Psych4BN3 Lecture 1 Outline

I. Intro to TA’s, course overview
II. Introduction to effects of alcohol on the brain and body, Part I
III. Introduction to tests of MTL, PFC and FSR system functions
IV. Assignment #1 – cognitive tests
V. Designing a questionnaire for assessing alcohol consumption
VI. Group work: divide into groups, discuss MTL/PFC/FSR tests and alcohol questionnaire.
IMPORTANT ANNOUNCEMENT:

This course relies heavily upon group work. If you decide to drop the course, please email your instructor and your group to let them know immediately!!!
## Course overview: Assessment

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation 3% attendance, 7% class discussions, 10% group work</td>
<td>20%</td>
</tr>
<tr>
<td>Assignment 1: Selection of cognitive tests</td>
<td>5%</td>
</tr>
<tr>
<td>Assignment 2: Ethics application (group)</td>
<td>10%</td>
</tr>
<tr>
<td>Assignment 3: Selection of research articles</td>
<td>5%</td>
</tr>
<tr>
<td>Assignment 4: Outreach activity (group)</td>
<td>15%</td>
</tr>
<tr>
<td>Presentation 1: lit review</td>
<td>15%</td>
</tr>
<tr>
<td>Presentation 2: research projects</td>
<td>15%</td>
</tr>
<tr>
<td>Final project write-up</td>
<td>15%</td>
</tr>
</tbody>
</table>

**Weeks:**
- Presentation 1: lit review - Week 7
- Presentation 2: research projects - Week 12
- Final project write-up - Due Apr 15
I. Course overview

Assessment

See syllabus online at

www.science.mcmaster.ca/pnb/department/psych4bn3/

Includes links to assignments and other resources
II. Introduction to effects of alcohol on the brain and body
Ethanol affects many areas of the body/brain

- Neurotransmitter systems
- Receptors
- Signal transduction proteins
- Enzymes
- Gene expression
Possible sites of action of ethanol in the CNS

1. Lipid structure in membrane core
2. Polar head of phospholipids
3. Protein-lipid interactions
4. Lipid-water interface
5. Channel gating mechanism
6. Recognition site for neurotransmitters and neuromodulators e.g. GABA, NMDA

Neurotransmitter-coupled ion channel
(from Fadda & Rossetti 98)
Extreme effects of chronic and/or severe alcohol abuse

• Acute effects
• Chronic effects
# Acute effects

<table>
<thead>
<tr>
<th>BAC %</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>.02-.04</td>
<td>Mildly relaxed, lightheaded</td>
</tr>
<tr>
<td>.05-.07</td>
<td>Disinhibited, exaggerated emotions</td>
</tr>
<tr>
<td>.08-.09</td>
<td>Slurred speech, impaired sensory-motor and decision-making</td>
</tr>
<tr>
<td>.1-.12</td>
<td>Lack of coordination, balance, judgement, impaired memory</td>
</tr>
<tr>
<td>.14-.17</td>
<td>Difficulty talking, walking, standing. May black out.</td>
</tr>
<tr>
<td>.2</td>
<td>May feel confused, disoriented, vomit, black out.</td>
</tr>
<tr>
<td>.25</td>
<td>Mental, physical and sensory functions severely impaired. Increased risk of serious injury, asphyxiation from choking on vomit</td>
</tr>
<tr>
<td>.3</td>
<td>You’re probably in a stupor, little comprehension of what’s going on, may suddenly pass out and be difficult to awaken.</td>
</tr>
<tr>
<td>.35</td>
<td>Similar to state of surgical anesthesia. May stop breathing.</td>
</tr>
<tr>
<td>.4-.5</td>
<td>Probably in a coma. Nerve centers controlling heartbeat and respiration are slowing down. It’s a miracle if you survive.</td>
</tr>
</tbody>
</table>

Source: Clemson Redfern Health Centre Website
How many drinks is too many?

http://www.occuhealthsolutions.com/Alcohol%20Drink%20Chart%20OccuHealth%20Solutions.htm
What is a binge?

• NIAAA defines binge drinking as a pattern of drinking that brings blood alcohol concentration (BAC) levels to 0.08 g/dL. This typically occurs after 4 drinks for women and 5 drinks for men—in about 2 hours.

What is a binge?

• The Substance Abuse and Mental Health Services Administration (SAMHSA), which conducts the annual National Survey on Drug Use and Health (NSDUH), defines binge drinking as drinking 5 or more alcoholic drinks on the same occasion on at least 1 day in the past 30 days.

• Widely varying definitions!

Adolescent bingeing

- 51% of male college students and 40% of females have routinely engaged in binge drinking in the previous two weeks.
- Students who binge may experience [...] disruption of sleep or study; property damage; and verbal, physical, or sexual violence (Harvard School of Public Health)

Why do adolescents binge?

- 48% of college drinkers report that "drinking to get drunk" is an important reason for drinking.
- Almost 1 in 4 drink alcohol 10 or more times a month.
- 29% report being intoxicated 3 or more times per month (2005 SAMHSA National Survey on Drug Use and Health).

Why do adolescents binge?  
The case of @Vodka_Samm


From a 2013 Huffington Post story:

“We learned a lot from a 22-year-old woman who tried to storm the field at a University of Iowa football game over the weekend.

What do you get when you're arrested at a college game, blow a .341 BAC and then tweet about it? Why, your very own commemorative T-shirt, of course.”
The case of @Vodka_Samm

“But Goudie wasn't done. When she was released from the slammer, she took to Twitter …”

The case of @Vodka_Samm

Just went to jail #yolo
— Samantha (@Vodka_samm) August 31, 2013
Blew a .341 in jail
— Samantha (@Vodka_samm) August 31, 2013
I'm going to get .341 tattooed on me because its so epic
— Samantha (@Vodka_samm) August 31, 2013
Update: 9/4, 2:30 p.m. -- Goudie had more than 20,000 followers on Twitter
Extreme effects of chronic and/or severe alcohol abuse

• Acute effects
• Chronic effects
Chronic effects

- Neuroadaptation
- Addiction
- Damage to brain and other organs
Neuroadaptation

• Sensitization
  Liking $\rightarrow$ wanting $\rightarrow$ craving

• Tolerance
  – Functional tolerance
  – Acute tolerance (within session)
  – Environment-dependent tolerance

• Withdrawal
  – convulsions, motor abnormalities, autonomic disturbances, negative affective state
  – Propensity toward alcohol-seeking
Chronic effects

• Neuroadaptation
• Addiction
• Damage to brain and other organs
Fronto-striatal reward and incentive motivational circuits

Effects of drugs of addiction on reward circuits

Alcohol Addiction

- reward circuits and stress circuits are involved in the transition from non-dependence to dependence

Source: Gilpin & Koob  Neurobiology of Alcohol Dependence
Chronic effects

• Neuroadaptation
• Addiction
• Damage to brain and other organs
Damage to brain and other organs: Alcohol-related disorders associated with long-term abuse

- Hepatic encephalopathy – liver failure
  - Tolerance may begin to decrease again
  - Cirrhosis of the liver can eventually cause death
- Pellagra – dermatitis, weakness, confusion, diarrhea, dementia and eventually death
  - caused by niacin (B3) deficiency, often associated with severe alcoholism
Damage to brain and other organs: Prenatal exposure

- Fetal alcohol syndrome: growth deficiency, facial dysmorphismology, smaller brain, cognitive and behavioural deficits, reduced cell proliferation in developing CNS, …

- In rodents, deficit in hippocampal neurogenesis persists into adulthood

The adolescent brain
The adolescent brain

- Myelination continues through adolescence in many brain regions.

- Adult-level decision-making and ability to assess incentive value of future rewards develops relatively late.
The adolescent brain

- Substantial brain development continues into adolescence, esp. dorsolateral PFC, OFC
- Synaptic pruning (decrease in grey matter, increase in white matter)
- Synaptogenesis
- Peak increase in dopamine
Adolescent brain:
Toxic effects of binge alcohol exposure

In rodents, binge alcohol exposure causes

• long-term deficits in hippocampal neurogenesis (Klintsova et al, 2007),
• spatial working memory deficits (Frank et al, 2008)
• brain damage to several areas (Crews et al, 2000)
Adolescent brain: 
Toxic effects of binge alcohol exposure

Human adolescents with alcohol use disorders showed
• altered anterior ventral PFC volumes: smaller in females, enlarged in males (Medina et al, 2008)
• reduced left hippocampal volume (Nagel et al, 2005)
A key study: Crews et al 2000

- Binge ethanol consumption causes differential brain damage in young adolescent rats compared with adult rats

Author(s): Crews FT, Braun CJ, Hoplight B, Switzer RC, Knapp DJ

Source: ALCOHOLISM-CLINICAL AND EXPERIMENTAL RESEARCH

Volume: 24 Issue: 11 Pages: 1712-1723 Published: NOV 2000

Abstract:
Background: Adolescents respond differently to alcohol than adults. Furthermore, binge drinking in young adolescents is becoming increasingly common.

Methods: To determine if the effects of binge drinking on brain damage are different in juveniles compared with adults, the effects of a 4 day binge ethanol treatment (e.g., 4 days of 4 times per day 15% ethanol intragastrically, approximately 9-10 g/kg/day ethanol) were investigated in adolescent-juvenile rats (JVN) 35 days old and compared with adult (ADT) rats 80 to 90 days old. Brain damage was measured by using the amino cupric silver stain of de Olmos et al. (1994).
Crews et al 2000 cont’d

• Results: Significant brain damage was found in both groups. The olfactory bulbs were equally damaged in both groups; however, the associated frontal cortical olfactory regions were damaged only in JVN. The anterior portions of the piriform and perirhinal cortices also were damaged only in JVN rats. Quantitation of silver-stained frontal areas in binge ethanol-treated JVN rats ranged from 400% to 1260% of control values. For example, in anterior perirhinal cortex, silver stain increased from $48 +/\text{-} 14$ to $444 +/\text{-} 114$ (mm$^2\times\text{10}(3)$ argyrophilic area; $p < 0.01$) in JVN control and binge ethanol-treated animals.
Still somewhat debated in the literature:

• Does long-term alcohol abuse cause dementia?

• Is moderate consumption beneficial?
But see e.g. Alcohol-related dementia: a 21st-century silent epidemic? (Gupta et al, 2008, British J Psychiatry)

Abstract: Evidence suggests a J-shaped relationship between alcohol consumption and cognitive impairment and other health indicators, with low levels of consumption having better outcomes than abstention or moderate to heavy drinking. Most research to date has focused on the protective effects of drinking small amounts of alcohol. As alcohol consumption is escalating rapidly in many countries, the current cohort of young and middle-aged people may face an upsurge of alcohol-related dementia. The dangers of heavy drinking and its effect on cognition require further attention.
Film: Alcohol and the brain

• (will be shown next week)
III. Introduction to tests of MTL, PFC and FSR functions
The hippocampus and the medial temporal lobe memory system

- **Hippocampus** (including dentate gyrus, CA3, CA1)
- **Parahippocampal gyrus**
- **Entorhinal cortex**

(Gazzaniga text figs 3.19, 3.23)
Prefrontal cortex
(Gazzaniga text figs 12.1, 12.2)

- Lateral prefrontal cortex
- Ventromedial prefrontal cortex
- Premotor areas
- Primary motor area
- Posterior cingulate gyrus
- Anterior cingulate gyrus

- Squirrel monkey
- Cat
- Rhesus monkey
- Dog
- Chimpanzee
- Human
Fronto-striatal reward and incentive motivational circuits

# Functions of the MTL, PFC and FSR

<table>
<thead>
<tr>
<th><strong>MTL</strong></th>
<th><strong>PFC</strong></th>
<th><strong>FSR</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Free recall</td>
<td>Working memory</td>
<td>Associations amongst reward cues e.g. alcohol word priming</td>
</tr>
<tr>
<td>Paired associate learning, cued recall (low vs high overlap, low vs high context)</td>
<td>Sustained attention</td>
<td>Attentional bias toward reward-related cues e.g. alcohol stroop</td>
</tr>
<tr>
<td>Remembering across long delays e.g. DMS/DNMS</td>
<td>Response inhibition</td>
<td>Association between reward and motivational outcomes, e.g. on mood priming for alcohol words</td>
</tr>
<tr>
<td>Configural vs simple stimuli</td>
<td>Strategic use of memory</td>
<td>Preparation for action, reward-seeking</td>
</tr>
<tr>
<td>Spatial memory</td>
<td>Task-switching</td>
<td>...</td>
</tr>
<tr>
<td>...</td>
<td>Multi-tasking</td>
<td>...</td>
</tr>
<tr>
<td>...</td>
<td>Prospective memory</td>
<td>...</td>
</tr>
<tr>
<td>...</td>
<td>Planning</td>
<td>...</td>
</tr>
<tr>
<td>...</td>
<td>Source memory</td>
<td>...</td>
</tr>
<tr>
<td>...</td>
<td>Temporal order memory</td>
<td>...</td>
</tr>
</tbody>
</table>
IV. Discuss Assignment #1.  
Due at beginning of Week 2 class
V. Developing a questionnaire for assessing alcohol consumption

As an example, see the Mehrabian & Russell AUQ

But you will be designing your own (first as a group, and then merging them into 1 for the whole class)
V. Developing a questionnaire for assessing alcohol consumption

Some potential issues:

- Frequency of drinking
- Years of drinking
- Amt consumed on each occasion vs on average
- Time since binge
- Withdrawal/hangover
- Any lifestyle correlates?
VI. Group work

• Divide into 3 groups, MTL, PFC and FSR
• Choose a focus for your study e.g. effects of binge alcohol consumption, effects of early drinking, effects of chronic alcohol use
• Note that each of you will also choose your own individual focus for your lit review presentation
• Group members should exchange email addresses
• Discuss MTL/PFC/FSR tests
• Discuss the alcohol questionnaire. Continue to discuss this week and email results to your TAs