties as "graphical interfaces" (icons, pointers, files, etc.) that help users control computer

[11] Frankish, "Illusionism as a Theory of Consciousness," 4.

functioning in an “abstract, metaphorical” way but cannot provide us a thorough understanding of computer technology. Phenomenal conscious properties are thus “metaphorical representations of real neural events, which facilitate certain kinds of mental self-manipulation but yield no deep insight into the processes involved.”[12]

This leads us to interpret and generalize the qualitative attributes of neural sensory experiences as descriptive conscious representations of neuro-cortical processes that coincide neuro-cognitive functioning. This allows us to create and view ‘universal’ concepts of neuro-cortical processes as the primary cause of qualitative phenomenal experiences in consciousness. Universal concepts of neuro-cortical processes thus correlate with the medical and psychological definitions of consciousness as both rely on certain expressions of phenomenal consciousness to determine a person’s overall state of consciousness. However, although phenomenal experiences are illusory, they do have a functioning role in cognition and behavior as “intentional objects” to generate objective responses to neural-sensory properties. Objective interaction through phenomenal experiences converges sensory and non-sensory driven neural properties with cognitive functions to generate a responsive phenomenal state that allows an individual to develop and express goal-oriented behavior towards stimuli.

[12] Frankish, "Illusionism as a Theory of Consciousness," 4.

The notion of phenomenal experiences as functioning intentional objects to converge sensory/non-sensory driven neural properties with cognition to generate a responsive phenomenal state further constitutes our development subjective individuation. However, if phenomenal experiences are not distinct qualitative properties of neural and sensory processes but still influences cognitive functioning, the experience of phenomenal consciousness is not only illusory but the experiential attributes are not directly associated with neuro-cognitive functions. The correlation between consciousness and neuro-cognitive functions is a fundamental and intrinsic brain mechanism based on various forms of neural connectivity that predetermines how stimuli properties are cultivated into a stimulus-driven individuation process.

The illusional theory of consciousness provides a plausible argument for how our descriptive concepts and representations of neuro-cognitive processes constitutes phenomenal conscious experiences as functioning intentional objects of reality. Its assertion that phenomenal experiences are illusory elements we develop to use as intentional objects to help converge neural processes with cognitive functions and contributes in formulating subjective individuation within a responsive phenomenal conscious state. Phenomenal consciousness as an illusory element in neuro-cognitive functions does not sufficiently explain the cognitive correlation of consciousness or why it is fundamental to reality. What is the exact relationship between consciousness and cognition? How do we know if cognition is directly correlated with consciousness other than the appearance of it? The correlation between consciousness and cognition pertains to our ability in utilizing stimuli information as cognitive components that influences and initiates various elements of neuro-cortical activity.

Neuro-Correlates of Consciousness (NCCs)—Global Workspace, Integrated Information, Dendritic Information

Neuroscience provides insight into consciousness by focusing on the neural correlates of consciousness (NCCs) as the main contributor of conscious states. Research in NCCs helps us understand the groundwork of conscious development, neural theories explore the explanatory links between neural networks and consciousness. The Global Workspace theory proposes that sensory information is implicated into states of consciousness and broadcasted within a neuronal workspace of higher-level cortical structures, specifically the prefrontal cortex. This access to a global workspace generates neural representations processed by cognition (perception, thought, ideas). Consciousness is thus defined as a mode of active awareness associated with higher-level cortical structures to that utilize consciousness transmute neural information into action.

Integrated Information theory (IIT) is a neuro-cognitive approach in which the Peripheral and Central Nervous systems generate the sensory-phenomenal aspects of conscious experience correlated with the functional aspects (subjectivity) of consciousness. IIT thus defines consciousness as an intrinsic and fundamental systematic property realized by the PNS/CNS. This approach identifies consciousness with certain forms of information that constitutes our subjective experiences of consciousness. Dendritic Integration theory (DIT), however, employs an understanding of how dendritic trees of neurons process and carry information to and from other neurons. Information is segmented between a neuron's soma and axon cross point to determine whether to initiate an action potential to be processed by the cortical thalamus to become conscious. In other words, the DIT theory proposes that consciousness is an associative element of integrated information initiated through neural

synapses that formulate action potential—or the cortical-cognitive application onto neural-processed information. Consciousness is thus an element of a cognitive action potential that which sustains our continuous state of consciousness.

While NCCs theories address the origins and functionality of consciousness, the Global Workspace and Integrated Information arguments are inaccurate by centralizing on the cortical and phenomenal characteristics associated with consciousness. According to both theories, consciousness functions as an active state of awareness initiated by an accumulation of neural information processed by higher-level cortical structures. Consciousness in the Global Workspace argument arises through a unification of neural information and sensory awareness whereas the IIT identifies consciousness as an accumulation of information that becomes "conscious" during neuro-cortical processing. Each theory defines the descriptive and functional aspects of consciousness as neuro-cortical properties to cultivate a conscious state of integrated information or a stimulus-driven individuation process. Consciousness is thus an emergent functioning property of the neuro-cortical system which simplifies the functioning role of consciousness into a by-product of neuro-cortical communication. Although this helps to support the medical and psychological interpretations of consciousness in relation to sensory-driven and non-sensory driven responses, it is based on a preconceived notion of neuro-cognitive functioning that maintains voluntary cognitive control (the prefrontal cortex) over neuro-cortical processes to be an indication of a functioning state of consciousness. An impaired or unconscious state, however, is marked by involuntary cognitive control (autonomic conscious state) over stimuli processing due to irregular neural functioning in the prefrontal cortex caused by a neurophysiological injury in the brain or mental-emotional distress. If

impaired neuro-cortical processing leads to autonomic cognitive functioning that produces irregular responses as opposed to higher-level cognitive responses, why is this cognitive process an indication of unconsciousness? If autonomic/involuntary cognitive functioning maintains the ability to process and respond to stimuli despite irregular activity in the prefrontal cortex suggests that consciousness is not a neuro-cortical system property that helps process stimuli but a neuro-cognitive system element that supports and cultivates both aspects of voluntary/involuntary cognitive functioning.

Dendritic integration is a cell-based theory of consciousness that addresses how neurons transmit information to other neurons, specifically the sensory process between action potentials and the thalamus. If consciousness is a neuro-cognitive element that cultivates cognitive functioning, for any "conscious" brain activity to occur requires a brain to be primarily in an awakened state regulated by *non-specific pathways* of the thalamus or the "modulator of the state of cortical neural circuits [that] allows transitions between non-conscious states and alert states of consciousness."[13] During a waking process, the firing rate of cortical neurons is increased as the EEG desynchronization (the blocking of alpha band rhythms that initialize sensory processing and motor behavior) transitions from slow-wave and REM sleep to a waking state. Thalamic activity, however, is decreased or deactivated during a sleeping state in which slow frequency oscillations arise (synchronous network state transitions) as cortical and thalamic neurons fluctuate between increased and decreased synaptic activity. Slow frequency

[13] Talis Bachmann, Mototaka Suzuki, Jaan Aru. "Dendritic Integration Theory: A thalamocortical theory of state and content of consciousness." *Philosophy and the Mind Sciences*, https://philosophymindscience.org ISSN: 2699-0369, (2020): 5.

oscillations therefore characterize an unconscious state when excitatory signals are deactivated. This affirms the notion that the thalamus is the primary mechanism to establish a baseline for conscious activity to arise. It is not the *source* of consciousness but the *ignition* for consciousness.

The cortical neurons associated with the thalamus and properties of consciousness are the cortical layer 5 pyramidal (L5p) neurons that integrate and distribute input to cortical and sub-cortical structures. There are two L5p, the cortico-cortical (receives visual input) and cortico-subcortical which receives input from top-down modulation brain structures. The role for CS neurons is to integrate information and generate responses related to movement (activity) regulation and cortical functioning as their dendritic trees communicate and distribute information across all cortical layers but L5 is the main cells that initiate thalamic activity. CS neurons have two integration mechanisms, the soma and apical, in which the apical "receives diverse input from higher cortical areas and non-specific thalamic nuclei" and the soma receives "feedforward input from lower-level cortical areas."[14] Both mechanisms appear to segregate and integrate context/sensory data input which is significant in regards to consciousness and unified neural-sensory properties with cortical subjectivity. However, this segmented interplay between the thalamic and cortical areas cannot be "activated" without a response from the thalamus. Communication between the two areas formulates a thalamocortical and corticocortical loop which is a necessary element "to integrate the contextually modulated

[14] Aru, Bachmann, Suzuki, "Dendritic Integration Theory: A thalamocortical theory of state and content of consciousness," 10.

cortical processing into conscious experience."[15] The activated interplay of the thalamocortical and corticocortical loop suggests that consciousness is an intrinsic attribute of a correspondent communication system rather than a mental-like system. Consciousness thus "functions" through the CS neuron apical processes of cognition to influence our soma sensory processes that unifies neuro-cortical sensory and contextual properties that gives rise to our conscious experiences.

Conscious functioning, however, does not rely primarily on higher-level cortical responses from the prefrontal cortex to maintain a conscious state. Rather, thalamic activity occurs in the low levels of the brain that regulate sensorimotor coordination, body functions, and relays nerve signals to and from the peripheral and central nervous system. Therefore, if the prefrontal cortex is damaged or exhibits deviation in cortical neural activity from ADHD, it does not prevent the thalamocortical and corticocortical loop in maintaining a functioning conscious state. Cortical deviations will determine how conscious activity *does function* to integrate stimuli information. However, one problematic aspect on the dendritic theory of consciousness is that the thalamocortical-corticocortical loop not only relies on a responsive thalamus to "activate" consciousness but also responsive functioning of both the cortical layer 5 pyramidal neurons and thalamocortical-corticocortical loop. Any malfunction or damage to these neuro-physical components compromises any state of consciousness.

[15] Aru, Bachmann, Suzuki, "Dendritic Integration Theory: A thalamocortical theory of state and content of consciousness," 15.

Relying on neuro-cortical processes to support conscious activity weakens the attempt to define it as a fundamental or intrinsic element in cognition and human experience. Each theory I discussed emphasizes the functioning physical properties that either generate or support conscious states. However, if one mechanism fails or is damaged the supposed functioning of consciousness is disrupted. Physical properties are thus incompatible to support consciousness but are, supposedly, reliant on consciousness to maintain functioning beyond an autonomic neural system. I propose that to define and understand consciousness we need to reevaluate our understanding of neuro-cortical system functioning behind the physical attributes and view consciousness as a support mechanism *for the system* rather than supported *by the system.* To improve our understanding of neuro-cortical functioning is to understand how neuro-cortical processes function when a neural process fails either by damage or brain abnormalities, or from neural deviation that changes how cortical and subcortical areas in the cerebral cortex receive and process stimuli. Understanding divergencies in neuro-cortical functioning caused by atypical processes changes how we understand brain function and its role in conscious activity. My approach to consciousness as an intrinsic element associated with cortical/subcortical processes will focus on its correlations with neuro-complexity. This will involve an analysis and discussion in Section 2 of the functioning properties of the nervous system, specifically how neurons communicate and influence components of the central and peripheral systems. To strengthen my argument, I will discuss the notion of neurodivergence in relation to ADHD as an example of the connection between higher/lower-level brain functioning, consciousness, and neuro-complexity. Section 3 will discuss my secondary argument on consciousness as a chaotic element and a neurodivergent property in

which increased and deregulated neuro-cognitive functioning leads to an increase of complexity and ultimately a heavier reliance on conscious activity to maintain the system. Neurodivergence is not necessarily the presence of differential neural processes but rather differential neural communication in which consciousness provides the access and capability to utilize alternative neural integration methods. The main goal of my argument is to define consciousness as a fundamental component of complexity that develops and supports neural system communication and integration to sustain all system functioning.

Section 2 Dynamic Complex System Properties—Central & Peripheral Nervous System & Conscious Activity

Overview:

The Central and Peripheral Nervous System is a dynamic neural network of autonomic and somatic neural activity that coordinates communication between the brain and spinal cord. This line of communication is a Level 1 neuronal process that activates neurotransmission and produce a feedback-feedforward loop to exchange sensory stimuli from the CNS/PNS with the brain. The exchange of stimuli with the brain induces a Level 2 that neuronal processes to develop reciprocal top-down/bottom-up neural pathways that functions to converge the CNS/PNS with brain functioning. Both Level 1 and Level 2 neuronal processes are initiated by stimuli receptivity in sensory and motor neurons.

Sensory neurons are peripheral and somatic nerve cells that detect and transmit afferent sensory signals from external-internal stimuli to the CNS. Sensory nerve receptors receive and convert stimuli signals into nerve impulses that relays the signals to the spinal cord through synaptic transmission towards the CNS. Motor neurons are efferent nerve cells located in the motor cortex of the brain that relay motor sensory signals from the CNS to peripheral and somatic neural areas in the body. Motor nerve cells release neurotransmitters to trigger physical movement from the body as either voluntary or involuntary (autonomic) responses. Synaptic transmission of sensory signals triggers the spinal cord to receive and relay sensory, motor, and autonomic nerve signals between the brain and body.

The spinal cord is an essential component in the PNS to converge communication with the CNS by relaying sensory messages to intersect at a connection point in the brain stem. The brain stem is located at the base of the brain between the cerebral hemispheres and connects with the spinal cord and functions as a neural passageway for the CNS/PNS. It contains 12 cranial peripheral nerves responsible for processing and relaying afferent, efferent, and autonomic sensory signals to different areas of the brain. Through its connection with the spinal cord, the brain stem creates a level 1 neuronal process by developing top-down (ascending-descending nerve signals) and bottom-up (descending-ascending nerve signals) pathways to coordinate feedback-feedforward communication that regulates the transmission of involuntary/voluntary neuronal responses. At level 1, the neuronal process of sensory nerve signals is primarily autonomic in which the neural response to sensory nerve signals creates a stimulus-driven reflex awareness that display involuntary reactions to a specific stimulus. This level of stimuli receptivity characterizes neurophysiological processes as components of conscious activity that generates the physical properties associated with an active dynamic neural network.

The functioning of neurophysiological processes with conscious activity establishes interconnected communication between level 1 and 2 neuronal processes. Interconnected neuronal processes develops a foundation of afferent-efferent sensory signals as a transit to push the CNS/PNS into an active awareness that recognizes external/internal differentials in sensory stimuli. Neurophysiological components in conscious activity are the beginning process in constructing neuro-complexity to converge the CNS with the PNS. This activates a starting point for level 3 in the neuronal processing of conscious activity to converge the CNS/PNS with

the cerebral cortex by connecting sensory stimuli and top-down/bottom-up pathways with the cortical and subcortical lobes. The cortical/subcortical lobes produce neuro-cortical responses that characterize the physical and cognitive aspects of conscious activity which are viewed as the primary indications for coherent brain activity.

Since the purpose of my argument is to understand consciousness as an element of neuro-complexity that coordinates stimuli with neuronal processes to activate higher-level cortical functions, I will continue using the term *conscious activity* to separate the phenomenal subjectivity associated with conscious experience to focus on the neural properties that underlie the *complex functions of conscious activity.*

As a dynamic neural network, the CNS/PNS consists of interconnected neurons that transmit autonomic/somatic sensory stimuli through synapse signals between the spinal cord and the top-down/bottom-up neural pathways in the brain. Nerve cells in presynaptic neurons detect autonomic/somatic sensory stimuli and release neurotransmitters that trigger nerve receptors in postsynaptic nerve cells to receive and carry autonomic/somatic sensory stimuli through impulse signals that are transferred into the spinal cord. Interconnected receptivity in neurotransmission develops a *functional connectivity* that maintains neural communication processes by increasing the release of synapse nerve signals to further induce engagement with top-down/bottom-up neural pathways. Since top-down/bottom-up pathways relay autonomic/somatic sensory signals from the CNS/PNS, somatic sensory signals are transferred through top-down neural pathways towards the cerebral cortex whereas bottom-up pathways receive and transfer autonomic sensory signals in the subcortical areas of the brain. This

separation of neural pathways is a conversion process of autonomic/somatic sensory signals into involuntary and voluntary stimuli.

The relay and integration of autonomic and somatic sensory signals into involuntary/voluntary stimuli modifies top-down/bottom-up pathways into a sensory signal conversion process. Nerve receptors in sensory neurons convert stimuli into sensory synapse signals that is transferred as sensory stimuli through the spinal cord towards the brain stem. Spinal cord transmission in the brain stem initializes top-down/bottom-up neural pathways into a secondary conversion process to convert sensory stimuli into voluntary/involuntary sensory stimuli in the brain. Stimuli conversion in the brain stem occurs to engage the subcortical lobes as a third conversion process in identifying and organizing involuntary/voluntary sensory stimuli into autonomic/somatic stimuli information.

Top-down/bottom-up neural pathways are responsible for relaying autonomic/somatic sensory stimuli between the brain stem and the subcortical neural structures in the brain. Subcortical neural structures are located below the cerebral cortex. They consist of the hypothalamus and amygdala and are the main areas for processing and converting autonomic/somatic sensory signals into involuntary/voluntary stimuli. Top-down/bottom-up neural pathways correspond with the hypothalamus and amygdala to generate emotional and behavioral responses from involuntary/voluntary stimuli.

The hypothalamus contains groups of afferent/efferent nuclei that regulate the autonomic homeostasis of the body. Afferent nuclei relay autonomic and somatic visceral signals from other areas in the brain related to body functions involving blood circulation, hunger, metabolism, and the sleep-wake cycle. Efferent nuclei process visceral signals from neural and non-neural signals (electric/chemical synapses) to generate involuntary responses that correspond with voluntary responses, such as low blood sugar induced hunger that compels an organism to seek food.

The amygdala is responsible for identifying the positive/negative elements from physiological (autonomic) and behavioral (somatic) stimuli to elicit correlated emotional responses from both subcortical and cortical regions. For example, the experience of hunger (somatic) from low blood sugar (autonomic) produces physical discomfort (negative) triggering a voluntary behavioral response in seeking food. Consuming food increases blood sugar (autonomic) producing a positive sensation (somatic) by eliminating the physical discomfort from hunger.

Stimuli conversion between the hypothalamus and amygdala is an interconnected neuronal process to coordinate stimuli information from visceral sensory signals to generate corresponding behavior. Subcortical neural structures utilize autonomic/somatic stimuli from involuntary/voluntary responses to create subcortical stimulus activity that increases connectivity with the cerebral cortex to convert involuntary/voluntary responses into cognitive stimuli. Stimuli conversion in the cerebral cortex integrates subcortical stimuli information with higher-level cognitive properties to synchronize involuntary/voluntary responses with autonomic/somatic stimuli. This synchronization of stimulus activity cultivates higher-level

cognitive stimuli to develop an individuation process that produces divergent elements in neuronal processes.

Stimuli conversion within subcortical neural structures is a level 2 intermediate neuronal process to integrate top-down/bottom-up neural pathways with the cerebral cortex. Intermediate level 2 processes combine autonomic/somatic stimuli with involuntary/voluntary behavioral responses into a cortical stimulus that initializes higher-cortical areas associated with attention and perception in the cerebral cortex. The cerebral cortex thus integrates involuntary/voluntary responses from autonomic/somatic stimuli creating a cortical stimulus to engage higher cortical functions. This process gives rise to a level 3 stimuli conversion that modifies involuntary/voluntary responses into stimulus information to converge autonomic/somatic sensory signals from the subcortical neural structures with cognitive structures in the cortical lobes.

The cognitive process of stimulus information from involuntary/voluntary responses generates the physical and emotional experiences we perceive as conscious activity. In other words, we interpret conscious activity to be a result of the neuronal processes associated with stimuli conversion. As stimuli conversion between Level 1 and 2 are primarily autonomic neuronal processes, functional connectivity occurs in the CNS/PNS as a transmission mechanism to provide a foundation for neural network development that supports and maintains interconnected neural communication. Stimuli conversion is thus an autonomic function in neuronal activity facilitated by functional connectivity to transmit and converge sensory stimuli with other neural functions in the CNS/PNS. Functional connectivity is therefore a mechanism to interchange and converge sensory stimuli with the cerebral cortex to

coordinate sensory stimuli with stimulus responses. This suggests that neuronal processes associated with stimuli conversion are components of functional connectivity to converge autonomic/somatic sensory stimuli from the body. Subcortical/cortical processes convert autonomic/somatic stimuli into involuntary/voluntary responses to correspond with emotional and behavioral activity. Functional connectivity thus correlates with stimuli conversion to generate autonomic/somatic neuronal activity in the brain by interconnecting involuntary/voluntary stimulus activity with *stimulus-driven* and *goal-oriented* responses from the cerebral cortex that characterizes the external representations of conscious activity. The convergence of autonomic/somatic neuronal activity within the brain is the foundation in developing cognitive processes to be representations of functional connectivity to express conscious activity.

The conversion and transmission of autonomic/somatic stimuli to develop functional connectivity is a mechanism of conscious activity to generate new forms of sensory stimuli to establish top-down/bottom-up neural pathways to regulate neural activity in response to stimuli. Conscious activity is a causal element to induce functional connectivity in neuronal processes within the CNS/PNS. Neurotransmission is a process to transfer sensory stimuli through different levels of conversion while increasing communication with other nerve functions. The process of stimuli conversion to increase neural communication by transferring sensory synapse signals develops *functional connectivity* to maintain stimuli conversion between autonomic/somatic stimuli in the CNS/PNS and the cerebral cortex. Stimuli conversion in the brain creates *cortical pathways* extending from the top-down/bottom-up neural

pathways in the brain stem that influences how neurons in the cortical/subcortical areas responds to stimuli activity.

For this chapter, I will discuss the neurophysiological properties of the CNS/PNS to define synapse signals as a conversion process and its correlation with conscious activity to regulate sensory stimuli. I will then discuss conscious activity as an element of neuro-complexity and its influence on top-down/bottom-up neural pathways to produce divergent neural activity.

Chapter 1 Complex Segregation of the Cerebral Cortex in the Central Nervous System

The cerebral cortex is a dynamic attribute of the CNS responsible for higher-level cognitive functioning through segregated neuronal activity that integrates sensory stimuli into cognitive information. Stimuli activity generated by sensory neurons activates cortical neurons within the cerebral cortex to identify and interchange sensory stimuli into different forms of information. This interchange of sensory stimuli is facilitated by cortical brain regions to integrate stimuli information into neural responses in correlation of an organism's interaction with environmental objects.

The cerebral cortex is divided into two cerebral hemispheres comprised of six segregated cortical lobes in the sensory, motor, and association areas that process multiple forms of stimuli information through higher-level cognitive functions. Segregated cortical lobes splits neural communication with excitatory neurons and interneurons to exchange stimuli information from various sources in the brain with sensory-motor neurons. This increases functional connectivity between the subcortical structures and the cerebral cortex to "prepare

the sensory and motor system [in responding] to new environmental demands."[16] Cerebral segregation therefore *decentralizes communication* in the cortical lobes to create a neural channel that incorporates multiple functions and sources of information from different areas of the brain into a cortical junction point.

Decentralized communication further influences sensory-motor neurons to acquire divergent features in transmission of sensory stimuli to reflect the neuronal activity occurring in the cortical lobes. Divergency in nerve functions is therefore differential methods in relaying and exchanging stimuli information through various outlets in subcortical/cortical areas to create multiple lines of communication, or *cortical pathways* to maintain and regulate sensory stimuli in the brain. Decentralized communication thus leads to "stimulus-dependent temporally correlated activity"[17] that allows variant responses to arise from the cerebral cortex and cortical neurons. Variant responses indicates that the organization of stimuli information in the cerebral cortex is a mutual relation with neuronal processes in which the conversion and integration of sensory stimuli reflects an organism's conscious activity and experiences with the environment. The role of functional connectivity is thus a mechanism of conscious activity to generate *cortical pathway*s that are determined by "the amount of information that is stored in that [pattern] *about* a particular environment."[18] *Cortical pathways* are thus conjoined with

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[16] Thomas Elbert, William J. Ray, Zbigniew J. Kowalik, James E. Skinner, et al. "Chaos and Physiology: Deterministic Chaos in Excitable Cell Assemblies" *Physiological Reviews, Vol. 74, No. 1, January (1994):* 2.
[17] G.M. Edelman, G. Tononi, O. Sporn, "Connectivity and Complexity: the relationship between neuroanatomy and brain dynamics," *The Neurosciences Institute, Neural Networks* 13, 909-922, May (2000): 910.
[18] Adami, Christoph. "What is Complexity*?" BioEssays* 24: 1085-1094, (2002): 1087.

top-down/bottom-up pathways to generate feedback-feedforward responses between the CNS/PNS and the organism. Functional connectivity therefore coordinates cortical neurons with stimuli information from multiple brain regions to incorporate relativity in neural responses while increasing the connection and communication between an organism and the CNS/PNS. Increased connectivity between both pathways leads to neural synchronization to unify lower brain activity with cortical functions in the cerebral cortex.

Chapter 2—The Role of Conscious and Chaotic Activity in the CNS: How Conscious Activity Influences Neural Activity

Overview

Segregated cortical lobes in the cerebral cortex does not provides us with an understanding of *how stimuli information is processed* but they do provide a basis for understanding *how stimuli information influences cortical activity*. Or more specifically, they provide a basis for understanding how sensory stimuli activity influences *cortical pathways* and *neural synchronization* to maintain communication with the CNS/PNS. Neural synchronization is an element of conscious activity in which the functional connectivity combined with decentralized neural communication in the brain generates correlated responses to extraneous/visceral stimuli. The relation between functional connectivity and decentralized neural communication indicates that neural synchronization is a crucial element in conscious activity for increasing and maintaining the functional connectivity between the spinal cord and cerebral cortex.

The spinal cord functions as a conduit for stimuli activity from the CNS/PNS by connecting nerve functions from the body with the brain. Spinal nerves extend outward from spinal columns that transfer synapse signals from motor and sensory neurons into the brain creating a reciprocal pathway to provide a "structural substrate" for "dynamic interactions" to take place "between cell populations"[19] Sensory stimuli transmitted from the spinal cord are modified into distinct forms of information through cortical neurons in the cerebral cortex. Synapse signals discharge information from the brain through spinal nerves as various physical responses from the body. The spinal cord is thus a channel to interchange autonomic/somatic synapse signals with cortical neurons to coordinate with top-down/bottom-up neural pathways. This pathway allows sensory and motor neurons to exchange stimuli with the brain to incorporate different areas of the cerebral cortex "leading to spatiotemporal correlations within and between cortical areas" (910).[20] Correlated spatiotemporal structures in the cerebral cortex regulates cortical processes by converting stimuli activity into separate forms of information. Cortical processes are further influenced by top-down/bottom-up neural pathways to regulate involuntary/voluntary stimulus activity through the development of stimulus-driven and goal-oriented neural activity.

[19] G.M. Edelman, G.Tononi, O. Sporn, "Connectivity and Complexity: the relationship between neuroanatomy and brain dynamics," 910.

[20] G.M. Edelman, G.Tononi, O. Sporn, "Connectivity and Complexity: the relationship between neuroanatomy and brain dynamics," 910.

Top-Down/Bottom-Up Response Pathways & Conscious Activity

Top-down/bottom-up neural pathways are attributes of the CNS/PNS that correlate with conscious activity to support *goal-oriented* and *stimulus-driven* neural activity. Spinal nerves develop a feedback-feedforward communication with the brain to transmit voluntary/involuntary nerve signals from the CNS/PNS through sensory-motor neurons. This increases the functioning connectivity of top-down/bottom-up neural pathways to process and convert involuntary/voluntary stimuli into primary and secondary stimuli that are incorporated into *goal-oriented* and *stimulus-driven* responses that maintain feedback-feedforward communication with the CNS/PNS. The conversion of involuntary/voluntary stimuli into goal-oriented/stimulus-driven responses is a process of conscious activity that synchronizes involuntary-voluntary nerve signals with cortical neurons to process stimuli information into responses. In other words, conscious activity is an attribute of high and low-level dynamic complexity to develop and synchronize cognitive structures within the brain.

Stimuli conversion is a correlated process of top-down/bottom-up pathways that corresponds with attention and perception to produce primary-secondary information. Attention is a combined top-down/bottom-up mechanism of the PNS/CNS and the cerebral cortex that helps detect and differentiate relevant-irrelevant stimuli or *stimulus-driven* from *goal-oriented* neural activity. Attention is primarily a top-down mechanism to develop experiential awareness and modify neuronal responses by utilizing stored information to create an interconnection between the senses and higher-level brain activity. According to Pinto, van der Leij, Sligte, Lamme, and Scholte, attention does not function as a unitary component but as two independent attentional mechanisms in which “one system controls the deployment of

top-down attention, while the other system regulates attentional reactions to salient external events."[21] Results from the 936 subjects that participated in a visual search and attentional capture task case study support this claim by showing uncorrelated top-down/bottom-up response processes. Pinto et al. further argues that top-down attention "is controlled by cortical systems that can select information [from] a combination of several sources of input [with] a variety of goals and priorities."[22] This implies that top-down attentional responses are generated and supported by a functional connectivity between the cerebral cortex and the CNS, whereas bottom-up responses are a reflexive mechanism controlled by the PNS.

Uncorrelated top-down/bottom-up responses allow the organism to voluntarily select or discard information based on relevancy of past and current experiences. However, as top-down attentional responses are slower due to their connection with the prefrontal cortex, bottom-down attentional responses are reflexive and appear to "activate" top-down responses. In other words, without autonomic attentional signals from the PNS the cerebral cortex cannot regulate attentional activity or create perceptual responses inhibiting the ability to convert stimuli. Top-down attentional responses therefore cannot occur without receiving bottom-up attentional signals. Pinto et al. further suggest that top-down attentional responses are not a causal factor for conscious activity but are "under conscious control" [23] that is regulated by autonomic bottom-up attentional processes. This approach characterizes conscious activity as

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[21] Lamme, A.F. Victor, Pinto. Yair, Scholte. H. Steven, et al. "Bottom-up and top-down attention are independent," *Journal of Vision,* 13(3):16, 1-14, (2013): 8.
[22] Lamme, A.F. Victor, Pinto. Yair, Scholte. H. Steven, et al. "Bottom-up and top-down attention are independent," 9.
[23] Lamme, A.F. Victor, Pinto. Yair, Scholte. H. Steven, et al. "Bottom-up and top-down attention are independent," 9.

an attribute of autonomic neural functions in which bottom-up transmission of sensory stimuli trigger top-down response to convert sensory stimuli into different forms of information.

That conscious activity is associated with bottom-down attentional responses implies that stimuli conversion and feedback-feedforward neurotransmission are primary components in activating and engaging the body towards extraneous stimuli. This further implies that neural feedback loops give rise to conscious activity to converge sensory impulse signals with other sensory/motor neurons. However, the results from the visual search and attentional capture task test study from Pinto et al. indicate that top-down/bottom-up response pathways function independently and require interaction to generate conscious activity. As both pathways are independent, bottom-up pathways "may boost [conscious activity] but unlikely to be a sufficient condition for it."[24] Involuntary attentional signals transmitted through bottom-up pathways thus provides sensory stimuli to help "push" or trigger conscious activity while top-down interaction with neuro-cortical processes regulates involuntary signals to complete the feedback-feedforward loop allowing conscious activity to finally "appear."

I argue, however, that involuntary attentional signals do not drive conscious activity but rather the increased connectivity between the cerebral cortex and the CNS/PNS to create top-down/bottom-up neural response pathways. *Conscious activity is thus supported by top-down/bottom-up interaction and communication with the CNS/PNS to regulate stimuli activity by converging involuntary and voluntary nerve signals with the cerebral cortex.* Conscious activity therefore does not occur through stimuli regulation in the top-down/bottom-up neural

[24] Lamme, A.F. Victor, Pinto. Yair, Scholte. H. Steven, et al. "Bottom-up and top-down attention are independent," 10.

pathways but rather as a connective element *to regulate stimuli*. In other words, conscious activity does not arise from stimuli regulation but as a mechanism that regulates stimulus activity *through stimuli conversion*. Conscious activity is a mechanism that generates neuronal activity.

As the spinal cord is a stimulus conduit between the brain and CNS/PNS, spinal nerves coordinate sensory stimuli through top-down/bottom-up neural pathways that determine how neuronal processes in the cerebral cortex receives and integrates sensory stimuli as information. In other words, conscious activity regulates sensory stimuli based on *how it interacts with cortical nerve functions* which indicates that neural activity does not correlate with conscious activity but is instead correlated with nerve function of the CNS/PNS. Response pathways are the *mechanisms of conscious activity* to regulate neural activity *from the CNS/PNS*. Conscious activity is therefore *a process to regulate stimulus activity* from the CNS/PNS by coordinating neural response pathways with the brain to synchronize cortical nerve functions in the cerebral cortex with the CNS/PNS. Synchronization with the CNS/PNS creates a continuous flow of sensory stimuli to initiate neural response pathways and develop feedback-feedforward loops from the spinal cord. Conscious activity maintains this loop by incorporating all elements of cortical and neural activity into response mechanisms without a “boost” from bottom-up attentional signals. In other words, conscious activity functions to regulate feedback-feedforward communication between neural response pathways and the cerebral cortex regardless of how the brain receives neural activity from the CNS/PNS.

To further explain, I will discuss the functional connectivity between attention and perception as cognitive and emotional mechanisms that influence and regulate neuro-typical or atypical neuronal activity. This discussion will introduce aspects of divergent and unregulated neural activity associated with Attention-Deficit-Hyperactivity-Disorder as an example of how conscious activity regulates sensory stimuli and nerve functions by synchronizing top-down/bottom-up response pathways despite irregular communication between the pathways and the executive functions of the cerebral cortex.

Chapter 3—Top-Down/Bottom-Up Neural Regulation

Overview

Attention and perception are attributes of the cerebral cortex in coordination of top-bottom/bottom-up response pathways that influence the conversion of sensory stimuli into primary and secondary information. The brain interacts with the CNS/PNS to help regulate voluntary-involuntary responses, thus allowing an organism to differentiate relevant from irrelevant stimuli. The ability to differentiate stimuli is associated with top-down/bottom-up response pathways in coordination of attention and perception to convert relevant/irrelevant stimuli into primary and secondary information or "*stimulus-driven* and *goal-oriented* attention."[25] Conversion into primary-secondary information is an interconnected process to incorporate the senses and the neocortex (sense perception, cognition, movement, spatial reasoning) to integrate stored information and modify response relativity. This process generates connections in which "neural activity [that] directly relates to our perceptual

[25]Lamme, A.F. Victor, Pinto. Yair, Scholte. H. Steven, et al. "Bottom-up and top-down attention are independent," 1.

experience [reflects] the integration of [sensory] signals from the outside world [and] prior knowledge stored in our brains."[26] In other words, activity in the prefrontal and neocortex is an indication of attention responding to an accumulation of stimuli from the spinal cord. Attention is triggered by the PNS/CNS and corresponds with perception to organize primary-secondary information into *goal-oriented* and *stimulus-driven* response mechanisms. The CNS/PNS utilize *stimulus-driven* responses to regulate involuntary physiological processes such as reflex functions, the muscular system and cardiovascular system. The cerebral cortex, on the other hand, integrates *goal-oriented* responses to synchronize with *stimulus-driven* responses.

Attention and perception are thus cognitive components of conscious activity that synchronize top-down/bottom-up response pathways with the brain to allow the "detection, identification, and processing of stimuli and situations"[27] to generate coherent neural responses. As neural synchronization is an attribute of conscious activity to regulate nerve functions, it disproves the notion of conscious activity to require neural regulation to converge nerve signals between the brain and the CNS/PNS. Instead, it confirms that conscious activity is a mechanism that *regulates* nerve functions *in response to increased functional connectivity* between the cerebral cortex and the CNS/PNS. Neural regulation thus occurs in relation to uncorrelated top-down/bottom-up neural pathways to determine a balanced or unbalanced process of sensory nerve signals. The balance of neural pathway responses will also determine the development of either *goal-oriented* or *stimulus-driven* functional connectivity. In other

[26] Chris Frith, J. Dolan, Raymond. "Brain mechanisms associated with top-down processes in perception" *Phil. Trans. R. Soc. Lond.* B 352, 1221-1230, (1997): 1221.
[27] F.Dolcos, S. Dolcos, A. Iordan, "Neural Correlates of Emotion-Cognition Interactions*",* 669-694, (2011): 669.

words, top-down functional connectivity generates task-dominant neural regulation whereas bottom-up functional connectivity generates stimulus-dominant neural regulation.

The reciprocal interplay between top-down/bottom-up response pathways is a subcortical neural regulation process that determines the conversion and integration of sensory stimuli into the cortical lobes. Cortical brain connectivity incorporates attention and perception to produce passive and proactive responses that further influence neural regulation. As discussed previously, top-down/bottom-up response pathways are uncorrelated and rely on conscious activity to manually synchronize responses in the brain. Uncorrelated pathways allow voluntary-involuntary nerve signals to influence an organism's responses in identifying stimuli information as either relevant or irrelevant towards its intended goal. This indicates a possible mode of dominant neural regulation correlated with voluntary-involuntary nerve signals that influences how conscious activity utilizes attention and perception to integrate stimuli information. Defining a dominant state of neural regulation will include a discussion on top-down/bottom-up connectivity with the brain and how varying attributes in neuronal divergency influences conscious activity.

The common approach to top-down/bottom-up neural pathway responses is to correlate the bottom-up transmission of involuntary nerve signals from the PNS to trigger or "push" responses from conscious activity through top-down voluntary nerve signals. This creates a feedback-feedforward loop for conscious activity to "emerge" from regulated neuronal responses. For conscious activity to emerge from this feedback-feedforward loop, there must be a top-down dominance in neural activity in which cortical neurons send modulatory signals back and forth to sensory neurons in the body so that they "increase their

response fidelity and thereby promote attention to particular sensory stimuli." This suggests that "each neocortical area is unique, and interacts with other areas by specific and focal transmissions"[28] Top-down neural dominance is thus a sustainment of attention on task-related and goal-oriented behavior. Cortical neurons within top-down dominance rely on bottom-up nerve signals to engage the higher brain structures in the cerebral cortex to process and influence the functional properties of sensory and motor neurons within the CNS/PNS. Interaction between cortical neurons and bottom-up nerve signals activates the cerebral cortex into "a specific working mode" to perform "different calculations [in] accordance to immediate sensory and behavioral context."[29] This working mode brain state of the cerebral cortex is a form of neural regulation associated with a top-down neural dominance. Conscious activity therefore occurs to convert and synchronize sensory stimuli primarily through top-down neural pathways to create a working mode brain state in the cerebral cortex. Top-down neural dominance thus implies that conscious activity is a product of neuro-cortical structure dominance or neuro-typical regulation that converts sensory stimuli to reflect task-related and goal-oriented behavior. However, unregulated neural activity in the midbrain deviates from this working mode brain state in the cerebral cortex, and this causes disconnected communication between top-down/bottom-up pathways.

[28] L. Bressler, Steven Richter, G. Craig, "Interareal oscillatory synchronization in top-down neo-cortical processing," *Current Opinion in Neurobiology*, 62-66, (2015): 63.
[29] Gilbert D, Charles. Sigman, Mariano. "Brain States: Top-Down Influences in Sensory Processing," *Neuron 54*, June (2007): 677

Disconnected communication with top-down/bottom-up pathways cause neural activity in the midbrain and the cerebral cortex to deviate from top-down cognitive functioning that affects the neural processing between the midbrain and the cerebral cortex. The midbrain is a region of the brainstem below the cerebral cortex that consists of dopaminergic neurons and neural pathways that create a convergence point between the brain and the spinal cord. Dopaminergic neurons are a group of nerve cells that release dopamine neurotransmitters to regulate voluntary movement, connecting behavior with reward stimuli, maintaining attentiveness to external salient stimuli, and emotional regulation. The segregated regions of the cerebral cortex establish cognitive patterns that involve "choosing specific behavioral responses, learning reward associations and behaviors, and transforming new behaviors into habits"[30] by interacting with excitatory/inhibitory cortical neurons to receive or block dopaminergic impulse signals. Dopaminergic activity within the segregated regions of the cerebral cortex and the midbrain creates a dopamine system to formulate an interconnection between "reward processes, non-reward cognitive processes and motor processes."[31] MRI images of individuals with ADHD also show anatomical differences in their gray matter volume as compared to individuals without ADHD.

Reduced gray matter causes an interference in communication between cortical and dopaminergic neurons that disconnects top-down/bottom-up neuronal processes causing an increase of unregulated top-down/bottom-up nerve signal transmission. This reduces the influence from top-down neural regulation to develop a sufficient working mode brain state in

[30] Predrag Petrovic. Xavier F. Castellanos, "Top-Down Dysregulation—From ADHD to Emotional Instability," *Hypothesis and Theory*, 23 May (2016): 15

[31] Predrag Petrovic. Xavier F. Castellanos, "Top-Down Dysregulation—From ADHD to Emotional Instability," 15.

the cerebral cortex. Does disconnected top-down/bottom-up neural pathways prevent neural synchronization? In other words, does ADHD cause the brain to be incapable of experiencing synchronized neural activity that allows an individual to regulate their cognitive and behavioral responses? Since conscious activity is a mechanism to convert and integrate sensory stimuli into multiple forms of information, ADHD does not necessarily prevent the brain from experiencing synchronized neural activity or neuro-typical regulation, but it may make it incapable of experiencing *a unified state of synchronized neural and cognitive activity*. Conscious activity responds to atypical neural activity through bottom-up neural pathways and utilizes cognitive components to manually regulate neuronal processes despite disconnected top-down/bottom-up pathways in the midbrain and the cerebral cortex.

Chapter 4—Typical & Atypical Conscious Activity

Overview

Neural regulation is a modulation process over nerve functions between the brain and the CNS/PNS to suppress or cultivate neuro-cognitive components that underlie emotional and behavioral experiences. The spinal cord transmits nerve impulse signals through top-down/bottom-up pathways to engage cortical neurons and neuro-cognitive components in the brain that generate *stimulus-driven* and *goal-oriented* responses. Cortical neurons trigger neuro-cognitive components to convert autonomic-somatic stimuli into primary and secondary information that allow the organism to directly respond to sensory stimuli based upon experiential relevancy. *Neural synapses are thus transmitted with the potential to become information*. If neural synapses carry potential information, it does not require regulation to transfer and convert impulse signals into sensory stimuli. *Stimuli conversion can therefore occur*

with either interconnected or disconnected neural functions. Furthermore, as top-down/bottom-up pathways are outlets to exchange *stimulus-driven* and *goal-oriented* responses, conscious activity manifests itself as a *synchronization process* to regulate stimuli conversion and establish an interconnected feedback-feedforward loop with the CNS/PNS. This interconnected loop engages with attention and perception to influence *stimulus-driven* and *goal-oriented* responses while processing autonomic nerve signals. Attention and perception thus influence *how neurons interact with the brain* with either a balanced or deregulated connectivity in the brain. In other words, how neuro-cognitive components process nerve signals from cortical neurons determines how conscious activity regulates our responses to stimuli. In this chapter, I will explain how I experience ADHD brain functioning to demonstrate, and to define, how neural regulation is a process of conscious activity that modulates all forms of neuro-cognitive responses to stimuli information. *Neural regulation does not refer to nerve functions but how nerve functions influence conscious activity to regulate neural responses*.

In top-down neural regulation, conscious activity works with dopaminergic neurons in the midbrain to develop a working mode brain state in the cerebral cortex to sustain attention towards task-related and goal-oriented behavior. Cerebral segregation is connected by gray matter and cortical neurons to create a dopamine system that regulates dopaminergic impulse signals that establish interconnected communication to modulate voluntary/involuntary nerve signals from the CNS/PNS. With ADHD, reduced gray matter allows autonomic/involuntary nerve signals to disrupt nerve signal transmission in the top-down/bottom-up pathways that directly influence communication between dopaminergic neurons and cortical neurons. Conscious activity, therefore, regulates and synchronizes unregulated neuronal activity with the

cerebral cortex through disconnected neural processes that utilize cognitive functions to integrate stimuli information through task-related and goal-oriented responses. Conscious activity in ADHD thus regulates top-down/bottom-up nerve signals through stimulus-based neural synchronization with the cerebral cortex.

Unlike neurotypical processes that are regulated through interconnected top-down/bottom-up communication, atypical processes correlate with unregulated neural connectivity caused by an interference in top-down/bottom-up nerve signals. Unregulated processes increase neuronal activity in the cerebral cortex that interferes with nerve signals from dopaminergic neurons in the midbrain. This leads to disconnected top-down/bottom-up nerve signal activity in which neural communication between the brain and CNS/PNS is controlled by stimulus-driven neural activity marked by insufficient utilization of goal-oriented neural activity from the cortical lobes. Unregulated neural signals do not, however, indicate a loss of nerve functions such as in abnormal brain function or neurodegenerative diseases, but the inability to organize stimuli information and develop goal-oriented neural synchronization. Conscious activity in ADHD therefore generates stimulus-based synchronization.

Stimulus-based synchronization in ADHD reflects how stimuli activate goal-oriented neural processes to integrate top-down information into goal-oriented responses. Although unregulated nerve signal activity prevents goal-oriented neural synchronization, functional connectivity maintains access to cognitive functions for conscious activity to regulate stimuli information through atypical neural processes. An aspect of atypical neural regulation is balancing the interactions between sensory-cortical neurons by “distracting” bottom-up nerve signals through cognitive functions, such as attention, to manually create a pathway for top-

down nerve signals to communicate with the cerebral cortex. This process to "distract" bottom-up nerve signals does not strengthen top-down neural pathways or regulates stimuli information but works instead to increase neural activity between pathways. "Distracting" bottom-up nerve signals thus involves using activities, such as music or other media, to provide background stimulation for bottom-up sensory nerve signals, which helps to induce focus on task-related activity by increasing stimulus-driven cognitive functions to correspond with goal-oriented cognitive functions. A second aspect of atypical neural regulation is a cognitive process of using salient stimuli to help accomplish task-related goals.

Unregulated nerve signals in ADHD disconnects top-down/bottom-up pathways by causing deviated nerve signal processing and the formation of a functioning working mode brain state. Developing a working state through deviated nerve signals thus requires the use of cognitive components to create a "*working brain space*" rather than a "working mode brain state." A working brain space involves utilizing various forms of stimuli information to help facilitate a task or goal-oriented behavior but requires a manual process to guide stimuli information towards goal-oriented activity. Conscious activity accomplishes this process by connecting a stimulus-based perception with stimuli information to guide top-down nerve signals into a working brain space. However, deregulated neuronal processes and disorganized stimuli information interferes in sustaining top-down comprehension (or control) of information causing those with ADHD to experience a cognitive instability or a "stimulus conflict."

For example, reading a book on astrophysics triggers intrusive subject-related thoughts that interfere with my weak comprehension forcing me to start over and repeat the process. I

mitigate these interruptions with a method to counterbalance the “stimulus conflict” by engaging those thoughts with the information in the book by underlining terms and paragraphs to write separate annotations on how these “extra” thoughts connect with the book. This counterbalance method is a stimulus-based cognitive process to manually engage top-down neural processes that would normally prevent a stimulus conflict from occurring.

In relation to my previous discussion in Section 1 on the DSM-V classification of ADHD as a neurodevelopmental disorder that impairs cognitive functioning, the ability to manually engage top-down neural processes through divergent cortical pathways indicates that cognition in ADHD is not impaired due to abnormal brain development as divergent methods of communication are stimulus-based cortical responses that correspond with bottom-up pathways to regulate stimuli information. Goal-oriented/top-down processes are used to support divergent functions. This further shows how functional connectivity is utilized through conscious activity to develop divergent processes in response to deregulated top-down/bottom-up pathways. Divergent conscious activity in ADHD therefore increases the functional connectivity of the cerebral cortex by incorporating stimulus-driven cortical pathways to help process and regulate stimuli information that cultivates into a stimulus-based neural synchronization.

Stimulus-based synchronization is a reversed method of neuro-typical regulation to increase nerve signal transmission from the PNS and generate divergent mechanisms in neuronal processes that substitutes goal-oriented cortical activity with stimulus-driven cognitive activity. Stimulus-based functioning in ADHD is characterized by disconnected

interaction within top-down/bottom-up pathways that produce unregulated neural activity in the cerebral and prefrontal cortex.

Disconnected pathway interactions are correlated with cerebral interference from low gray matter volume that causes deviated synapse transmission between inhibitory and excitatory neurotransmitters to intervene on blocking and receiving nerve signals that filter autonomic/somatic stimuli to allow “unfiltered” stimuli to accumulate in the brain. Unfiltered stimuli are autonomic/somatic nerve signals that are not organized into goal-oriented or stimulus-driven responses but as “all-purpose” stimuli that trigger responses from both top-down/bottom-up neural pathways causing a stimulus-conflict. The deviated communication from inhibitory and excitatory neurons removes the separation method of organization to replace goal-oriented processes with stimulus-driven neural activity as the primary structure to process stimuli information. This causes goal-oriented processes to become “inactive” by responding to stimulus-driven neural activity without directly influencing cognitive responses.

In other words, inactive goal-oriented processes are an access deficiency to higher cortical functioning from the prefrontal cortex due to autonomic/involuntary nerve signals reaching the brain faster than somatic/voluntary nerve signals. Divergent neural activity in ADHD therefore involves reversed neural processing and increased communication with stimulus-based cortical functioning that develops divergent cortical pathways to access goal-oriented cognitive functioning. Neuro-divergency is thus a response to *access deficiency* in the cerebral cortex to counteract stimulus-conflict caused by deviated synapse transmission from inhibitory and excitatory neurotransmitters. Access deficiency does not reduce functional connectivity but increases nerve signal activity in the cortical lobes to generate divergent

neuronal processes that function to counter-balance *stimulus-conflict* from disconnected top-down/bottom-up pathways. If neuro-cortical functions in ADHD develop divergent neural processes to counteract stimulus-conflict as a response to access deficiency in the cerebral cortex, neuro-divergency in ADHD could thus reveal a preexistent state of divergency in the cerebral cortex that determines the role of conscious activity with both typical and divergent neuro-cognition processes.

Section 3

Chapter 5: Neural Synchronization as the Foundation for Neuro-Typical and Atypical Conscious Activity

Overview

Communication between the cortical lobes and sensory-motor neurons is generates an interconnected neuronal network of stimulus-based or goal-oriented neural processes to converge the cortical lobes with the CNS/PNS. Inhibitory and excitatory neurotransmitters convert and regulate autonomic/somatic sensory stimuli as *stimulus-driven* (involuntary) and *goal-oriented* (voluntary) information to increase neural connectivity with cortical/subcortical functioning. This network-based functional connectivity allows conscious activity to configure multiple sources of information into goal-oriented or stimulus-driven responses. Functional connectivity via cortical communication is the primary mechanism for conscious activity to synchronize the top-down/bottom-up neural pathways with the CNS/PNS.

The neurotypical process to regulate stimulus-driven information with goal-oriented responses is coordinated by gray matter tissue to maintain neural communication in the segregated cortical lobes. Gray matter in ADHD, however, which in turn changes the process in

neural communication by causing deviated synaptic transmission between excitatory and inhibitory neurotransmitters. Reduced gray matter interferes with inhibitory neurotransmitters in blocking and receiving autonomic/somatic nerve signals causing the cerebral cortex to receive more autonomic signals than somatic signals. This increase of autonomic signals gives rise to reversed neural processing by developing stimulus-based cortical pathways that process and organize autonomic/somatic nerve signals as “all purpose” stimuli information to combine goal-oriented and stimulus-driven responses together. Combined stimuli responses eliminate the separated organization of involuntary/voluntary synapses, allowing autonomic nerve signals to override somatic nerve signals and leading to a stimulus-conflict in the cortical lobes. Stimulus-conflict is deviated neural regulation that causes an access deficiency to higher-level cognitive functioning causing goal-oriented processes to become “inactive” or respond to stimulus-driven neural activity without direct cognitive influences. Access deficiency and deregulation causes a state of *cerebral chaos*, or disunified functional connectivity, that disconnects top-down pathways to incorporate bottom-down pathways as the main response process. Disunified connectivity is not an indication of neural dysfunction but a reversed top-down/bottom-up neuronal responses. Disconnected top-down responses increases the influence from autonomic/involuntary nerve signals to cultivate a stimulus-based neural synchronization.

Spinal cord communication between the brain and the CNS/PNS in ADHD remains intact despite disconnected top-down neural processes. Conscious activity develops divergent cortical pathways by utilizing bottom-up neural pathways as the primary neural communication system. Neural regulation in ADHD is therefore based upon “unfiltered” neuro-cortical activity that

creates an accumulation of all-purpose stimuli information to combine goal-oriented and stimulus-based cognitive responses. If disconnected top-down pathways increase neuronal activity through bottom-up pathways to counteract deregulated processes, could this suggest that without top-down/bottom-up regulation the cerebral cortex would function as a disjunct mechanism of the CNS that receives stimuli as potential trigger points but cannot produce responses towards stimuli? If the development of top-down/bottom-up neural pathways is balanced but the midbrain is inactive, does the cerebral cortex receive sensory-motor stimuli from the CNS/PNS as potential stimulus-driven/goal-oriented nerve signals? In other words, without functional connectivity to converge each point of neural processing in the brain, the cerebral cortex is a disjunct neurophysiological component of isolated chaotic energy that remains idle until stimulus-driven neuronal activity compels it into a functioning state. The notion of cortical nerve functions as contained isolated chaotic energy within the cerebral cortex coincides with the dynamic neural network in the CNS/PNS will further determine the function of conscious activity and its role in stimuli conversion and neural synchrony.

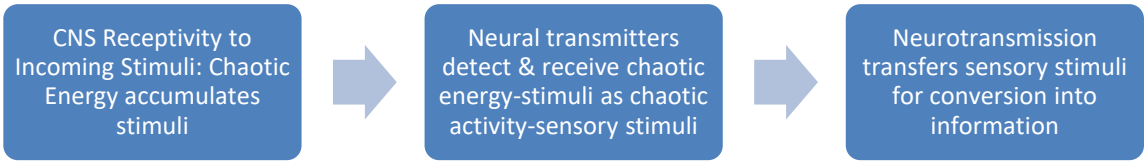
The function of conscious activity in ADHD is to regulate stimulus-conflict in the cerebral cortex by incorporating stimulus-based pathways to manually process and integrate information. This creates divergent qualities in neuronal processes in which stimuli conversion from disconnected top-down/bottom-up pathways do not directly regulate a stimulus-conflict but rather increases neuro-cognitive responses towards stimuli information. This would define stimuli conversion as a chaotic function of conscious activity to create new forms of stimuli to counterbalance a stimulus-conflict caused by disconnected top-down pathway regulation. The following chapter will analyze sensory chaos and chaotic activity as interpretations of sensory

impulse signals and synapses to discuss the chaotic correlation between sensory-motor neurons and conscious activity. Or more specifically, on how sensory impulse signals generates chaos in the CNS/PNS prior to stimuli conversion in the top-down/bottom-up neural pathways initiated by conscious activity to synchronize neurotypical/atypical functional connectivity.

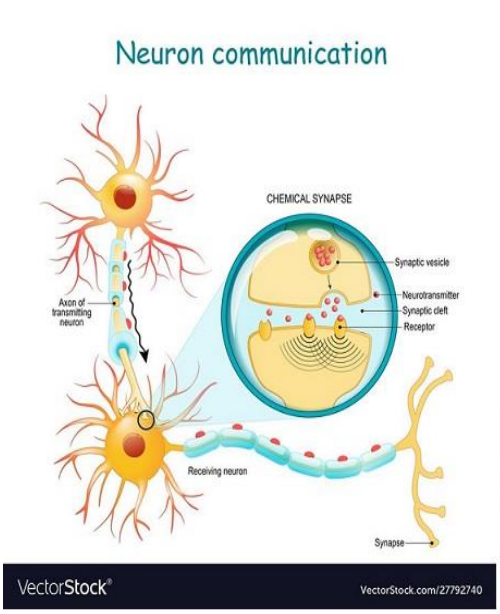
Chapter 6: The CNS/PNS & Conscious Activity as Chaotic Elements

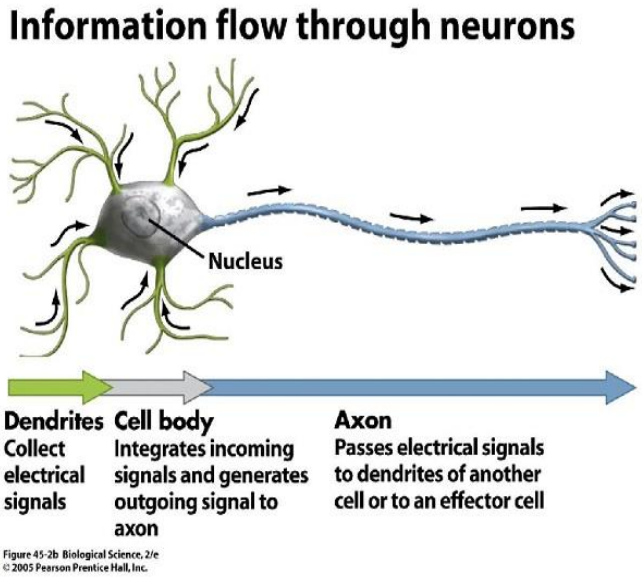
The CNS/PNS functions as a dynamic and chaotic complex system that generates both neurotypical and atypical "chaotic" system behavior in response to normal or deregulated neural processes. Sensory-motor neurons correspond as chaotic components of the CNS/PNS that process autonomic/somatic sensory stimuli through synaptic transmission to trigger neuro-physical reactions from the body we perceive as conscious activity. Physical reactions are autonomic properties correlated with the CNS/PNS but are not indications of conscious activity taking place as these reactions are involuntary and occur without conscious activity. However, the presence of neural activity is an indication that CNS/PNS is receptive to stimuli or *capable of receiving* stimuli. In other words, neural receptivity is an element of complexity to influence how nerve functions detect stimuli before transmitting it through the spinal cord. The sensitivity of nerve processes increases sensory receptivity that cultivates nerve cell chaotic energy to generate a consistent state of stimulus-driven responses from the CNS/PNS. Neurons are thus the primary response component to autonomic/somatic sensory stimuli to establish functional connectivity between the CNS/PNS and the environment. Physiological reactions and neuro-cortical responses therefore cannot occur without sensory receptivity to develop chaotic neural energy.

Chaotic energy is a causal property of neuro-complexity to instigate the initial process of sensory stimuli as potential components for stimuli conversion. Stimuli processing involves three parts: CNS/PNS sensory receptivity (stimuli assimilation), chaotic energy (stimuli accumulation), and neural processing (stimuli transmission).



Chaotic energy is the accumulation of sensory stimuli to form clusters of *potential* stimuli that initiates neuro-physical responses. Potential stimuli are extraneous or visceral input signals detected by nerve dendrites to trigger a presynaptic impulse from the nerve cells. Axons carry the impulse and release neurotransmitters to transfer the signal as a postsynaptic impulse that stimulate or inhibit other neurons to produce physical responses we identify as an expression of conscious activity. As chaotic attributes, nerve functions can deviate from this process through retrograde transmission in which dendrites of a postsynaptic neuron may release neurotransmitters to disrupt receptors of other presynaptic neurons and inhibit additional release of neurotransmitters. Blocked neurotransmitters lead to a reuptake or degradation of impulse signals where stimuli information is restored back into the axon or degraded by enzymes. Restored information returns as short-term potential stimuli for future use until it is also eventually degraded.





Chaotic activity is an oscillating force to push isolated stimuli particles into potential stimuli clusters triggering presynaptic signals that transmit sensory stimuli through postsynaptic impulses. The collaboration between neurotransmitters and postsynaptic impulses are primary factors in the integration process of chaotic activity as a symbiotic element to influence top-down/bottom-up neural pathways directed towards higher cognitive functioning processes in the brain. Symbiotic elements are indications of conscious activity as a "state space" of potential energy that corresponds with the CNS/PNS through neural components to create an overall system structure or "conceptual space [that] represents a full description of the system."[32] Conscious activity is a source to provide potential chaotic energy and modulate sensory stimuli through top-down/bottom-up pathways to regulate sensory-motor responses.

[32] Stephen H. Kellert. "In The Wake of Chaos: Unpredictable Order in Dynamical Systems" The University of Chicago Press, (1993): 8.

Each level of processing is a potential space for neurons to transmit sensory stimuli to other nerve functions.

The CNS/PNS is an interconnected network of sensory-motor neurons that constitutes the formation of top-down/bottom-up neural response pathways between the brain and spinal cord. Chaotic activity initiates the CNS/PNS by triggering the transmission of autonomic and somatic sensory signals through the spinal cord. Excitatory cortical neurons and dopaminergic neurons from the midbrain transfer autonomic/somatic sensory signals from the spinal cord into the midbrain-thalamic nucleus junction point as stimuli information to be relayed into the cortical/subcortical areas of the cerebral cortex. Stimuli information received by subcortical neural structures is further processed into the cortical lobes to connect stimuli information with neuro-cognitive functions. The transfer and coordination of autonomic/somatic signals from the midbrain-thalamic nucleus junction point with cortical/subcortical areas is a process that converges chaotic activity from the CNS/PNS with the top-down/bottom-up cortical pathways to regulate the interchange of stimuli between the midbrain and the cerebral cortex. As sensory-motor neurons receive autonomic/somatic sensory signals primarily as extraneous or visceral stimuli prior to neuro-cortical organization, autonomic/somatic sensory signals are triggers in the CNS/PNS to compel sensory-motor neurons that process chaotic activity as extraneous or visceral stimuli. Transmission of extraneous/visceral stimuli through sensory-motor neurons converts chaotic activity into *sensory chaos* in which signals are “unidentified stimuli” until they reach the cerebral cortex. Autonomic/somatic sensory signals from the CNS/PNS are thus transmitted with the *potential* to become “identified stimuli” that activates subcortical/cortical neuronal processes to transfer and create new forms of sensory stimuli.

Sensory chaos from the CNS/PNS is thus converted into *neuronal chaos* through top-down/bottom neural pathways by identifying and separating sensory stimuli into stimulus-based and goal-oriented information. Balanced or unbalanced top-down/bottom-up neural pathways will thus determine if stimuli conversion regulates or increases *neuronal chaos* in the cerebral cortex.

Communication between the CNS/PNS and the spinal cord is a neural process to activate neuro-cortical functioning by converting sensory chaos from the CNS/PNS into neuronal chaos/stimuli information in the cortical lobes. The balance of top-down/bottom-up pathways, however, determine how neuro-cortical structures respond and process sensory chaos. Balanced neural pathways are a stimulus barrier to regulate autonomic/somatic stimuli from the subcortical structures into stimulus-driven and goal-oriented stimuli information in the cortical lobes. Unbalanced neural pathways process autonomic/somatic stimuli as all-purpose stimuli information that causes a stimulus-conflict to occur in the cortical lobes. The separation of stimuli information is correlated with the segregated areas in the cerebral cortex to produce stimulus-driven/goal-oriented responses whereas all-purpose stimuli information is conjoined with the segregated areas to produce combined responses. If the cerebral cortex receives and processes stimuli information from both balanced and unbalanced top-down/bottom-up pathways to produce correlated responses, this may indicate that the cerebral cortex contains chaotic energy as a preexistent functional state of the brain to communicate with the CNS/PNS without top-down/bottom-up pathways. In other words, neuro-cortical structures are divergent elements with the ability to generate responses towards stimuli information from balanced or unbalanced neural pathways. Divergency in neuro-cortical structures would thus signify chaotic

energy in the cerebral cortex as a functioning state to process and integrate neuronal chaos. The development of top-down neural pathways therefore activates neuro-cognitive functions to regulate stimuli information/neuronal chaos while bottom-up neural pathways utilize neuro-cognitive functions to converge cerebral and neuronal chaos together. The transmission of autonomic/somatic sensory nerve signals from the CNS/PNS therefore generates *chaotic neural activity* to converge the cerebral cortex with the CNS/PNS.

Top-down/bottom-up pathways function as neuronal mechanisms to increase functional connectivity by developing a neural interchange between the mid-brain and spinal cord that transfers sensory chaos into neuronal chaos. This increases functional connectivity in the cerebral cortex supported by *primary* (sensory/motor), *secondary* (afferent stimuli), and *associative* (integration) areas of the cortical lobes to maintain stimuli interchanges within the segregated areas to form "the basis of cognitive functions" that generate responses as "optimally adaptable to perturbations in the external environment."[33] Neural interchange in the cerebral cortex is thus facilitated by neuronal chaos to induce communication with neuro-cortical functions to create cortical pathways that are "linked by long-range intrinsic connections"[34] of stimuli information from the top-down/bottom-up neural pathways in the mid-brain. Neuronal chaos increases functional connectivity in the cerebral cortex by merging cortical pathways with top-down/bottom-up pathways to coordinate stimuli information into

[33] Danielle S. Bassett, Michael S. Gazzaniga, "Understanding Complexity in the human brain," *Trends in Cognitive Sciences, Vol. 15, No.5,* May (2011): 200.

[34] G.M. Edelman, G.Tononi, O.Sporn, "Connectivity and Complexity: the relationship between neuroanatomy and brain dynamics," 910.

goal-oriented or stimulus-driven responses. Responses are thus "empirical relations between the environmental phenomena and the organism"[35] (Patten, 207) in which neuro-cortical processes correlate with extraneous salient stimuli through sensory-motor neural interactions. This network of neural pathways is a dynamic process to reflect *how* information is processed whereas the information itself is "always about something" causing certain pathways to "embody information about one environment"[36] and randomly responding to another. Merging the pathways between the mid-brain and the cerebral cortex regulates the sensory and neuronal chaos interplay through the integration of the primary, secondary, and associative areas to correspond with stimuli information.

Chaos as a functional state of the CNS/PNS is initiated by an accumulation of sensory-motor stimuli in the autonomic/somatic nervous systems. Extraneous and visceral sensory stimuli trigger nerve receptors to receive and transmit synaptic impulses as autonomic/somatic stimuli through the spinal cord to activate other nerve functions. Spinal cord transmission is a stimuli interchange with excitatory cortical neurons to transfer autonomic/somatic stimuli into the mid-brain and the subcortical/cortical areas. Transference into the mid-brain initiates top-down/bottom-up pathways to convert autonomic/somatic stimuli as information in the cerebral cortex. This conversion of sensory stimuli is a distribution of sensory and neuronal chaos to provide a basis for interconnected communication within the CNS/PNS. The transmission of sensory chaos is a process to integrate autonomic/somatic stimuli as neuronal chaos in the cerebral cortex. The balance of top-down/bottom-up pathways determine the

[35] Bernard C. Patten. "Systems Approach to the Concept of Environment," *Ohio J.Sci. 78(4), (*1978): 207.
[36] Christoph Adami. "What is Complexity*?" BioEssays* 24: 1085-1094, (2002): 1087.

activation of the cortical lobes to either regulate or increase neuronal chaos through the development of neurotypical or divergent cortical pathways. As components of neuro-complexity, neurons are not bound by conditioned structures to generate specific neural activity, thus allowing neuronal processes to produce neuro-typical and divergent behavior in correlation with top-down/bottom-up neural regulation. Divergent neural behavior is thus a secondary emergent property of neuro-complexity as "rules governing the behavior of the system [appear] to be fundamentally different and independent from the rules governing component [activity]."[37] Neuronal chaos is therefore a stimulus-driven element of conscious activity to induce various levels of divergency in neuro-cortical processes with the potential to produce divergent responses.

The correlated functioning between sensory chaos and conscious activity connects with the discussion from Section 1 on the medical definition of conscious activity associated with sensory-driven conscious states. Chaotic activity is a preliminary mode of conscious activity generated by the sensory receptivity in nerve cells towards extraneous/visceral stimuli. Chaotic activity is the reception and process of stimuli to initialize neuro-transmission and conversion. The process to convert and transmit stimuli produce physical expressions as a low-level body awareness responding to electrical synapse transmission that activates a neuronal response from the brain stem. This low-level synaptic transmission is a primary foundation for conscious activity to establish stimuli conversion as a function in developing interconnected

[37] W.W. Burggren, M.G. Monticino. "Assessing Physiological Complexity," *The Journal of Experimental Biology* 208, 3221-3232, 21 June (2005): 3224.

communication. Although chaotic activity does not induce a neuro-cortical response, communication with the brain stem converts chaotic activity into sensory chaos in which extraneous/visceral stimuli received by sensory neurons triggers the PNS to process sensory stimuli into autonomic synapse signals. The development and conversion of chaotic activity into sensory chaos is a process of conscious activity to induce a neuronal response that initiates a chain reaction of stimuli conversion. Once communication with the brain is established to convert chaotic activity into sensory chaos, neuronal processes function in correlation with conscious activity to increase neural connectivity in support of neuro-cortical development. Sensory chaos is thus utilized by conscious activity to generate the neuro-cortical pathways that cultivate the sensory-driven responses we associate with as a conscious state. The process to transmit sensory chaos through neurotransmitters is not to produce a response but to establish a network foundation that maintains stimuli transmission to expand conversion to other nerve functions. Conscious activity is therefore the presence *and* conversion of chaotic activity to expand interconnected communication throughout the CNS/PNS.

Conclusion

To identify conscious activity as a function of the neuro-cortical system quantifies certain attributes to arise and construct a "coherent state" to formulize system behavior at specific moments during current and future activity. The functioning properties associated with conscious activity are defined by "specifying the numerical value of all quantitative features [to] obtain a compact description of a [function] at a certain time."[38] For example, the Dendritic

[3838] Stephen H. Kellert. *In The Wake of Chaos: Unpredictable Order in Dynamical Systems,* (The University of Chicago Press, 1993), 2.

Integration theory from Section 1 deducts the neural correlates of consciousness by its association with increased thalamic activity and the firing of cortical neurons during an awakened state. The brain appears to experience a conscious state during specific neural interactions at a calculated moment of time. In relation to Information Integration theory, sensory information properties of the CNS/PNS are processed as phenomenal attributes that coordinate with neuro-cortical components to generate conscious states. Both descriptions are generalized dynamic chaotic system processes of neural properties that designate conscious activity as an "end result" of multiple causal interactions. Neurons as chaotic components suggests conscious activity is an emergent property of dynamic chaotic system processes. However, since chaotic properties are receptive to extraneous and visceral initial conditions, chaotic neural activity may produce irregular or aperiodic behavior with the potential to disrupt or impair conscious activity. This refers to my initial argument in Section 1 in that defining conscious activity as a property of neuro-physical processes is ultimately unreliable to support conscious activity. The qualitative aspects of neural processes in the CNS/PNS allow us to quantify chaotic activity and determine long term system behavior that we commonly associate as the emergence of conscious activity. The quantification of chaotic activity also indicates deterministic properties that underline the complex structures of dynamic systems in which neuronal and cerebral chaos i.e., conscious activity, is not an emergent property *of* complexity but an intrinsic element *to* complexity. Conscious activity therefore does not arise *from* neural or chaotic processes but is itself a complex chaotic property that initiates specific neural behavior characterized as being conscious activity—conscious activity is not a correlation with information but the *presence* of information. Neurons and neural processes are chaotic

components to indicate *the presence of conscious activity* through transmission and conversion of sensory-motor stimuli as sensory chaos into information-neuronal chaos in the cerebral cortex.

Neuronal chaos is the transmission of sensory chaos that influences the subcortical/cortical lobes to use various methods of stimuli conversion to integrate multiple forms of stimuli information. Conscious activity in the cerebral cortex is thus a process to maintain chaotic neural activity as a support system towards new stimuli information. In other words, the presence of conscious activity in the CNS/PNS is the development and integration of chaotic activity through extraneous and visceral stimuli from sensory-motor neurons. Each component of the CNS/PNS is an outlet or channel for conscious activity to produce sensory and neuronal chaos. If chaotic activity is developed and maintained in the CNS/PNS through sensory-neuronal chaos, this entails that the presence of conscious activity is the development of divergency to sustain neuronal processing in the CNS/PNS. Neuro-typical functioning in the cerebral cortex does not regulate stimuli information/neuronal chaos to prevent a stimulus-conflict but balances stimulus-driven and goal-oriented cortical responses. Chaotic activity within the cerebral cortex is an indication of a stimulus-conflict *before* or *without* the development of neuro-typical functioning. Divergent neuro-functioning in ADHD is a representation of the cerebral cortex without balanced cortical responses. Conscious activity is therefore the presence of chaos through various pathways of divergent functioning.

If conscious activity is the presence of chaos that instigates the development of neuronal functioning within the CNS/PNS, what is the relation between conscious activity and cognition that develops the subjective individuation we interpret as phenomenal

consciousness? If neuro-typical and divergent neuro-functioning influences how stimuli information is processed, how does neuro-typical/divergent functioning influence our interactions with the environment, specifically the notion of unconscious states as *autonomic conscious activity*? In other words, how do we embody conscious activity? By understanding the role of conscious activity in the CNS/PNS as a chaotic element in neuro-complexity to generate divergent neural properties we can begin to understand that conscious activity is a cognitive and phenomenological property that generates various modes of consciousness.

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GLOSSARY

Access Deficiency—disconnection of top-down neural pathways that removes direct influences from high-level cortical functioning in the cerebral cortex.

Adaptation—component fortification to enhance communication

Attention— a mechanism of the peripheral nervous system and prefrontal cortex associated with automatic reflexes and voluntary actions that influences judgement and decision-making to generate responses. *The ability to focus and differentiate relevant from irrelevant stimuli.*

Biocomplexity— an interactive relationship that responds to or influences the engagement between organisms and the landscape/environment.

Cerebral Chaos— a functional state of disunified functional connectivity in the cerebral cortex generated by an accumulation of unregulated *neuronal chaos* to initiate top-down/bottom-up neural pathways between the midbrain and cerebral cortex. Unbalanced/deregulated top-down/bottom-up neural pathways cause deregulated *neuronal chaos* that reinforces cerebral chaos as neuro-cortical functioning state. (*see neuronal chaos)

Cerebral Cortex—contains higher-level regions of the cortical lobes

Cerebral Segregation—separate cortical brain regions with specific and specialized functions. Cortical neurons generate functional connectivity to establish communication within brain regions.

Chaos—isolated elements within a system prior to conversion that drives elements towards interactive communication. An accumulation of sensory stimuli in the CNS/PNS with interactivity potential. *System chaos is the presence of potential information*.

Chaotic Activity—converted sensory stimuli into stimuli information. *Chaotic activity is generated and maintained by top-down/bottom-up pathways through reciprocal communication between the spinal cord and the brain. –See stimuli conversion.*

Chaotic State—a system of stability and instability that creates a vulnerable sensitivity to any change. *Chaos/chaotic state generates disproportionate or unpredictable outcomes.*

Complexity—interactive hierarchal organization. *All living organisms are complex systems.*

Component of Cognition— an aspect of conscious activity; converted sensory stimuli into separate forms of information. Cognitive components function to synchronize top-down/bottom-up processing with the brain. Cognitive components represent *chaotic* and *physiological-integration* or interactive engagement between an organism and the environment.

Communication—information exchange and preliminary organization. An ongoing redistribution of energy. *Communication is an aspect of order and required for organization to occur.*

Conscious Activity—conversion and synchronization of stimuli information/sensory chaos into cognitive components to create new information that generates chaotic activity. *Conscious activity functions as a precursor to engagement/consciousness.*

Consciousness—chaotic activity that maintains organization processes to sustain or stabilize *functional connectivity* and *neural synchrony*. Consciousness supports complex processes. *System engagement with the environment; applied cognition.*

Cortical Element—individual attributes or components of a larger system. Elements contribute to a system's overall behavior and functioning.

Cortical Lobes—six functional regions of the cerebral cortex containing sensory, motor, and association areas. Each region maintains neural processing associated with voluntary control of attention, perception, memory, problem solving, thinking, comprehension, language.

Cortical Pathways—organized neural activity in the brain

Chaotic-Integration—Environmental or external expression of a system level of complexity

Decentralized Communication—divided neuro-cortical communication of sensory stimuli in the brain due to cerebral segregation—*see cerebral segregation.*

Divergency—differential or alternative means of neural responses and brain function in the cerebral cortex. Divergencies occur with unregulated neuro-cortical activity with autonomic and somatic stimuli that increases cognitive functioning and stimuli information.

Feedback Loop—the convergence of sensory impulse signals into interactive components of information. Feedback loops provide support towards chaotic activity/consciousness.

Functional Connectivity—neuronal response to heighten neural communication by increasing impulse signals to activate and converge brain functions with the CNS/PNS. Generates neural synchrony.

Goal-Oriented Response—behavioral response associated with the CNS and the cerebral cortex that correspond with perception to produce voluntary and task-related actions.

Integration—system coordination towards a functioning or unified whole. *The process of consciousness to sustain communication.*

Irrelevant Stimuli—extraneous neural activity from nerve functions in the PNS that correspond with autonomic attentional reactions to generate *stimulus-driven* actions and behavior.

Involuntary Response—reflexive nerve reaction from the PNS to regulate autonomic physiological and sensory responses.

Limbic System—structures of the subcortical area that regulate brain functioning associated emotional, behavioral, and memory processing. This includes lower-level autonomic emotional/behavior functions that regulate reward pathways

Negative System Feedback—reduction of system output towards stabilization or original state of functioning

Neurons, Neural Activity—chaotic components/properties that receive and process information. Neurons assist with feedback loop system communication.

Neural Regulation—nerve function modulation to suppress or cultivates responses from neurons in the brain and the CNS/PNS.

Neural Synchrony—a functioning state of physical complexity generated through conscious activity by coordinating multiple brain regions into neural sequence patterns that regulate brain activity in the cerebral cortex. Neural synchrony reflects of how conscious activity maintains functional connectivity

Neuronal Chaos— the activation of top-down/bottom-up neuro-cortical functions that identify and regulate sensory stimuli from the CNS/PNS. Unbalanced top-down/bottom-up neural pathways generates unregulated neuronal chaos and *cerebral chaos* instability. (**see cerebral chaos)*

Neuronal Process—individual neural pathways that interconnect to form a functioning network

Nonperiodic Order—the fluctuation between stability and instability

Order—pattern formation, or applied pattern formation. *The establishment of integration based upon a system's state of functioning. An organized state over chaotic activity*

Organization—the process of integration. *The integration of information by way of successful communication between components.*

Perception— a process to configure multiple forms of sensory stimuli into comprehensive sources of knowledge. Interconnected senses and higher-level brain activity integrates stored information to develop experiential awareness and modify response relativity. *Perception generates meaningful connections within neural sequence patterns.*

Positive System Feedback—acceleration of system output in direction of change towards instability

Primary and Secondary Information—converted stimuli associated with voluntary/involuntary control attention-perception in top-down/bottom-up processing.

Relevant Stimuli—task-related neural activity that correspond with attentional perception to produce *goal-oriented* actions and behavior.

Response Pathways—a line of feedback communication to transfer synapse signals between CNS/PNS neurons and the cerebral cortex through the spinal cord to provide the groundwork for dynamic interactions—*see top-down/bottom-up response pathways.*

Response Relativity— neural responses associated with *functional connectivity* and *conscious activity* that reflects an organism's behavior and perception of its environment. *A precursor to embodiment/consciousness.*

Self-Organization—spontaneous internal pattern or production of order. *An internal production of order without the aid of an external agent. Self-organization is driven by a "preferred" mode of integration towards a state of conformity.*

Sensory Chaos—unidentified involuntary/voluntary sensory signals from the CNS/PNS that are transmitted with the *potential* to become "identified stimuli" or stimuli information through top-down/bottom-up neural pathways. *Sensory chaos* culminates into unregulated *neuronal chaos*

Stimulus Conflict—a cognitive instability due to an accumulation of unfiltered stimuli from autonomic/somatic nerve signals that are not organized into goal-oriented or stimulus-driven responses but as "all-purpose" stimuli.

Stimuli Conversion—conversion of stimuli into separate forms of information *(*see primary and secondary information*) through cortical lobes in the cerebral cortex based on stimulus type and relevancy to previous experiences. Coordinates with top-down/bottom-up neural pathways.

Stimuli Information—converted sensory-motor stimuli as cognitive components

Extraneous Stimuli Events—Environmental and physiological phenomena that stimulate the nervous system.

Stimuli Regulation—process of cognition to coordinate primary and secondary information with relevant stimuli and behavior

Stimulus-Driven Response—reactive behavior response associated with converged neural activity from the CNS/PNS.

Subcortical—neural structures of the Limbic System that process and regulate the relay of autonomic/somatic sensory information from other brain areas. Located beneath the cerebrum and the cerebral cortex

Top-Bottom/Bottom-Up Neural Response Pathways— voluntary control and sustainment of attention-perception towards relevant objects and environmental phenomena; transient and

automatic/involuntary control of attention towards irrelevant/salient objects and phenomena. *See *stimuli conversion*

Visceral Stimuli Events—sensory stimuli that originates from within the body. Transmission of sensory stimuli through neuro-chemical synapses.

Voluntary Response—combined nerve functions of the CNS and the cerebral cortex that correspond with cognitive components to integrate and synchronize stimuli information with top-down/bottom-up response pathways.