Psychosocial and Cognitive Outcomes of Youth Cannabis Use

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Substance Use Spectrum

Although many young people experiment and use substances (especially alcohol and cannabis), only a minority of users become addicted or develop problems.

21% of youth aged 15 to 19y, and 30% of those aged 20 to 24y use cannabis

only 5 to 15% report experiencing problems with their use and/or dependence

Canadian Tobacco, Alcohol and Drugs Survey 2015; Canadian addiction survey 2004; Anthony et al., 1994

2019 North American Cannabis Summit
Objectives

- Summarize the results of my research and that of other researchers on:
  - The cognitive and psychosocial consequences of adolescent cannabis use
- Identify some of the limitations of studies and knowledge so far
- Discuss some of the implications for future research and prevention of problematic substance use.
Cannabis use and psychosocial functioning
(Castellanos-Ryan, Rioux & London-Nadeau, in press)

- Literature review (longitudinal and prospective studies; articles published since 2000) examining associations between cannabis use and psychosocial functioning, i.e.:
  - Academic achievement
  - Employment and revenue
  - Quality of life and social relationships (e.g. partner/domestic violence)

Book chapter to appear in:
Cannabis use and psychosocial functioning
(Castellanos-Ryan, Rioux & London-Nadeau, in press)

- Mixed results
  - when important confounding variables (e.g., demographic, environmental and individual differences as well as time-varying factors, other substance use) are controlled, the impact of cannabis use on psychosocial variables is low or not significant.
  - Nevertheless, some studies have found an association between cannabis use and psychosocial variables, particularly for chronic, dependent or early cannabis use.
    - Financial difficulties and unemployment
    - Academic achievement (but not specific to cannabis use)
As bi-directional effects have been shown between cannabis use and psychosocial variables, psychosocial factors should be considered as important risk factors for cannabis use.

- Several studies show that low academic achievement and low cognitive functioning in childhood, which are associated with psychosocial functioning later, are also associated with an increased risk of initiating cannabis use earlier or consume more during adolescence.

Castellanos-Ryan et al., 2017; Duncan, Duncan, Biglan, & Ary, 1998; Henry, Smith, & Caldwell, 2007; Newcomb & Bentler, 1986
Adolescent cannabis use, change in neurocognitive function, and high-school graduation: A longitudinal study from early adolescence to young adulthood

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Adolescent Cannabis Use and cognition: Introduction 1

- There is concern that cannabis use during adolescence may interfere with the maturational processes of the brain (esp. frontal lobe and pre-frontal cortex).

- Support for this hypothesis comes mainly from cross-sectional studies or studies comparing clinical samples of heavy users and non-users.

- Poor performance on certain executive function tasks (e.g. at 12-14 years) have been shown to predate substance use onset and increased cannabis use frequency by 17/18 years (Squeglia et al., 2014).
A small number of longitudinal studies have now been conducted, with mixed results.

- Persistent cannabis use across 18-38 years associated with poor cognitive function at 38 years, globally, but only for those who began using at 18 years (Meier et al., 2012).

- Heavy cannabis use associated with declines in cognitive function (IQ, memory and processing speed) but only if cannabis use persists, i.e. cognitive function recovers with abstinence (e.g., Fried et al., 2005; Schulte et al., 2014).

- Familial and other risk factors may account for the associations between adolescent cannabis use and later cognitive, academic and mental health outcomes (e.g. Jackson et al., 2016; Meier et al, 2018).
1. To investigate bidirectional effects between cognitive function and adolescent cannabis use

2. To investigate whether it is actual adolescent-onset cannabis use, independent of other factors, that is associated with decreased neurocognitive performance and poor academic achievement by early adulthood.
Adolescent Cannabis Use and cognition: Method

**Sample:** Adolescent boys from the Montreal Longitudinal and Experimental Study of Low SES Boys, i.e. Caucasian boys living in low SES neighbourhoods in Montreal, Canada. (N=1,030).
- Cognitive subsample (N= 295)

**Measures:**
- **Cannabis use frequency over the last 12 months** was assessed annually from ages 13-17 years (PESQ (Winters, 1992); 7-point scale: from never (0) to 40 or more times).
Adolescent Cannabis Use and cognition: Procedure

IQ, Digit Span, CPT, NR
SOP, CAT, PAL
Cannabis, Alcohol and Tobacco Use Frequency

Cognitive Testing

Age in years

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Adolescent Cannabis Use and cognition: Method

- **Cognitive Battery at 20 years, and 13/14 years:**
  - Verbal IQ: Vocabulary (WAIS)
  - Short-term memory: Digit Span forward & back, Paired Associates Learning
  - Working memory: Number randomisation, Self-Ordered pointing task
  - WM, planning & learning by trial and error: Conditional Association task
  - Perseveration, reward processing & learning by trial and error: Card Playing Task

- **Covariates:**
  - Age at testing, family adversity in childhood
  - Academic achievement 13-15 years and High school graduation
  - Alcohol and tobacco use 13-17 years
  - Substance use in adulthood (20 years)
    - Cannabis, Alcohol, stimulant and tobacco
  - Externalizing problems (ADHD and CD) 13-15 years
Method: Analyses

- Latent growth analyses of cannabis use frequency across 14 to 17 years.
- Regressions and path analyses examined whether cannabis use age of onset and change of use across adolescence were associated with change in neurocognitive function (from 13-14y to 20 y).
- Models were conducted using Mplus v. 6 with MLR estimation. Full information maximum likelihood (FIML) was used to account for missing data.
Unconditional latent-growth model of self-reported cannabis use frequency from 14 to 17 years, centered at 14 years (a), and the average cannabis use frequency across adolescence (b).

Castellanos-Ryan et al. (2017)
Results: cannabis and cognition

Cognition at 13/14y
- High Verbal IQ 13
- Short term memory (PAL)
- Working Memory (SOP)

Cannabis use 14-17y
- Age onset
- Frequency at 14
- Frequency Growth 14-17

Change in cognition from 13/14 to 20 y
- Verbal IQ
- WM+ planning (Conditional association)
- Perseveration+ reward processing (Card playing task)

Castellanos-Ryan et al. (2017)
Results: cannabis and cognition

Cannabis use 14-17y

Age onset

Frequency at 14

Frequency Growth 14-17

OR=0.54

Change in cognition from 13/14 to 20 y

High-school graduation

Verbal IQ

WM+ planning (Conditional association)

Perseveration+ reward processing (Card playing task)

OR=1.34
Change in conditional association task (working memory, planning and trial-and-error learning) by adolescent cannabis use scores.

- Non increasing (stable) cannabis use across adolescence
- Average increasing (=mean slope), resulting in using 3-5 times per year by 17
- High Increasing (1SD>mean slope), resulting in using 10-19 times per year by 17

Castellanos-Ryan et al. (2017)
Change in card playing task by adolescent cannabis use scores.

Castellanos-Ryan et al. (2017)
Findings are consistent with recent studies showing that adolescent cannabis use is associated with poorer cognitive functioning in young adults (Meier et al., 2012).

But effects are not global - specific to learning by trial and error in “cool” and “hot” contexts, and that cannabis use needs to have an onset before the age of 17 years to detect these effects.
Age of Cannabis Use Onset and Adult Drug Abuse Symptoms: A Prospective Study of Common Risk Factors and Indirect Effects

Charlie Rioux, BSc$^{1,2}$, Natalie Castellanos-Ryan, PhD$^{2,3}$, Sophie Parent, PhD$^{3,4}$, Frank Vitaro, PhD$^{2,3}$, Richard Ernest Tremblay, PhD$^{1,2,5,6}$, and Jean Richard Séguin, PhD$^{2,7}$
Cannabis use onset and later drug use disorders

- Age of Onset of Cannabis use significantly associated with adult drug use disorders (OR=0.69; 95%CI=0.61 - 0.78).
  - Each year of cannabis use abstinence was associated with a 31% reduction in the odds of having a drug use disorder by 28 years.

- However, the risk decreases (OR changes from .69 to .97) and becomes non-significant, when we control for other important factors measured in adolescence and early adulthood that could explain the link between age of initiation and disorders of drug use (especially the use of other substances).

Controlling for common child risk factors: Father AUDs, family adversity, academic achievement, IQ, impulsivity, deviant friends, delinquency and parental supervision (at 13y or less).

Controlling for ado/early adult covariates: smoking, alcohol and other drug use at 17 years, high school graduation and delinquency at 20 years.

Rioux, Castellanos-Ryan et al., 2018, Canadian Journal of Psychiatry
Indirect pathways from age of onset of cannabis use to drug abuse at 28 years through late adolescent/early adulthood factors

- High school diploma
- Cigarette use frequency, 17 years
- Cannabis use frequency, 17 years
- Other drug use frequency, 17 years
- Alcohol frequency, 17 years
- Delinquency, 20 years

Rioux, Castellanos-Ryan, et al. (2018)
### Odds of drug abuse symptoms by 28 years for each year of delayed onset of cannabis use

<table>
<thead>
<tr>
<th>Onset by</th>
<th>Drug abuse symptoms</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 years</td>
<td></td>
<td>3.44*</td>
<td>1.05 - 11.22</td>
</tr>
<tr>
<td>14 years</td>
<td></td>
<td>1.97*</td>
<td>1.08 - 3.61</td>
</tr>
<tr>
<td>15 years</td>
<td></td>
<td>1.10</td>
<td>0.68 - 1.80</td>
</tr>
<tr>
<td>16 years</td>
<td></td>
<td>0.87</td>
<td>0.51 - 1.49</td>
</tr>
<tr>
<td>17 years</td>
<td></td>
<td>1.14</td>
<td>0.64 - 2.03</td>
</tr>
</tbody>
</table>

*a Comparison group for each analysis is later cannabis use. Analyses control for significant covariates including alcohol use frequency and cannabis use frequency at 17 years.*

**Conclusion:**
- Age of onset matters…
- But also frequency of use and polysubstance use (and undoubtedly quantity of use and potency of cannabis, but data is lacking)

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Direct and indirect pathways from early risk factors to drug abuse at 28 years through age of onset of cannabis use

Other risk factors: school dropout, poor working memory, psychopathology and family dysfunction; Castellanos-Ryan et al, 2013, 2016; Fergusson et al., 2008; Hawkins et al., 1992.

Rioux, Castellanos-Ryan, et al. (2018)
General summary and conclusion

- Importance of controlling for covariates and risk factors when examining consequences of CU (and other SU)

- Although results are mixed, there is evidence that adolescent CU is associated with later drug use problems, negative psychosocial outcomes (academic achievement and employment) and some cognitive outcomes - but only for early onset and frequent/heavy CU.
  - But effects are small.

- Early onset cannabis use is just one indicator of more complex developmental pathways to later problems that begin in childhood, so prevention efforts should target early risk factors.
  - impulse-control, delinquency and affiliation with deviant peers (externalizing pathway).
  - hopelessness and anxiety sensitivity (internalizing pathways)
  - sensation seeking (early adolescence)
  - family dysfunction, and negative parenting practices.
Impact of a 2-year multimodal intervention for disruptive 6-year-olds on substance use in adolescence: randomised controlled trial

Natalie Castellanos-Ryan, Jean R. Séguin, Frank Vitaro, Sophie Parent and Richard E. Tremblay

**Background**
Adolescent substance use is associated with both earlier childhood behavioural problems and serious lifetime addiction problems later in life.

**Aims**
To examine whether, and through which mechanisms, targeting risk factors in early childhood prevents substance use across adolescence.

**Method**
Disruptive kindergarten boys (n = 172) living in Montreal were randomly allocated to a preventive intervention and a control condition. The intervention was delivered over 2 years (7–9 years of age) with two main components: (a) social and problem-solving skills training for the boys; and (b) training for parents on effective child-rearing skills.

**Results**
Adolescent substance use, up to 8 years post-intervention, was reduced in those who received the intervention (d = 0.48–0.70). Of most interest, the intervention effects were explained partly by reductions in impulsivity, antisocial behaviour and affiliation with less deviant peers during pre-adolescence (11–13 years).

**Conclusions**
Adolescent substance use may be indirectly prevented by selectively targeting childhood risk factors that disrupt the developmental cascade of adolescent risk factors for substance use.

**Declaration of interest**
None.
Results
(Montréal Longitudinal and Experimental study of low SES boys).

Frequency of alcohol use

Number of drugs used

Thank you!

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