Neurobiology and Treatment of Addiction 2015

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Times are Changing
- Treatment is at a different day. Professionals must understand new trends and the science to deliver appropriate treatment in today’s times.

NEUROSCIENCE
WHY IS IT IMPORTANT TO UNDERSTAND BASIC NEUROSCIENCE & NEUROGENESIS?

Brain Structure New 3D MRI

Neurogenesis
- 3 Possible Ways to Promote Neurogenesis – and thus Healing – In Our Brains
  1. Learn new things. When put in plain cages, the brains of Dr. Gould’s marmosets (another primate she works with) experienced decreased neurogenesis. When the same animals were transferred to an “enriched” enclosure with things like hidden food and a variety of toys, their brains, “...underwent radical renovations at the cellular level,” in less than four weeks. Learning a new language, hobby or new sport can help in regenerating brain functioning. Working puzzles, etc.

Neurogenesis
- 2. Anti-depressants- There is evidence that anti-depressants actually work by promoting neurogenesis.
- Exercise. Yes, you’ve heard this before. But according to article in BioEd online, physical exercise promotes the generation of new neurons (neurogenesis).

The Pill To Forget Bad Memories
- A drug which appears to erase painful memories has been developed by scientists.
- The astonishing treatment could help sufferers of post-traumatic stress disorder and those whose lives are plagued by hurtful recurrent memories.
- They also warned it could have damaging psychological consequences, preventing those who take it from learning from their mistakes

The Pill to Forget
- “It may perhaps be beneficial in some cases, but before eradicating memories, we must reflect on the effects that this will have on individuals, society and our sense of humanity.”
- Dutch researchers claim to have erased bad memories by using “beta-blocker” drugs, which are usually prescribed to patients with heart disease.
Vaccines and Treatment

How Vaccines Work
- Vaccines, for the most part, are preventative measures. They introduce a small amount of foreign cells into the body – not enough to overwhelm the patient, but enough to kick-start the immune system and give it an opportunity to develop the antibodies that create an immune response, according to the New York Times. The next time the foreign cells appear, the immune response will kick in and knock it out – theoretically.

Vaccines & Treatment

With a reduced amount of nicotine reaching the brain, fewer stimulants are released and the pleasurable, positive-reinforcing effects of nicotine are diminished, thereby making it easier to quit smoking.
- Pre-clinical studies with NicVAX have shown that vaccination prevents nicotine from reaching the brain and blocks the effects of nicotine, including effects that can lead to addiction or can reinforce and maintain addiction in animals.
- NicVAX, in combination with quit-counseling, has been clinically demonstrated effective.

Vaccines & Treatment

A group of scientists are working on a vaccine that could reduce addiction to one of the world’s most notorious narcotics: HEROIN.
- Researchers at the country’s National Institute of Psychiatry say they have successfully tested the vaccine on mice and are preparing to test it on humans.
- The vaccine, which has been patented in the US, makes the body resistant to the effects of heroin, so users would no longer get a rush of pleasure when they smoked or injected it.

Vaccines and Treatment

Are Vaccines the New Drug Addiction Treatment?
- Vaccines are a popular focus in drug addiction treatment research. How wonderful would it be if avoiding drug addiction or breaking free from dependence was as simple as getting a shot?
- Diligently, scientists are testing different substances to try and make the dream a reality. Some vaccines will be released in the next year.

Vaccines and Treatment

Nasal Spray and Tx

TRH (thyrotropin releasing hormone) works as a nasal spray to prevent suicides. TRH can help with depression, bipolar disorders and suicidal urges. TRH can help with depression, bipolar disorders and suicidal urges. Army now testing and release is anticipated in 2015

Vaccines & Treatment

Nicotine is a small molecule that upon inhalation into the lungs quickly passes into the bloodstream and subsequently reaches the brain by crossing the blood-brain barrier.
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Vaccines and Treatment

Cocaine vaccine could make drug addiction a distant memory
- The first ever vaccine for drug addiction has just been created. By combining a cocaine-like molecule with part of the common cold virus, you get a vaccine that turns the immune system against cocaine, keeping it away from the brain.
Vaccines and Treatment

Cocaine Vaccine

The vaccine was created by taking just the part of the cold virus that alerts the body's immune system to its presence, and then researchers connected the signaling mechanism to a more stable version of the cocaine molecule.

Vaccine against Alcoholism will be tested on Humans in 2013

- A vaccine targeting an enzyme that metabolizes alcohol is being developed by researchers. It could be trialed on humans and may prove as preventative against alcoholism.
- US researchers in October found out a genetic variation known as CYP2E1 that works against alcoholism and 10-20% of people possessing this genetic condition start feeling high after having few glasses of alcohol.
- The gene is prevalent in the brain and is believed to contain an enzyme that metabolizes alcohol.

New Science in Alcohol

Brain Hacking

- In the chilling not so distant future there will be capability to hack the brain and extract information. Using an EEG connected with designed software. This is attached to the scalp and scientists have been able to tap regions of the brain to gain information around sensitive information stored in your brain.

Ondansetron

Digital Pills

- FDA approved pill attachment that can be used to transmit information as to whether someone has taken their pills timely. Can be used for people that have problems with remembering meds or who have been medication resistant. Bi-polar disorders etc.

FDA Approved

Digital Meds

- The chip works by being imbedded into a pill. Ingest it at the same time that you take your medication and it will go to work inside you, recording the time you took your dose. It transmits that information through your skin to a stick-on patch, which in turn sends the data to a mobile phone application and any other devices you authorize.

Brain Mapping

- Scientists have identified an area of the brain called the caudate that is responsible for constant and repetitive and precise replay of events. Individuals with total life recall have been studied to show differing areas of their brain. (Mary Lou Henner.) They have identified 9 areas of the brain responsible for memory encoding and retrieval. Can be helpful in TX of OCD and other similar disorders.
Vaccines for Meth

- MethBlocker™ as it is administered as a quantum vaccine daily x 3 consecutive days and then every 10 days for 2 months at any age before age 14 to provide a LIFETIME immunity to developing dysfunctional behavior that leads to meth addiction.
- Any hidden dysfunctional tendencies and/or genetic predispositions are erased by MethBlocker™ programs that continue to run daily for that person’s lifetime. And QuantumMAN™ provides a lifetime guarantee of satisfaction with this quantum vaccine.

Brain Chemistry to Stop Addiction

- The discovery of a molecular "addiction switch" in the mammalian brain has the potential to control the addiction processes in drug addicts, say University of Toronto researchers.
- A study published Jan. 18 in the online edition of Nature Neuroscience finds that a region of the brain called the VTA contains receptors that, when exposed to a certain enzyme, can control the switch from an addicted to non-addicted state and back again. This goes against previous ideas that viewed drug addiction as a permanent change in the brain.

Psychogenitics and Treatment

- Patients are given a cheek swab for testing and based on their particular DNA the test determines which medication will be most appropriate.
- IT will provide indicators for best for use, use with caution and not recommended.

DNA and Treatment

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NEUROSCIENCE & ADDICTION

- Understanding the brain will be critical in future treatment of addiction and mental health disorders.

Your Amazing Brain

- Receives information – within a fraction of a second, too minuscule to measure
- Acts on the external universe – allows you to cry, walk, play a musical instrument
- Utilizes language – one of your most advanced functions
- Possesses emotions – creates your affective universe

CEREBELLUM

- SERVES AS THE REFLEX CENTER AND INTEGRATING THE SKELETAL MUSCLE MOVEMENTS
- WITH ALCOHOL LOSS OF MUSCLE COORDINATION LOSS OF BALANCE.

MIDBRAIN

- HOUSES THE CENTERS WHICH CONTROL VISUAL AND AUDITORY REFLEX AS WELL AS HEAD MOVEMENT.
- CREATE VISUAL AND AUDITORY HALLUCINATIONS.
- Changes will affect MH & SUD
THALAMUS
- Functions as the central relay station of the brain where all incoming sensory impulses except for smell is located.
- Responsible for interpreting sensations as either painful or pleasurable and body temperature.

HYPOTHALAMUS
- It controls heart rate, blood pressure, water, balance, hunger, body weight, movements, sexual behavior.
- Regulates emotions and behavior.
- Changes here would affect what?

LIMBIC SYSTEM
- It regulates emotions, fear, anger, pleasure and sorrow. It has significant effect on behavior especially that of survival.
- Pleasure part of the brain.

TEMPORAL LOBES
- Sensory areas responsible for hearing, memory of visual scenes, music, and other complex sensory impulses.

The Forebrain
The Limbic System
- The Amygdala
  Responsible for evaluating sensory information
  It determines its emotional importance remembering pleasurable events
  It makes the decision to approach or to withdraw, issues with attachment
  Its initial response may be overridden by the appraisal of the cerebral cortex. Pleasure of Memory.
- The Hippocampus
  The gateway to memory

BRAIN DOMINANCE
- Are you right brained or left brained?

Laterization
- Left Hemisphere
  Verbal competence
  Speaking, reading,
  thinking, reasoning
  Processes info in a
  sequence
  One piece of data at a
  time
  Logical

- Right Hemisphere
  Nonverbal areas
  Comprehension, spatial
  relationships, drawing,
  music, emotion
  Processes info. As a whole
  Intuitive

Emotion and Lateralization
- Left Hemisphere
  • Important for the expression of positive emotion
  • Damage to the L.H.
  leads to loss of the capacity of joy.
  • Activation in the L.H.
  leads to tendencies to approach other people.

- Right Hemisphere
  • Important for the expression of negative emotion
  • Damage to the R.H. may make people euphoric.
  • Activation in the R.H. leads to tendencies to withdraw from people.
A Major Reason People Take a Drug is They Like What It Does to Their Brains.

Brain Exercise
I cudnuolt blveiee ttha tI cluod aulaclty uesdnatnrd waht I was rdanieg. Th phaonmneal pweor of the hmuan mnid Aoccdrnig to a rscheearch at Cmabrigde Universty, it deosn't mttaer in waht oredr the ltteers in a wrod are, the olny iprmoatnt tihng is taht the frist and lsat ltteer be in the rghit pclae. The rest can be a taotl mses and you can sitll raed it wouthit a porbelm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe. Amzanig huh? yaeh and I awlyas thought slpeling was ipmorantt!

Brain Chemistry
Drug use not only changes brain chemistry in fundamental ways; it is the only drug that affects all of the brain neurotransmitters.

Initially, a person takes a drug hoping to change their mood, perception, or emotional state... hoping to change their brain.

But then...
After a person uses drugs for a while, why can't they just stop?
Because... Their Brains have been Re-Wired by Drug Use

Cognitive Process During Addiction

Introductory Phase

May Be Illegal
May Be Expensive
Hangover/Fatigued
May Miss Work

Relief From
AOD

Introductory Phase

Relief From
Depression
Anxiety
Increased Energy
Increased Work Output
Increased Thinking
Increased Status
Increased Energy
Increased Work Output
Increased Thinking
Increased Status

Conditioning Process During Addiction

Introductory Phase

Strength of Conditioned Connection

Triggers
Parties
Special Occasions

Responses
Planned Thoughts about AOD
No Physiological Response
Infrequent Use

Development of Obsessive Thinking

Introductory Phase

Non-recognition
Confusion regarding occasional atypical behaviors
Admiration for abnormal accomplishments achieved through drug/alcohol use

Family Response to Increasing Addiction

INTRODUCTORY PHASE

Non-recognition
Confusion regarding occasional atypical behaviors
Admiration for abnormal accomplishments achieved through drug/alcohol use

Development of Craving Response

Introductory Phase

AOD Effects
Heart/Pulse Rate
Respiration
Adrenaline
Energy
Taste

Conditioning Process During Addiction

Abuse Phase

Strength of Conditioned Connection

Moderate

Triggers
Parties
Friday Nights
Friends
Concerts
Alcohol

Responses
Thoughts of AOD
Eager Anticipation of AOD Use
Mild Physiological Arousal
Cravings Occur as Use Approaches
Occasional Use

Development of Obsessive Thinking

Abuse Phase

Introductory Phase

Food
Sports
School
Girlfriend
Hobbies
Job
AOD
Exercise
Parties

Development of Obsessive Thinking

Introductory Phase

Food
Sports
School
Girlfriend
Hobbies
Job
AOD
Exercise
Parties

Cognitive Process During Addiction

Abuse Phase

Introductory Phase

Depression Relief
Confidence Boost
Random Relief
Sexual Enhancement
Social Lubricant
Vocational Disruption
Relationship Concerns
Financial Problems
Beginnings of Physiological Dependence

Conditioning Process During Addiction

Abuse Phase

Strength of Conditioned Connection

Moderate

Triggers
Parties
Friends
Concerts
Alcohol
"Good Times"

Responses
Thoughts of AOD
Eager Anticipation of AOD Use
Mild Physiological Arousal
Cravings Occur as Use Approaches
Occasional Use
Increasing Addiction
Family Response to Increasing Addiction

**ABUSE PHASE**
- Experimentation with solutions
- Extreme responses
- “Enabling”

**Dependence Phase**
- Social Currency
- Occasional Euphoria
- Relief From Lethargy
- Relief From Stress
- Non-Rhythms
- Infections
- Relationship Disruption
- Family Distress
- Impending Job Loss

**Characteristics**
- “Enabling”

**Relief From Lethargy**

**Dependence Phase**
- Continual Thoughts of AOD
- Psychological Arousal of AOD

**AOD Effects**
- Heart Rate
- Breathing Rate
- Energy
- Adrenaline Effects

**Powerful Physiological Response**
- Breathing Rate
- Energy
- Adrenaline Effects

**Depression and Fatigue**
- Guilt and shame
- Overpowering
- Unemployment
- Paranoia
- Seizures

**Family Distress**
- Nose Bleeds
- Infections
- Loneliness
- Boredom
- Stress
- All Friends
- Weekends

**ADDICTION PHASE**
- Development of Obsessive Thinking
- Development of Craving Response
- Family Response to Increasing Addiction

**Disaster Phase**
- Loss of Family
- Seizures
- Unemployment
- Bankruptcy

**Cognitive Process During Addiction**

**Conditioning Process During Addiction**

**Strength of Conditioned Connection**
- Triggers
  - Weekends
  - All Friends
  - Stress
  - Boredom
  - Anxiety
  - After Work
  - Loneliness
- Responses
  - Continuing Thoughts of AOD
  - Strong Physiological Arousal
  - Psychological Dependency
  - Strong Cravings
  - Frequent Use

**ADDITION PHASE**
- Avoidance of problem
- Blaming the addicted
- Blaming selves
- Guilt and shame

**Severe Depression**
- Depression
- Overpowering

**Relief From Fatigue**

**Development of Obsessive Thinking**

**Development of Craving Response**

**Family Response to Increasing Addiction**
Family Response to Increasing Addiction

**DISASTER PHASE**
- Separation
- Internalization of bad feelings
- Resignation and hopelessness
- Establishment of unhealthy family rules

Natural Rewards Elevate Dopamine Levels

Effects of Drugs on Dopamine Levels

Dopamine Transporter Loss After Heavy Methamphetamine Use

The Memory of Drugs

**NEUROTRANSMITTERS**
- **SEROTONIN** – DEPRESSANT, SLEEP, CALM, PLEASURE
- **GABA** – RELAXANT, STRESS REDUCTION, SEIZURE THRESHOLD
- **HYDROCODONE** – PAIN RELIEF, PLEASURE
- **NICOTINE**, METH, THC – SMOKING, LEARNING, CONCENTRATION
- **ETHANOL**, MENT, COCAINE – ALL DRUGS, EATING, GAMBLING
- **GLUTAMATE** – ORGANIZATION OF BRAIN SIGNALING, MEMORY, PAIN
- **ACETYLCHOLINE** – INVOLUNTARY ACTIONS, MEMORY, MOTIVATION
- **DOPAMINE** – PERCEPTION, MOVEMENT, PLEASURE
**Neurotransmitters**

- **Serotonin**
  - Sleep, appetite, sensory perception, temperature regulation, pain suppression, and mood
- **Dopamine**
  - Voluntary movement, learning, memory, and emotion
- **Acetylcholine**
  - Muscle action, cognitive functioning, memory, and emotion

**Dopamine**

- Increased heart rate and the slowing of intestinal activity during stress, learning, memory, dreaming, waking from sleep, and emotion

**GABA (gamma-aminobutyric acid)**

- The major inhibitory neurotransmitter in the brain

**Brain Development**

- **Ages 0 to 5 yrs**
  - Excess neurons are pruned in first 18 mos but brain keeps growing. Brain cells become more adapt at communicating and babies learn to talk.
  - Initial Issues:
    - Autism 4 x more prevalent in boys
    - Epilepsy 10% will have seizure in lifetime
    - ADHD Effects 3x more boys than girls
    - 5% of school ages have ADHD

- **Ages 5 to 10**
  - The brain begins to shrink losing about 2% of it weight and volume
  - Abnormal high loss of grey matter may lead to onset of schizophrenia.
  - Initial Issues:
    - Perv. Disorders – Affects 2.4 million ages 18 to 54 More common in women.
    - Social problems – From being watched or embarrassed or being around others.
    - Peak suicide years – Leading cause of death among young people 15 to 24 white males are at greatest risk.

- **Ages 10 to 13**
  - Just before puberty the brain’s gray matter thickens especially in frontal late the seat of planning, impulse control and reasoning. Growth triggered by sex hormones.
  - Initial Issues:
    - Obsessive Compulsive Disorder – Caused by abnormally functioning brain circuits, neurotransmitters and hormones become involved
    - Eating Disorders – more common in girls
    - Conduct Disorders – Disregard for norms and rules, affects 6 to 15% of boys and 9% of girls under age 18.

- **Ages 13 to 20**
  - By late 20s information processing begins to slow down. Memory centers in the hippocampus and frontal lobes even underdeveloped in adolescence may impact symptoms in late 60’s such as Alzheimer’s disease.
  - Initial Issues:
    - Postpartum depression – 10% of new mothers
    - Schizophrenia – affects 1% of population
    - Bi-polar disorder – about 2.5 million are bi-polar

- **Ages 20 to 30**
  - By late 20s information processing begins to slow down. Memory centers in the hippocampus and frontal lobes even underdeveloped in adolescence may impact symptoms in late 60’s such as Alzheimer’s disease.
  - Initial Issues:
    - Postpartum depression – 10% of new mothers
    - Schizophrenia – affects 1% of population
    - Bi-polar disorder – about 2.5 million are bi-polar
Brain Development
Ages 30 to 60
- Learning and memory and other complex mental processes become more difficult and reacting to stimuli takes longer. Plagues and tangles may form in certain brain regions.
- Menopause – sudden mood swings, inability to cope, memory lapses
- Onset of Alzheimer’s
- Huntington Disease – more than 250,000 are at risk of inheriting it

What are the goals of brain imaging?
Figure out how drugs act.
What are the acute effects?
Characterize addiction.
What’s wrong in the brain? What circuits?
Advance treatment.
Provide a rational basis to design medicines or cognitive-behavioral therapies.

The anterior cingulate and insular cortices participate in emotional experiences.
The amygdala links perception with emotion and memory.

Prefrontal Cortex Dysfunction in Stimulant Abusers

Serotonin
When a person is depressed, their serotonin level is low, which causes several changes to the body:
1. Pain Threshold Lowered: A depressed person feels more pain from no apparent source.
   (back pain is very common amongst sufferers)
2. Sleep Disturbance: A depressed person's day runs on an average of 22 hours, not 24. And there are many spikes in temperature throughout the night which causes a person to wake many times, resulting in not getting any REM sleep.

Depression and Substance Use
- Common symptoms with both depression and substance use.
- Mood changes
- Anhedonia
- Irritability
- Insomnia
- Sleep patterns change
- Concentration difficulty

What Causes Mania?
- The neurotransmitters: Norepinephrine, dopamine, and serotonin, have been studied since the 1960s as factors in mania and depression.
- For example, during a manic episode, clients with bipolar disorder have a significantly higher Norepinephrine and epinephrine levels than a depressed or euthymic (normal mood) person.
- Noradrenergic and dopaminergic are responsible for “fight or flight” responses.

Anti-Social Personality
Pre-frontal Cortex not fully developed

Bi-Polar Affective Disorder

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Neurobiological Changes in Response to Traumatic Stress

- Limbic System — Hippocampus and Amygdala (Affect and Memory, Judgment, prioritizing information)
- Sugar Addictions and Effects of Trauma on Brain Arousal and Depression,
- Changes in Ventral System (VMH area)

Addiction & Trauma

The brain images below show how alcohol may harm brain cellular function. Compared with a young non-drinker, a 15-year-old heavy drinker shows decreased metabolism in the right orbitofrontal cortex during a memory task. This finding may be linked to the lack of ability to filter out distractions.

Anxiety in MA Abusers

Amygdala Activity

Changes in Norepinephrine

Emotions

Adolescents use the Amygdala right or left hemisphere rather than the Frontal Cortex (used by older adults) to read emotions. Adolescents often misread facial expressions. Adults see fear in adolescents may see anger or shock.

PET scan of brain for depression

A PET scan can compare brain activity during periods of depression (left) with normal brain activity (right). An increase in blue and green colors, along with decreased white and yellow areas, shows decreased brain activity due to depression.

Schizophrenia

Brain scans of teens with schizophrenia show brain lesions in thalamus and frontal cortex

Reframing the “problem” of Personality Disorders

- One way to understand personality disorders is that the person coped in the best way they knew how, in response to difficult circumstances, and at that past time (typically during childhood), it helped them to survive. (i.e., ADAPTIVE)

Conclusion

- Neuroscience can help in the future of medications, and treatment.
- All professionals working in addiction must be aware of the advances to provide appropriate and up to date treatment.
- Questions or Comments?
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