The Neuropsychology of Alcoholism

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APRIL 27, 2016
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Neuropsychological Aspects of Substance Use Disorders: Evidence-Based Perspectives

by Daniel N. Allen and Steven Paul Woods

Has great individual chapters on specific substances
Drug and alcohol abuse is a chronic brain disease that causes compulsive substance use despite harmful consequences.

All behavioral experiences lead to physiological changes in the brain, not just psychological change.

Substance abuse leads to physiological brain changes in cognitive, behavioral, and emotional ability.

You ignore these facts at the risk of failure as a clinician.
The most difficult psychiatric patients have neuropsychological deficits, including memory and executive deficits:

- Schizophrenia
- Bipolar Disorder
- Borderline Personality Disorder
- Psychosis
- Severe Depression
- OCD
- Substance Abuse

Example: Cognitive deficits predict functional outcome in Schizophrenia, not psychiatric sxs; containment of the latter does not improve the former.

All Psych clinics need a Cog-Smart group to address the cognitive issues present in these patients.
Common Neurobiological Substrate for Mental Illness: EF network

- Major 2015 metaanalysis: tested for areas of common gray matter volume increase or decrease across Axis I diagnose

- 193 studies comprising 15,892 individuals across 6 diverse diagnostic groups (schizophrenia, bipolar disorder, depression, addiction, obsessive-compulsive disorder, and anxiety)

- Results: Gray matter loss converged across diagnoses in frontal regions (Anterior cingulate, Insula)

- Lower gray matter in this network was associated with poor executive functioning.

Madeleine Goodkind, et al, 2015
Recommendation: Executive Function Groups

- This study reinforces need for all psych. clinics to have a regular Executive Function group for Psychiatric patients.

- Need for teaching behavioral memory techniques, external prosthesis/reminder systems, problem solving strategies.

- Need to do routine MOCAs on psych pts.
Alcohol

- A central nervous system (CNS) depressant.
- Moderate to high doses suppress neural activity.
- Low doses stimulates neural activity, often increasing social interaction.
Neuropathology

Chronic heavy consumption leads to dose-related neurotoxic CNS damage and a pattern of neuropsychological dysfunction.

There is a pattern of alcohol-specific damage known as the neurotoxicology of essential alcoholism.

Brain atrophy occurs largely due to white matter atrophy, as well as neuronal loss in PFC, hypothalamus, and cerebellum in Korsakoff's.

D. Gansler & H. Duncanson, 2014
Risk factors for developing AUD (Alcohol Use Disorder)

- Greater activation of the reward circuit accompanied by blunted executive control systems
- Impulsivity, poor affect regulation, and poor executive function
- Antisocial tendencies
- Early adversity
- Genetics (e.g., family history, genotypes): 50% of risk
- Earlier onset of drinking, greater the addiction

Alcohol Benefits in Normals

- 90+ study: longevity correlated with 1 daily drink

- 2009 prospective study (Anstey): light to moderate drinkers compared with nondrinkers in late life have reduced risk of dementia

- Protective effect on cardiovascular and cerebrovascular health

Who drinks & how much:

30% don’t drink;

Next 30%: 1 drink per day;

Top 20%: 2 drinks per day;

Top 10%, 74 alcoholic drinks per week (10 drinks per day) = (70% of the alcohol consumed in any year by everyone)

Median = 3 drinks per week;

51% of adults = regular drinkers

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<th>Second Decile</th>
<th>Third Decile</th>
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Source: "Paying the Tab," by Philip J. Cook

Drinks icons via Gabriela Muniz, The Noun Project

Paying the Tab by P. J. Cook, 2007; (NESARC) data
Relative rates of alcohol dependence

Sample average = 3.5%

Hispanics and Blacks have a higher risk for developing alcohol-related liver disease than whites

Moderate & Binge Drinking

Moderate drinking is up to 1 drink per day for women and up to 2 drinks per day for men.

Binge Drinking: (NIAAA) = blood alcohol concentration (BAC) levels to 0.08 g/dL; 4 drinks for women and 5 drinks for men—in about 2 hours.

SAMHSA: 5 or more alcoholic drinks on the same occasion on at least 1 day in the past 30 days.

http://www.samhsa.gov/capt/tools-learning-resources/binge-drinking-terminology-patterns
Alcohol Use Disorder (AUD)  
(Dependence/Abuse)

- Heavy intake – 4 or 5 drinks per day
- Craving
- Social & occupational dysfunction
- Tolerance
- Withdrawal
- Continued use despite negative consequences
Addictive Drugs in the brain

- All drugs are Trojan horses in the brain

- All addictive chemicals are mimics which look and act like an existing brain neurotransmitter, esp. dopamine (anticipation & reward chemical)

- Increases available amount of dopamine which produces a high; brain responds by reducing dopamine receptors

- Drugs capture reward pathways in the brain which control motivation & compulsion
Alcoholism: NP Impairment

- Among 90% of alcoholics without severe impairment,
  - 50% have no detectable NP deficits with 3 weeks of abstinence
  - other 50% experience mild to moderate NP deficits

- With abstinence:
  - mild to moderate deficits resolve in 70-90% of individuals over a 6 month period
  - persist in the other 10-30%.

- This persistent condition is known as the intermediate-duration neurocognitive disorder associated with alcoholism (dx = mild NCD)

D. Gansler & H. Duncanson, 2014
Range of Cognitive Impairment

- **Mild (subtle) deficit** = may or may not evidence impairment in daily life

- **Moderate** = more likely show some impairment in daily life

- **Severe** =
  - Wernicke’s Encephalopathy (WE) (acute),
  - Korsakoff’s Disease,
  - Intermediate-duration neurocognitive disorder associated with alcoholism (chronic)
Substance Abuse: Cognitive Consequences

- Brain damage is a common and potentially severe consequence of long-term, heavy alcohol consumption.

- Even mild-to-moderate drinking can adversely affect cognitive functioning.

- Persistent cognitive impairment, with an established pattern of chronic heavy drinking, can contribute to:
  - poor job performance in adult alcoholics,
  - can interfere with learning and academic achievement in adolescents

** Cognitive impairment impedes recovery from alcoholism
33 – 75% of alcoholics entering treatment display neuropsychological deficits, mostly in the mild to moderate range.

- Executive Functioning (Problem-solving, Abstract thinking, Concept shifting)
- Learning / Memory (verbal and behavioral)
- Visual spatial ability
- Balance & Gait

Eckardt & Martin, 1986; Meek et al., 1989
Substance Abuse: Neuropsychological Deficits

- Substance abuse causes wide range of neuropsychological deficits

- These NP deficits associated with:
  - Treatment process and outcome.
  - Patient ability to learn and have insight.

- NP results correlate with:
  - Clinician ratings of impairment
  - Therapeutic progress,
  - Relapse
  - Employment status
Importance of Neuropsychological Deficits

- Neuropsychological Deficits interfere with Treatment:
  - Memory limitations
  - Executive Functional Deficits

- Psychogenic or Neurogenic Interpretation:
  - Alcoholism and denial are intrinsically linked
  - Denial is single biggest obstacle in getting treatment for alcoholism
Deficit blindness (Anosognosia): Need cognitive testing

- Psychological lack of motivation vs. neurological impairment:

- Nature of denial/lack of awareness: Anosognosia:

- Alcoholics with significant PFC deficits (based on frontal impairment) will exhibit neurogenic denial of deficits (Anosognosia) – they are deficit blind

- As a clinician, the chance of knowing whether a patient has objective cognitive dysfunction based on their verbal report is probably less than 50%, making cognitive assessment based on interview likely worthless.
Prevalence of Frontally Based Impairment

NP testing impairments exhibited on:

- Categories = 50%
  - Abstract thinking
- COWAT = 50%
  - Verbal fluency
- Trails-B = 17%
  - Cognitive flexibility
- Stroop = 12%
  - Cognitive response inhibition

Morgenstern & Bates, 1999
Clinical Recommendations

- There is no cure for addiction; it is a brain disorder & long term behavioral memory conditioning; but treatment & AA can lead to long-term sobriety

- Need to do some brief cognitive assessment early

- **MoCA**: Montreal Cognitive Assessment

- [http://www.mocatest.org/](http://www.mocatest.org/)

- If significant deficit, may need formal NP testing.
Neuropsychological Testing Performance

Neuropsychological testing performance outcome in alcoholics is highly multifactorial in nature.

Alcohol is not the only cause of deficits.
B. Neuropsychiatric Risk Factors:
- Pre-abuse FAS/FAE
- Systemic illnesses and general health
- Head injury
- Psychiatric comorbidity
- Use of other drugs

D. Alcohol History:
- Amount per occasion
- Duration of abusive drinking
- Pattern over lifetime
- Recent amount/duration
- Length of abstinence

C. SES & Education

E. Test Characteristics & Subject Sample

F. Motivation & Expectancies

A. Age
- Gender
- Family History
- Temperament

Rourke, S. B. and Løberg, T, 1996
Neuromedical Risk Factors

- Besides dose-related neurotoxic effects of chronic alcohol consumption, NP deficits due to:
  - Metabolic factors resulting from intoxication and withdrawal syndrome
  - Cerebrovascular disease
  - Hepatic encephalopathy
  - Alcohol-related physical complications (gastritis, esophagitis)
  - Traumatic brain injury (TBI)
Newly Dry Brains: Neuropsychological Impairment in Abstinent Alcoholics

Bad News: Alcohol is neurotoxic

Good News: Abstinence reverses damage

- Overwhelming evidence:
  - Significant pattern of cognitive deficits in alcoholics/CD: 33-75\% with detectable deficits, long before liver, neurological and medical symptoms;
  - Specific etiology not established
Predictors of NP Impairment

Age: more important than length of drinking history
Family history, genetics
Age of beginning drinking
Years of drinking, esp. 10 years +
Maintenance drinkers worse than binging
Amount of ETOH per session > frequency
Presence of classic sxs (DTs, blackouts, Sz) unrelated to NP impairment
Years of ETOH, # of drinks not strongly related to NP impairment
(.3 to .4 correlation; 20% of variance)

Hawkins, Catalano, & Miller, 1996
ADHD and Chemical Dependency

- Compared with controls, adults with ADHD have a:
  - 3 to 4-fold higher rate of marijuana and cocaine use
  - 3-fold higher rate of alcohol abuse
  - utilize tobacco 40% more

David Pating, MD, KP CDRP:
- ADHD Treatment with stimulants reduces CD relapses
In light of teens’ ongoing development and maturation, some states have introduced graduated driver licensing laws to restrict their actions behind the wheel. Courtesy, with permission: The Allstate Corporation
Drug Use starts early and peaks in Adolescence

Evidence from surveys

First Drug Use (number of initiates)

Infant Child Teen Adult Older Adult

The Adolescent Brain, Steve Hanson, OASAS: http://slideplayer.com/slide/5977856/
The Great Pruning, ages 5 to 21: 50% loss of synaptic connections

Brain maturation: from back to front

Images of brain development in healthy youth: ages 5 to 21

Blue represents maturation of brain area

Paul Thompson, PhD, UCLA:
Adolescence Brain Changes

- More vulnerable to neurotoxic events because brain is in last major developmental period
- While overall brain volume stays same after puberty, there are ongoing synaptic refinement & myelinization results in reduced gray matter and increased white matter volumes by late adolescence.
- Major synaptic pruning (loss of 50% of synaptic connections in the brain)
- Maturation of frontal and limbic regions
- Increase in myelinization (15x faster)
- Dopamine distribution changes (risk taking, reward seeking)
Neuroimaging & NP findings in adolescents

- Smaller PFC in teens with AUDs and correlation of smaller volume with greater alcohol consumption.

- Hippocampal volume correlate with age at AUD onset (younger age at initiation, smaller volume) and duration (shorter duration, larger volume).

- Both binge drinkers and marijuana users have poorer white matter integrity; binge drinkers show even poorer white matter health in several cortical and subcortical regions.

- Worse NP performance in attention and information processing, memory, visuospatial functioning, language abilities, and executive functioning compared to nondrinking controls.

Jacobus & Tapert, 2013
Deficit Source

**ETOH neurotoxicity:**

- Mice with 4 m ETOH—50% HC dendritic loss

- **Cerebral atrophy most common finding**
  - White matter more affected than gray
  - Frontal and parietal regions most affected

- **Disrupts hippocampal connections**

- **Subcortical atrophy**
  - Cerebellum
  - Caudate nucleus
  - Limbic system

JCM Brust, 1993
Deficit Source 2

Nutrition: thiamine deficit

Liver disease: hepatic encephalopathy: lower PIQ

Vascular pathology: reduced Cerebral Blood Flow

Brain trauma

Age of drinking onset: Cloninger’s Type 2 (early onset: symptoms of antisocial personality disorder, more social consequences of drinking and higher sensation-seeking scores, worse prefrontal)

Fetal Alcohol Syndrome

Smoking: COPD
Alcohol and Brain Damage

Alcohol does not kill neurons in adults.

Alcohol damages dendrites and white matter, reducing message traffic between neurons and transmission speed.

Damage is mostly reversible, but neuronal structure is changed in the process.
Chronic heavy alcohol consumption is frequently associated with cognitive compromise.

On average, NP test performance of heavy drinkers falls within the average to low average range.

Consumption of 3-4 drinks for 7 days a week are associated with reduced cognitive function.

Heavy drinkers (26 drinks): performance reductions in word-list generations, VS skills, memory & psychomotor speed.
Non-Korsakoff Alcoholism: Mild NCD

- **Non-Korsakoff alcoholism (chronic AUD) cognition**: deficits in problem solving, abstraction, perceptual motor skills

- **Age & maximum quantity & frequency of recent alcohol use predict deficit level; Mild not Major NCD**

- **Younger than 40-45**: better recovery & less severe deficits than older
Non-Korsakoff Alcoholism 2

- No correlation between years of alcoholism and severity of NP deficits

- Quantity and frequency of consumption in 6-month period prior to evaluation are best predictors of NP impairment

- Lower extremity motor deficits are correlated with length of drinking

- 2 systems of brain deficit in alcoholism:
  - Cerebellar-pontine-prefrontal (motoric)
  - Prefrontal-parietal corticocortical (cognitive)
Subacute deficits in non-Korsakoff Alcoholism

- Problem-solving/executive functioning, recent memory, VS ability, and perceptual and motor skills deficits

- Executive function often more resistant to recovery of function.
  - Influenced by family hx of alcoholism and is a predisposing vulnerability to alcoholism
  - Influenced by psychiatric comorbidity,
  - And may be less mediated by dose-effect relationships.

- During intermediate duration phase, recovery in any or all functions, but deficits may be long-standing among 10-30% who display them beyond subacute phase.
Individual differences among Non-Korsakoff Alcoholics

- Alcoholics:
  - uncomplicated types vs
  - those with complex neuromedical risks (hepatic, neurological, nutrition, hypoxemia, alcohol withdrawal, psychiatric)

- Minimal Hepatic encephalopathy (MHE) is:
  - most likely manifestation of cirrhosis from alcoholism
  - most likely to complicate the severity and duration of NP presentation (esp. psychomotor slowing, attention & EF, involving fronto-subcortical networks)
Neuroimaging in “uncomplicated” alcoholics

- Ventricular enlargement, particularly the third ventricle

- Gray and white matter volume loss
  - Prefrontal cortex (PFC), most notably the dorsolateral PFC
  - Hippocampus
  - Cerebellum
  - Corpus callosum

- Associated with longer lifetime alcohol use and poorer NP functioning

- Can partially recover with abstinence through regeneration

- Future relapses had smaller brain volumes than future abstainers in regions of the reward system
Recovery in Non-Korsakoff Alcoholism

- Acute (1-2 weeks), sub-acute (3 weeks to 2 months), and intermediate (2-6 months)
- Recently detoxified: general NP deficits (excluding intact vocabulary) within 1st week or 2 of detoxification
- In general, if deficits are present in non-Korsakoff alcoholism, the same deficits tend to be present and possibly more serious, in Korsakoff alcoholism
Modal Neuropsychological Findings

**Big 4 Major Neuropsychological Deficits in AUD:**

- Executive Functioning
- Explicit Memory, esp. nonverbal
- Visual Spatial
- Motor Ability

Deficits are mild to severe
EF is distinct from Behavioral Memory (more automatic memory processes that have been overlearned by repetition; highly resistant to change).

EFs allow us to respond flexibly to the environment.

EF is essential for successfully navigating nearly all of our daily activities.

Impairments in EF thus have serious consequences.
Coming Up Next: Example of Behavioral Memory

- Typewriting skills are behavioral memory
Behavioral Memory
Executive Functioning

- EF = Applying knowledge toward real world goal directed behavior

- Executive functioning examples:
  - Self monitoring behavior
  - Anticipate consequence of action
  - Disregard erroneous strategies
  - Inhibit automatic but inappropriate response
  - Comply with treatment
  - Do something when needed (not just know how to do it)

- Prospective Memory: frontally mediated memory of an intention; best predictor of ability to live independently
NP in uncomplicated, recently detoxified Alcoholics

- All cognitive domains except IQ are affected.
- Executive dysfunction may be both a determinant and consequence.
- Most recovery occurs during the first month of abstinence;
- 30-80% have cognitive recovery after 1 month of abstinence
- If deficits persist beyond the first month, recovery may take months or years; 20% will not recover fully.
Neuropsychological Deficits

- IQ: At risk for lower performance on NART-estimated IQ
- Lower performance on Perceptual Reasoning & Processing Speed on WAIS4
- Attention: complex attention ↓↓
- Working memory: consistently impaired ↓↓
Neuropsychological Deficits 2

- Processing speed ↓↓: one of the most consistently impaired

- Language: normal

- Visuoperceptual & Visuospatial ↓↓: commonly impaired

- EF dysfunction ↓↓↓↓: categorical thinking, set establishment and maintenance, and decision making deficits
  - flexibility, problem solving, cognitive and behavioral inhibition, search strategy
  - Korsakoff: severe EF deficits
Neuropsychological Deficits 3

**Sensorimotor functions**: ataxia of gait and reduction in manual dexterity are common; fine motor control and grip strength normal;

Sensorimotor: color vision, visual search, **response slowing ↓**, peripheral neuropathy

**Motor Speed**: ↓
Neuropsychological Deficits 4

- **Memory**: common ↓, but not universal; superficial encoding, intrusions, visual memory ↓
  - Recently detoxified: reduced word-list learning & paired associate learning
  - Non-Korsakoff: learning deficits, working memory deficits; subcortical retrieval pattern of memory deficits, with ok retention & recognition
  - Korsakoff: profound encoding & retrieval of episodic memory

- **Procedural/behavioral memory is intact**: AA had it right

- **Abstinence crucial**: 3 weeks to cognitive recovery in younger alcoholics; longer for older
Summary: Neurocognitive Impairments

Age is significant variable in reversibility of deficits

Continuum: 10% severe; 50-70% some cognitive deficits; 20% normal

- **Specific Deficits; Often Subclinical Levels:**
  - Often significantly inferior to community controls

- **Not associated with withdrawal processes**

- Equivalent impairment for males/females
Clinical Recommendation 2

- **Dissociation:**
  - Knowledge or ability to describe appropriate behavior does not equal ability to do it appropriately;

- **Implications:** Don’t depend on verbal insight

- Neurologically challenged/impaired, not unmotivated

- Do a MoCA!

- Work on behavioral memory enhancement, a la AA.
Memory and Alcohol

**State dependent learning** / Context dependent memory:
Where is that bottle?

**Blackouts** = Temporary Amnesia:
BAC level of .2
9 hours to 3 days in length
51% undergraduates = 1x
_alcohol suppresses CA1 in hippocampus: encoding deficit_

**Acute effects on Memory:**
Retrieval poorer than Recognition
Retrieval cues aid alcoholics
Moderate alcohol consumption significantly decreases neurogenesis (1400 new stem cells daily) in the adult hippocampus.

In rats, the number of cells produced in the dentate gyrus of the hippocampus was reduced by nearly 40%.

Moderate consumption of alcohol for a relatively short period of time can have profound effects on structural plasticity in the adult brain.

Anderson ML et al., 2012
Memory and Alcohol 2

Episodic/factual Memory impaired, esp. visual/nonverbal

Procedural Memory preserved (secret of AA’s success)

Poorer semantic encoding strategies (EF):
  higher intrusions,
  less semantic category usage

Normal forgetting rates

Continuum of memory effects:
  social drinkers to alcoholics (retrieval deficit) to Korsakoff (amnesia),
  esp. nonverbal memory
Memory and Alcohol: Morris Water Maze

The black, open circle is the old location and the solid red circle is the new location. Control rats (left) rapidly learn to find the new location. Weeks after treatment when alcohol was no longer present, binge treated rats (right) perseverated on the old location. They never found the new location.

Crews, FT, & Nixon, K, 2008
Clinical Recommendation 3: Memory

- **AA is right**: use *procedural/behavioral memory* not insight or talking, esp. in early recovery

- **Behavioral repetition/avoidance** is target

- But also **external reminder systems** to reinforce poor memory

- **Download CJV’s Executive Skills & Metacognitive Therapy booklet from website**
Clinical Recommendation 3: Memory

- **Keep it simple**: Modify written material to make it concise and to the point.
- Paraphrase concepts, *use concrete examples, incorporate visual aids*, or otherwise present an idea in more than one way.
- If it helps, *allow the individual to take notes* or at least *write down key points* for later review and recall.
- **External prosthesis**: Encourage the use of a *calendar or planner*; if the treatment program includes a daily schedule, make sure a "pocket version" is kept for easy reference.
- Make sure *homework assignments are written down*. 
Clinical Recommendation 3: Memory

- Do not take for granted that something learned in one situation will generalize to another.

- Procedural memory is sensorimotor specific

- Repeat, review, rehearse; repeat, review, rehearse.
Visualspatial Functions

Simple visualspatial functions intact

Impaired color vision, visual search

Visual-spatial organizational functioning impaired, esp. slowness

Emotional processing impaired:
   Emotional cues and facial emotion expression interpretation↓
Clinical Recommendation 4: EF

- US Law vs neuroscience: Knowledge of right & wrong can be present along with total inability to inhibit behavior
- US Law: no death penalty or life sentence without parole for adolescents (due to lack of EF); but does not apply to AUD
- Executive Dysfunction is cause of neurogenic lack of awareness & loss of inhibition

- Impairments in Self-Awareness; Introspection
- Neurologically based Poor Self Monitoring leads to inability to understand the consequences of one’s actions.
Clinical Recommendation 4b: EF

- Caution: when making inferences about motivation based on observed behaviors.
- Non-compliance may not arise from lack of motivation or resistance.
- Unawareness of deficits can be due to executive dysfunction and may not always be due to psychological denial.
Clinical Recommendation 4c: EF

- **Inflexibility** can lead to **perseveration** i.e. repeating an inappropriate behavior

- Poor ability to inhibit a response can lead to a **broad range of inappropriate behaviors**: safety issues; striking out; verbal outbursts; sexual remarks or behaviors; socially Inappropriate comments
Clinical Recommendation 4e: EF

- Let a person know a behavior is inappropriate.
- Do not assume the individual knows and is choosing to do so anyway.
- Provide straightforward feedback about when and where behaviors are appropriate.
- Test prospective memory by having them remember to remind you of something 15 minutes later
Intoxication: Neurological Condition

Intoxication: alcohol is a CNS depressant with neurocognitive deficits:

- Slurred Speech
- Ataxia
- Neuropsychological Deficits (Memory, Executive deficits)
- Behavioral disinhibition
- Reaction Time↓
Stages of Neuropsychological Recovery:  **Acute**

Acute deficits: 1 week abstinence:

Most alcoholics impaired immediately after cessation of drinking

Younger improve over 3-4 weeks to WNL

Older (>40) have slower recovery

Memory and Visual-motor improve markedly

Improvement diminishes or reverses if relapse  

Ryan & Butters, 1986
Stages of Neuropsychological Recovery: **Short Term**

Short term: 2-5 weeks

Younger (<35 age, 5-10 years use) recover to WNL

More chronic history and older age, poorer NP performance:
   Executive, perceptual-motor, LT verbal and nonverbal memory (latter worse), visual-spatial deficits
Stages of Neuropsychological Recovery: **Long Term**

Long Term: 13 months+

Less conclusive evidence for deficits:
- Nonverbal learning and memory, esp. Visual memory ↓
- Complex memory, esp. encoding strategy ↓
- Executive functioning ↓

5 years: significant improvement but not as good as controls

Poorer recovery: TMT-B, Digit Symbol
Characteristic Behaviors of detoxified Alcoholics: EF

Executive Functions:
- impaired judgment
- blunted affect
- poor insight
- social withdrawal
- reduced motivation
- distractibility
- cognitive rigidity
- inattention
- perseveration

NP test impairment:
- WCST
- Categories Test
- TMT
- Stroop

Frontal Lobe Dysfunction
Characteristic Behaviors of Alcoholics: VS

**Visual Spatial Dysfunction**
- poor sense of direction
- impaired constructional ability
- impaired spatial placement
- impaired drawing ability

**Parietal Lobe Dysfunction**

NP test impairment:
- Rey Complex Figure
- Block Design
Visual Impairment on Rey Complex Figure Recall

CJV personal collection
Characteristic Behaviors of Alcoholics: **Motor**

- impaired timing
- impaired tracking
- impaired balance
- impaired gait
- increased falls

> Cerebellar Dysfunction

Gender Differences

Majority of studies: recently detoxified males

Males to Females: 5:1; Men drink 2.5 times more alcohol in lifetime

Women have similar pattern & degree of NP deficits as men

Women metabolize alcohol differently; display NP deficits sooner

Women develop cirrhosis, cardiomyopathy, & peripheral neuropathy sooner

Gender Differences

- Women have less body water than men of similar body weight, so that women achieve higher concentrations of alcohol in the blood after drinking equivalent amounts of alcohol.

- Women have smaller quantities of the enzyme dehydrogenase that breaks down alcohol in the stomach.

- A woman will absorb about 30% more alcohol into her bloodstream than a man of the same weight who has consumed an equal amount.

- More psychiatric comorbidities
Personality Consequences of SA

- **SA produces Disinhibition:**
  - 48-50% of all assaults,
  - 48-65% of homicides,
  - 34% of drownings,
  - 42% of injuries,
  - 47% of young male car crashes;
  - 50% of date rape;
  - 16% of child abuse; burglaries, spousal abuse, suicide attempts
- 50% of successful suicides done under influence of alcohol
- Depression
- Action orientation
- Alexithymia

Vijayakumar, L; Kumar, MS; Vijayakumar, V, 2011.
Neuroimaging Findings

Recent detoxified: Cerebral atrophy and volume loss, esp. in older Prefrontal sensitive to effects of aging & ETOH

Prolonged abstinence (6 m) causes White Matter increase, decreased 3rd Ventricle volume

PET studies: NP deficits related to decreased glucose metabolism and hypoperfusion in frontal cortex & subcortical structures

SPECT: reduced rCBF
Neuroimaging

- **Structural MRI:**
  - Smaller cortical gray and white matter volumes & larger ventricles
  - Pronounced in frontal, limbic and cerebellar areas
  - Older show greater volume deficits, esp. frontal
  - Hippocampal volume deficits in adolescent and young adults
  - Younger age of onset and longer duration of use correlates with smaller hippocampal volumes

- **Functional MRI:**
  - Alcoholics use more higher order cognitive processes to do simple tasks

- **Diffusion Tensor Imaging:**
  - Poor WM integrity, esp. corpus callosum
  - Demyelination
Emotional Perception and Alcoholism

- Alcoholic individuals display abnormalities in their perceptions of facial and linguistic emotional stimuli
  - Impairment in emotional facial-expression recognition
  - Deficits in processing affective cues in speech
  - See more fear and less anger in facial expressions
  - Enhanced fear responses

- They perceived the valence of negative facial stimuli to be more neutral as a function of age

Clark, U, et al., Neuropsychology, 2007
Brain is clearly a dynamic organ

Structural brain abnormalities can be partially reversible with sustained sobriety, possibly reflecting remyelination & cellular revoluming:

- Increase in glucose utilization post 30 days of sobriety
- Increase in cortical grey volume, even more WM volume, & hippocampal volume with 30 days
- Neurogenesis increase with sobriety in rats
- With 5 years sobriety, increased brain volume
- Increased frontal and limbic areas with recovery
Wernicke-Korsakoff Syndrome

Carl Wernicke, b Poland 1848
Sergei Korsakoff, b Russia 1853

J.F. Lehmann, Muenchen, in public domain
http://home.kpn.nl/b1beukema/vitaminen.html
In 1881, Carl Wernicke described a neurologic syndrome of acute onset characterized by:

- a global confusional state,
- ataxia,
- ophthalmoplegia (eye muscle weakness),
- nystagmus,
- polyneuropathy in the arms and legs

Thiamine (B1) deficiency + heavy drinking

10% fatal
Korsakoff Syndrome

In 1887 Korsakoff added the characteristic:
- problems in new learning (anterograde amnesia)
- as well as the deficits in remembering past events (retrograde amnesia),
- and emphasized that these occurred in the context of clear attention and consciousness

Some patients tended to confabulate, sometimes making up stories or events entirely, but more frequently confusing the temporal context of actually experienced events.
Wernicke-Korsakoff’s Syndrome

Persistent (Korsakoff’s):

- Normal IQ
- Severe Anterograde and temporally graded retrograde amnesia imposed over typical neurotoxic alcohol effects:
  - defective encoding;
  - severe retrieval deficit;
  - but can recall stores of sexual content
  - better with recognition;
  - but 2 of 3 recalled 9/11/2001 event

Butters & Stuss, 1989
Wernicke-Korsakoff’s Syndrome 4

Executive dysfunction; lack of awareness if frontal; blandness, confabulation

Processing speed impaired

28% slight recovery, 26% permanent syndrome
Korsakoff’s Syndrome 1

- **Dense Amnesia**

- **Executive Dysfunction** (deficits in planning, decision making, and problem solving; poor WCST, TMT)

- **Attention Deficit**

- **Visuospatial and visual-perceptual deficits** are also observed on a variety of concept formation tests that require discrimination and classification of complex visual stimuli

- **Abnormally long time to identify visually presented material**

Kopelman, 1995
Korsakoff’s Syndrome 2

- Retrograde amnesia a typical feature, commonly extending back 25 years or more

- Memory for autobiographical information as well as knowledge of public events and facts are affected

- Memories from childhood and early adulthood are remembered better than memories from the recent past. (Kopelman 1989; Fama et al 2004)
COGNISTAT: Korsakoff’s

[Image of a cognitive status profile showing different ranges for various cognitive functions such as LOC, ORI, ATT, LANGUAGE, CONST, MEM, CALC, and REASONING. The profile includes categories for average range, mild, moderate, and severe with corresponding scores and shaded areas indicating different levels of cognitive status.]
Comparing Korsakoff and non-Korsakoff alcoholics

- Sudden Onset in Korsakoff’s

- Korsakoff patients are impaired on tests of memory, fluency, cognitive flexibility, and perseveration

- Non-Korsakoff alcoholics may show some milder frontal system deficits as well
Korsakoff’s vs. Alcohol induced NCD

- In **Korsakoff syndrome** patients have a disproportionate disorder of memory.

- No distinct neuropathological basis has been established for alcoholic major NCD.
Neuropsychological and Neurological Deficits Associated with Cirrhosis

- NP deficits are independent of other liver disease symptoms (PSE)
- Deficits esp. in spatial, practic, and perceptual-motor: VS, handwriting, VIQ, memory
- Neuropathology: frontal atrophy, cortical hypoperfusion, neuronal necrosis, demyelination
- EEG: triphasic wave pattern
- Issue of some covariance with alcohol effects
TBI and Alcoholism

- Alcohol is present in:
  - 41% of fatal TBI
  - 7% of falls
  - 60% of MVA
  - >70% of MVA comas
  - 1 person injured every 2 min where alcohol present
Alcohol related Atrophy, esp. Prefrontal

Preexisting EF vulnerabilities

- Nonalcoholic adult offspring of alcoholic individuals showed increased impulsiveness and decreased EF, suggesting weakness of 2 distinct neurobehavioral decision systems.

- Findings support evidence that EF weaknesses may qualify as a suitable endophenotype (genetically based behavior pattern) candidate for alcoholic disease.
Two-systems compromise model

- **Best fits current data**

- **Posits** alcohol neurotoxic compromise of
  - Cerebellar-pontine-prefrontal (motoric)
  - Prefrontal-parietal cortico-cortical system (cognitive)
  - producing motor and cognitive compromise, respectively

- It is based on a pattern of compromise of executive function, visuospatial abilities, and ataxia of gait, along with relative sparing of declarative memory and upper limb speed and strength
Recovery and White Matter

- **Reversal of atrophy**: abstinence followed by reversal of sulcal and ventricular enlargement

- **Increased cortical grey matter** after 2-4 weeks of sobriety

- **Increase in white matter volume** related to decrease in 3rd ventricular size, 2-7 months
Recovery of Deficits

With longer sobriety, there is significant improvement in brain structure and function.

De-atrophication: dendritic & white matter regrowth

3 weeks as typical recovery

Drinking pre and post age 40

Neuropsychological deficits improve over 4 to 5 years

Neuropsychology of Alcoholism - Parsons et al. 1987
Recovery 2: Reversal of Atrophy

- Cognitive functions and motor coordination improve within 3 or 4 weeks of abstinence; cerebral atrophy reverses after the first few months of sobriety.

- Structural pathology often disappears with long-term abstinence.

- Frontal lobe blood flow continues to increase with abstinence, returning to approximately normal levels within 4 years.
Recovery 3: Executive Functioning is slowest to recover

- Skills that require novel, complex, and rapid information processing take longest to recover.

- New verbal learning is among the first to recover. Visual-spatial abilities, abstraction, problem solving, and short-term memory, are the slowest to recover.

- May be persistent impairment in these domains, particularly among older alcoholics [over 40

Neuropsychology of Alcoholism - Parsons et al. 1987
### Chronic substance abuse effects on NP evaluation

<table>
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<tr>
<th>Domain</th>
<th>IQ/Achv</th>
<th>Atten</th>
<th>PSpeed</th>
<th>Lang</th>
<th>Vspatial</th>
<th>Mem</th>
<th>EF</th>
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Vella based on D. Gansler & H. Duncanson, 2014
A Neuropsychological Perspective on Treatment Tactics 1

Neurologically challenged/Impaired, not unmotivated

Wait 2-3 weeks for cognitive assessment

Neurogenic lack of awareness: Anosognosia - impaired insight into deficits

Don’t depend on insight: insight therapy inappropriate early on, phase appropriate
Clinicians’ misattributions of patients’ behaviors

- Verbal skills (previously learned information) remain relatively preserved, so patients appear unimpaired
- Clinicians fail to identify cognitive impairment in at least 40% of patients

- Neuropsychological dysfunction may result in more rule violations in treatment and higher drop out rates

- Low motivation and minimization and denial may be attributable to cognitive deficits

(Fals-Stewart et al., 1994)
A Neuropsychological Perspective on Treatment Tactics 2

- Think external prosthetics for neurological vs. psychological Tx

- Different treatment approaches for cognitively impaired clients: different levels of care

- Need for Mental Status screening, i.e. MoCA
Clinical Implications of NP perspective

- **Patient – Treatment Matching:**
  - Pre-treatment neuropsychological assessment
  - Target skills to individual patient’s neuropsych profile
  - Reduction in number of skills taught in CBT
  - Behavioral possibly better than cognitive focus
  - Extensive repetition
NP Rehabilitation

- Cognitively impaired patients might benefit from cognitive rehabilitation in addition to traditional alcohol treatment;
  - A la TBI, schizophrenia, cog rehab

- Employ errorless learning strategies for simple verbal information (http://www.projectlearnet.org/tutorials/errorless_learning.html)

- Encourage elaborative processing (http://adaptivereading.pbworks.com/w/page/3949397/FrontPage)

- Provide clear rules for actions and structure tasks/routines
A Neuropsychological Perspective on Treatment Tactics

- Encourage **Physical Exercise**: neurogenesis & EF enhancement

- **Replace use of executive function with procedural memory/prospective memory tactics**

  - Airline Pilot research: Flip procedure books

- **Implementation Intentions** (50%↑):
  - “When situation \( x \) arises, I will perform response \( y \)”

- Steps: the how, the when and the where of doing any goal
Emphasize Procedural/behavioral memory:

- AA had it right – walk the walk

Behavioral strategies:
- behavioral repetition
- concrete
- sponsor model
- avoid triggers

Use of reminder strategies
- Calendars, dayminders
- Google calendar (text message reminders)
Evidence-Based Practices Resources:

- NIH:

- SA and MH Services Admin:
  - http://www.nrepp.samhsa.gov/

- National Institute on Alcohol Abuse:

- National Institute on Drug Abuse

- Univ. of Washington Alcohol & Drug Abuse Institute:
  - www.pscyhoologicaltreatments.org


Citations

Bibliography

- Paying the Tab: The Costs and Benefits of Alcohol Control by Philip J. Cook, 2007
Bibliography

- Neuropsychology of alcoholism: Implications for diagnosis and treatment. Parsons, Oscar A. (Ed); Butters, Nelson (Ed); Nathan, Peter E. (Ed), 1987
- The Chemical Brain – Sidney Cohen (1988)
- Neurobehavioral Toxicology: Neurological and Neuropsychological Perspectives – J/ Albers & S. Berent (2005)