Neuroscience of Addiction

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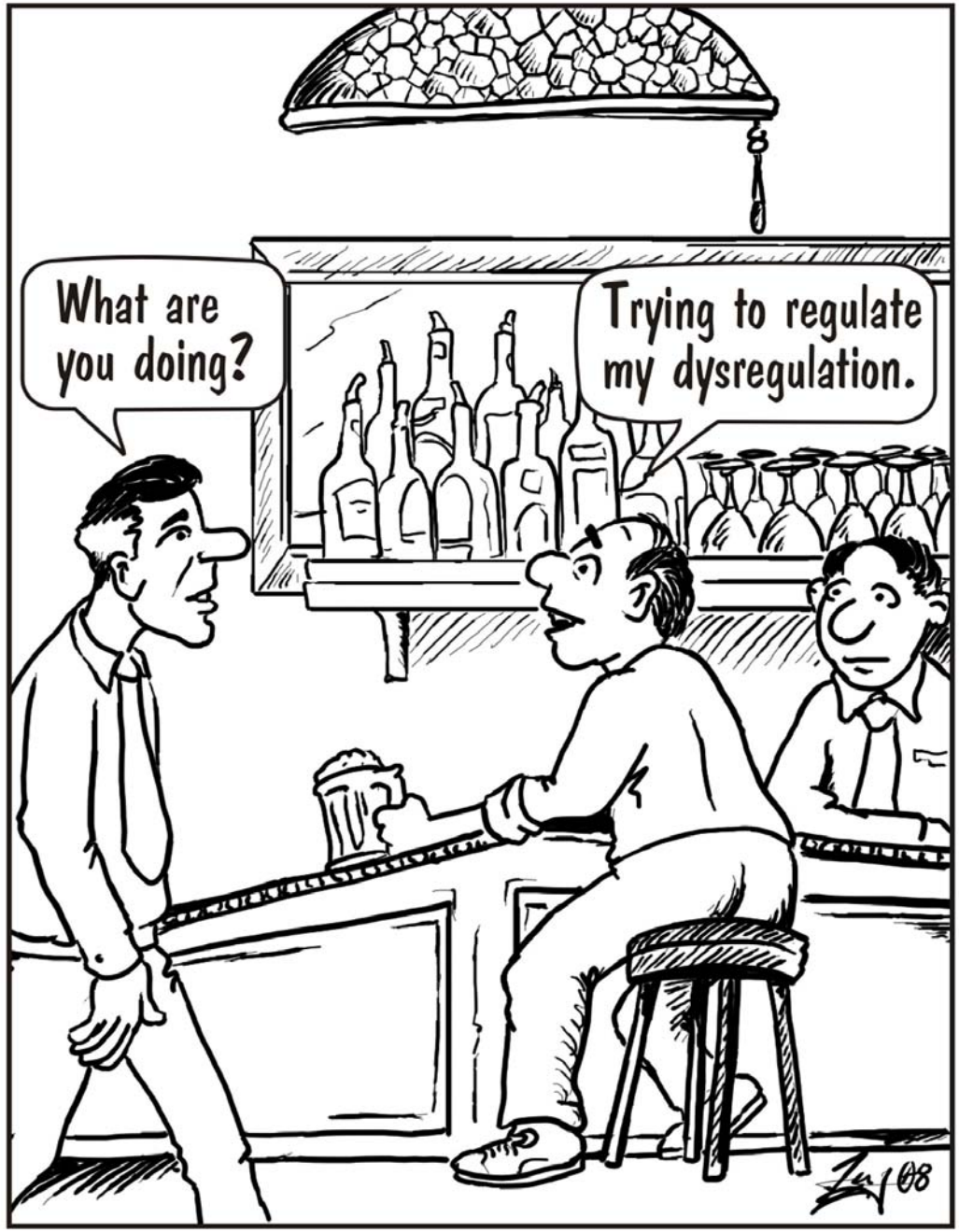

What are you doing?
Trying to regulate my dysregulation.

Three Points….

1. terminology is critical
2. neuroscience 101
3. neuroscience and treatment

There is terrible misunderstanding if we don’t use the correct terminology…….

Myths

- addicts are bad, crazy, or stupid
- addiction is a will-power problem
- addicts are criminals
- addicts should be punished, not treated, for using drugs
- A.A. is all alcoholics need to recover
- people addicted to one drug have "addictive personalities"

(www.utexas.edu/research/asrec)

What is “addiction”?

- synonymous with “abuse”
- anytime something is taken/done “too much, too often, for too long”
- a serious health problem (heroin)
- not so serious (exercise)
- preventable (“just say no….”)
- scientifically includes compulsive behaviors

The Facts……

DSM-IV*: TWO drug problems

- drug **abuse** is a **problem** to solve, caused by bad choices, self-anesthetization, celebration, or just wanting to get high
- chemical **dependence** is a brain **disease** caused by genetic vulnerability, drug use, and environmental influence

* Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition

How to reduce these…

- **abuse** - education, coercion, punishment, environmental change, maturation, pressure to stop, life events
- **dependence** - "treatment" to positively affect abnormal brain function to **reduce need** for drug
- **both** are serious conditions!

Why is proper differentiation so important?

- we know there are two diagnosable drug problems
- one is a disease, one is not
- understanding the nature of the problem is critical for determining proper treatment
- people argue about addiction as a disease; there is less disagreement about dependence as a disease

How dare you call dependence a “brain disease”?

- some people who don’t know the complete neurobiological/genetic “addiction” research literature argue against “disease”
- weight of the research evidence is that “dependence” (not “abuse”) is a disease
- Sources: NIDA, HBO, Koob, Nestler, etc.
- “but aren’t you absolving people from being responsible for what they did?”
- “you don’t believe in punishing them?”
- major field organizations recognize addiction as a disease - NCADD, AMA, ASAM, NAATP, RSA

RESEARCH VALIDITY ESTIMATE (RVE)

(A Thoughtful Appraisal of High-Quality Scientific Research)

High RVE

- many large, well-controlled studies
- replicable results
- much peer-reviewed, published literature

Low RVE

- few replicable studies
- highly speculative results
- little peer-reviewed, published literature

100
-
0

Who becomes dependent?

Estimated lifetime prevalence of risk

Drug Users Who Developed Dependence

(U.S. Epidemiological Estimates, 1992-98):

- nicotine - 32%
- heroin - 23%
- cocaine - 17%
  (crack - 20%)
- alcohol - 15%
- stimulants other than cocaine - 11%
- cannabis - 9%
- "sedatives" - 9%
- analgesic opioids - 9%
- psychedelics - 5%
- inhalants - 4%

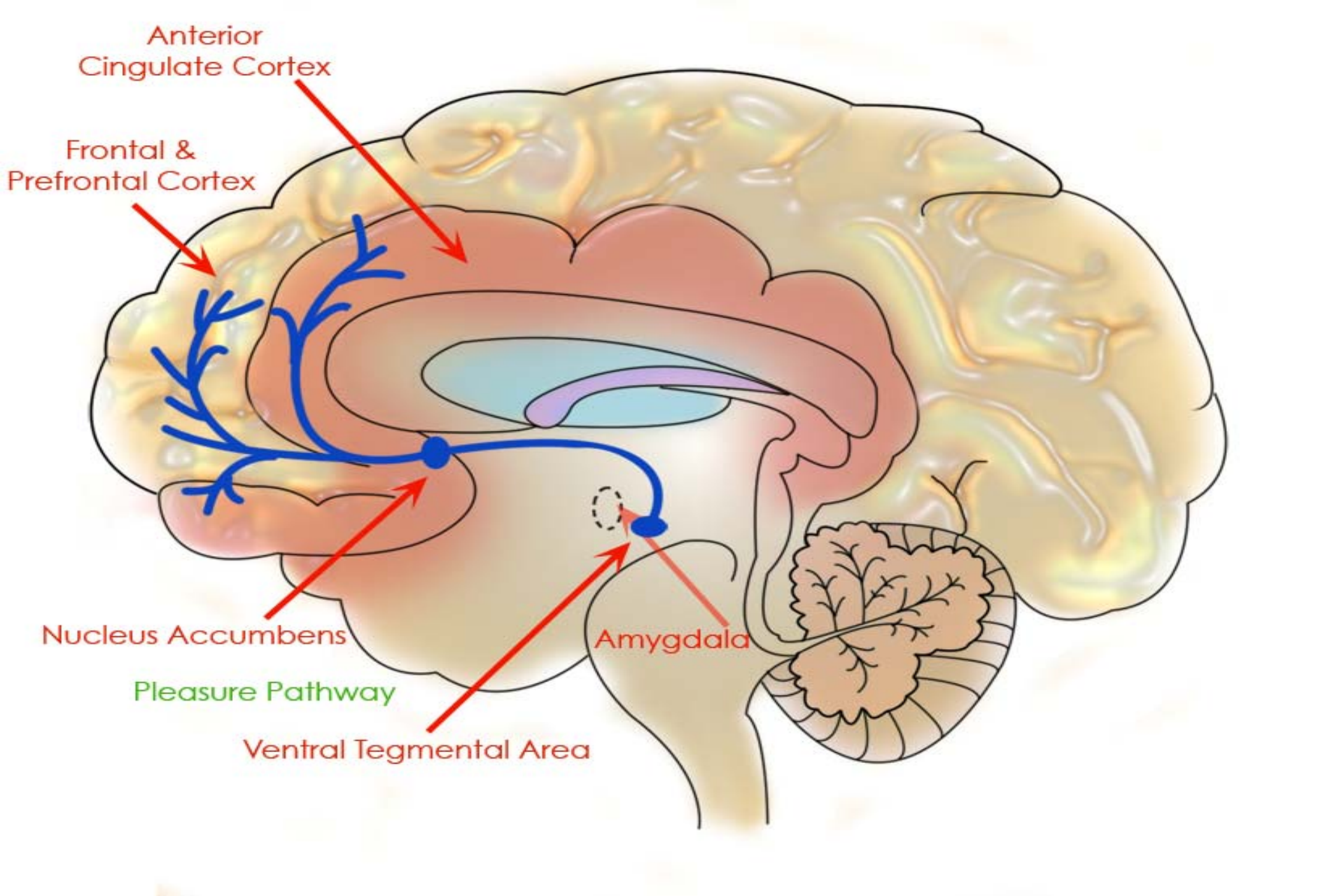
Anthony et al., 1994
Chen & Anthony, 2004
Hughes et al., 2006

Neuroscience 101

Dependence occurs because of neurochemical dysregulations of the mesolimbic dopamine system (MDS)*

*** a.k.a. Medial Forebrain Bundle (MFB)**

or “Pleasure Pathway” or “Reward Pathway”


Anterior
Cingulate Cortex
Frontal &
Prefrontal Cortex
Nucleus Accumbens
Amygdala
Pleasure Pathway
Ventral Tegmental Area

What happens?

Drug actions reveal vulnerable brain chemicals

- cocaine, amphets - dopamine (DA)
- LSD - serotonin (SER)
- heroin - endorphins (END)
- benzodiazepines - GABA
- nicotine - acetylcholine (ACH)
- alcohol (ETOH) - glutamate (GLU)
  - substance P (SUBP)
- marijuana - endocannabinoids (ENCB)

The newest….

- Substance P and its receptor, neurokinin 1 (NK1R) - in brain areas involved with stress responses and drug reward
- mice genetically deficient in NK1R = decrease in voluntary alcohol drinking
- alcohol dependent patients given NK1R antagonist or placebo = decreased craving, increased well-being, reduced responses to stress

George et al.(Heilig) Science 319:1536-9 (2008)

Thus, drugs are associated with specific neurotransmitters

- we assume that genetics + drug-use lead to "dysregulations" of MDS neurotransmitter systems
- when people use, the drugs "connect" to the specific dysregulated neurotransmitter system
- this may be why people have "drugs of choice"

Dysregulation =

- continued exposure of the MDS pathways to a drug leads to changes (adaptations) in nerve function ("neuroadaptations")
- the changes reach a threshold
- ….leading to compulsive use over which the individual has impaired control (symptom of the disease)

What causes the neurotransmitter systems to become “dysregulated”?

- genetic vulnerability *
- exposure to a drug *
- other aspects of the environment, besides drugs?

A Brain Chemistry Disease!

- addicting drugs seem to "match" the transmitter system that is not normal
- genetic susceptibility is clearly involved - but onset time is variable
- cases range from mild to severe
- severity of cases relates to treatment outcome
- remember, this is NOT "drug abuse"

Important Point!

Dependence is not a loss of "will power", for two reasons:

- The main problem with dependence lies in the subconscious MDS.
- Problems with the frontal cortex produce a pathological impairment of decision-making. This is similar to other brain diseases.

Thus, dependence is not primarily under conscious control!

Treatment of Abuse and Dependence

Today's Options
(It's all about options….)

- traditional: 12 step programs (abstinence)
- behavioral: individual/group counseling
- misunderstood: harm reduction, MM
- new: motivational interviewing, CBT, MET, primary care management, vouchers
- medical tx: detox meds, meds to enhance abstinence - reward blockers, anticraving meds, methadone, buprenorphine, vaccines

(MM= Moderation Management, CBT= cognitive behavioral therapy, MET= motivational enhancement therapy)

If this is a brain disease, logic says:
<u>Behavioral Therapies Probably Change Brain Chemistry!</u>

In other words, the MDS dysregulation begins to move back towards normal.

It cannot be totally normalized, just "pushed back" towards normal, in much the same way that medications change brain chemistry.

(For some people, the spirituality of recovery is a very powerful way to push the brain back towards normal - e.g., brain scans and meditation.)

What is “recovery”?

New - Betty Ford Institute (October 2007, J.Sub.Ab.Treat.)

Recovery from substance dependence is a voluntarily maintained lifestyle characterized by:

- sobriety - abstinence from alcohol and all other non-prescribed drugs (including nicotine)

2 - What is “recovery”?

AND

- personal health - improved quality of personal life as defined and measured by scores on the physical health, psychological health, and spirituality domains of the WHO QOL Scale
- citizenship - improved quality of social function as defined and measured by scores on the social function, environment, and independent living domains of the WHO QOL Scale

3 - What is "recovery"?

- "Sobriety is best achieved through the practice of abstinence from alcohol and all other drugs of abuse." There is not yet agreement regarding recovery facilitated by psychosocial and pharmacological treatments.
- Early sobriety = at least one month, < 1 yr

  Sustained sobriety = one to 5 years

  Stable sobriety = lasting 5 years or more

Things to Remember

- New research is changing our understanding of chemical dependence (loosely called “addiction”).
- Learning this new information requires a willingness to give up old ideas and learn new ones.
- Bibliography can be found at: www.utexas.edu/research/asrec