Julie and Jeffrey Johnson were born 3 years apart.

Jeffrey could always make Julie smile.

He taught Julie to love running.

But then Jeffrey started getting high.

He called Julie late one night sounding despondent and they talked for 3 hours.

The next morning their Dad found Jeffrey dead. He was 19 years old.
The Teen Brain

What’s going on in there?


Unintentional Injuries 41%
Motor vehicle crashes 61%
Poisoning 26%
Other 13%

Alcohol/drugs are a major contributor!

The “Golden Window”
The human brain continues to grow and develop through the mid-20's.
THC Acute Effects on Brain Function

- Cerebrum
- Cingulate Gyrus
- Basal Ganglia
- Hippocampus
- VTA
- Cerebellum

Legend:
- Movement
- Sensations
- Vision
- Judgment
- Memory
- Reward
- Coordination
Adverse Effects of Short-Term Use and Long-Term or Heavy Use of Marijuana.

• **Immediate**: impaired motor coordination (*driving skills and increasing risk of injury*), impaired short-term memory (*difficulty learning and retaining information*), altered judgment (*increasing risky sexual behaviors, pregnancy and STI transmission*), paranoia and psychosis

• **Lifetime**: brain damage: psychiatric d/o's, addictive d/o's (*5x greater risk with early onset of use*), altered development, decreased cognitive impairment (*lower IQ*).

As THC content increases, we see more adverse effects:

- Paranoia
- Anxiety and panic
- Hallucinations
- Hyperemesis
- Erratic mood swings
- Aggressive behavior

*Source: National Drug Abuse Warning Network, 2011*
TOP: Increases over Time in the Potency of Tetrahydrocannabinol (THC) in Marijuana

BOTTOM: Number of Emergency Department Visits Involving Marijuana, Cocaine, or Heroin.


Level of Confidence in the Evidence for Adverse Effects of Marijuana on Health and Well-Being.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Overall Level of Confidence*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addiction to marijuana and other substances</td>
<td>High</td>
</tr>
<tr>
<td>Abnormal brain development</td>
<td>Medium</td>
</tr>
<tr>
<td>Progression to use of other drugs</td>
<td>Medium</td>
</tr>
<tr>
<td>Schizophrenia</td>
<td>Medium</td>
</tr>
<tr>
<td>Depression or anxiety</td>
<td>Medium</td>
</tr>
<tr>
<td>Diminished lifetime achievement</td>
<td>High</td>
</tr>
<tr>
<td>Motor vehicle accidents</td>
<td>High</td>
</tr>
<tr>
<td>Symptoms of chronic bronchitis</td>
<td>High</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>Low</td>
</tr>
</tbody>
</table>

* The indicated overall level of confidence in the association between marijuana use and the listed effects represents an attempt to rank the strength of the current evidence, especially with regard to heavy or long-term use and use that starts in adolescence.

Marijuana and Driving

Studies of performance show that THC impairs attention, working memory, coordination, reaction time, and visual perception.


Risk of Addiction

The Brain’s Reward Pathway

- **JOY** rewards behaviors needed for survival (e.g., work resulting in food, reproduction)
- Drugs are a **counterfeit** for well earned rewards.
The Limbic System

• Part of primitive “lizard” brain
• Stores memories of rewards: food, sex, alcohol and drugs
• Responsible for powerful cravings

Younger Age of First MJ Use Increases Risk of MJ Disorder
Number of People Aged 12+ Receiving Drug Abuse Treatment in Past Year (2011)

- **Marijuana**: 333578
- **Cocaine**: 11885
- **Pain meds**: 186986
- **Stimulants**: 278481
- **Heroin**: 17875
- **Hallucinogens**: 143827
- **Tranquilizers**: 0


Marijuana is especially addictive for teens ...

- **88%** of all substance abuse treatment admissions for those 12-17 years old involved marijuana

Source: Data from the Treatment Episodes Data Set (TEDS), SAMHSA, 2012
Risk of Mental Illness

Human Brain White Matter Connectivity

Studies on MJ Use and Psychosis

<table>
<thead>
<tr>
<th>Study (use)</th>
<th>Odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHDS (daily)</td>
<td>1.56 (1.20-2.03)</td>
</tr>
<tr>
<td>ECA (daily)</td>
<td>2.00 (1.27-3.16)</td>
</tr>
<tr>
<td>EDSP (daily)*</td>
<td>2.23 (1.30-3.83)</td>
</tr>
<tr>
<td>NEMESIS (weekly)*</td>
<td>6.81 (1.79-25.91)</td>
</tr>
<tr>
<td>NPMS (dependence)*</td>
<td>1.47 (0.55-3.93)</td>
</tr>
<tr>
<td>Swedish (&gt;50 times)</td>
<td>3.10 (1.72-5.58)</td>
</tr>
<tr>
<td>Overall</td>
<td>2.09 (1.54-2.84)</td>
</tr>
</tbody>
</table>

Studies on MJ Use and Depression


REGULAR USE OF MARIJUANA CORRELATES TO INCREASES IN DEPRESSION AND ANXIETY LATER IN LIFE

Lynskey et al., Arch Gen Psychiatry, 2004;61(10):1076-1082
Potera et al., British Medical Journal, 2002;325:1195-1198
Zammit S et al., BMJ, 2002;325:1199.
THC Harms Brain Connectivity

B  FA adolescent cannabis users < FA controls

This bundle of axons (connecting fibers) is one of the brain's communication “super highways”.

The Brain’s Information Superhighway:
Myelinated axons = White Matter Tracts


Source: Gordon J. Harris, PhD.


Percent of 12th Graders Reporting Using Substance in Lifetime, 2000-2013


Perceived risk is at a nearly historic low!

Julie Johnson
with her Dad @ The Falmouth Road Race

Summary & Recommendations