DRIVER BEHAVIOR & PERFORMANCE

TECHNICAL REPORT

FOUNDATION FOR TRAFFIC SAFETY

Development and Validation of Messaging to Deter Cannabis Impaired Driving

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Title

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Foreword

For more than 75 years, the AAA Foundation for Traffic Safety has carried out various work to fulfill its mission of preventing traffic deaths and injuries by conducting research into their causes and by educating the public about strategies to prevent crashes and reduce injuries when they do occur. The work presented in this technical report, to examine cannabis users' thoughts and reasons for driving under the influence of cannabis and develop public messages to discourage users from impaired driving, is the latest example of our organization's commitment to improve traffic safety,

As more states consider legalization of cannabis for recreational and medical purposes, cannabis impaired driving has become a major traffic safety concern. Research has shown that some people who consume cannabis are unaware of how or to what extent it may impact their ability to drive safely. There is an urgent need to correct public misperceptions about cannabis use and driving. This study interviewed cannabis users to gain a better understanding of attitudes, perceptions, and reasons for driving under the influence of cannabis. Using the results of these discussions, public health messages aimed at deterring cannabis impaired driving were developed. Information presented in this report should be a useful resource for traffic safety advocates and practitioners.

C. Y. David Yang, Ph.D.

President and Executive Director

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About the Sponsor

AAA Foundation for Traffic Safety
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Founded in 1947, the AAA Foundation for Traffic Safety in Washington, D.C., is a nonprofit, publicly supported charitable research and educational organization dedicated to saving lives by preventing traffic crashes and reducing injuries when crashes occur. Funding for this report was provided by voluntary contributions from AAA/CAA and their affiliated motor clubs, individual members, AAA-affiliated insurance companies, and other organizations or sources.

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List of Abbreviations and Acronyms

DUI-C	Driving under the influence of cannabis
NFC	Need for Cognitive Closure
NRS	National Roadside Survey
PSU	Primary sampling unit

Executive Summary

With the recent liberalization of cannabis control laws, increasingly larger numbers of drivers are testing positive for cannabis. Research suggests many cannabis users believe driving under the influence of the drug is relatively safe. The purpose of this multiphase project was to understand cannabis users' thoughts, perceptions, and reasons for driving under the influence of cannabis and develop public health messages that might deter users from impaired driving in the future.

The project had three main phases: message development, message ranking, and message validation. In the message development phase, the research team conducted 11 focus groups with subgroups of 88 cannabis users with a history of drugged driving. Subgroups included older adults, middle-aged adults, younger adults, medical cannabis users, recreational cannabis users, habitual users, occasional users, those in recreational-legal states, those in recreational-illegal states, and those who regularly use alcohol and cannabis together. Drawing on focus group discussions, the research team developed messages designed to persuade cannabis users not to drive under the influence. These were supplemented with messages edited from a ChatGPT query "What are some messages to convince people not to drive under the influence of cannabis?"

In the message ranking phase, two samples of cannabis users were recruited to help identify message effectiveness. Using an online survey platform, the first sample of cannabis users (n=63) was asked to rank the messages within randomized blocks in terms of their perceived effectiveness. Results identified the top ranked individual messages. Next, a second sample of cannabis users (n=50) were asked to rank the most promising messages head-to-head.

Once the messages were ranked, the research team selected three messages to evaluate in the message validation phase. To validate the messages, participants were presented with a hypothetical scenario where a person consumed cannabis to the point of feeling high, but suddenly realized that they needed to go somewhere and it was important to leave almost immediately. One of the risk messages was then integrated into the scenario. After reading it, participants were asked to imagine themselves in that situation and indicate how likely it would be (percent) that they would drive in that situation (as opposed to taking an Uber or following some other path). Participants also answered questions about demographics, cannabis use, and personality characteristics. Finally, the most promising message from this stage was compared with a poorer scoring message to validate the viability of the message.

Analysis of the focus groups discussions identified six broad themes that may be useful in developing messages to deter cannabis-impaired driving:

- Legal and financial consequences
- Safety concerns
- Statistics and science
- Narrative or testimonial
- Personal responsibility
- Separating cannabis use from driving.

The analysis showed little evidence that different cohorts of users identified more strongly with specific themes or message types. In general, however, focus group discussants suggested the most effective messages would be those that (a) were positive, (b) were realistic, (c) avoided stereotypes, and (d) reflected diversity.

The ranking exercise indicated that messages that highlighted personal responsibility and safety concerns performed better than messages based on legal risks and separating cannabis use from driving.

The top-rated messages from the ranking study were the following:

- Driving high isn't just reckless; it's selfish. Think twice before getting behind the wheel after using marijuana.
- You wouldn't drink and drive, so why drive high? Don’t drive under the influence of marijuana.
- Marijuana impairs your judgement, slows your reactions, and increases your risk of crashing. Don’t drive high.

In the validation study, exposing participants to the top-rated “Driving high isn’t just reckless; it’s selfish…” message resulted in significantly lower willingness to drive scores (19.9%) than a poorer scoring message from the ranking study (34.2%). The relatively large effect of the “Driving high isn’t just reckless; it’s selfish…” message on willingness to drive persisted for high-risk users including habitual users, those who frequently drove under the influence, recreational users, and those who lived in recreational-legal states.

While this study produced a list of messages to deter driving after cannabis use, the message that “Driving high isn’t just reckless; it’s selfish…” seemed more effective than other messages in terms of lowering participants’ willingness to drive under the influence in a hypothetical scenario. Notably, this message was developed by ChatGPT, rather than the focus group process, a finding that warrants further exploration. Participants’ ranking of messages appeared relatively consistent with findings on message effectiveness (as measured by participant reports of willingness to engage in the behavior). Strategically, to increase efficiency, future message development approaches could consider quickly constructing many messages (with less concern for quality), followed by an inexpensive ranking process to narrow down the most effective messages. However, even the best messages will only affect a portion of the people exposed to them. Multimethod, multifaceted approaches are needed to achieve sizeable population reductions in impaired driving.

Introduction

With the recent liberalization of cannabis control laws, the number of drivers testing positive for cannabis appears to be on the rise (Berning et al., 2015; Johnson et al., 2012; Masten & Guenzburger, 2014; Salomonsen-Sautel et al., 2014). Many cannabis users report perceptions that driving under the influence of the drug is relatively safe (Green, 2018; Voas et al., 2013), and this belief may predict the willingness to drive while impaired (Davis et al., 2016).

There is pertinent need to identify effective means of persuading cannabis users not to get behind the wheel while they are under the influence. However, this effort needs to be thoughtful and planned out. A review of earlier literature suggests that public information and education programs have had only limited success in reducing the harm from risky drinking and drug-use behavior, including impaired driving (Botvin, 1990; Hawkins et al., 1992; Larimer & Cronce, 2007; National Institute on Alcohol Abuse and Alcoholism, 2002). Risk messaging that might seem intuitive may, in fact, be ineffective, and thus it is important to screen and validate risk messages.

The need to carefully develop and test public health messaging is also important because as cannabis use becomes normalized, a wider variety of people will use cannabis. For example, data from the National Survey on Drug Use and Health (https://www.cdc.gov/nchs/hus/sources-definitions/nsduh.htm) show that adults aged 65 and older are the fastest growing cohort of cannabis users and also the group *least* likely to try to quit. It follows that their motivations for cannabis use might be very different than that of younger users. Messages that resonate with younger users may not resonate with older adults, and vice versa. It is reasonable that messages tailored for specific subgroups will be more effective than generalized messages, but research is needed to understand what message themes work for which subgroups, and why.

Finally, research has found that under some circumstances, providing risk information can actually exacerbate risk-taking behavior (Johnson & Kopetz, 2017; Starnes et al., 2021). For example, research on alcohol-impaired driving indicates that drivers with particular personality traits may process and distort risk information in a way that justifies the decision to engage in relevant behavior (Johnson & Kopetz, 2017). This underscores the importance of carefully reviewing the construction of risk messages before implementation.

Objective

The primary objectives of this project were to identify cannabis and driving risk factors, develop frameworks for constructing effective messages that resonate with cannabis users, and identify mediums through which messages may be most impactful

across multiple groups of users. The research was accomplished in the following three phases:

1. **Focus Group Discussions:** Various cohorts of cannabis users who report driving under the influence of cannabis (DUI-C) were recruited. Focus group discussions were conducted in order to gain a better understanding of cannabis users' beliefs and perceptions about the risks of cannabis-involved driving, reasons for driving under the influence, and themes that might effectively change cannabis users' driving behavior. These focus groups also provided the opportunity to explore whether different types of cannabis users had different perceptions and motivations that might inform different messaging strategies. Specifically, groups examined included: older versus middle-aged and younger users, medical versus recreational users, users in states where recreational cannabis was legal versus illegal, and habitual versus occasional users. Underlying themes were identified from these focus group discussions. The research team then drafted specific messages designed to deter driving under the influence of cannabis.
2. **Message Ranking:** The prevention messages generated from the focus group discussions were supplemented by messages generated through ChatGPT. Whether natural language learning models can produce effective prevention messaging is a distinct research question. These messages were presented to distinct panels of cannabis-using participants who were asked to rank the messages in terms of their perceived effectiveness.
3. **Message Validation:** Messages that participants indicated might resonate with cannabis users and influence their behavior were tested for effectiveness. A different set of cannabis-using participants were exposed to the messages in the context of a hypothetical scenario in which they were high from cannabis use and suddenly found themselves in the situation where they needed to drive. A comparison of "willingness to drive" rates as a function of the messaging informed which messages would be most effective.

Focus Group Discussions

In total, the research team conducted 11 online focus groups including 88 individuals with a history of drugged driving between August 8 and December 13, 2023; however, several obstacles and pitfalls were encountered in the process.

Site Selection

This study's intention was to recruit participants from multiple locations across the United States, in part so that views of cannabis users from places where recreational use of cannabis was legal versus illegal were included, but also to improve the

generalizability of results. Guided by the desire to avoid bias, two recreational-legal locations and two recreational-illegal locations were randomly selected (proportionate to population size) from the list of 60 primary sampling units (PSUs) used in the 2013-2014 National Roadside Survey (NRS) (Kelley-Baker et al., 2016). The NRS is a nationally representative sample of weekend nighttime drivers in the contiguous United States, and drawing from those locations would help support this study's goal of minimizing sample bias in the focus group study. Selected areas included Orange County, CA, and Wayne County, MI, as recreational-legal areas, and Palm Beach County, FL, and Allegheny County, PA, as recreational-illegal areas.

Focus Group Construction

A priori, the research team decided to create 16 distinct focus groups defined by the characteristics of the group attendees. These groups were defined by crossing 2 (legal vs. illegal) x 2 (occasional vs. habitual use) x 2 (older vs. younger) x 2 (medical vs. recreational use). Thus, one of the 16 groups would be older, habitual, medical users living in recreational illegal states, etc. However, the research team acknowledged that some groups might not be very prevalent in the actual population. For example, the number of younger, occasional, medical-only users might be quite small, so the research team assumed that the composition of our focus groups might change over the course of data collection and that some categories may need to be relaxed or collapsed. In practice, groups were intentionally expanded to include middle-aged participants. Towards the end of the focus group discussions, some groups were mixed, without defining demographic features (other than driving under the influence of cannabis). A subsequent section describes the composition of the focus groups further.

Participant Prescreening

Focus group participants were recruited using a two-stage process. First, online advertisements on Craigslist solicited participants in the four targeted communities. The online advertisement asked people who use cannabis to follow a link to an online prescreening survey. The survey collected information on demographics, including age, frequency of cannabis use, frequency of driving after using cannabis, mixing cannabis with alcohol, and the reasons for cannabis use—e.g., solely to treat pain (medical) or at least sometimes recreational. Contact information was also collected. A print version of the prescreening survey is available in Appendix A. In all, the Craigslist recruitment method generated prescreening data from 1,493 people.

Participant Recruitment

Only persons aged 18 and older who indicated driving under the influence of cannabis more than a few times per year were considered for focus groups. Prescreening items such as frequency of use, reasons for use, and age were used to allocate

participants into one of the 16 *a priori* distinct group types. Older users were defined as those age 55 and up, and younger users as those between 18 and 30. With more data, more extreme cutoffs may have been selected. Later, middle-aged users were defined as those between 31 and 54. Medical users were indicated by those who indicated *only* using cannabis to treat pain or some other medical issue (whether or not directed by a physician). All others were labeled as recreational (even if they used for both medical and recreational reasons). Participants were categorized as habitual users if they reported using cannabis at least several times per week, and occasional users if they used several times per month or less (but at least a few times per year).

Other prescreening items, such as mixing alcohol with cannabis, were used later in constructing groups. As anticipated, not all group types were well represented by participants in the prescreening dataset. There were very few older, medical-only, occasional users, for example. The majority of individuals who completed the prescreening survey were recreational, habitual users. A list of potential focus group candidates was constructed from the group types that were well-represented. Individuals were prioritized to ensure gender and racial diversity. Individuals from the lists were contacted and scheduled to take part in an online focus group.

Problems and Pitfalls

During the process of recruiting participants and conducting focus groups, the research team encountered what appeared to be a semi-organized effort from a large number of individuals to misrepresent who they were on the prescreening survey. After the first few successful focus groups, the research team observed among prescreening participants a large portion whose zip codes did not match any of the recruitment areas. Notably, during the focus groups themselves, some participants resisted turning on their camera (which was a requirement of the online focus group) or tried to conceal themselves from the camera, and in general were lackluster in their contributions. Focus group moderators discovered that a group of fraudulent participants had figured out the prescreening response patterns used in participant selection, and had infiltrated the subject pool. In fact, several focus groups were cancelled because the research team did not have much confidence that attendees actually matched the descriptions in prescreening surveys.

The research team responded to this challenge by adding another layer of vetting to the recruitment process, requiring a preparatory call and review of driver's licenses or other identification before any individual was invited to attend a focus group discussion. Additional participants were drawn from Prolific.com to complete the focus group discussions. Prolific.com is a participant panel and online study administration platform with over 100,000 registered participants.

An abbreviated version of the prescreening survey was administered to a sample of 1,000 Prolific.com participant members residing in California, Pennsylvania, Florida, and Michigan. However, it was not possible to further restrict the sample to the specific counties in question. From this sample, 317 experienced cannabis users were identified. This pool populated all of the subsequent studies for this project, including the final focus groups.

Focus Group Procedures

At the scheduled time, focus group participants followed a link to a Zoom meeting where the focus group discussion was being held. In a virtual waiting room, a moderator would change participants' display names, as needed, to protect their identities. For example, in some cases, participants' phone numbers or first and last names were displayed on the Zoom screen, and the moderator changed them to reflect first names only. Participants were asked to keep their cameras on during the discussions. The discussions were both audiotaped and video recorded. The audio recordings were later professionally transcribed. The video recordings were only retained to ensure the research team could identify which participant made which comment, after which the videos were deleted.

The focus group topic guide is included in Appendix B. The discussions focused on reasons for driving under the influence of cannabis, perceptions of risk, and understanding of laws. Different broad categories of prevention were discussed, including safety risks (crashing), legal risks, and normative pressure. Participants responded to different potential law enforcement strategies that might deter driving under the influence, and participants raised various themes related to the types of messages they thought could be effective in discouraging people from driving while under the influence of cannabis.

Participants received between $75 and $100 for taking part in the focus group discussion.

Completed Focus Group Discussions

In all, 11 focus group discussions including 88 individuals from four different states were conducted between August 8 and December 13, 2023. The composition of the focus groups and numbers of subjects is provided in Table 1. Note that earlier focus groups were comprised of participants that all shared specific features (e.g., age, frequency of use, etc.). However, many group types were not well represented in the sample, and it was necessary to collapse across some dimensions. The investigation was subsequently expanded to include a specific concentration on middle-aged users (not just younger and older), and a specific focus on those who combined alcohol and cannabis. However, the qualitative analysis of the focus groups failed to find themes that reliably

distinguished types of participants (e.g., older users, medical users, etc.). For instance, there was no evidence that certain themes seemed to resonate more with specific cohorts.

Table 1. Composition of Focus Group Types

Group Type	Number of Focus Groups	Number of Participants
Younger, Recreational Users, Habitual, Legal State	1	8
Younger, Recreational Users, Habitual, Illegal State	1	6
Older, Recreational, Habitual, Legal State	1	9
Older, Recreational, Habitual, Illegal State	1	10
Mid-Aged, Recreational, Habitual, Legal State—Mixes Alcohol and Cannabis	1	12
Mid-Aged, Habitual Users—Non-Mixers	1	7
Non-Habitual + Recreational users (any age, state)	1	7
Older Adults	1	5
Younger Adults	1	8
Mixed Groups	2	16

Qualitative Results

All focus group discussions were recorded using Zoom and then processed using Nvivo Transcription Services to produce transcripts for each session. These transcripts were then cleaned and corrected for transcription errors against a review of the original audio (i.e., quality assurance) before being grouped as a dataset for thematic analysis (Guest et al., 2012). The research team applied deductive codes to the dataset via *a priori* conceptual categories. The codebook used for this process was composed of themes of interest that emerged during preliminary analysis. These themes included terminology used (e.g., “cannabis” vs. “weed”), context for driving under the influence, effects of cannabis on driving, comparisons between cannabis and alcohol, knowledge of the illegality of DUI-C, importance of legal risks, importance of safety risks, importance of social perceptions, broader perceptions among older drivers, enforcement as a deterrent, suggested messages, suggested messaging strategies, and “other.” Code frequencies were examined across the dataset and relevant content to identify the most salient themes and illustrative quotes to include in project outputs.

Overall, participants thought that developing messages to address DUI-C would be a challenging process, with some questioning whether any messaging could ever be truly effective. According to participants, the primary issue is that most people who regularly use cannabis do not perceive DUI-C as a particularly risky activity that warrants correction. For instance, as one 55-year-old Native American woman from Michigan said:

I think [this is] going to be an uphill battle. Because I think all of us, it's totally understood that drunk driving kills, right? I mean, most of us have had a family member, friend, co-worker, someone that we've known [who] has been involved in a drunk driving accident or gotten a DUI because of an accident or someone [who was] killed. But how many of us have ever heard of a pot driving accident or a high driving accident? You don't really hear that. So, I don't think that we're, as a society, even us as users, we're not really self-aware that our driving could be really impacted by marijuana.

Although most participants did associate possible negative consequences with DUI-C (if not for themselves, then potentially for others) such as slowed reaction times, accidents, arrests, etc., they also made statements suggesting that the perceived likelihood of realizing any of these consequences is exceedingly low.

Focus group discussions revealed three important points to consider in developing messages to deter cannabis impaired driving. First, for many participants (including some delivery drivers), use of cannabis may be a strategy to reduce anxiety, relax, improve focus, or otherwise cope with daily driving. Second, some participants see cannabis use during or prior to driving as an enjoyable pastime. Third, participants who use cannabis to manage chronic pain or other conditions may perceive this use as a medical necessity without which they cannot function. For these individuals, DUI-C is often perceived as an unavoidable reality of their lives.

Message Themes

Message "themes" that emerged from our analysis of focus group transcripts fell roughly into six categories:

- Legal and financial consequences
- Safety concerns
- Statistics and science
- Narrative or testimonial
- Personal responsibility
- Separating cannabis use from driving

Legal and Financial Consequences. The potential legal and financial consequences of DUI-C, including the inherent "hassle" of dealing with law enforcement and the criminal justice system, were popular suggestions among participants regarding what messages might resonate most widely with people who use cannabis. Among these potential consequences, participants cited arrest, thousands of dollars in fines, insurance potentially not covering accidents involving DUI-C, increased insurance costs, losing one's driver's license, and court-mandated classes (and associated costs). As illustrated by

the following four quotes, some participants seemed to rank the potential financial costs as most salient:

> *Highlight the consequences. Because we all think about the consequences of drunk driving, but I don't think I've ever thought about the consequences of weed driving ... [a female participant].*

> *I think that focusing on money is effective. I've seen ads about alcohol or posts that are like, 'Would you rather pay for a $20 Uber now, or like depending on what the fine is, like a $5,000 fine in the future?' [a female participant].*

> *If you equate getting high with the huge nightmare it is for a DUI, like how much money it is, how much it ruins your life to get caught… the monetary effects would probably be the biggest deterrent [a male participant].*

> *A $75,000 joint. Because it cost me $75K to get my life back. And six months in County [a male participant].*

Participants also recognized the importance and need for greater education about DUI-C laws among people who use cannabis since many may be unaware that DUI-C will be treated the same as DUI (alcohol) by law enforcement and the court system. In terms of messaging, some participants thought that making explicit comparison between DUI-C and DUI could be effective: "We do need to know the consequences of driving under the influence of cannabis. And I think that's an important part of the message" [a 56-year-old White, Hispanic, female from California]. Similarly, a White, non-Hispanic, 58-year-old female from Florida supposed:

> *I think if you break down the laws to people, like even if you're [just] sitting in your car with your friends, you could get a DUI and, you know, you can't drive. You can't go to work. And then talk about how that affects [your] life and livelihood. If you can't pick up your kids at school, you know…. You can't drive your mom to the hospital; you can't do a lot of things if you don't have a license.*

Safety Concerns. Concerns for safety, mainly in the form of the increased risk of accidents and harm to oneself or others, were collectively another top theme participants thought might be leveraged for effective messaging. For instance, a Black, Hispanic, 36-year-old male participant from California described what he thought had been particularly effective messaging that he had seen in Mexico. It depicted a family who died in a wreck, and he explained, "…it doesn't matter if it's alcohol or drugs, the family is still dead." However, not all participants agreed that "shock" approaches would always be effective. From their perspective, these sorts of tragic outcomes are just not supported by personal experiences. As a 55-year-old, Native American, female

participant from Michigan explained: “I don't think that works on us because, ‘Well, that's not me.’ Like me, I haven't had an accident or ticket in 35 years or whatever. So how do you appeal to someone like me?” In fact, some participants suggested that “scare tactics” might be less effective as they could be easier to ignore if they are not generally perceived as being realistic.

Additionally, there was a tendency among some participants to associate the risk of accidents more with other drivers’ behavior than with their own actions while driving under the influence of cannabis. For these participants, the primary concern was not so much safety. Instead, it was more the potential for others to cause the accident, but then for them to be caught and held responsible since they were under the influence of cannabis.

Interestingly, two different participants chose to emphasize animal-related safety risks they associated with DUI-C. One female participant offered, “I think one of my biggest fears when I'm driving in general, but especially if I had any weed or whatever, is that I'm going to hit an animal on the street, especially because they're harder to see. So that is a big thing.” Similarly, a male participant who is the owner of a pet cat suggested, “You’ve got pets at home, so drive carefully.”

Statistics and Science. At least one participant from almost every focus group made statements suggesting that a straightforward, “scientific” approach to messaging could be effective. The idea here would be to present research findings that demonstrate the physiological effects of cannabis on the body, reaction times, peripheral vision, reflexes, etc., and the detrimental impacts this could have (or better yet, has been *proven to have had* in real-world contexts) on drivers. As one White, non-Hispanic, 58-year-old Florida woman offered: “I mean, I know statistics can be twisted, so people don't always believe in statistics. But if you see enough black and white evidence, that something you're doing, that you're not aware of, is causing things that you weren't aware of, then that can open your eyes…” Some participants also suggested that presenting facts may help drivers to draw their own conclusions concerning their personal responsibility. A White, Hispanic, 56-year-old female participant from California explained:

> *I think any public message, any campaign, if it can be based on facts, it will be effective. And the facts of what we've talked about here today, are facts. There's a reaction time fact. You might miss your exit. You know, there are a number of impacts [of cannabis] that are documented, easily understood. And it does [circle] around the idea of paying attention and knowing your limits.*

While these statements demonstrate a preference for quantifiable data to be presented in a straightforward manner concerning the risks of DUI-C, others also noted the importance of legitimacy and the trustworthiness of sources. This was seen as important to ensuring that whatever “facts” or statistics are presented are believable:

"…and make sure that you cite how you got that research. …who came up with that? Is it the National Drug Association? You know, who came up with that? Like, that makes it credible as well" [a White, non-Hispanic, 32-year-old female participant from California].

Narrative or Testimonial. A preference for the use of storytelling in anti-DUI-C messaging was another fairly popular theme. For instance, some participants suggested using real-life stories of people who have caused accidents while DUI-C. Describing the potential effectiveness of this approach, one male participant noted:

> *I think people are always a little bit more captivated by storytelling. Statistics, while they're alarming and get your attention, I think a story would be a little more intimate, make it a little bit more real as to how this applies to someone's life. And that will be what grabs them a little bit more: this is an issue separate from cannabis; this is cannabis use while driving.*

In this way, this approach would also offer the advantage of having messages "focus on the driving part, not the drug," which participants seemed to appreciate.

Describing what she thought might be an effective scenario, a White, non-Hispanic, 32-year-old female from California said:

> *I think the mother of, I mean, it sounds cruel to say, but like a mother, a parent of somebody that was killed as a result of someone driving high. And she could be like, "hey, my son, you know, tell the story of your son. My son was in high school or whatever stage in life he was, had a bright future until the night of, you know, September 22nd, 2023. He was struck by…" you know, stuff like that really gets me emotionally as well. And it's relatable. And that would make me feel guilty about doing it. I don't want to kill some middle schooler with a bright future just because I was hungry for Cheetos at midnight because I was high. I just feel like that's really powerful. Something like that. To kind of weave a story. Stories are emotional. Stories are gripping and memorable.*

Others also expressed support for the idea that the prospect of harming another innocent person through DUI-C could be more effective at deterrence than other similar narratives that instead involve harm coming to the drivers themselves.

Personal Responsibility. The importance of personal responsibility, or "to put ownership on it," was another theme that clearly emerged from multiple focus group discussions. This sentiment is reflected in many of the suggested anti-DUI-C messages participants put forward for consideration. These include variations of the "Know your limits" (and do not exceed them) theme including, "If you know you're too high, don't get

behind the wheel." Other participants made similar statements citing responsibility such as:

- "…be responsible, be respectful and be mindful and be careful" [a 56-year-old, White, Hispanic female from California].
- "It's not about demonizing marijuana. It's about demonizing a choice. It's about responsibility" [a female participant].

Separating Cannabis Use from Driving. The idea to suggest separating cannabis use (figuratively and literally) from the act of driving was another message theme that was proposed and discussed by multiple focus groups. Separate messaging suggestions took two similar but distinct forms: (1) cannabis use and driving should be activities that do not overlap (e.g., "Keep the high off the highway"); and (2) emphasize the benefits of the separation to cannabis use (e.g., it is more enjoyable to use cannabis at home or other safe places that do not involve driving). Examples of each of these sub-themes are provided below.

To emphasize the importance of keeping cannabis and motor vehicle use as separate activities, participants made various analogies. For example, a 55-year-old, Native American woman from Michigan explained:

> *I think my idea is where is it totally not acceptable to use marijuana? Airline pilots, surgeons, school bus drivers… [….] As much as I use it every day, all day, I still would want someone to be on top of their driving game, on top of their professional game, whether it was a surgeon or an airline pilot or traffic controller. So, we've agreed as a society [for those] very significant jobs, no tolerance, zero tolerance, maybe using something like that angle?*

Making an analogous point more directly, while highlighting the importance of avoiding messages that might be perceived as prohibiting the use of cannabis entirely, a 23-year-old, Black, Hispanic male from California offered:

> *I'd say, "just wait. Just wait till you get to your destination." Because you can't stop somebody from doing it completely. Like, you just can't stop somebody from drinking. So, I'll just say, a sign that says, "don't smoke and drive." "Wait till you get home," something like that. [….] And it's not saying that you can't smoke. And I feel it will kind of ease its way into people's minds, especially young people's minds, faster. Okay, it's not telling me: "don't smoke and drive;" it's saying, "don't smoke while you drive; wait till you get home."*

Some participants also made a case for using messaging that emphasizes the benefits of enjoying cannabis at home instead using it before while driving a vehicle. For

instance, one male participant explained: “I used to do it a lot more in the car. But honestly, I just prefer now to do it at home. To wait and be in a more chill environment.”

Similarly, a 34-year-old Black, non-Hispanic male from Michigan suggested: “…promote the ‘at home thing.’ Like you don't want to go outside smelling like marijuana. You don't want your neighbor to see you [high]. When you smoke, smoke at home. If you do something like that, that might encourage people to be like, ‘you know what, I'm not going to get in my car, I'm going to stay home and smoke.’”

Emphasizing the advantages of using cannabis at home, rather than while driving, and doing so in a positive manner, a 55-year-old, Native American woman from Michigan offered:

> *I also think probably coming at people that smoke marijuana, maybe, recreationally: “Keep the high and the happiness at home.” Keep off the road, you know, keep it at home. You don't need to be… you kind of lose your buzz when you're driving. It affects your buzz. [You] have to concentrate. So, you're actively fighting the high to get your perspective back, to get your presence back, to get your body sensations back. So, you kind of lose the high. So, maybe appeal to the stoners as, “You're going to lose your buzz if you're driving.” Not only is it illegal or whatever, and you might be late somewhere, so stay home.*

However, despite the popularity of these approaches, some participants also noted disadvantages associated with potential “keep them separate” or “better enjoyed at home” anti-DUI-C messages. Namely, medicinal users expressed concerns that these types of messages could be much less effective, or even somewhat off-putting, to people who use cannabis every day as means to manage chronic medical conditions. These types of cannabis users tended to portray themselves as being very cautious concerning the amount, type, and timing of cannabis used to avoid hindering the cognitive and physical abilities needed to operate their vehicles. Furthermore, as these participants pointed out, such users may have no choice other than to drive while under the influence of cannabis, especially in rural areas where taxis, Uber, etc., are unavailable or when these alternatives are unaffordable. Additionally, “keep it separate” or “at home” messaging may prove less effective on people who enjoy driving under influence of cannabis as a pastime, as well as those who consume cannabis before driving to reduce anxiety and/or cope with the frustrations of traffic, etc.

Messaging Strategies

Message Development Strategies

- Be positive
- Be realistic, avoid stereotypes, and reflect diversity
- Target messages to ensure relevancy

Participants suggested various strategies that could be employed to increase the effectiveness of anti-DUI-C messages. These strategies included being positive and realistic, reflecting the diversity of cannabis users while avoiding stereotypes, and targeting messages. The specific messages derived from the qualitative analysis are detailed in a subsequent section.

Be Positive. Most participants seemed to agree that anti-DUI-C messaging should be positive, accepting of people who use cannabis, and nonjudgmental or "morally neutral." For example, one female participant suggested, "Showing and reaching out in a very positive way to all, realistic, users. And supporting, almost like celebrating [cannabis use] as well." According to another participant, a young man who uses cannabis to cope with the effects of a chronic disease: "You want to feel like you're being embraced, accepted, not judged" and "if you can see yourself in the advertising, it's going to resonate more." Similarly, another male participant in the same focus group discussion wanted to emphasize the importance of, "depicting people in a way that makes them feel valued and understood." According to a female participant, "if we feel that we're being demonized, we're just going to be pissed off." Other related suggestions included using humor to make messaging more engaging.

Be Realistic, Avoid Stereotypes, and Reflect Diversity. Participants also expressed a strong preference for realistic messaging that avoids the exaggerated and heavily stereotyped messaging mistakes of the past: "If it's ridiculous, people are just going to mock it." As one female participant put it:

> *I think that for me, anything that starts off the bat that [DUI-C] is going to ruin lives, you're going to kill everyone, is automatically going to turn me off. Not that I don't think that it can happen, but because I think that that's a generalization. And, you know, when things are exaggerated like that, you're immediately more prone to dismiss it. I think that something that might kind of appeal to me is something where it just kind of talks about the hassles of it. Like, "Oh, you're confused or you're a little anxious or you have to decide where to turn. Why deal with it?" You know what I mean? [….] Not really like it's the most dangerous thing in the world.*

Most participants seemed to feel strongly about the need to avoid the use of stereotypes that do not reflect the diversity of people who use cannabis (including older

people) or why they use it (e.g., chronic, debilitating pain vs. getting high for fun). According to a female participant:

> *I think it's really important to show that people of all ages and all backgrounds do this. And it's not weird. Just normalizing that. Because whenever I think of an ad like this, it's always just some teenager smoking weed.*

Participants suggested that messages recognize, or at least be informed by, the idea that there is no one "type" of cannabis user. Instead, "all kinds of people from all walks of life" use cannabis. As one male participant from offered:

> *We want to be seen. We're not all your skateboard stoner types. We're not all professionals using a vape pen. We're not all medical patients. There needs to be that acknowledgement for all walks of life, for the individuals who are consuming cannabis products.*

Target Messages. Participants were split between those who favored universal messaging and those who thought developing specific messages for certain groups would be more effective. During discussions, the majority seemed to see the value in targeting messages to ensure relevancy, though most could also imagine some types of messages that might be effective across demographic groups. Suggested categories for targeting included older vs. younger people, novice vs. experienced cannabis users, people in legal vs. illegal states, and medicinal (especially people who use cannabis daily to manage chronic pain or other conditions) vs. recreational users.

Message Development

Using the results of the focus group discussions, the research team developed 16 messages across five themes: safety concerns, legal consequences, personal responsibility, separating cannabis use from driving (i.e., "keep the high at home"), and messages targeted specific groups (i.e., older drivers). None of the messages involved the theme of using personal narratives, as that format required much lengthier descriptions. Further, the theme of "statistics and science" was dropped as any messages would be subsumed with safety concerns or legal risk.

Given the growth of artificial intelligence and natural language processing models, to supplement the focus groups, the research team decided to use ChatGPT to generate a list of messages designed to prevent DUI-C. An interesting question is whether artificial intelligence could be used to develop effective messages, and whether the expensive process of conducting focus groups was necessary. The query: "What are some messages to convince people not to drive under the influence of cannabis?" was entered into ChatGPT. A list of seven messages was generated, which were then lightly edited and reduced for brevity. Cursory internet searches failed to provide any evidence to suggest

that these seven messages were taken directly from existing prevention programs. These seven messages were then categorized into the themes from the focus group discussions.

A complete list of developed messages is available in Appendix C. A full list of messages is not included in the body of the report itself because the entire list is displayed below under message ranking.

Message Ranking

Two separate ranking studies were conducted to assess which messages would best resonate with the target audience. Samples from both studies were recruited from the pool of identified experienced cannabis users from Prolific. Using an online survey platform, the first sample of cannabis users (n=63) was asked to rank the messages within randomized blocks in terms of their perceived effectiveness, i.e. how impactful respondents felt each message would be. Results identified the top ranked individual messages. Next, a second sample of cannabis users (n=50) were asked to rank the most promising messages head-to-head. Table 2 displays descriptive characteristics of respondents who participated in both ranking studies. Participants were characterized as frequent DUI-C drivers if they reported that they occasionally or frequently drove within 2 hours of using a marijuana product.

Table 2. Sample Descriptions for the Ranking Study 1 and Ranking Study 2

Demographics	Ranking Study 1: Randomized Blocks (n=63)	Ranking Study 2: Head-to-Head (n=50)
Sex	57.4% male	60.0% male
Race	70.5% White, Non-Hispanic	68.0% White, Non-Hispanic
Median Age	41.0 years	38.5 years
% Over Age 50	27.7%	26.0%
Cannabis Use	50.4% at least 2x/week	52.0% at least 2x/week
Reasons	17.0% medical only	24.0% medical only
Driving	31.7% frequent DUI-C	32.0% frequent DUI-C
Residence	50.0% recreational-use legal	54.9% recreational-use legal

Ranking Study 1: Randomized Blocks

The final list included 23 messages, and the research team believed it would be difficult for participants to meaningfully rank and compare a list that long. Accordingly, for the initial ranking study, the messages were randomized into three blocks of five messages each, and two blocks of four messages each. Reviewing and ranking messages within each block would be considerably more manageable. There were five different versions of this randomization, however. Accordingly, the messages included in Block A

of the first version were different than the second version, and third version, etc. This was designed to reduce bias attributable, and participants were assigned to one of five different versions.

A sample of 63 cannabis-using participants identified from Prolific were exposed to the five blocks of messages and asked to rank the messages within each block. Rankings were 1 to 5, or 1 to 4, depending on the number of messages in a given block, with lower rankings reflecting messages perceived to be more impactful, more likely to resonate with audiences. Thus, each message was ranked 63 times against a subsample of other messages.

Table 3, below, shows the list of 23 messages and their mean rank score (**lower means indicate better rankings**). Themes were: (S) – safety concerns; (L) – legal consequences; (PR) – personal responsibility; (H) – home (keep the high at home); and (O) – messages targeted for older drivers.

Table 3. Mean Ranking of Anti-DUI-C Messages

Message	Mean Rank	Theme
It doesn't matter whether it's legal. It doesn't matter whether it's medicine. Cannabis can impair your driving and it is illegal to drive while using it. Don't drive under the influence.	2.27	S
Driving high isn't just reckless; it's selfish. Think twice before getting behind the wheel after using marijuana.	2.38	PR
You wouldn't drink and drive, so why drive high? Don't drive under the influence of marijuana.	2.41	PR
Marijuana impairs your judgement, slows your reactions, and increases your risk of crashing. Don't drive high.	2.43	S
Know your limits. If you're impaired, don't drive.	2.44	PR
Don't spoil your high by getting behind the wheel. Keeping it at home is better for everyone.	2.56	H
We all want to make it home safely. Driving under the influence of marijuana puts everyone at risk. Please, be responsible.	2.60	PR
Even if cannabis is legal to use, it's never legal to drive impaired. Know the law. Know the consequences.	2.62	L
Edibles can be unpredictable. Play it safe and don't drive.	2.71	PR
People say that driving high is safer than driving drunk. But safer isn't safe. Whether alcohol or cannabis—don't take the risk. Choose to drive sober.	2.71	S
Marijuana may make you feel relaxed, but it impairs your ability to drive safely. Only alert driving is safe driving.	2.71	S
Even if it's medicine, cannabis can hurt your ability to drive safely. Plan when you need to dose and when you need to drive.	2.73	S

Message	Mean Rank	Theme
Driving under the influence of marijuana isn't just illegal; it's dangerous and can lead to devastating consequences on the road. Please, don't take that risk.	2.76	S
Driving under the influence of marijuana affects everyone on the road. Keep our communities safe and don't drive impaired.	2.79	PR
People from all walks of life use cannabis. People from all walks of life get in crashes. It doesn't matter who you are—cannabis and driving don't mix.	2.87	PR
Couchlocked? Take the hint and don't get behind wheel.	3.06	PR
You think the police can't tell you've been vaping? You're wrong. Play it safe. Don't drive high.	3.08	L
Keep the high off the highway.	3.22	H
Driving under the influence of cannabis isn't always without consequences. Is a joint worth going to jail?	3.25	L
Vape + Steering Wheel = Bars	3.25	L
Last month, State law enforcement busted 399 drivers for driving while high. Don't be #400.	3.27	L
Driving under the influence of cannabis isn't safe for anyone. But research shows it's particularly dangerous for older drivers. If you're high, don't drive.	3.41	O
Older drivers already get a bad rap. Don't make it worse by driving under the influence of cannabis.	3.46	O

Analysis by theme revealed a statistically significant difference in mean ranking between the five themes, $F(4, 18) = 6.4$, $p < 0.05$, although the results should be considered with caution because some theme-categories had only two entries. The rankings are shown in Table 4, below. Exploratory post-hoc examination reveals that the statistically significant differences in mean ranking by theme is driven primary by poorer ranking scores for messages in the legal consequences category compared to safety concern and personal responsibility messages. While messages that ask users to separate cannabis use from driving ("Keep the high at home") were popular with focus group participants, those messages were not among the most highly ranked.

Table 4. Mean Ranking of Anti-DUI-C Messages by Theme

Theme	Mean Rank
Safety Concerns	2.60
Personal Responsibility	2.66
Separating Cannabis from Driving (Keep the high at home)	2.89
Legal Consequences	3.09
Older Drivers	3.44

Multivariate analyses suggest that message rankings were statistically invariant to participant sex, race, and cannabis-use frequency—in other words, how they were ranked did not depend on the characteristics of the audience. There was an overall significant effect of age on rankings ($p < 0.05$), but detailed examination suggests that only a few individual questions varied as a function of participant age. Rankings of messages 19, 12, and 2 (see Appendix C for numbered messages) improved to the extent that participants were older, while rankings for messages 20 and 10 got worse. The overall effects were relatively small. Notably, however, sample sizes may not have been large enough to detect subgroup differences, so results should be interpreted with care.

Message Ranking Findings:

- Messages that highlighted ***personal responsibility*** and ***safety concerns*** performed best
- Age had a small influence on the message ranking
- No evidence that cannabis users ranked message differently by sex, race or cannabis-use frequency

Ranking Study 2: Head-to-Head Comparison

Because the results from Ranking Study 1 were undoubtedly affected by the composition of messages within each block, a second ranking study was conducted focusing on the most promising messages only. The top four messages from Ranking Study 1 (see Table 3) were selected for Ranking Study 2. In addition, for validation, one moderately ranked message ("Marijuana may make you feel relaxed, but it impairs your ability to drive safely. Only alert driving is safe driving") and one poorly ranked message ("Driving under the influence of cannabis isn't always without consequences. Is a joint worth going to jail?") were selected for Ranking Study 2. In the second ranking study, 50 participants were recruited from the pool of identified cannabis users from Prolific and tasked with completing an online survey. All participants were exposed to the same six messages and asked to rank them in terms of their perceived effectiveness. Results are provided in Table 5.

Five of the six messages maintained the same relative position observed in the first ranking study of all 23 messages. Surprisingly, however, the previously top-rated message fell to rank #5. The other items were ranked the same way as the initial ranking study.

Table 5. Head-to-Head Message Rankings

Message	Mean Rank
Driving high isn't just reckless; it's selfish. Think twice before getting behind the wheel after using marijuana.	2.92
You wouldn't drink and drive, so why drive high? Don't drive under the influence of marijuana.	3.24
Marijuana impairs your judgement, slows your reactions, and increases your risk of crashing. Don't drive high.	3.34
Marijuana may make you feel relaxed, but it impairs your ability to drive safely. Only alert driving is safe driving.	3.58
It doesn't matter whether it's legal. It doesn't matter whether it's medicine. Cannabis can impair your driving and it is illegal to drive while using it. Don't drive under the influence.	3.76
Driving under the influence of cannabis isn't always without consequences. Is a joint worth going to jail?	4.16

Message Validation

Once the messages were ranked, the research team selected three messages to evaluate in the message validation phase. Messages were tested to determine whether providing these messages to participants who faced decisions to drive under the influence of cannabis would change behavior. Methodology followed a design used previously in Johnson and Kopetz (2017). Two study samples, the Pilot Study sample (n=60) and the Main Study sample (n=87), were recruited from the Prolific pool of identified cannabis users. In each study, participants responded to an online questionnaire detailing some personal characteristics and then were presented with a hypothetical scenario.

Personal characteristics measured in the online survey included the Need for Cognitive Closure (NFC) scale (Roets & Van Hiel, 2011; Webster & Kruglanski, 1994). High scores on the NFC scale can indicate a person unwilling to process new information (such as risk messages), and previous research from the research team (Johnson & Kopetz, 2017; Starnes et al. 2021) found that for some participants with high NFC scores, providing strong risk messages actually increased willingness to engage in risky behavior. Thus, the research team had explicit interest in examining whether that might also be the case in this study. No other personality measures were included in the research.

After answering questions about personal characteristics, participants were presented with a hypothetical scenario to test the effect of different messages. Participants were asked to imagine settling down after a long day, deciding to use cannabis, and using enough that they felt high. Then, they were reminded of an

important errand they needed to run, something that *swore* they would accomplish, and it had to be done now. Driving oneself and taking an Uber are both options, but participants need to weigh the fact that they are high against the hassle and expense of taking an Uber. The scenario also mentioned that participants recall a public service announcement floating around social media. This is where the specific persuasive message is introduced. Participants are asked to take all the information into consideration when they determine how likely it is they would drive in that situation. A full copy of the scenario is provided in Appendix D.

The Pilot Study focused on the persuasive effect of three messages. While normally the research team would have selected the top three (in terms of ranking), the top four from the final list (Table 4) were all generated from ChatGPT. Therefore, the top two from the final list were selected. In addition, the top message that was developed from the focus group discussions was selected: “It doesn’t matter whether it’s legal. It doesn’t matter whether it’s medicine. Cannabis can impair your driving and it is illegal to drive while using it. Don’t drive under the influence.” Note that this was the top ranked message during the initial phase of ranking (Table 3).

Each of the three selected messages were treated as interchangeable versions of an effective message (given they had already been reviewed and ranked). Next, in the Main Study, the most promising message from the Pilot Study was tested against a more modestly ranked message, identified from the ranking study. A no-message control condition was not considered. The inclusion of a no message control may have been able to indicate whether any message is better than no message, but could not diagnose message quality, and therefore was not used in this study.

Pilot Study

First, a Pilot Study was conducted to compare the three effective messages against each other (using the hypothetical scenario) to see if they indeed were equivalent. A sample of 60 participants was recruited from the Prolific pool and randomly assigned one of the three messages. Study sample demographics are shown in Table 6. This study produced a marginal main effect of message ($p = 0.10$) but strongly suggestive results. When subjects were exposed to the top-ranked message “Driving high isn't just reckless; it's selfish. Think twice before getting behind the wheel after using marijuana,” a mean of 22.2% indicated that would drive in that situation. In response to “You wouldn't drink and drive, so why drive high? Don’t drive under the influence of marijuana” and “Marijuana impairs your judgement, slows your reactions, and increases your risk of crashing. Don’t drive high,” scores were 37.6% and 47.2%, respectively. In response to the likelihood that a typical person would drive in that context, the mean percentage scores were 39.8%, 50.4%, and 52.6%, respectively.

Main Study

In the Main Study, a second sample of 87 participants was recruited from the Prolific pool of cannabis users and randomly assigned to either the most promising message "Driving high isn't just reckless; it's selfish. Think twice before getting behind the wheel after using marijuana" or a relatively poorly ranked message "Driving under the influence of cannabis isn't always without consequences. Is a joint worth going to jail?" The latter was selected because it contained law enforcement/punishment content typical of much drugged-driving prevention messaging. Sample characteristics are shown in Table 6.

Four participants failed attention check questions on the NFC scale, leaving sample sizes of n = 37 and n = 46 assigned to the high-ranked message and low-ranked message conditions. Message was the primary factor, but analyses also controlled for participant age and sex. The initial tests of the outcome "How likely would YOU drive" also included an NFC x Message interaction, which did not approach statistical significance. However, in the main effect model analysis, both NFC and message condition were statistically significant (see Table 7). Note that message condition was treated as a directional (one-tailed) test giving the rankings results.

Message Validation Findings

- Exposing participants to the *message **"Driving high isn't just reckless; it's selfish. Think twice before getting behind the wheel after using marijuana"*** resulted in significantly lower willingness to drive scores compared to other messages.
- This message was effective for high-risk users including those who frequently drive under the influence, recreational users and those in recreational-legal states

Table 6. Sample Descriptions for the Pilot Study and Main Study

Demographics	Pilot Study (n=60)	Main Study (n=87)
Sex	61.7% male	62.2% male
Race	65.0% White, Non-Hispanic	62.2% White, Non-Hispanic
Median Age	40.2 years	38 years
% Over Age 50	15.3%	23.5%
Cannabis Use	60.0% at least 2x/week	59.8% at least 2x/week
Reasons	16.0% medical only	23.2% medical only
Driving	50.8% frequent DUI-C	39.0% frequent DUI-C
Residence	50.0% recreational-use legal	54.9% recreational-use legal

Table 7. Results of Message Effectiveness Test

Effect	Test Results	Direction
Participant Sex	$F(1, 73) = 2.2$, $p = 0.14$	–
Participant Age	$F(1, 73) = 1.2$, $p = 0.28$	–
NFC	$F(1, 73) = 8.4$, $p < 0.01$	$B = 1.13$*
Message Condition	$F(1, 73) = 3.3$, $p < 0.05$	High Ranked = 19.9%; Low Ranked = 34.2%

** B represents the unstandardized regression weight, where a positive value of B indicates that higher levels of NFC (treated as a continuous variable) were associated with higher willingness to drive.*

NFC was positively related to willingness to drive in the hypothetical scenario; thus, independent of other factors, people higher in NFC scores indicated a higher likelihood of driving. Further, people who were exposed to the high-ranked message "Driving high isn't just reckless, it's selfish…" reported being over 40% less likely to drive while high than those who were exposed to "Driving under the influence of cannabis isn't always without consequences. Is a joint worth going to jail?" Note that the percent score of the low-ranked control message in the Main Study (mean = 34.2%) was comparable (even nominally better) than the two other messages used in the Pilot Study (means = 37.6% and 47.2%, described above).

Analysis of the item "How likely is it that the TYPICAL person would drive" did not yield statistically significant main effects or interactions involving NFC and message condition.

Message Effects by Cannabis-Use Frequency, Driving Frequency, Reasons for Use, and Legal Status

As a follow up, potential interaction effects between message condition and other individual difference variables measured during prescreening were examined: cannabis-use frequency, driving under the influence of cannabis frequency, medical versus recreational use, and whether the participants' state had legal recreational cannabis. For

these interaction effects, analyses focused only on the question about the likelihood of YOU driving given no prior effects related to the question about the TYPICAL person.

There were no statistically significant interaction effects between message condition and each of the four cannabis-related variables (all p-values > 0.28). While the Main Study was relatively small and not powered to detect statistically significant differences between or among subgroups, analyses included some exploratory examinations to help ensure that the impact of the identified most promising message, "Driving high isn't just reckless, it's selfish…," persisted within the groups that are at highest risk of driving under the influence. Table 8 shows the likelihood of driving percentage scores for the two messages for four higher risk subgroups.

Table 8. Sample Mean Likelihood of Driving Percentage Between Message Conditions for Highest Risk Participants

Users	High-Ranking Message *Driving high isn't just reckless*	Low-Ranking Message *Joint worth going to jail?*
Occasional or Frequent Users	29.5%	41.1%
Occasional or Frequent DUI-C	35.1%	52.3%
Recreational/Mixed Users	20.5%	35.5%
Recreational Legal State	14.3%	36.0%

In the main analysis, the high-ranking message was significantly more effective than the low-ranking message. The pattern appeared to persist when examination was limited to occasional/frequent cannabis users (versus infrequent users), those who drive under the influence of cannabis frequently, those who do not use for solely medical reasons, and those living in states where recreational cannabis is legal.

Discussion

Messages that emphasized legal consequences of DUI-C, such as arrests, jail, or police, were ranked significantly worse (less effective) than messages that emphasized safety concerns and personal responsibility. The results would suggest that prevention campaigns based primarily on messages about legal consequences may be less effective. While focus group members were aware that citations and arrests for DUI-C are possible, there was a broad perception that it wasn't very common, and that police did not enforce drugged driving the same way they enforce drunk driving. Messages that portray people getting arrested for DUI-C may be inconsistent with the audience's personal experience, and this might undermine their effectiveness.

It is important to note, however, that High Visibility Enforcement (HVE) programs—which pair increased enforcement activity (e.g., sobriety checkpoints) with

widespread publicity about the enforcement—are effective in reducing impaired driving (e.g., Elder et al., 2002; Johnson, 2016). These programs do rely heavily on messages about the legal consequences of DUI-C but are explicitly tied to the specific, ongoing enforcement component. HVE programs are designed to deter would-be impaired drivers from operating under the influence in the first place, convincing them that the legal risks for doing so have changed due to the program. Accordingly, while messages about the legal consequences of DUI-C may not be persuasive as stand-alone programs, when coordinated with active and visible impaired driving enforcement, they could produce meaningful reductions in drugged driving.

This project produced 23 specific public health messages designed to deter driving under the influence of cannabis, along with their rankings regarding perceived effectiveness. The effectiveness of the top-ranked messages was tested by measuring participants' willingness to drive after message exposure under a hypothetical DUI-C scenario. The personal responsibility message "Driving high isn't just reckless; it's selfish. Think twice before getting behind the wheel after using marijuana" stood out as the most effective communication generated by the project for reducing cannabis users' willingness to drive under the influence. The message was the highest ranked among the messages generated during the project and demonstrated the largest impact on self-reported willingness to drive. The message produced considerably lower "willingness-to-drive scores" relative to a poorly ranked legal consequence message (documented through a formal statistical test) but also nominally compared to other highly ranked personal responsibility and safety messages.

However, it is not clear why the "Driving high isn't just reckless; it's selfish…" message was effective. It can be assumed that the phrase about DUI-C being *selfish* is the actionable element, as it is what best distinguishes it from other messages on the list. If calling someone selfish is effective, it implies that at least some of the participants have the belief that driving under the influence of cannabis does impart some risk, and that on some level it is not appropriate (however, whether this is due to perceived risks or violation of norms is not clear). In fact, the whole personal responsibility theme—which is less heavy-handed in detailing risks than the safety concerns theme—assumes that at some level drivers understand that there is a problem with driving while under the influence of drugs.

Speculatively, calling cannabis-impaired drivers selfish triggers an understanding that they could and should separate cannabis use from operating a vehicle, but they are simply choosing not to do so, electing the convenience of driving over more responsible action. The message points out that such behavior is selfish, which seemed effective in reducing participants' willingness to drive. Of course, this is not true for all participants. Some people who saw the "Driving high isn't just reckless; it's selfish…" message in the scenario still indicated being 100% certain they would still drive.

It is worth noting that while “Driving high isn't just reckless; it's selfish…” clearly fits the personal responsibility theme identified through the focus group discussions, it was inconsistent with messaging strategies suggested by focus group participants. For example, the message is not positive and does not articulate risks nor emphasize diversity. Perhaps the novelty of the message is such that cannabis users haven’t developed counterarguments.

Strengths, Limitations, and New Questions

The strengths of the research included in-depth group discussion with multiple, diverse groups of cannabis users with a history of drugged driving, and then multiple approaches to testing the messages—first, ranking their potential impact and then using a hypothetical scenario to test whether willingness to engage in DUI-C was affected by message exposure.

One limitation of the project was that sample sizes did allow not for more complex designs and more fine-grained analysis of subgroups. The difficulties encountered in recruiting cannabis users and conducting online focus group discussions cost this study both time and resources.

Other limitations were linked to the use of focus groups to generate potential messages. Asking participants to rank messages seemed an efficient way of identifying those messages that were most effective, and the most highly ranked messages appeared to be the most effective of those examined in changing willingness to DUI-C. The long and costly process of holding numerous focus group discussions in order to inform quality messages may not be necessary. If messages, regardless of quality, could be generated in volume through some other method (such as brainstorming), having participants rank those messages is a relatively fast and inexpensive way to identify those of the highest quality.

Another challenge with focus group discussions is that the pool of identified message themes may not be exhaustive. Although focus group discussions were stopped only when it appeared participants were no longer producing new information, it is unknown whether there were other important themes that were never realized. Extending the argument further, in fact it is possible that cannabis users in the focus group might not even be aware of the messages that would most effectively change their behavior.

There is a logical argument, for example, that if cannabis users are able to generate highly convincing arguments for not driving under the influence, they themselves should refrain from driving while impaired. Yet, this study’s sample was based on people who reported DUI-C; why were they not able to convince themselves? Of course, it is possible that only through the structured process of having these topical discussions did those convincing arguments materialize. It is an empirical question (and

an interesting one) whether engagement in group discussions exposed participants to new ideas and lines of thought that had an impact on future behavior.

Implicit Knowledge, Need for Cognitive Closure, and Message Effectiveness

Focus group discussions may not generate the most effective arguments because participants simply do not know what those arguments are. Focus group discussions may also fall short because people (in general) do not always know, nor have access to, the underlying cognitive processes that motivate their behavior. For nearly 50 years, psychological research has demonstrated how *implicit cognition*—mental structures and functions that exist outside of conscious awareness—can influence thoughts, perceptions, and actions (Greenwald & Banaji, 1995; Greenwald et al., 2022; Higgins et al., 1977; Nosek et al., 2011). Scores of experiments have shown how subtle environmental manipulations can influence behavior in ways that feel organic and self-initiated to participants.

A thorough discussion of the scientific literature on this topic is beyond the scope of this report. But to the extent that people do not always know *why* they feel or do things they do, the messages generated by focus group participants may not dovetail with the actual underlying motivations for their DUI-C behavior. In fact, providing messages that conflict with actual strong underlying motivations can produce deleterious results.

In this research team's previous research (Johnson & Kopetz, 2017; Starnes et al., 2021), individual differences in *need for cognitive closure* interacted with strength of the risk information or message. In those studies, persons with higher NFC were more willing to engage in risky behavior (drinking and driving) when exposed to strong risk information versus weaker risk information. On the other hand, subjects with lower NFC behaved as expected—the strong risk information reduced their willingness to drink and drive more than did the weak information. NFC assesses, among other things, intolerance or ambiguity, the motivation to make fast decisions, and the tendency to cling to those decisions once made; it is also characterized by the unwillingness to consider new information once decisions are made. Previous hypotheses emphasized that when people with higher NFC scores had already decided to drive and had established that as a goal, the presentation of strong risk information challenged that goal in a way that was discomforting. As a result, participants with higher NFC suppressed or distorted the risk information, resulting in increased willingness to engage in the behavior.

In the present study, there was no evidence of an interaction involving NFC and message strength (low versus high rank). However, NFC was still a strong main effect predictor of willingness to DUI-C; persons higher in NFC reliably showed greater willingness to drive, regardless of the risk message. A person whose NFC score was one

standard deviation above the mean was 22.3 percentage points more willing to drive than someone whose NFC score was one standard deviation below the mean.

Conclusion

As a standalone countermeasure, this research suggested that messages that followed the themes of safety concerns and personal responsibility were perceived to be more effective than those that focused on legal consequences and were found to be more effective in reducing participants' willingness to drive while under the influence of cannabis. The specific message "Driving high isn't just reckless; it's selfish. Think twice before getting behind the wheel after using marijuana" was the overall highest ranked message and nominally outperformed other highly ranked messages in impacting participants' willingness to drive under the influence of cannabis.

The project noted some limitations with using focus groups to generate effective messages. Participants who drive under the influence of cannabis may not be the best at articulating the most effective arguments against DUI-C, since they are unable to convince themselves. Further, people in general may not be fully aware of all the underlying cognitive processes that motivate their risky behavior, and thus would not necessarily know the best messages for changing that behavior. In fact, research shows that even with strong, effective messages, some individuals—with predictable personality characteristics—may actively resist integrating message arguments into their behavioral decisions.

Without doubt, developing and communicating effective messages is an essential part of improving traffic safety by reducing impaired driving. But ideally, impaired driving countermeasures should be multimethod and multifaceted, employing policy, enforcement, and environmental strategies, as well as health information, in order to reduce public harm.

Project Summary Table

Project Goals

1) Understanding cannabis users' thoughts, perceptions, and reasons for driving under the influence of cannabis
2) Develop frameworks for public health messages that might deter cannabis impaired driving

Method

Three main tasks were performed to try and better understand these users and develop effective deterrence messaging: message development, message ranking, and message validation

Step 1: Message Development	Step 2: Message Ranking	Step 3: Message Validation
• Conducted focus groups with those who have driven under the influence • Developed candidate messages based on focus group input • Edited messages derived from a ChatGPT query	2a) Randomized Blocks One sample of cannabis users ranked messages in randomized blocks for perceived effectiveness 2b) Head-to-Head Rankings A second sample of cannabis users ranked the most promising messages head-to-head	• Three of the top ranked messages from step two were selected for validation • Participants scored message effectiveness in a hypothetical scenario

Results

Focus groups identified:	The top 3 ranked messages were:	The most effective message was:
Six main useful message themes 1. Legal and financial consequences 2. Safety concerns 3. Statistics and science 4. Narrative or testimonial 5. Personal responsibility 6. Separating cannabis use from driving Four suggested messaging elements 1. Be positive 2. Be realistic 3. Avoid stereotypes 4. Reflect diversity	"*Driving high isn't just reckless; it's selfish. Think twice before getting behind the wheel after using marijuana.*" "*You wouldn't drink and drive, so why drive high? Don't drive under the influence of marijuana.*" "*Marijuana impairs your judgement, slows your reactions, and increases your risk of crashing. Don't drive high.*"	"*Driving high isn't just reckless; it's selfish. Think twice before getting behind the wheel after using marijuana.*" • This message was effective for high-risk users including those who frequently drive under the influence, recreational users and those in recreational-legal states

Key Takeaways and Recommendations

- Messages that highlighted personal responsibility and safety concerns performed best
- To efficiently identify messages, multiple options should be developed quickly, with more emphasis placed on ranking and paring down than initial development
- Even the most effective messaging will only affect a portion of those who see it
- Multi-method and multi-faceted approaches are still needed to achieve reductions in impaired driving

References

Berning, A., Compton, R., & Wochinger, K. (2015). *Results of the 2013–2014 National Roadside Survey of Alcohol and Drug Use by Drivers.* (Traffic Safety Facts Research Note. Report No. DOT HS 812 118). National Highway Traffic Safety Administration. https://doi.org/10.21949/1525810

Botvin, G. J. (1990). Substance abuse prevention: Theory, practice, and effectiveness. *Criminal Justice and Behavior, 13*, 461–519. https://doi.org/10.1086/449180

Davis, K. C., Allen, J., Duke, J., Nonnemaker, J., Bradfield, B., Farrelly, M. C., Shafer, P., & Novak, S. (2016). Correlates of marijuana drugged driving and openness to driving while high: Evidence from Colorado and Washington. *PloS One*, 11(1), e0146853. https://doi.org/10.1371/journal.pone.0146853

Elder, R.W., Shults, R.A., Sleet, D.A., Nichols, J.L., Zaza, S., & Thompson, R.S. (2002). Effectiveness of sobriety checkpoints for reducing alcohol-involved crashes. *Traffic Injury Prevention, 3*(4), 266–274. https://doi.org/10.1080/15389580214623

Green, K. (2018). Perceptions of driving after marijuana use compared to alcohol use among rural American young adults. *Drug and Alcohol Review, 47*(5), 637–644. https://doi.org/10.1111/dar.12686

Greenwald, A. G., & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review, 102*(1), 4–27. https://doi.org/10.1037/0033-295X.102.1.4

Greenwald, A. G., Dasgupta, N., Dovidio, J. F., Kang, J., Moss-Racusin, C. A., & Teachman, B. A. (2022). Implicit-bias remedies: Treating discriminatory bias as a public-health problem. *Psychological Science in the Public Interest, 23*(1), 7-40. https://doi.org/10.1177/15291006211070781

Guest, G., MacQueen, K. M., & Namey, E. E. (2012). *Applied thematic analysis*. SAGE Publications, Inc., https://doi.org/10.4135/9781483384436

Hawkins, J. D., Catalano, R. F., & Catalano Jr., R. F. (1992). *Communities that care: Action for drug abuse prevention*. Jossey-Bass Publishers.

Higgins, E. T., Rholes, W. S., & Jones, C. R. (1977). Category accessibility and impression formation. *Journal of Experimental Social Psychology, 13*(2), 141–154. https://doi.org/10.1016/S0022-1031(77)80007-3

Johnson M. B. (2016). A successful high-visibility enforcement intervention targeting underage drinking drivers. *Addiction, 111*(7), 1196–1202. https://doi.org/10.1111/add.13346

Johnson, M. B., Kelley-Baker, T., Voas, R. B., & Lacey, J. H. (2012). The prevalence of cannabis-involved driving in California. *Drug and Alcohol Dependence, 123*(1–3), 105–109. https://doi.org/10.1016/j.drugalcdep.2011.10.023

Johnson, M. B., & Kopetz, C. E. (2017). The unintended effects of providing risk information about drinking and driving. *Health Psychology, 36*(9), 872–880. https://doi.org/10.1037/hea0000526

Kelley-Baker, T., Lacey, J. H., Berning, A., Ramirez, A., Moore, C., Brainard, K., Yao, J., Tippetts, A. S., Romano, E., Carr, K., & Pell, K. (2016). *2013–2014 National Roadside Study of alcohol and drug use by drivers: Methodology*. (DOT HS 812 294). National Highway Traffic Safety Administration. https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/812294-national-roadside-study-methodology-report-2013-2014.pdf

Larimer, M. E., & Cronce, J. M. (2007). Idenification, prevention, and treatment revisited: Individual-focused college drinking prevention strategies. *Addictive Behaviors, 32*(11), 2439–2468. https://doi.org/10.1016/j.addbeh.2007.05.006

Masten, S. V., & Guenzburger, G. V. (2014). Changes in driver cannabinoid prevalence in 12 US states after implementing medical marijuana laws. *Journal of Safety Research, 50*, 35–52. https://doi.org/10.1016/j.jsr.2014.03.009

National Institute on Alcohol Abuse and Alcoholism. (2002). *How to reduce high-risk college drinking: Use proven strategies, fill research gaps* (Final Report of the Panel on Prevention and Treatment, Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism).

Nosek, B. A., Hawkins, C. B., & Frazier, R. S. (2011). Implicit social cognition: from measures to mechanisms. *Trends in Cognitive Sciences, 15*(4), 152–159. https://doi.org/10.1016/j.tics.2011.01.005

Roets, A., & Van Hiel, A. (2011). Item selection and validation of a brief, 15-item version of the Need for Closure Scale. *Personality and Individual Differences*, *50*(1), 90–94. https://doi.org/10.1016/j.paid.2010.09.004

Salomonsen-Sautel, S., Min, S.-J., Sakai, J. T., Thurstone, C., & Hopfer, C. (2014). Trends in fatal motor vehicle crashes before and after marijuana commercialization in Colorado. *Drug and Alcohol Dependence*, *140*, 137–144. https://doi.org/10.1016/j.drugalcdep.2014.04.008

Starnes, M., Kopetz, C., & Johnson, M. (2021). For better and for worse: The role of negative affect in decisions to drink and drive. *Motivation and Emotion, 45*, 354–367. https://doi.org/10.1007/s11031-021-09876-4

Voas, R. B., Johnson, M. B., & Miller, B. A. (2013). Alcohol and drug use among young adults driving to a drinking location. *Drug and Alcohol Dependence*, *132*(1–2), 69–73. https://doi.org/10.1016/j.drugalcdep.2013.01.014

Webster, D. M., & Kruglanski, A. W. (1994). Individual differences in need for cognitive closure. *Journal of Personality and Social Psychology*, *67*(6), 1049–1062. https://doi.org/10.1037/0022-3514.67.6.1049

Appendix A: Prescreen Eligibility Survey

Introduction

A non-profit research organization, the Pacific Institute for Research and Evaluation (PIRE) located in Beltsville, MD, is seeking participants for a voluntary and confidential paid study. This study is funded by The AAA Foundation for Traffic Safety, a group affiliated with the American Automobile Association.

- We are seeking participants, ages 18 and over. We are interested in adult participants of all ages, but we are particularly interested in getting the opinions of marijuana users ages 50 and older.
- If eligible, the research involves participating in a virtual focus group. Some people who are not selected to take part in a focus group might be invited later (up to 7 months later) to complete a paid online survey.
- Those who participate in a focus group (2-hours or shorter) will be offered a $100 Amazon gift code by email or text after completing the focus group.
- Participants invited to complete a brief online survey will be compensated with a $25 Amazon gift code by email or text after they complete an online survey.

Complete the questionnaire below for focus group eligibility and to provide contact information.

No compensation is provided for completing this online eligibility questionnaire. Only proceed if you are willing to answer questions about substance use and provide your contact information. This should take about 5-10 minutes to complete.

Eligibility Questionnaire

Qualtrics Survey Confidentiality. This Qualtrics survey link has been set not to collect Internet Provider computer addresses. The answers you provide to the eligibility questions and your contact information will be stored by Qualtrics in an encrypted format that can only be accessed by PIRE researchers. Your responses will only be used to determine whether you are eligible to take part in paid research.

PIRE Confidentiality. PIRE is taking these steps to ensure that your data remains confidential:

- The answers to these questions will be used to determine if you are eligible to participate in a paid focus group, OR for an online paid survey.
- If you are eligible for a focus group, you will be contacted by research staff to confirm your eligibility and availability to participate. If you decline to participate at that time, your answers to the questions and contact information will be destroyed that day.
- If you are eligible to complete an online survey, you will be contacted and given a link to complete a survey within the next 7 months. After completing the online survey, your contact information will be deleted within 7 days of completing the survey.
- If you are not eligible for *any* of the studies, your answers to the questions and contact information will be destroyed within 7 days of completing this eligibility questionnaire.

You may skip questions you do not want to answer and may stop participating at any time.

Demographic Information

1. **Gender** ☐ Male ☐ Female ☐ Transgender Male ☐ Transgender Female
   ☐ Gender Variant/Non-conforming ☐ Other/Not listed ☐ Prefer not to answer

2. **Age** Enter Age

3. **Do you identify yourself as:**
   - ☐ White (non-Hispanic)
   - ☐ White (Hispanic)
   - ☐ Black / African-American
   - ☐ Asian
   - ☐ Native American
   - ☐ Pacific Islander
   - ☐ Other

4. **Do you consider yourself as having any Hispanic / Latino heritage?** ☐ Yes ☐ No

Driving History

5. **How often do you drive?**
   - ☐ Never
   - ☐ Monthly or less
   - ☐ Several times a month
   - ☐ About once a week
   - ☐ Several times a week
   - ☐ Daily or almost daily

Use of Substances

6. **How often you do drink alcohol or consume any alcoholic beverages?**
   - ☐ Never
   - ☐ Only a few times a Year
   - ☐ About once per Month
   - ☐ Several times per Month
   - ☐ About once per week
   - ☐ Several Times per Week
   - ☐ Almost every day / Daily

7. **In the past 30 days, on approximately how many days did you drink alcohol?**_____ (0 to 30)

8. **On days that you do drink alcohol, how many drinks do you <u>usually</u> consume?**
   (One drink = one can of beer / one shot of hard liquor / or one glass of wine)
   - ☐ I don't drink alcohol
   - ☐ 1-2 drinks
   - ☐ 3-4 drinks
   - ☐ 5+ drinks

9. **Please select the statement that most accurately reflects your use of marijuana products? (This can be recreational marijuana or medical marijuana, smoked or in the form of edibles.**
   - ☐ I don't use marijuana products
   - ☐ I use marijuana products a few times per year
   - ☐ I use marijuana products about once per month
   - ☐ I use marijuana products several times per month
   - ☐ I use marijuana products about once per week
   - ☐ I use marijuana products several times per week
   - ☐ I use marijuana products daily or almost daily
   - ☐ I use marijuana products multiple times per day

10. **How would you describe your use of marijuana products?**
    I <u>only</u> use marijuana products to deal with pain or health issues (whether prescribed by a Doctor or not). ___ Yes ___ No
    I <u>only</u> use marijuana products for personal recreation. ___ Yes ___ No
    I use marijuana products for both recreational and medical/health reasons ____ Yes ____ No

11. **How often do you drive within 2 hours after using a marijuana product?**
    - ☐ Never
    - ☐ Only a few times a Year
    - ☐ About once per Month
    - ☐ Several times per Month
    - ☐ About once per week
    - ☐ Several Times per Week
    - ☐ Almost every day / Daily

12. **How often do you drink alcohol at the same time you use marijuana?**
    - ☐ Never or almost never
    - ☐ Some of the time
    - ☐ Always or most of the time

13. **How often do you drive within 2 hours drinking alcohol and using cannabis at the same time?**
    - ☐ Never
    - ☐ Only a few times a Year
    - ☐ About once per Month
    - ☐ Several times per Month
    - ☐ About once per week
    - ☐ Several Times per Week
    - ☐ Almost every day / Daily

14. **Please select the statement that most accurately reflects your use of drugs <u>other</u> than marijuana. Include illegal drugs (e.g., cocaine, methamphetamines, ecstasy, etc.) or prescription drugs taken for non-medical reasons (illicit drugs).**
    - ☐ I don't use other illegal or illicit drugs.
    - ☐ I have used other illegal / illicit drugs, but it has been over year ago.
    - ☐ I have used other illegal / illicit drugs *in the past year*
    - ☐ I have used other illegal / illicit drugs *within the past six months*
    - ☐ I have used other illegal / illicit drugs *within the past month*

Contact Information

If selected to participate, we will need to contact you. Any contact information provided by you will be kept strictly confidential. If you are not selected for participation, all your questionnaire data and contact information will be destroyed within 7 days.

Please provide the following contact information:

First Name Only:
Home Zip Code:
Name of Home County:
Email address:
Best Phone number:
Is it OK to text you at the above number? Y/N
What is your preferred method of communication? __ Email; ___ Text; ___ Phone call

Thank You.

Appendix B: Focus Group Discussion Moderator's Guide

Introduction: Thank you for joining us today and for agreeing to take part in this online focus group discussion. My name is ____ and I am a researcher with the Pacific Institute for Research and Evaluation. Helping me today is ____. The Pacific Institute for Research and Evaluation or "PIRE" is a non-profit research organization. We received funding to conduct this study from the AAA Foundation for Traffic Safety. The Principal Investigator is Dr. Mark Johnson. The purpose of our focus group today is to learn more about your thoughts, perceptions, and experiences related to driving while under the influence of cannabis.

This group discussion should last for around two hours. Please remember there are no right or wrong comments or responses to questions. We just want to hear about your experiences in your own words and your honest thoughts, suggestions, and responses within this discussion. Some of the questions about cannabis use might be considered sensitive, so you should be in a location in which you will not be overheard by others. We know it can be even more difficult during online discussions, but please do your best not to interrupt or speak over each other. Additionally, consider muting yourself when you are not speaking, especially if you anticipate or encounter any background noise. However, feel free to leave your audio on if turning it off/on is too cumbersome. We also ask that you respect the opinions of others in the group. Please keep your cameras on and remain visible for the entire discussion. If you need a break or to use the restroom, please let us know. If you are disconnected from the call, please reconnect as soon as possible. If you are joining us via a computer, please turn off your phone or set it to silent and place it where it will not distract you.

We will be recording this discussion. Please know that this recording will only be shared with authorized research staff at PIRE. The video and audio recording will be used to produce a transcript of our discussion. This transcript will be grouped together with those from other focus groups and analyzed as a part of our research. Once this process

is complete, all the recordings will be deleted. We may use quotes from this discussion when we report the results of this study, but we will not connect these quotes to your name or any other identifying information.

You all agreed to take part in today's discussion knowing that you would be seen and heard by us and the other participants. When you began this call, we adjusted your display name so only your first name appears to others in the group. Please use first names only. When we create the transcript, we will assign participant numbers instead of names and other identifying information will be removed.

Remember, your participation today is entirely voluntary. If there are any discussion points, themes, questions, etc. that you do not want to address or discuss, you are free to keep quiet or let us know by saying, "I'd prefer not to discuss that" or something similar. You may also choose to end your participation in this discussion at any time, for any reason. Again, just let us know.

Additionally, please keep all participants and information confidential. Please do not tell others what you see or hear today. However, keep in mind that although we have asked you all not to share what is said today outside of this group, there is no guarantee that what is said will remain private. As such, please try to avoid saying anything you feel might be potentially damaging or embarrassing. Additionally, we may intervene if anyone starts to disclose anything too personal.

We will take a short bathroom break after one hour. Are there any questions before we begin? [*Answer all questions*]

If you all are ready, we will now start recording and begin the discussion. [*Enable recording*] We are now recording.

Warm up/Icebreaker/Terminology

As I mentioned, the purpose of our discussion today is to learn about your thoughts and experiences related to driving while under the influence of cannabis (DUI-C). [*Encourage each participant to contribute for each of the following prompts*]

1. To start off, let's discuss terminology. How do you usually refer to "cannabis" when speaking to friends, family members, etc.? [Probes: How would you prefer to refer to cannabis today during this discussion? *If the group comes to consensus on preference, use that throughout.*]
2. How would you describe being under the influence of [cannabis], meaning how would you phrase it or what terminology would you use?
3. What about driving under the influence of cannabis, how do you talk about or refer to that? [How would you prefer to refer to driving under the influence of cannabis during our discussion today? *If the group comes to consensus on preference, use that throughout.*]

Context

4. I'm interest in some general questions about cannabis use. For this first question, you might not be clear answers, but when you use cannabis, do you typically use strains that are THC dominant, or do you use strains with a lot of CBD, maybe indica or medical strains, is it a mix, or do you not really pay attention to that?
5. How do you think cannabis affects you? What sort of *physical* changes do you experience when you use it? What about cognitive or mental changes? Does it affect your decision making or ability to think clearly?
6. Okay, what first comes to mind when you hear someone mention "[DUI-C]"? How do you think DUI-C affects your driving?
7. What are your thoughts about how [DUI-C] is perceived among your friends and family members? [Probes: Is it "a thing," meaning is [DUI-C] something you or your friends and family members discuss? Why or why not? If so, how often is it

mentioned or discussed?] What would you say about how [DUI-C] is perceived by your community? What about in society generally? What about comparing how people see [DUI-C] versus Driving Under the Influence of Alcohol (DUI-A)? How are they perceived as similar or different?

8. If you think back on times when you have [DUI-C], how would you describe the situation? What are some of the common factors associated with times you have [DUI-C]? [Probes: Think about the when, where, and why related to DUC].
9. What are your thoughts on decision making related to [DUI-C]? Or, in other words, what are the pros and cons, reasons to, reasons to not [DUI-C], that sort of thing? What about decisions concerning smoking or consuming [cannabis] while driving (as opposed to driving after smoking/consuming)?

Risks

10. In general, is [DUI-C] something that is worrying or concerning? Why or why not?
11. Okay, now let's focus on the potential risks of [DUI-C]. What do you think are the most important risks and why? Now, let's take each of these in turn. [*Review the risks they have mentioned*] Which of these are the most important risks and why? Thinking about each of these risks, how likely are they to occur to you or one of your friends or family members? Please explain.
12. Just briefly, I'd like to get your thoughts about how the risks of DUI-C compared to other driving behavior, for example, drinking and driving, driving while texting or talking on the phone, or excessive speeding or aggressive driving. How does DUI-C compare to these other driving behaviors?

Enforcement

13. Okay, now let's talk about laws concerning [DUI-C]. What are the laws concerning [DUI-C] in your state? What do you think about these laws?
14. What do you think about how these laws are enforced? [Probes: Are these laws effective deterrents? Why or why not?]

15. How is the enforcement of [DUI-C] laws like the enforcement of DUI-Alcohol laws? How is it different?
16. Scientists are currently working to develop a new type of breathalyzer device that will be able to detect [cannabis] like the current breathalyzers used by law enforcement to detect alcohol. If or when such devices become available to law enforcement, how might that affect your views on a) [DUI-C]; b) decision-making concerning whether to drive after consuming [cannabis]; and c) how DUI-C laws are enforced?

Potentially successful messaging

Alright, as we mentioned, the aim of our study is to help develop and test messages that are designed to prevent people from [DUI-C].

17. Have you heard or seen any anti-[DUI-C] advertising campaigns before in your state on the radio, tv, internet, social media, newspapers, billboards, or elsewhere? If so, what did these messages say and where did you see them?
18. When you think about messages that might be effective [or more effective if they report having seen previous messaging] as a part of campaigns to prevent people from [DUI-C], what comes to mind? [*Allow/prompt each person to respond*]

    [*Make a list of suggested messages in the notes and share the screen with the group. If the group came up with some suggested messages, continue to* ***Question 16****. If the group struggles to come up with potential messages, continue to* ***Question 15*** *and ask them to think about previous anti-DUI campaigns.*]
19. If we think about DUI campaigns that have been used to discourage drinking and driving, what are some of the messages or themes that you think have been most effective and why? [Probes: In anti-DUI messaging, there tends to be three types depending on what they emphasize: (1) safety risks to the person and others (for example, car accidents; killing yourself or someone else); (2) legal risks (for

instance, going to jail; “Drive sober or get pulled over”); and (3) social perceptions or “what it means” to be someone who drinks and drives, or even someone associated with a person who does (“Friends don't let friends drink and drive”, etc.). Do you think similar messaging could be effective in preventing people from [DUI-C]? Why or why not? How should anti-DUI-C messages be similar or different to anti-DUI messages? Please explain.

20. Okay, so far as a group we’ve discussed __ potential anti-DUI-C messages: [*review from notes/screen*]. Of these, what messages do you think might be the most effective and why? [Probes: Think about for you personally, what messages might be the most convincing for you and why?] What are some of the common themes in the messages you think might be most effective? [Probes: To put it another way, what do these messages have in common? And what makes them different? How are these suggestions similar or different from those associated with preventing DUI? What similarities or differences are important and why?]
21. What do you think about the need for specialized messaging? [In other words, do you think special or custom messaging is needed to be effective among a certain group or demographic? If so, what types of groups or demographics might need custom messaging? [Probe: For instance, older vs. younger people; people in states where cannabis is legal vs. illegal; recreational vs. medicinal users; people who use cannabis with alcohol vs. those who do not; people over the age of 60; rural vs. urban].
22. Okay, let’s think about what kinds of messages might be most persuasive with each of the groups we’ve mentioned [*Review groups*]. Who has some suggestions? [*Ask the group for comments after each suggestion*]

Closing questions

23. We have discussed quite a lot today. What have we missed that you think is important for us to know about? [Probes: About [DUI-C]; why people [DUI-C] and associated decision-making; perceptions of [DUI-C] and its acceptability or

unacceptability; the most important risks of [DUI-C]; the enforcement of [DUI-C] laws; differences or similarities between [DUI-C] and DUI-Alcohol; and messaging that might be effective in discouraging [DUI-C] generally, as well as among any groups or demographics?]

24. Is there anything else that we haven't talked about today that you think is important for us to know or anything else you would like to add before we close the session? Do you have any questions for us?

Okay, I think we can end this discussion. [*Cease recording and let everyone know*] Thank you all again for your time. You all have made an important contribution to our research, and we greatly appreciate it. Please feel free to contact us if you have any questions or concerns. You will all receive a $100 Amazon gift code that will be sent by email or by text, using the information you provided and confirmed for us. These gift cards will be sent within 24 hours.

Appendix C: Final Messages from Focus Group Discussions and CHATGPT

Cannabis Message from Focus Groups

1. Keep the *high* off the highway.
2. Don't spoil your high by getting behind the wheel. Keeping it at home is better for everyone.
3. Couchlocked? Take the hint and don't get behind wheel.
4. Vape + Steering Wheel = Bars" [Image of person waiting to be arraigned]
5. Driving under the influence of cannabis isn't always without consequences. Is a joint worth going jail? [Image of police stop]
6. Even if cannabis is legal to use, it's never legal to drive impaired. Know the law. Know the consequences.
7. Edibles can be unpredictable. Play it safe and don't drive.
8. Know your limits. If you're impaired, don't drive.

Informational

9. Last month, State law enforcement busted 399 drivers for driving while high. Don't be #400.
10. You think the police can't tell you've been vaping? You're wrong. Play it safe. Don't drive high. [image of police administering a roadside THC test to a driver]
11. It doesn't matter whether it's legal. It doesn't matter whether it's medicine. Cannabis can impair your driving and it is illegal to drive while using it. Don't drive under the influence.
12. Even if it's medicine, cannabis can hurt your ability to drive safely. Plan when you need to dose and when you need to drive.
13. Driving under the influence of cannabis isn't safe for anyone. But research shows it's particularly dangerous for older drivers [show study citation]. If you're high, don't drive.
14. Older drivers already get a bad rap. Don't make it worse by driving under the influence of cannabis.
15. People from all walks of life use cannabis. People from all walks of life get in crashes. It doesn't matter who you are—cannabis and driving don't mix.
16. People say that driving high is safer than driving drunk. But safer isn't safe. Whether alcohol or cannabis—don't take the risk. Choose to drive sober.

ChatGPT

17. Marijuana impairs your judgement, slows your reactions, and increases your risk of crashing. Don't drive high.
18. Driving under the influence of marijuana isn't just illegal; it's dangerous and can lead to devastating consequences on the road. Please, don't take that risk.
19. We all want to make it home safely. Driving under the influence of marijuana puts everyone at risk. Please, be responsible.

20. Driving under the influence of marijuana affects everyone on the road. Keep our communities safe and don’t drive impaired.

21. Driving high isn't just reckless; it's selfish. Think twice before getting behind the wheel after using marijuana.

22. Marijuana may make you feel relaxed, but it impairs your ability to drive safely. Only alert driving is safe driving.

23. You wouldn't drink and drive, so why drive high? Don’t drive under the influence of marijuana.

Appendix D: Study Vignette

Next, please read the brief vignette below. The person in the vignette is tasked with making a decision. Imagine yourself in that situation. Or, if you have difficulty picturing yourself, think of someone you know well. After reading the vignette, you will be asked to answer questions about how you might respond in that situation.

After a very busy afternoon, you make it home and finally get a chance to relax.

You grab your vape pen, sit back, and take a hit. It's a cartridge you haven't tried before, and the effect isn't quite what you expected. It's not bad, just not what you expected. But you take another hit anyway, and let it sink in. After a few minutes more, you take another, and soon enough, you're feeling pretty high.

Then your phone chimes.

The errand.

You promised you would pick something up at the store for a friend. Not just promised, but you *swore* you would get it done. It was important, but somehow, you forgot.

You glance at your phone again. The place will be open for another hour, and after that it will be too late. It's about a 30-minute drive, so there's time. You could also take an Uber; there's time for that, too. But it's more hassle, and more expense.

All the while, you remember a public safety message that has been hitting social media:

[INSERT MESSAGE HERE]

Considering everything you've read, please indicate the likelihood that you (or someone close to you) would drive yourself in this situation, as opposed to taking an Uber or following some other path. Give your rating on a scale of 0% to 100%, where 0% means there is no chance you would drive and 100% means you would absolutely drive, and the numbers in between reflect the percent chance you would drive.

There is a _____% chance I would choose to drive myself in this situation.

Now think about the typical person, not necessarily you or someone you know well. Using the same information, please answer the following:

There is a ____% chance the typical person would choose to drive themselves in this situation.