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Behavioral, Pharmacological, & Systemic Treatment of Moderate to Severe Brain Injury: concepts, theory, practice

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Traditional theories of recovery of function from brain injury focus on reductionistic physiological mechanisms.

- 1) Resolution of edema / neurophysiological pathology
- 2) Synaptogenesis / Neuroplasticity
- 3) Neurogenesis: debunked
- 4) Functional reserve hypothesis
- 5) Equipotentiality

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The traditional schema represents a static system based on geography of localized function.

Individual capacities vs a systemic model of brain behavior.

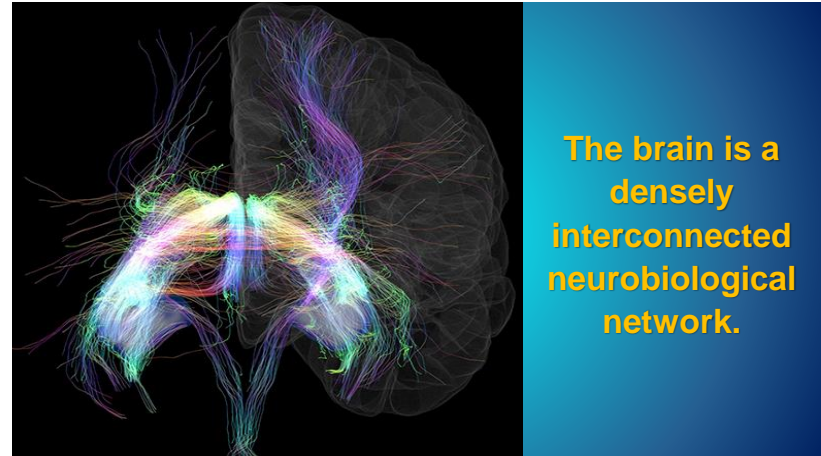
Does not advance a model of brain behavior but represents a deficit based viewpoint.

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What are we attempting to accomplish?

We are seeking to understand brain behavior and then use that understanding to foster recovery from brain injury!!!

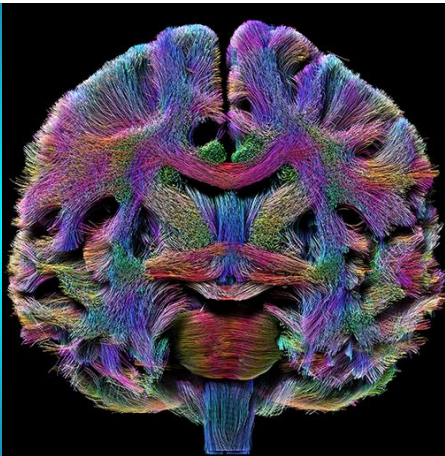
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The brain is a densely interconnected neurobiological network.

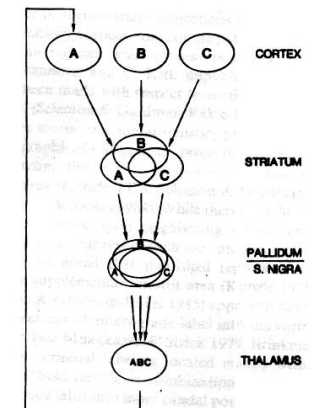
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This neurobiological system has been articulated, at least in part, largely within the realm of functional neuroanatomy.



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The modern conceptual articulation began with Alexander, Delong, and Strick's (1986) Article "Parallel Organization of Functionally Segregated Circuits Linking Basal Ganglia and Cortex".

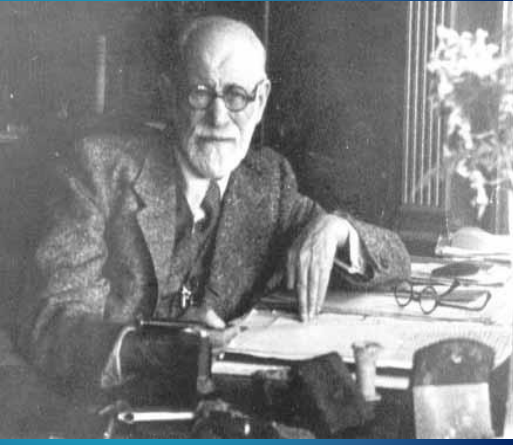


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Freud's 1895 "Project for a Scientific Psychology" the goal of which was "to construct a model of the human mind in terms of its underlying neurobiological mechanisms"

At that time Freud wrote "at some future date we shall have to find a contact point with biology"

(Samardzic & Nikolic, 2013).



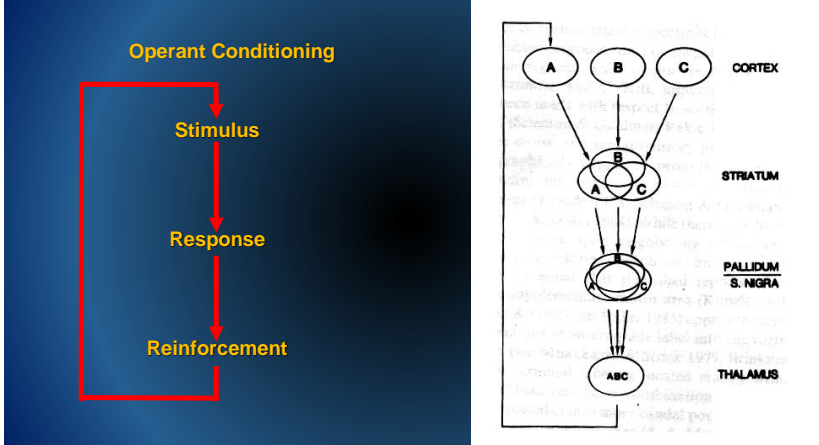
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Operant Conditioning

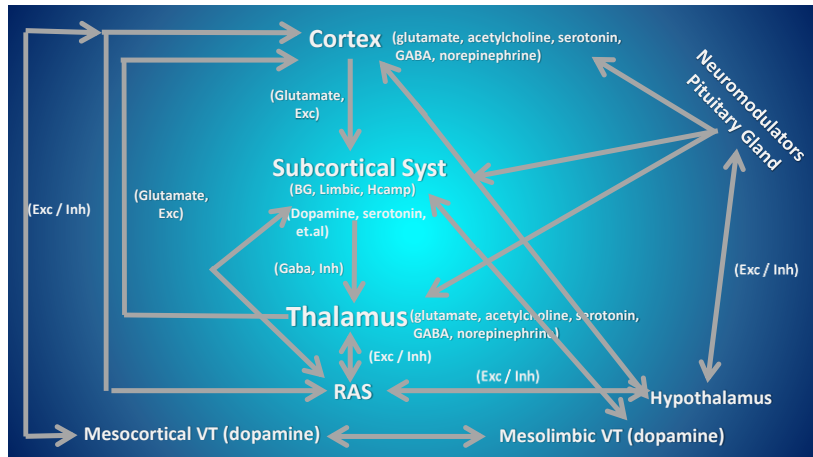
Stimulus

Response

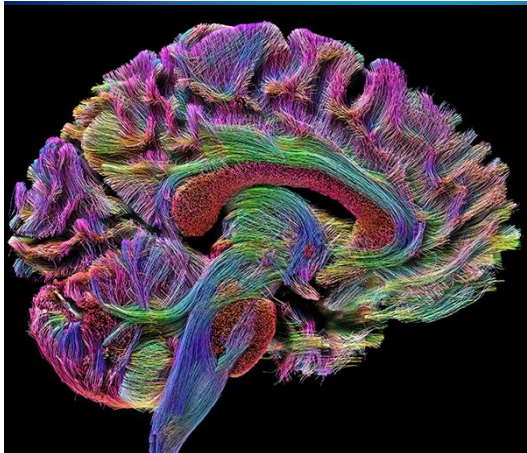
Reinforcement



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The basic tendency of this system would seem to be that of seeking control / regulation.

This fundamental propensity for control appears to exist on a micro to macro level continuum as do all neurobiological behaviors.

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A single neuron can adapt itself behaviorally to change / perturbation and retain that adaptive pattern.

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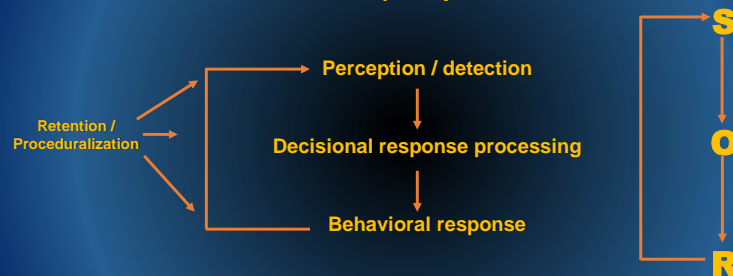
“Wisdom of the Body” W. B. Cannon (1926)

Homeostasis: the neuro-biological tendency to seek dynamic balance

Allostasis: the neuro-biological tendency to alter physiological parameters in response to perturbation to re-establish dynamic balance

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So behaviorally one can argue that this neuro-biological adaptive tendency functions microscopically and macroscopically as follows:



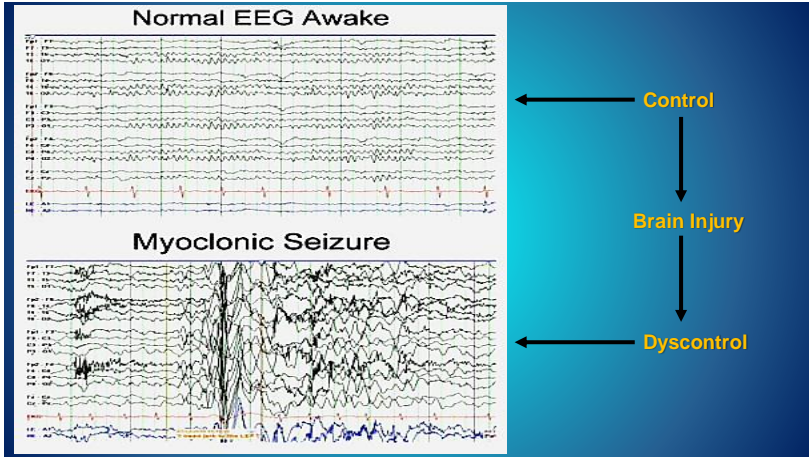
With the goal always being achieving regulation!

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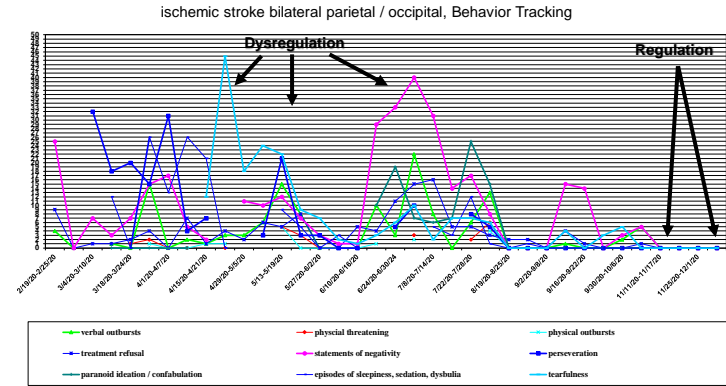
Brain Injury = control → dys-control

Recovery = dys-control → control

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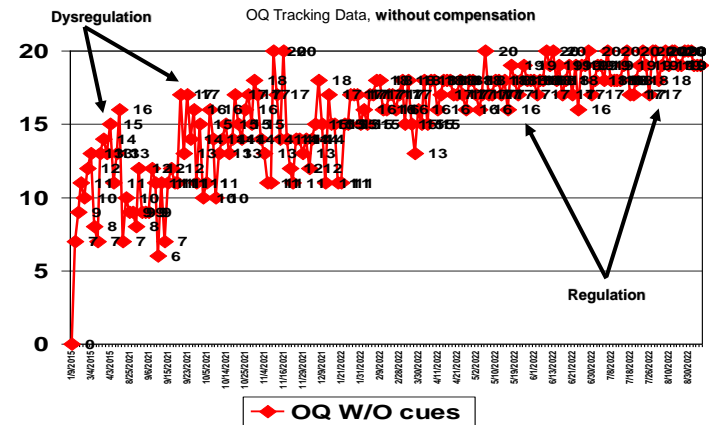
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How do we facilitate the propensity of the brain to seek regulation??

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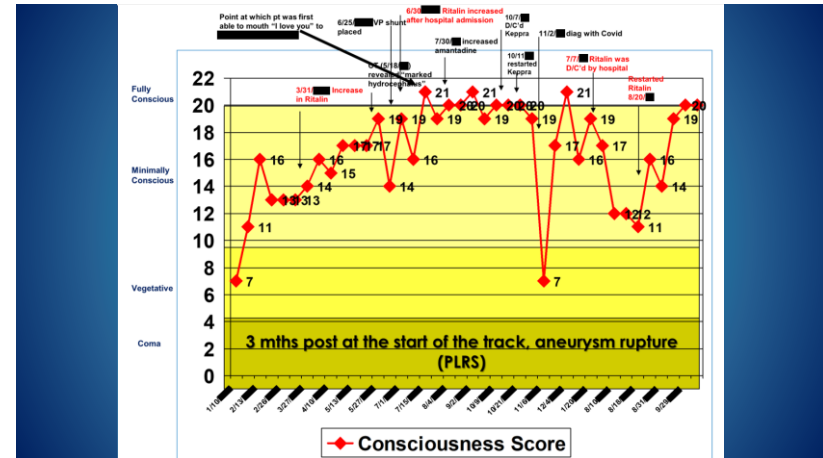


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Basic Assumptions of Treatment

- 1) The primary motivation of all human beings is to seek dynamically balanced control.
- 2) All Tx's / compensatory strategies should be focused on enhancing return to regulation.
- 3) All assessment procedures should be focused on capturing dysregulation and a return to regulation.
- 4) Always take an idiographic approach!

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Two avenues to gaining regulation:

- 1) Natural recovery of function:
 - I: synaptogenesis
 - II: resolution of secondary effects
 - III: homeostasis / allostasis
- 2) Compensation / Facilitation of Adaptivity:
 - I: behavioral intervention
 - II: environmental alteration
 - III: psychopharmacology

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Two areas of disorder / maladaptivity within the realm of compensation / facilitation:

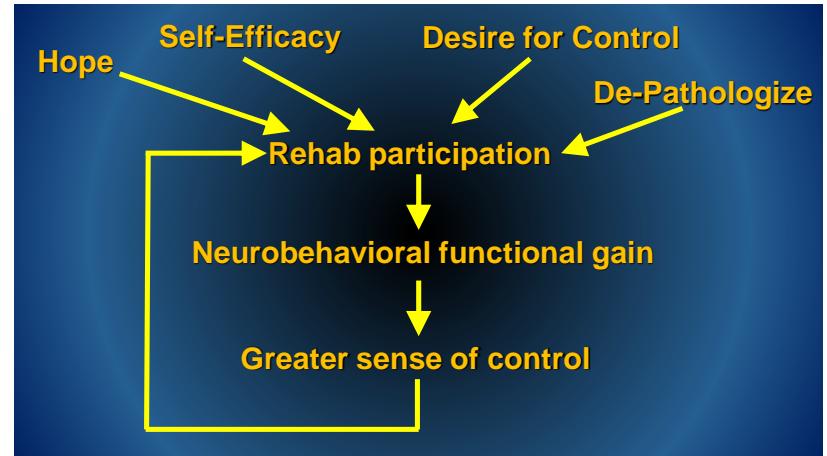
- 1) Behavioral / Psychological Disorder
- 2) Neurobehavioral / Neurocognitive Disorder

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Behavioral / Psychological Disorders / Interventions

- 1) Depression, anxiety, reactive emotional distress.
- 2) Enhancing / establishing self-efficacy expectations.
- 3) Familial adaptation and relation re-establishment.

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Neurobehavioral disorders

1. Hypoactivity/dysbulia vs Hyperactivity/lability
2. Anosagnosia vs full insight
3. Perseveration vs ordered behavioral sequencing
4. Stimulus boundedness/environmental enslavement vs cognitive/behavioral dys-control

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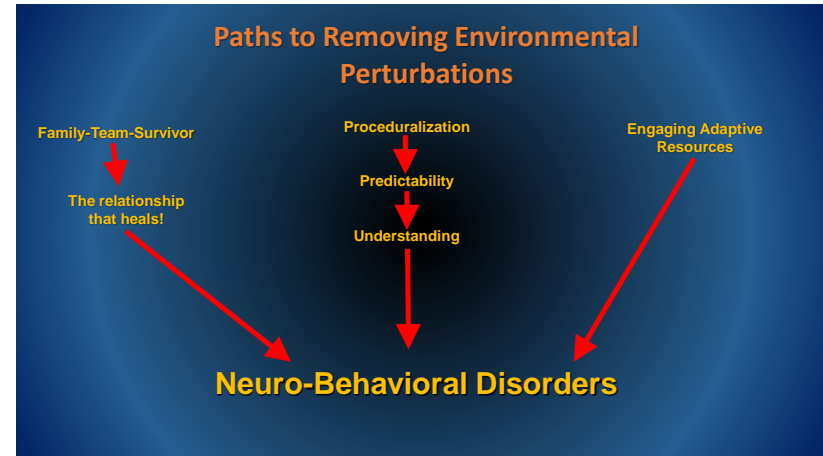
Systemic / Environmental / Behavioral Intervention for NBD's

- 1) Socio-emotional surround stabilization.
- 2) Environmental Proceduralization.
- 3) Resource Facilitation within the unit and within the community.

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- 1) Easily predictive environ / schedule.
- 2) Plays to the survivor's current strengths.
- 3) Precursus compensation for current weaknesses.

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Pharmacological Intervention

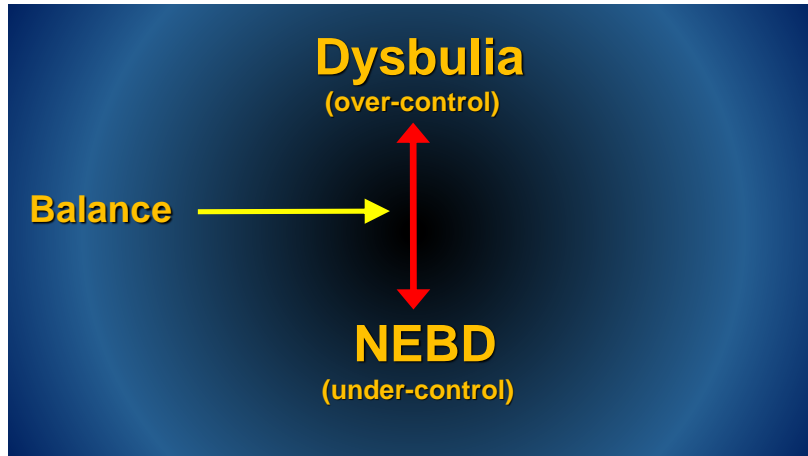
- 1) NEBD: neurogenic emotional / behavioral dysinhibition.
- 2) Higher executive dysfunction: attention, mental control, stimulus boundedness.
- 3) Other alterations of regulatory capacity: sedation, encephalopathy, insomnia, depression / anxiety.

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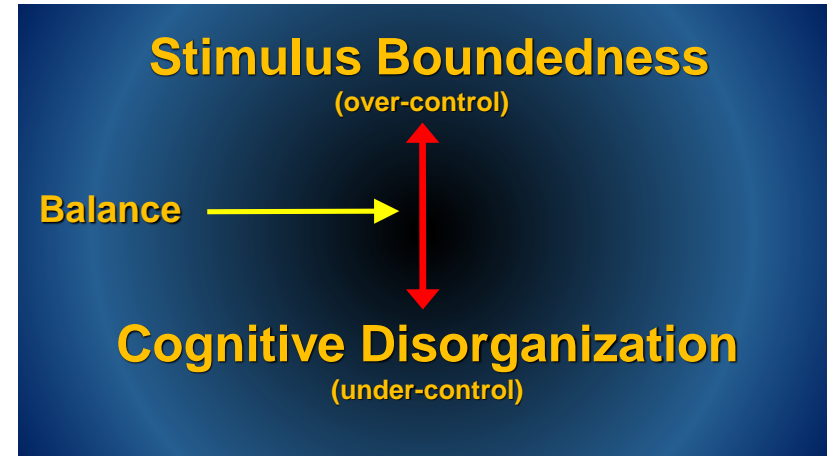
Pharmacological Intervention:

Balancing a dynamic interplay between inhibitory and excitatory forces

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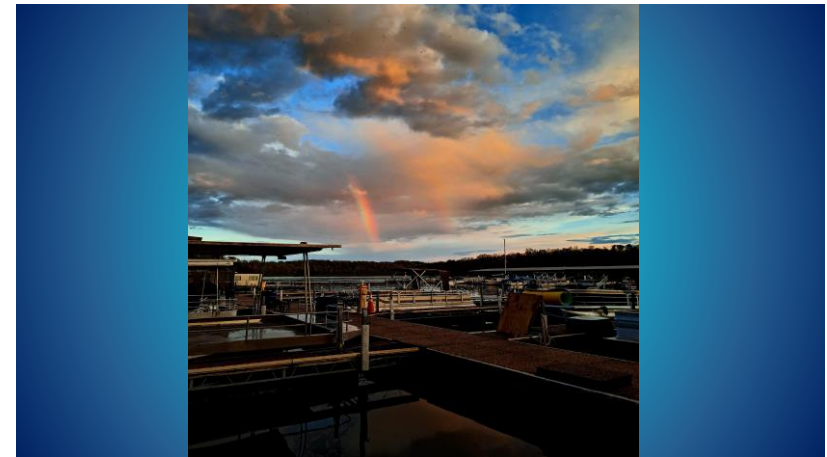


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Summary:

- Brain injury can be survived.
- Persons with brain injury can adapt.
- Taking a systemic / Idiographic approach is most likely to result in positive change.
- Its not just one thing that matters. It all matters.
- Always believe and hold hope closely!

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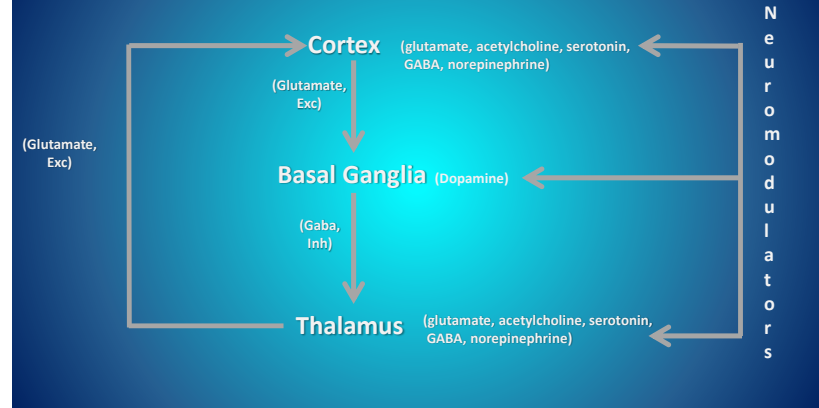
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This process then would theoretically imply a reciprocal neurobiological system with the following functional / behavioral parameters:

- 1) An internal / external monitoring system → sensory / perceptual
- 2) A reasoning and problem solving system → abstraction
- 3) A command and control system → int / ext initiation / regulation
- 4) A behavioral potentiation system → learning and memory

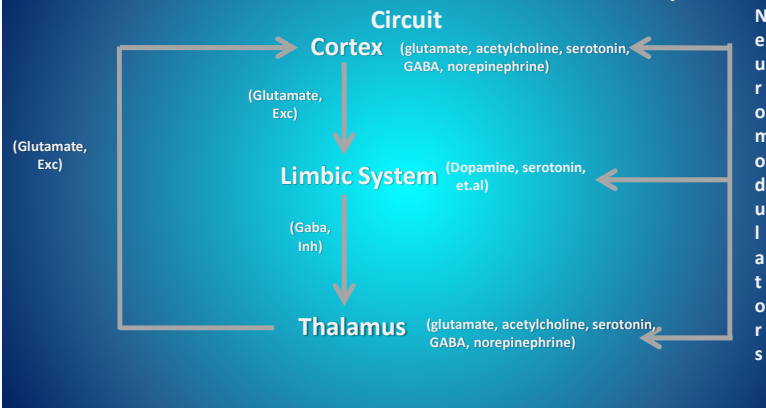
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Volitional Control / Decisional Process / Circuit



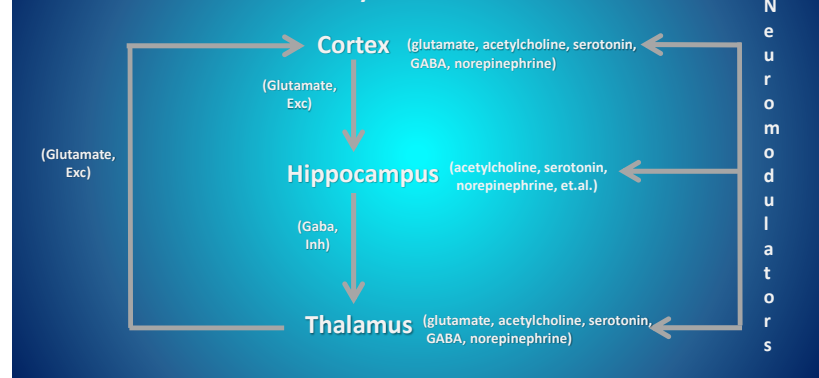
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Emotion / Affect Generation Process / Internal Perception Circuit



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Behavioral Potentiation / Experiential Permanence / Learning and Memory Process Circuit



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Neuronal Respiration

- 1) Glucose production via gut microbiome metabolism
- 2) Glucose transport via astrocytic action
- 3) Glycolysis producing ATP and lactate
- 4) Neuronal metabolism of ATP to release energy for neuronal operations
- 5) Astrocytic metabolization of lactate and ammonia
- 6) Then the process repeats

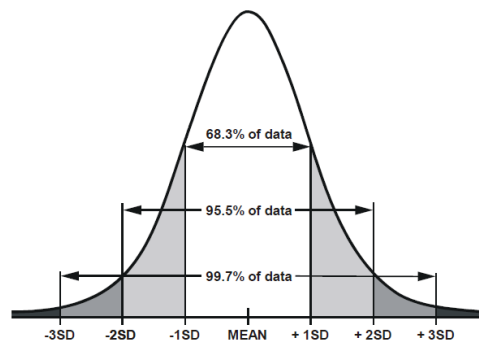
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The tendency to seek control is reflected in the observation that the neuronal respiratory system can respond to perturbations by altering the metabolic process to maintain neuronal energetics.

It can respond to loss of glucose by using lactate as a secondary energy source.

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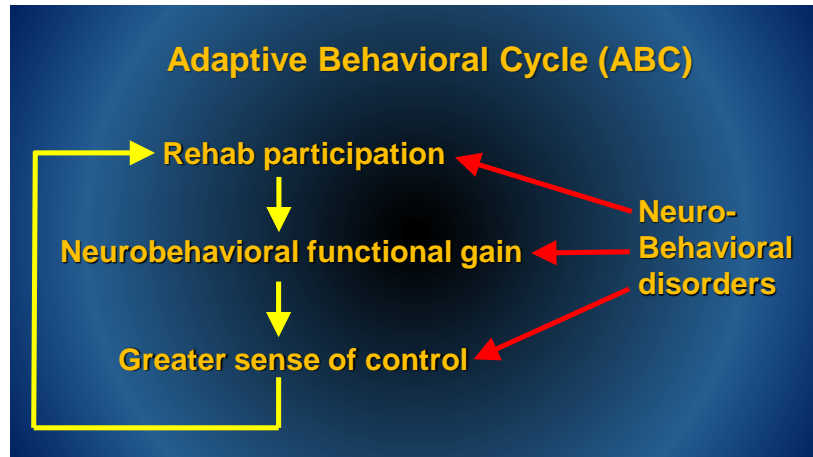
Areas under the normal curve that lie between 1, 2, and 3 standard deviations on each side of the mean



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- 31.7% of the sample falls outside of 1 SD from the mean.
- 65.8% of the sample falls outside of .5 SD from the mean.
- 82.9% of the sample falls outside of .25 SD from the mean.

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