High Expectations:
An Observational Study of Programming and Cannabis Intoxication

Wenxin He, Manasvi Parikh, Westley Weimer, Madeline Endres

University of Michigan
35% out of 800 survey participants had used cannabis while programming.

It’s important to remember that marijuana affects everyone differently. It destroys some people (like me) but vastly improves the quantity and quality of output of others. That said, it was common to smell weed in the parking lot at Google.

It probably depends a lot on the company. I doubt very many people are smoking over at LinkedIn :P

I’m interviewing for a coding job with a well known company that does suspicionless drug tests. How can I ask during the interview stage whether my marijuana use, that doesn’t affect my performance, will be an issue for them?
35% out of 800 survey participants had used *cannabis* while *programming*

Professional programmers reported positive views on the impact of cannabis on *brainstorming*, neutral views on *coding and testing*, and negative views on *debugging*, *design*, and *documentation*.

*Anti-cannabis hiring and retention policies* are prevalent in software companies.

29% of software developers took *drug tests* for *programming-related jobs*.
There is little empirical understanding of the true impacts of cannabis on programming.

We want to build a model to be used by individual developers and policy makers in making more informed cannabis and programming decisions.

We present results from the first controlled observational study of cannabis’s effects on programming ability, reporting data from 70+ programmers and answering pre-registered research questions.
TALK OUTLINE

- Motivation
- Study Design and Experimental Process
- Research Questions Answered
  - Effects on Program Correctness
  - Effects on Programming Speed
  - Difference in Program Method Divergence
  - Effects of Cannabis Use History
  - Programmers’ Stylistic Choices
  - Programmers’ Self-perception
- Implications and Future Work
DESIGN CONSIDERATIONS

Goal: a rigorous model showing how cannabis use impacts programming

- Achieving **sufficient statistical power** to answer our pre-registered research questions
- Balancing **ecological validity** with experimental control
- Maximizing participant **privacy and safety**
STUDY DESIGN

Cannabis Use History Survey → Remote Programming Session 1 → Remote Programming Session 2
In each session:

1. short programming questions (20min)
2. LeetCode problems (50min)
3. debrief

```python
def func(nums):
    x = 2;
    for i in range(len(nums)):
        x += nums[i]
    print(x)
nums = [1, 2, 3, 4]
func(nums)
```

Clunker Motors Inc. is recalling all vehicles in its Extravagant line from model years 1999-2002. Given an int variable modelYear and a string modelName, print "RECALL" if modelYear and modelName match the recall details.
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2 easy (15 min each):
- 1-D array + tree/linked list

1 medium (20 min):
- 2-D array
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RESEARCH QUESTION 1 - Program Correctness

**RQ1**: How does cannabis intoxication while programming impact program correctness?

- Pre-registered Hypothesis: Programs will be less correct when written by intoxicated programmers.
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RQ1: How does cannabis intoxication while programming impact program correctness?

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Finding: **Cannabis use decreases program correctness** (0.0005 < p < 0.05, 0.28 < d < 0.44, 10 - 14% fewer passed tests).

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**RQ2:** How does cannabis intoxication while programming impact programming speed?
- Pre-registered Hypothesis: Cannabis-intoxicated programmers will take longer to write programs.

**Finding:** *Cannabis use impairs programming speed* (p < 0.04, d = 0.3, 10-14% slower).

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High vs. Sober: How does Cannabis Impair Programming?

Programming While Sober

- Normal Keystrokes
- Delete Keystrokes

Programming While High

1-D Array Problem (Sober)

1-D Array Problem (High)
High vs. Sober: How does Cannabis Impair Programming?

This decrease in speed is associated with **typing slower**, **deleting more** characters, and more time spent **not typing**.

Programming While Sober

Programming While High
RESEARCH QUESTION 3 - Self Perception

RQ3: Are programmers able to **accurately assess** how cannabis impacts programming performance?
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Fig. Self-reported subjective programming performance when high (compared to when sober)
RESEARCH QUESTION 3 - Self Perception

**RQ3**: Are programmers able to **accurately assess** how cannabis impacts programming performance?

Fig. Self-reported subjective programming performance when high (compared to when sober)

Most programmers can **accurately judge** relative programming performance while high ($r = 0.59$).
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Findings Summary

We observe a **significant impairment** associated with ecologically valid cannabis use while programming (10% fewer correct tests, 10% slower programming).

From programmers’ debrief:
- harder to focus and easier to get distracted
- more enjoyment, fewer worries, and decent insight into alternative perspectives
- accurate self-perception
The variance we observe in outcomes for cannabis intoxication is much less than the **productivity variance** already found in new hires.

A 10% difference is not large compared to such **already-existing** variance.

Some programmers in our sample received **full correctness** scores even while high, or performed better when high. Most were able to **accurately recognize** their own cannabis-related impairment or the lack of it.
The variance we observe in outcomes for cannabis intoxication is much less than the **productivity variance** already found in new hires.

A 10% difference is not large compared to such **already-existing** variance.

Some programmers in our sample received **full correctness** scores even while high, or performed better when high. Most were able to **accurately recognize** their own cannabis-related impairment or the lack of it.

**The low observed magnitude** of cannabis impairment, may indicate that strict drug policies **might not be optimal uses of resources.**
CONCLUSIONS

In a **controlled observational study** with 74 participants,

- At ecologically-valid dosages, cannabis intoxication **impairs both program correctness and speed (10%)**.
- Programmers can self-perceive performance differences even when intoxicated.

We hope our results contribute to the development of evidence-based policies and help programmers make informed decisions.

**Wenxin He** (wenxinhe@umich.edu), Manasvi Parikh, Westley Weimer, Madeline Endres
There are several challenges and barriers in conducting cannabis and cannabinoid research.

Figure 2. State Cannabis Laws
April 2022

The Schedule I Status of Marijuana

Updated October 7, 2022

The Controlled Substances Act (CSA) places various substances in one of five schedules based on their medical use, potential for abuse, and safety or risk for dependence. The five schedules are progressively ordered with Schedule V substances regarded as the least dangerous and addictive and Schedule I substances considered the most dangerous and addictive. Schedule I substances are considered to have a “high potential for abuse” with “no currently accepted medical use in treatment in the United States.” The CSA prohibits the manufacture, distribution, dispensation, and possession of Schedule I substances except for federal government-approved research studies.

Marijuana is listed as a Schedule I controlled substance under the CSA, and has been on Schedule I since the CSA was enacted in 1970 (PL 91-513). For background on how marijuana came to be placed on Schedule I, see CRS Report R44782, The Evolution of Marijuana as a Controlled Substance and the Federal-State Policy Gap.

The Schedule I status of marijuana means that the substance is strictly regulated by federal authorities. Yet, over the last several decades, most states and territories have deviated from across-the-board prohibition of marijuana, and now have laws and policies allowing for some cultivation, sale, distribution, and possession of marijuana.

On October 6, President Biden announced reform to federal marijuana policy. First, he stated he would “pardon ... all prior federal offenses of simple possession of marijuana.” Second, he urged all governors “to do the same with regard to state offenses.” Finally, he requested that the Department of Justice (DOJ) and Department of Health and Human Services (HHS) “initiate the administrative process to review expeditiously how marijuana is scheduled under federal law.” He also noted that “important limitations on trafficking, marketing, and underage sales should stay in place.”
Cannabis Session Logistics

- used cannabis 10–15 minutes before the start of the session
- consume cannabis via vaping or smoking
- use the amount they would typically use when programming
- uploaded pictures of the product and indicated the amount
Eligible participants were at least 21, had used cannabis in the last year, and had smoked or vaped cannabis before.

**Demographics:**
- 74 participants in total
- 72% Men, 20% Women, 8% Non-binary
- Age: 20 - 49, average 24
- 38%: Currently Employed at a CS-related job
- 50%: Undergraduate Student in CS related field
- 16%: Graduate Student in CS-related field
- 4%: Unemployed or N/A(REMOVE)
Cannabis impairs writing and tracing through programs.

(a) Code produced by participant when sober
```
def is_sorted(integers):
    for i in range(len(integers)-1):
        if integers[i] > integers[i+1]:
            return False
    return True
```

(b) Code from same participant when intoxicated
```
def is_sorted(input_list):
    return helper(None, input_list)

def helper(min_val, input_list):
    if len(input_list) == 0: return True
    if min_val > input_list[0]: return False
    return helper(input_list[0],
                  input_list[1:])
```

High programmers often complicate their solutions and add extra conditionals while still missing edge cases.
Stylistic Choices

- added comments
- print statements
- helper functions
- additional test cases

We find no significant style differences between programs written while high vs. sober (0.20 ≤ p ≤ 0.85).
RESEARCH QUESTION 4 - Method Choice and Divergence

**RQ4**: How does cannabis intoxication influence programmers’ algorithmic method choice?

- Pre-registered Hypothesis: Solutions to free-form programming problems by cannabis-intoxicated programmers will exhibit greater method choice divergence and diversity.
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We found no statistically-significant evidence that cannabis intoxication impacts implementation divergence ($p \geq 0.08$).
Cannabis History Survey

Which of the following best captures the average frequency you currently use cannabis?

- I do not use cannabis
- less than once a year
- once a year
- once every 3-6 months (2-4 times/yr)
- once every 2 months (6 times/yr)
- once a month (12 times/yr)
- 2 – 3 times a month
- once a week
- twice a week
- 3 – 4 times a week
- 5 – 6 times a week
- once a day
- more than once a day

How many days of the past week did you use cannabis?

- 0 days
- 1 day
- 2 days
- 3 days

Which of the following best captures the number of times you have used cannabis in your entire life?

- 1 – 5 times in my life
- 6 – 10 times in my life
- 11 – 50 times in my life
- 501 – 1000 times in my life
- 1001 – 2000 times in my life
- 2001 – 5000 times in my life