

# ALTERED STATES OF THE HUMAN MIND: IMPLICATIONS FOR ANTHROPOGENY

## Glossary

**Academic neuroscience:** a multidisciplinary science that is concerned with the study of the structure and function of the nervous system. It encompasses the evolution, development, cellular and molecular biology, physiology, anatomy and pharmacology of the nervous system, as well as computational, behavioral and cognitive neuroscience ([nature.com/subjects/neuroscience](http://nature.com/subjects/neuroscience)).

**Academic psychology:** a biological and experimental branch of science concerned with the mind, brain and behavior

**Adenosine:** a nucleoside that modulates many physiological processes.

**Adenosine receptor:** a membrane protein that signals when bound to adenosine. Caffeine chemically resembles adenosine and is an **antagonist** of this **receptor**.

**Agonist (pharmacology):** a molecule that activates a **receptor** rather than blocking or dampening it like an **antagonist**.

**Alcohol (ethanol):** a primary fermentation product of sugars in over-ripe fruit by yeasts and molds. The earliest alcoholic beverages produced by humans likely included mead and wines obtained from direct fermentation of diluted honey and fruit juices, respectively. This would have required the use of containers. Beer, on the other hand, requires a first step to produce fermentable simple sugars from starch. This can be achieved by malting, sprouting grain to obtain plant enzymes that are then used in mashing, the enzymatic digestion of starch into fermentable simple sugars. Malted grains and starch from tubers, banana, etc., can also be combined to produce alcoholic beverages. The use of symbiotic communities of bacteria and yeast (SCOBY, including Qu or koji) allows for the direct fermentation of grain and tuber starches to ethanol, such as in Chinese rice wine. Finally, distillation, a technology that is only a few thousand years, allows the concentration of alcohol into distilled spirits.

**Alcohol dehydrogenase:** a family of genes that, in humans, encodes enzymes that facilitate the first step of alcohol metabolism.

**Alcoholism (non-clinical definition):** consumption of alcohol that results in significant mental or physical health problems.

**Aldehyde dehydrogenase:** a family of genes that, in humans, encodes enzymes that facilitate the second step of alcohol metabolism. Variants of this gene are implicated in adverse reactions to alcohol consumption.

**Allosteric modulators:** molecules that bind to a site on a protein other than the substrate binding site and induce a change in the protein's shape.

**Altered states of consciousness (ASCs):** a change in one's normal (waking) mental state.

**Amphetamines:** psychostimulant drugs that alter the signaling by neurons and other cells. E.g., Adderall.

**Antagonist (pharmacology):** a molecule that blocks or dampens a biological response by binding to and blocking a

**receptor** rather than activating it like an **agonist**.

**Axon (Nerve Fiber):** In invertebrates, a long, slender projection of a **neuron** that transmits information (as electrical impulses) to different neurons, muscles, and glands.

**Barbiturates:** a class of drugs that act as a **central nervous system** depressant. E.g., Amytal.

**Basal Ganglia (Brain):** subcortical nuclei in the base of the forebrains of vertebrates, including humans, which are involved with a variety of functions including control of voluntary motor movements, procedural learning, and routine behaviors or "habits" such as teeth grinding, eye movements, cognition, and emotion.

**Benzodiazepines:** depressants that act via **GABA receptors** and produce sedation, induce sleep, relieve anxiety and prevent seizures. E.g., Xanax.

**Bright white light (BWL):** a light-based therapy to treat both **seasonal affective disorder (SAD)** and **non-seasonal depression**.

**Caffeine:** a natural alkaloid and insecticide produced by several unrelated plant species (coffee, tea, and cacao). It also functions as a **central nervous system** stimulant that reversibly blocks the action of **adenosine** on its **receptors**.

**Central nervous system (CNS):** the majority of the nervous system that consists of the brain, spinal cord, retina, optic nerves, and olfactory epithelium. The CNS integrates sensory information and coordinates and influences the activity of the body in bilaterally symmetric animals (all multicellular animals except sponges and radially symmetric animals such as jellyfish).

**Channel receptor:** proteins located in plasma membranes that form a passageway that can open or close to allow or stop the flow of particular ions across the membrane. (see also **receptor**)

**Chemical synapse:** a biological junction between neurons where signals are sent from cell to the next via release of chemicals (neurotransmitters).

**Cocaine:** a natural alkaloid and insecticide produced by the South American coca plant that also acts as a natural stimulant.

**Cognitive enhancers:** drugs that are used to improve memory, increase mental alertness, and concentration, and boost energy levels and wakefulness. E.g., amphetamines; nicotine; caffeine.

**Connectome:** a comprehensive map of neural connections in the brain

**Consciousness:** the waking state and awareness of existence.

**Contemplative neuroscience:** a branch of neuroscience that studies the effects of meditation and other forms of contemplation.

**Corticosteroids:** a class of steroid hormones. E.g., cortisol.

**Corticotropin-releasing factor (CRF):** a **neuropeptide** that regulates the hypothalamic pituitary adrenal (HPA) axis response, a major neuroendocrine system.

**Dopamine:** a **neurotransmitter** that is involved in reward circuits, motor control, and in the release of various hormones.

**DRD2:** a gene that encodes the **dopamine receptor D2** protein, a receptor targeted by many antipsychotic drugs.

**Drug addiction:** a chronically relapsing disorder characterized by loss of control and compulsive drug seeking.

**Dynorphin:** a class of endogenous opioid peptides that have been shown to play a role in the complex molecular changes in the brain that result from **cocaine** addiction.

**Dysphoria:** a state of unease or general dissatisfaction.

**Early-night wake therapy (EWT):** a sleep schedule therapy hypothesized to relieve **peripartum depression** by altering melatonin and sleep timing (sleep from 3:00 - 7:00 am).

**EMBODY Task:** the use of individualized machine learning applied to functional MRI data to measure diverse mental states during meditation.

**Etomidate:** an intravenous agent used for **general anesthesia** and sedation for short procedures that suppresses **corticosteroid** synthesis.

**Excitatory neurotransmitter:** a chemical messenger that increases the likelihood that the neuron will fire an electrical signal (depolarization of the membrane) called an action potential.

**Extended amygdala:** a paired macrostructure in the brain that is involved in reward cognition.

**GABA receptors:** a class of membrane proteins that act as receptors for the **neurotransmitter** GABA and are mostly found on inhibitory neurons.

**General anesthesia:** a combination of medications that put you in a sleep-like state before medical procedures.

**Global Neuronal Workspace (GNW):** a hypothesis that offers a simple connectomic scheme based upon the contribution of neurons with long-range axons to conscious processing. Their reciprocal interactions contribute to the formation of a global workspace, broadcasting signals from the sensory periphery to the whole brain, thus yielding "conscious" experience. The GNW hypothesis privileges cortical pyramidal cells with long-range excitatory axons, particularly dense in prefrontal, temporoparietal, and cingulate regions, that, together with the relevant thalamocortical loops, reciprocally interconnect multiple specialized, automatic, and non-conscious processors. Another important feature of this hypothesis is that the GNW activates in a non-linear manner, called "ignition," upon access to conscious processing. Ignition is characterized by the sudden, coherent, and exclusive activation of a subset of workspace neurons coding for the current conscious content, with the remainder of the workspace neurons being inhibited.

**Glucocorticoids:** a class of **corticosteroids** that are involved in stress response and are also a part of the feedback mechanism in the immune system. E.g., Dexamethasone (a synthetic glucocorticoid).

**Hyperalgesia:** increased sensitivity to pain.

**Hyperkatifeia:** pain, **hypohedonia**, **dysphoria**, anxiety, **hyperalgesia**, irritability, and sleep disturbances associated with drug abstinence following excessive drug taking.

**Hypocretin (Orexin):** a neuropeptide that regulates arousal, wakefulness, and appetite.

**Hypohedonia:** a diminished capacity for pleasure.

**Inhibitory neurotransmitter:** a chemical messenger that decreases the likelihood that the neuron will fire an electrical signal called an action potential. (See also **excitatory neurotransmitter**).

**Intersectional neuroscience framework:** a research framework that adapts procedures to be more inclusive of underrepresented groups through community engagement with diverse participants and individualized methods to accommodate neural diversity.

**Isoflurane:** a potent inhalational anesthetic used for induction and maintenance of general anesthesia. Works via **GABA receptors**.

**Late-night wake therapy (LWT):** a sleep schedule therapy hypothesized to relieve **peripartum depression** by altering melatonin and sleep timing (sleep from 9:00 pm - 01:00 am).

**Major depression (clinical depression):** a severe and persistent low mood, profound sadness, or a sense of despair lasting at least two weeks but usually much longer.

**Mescaline:** a potent psychedelic found in the **peyote** cactus. Structurally similar to **dopamine** and **norepinephrine** and also activates serotonin **receptors**.

**Mindfulness:** the state of being conscious or aware.

**Mindfulness meditation:** a meditative practice centered around being present in the moment.

**Negative reinforcement:** a response or behavior that is strengthened by stopping, removing, or avoiding a negative outcome or aversive stimulus.

**Neurotransmitter:** a chemical released by nerve cells to send signals to other cells.

**Neurotransmitter receptors:** a membrane receptor protein that is activated by a **neurotransmitter**.

**Nicotine:** a natural alkaloid and insecticide produced by several plant species (tobacco and jimson weed). It also functions as a **central nervous system** stimulant as an analog of the **neurotransmitter** acetylcholine.

**Nicotinic acetylcholine receptor:** a receptor polypeptide that responds to the **neurotransmitter**, acetylcholine, and also responds to **nicotine**.

**Non-seasonal depression:** depression that is not related to changes in the seasons.

**Nootropics:** so called "smart drugs" or cognitive enhancers that are claimed to improve cognitive function. E.g., Modafinil.

**Norepinephrine (noradrenaline):** a hormone and neurotransmitter that mobilizes the brain and body for action.

**Nucleoside:** glycosylamines corresponding to nucleotides lacking a phosphate.

**Pathogen:** a bacterium, virus, or other microorganism that can cause disease.

**Peripartum depression:** depression that occurs during pregnancy.

**Peyote (*Lophophora williamsii*):** a small, spineless cactus with psychoactive alkaloids (mescaline) that is native to Mexico and southwestern Texas.

**Postpartum depression:** depression that occurs after pregnancy. 15% of women experience depression after childbirth, making this the most common complication of childbirth.

**Presynaptic transport:** the transport of vesicles containing neurotransmitters on the presynaptic side prior to release of neurotransmitters into the synaptic cleft (**chemical synapse**).

**Propofol (Diprivan):** a short-acting medication, believed to work at least partly via **GABA receptors**, that is used for the starting and maintenance of **general anesthesia**, sedation for mechanically ventilated adults, and procedural sedation. Effects include decreased level of consciousness and a lack of memory for events.

**Psychostimulants:** a broad class of drugs that stimulate sympathetic nerves and whose effects can include increased movement, arousal, vigilance, anorexia, vigor, wakefulness, and attention. Some psychostimulants, especially at high doses and with a rapid route of administration, can produce euphoria, a sense of power and confidence, and addiction. **Cocaine** is a psychostimulant.

**Pyramidal neurons:** a type of neuron found in the mammalian cerebral cortex, the hippocampus, and amygdala of the brain. They are the most abundant excitatory cell type and receive both excitatory and inhibitory input.

**Receptor:** a molecule on the surface of host cells used by **pathogens** for attachment and/or invasion. Examples: angiotensin-converting-enzyme 2 (ACE2) used by **SARS-CoV-2**; **Sialic acid** used by **influenza A**.

**Rituals:** a sequence of activities involving gestures, words, actions, or objects, and are often traditional to a community or religion. In psychology, a ritual is a repetitive behavior systematically used by a person to neutralize or prevent anxiety.

**Seasonal affective disorder (SAD):** a type of depression related to changes in the seasons.

**Singing in tongues:** an act of religious worshiping through

glossolalia, a practice in which people sing or utter words or speech-like sounds, often thought by believers to be languages unknown to the speaker. Glossolalia is practiced in Pentecostal and charismatic Christianity, as well as in other religions.

**Structural homologs of brain neurotransmitters:** substrates that, by virtue of their chemical similarity to neurotransmitters, interact with receptors.

**Vasopressin (antidiuretic hormone):** a hormone synthesized in the hypothalamus and then transported to the blood to regulate extracellular fluid volume in the blood vessels and kidneys. It also plays a role in vasoconstriction. Vasopressin and oxytocin evolved from a single primordial neurohypophyseal hormone called vasotocin, which is present in lower vertebrates. Vasopressin, oxytocin, and their receptors are involved in regulating mating systems in several mammals.

**WEIRD:** people belonging to societies that are Western, Educated, Industrialized, Rich, Democratic, as originally proposed by CARTA member, Joseph Henrich.