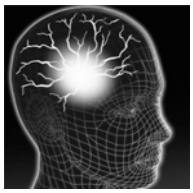
Co-Morbidity of Substance Abuse & Neuro-Cognitive Effects on Brain Functioning



Scripps 7th Annual Brain Injury Conference

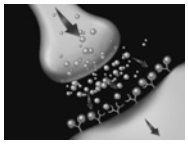
03/17/12

Mark McDonough, Ph.D.
sandiegoneuropsychology.com

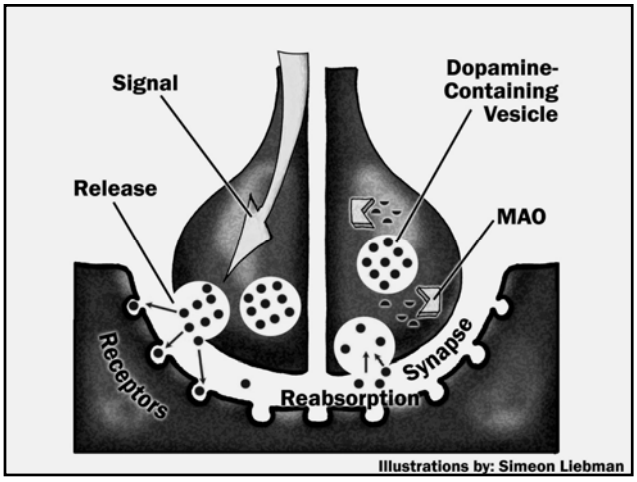
How Do Substances Work in the Brain?

- Neurotransmitters & Reward Centers
- SUD Physiological and Functional Effects
- Co-Morbidity in pre-TBI patients
- SUD use in Post-TBI patients
- SUD Impact on Recovery/Outcome
- Identifying Factors & Interventions
- Abstinence

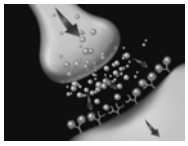
Neurotransmitters



- Chemicals facilitating signals from one neuron to another
- 100 plus
- Acetylcholine - 1921 Nobel prize
- Norepinephrine - 1946 Nobel prize



Neurotransmitters



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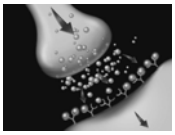
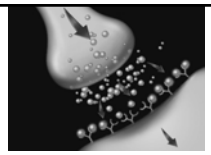


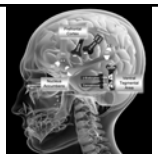
- Dopamine – 1950's
  - inhibitory
  - "…if it feels good…"
  - Too much, too little
- GABA- 1950 (gamma aminobutyric acid)
  - Inhibitory

Neurotransmitters



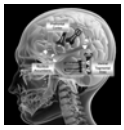
- Glutamate
  - Excitatory
  - Common throughout but c/b toxic
- Serotonin
  - Inhibitory
  - Emotional processing

'Reward" Centers



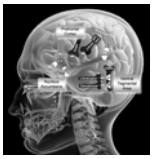
- Positive reinforcement
- Olds & Milner: "Law of Effect"
- Similar drugs of choice (across species)

"Reward" Centers

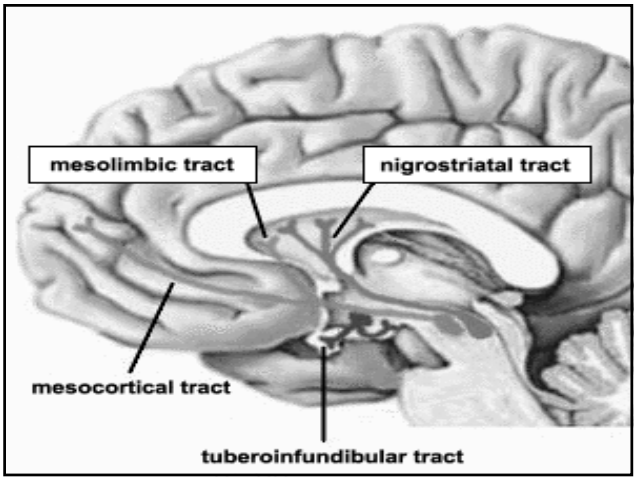


- ***Speeed*** **= reinforcement & dependence**
- **Immediate v. delayed** (in rats, humans, Logan, 1965; Wise, 1995)
- **IV heroin upped DA 150-300% in nucleus accumbens OR ventral tegmental areas…"both ends"** Wise, et al (1995)

"Reward" Centers



- **two major dopaminergic systems**
- **nigrostratial** & **mesolimbic**
- **Begin in the ventral tegmental area (VTA)**
- **Go to the nucleus accumbens and more anterior regions including the amygdala and prefrontal cortex**



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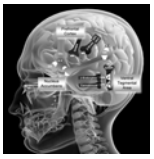

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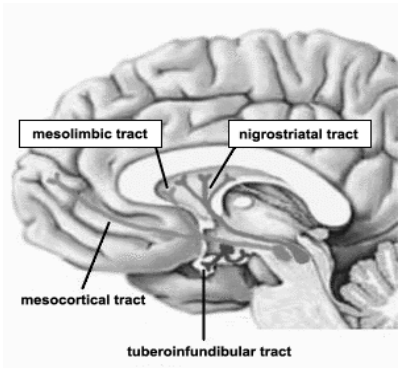
Functional Brain Anatomy



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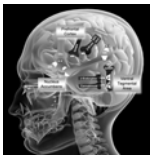

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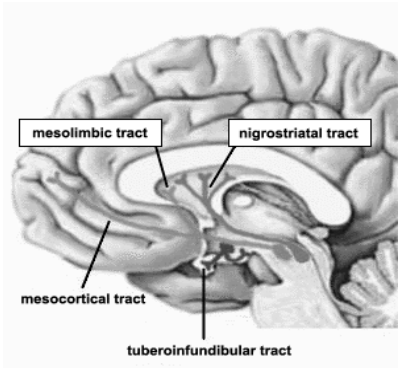
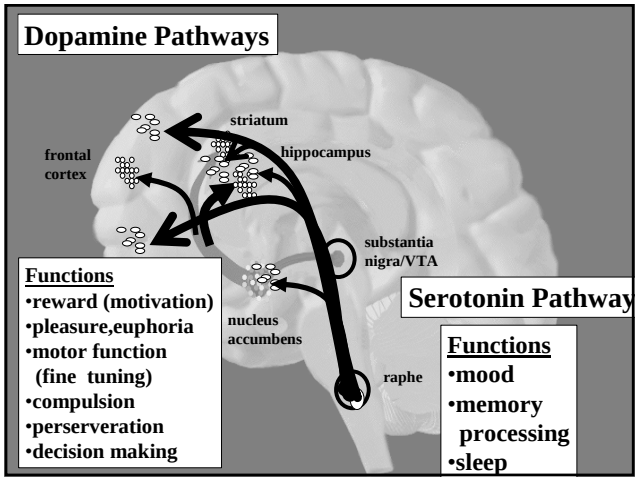
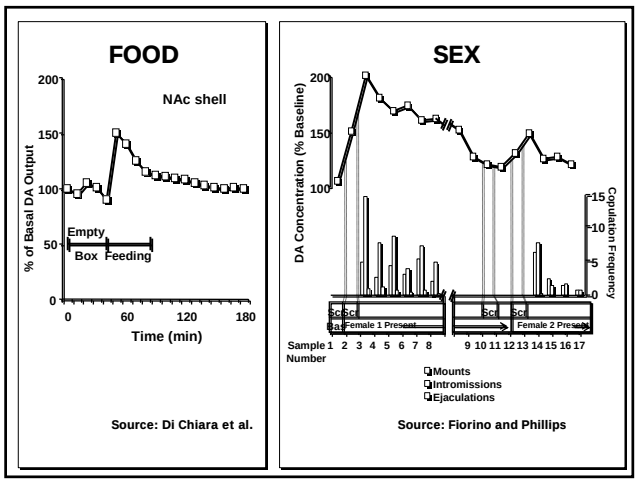
Functional Brain Anatomy

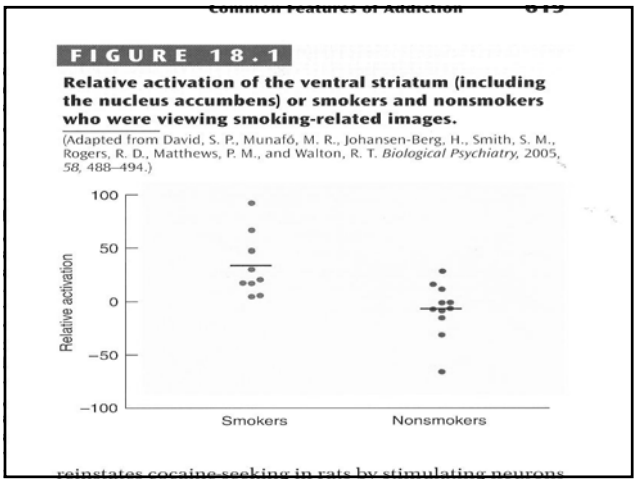


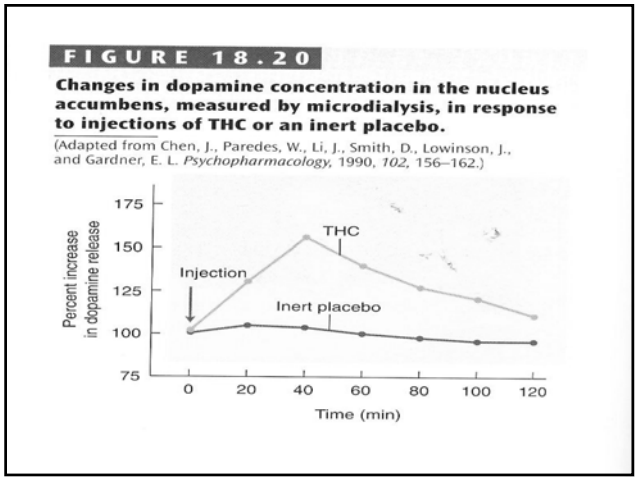


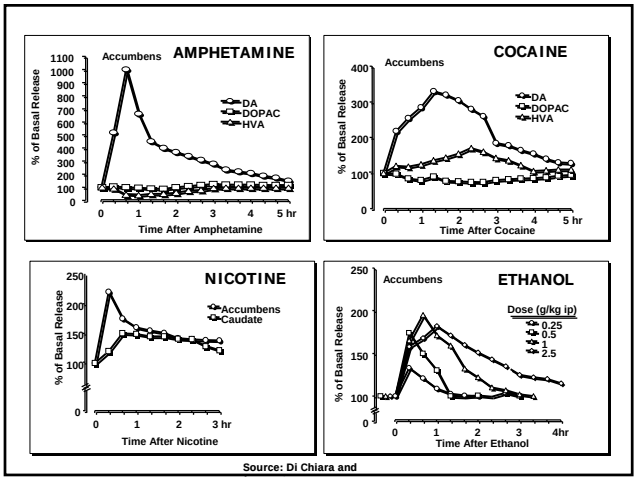
Co-Morbidity of Substance Abuse and Neurocognitive Effects on Brain Functioning

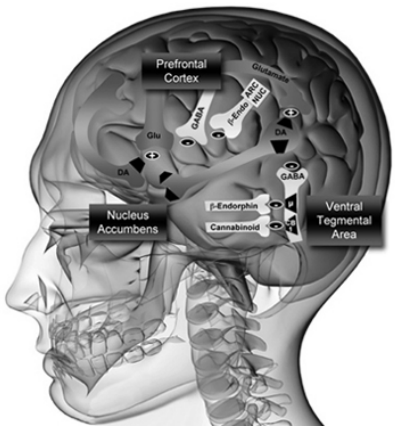
Mark McDonough, PhD





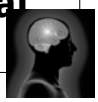






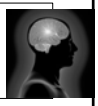
Physiological & Functional Substance Effects

Physiological & Functional Substance Effects



- **Cannabis Physio Effects:**
- **Cannabinoid receptors highest in basal ganglia, cerebral cortex, and hippocampus**
- **Implicates particular neuropsychological functions**

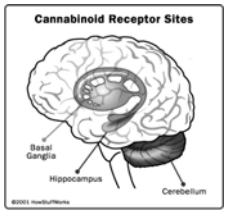
Physiological & Functional Substance Effects



- **Cannabis Physio Effects:**
- **Elevates DA by blocking re-uptake**
- **Studies confounded by comparing toxic, s/t, and L/T abstinent**
- **CT, (no structural changes) EEG (some studies show subtle), MRI (no hippocampal)**

Physiological & Functional Substance Effects

- **Cannabis Functional effects (same research confounds)**
- **Polarized research**



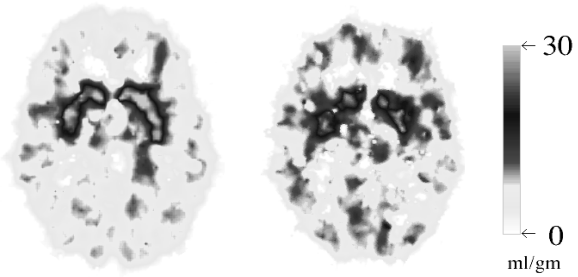
reduced hippocampal and amygdala volume
(Yucal et al, 2008)

– **hyperactivity in the hippocampus**
(Eldreath et al , 2004)

Physiological & Functional Substance Effects - Meth

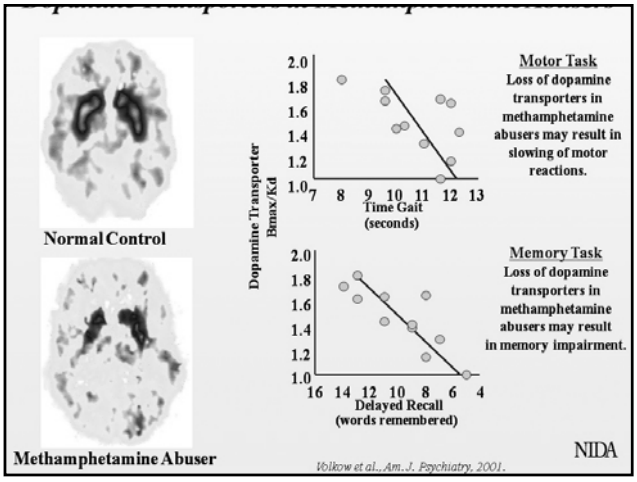
- **reduced dopaminergic axons and terminals in striatum**
- **Loss gray matter in cingulate, limbic paralimbic cortexes and inferior frontal gyrus**
- **long term effects**

Dopamine Transporter Loss After Heavy Methamphetamine Use (PET analysis)



Comparison Subject METH Abuser

Source: Volkow, N.D. et al., Am J. Psychiatry, 158(3), pp. 377-382, 2001.



Physiological & Functional Substance Effects - Meth

- **Functional:**
- **information processing and attention**
- **episodic memory** (executive aspects of encoding and retrieval)
- **associated with lower frontal grey matter density as well as hypometabolism**

Physiological & Functional Substance Effects - Meth

- **attention/processing speed; learning/memory; working memory; timed/untimed executive functions**
- **Minimal improvement**
- **Longer duration is needed** (up to 3 yrs?)

Physiological & Functional Substance Effects - Meth

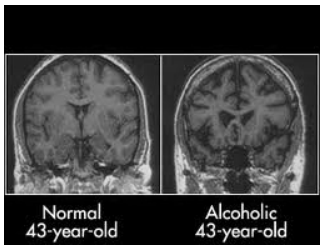
- Volkow et al (2001) **researched brain dopamine (DA) transporters short abstinence (< 6 months) & retested 12-17 months**
- **increases with protracted abstinence (caudate + 19%, putamen + 16%). But, neuropsych did not improve at pace; suggesting an increase of the DA transporters was not significant for complete functional recovery**

Physiological & Functional Substance Effects ETOH

- **Physio:**
  - **decreased levels of DA receptors in the striatum**
  - **Reduction in hippocampal and prefrontal white matter**
  - **Malnutrition & liver disease additive**
- **Korsakov's**
  - **deficiency in thiamin (vitamin B1) lesions in white matter structures producing a dense amnesia**

Physiological & Functional Substance Effects ETOH

- The "typical alcoholic"
- Wernicke's Encephalopathy



Physiological & Functional Substance Effects ETOH

- Functional:
  - inability to encode new information
  - declarative memory/knowledge
  - Undeterred by absence of actual memory…confabulate

NOW READ THIS

Shatterproof pint glass to cut Brits' bar-fight wounds

By Gregory Katz
ASSOCIATED PRESS

LONDON — Soon Britons will be able to get smashed at the pub while their pint glasses won't.

The shatterproof pint glass was proudly unveiled by the government yesterday. Officials said the country would save billions in health care costs by coming up with a glass that doesn't double as a lethal weapon.

But noticeably, no officials were talking about reforming the British binge-drinking culture at the root of the problem.

There are about 87,000 alcohol-related glass attacks each year, with many resulting in hospital visits, Home Secretary Alan Johnson said as he introduced the two prototype shatterproof pint glasses.

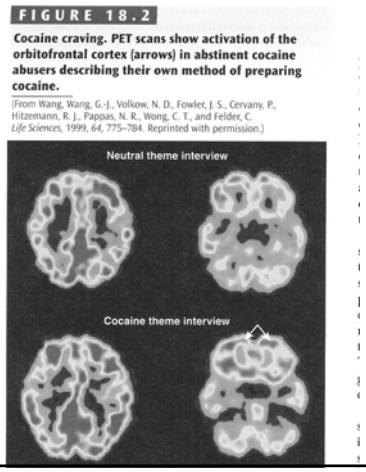
"Glassing causes horrific injuries and has a lasting and devastating impact on victims and their families," Johnson said. "I hope these designs will help bring an end to such attacks."

Two types of shatterproof technologies are in the works: One has a thin bio-resin coating on the inside that strengthens it, and the other bonds two thin layers of glass together in the same way as car windshields. Both are difficult to break and will keep the shards together if they do, rendering them useless as weapons.

The government is touting the prototypes as the first significant improvement in bar glassware in decades. The plan is to introduce the new glasses for use on a voluntary basis in pubs if tests show that they're durable, cost-effective and safe.

Physiological & Functional Substance Effects: COKE

- Physio:
  - inhibits the reuptake of dopamine
  - vasculature tone - hemorrhagic and ischemic strokes
  - Increase in orbito-frontal cortex in early detox
  - Reduction in frontal during prolonged detox



Physiological & Functional Substance Effects: COKE

- **Functional:**
  - **visuomotor performance, visuospatial abilities, psychomotor speed, manual dexterity, verbal learning and memory, executive functioning, novel problem solving, and abstraction.**
  - **Study: only 41% of coke users completed the task significantly (P < 0.001). Perseveration**

Substance Abuse Disorders (SUD) Co-Morbidity in TBI patients

Co-Morbidity in TBI patients

Co-Morbidity in TBI patients

- SUDs contribute to injury, compromise rehab, negative health effect
- pre-injury:
  - 44-79% hx of etoh
  - 21-40% drug use b/f injury
- 47% + Illicit substance in E.R.
  - (Substance was reported by 26% of patients)

SUD use in Post-TBI (40%?)

- Pre-post comparisions suggested etoh use declined, then rose:
- Pre etoh use – 73%
- 8 months post: 28% mod to heavy
  58% abstinent
- 28 months post: 35% mod to heavy
  49% abstinent
- Varied by injury severity

SUD use in Post-TBI

- Compared 30 TBI & 30 SCI; 1 yr post (Kolakowsky-Hayner & Taylor et al)
- 50% TBI/SCI no etoh but...
- SCI > daily etoh use and...
- More drug use SCI – 20.7%
  TBI - 3.3 %

SUD use in Post-TBI

- Limited evidence (with a caveat) to say TBI creates SUD in those with no pre-TBI SUD
- Perhaps a minimal short-term risk
- pre-injury SUDs are greater risk for relapse after TBI

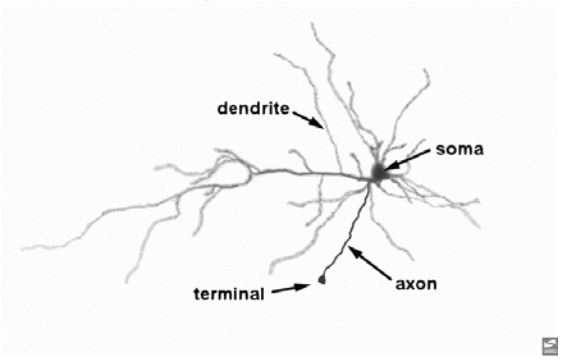
SUD Impact on Recovery/Outcome

- **Pre-Injury abuse:**
- **post emotional cognitive decline**
- **decrease return to work**
- **lower life satisfaction**
- **lower probability of good outcome (Ruff)**

SUD Effect Recovery/Outcome

- **Etoh at injury:**
- **acute complications**
- **greater intracranial hemorrhage and atrophy – complicates white matter recovery**
- **longer hospital stays**
- **poorer discharge status.**
- **For recovery:**
- **Higher mortality rates**
- **poorer neuropsychological outcome**
- **increased chance of second injury**
- **late deterioration (Corrigan, 1995)**

Impact on Recovery/Outcome



Impact on Recovery/Outcome

Means and SD's for WMS in Subjects with Differing Pre-Injury Levels of Alcohol Use

	None	Mild	Mod	Heavy	Total
- BAL	96.79	95.45	95.50	84.00	95.92
+ BAL	-	94.50	91.33	78.19	81.62

Identifying Factors & Interventions

- **Assessment Instruments**
- **Brief Michigan Alcohol Screening Test (BMAST)**
- **the Substance Abuse Subtle Screening Inventory (SSI) and the CAGE.**
- **Short Michigan Alcohol Screening Test (SMAST)**

Identifying Factors & Interventions

- **When to Assess?**
  - **The Ideal versus the Reality**
  - **Considerations of the ongoing nature of the recovery**
  - **May be Dependent on outside and other factors**

Identifying Factors & Interventions

- **What Questions Can be asked/What can they expected to do?**
- **Are your clients "getting it"**
- **Are they cognitively able**

Identifying Factors / Interventions

- **Pre-injury history of alcohol or drug abuse**
- **Intoxication at time of injury**
- **History of legal problems related to substance abuse**
- **Substance abuse among family members and/or friends**

Identifying Factors & Interventions

- Denial or lack of awareness about dangers associated with substance use
- Age less than 25 years
- Physically healthy with income and transportation access

Interventions

- **Critical Features of Substance Abuse Treatment for TBI** (Taylor et al)
- Identify abuse risk factors and challenges to recovery
- Monitor over time
- Participations in recognizing substance problems
- Involve family members

Identifying Factors & Interventions

- Educate for relapse prevention
- Be pro-active, prevention > treatment
- Re-frame positive aspects of abstinence
- Use repetition and present in a variety of modalities to promote learning

Interventions

- prepare for relapses with resources (AA, NA, etc.)
- Pros/cons of in/outpatient programs
- Educate and coordinate treatment programs about TBI based accommodations/understanding

Sustained Abstinence

cerebral functioning can improve

- **Equation of factors**
  - **Dose dependent (amount/frequency)**
  - **Age of onset**
  - **Co-morbidity (psych, medical,etc)**
  - **Type of substance, co-occurring substance**
  - **Age at time of rehab**

Sustained Abstinence

- **ETOH:**
  - **better after 2 wks** (Ekhardt, 88) **BUT even after five years, decreased short term memory** (Brandt et al 1983).
- **OPIATES:**
  - **better decision-making & found to predict abstinence (16)**
- **CANNABIS:**
  - **detectable 7-14 days after heavy use but appear reversible use.**

If you are able to process what the therapist is telling you, you are more likely to stay in treatment. But if you cannot, you are more likely to drop out"
(Mann, 2003).