

Chronic and Acute Effects of High-Potency Flower vs. Concentrates on Cognition

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Diversity of Products in Legal Dispensaries





Legal dispensaries carry a wide variety of highpotency products including:

- Flower (>20% THC)
- Edibles (10 mg THC)
- Tinctures
- Lotions
- Suppositories
- Concentrates (>60% THC)
- Past research has focused almost exclusively on flower and edibles

CANNABIS CONCENTRATES



CRUMBLE Dried oil with a honeycomb like consistency



BADDER/BUDDER Concentrates whipped under heat to create a cake-batter like texture



SHATTER A translucent, brittle, & often golden to amber colored concentrate made with a solvent

ROSIN

End product of cannabis

flower being squeezed

under heat and pressure





BUBBLE HASH Uses water, ice, and mesh screens to pull out whole trichomes into a pastelike consistency

Concentrates are Becoming Increasingly Popular

- Typically contain >60% THC but can exceed 90% THC (Raber et al., 2015; Smart et al., 2017)
- 58-66% of adult cannabis users have used concentrates, 13-37% use them on a regular basis (Daniulaityte et al., 2017; Sagar et al., 2018)
- Concentrate shares increased by 146% while flower shares decreased by 22% in WA state from 2014-2016 (Smart et al., 2017)
- People are highly concerned these extremely high-potency products will magnify harms



CRYSTALLINE Isolated cannabinoids in their pure crystal structure



DRY SIFT Ground cannabis filtered with screens leaving behind complete trichome glands. The end-product is also referred to as kief

Legal Barriers to Cannabis Research



 U.S. classification of cannabis as Schedule I drug imposes legal restrictions and hurdles that have impeded research on its acute effects

- Researchers must spend years applying to various agencies (IRB, FDA, DOH, DEA) before they can administer cannabis in their labs
- Until very recently only low quality, low-potency (<10% THC) cannabis flower has been available to human researchers through the NIDA drug supply

Market Cannabis

NIDA Cannabis



Cannabis and Cognition

 Most recent meta-review of meta-analyses (Dellazizzo et al., 2021) indicates small-to-medium-sized effects on cognition that are most reliably found on tests of:

- Memory
- Executive functioning
- Some evidence CBD may protect against effects of THC (Englund et al., 2013; Morgan et al., 2010
- Many aspects of memory have not been examined
- Heavy reliance on low-potency products

Flower vs. Concentrates



- Almost no research on cognition in concentrate users
- Concentrate users perceive greater risk of developing problems with cognition (Daniulaityte et al., 2017)
- Cannabis users subjectively report worse memory & attention when using concentrates (Chan et al., 2017)
- Acute concentrate intoxication not associated with worse objective impairment in memory than flower intoxication (Bidwell, et al., 2020)

Study 1: Goal and Aim

Goal: Examine which aspects of cognition are detrimentally affected by chronic use of high-potency cannabis

Specific Aim: Examine whether cannabis concentrate users have objectively worse cognitive test performance than exclusive flower users under sober conditions









Inclusion Criteria

- 18-39 years of age
- Cannabis users daily or near daily use for at least one year and positive urine test
- Non-users use fewer than 10 times in life, no use in past year, and negative urine test

Cannabis users had to abstain from using cannabis on the day of the testing session

Exclusion Criteria

- Diagnosed or treated serious medical, neurological, or psychiatric conditions
- Learning disabilities, concussions, head injuries
- Diagnosed or treated substance use disorders
- Use of illicit drugs in past 6 months
- Heavy drinking (>4 drinks >4 times/week)
- Heavy smoking (>20 cigarettes/day)

Experimenters were blind to participants' cannabis use status



Participants & Method

- 98 Non-Users
 - 54% women, 58% white
 - Age (*M* = 24; *SD* = 4.7)
- 46 Flower Users (exclusive)
 - 48% women, 76% white
 - Age (*M* = 24; *SD* = 4.5)
- 54 Concentrate Users (also used flower)
 - 54% women, 69% white
 - Age (*M* = 22.5; *SD* = 3.2)
- Groups differed in level of education but no other demographic characteristics
- Completed 1.5-hour cognitive test battery in lab

Prospective Memory





Cuttler, Petrucci, & LaFrance (under review)



Null Effects

- No significant influence of high-potency cannabis flower or concentrates on tests of:
 - Visuospatial Memory (BVMT-II)
 - Temporal-Order Memory
 - Source Memory
 - Working memory (Digit Span Backwards)
 - Executive Function (Stroop, Zoo Map, Tower Test)

 No significant differences in performance of flower vs. concentrate users

Cuttler, Petrucci, & LaFrance (under review)



Study 2: Goal and Aims

Goal: Examine **acute** effects of high potency (>20% THC) cannabis on prospective memory, source memory, false memory, temporal order memory, and nonnormative decision making

Specific Aims

- 1. Compare effects of cannabis concentrates to cannabis flower
- 2. Compare effects of cannabis flower with CBD to cannabis flower without CBD

Zoom Method



- Bypassed legal restrictions by having participants purchase and administer their own cannabis in their own environment while being observed over Zoom
- Asked to abstain from cannabis use prior to testing session
- Remained sober or inhaled their cannabis product over Zoom
- Administered cognitive tests
 over Zoom
- Amazon gift card for compensation of time NOT cannabis purchase

Exclusion Criteria

- No diagnosed or treated *serious* medical, neurological, or psychiatric conditions
- No learning disabilities, concussions, or head injuries
- No diagnosed or treated substance use disorders
- No use of illicit drugs in past 6 months
- No heavy drinking (defined as > 4 drinks > 4 times/week)
- No heavy smoking (defined as > 30 cigarettes/week)
- No current pregnancy or breastfeeding
- No prior serious adverse reactions to cannabis (e.g., psychosis, panic attack)

Inclusion Criteria

- 21+ years of age (able to legally purchase cannabis in WA)
- Residing in WA State (where recreational cannabis is legal)
- Access to computer with stable internet connection in personal/home environment
- Experienced cannabis user
 - Used cannabis \geq 50 times in life
 - Used cannabis ≥ once per week for ≥ one year
 - Experience with cannabis concentrates
 - Typically take ≥ 5 puffs of joint and ≥ 3 hits of concentrate per session

Experimental Conditions





80 adults (45M, 35W)

- *M*_{age} = 24
- 1. Sober: control (n = 20)
- 2. THC Flower (n = 20): High THC (>20%), no CBD (0.00%)
- THC + CBD Flower (n = 20): High THC (>20%) with CBD
 (≥0.70%)
- 4. Concentrate (*n* = 20): High
 THC (>60%) with CBD
 (≥0.70%)

Random assignment produced equivalent groups



Participants self-titrated their use of extremely high potency cannabis concentrates

As a result, they achieved the same subjective level of intoxication as those inhaling high potency flower

Cuttler, LaFrance, & Stueber (2021) Scientific Reports

Memory



The THC+ CBD flower group freely recalled fewer words than the sober group

Cuttler, LaFrance, & Stueber (2021) Scientific Reports



The THC+CBD flower group recalled fewer words than the sober group The concentrate group falsely recalled more related words than the sober group All three cannabis groups falsely recalled more unrelated words than the sober group



Null Effects

- No significant effects of high-potency cannabis on tests of:
 - Prospective Memory
 - Temporal-Order Memory
 - Non-Normative Decision Making
- No significant differences in performance of those who used flower vs. concentrates

Cuttler, LaFrance, & Stueber (2021) *Scientific Reports*

Summary & Conclusions

- Most reliably detected chronic and acute effects of high-potency cannabis on memory
 - Lack of other effects may pertain to use of highly experienced cannabis users
 - Acute study in own comfortable environment
- No evidence that CBD offsets acute detrimental effects of THC
 - Indeed, more memory impairments were detected in the CBD flower group
- No evidence that cannabis concentrates are worse for cognition than flower
 - Participants self-titrate concentrates to achieve similar intoxication and impairment as flower



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The Health & Cognition



Alcohol and Drug Abuse Research Program

WSU's Dedicated Marijuana Account