Production, perceptions, and punishment:
Restrictive deterrence in the context of cannabis cultivation

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ABSTRACT

Background: American authorities have invested extraordinary resources to keep up with the growth in marijuana cultivation, and state-level marijuana laws have been changing rapidly. Despite these changes, little research on the relationship between criminal justice sanctions and grower behaviours exist, in particular research that examines restrictive deterrence – the altering of an illegal behaviour as opposed to desisting from it completely.

Methods: We examine restrictive deterrence in the context of cannabis cultivation by modelling the relationship between the threat of sanctions and the size of cultivation site and number of co-offenders. We use data from an anonymous web survey where participants were recruited through advertisements on websites related to marijuana use and cultivation. Negative binomial regression were used on 337 cases that contain valid data on size of cultivation site and 338 cases that contain valid data on the number of co-offenders.

Results: Our study found some evidence that the severity of state sanctions reduces the size of cultivation sites among growers who reside in the state. However, the number of contacts with the police had the opposite effect. In addition, we did not find a restrictive deterrent effect for the number of co-offenders, suggesting that different factors affect different decision points. Interestingly, objective skill and subjective skill had positive and independent effects on size of site.

Conclusions: Results suggest that state-level sanctions have a structuring effect by restricting the size of cultivation sites but further increases in sanctions or enforcement are unlikely to deter more individuals from growing marijuana. In fact, there may be some potential dangers of increased enforcement on marijuana growers.

Domestic cannabis cultivation in the United States has increased over the past three decades, as evidenced by the 5.2 million plants eradicated in 2006 and the more than 10.3 million plants in 2010 (Drug Enforcement Administration, 2013). While American authorities have been spending millions of dollars on the criminal justice response to this growth, sanctions are hardly uniform. State-level marijuana laws are dramatically disparate and have been changing rapidly. For example, in Maine, cultivation of 5 plants or less constitutes a misdemeanor offense, carrying a six month prison term, whereas cultivation of any amount in New Mexico is considered a felony offense carrying a nine year prison term (National Organization for the Reform of Marijuana Laws, 2013). In the past fifteen years we have seen 21 states legalize medical marijuana use and small scale cultivation, and two states legalize recreational use and production of the drug (National Organization for the Reform of Marijuana Laws, 2013). Despite these facts, research offers little direction to policy makers as to how criminal justice sanctions affect grower behaviours.

This is not to say that researchers have completely neglected cannabis cultivation. On the macro level, there has been size estimates of the cultivation industry (Bouchard, 2007), assessments of the effects of potential legalization (Kilmer et al., 2010), and examination of the success of eradication efforts (Potter, 2011; Wilkins et al., 2002). On the individual level, there has been descriptive work on the typologies of marijuana growers (Hough et al., 2003; Nguyen and Bouchard, 2010; Potter, 2010; Weisheit, 1992), co-offending behaviour (Bouchard and Nguyen, 2010; Malm, 2006; Malm et al., 2008; Malm et al., 2011; Nguyen and Bouchard, 2013) and grower motivations (Hakkarainen and Perala, 2011). Yet, few studies have examined the factors that influence various characteristics of the cultivation site, especially factors associated with the criminal justice response to cultivation. This line of inquiry is essential because as

policy surrounding marijuana use changes, law makers will be forced to consider factors that influence the supply-side of the market.

The deterrence doctrine can help us understand how enforcement policy affects marijuana cultivation sites. Deterrence operates under the assumption that humans are rational and weigh the costs and benefits of their actions (Bentham, 1789; Cornish and Clark, 1986). This rationality should lead to an inverse relationship between the certainty, severity, and celerity of official sanctions and the probability of committing an offense (Beccaria, 1764; Paternoster, 1987). The deterrence doctrine has a long history in criminology and, directly or indirectly, is one of the cornerstones of the criminal justice system (Piliavin et al., 1986). The threat of sanctions can impact an individual in two ways: first, it can prevent a person from engaging in an offense - *absolute deterrence*; second, the threat of sanctions can alter an individual's behaviour by reducing the frequency of engaging in the offense - *restrictive deterrence*. According to Gibbs (1975:33), "restrictive deterrence is the curtailment of a certain type of criminal activity by an individual during some period because, in whole or in part, the curtailment is perceived by the individual as reducing the risk that someone will be punished as a response to the activity."

RESTRICTIVE DETERRENCE

The literature on absolute deterrence suggests that there is a marginal deterrent effect to the threat of sanctions (Nagin, 1998). In general, there is a modest inverse relationship between the perceived certainty of punishment and crime, but no real evidence of a deterrent effect for severity, and few conclusions regarding the celerity of punishment (Paternoster, 2010). While there has been a long history of examining absolute deterrence, restrictive deterrence remains a relatively understudied component of the deterrence doctrine. The dearth of studies omits an important subset of the population of offenders who do not cease offending but are nonetheless

impacted by the threat of sanctions. Greater understanding to the varied responses to sanctions is an important tool for understanding offender decision making, law enforcement, and crime prevention policy.

Most studies on restrictive deterrence use interviews with offenders, mostly drug-related, and demonstrate support for the theory. Jacobs (1996) interviewed crack dealers, and found that dealers study buyer physical and verbal clues to ensure that they are not undercover police. These findings led Jacobs (1996) to extend Gibbs' (1975) conceptualization of restrictive deterrence. Gibbs posited that individuals not only respond probabilistically (reduction in frequency), but also particularistically. Particularistic restrictive deterrence refers to "a reduction in offense frequencies based on tactical skills offenders use that make them less likely to be apprehended" (Jacobs, 1996:425). Jacobs (1996) extended Gibb's conceptualization of restrictive deterrence by moving beyond offending frequencies to include differential techniques to avoid arrest. This conceptualization is reminiscent of Eck's (1993) presentation of crime displacement. Eck argues that there are several ways in which offenders can adjust their criminal activities due to blocked opportunities: temporal, spatial, target, method, crime type, and perpetrator. Jacques and Allen (2013) drew on qualitative interviews with young, suburban, middle-class drug dealers to examine how political, moral, sympathetic, religious, and physical sanctions change offending behaviour. They found that political, moral and sympathetic sanctions led to restrictive behaviour while the effect of physical sanctions operated indirectly, through fears related to drug consumption. Barratt and colleagues (2005) assessed whether perceptions of certainty, severity, and fairness of punishments outlined by the Cannabis Infringement Notice policy in Western Australia affected how cannabis users intended to obtain cannabis. They found that a significant

proportion reported intending to change their behaviour to fit within the policy, including

purchasing within the threshold and growing plants below the allowable number of plants.

Compared to qualitative studies, quantitative research on restrictive deterrence has

produced mixed results. Only a handful of quantitative studies have examined restrictive

deterrence. Paternoster (1989) analysed data from a sample of high school students to examine

the relationship between perceived certainty and perceived severity of punishment on both the

onset and the frequency of marijuana use, drinking alcohol, petty theft, and vandalism. Findings

indicate that perceived certainty had some effect on absolute deterrence but perceived severity

had no effect on absolute or restrictive deterrence. Gallupe et al. (2011) examined restrictive

deterrence in a sample of drug market offenders and found that offenders who responded to

arrest by changing their behaviours were re-arrested more quickly than offenders who did not

change their routine. However, marijuana growers who did respond to restrictive deterrence by

changing locations or increasing the number of plants were not re-arrested more quickly than

growers who maintained their routine. The next section considers why marijuana cultivation is

an excellent case study to examine restrictive deterrence.

RESTRICTIVE DETERRENCE IN THE CONTEXT OF MARIJUANA

CULTIVATION

The restrictive deterrence framework is especially useful in the context of marijuana

cultivation due to several distinct features. First, data on marijuana seizures and trends indicate

that growers' activities have been influenced by the threat of punishment by adapting their

practices in order to reduce risks of detection (Bouchard, 2007). For example, the National Drug

Intelligence Center (2009:4) noted "cultivators, particularly Caucasian groups, have relocated or

established their operations indoors because of the reduced risk of law enforcement detection in

comparison with outdoor grows, which are being increasingly targeted by vigorous outdoor cannabis eradication operations." Similarly, Gallupe et al. (2011) examined a subsample of marijuana growers and found that growers responded to arrest by changing locations, and by altering the size of their cultivation site. Growers who increase the number of plants experience longer periods without arrest; however, these growers were more likely to start out as small-scale. They argue that small time growers are less likely to come to the attention of police and therefore, may be given the freedom to learn from previous experiences. Nevertheless, results demonstrate that growers are responsive to sanctions and react in ways that are consistent with restrictive deterrence.

Second, individuals are involved with marijuana cultivation for a wide variety of reasons, which may lead to a similarly varied set of responses to the threat of sanctions. Research into grower typologies suggest that a good number of individuals engage in cultivation for the intrinsic rewards or for the love of the plant (Weisheit, 1992; Potter, 2010). Other growers are engaged in large scale cultivation sites and garner considerable monetary rewards from cultivation (Nguyen and Bouchard, 2013). It is reasonable to infer that small scale plant lovers may be more susceptible to variations in plant limits but not be as sensitive to variations in sanction levels, especially given that the small size of their operation is unlikely to generate police attention in the first place. These issues, however, have not been systematically investigated in prior studies.

Third, scholars have suggested that certain types of crimes, such as violent crimes, are often unplanned and therefore are not well explained using the deterrence doctrine (Sherman et al., 1992). Further, different individual physiological states can impact an individual's decision making. Drug users, for instance, tend to have higher discount rates, are more impulsive, and

have a heightened sensitivity to rewards when compared to individuals who do not use drugs (Bechara et al., 2001; Fishbein et al., 2005). Unlike many other crimes, participation in marijuana cultivation involves considerable planning and investment. Starting a cultivation site, regardless of size, can take several months to complete and requires regular maintenance and tending of plants (Bouchard, 2007).

Lastly, there are a number of characteristics that are associated with a greater risk of detection that growers can choose to alter. For example, the size of cultivation site, outdoor sites vs. indoor sites, and the number of co-offenders have all been linked to a greater probability of detection (Athey et al., 2013; Bouchard, 2007; Bouchard and Nguyen, 2010). Therefore, marijuana cultivation provides a number of different responses that can shed light on probabilistic and particularistic restrictive deterrence.

The current study examines the impact of certainty and severity of punishment on two important decisions made by growers: the size of the cultivation site and the number of accomplices involved in the grow site. In terms of size of site, research into drug markets suggests that there is an inverse relationship between size of operation and the probability of detection (Bouchard, 2007; Bouchard and Morselli, 2013; Paoli et al., 2009; Reuter, 1985; but see Bouchard and Ouellet, 2011). Similarly, many years ago Erickson (1971; 1973) coined the phrase "group hazard hypothesis", which argues that violating the law with accomplices increases the likelihood of detection. Traditionally measured by the inconsistency between official records and self-reported delinquency, several studies have found support for the idea that group crime is more likely to result in police contact/arrest than solo offending (Erickson, 1973; Feyerherm, 1980; Morash, 1984; Brownfield et al., 2001; Hindelang, 1976). It is also common knowledge among individuals involved with drug markets that increasing the number

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of co-offenders is associated with a higher probability of detection (Bouchard and Ouellet, 2011; Desroches, 2005).

We use a sample of marijuana growers who participated in an anonymous online survey. The survey contained detailed questions regarding: characteristics of the grower, the marijuana site, respondents' self-perceived skill, and his/her perceived certainty of punishment. Our findings suggest that growers who reside in states with more severe punishments for cultivation grow fewer plants, but also that increased police contact is associated with larger cultivation sites. In addition, severity of sanction does not impact the number of co-offenders. Our results offer important insight into the role of restrictive deterrence in marijuana cultivation, providing important commentary both in terms of policy and theory.

DATA/METHODS

To examine the relationship between the threat of sanctions and the size of cultivation site and number of co-offenders, we use data from an anonymous web survey of adults who participated in marijuana cultivation at least once. Because marijuana growers are a hidden population, online survey methods are ideal to capture information regarding their activities (Potter and Chatwin, 2011; Barratt et al., 2012). Participants were recruited through advertisements on websites related to marijuana use and cultivation. Researchers contacted seven discussion-based cannabis websites and two cannabis magazines attempting to recruit both former and current growers over the age of 17 from the United States and Canada (for more information on recruitment and online methodology see Barratt et al, this volume). Three sites agreed to post the recruitment advertisement (Grasscity.com, Rollitup.org, and hightimes.com). Once the participant clicked on the link contained in the advertisement, they were redirected to the introductory page of the survey. The study commenced in February 2012 and was completed

in December 2012. The survey contained 58 items that asked about growers' experiences with marijuana cultivation, reasons for growing, personal experiences with the criminal justice system, and demographics. Important to the current paper, it asked detailed questions about the last time an individual participated in cultivation. This study is a part of a larger, international comparative study on the characteristics and patterns in cultivation (see Barratt et al., 2012 for details about the international study).

Dependent variables:

The current study uses two dependent variables, size of site and number of co-offenders, to examine the role of sanctions on restrictive deterrence.

Size of site: Our first dependent variable is a decision that every marijuana grower must contend with: how many plants should be grown? Given the research indicating that there is a positive relationship between size and the risk of detection, we hypothesize that a probabilistic response to the threat of apprehension would be to decrease the number of plants grown at the cultivation site. Figure 1 shows that the average number of plants is 20, with a median of 6 plants, suggesting that the distribution is right skewed. However, because the negative binomial estimator is developed to handle highly skewed distributions, we retained the variable in its original form.

Number of co-offenders: Our second dependent variable considers the number of co-offenders a grower worked with from start to finish. The number of co-offenders ranged from 0 (the individual worked alone) to 10. Over half of the respondents indicated that they did not have any accomplices (54%) and less than 3% of the respondents reported that they worked with three or more accomplices (see figure 2).

~ Figure 1 here ~

~Figure 2 here ~

Sanction variables:

We have three variables that tap into the threat of sanctions:

General state punitiveness: Data regarding state penalties were gathered from the National Organization for the Reform of Marijuana Laws website (http://norml.org/). The website outlines state laws and penalties for marijuana possession, trafficking, and cultivation. We constructed a measure that captures the general punitiveness of state penalties for cultivation by taking the minimum state penalty for cultivation, which gives us an indication of the general punitiveness of each state. We use the minimum state penalty for cultivation for two main reasons. First, the minimum legislated penalty provides a baseline that we can use to compare across states. Second, the majority of the growers who participated in the survey are small-scale growers who are more likely to consider minimum than maximum penalties in their risk calculations. Based on deterrence theory, we would expect that growers in states that are more punitive will be involved with smaller sites and have fewer co-offenders. In the current study, we focus on sentencing severity, although there have been numerous ways deemed appropriate to measure state punitiveness, including arrest rates, conviction rates, and incarceration rates (Selke and Anderson, 1992).

A total of 44 states are represented in our sample. States that are not represented include: Connecticut, Delaware, Hawaii, North Dakota, and South Dakota. There is considerable variation in general state punitiveness. The punitiveness variable is represented by the minimum number of days of incarceration for a cultivation offense. The minimum state penalty ranged from 30 days to approximately 7,300 days (approximately 20 years) for a cultivation offense. The states with the fewest number of days as a minimum penalty include Ohio, Pennsylvania and

North Carolina while the most punitive states include Washington, Wisconsin, New Mexico, and Kansas. Because of skew, a logarithmic transformation of the general state punitiveness was conducted. Voters in Washington and Colorado passed ballot initiatives in November 2012 to legalize marijuana for recreational use. However, given that all our surveys were completed by December 2012 and the laws did not come into effect until 2014, these initiatives should have little bearing on our analyses.

We use minimum number of days for several reasons. First, all states specify a minimum number of days of incarceration for cultivation offences, which provides us with a comparable metric across states. In contrast, some states specify a minimum number of plants while other states specify a minimum weight. There is great variation in the number of plants specified by certain states. For example, in Kansas 5 plants carry a 12 year imprisonment term whereas in Pennsylvania 10 to 21 plants carry a 1 year imprisonment term. In terms of weight, cultivation of 50 kilograms or less in Iowa carries a 5 year term in prison and any amount of cultivation in New York carries a minimum of a 1 year imprisonment term. The variation in thresholds presented a challenge so we opted to use the minimum number of days. Nonetheless, we recognize that our indicator is not perfect, but we believe it provides a reasonable approximation of the concept available to us and is also salient to growers. We include two additional measures that tap into state punitiveness and two measures of individual experiences with sanctions to examine the relationship between state sanctions and restrictive deterrence. We further consider the limitations of the measure in the discussion section and offer ideas for future research.

Medical marijuana: An increasing number of states have passed laws eliminating criminal penalties for using marijuana for medical purposes. There has been reluctance among some states to legalize the possession of marijuana for medical purposes because the federal government has

traditionally refused to pass medical marijuana laws. However, state laws represent a political response to patients seeking relief from debilitating symptoms, which can be seen as less punitive against marijuana in general (Hoffman and Weber, 2010). We therefore included a dichotomous measure =1 if a state has legalized the use of medical marijuana. About half of the states in our sample have legalized medical marijuana.

Mandatory minimum: We include a binary measure indicating whether or not marijuana cultivation carries a mandatory minimum penalty. If the particular state does specify a mandatory minimum, we code the variable = 1 and no mandatory minimum = 0. The rationale behind mandatory minimums is that the certainty and severity of the mandatory minimum should deter individuals from engaging in the offense (Tonry, 1998). Therefore, growers in states that specify a mandatory minimum sentence for cultivation should be involved with smaller sites and have fewer co-offenders. The majority of the states (81%) represented in our sample specify a mandatory minimum sentence associated with cultivation (Table 1).

Individual experiences:

In addition to legislated state penalties, we include two criminal justice measures that vary across individuals: the perceived certainty of arrest and contacts with the police because of cultivation. It is important to underscore that similar to our sanction variables, these measures are cultivation specific.

Perceived certainty of arrest: To measure perceived certainty of arrest, subjects were asked "How likely is that you would be caught and arrested for growing marijuana?" Subjects rated their chances from 0 = no chance to 10 = certain to be caught. The average perceived certainty rating was 2.7, suggesting generally low risk perceptions.

Police contact: Research shows that offenders update their perceptions of the risk of arrest with their own arrest experiences (Anwar and Loughran, 2011). Therefore, we include a binary measure to indicate whether or not an individual self-reported ever being arrested for marijuana cultivation. Only approximately 9% of our sample reported having been in contact with the police because of their cultivation.

Control variables:

We include a number of control variables to account for an individual's personal experience with marijuana cultivation and demographic characteristics.

Perceived skill: Research suggests that confidence in one's own ability is positively related to both self-reported offending, arrest (Loughran et al., 2013), and instigation in group crime (McGloin and Nguyen, 2012). Subjects were asked to rate from a scale of 1 (no skill) to 10 (highly skilled) "How do you rate your current ability to grow marijuana?" On average, growers rated their skill level to be high (8.0).

Experience: We also included a measure of objective skill. Subjects were asked how many crops of marijuana he/she has grown thus far. Our sample, on average, has grown 46 crops at the time of the survey was conducted. The experience variable was also log transformed for the regression analyses due to skewness.

Hard drug use: To account for differential decision making, respondents who reported using methamphetamine, amphetamine, cocaine, ecstasy, LSD, magic mushrooms, synthetic cannabinoids, heroin, other opioids, benzodiazepines, or sedatives in the past 12 months were coded as engaging in hard drug use. About 30% of our sample engaged in hard drug use in the past 12 months.

Type of site: Studies have found that some growers respond to the threat of sanctions by shifting from outdoor sites to indoor sites (National Drug Intelligence Center, 2009). We control for the location of the site with three binary indicators: indoor, outdoor, and both indoor and outdoor. In our regression analyses we use outdoor sites as the reference category. The vast majority of growers in our sample had indoor sites (80%).

Age: Table 1 illustrates that the average age of subjects in our sample is approximately 32 years.

Gender: Males in our sample were coded = 1 and females = 0. Approximately 87% of our sample is male.

White: We also included a binary indicator = 1 if the subject self-identified as being Caucasian and 0 = if the subject self-identified as being any other race/ethnicity. The majority (83%) of our sample are Caucasian.

Size of marijuana market: Our measure of the size of the marijuana market is the prevalence of past month users (12 years old or older) in each state during 2011-2012. The data were collected from the National Survey on Drug Use and Health.

Legal grower: We have some growers who reported that they were legally growing medical marijuana, but we have no way of discerning if these respondents were also illegally growing. We therefore include an indicator = 1 if they reported legally growing medical marijuana and 0 = otherwise. Approximately 11% of our sample reported growing medical marijuana legally.

~ Table 1 here ~

Analytic plan:

We restrict our analyses to individuals residing in the United States who reported the last time they were involved in cultivation was in 2011 or 2012. This was done for two reasons. First, restricting the analyses to the last time a grower was involved in cultivation reduces recall bias,

which is caused by differences in the accuracy or completeness of recollections (Weathington et al., 2010). Second, several of our measures of sanctions are derived from state laws and penalties for marijuana cultivation. Because state sanctions change over time, it is important that the time that an individual participated in cultivation is consistent with state laws and penalties for cultivation.

There are 337 cases that contain valid data on size of cultivation site and 338 cases that contain valid data on the number of co-offenders. Our control variables contained few missing values and in order to avoid data loss due to listwise deletion, we estimated models using multiple imputation with Stata's Imputation with Chained Equation command (Allison, 2002; Royston, 2004; Schafer and Graham, 2002). There were very few missing values. The variable that had the most missing values was the race/ethnicity variable, which had 16 cases with missing values (approximately 5%).

First, we examine the bivariate relationship between all our variables using Pearson product-moment correlation coefficients. Second, we run several regression models for both our dependent variables. We investigate the relationships among each of our sanction measures and our outcomes, and then estimate these relationships while accounting for the control variables. Because size of cultivation site and number of co-offenders are both over-dispersed count outcomes, we conduct negative binomial regressions.

RESULTS

Table 2 displays the results from our correlation matrix. As expected, our two dependent variables, size of cultivation site and number of co-offenders, are positively correlated with one another ($r=.11$, $p<.05$); however, the correlation is weak thereby necessitating separate consideration of each variable. While state punitiveness and size of cultivation site are not

significantly related, both legalized medical marijuana state (r=.05, p<.05) and presence of a

mandatory minimum sentence (r=.06, p<.05) are weakly positively related to the size of

cultivation site. The direction of the relationship between site size and mandatory minimum is

unexpected. Looking at our individual level variables, perceived certainty is positively related to

cultivation size as is having at least one police contact due to cultivation (r=.27, p<.05). Like size

of cultivation site, police contacts is moderately positively related (r=.18, p<.05) to number of

co-offenders. One interesting result that emerged from our control variables is that the positive

correlations between experience (r=.23, p<.05), perceived skill (r=.22, p<.05), and size of site

are the strongest in the analyses. The positive relationship between experience (r=.15, p<.05),

perceived skill (r=.10, p<.05) and the number of co-offenders are also worth noting. This

suggests that individual experiences with cultivation play an important role in decisions

regarding cultivation.

~Table 2 here ~

Our first set of regressions predicts the size of cultivation sites (Table 3). Models 1 to 5

examine the bivariate relationship between our sanction variables and the size of site. Model 1

shows that the general punitiveness of the state in which a grower resides is negative and only

marginally significant (p<.10) as it relates to the size of the site. Models 2 and 3 look at the

whether or not a state has legalized medical marijuana and whether or not the state specifies a

mandatory minimum sentence for cultivation. These two predictors are positive and significant.

That is, if a state has legalized medical marijuana there is a higher probability that an individual

will be involved with a larger cultivation site. Surprisingly, growers who reside in states with a

mandatory minimum sentence for cultivation are also more likely to have larger sites; however

this relationship disappears once the controls are added into the model. Generally, state sanctions account for very little of the variation in size of site, as evidenced by McFadden's Pseudo R^2.

Model 4 and 5 examine individual experiences with sanctions. Model 4 shows that the higher the perceived certainty for arrest, the more likely to be involved in larger sites. Either the deterrent mechanism is not working in the expected direction (higher perceived risks could lead to smaller sites) or the mechanism we are capturing is simply different: individuals who decide to set up larger cultivation sites adjust their perceptions of risks in the same direction. Model 5 reveals that the relationship between having at least one prior police contact for marijuana cultivation and the size of cultivation site is also positive. The temporal order of these particular relationships is difficult to discern given our data are cross-sectional. For example, individuals who were arrested for their participation in a cultivation site may have been so because of the larger sites in which they are involved, and not the other way around. However, because we ask about the last participation, and most respondents are still active, the police contact is unlikely to have occurred after the last participation. This implies that the respondents with a history of arrest returned to cultivation post-arrest and still grow larger sites compared to the rest of the sample.

Model 6 includes all of our sanction variables and our control variables. State punitiveness and legalization of medical marijuana remain significant and in their expected direction. Police contact is also positive and significant. Only four of our control variables emerged as significant predictors of the size of cultivation sites: experience with growing, perceived skill with growing, cultivating both indoor and outdoor, as well as being a legal grower. Respondents who participated in both indoor and outdoor sites compared to outdoor sites only were more likely to be involved in larger sites. In addition, legal growers reported

cultivating significantly more plants than others. Hard drug use, and demographic characteristics of the grower do not predict the size of a cultivation site. In general, results from the regression analyses indicate that while some state sanctions do have a structuring effect in keeping cultivation sites small, individual experience with the criminal justice system and experience with growing also appear to have an important effect.

~ Table 3 here ~

Results from our analyses predicting the number of co-offenders appear in Table 4. Model 1 examines the relationship between punitiveness of the state in which a grower resides in and the number of co-offenders involved with the site. The coefficient does not reach statistical significance. Model 2 shows that the legalization of medical marijuana is also not related to the number of co-offenders. Similarly, models 3 and 4 show that whether or not the state specifies a mandatory minimum sentence for cultivation, and the subject's perceived certainty of arrest do not significantly predict the number of co-offenders. However, model 5 shows that having experienced at least one police contact for cultivation increases the number of co-offenders. Similar to number of plants, the temporal order of this particular relationship is difficult to discern. This relationship will be discussed further in the next section. Model 6, our full model, shows that police contact remains an important predictor of the number of co-offenders; however, only one of our control variables is significant, that is, being a legal grower. Here the effect is negative, suggesting that legal growers mostly do it alone – even if they generally have larger sites than others after controlling for the effect of other predictors. In general, our sanction variables do not have an impact on the number of co-offenders, suggesting that decisions regarding the number of co-offenders likely lie elsewhere.

~ Table 4 here ~

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DISCUSSION

The current study examined the relationship between the role of certainty and severity of sanctions in restrictive deterrence among a sample of marijuana growers. Understanding the role of restrictive deterrence on drug producers holds both short term and longer term benefits. In the short term, such research will help clarify the connection between punitive cannabis cultivation laws and the size of the production end of the illicit cannabis market. In the longer term, insight into restrictive effects of policies can provide a more well-rounded view of sanction effectiveness than the current body of literature which is dominated by examinations of absolute deterrence. Even though the certainty and severity of sanctions do not deter some individuals from engaging in cannabis cultivation altogether, policies can still impact the frequency or scale of operations. Expanding the body of restrictive deterrence research is particularly timely considering the rapid pace of policy and legislative change surrounding marijuana use and cultivation in the United States.

In terms of the size of cultivation site, the current study found that growers who reside in states that are more punitive towards marijuana cultivation have smaller cultivation sites, even when controlling for a number of individual characteristics. Growers in states that have legalized medical marijuana also participate in larger sites. Taken together, these findings lend some support to restrictive deterrence, and corroborates with studies that have examined restrictive deterrence among marijuana users and growers (i.e. Barratt et al., 2005; Gallupe et al., 2011). Our measure of punitiveness is cultivation specific and provided us with a general indicator of the severity of penalties associated with marijuana cultivation for each respective state. The legalization of medical marijuana is also related to the size of cultivation sites. These effects are structuring in the sense that they appear to lead to smaller sizes for growers who reside in that

state, irrespective of other variations in individual characteristics. Given the fact that the other severity and certainty measures did not emerge as significantly associated with size, once controlling for individual level factors, we must remain cautious in making strong conclusions about this particular result. Future research on restrictive deterrence and cannabis cultivation should ask growers if state penalties are considered in their growing decisions. Additionally, researchers should examine whether specific legislative changes produce significant effects on decisions regarding operational size. It could very well be that further changes in relative punitiveness (in both directions) are not associated with behavioural changes past the general structuring effect uncovered in this study. Kleck et al. (2005) examined aggregate punishment levels and individual perceptions of punishment and found no detectable impact of actual punishment levels on perceptions of punishment. A similar phenomenon was uncovered for illegal drug prices, where general punitiveness determined a general price level, but that further changes in the intensity of enforcement on drug markets would not have an impact on prices (Caulkins and MacCoun, 2003; Caulkins and Reuter, 1998).

Our sanction variables were not related to the number of co-offenders. This is suggestive of two things. First, factors that impact the decision regarding the size of the cultivation site potentially differ from factors that impact the number of co-offenders involved in a particular grow site This proposition is strengthened by the weak, albeit significant, positive association between the two variables (r=11, p<.05). Second, unlike absolute deterrence, which examines participation in an illicit activity, restrictive deterrence may be more difficult to disentangle, given that there are various decision points in the commission of an offense. Cornish and Clarke (1986) for example note that the decision to become involved in crime is very different than the decisions to commit particular crimes at particular times/in particular circumstances. It is also

possible that we did not find effects due to the characteristics of our sample. Research investigating the decision to co-offend shows that factors such as experience (Nguyen and McGloin, 2013), adversity (McCarthy et al., 1998), and age (Van Mastright and Farrington, 2009) are related to group crime. Most of the growers in our sample had small sites and tended to their plants from beginning to end, reducing the need to have co-offenders. Our survey was also limited to individuals who were at least 18 years old, which removes adolescents, who are most likely to engage in group crime (Piquero et al., 2007).

Interestingly, our measure of perceived certainty of arrest did not predict the size of site nor the number of co-offenders once controlling for individual factors. This is somewhat surprising given that this measure has been used in previous studies examining deterrence (Nagin, 1998) and demonstrates a small effect on crime. Our findings likely differ for two reasons. First, we restricted our sample to individuals who were not deterred from engaging in marijuana cultivation altogether and it may be possible that certainty of punishment plays a stronger role in absolute deterrence than restrictive deterrence. Second, the majority of the growers in our sample reported that their probability of detection was extremely low. It is possible that individuals who perceived a high probability of detection were deterred from engaging in cultivation altogether or were too paranoid to participate in an online survey and therefore were not part of our sample.

One of the most interesting findings in this study is the effect of our two measures of skill – an objective measure and a perceptual measure. Both objective experience, measured by the number of crops a respondent had grown, and perceived skill were positively related to larger cultivation sites. Further examination into the effects of criminal experience and skill is particularly important from a policy perspective. Individual experience and perceived skill with

cultivation are clearly important factors in moderating the size of the cultivation site and could possibly weaken any deterrent effects that sanctions may have on grower behaviour. Further, it is important to not only prevent individuals from getting involved with illicit marijuana cultivation but also prevent individuals from increasing the intensity of their participation, in terms of being involved with larger sites. It is also possible that individuals with more experience and skill are likely garner greater monetary returns from cultivation (Nguyen and Bouchard, 2013) and are less likely to desist from the crime (Brezina and Topalli, 2012). In a recent paper, Brezina and Topalli (2012) examine criminal perceptions of effectiveness and success. Importantly, they found criminal self-efficacy is negatively related with intentions to desist.

Our analyses provided commentary on the role of sanctions and restrictive deterrence among a sample of marijuana growers. However it is important to acknowledge that our study has several limitations, which we hope that future studies can improve upon. First, because our data are cross-sectional, it is difficult to disentangle temporal order between our predictor variables and our outcome variables. This is exemplified by our finding having least one police contact is positively related to both size of site and number of co-offenders. Causal ordering for our findings concerning state sanctions is less of a concern because it is less likely that the size of cultivation sites affect specified state sanctions. On one hand, the experiential effect would hypothesize that experience with police heightens the perceived probability of detection and therefore have a deterrent effect (Saltzman et al., 1982). On the other hand, larger sites and a greater number of co-offenders are likely to garner more police attention, resulting in a positive relationship. In other words, the causal ordering would be reversed: large size attracts police contacts. At the same time, because respondents reported the size of their last grow site, and the vast majority are still active, our findings also suggest that respondents who report a police

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contact are still active and are still among the largest producers in the whole sample. In any case, the results suggest that efforts to increase intensity of enforcement on growers may not have the deterrent impact expected.

In an attempt to contextualize the above result, we take a closer look at respondents who reported coming into contact with the police because of their growing. Appendix A (table 5) examines characteristics that may impact the probability of coming into contact with the police (e.g. Bouchard and Nguyen, 2010). Results suggest that growers who come into contact with the police are more involved with cultivation than those who do not. Respondents who had police contacts started cultivation at a younger age, were more likely to rely on earnings from growing, were involved in larger sites (74 vs. 14 plants), and spent more time tending to their plants. Interestingly, they did not differ on their participation in other criminal activities or hard drug use. This suggests that cultivation-specific factors, such as size, may have played a more important role in their arrest than individual factors.

Second, our state punitiveness measure (minimum state penalty) for cultivation captures the minimum legislated penalty. Although this measure provides a baseline by which state punitiveness can be compared, some states' minimum legislated penalty comes with a caveat such as a minimum number of plants. As such, there are some limitations. First, a measure with a consistent baseline across states would be complementary to our measure in determining the rank order of state punitiveness. Second, prosecutorial and judicial discretion are not taken into account with our measure. A future line of inquiry might be to examine the relationship between sentences meted out and various outcomes of cannabis cultivation.

Third, our sample is very select and it is therefore not possible to generalize our findings to other groups of marijuana growers. Growers who are willing to respond to online surveys may

be selectively different from those who do not respond. Further, self-selection bias is likely to have implications on the internal validity of our results. Our sample consisted mostly of small home growers who were willing to participate in an anonymous online survey and this would most likely make our estimates of state sanctions downward bias. That is, the outcome variables, number of plants and co-offenders, are likely to limit the effect of the predictor variables because of the small home growers in the sample (see Winship and Mare, 1992). It would be informative to gather information through different sampling strategies and among growers with various motivations. In supplementary analyses, we considered how "commercial" a cultivation site was. The outcome was a factor score that consisted of the size of the site, the number of co-offenders, and the total earnings garnered from the site. Results were consistent with our co-offending models. It could very well be that purely commercial, large-scale growers do not respond to state punitiveness, and instead follow the forces of the market.

In sum, our study found some evidence that the severity of state sanctions reduces the size of cultivation sites among growers who reside in the state. We also found that growers who reside in states that have legalized marijuana are likely to participate in larger sites. However, we did not find support for a restrictive deterrent effect for the number of co-offenders, suggesting that different factors affect different decision points. We also found a positive association between police contacts and the size of the last cultivation site growers participated in and the number of co-offenders. Interestingly, we found that objective skill and subjective skill had positive and independent effects on the size of site.

The status of marijuana in the United States has never been so strongly debated. At the time of writing, two states (Colorado and Washington) have legalized small amounts of possession and Colorado allows growers to cultivate up to six plants for private personal use.

Early reports suggest that Colorado has garnered millions of dollars in tax revenue in the short amount of time since legalization (Healy, 2014) and as a result, several more states have been on record stating that they will consider similar legislation (Frosch, 2013). Our study suggests that growers respond to variations in policies, at least to a certain extent, and that many growers opt to restrict the scale of their activities, instead of desisting from the market altogether. Could this be used to frame policies (e.g, legal plant limits) in order to provide incentives for growers to settle for small-scale cultivation, and not move to large-scale commercial operations? The Australian experience certainly suggests potential for policies tolerating small-scale cultivation in a regime where commercial cultivation is still illegal (Barratt et al. 2005). It is too early to draw conclusions about the true costs and benefits of the Colorado and Washington State experience in allowing the cultivation of a small number of plants in a regulated regime. The one certainty is that research into the impact of these policy changes on the marijuana industry will be of crucial importance in having other states follow in their footsteps.

REFERENCES

Allison, P. (2002). *Missing Data*. Thousand Oaks: California: Sage Publications.

Anwar, S., & Loughran, T. A. (2011). Testing a bayesian learning theory of deterrence among serious juvenile offenders. *Criminology*, 49(3), 667-698.

Athey, N., Bouchard, M., Decorte, T., Frank, V. & Hakkarainen, P. (2013). Cannabis cultivation and detection: A comparative study of Belgium, Finland, and Denmark. *Drugs: Education, Prevention, Policy*, 20: 203-215.

Barratt, M.J, Bouchard, M, Decorte, T, Frank, V.A., Hakkarainen, P., Lenton, S., Malm, A., Nguyen, H. & Potter, G.R. (2012). Understanding global patterns of domestic cannabis cultivation. *Drugs and Alcohol Today*. 12(4), 213-221.

Barratt, M. J., Barratt, M. J., Chanteloup, F., Lenton, S., & Marsh, A. (2005). Cannabis law reform in Western Australia: An opportunity to test theories of marginal deterrence and legitimacy. *Drug and Alcohol Review*, 24(4), 321-330.

Beauregard, E., & Bouchard, M. (2010). Cleaning up your act: Forensic awareness as a detection avoidance strategy. *Journal of Criminal Justice*, 38(6), 1160-1166.

Beccaria, C. (1764). *On Crimes and Punishments*. London.

Bechara, A., Dolan, S., Denburg, N., Hindes, A., Anderson, S.W. & Nathan, P.E. (2001). Decision-making deficits, linked to a dysfunctional ventromedial prefrontal cortex, revealed in alcohol and stimulant abusers. *Neuropsychologia* 39: 376–389.

Bentham, J. (1789).*An Introduction to the Principles and Morals of Legislation*. London: T.Payne & Son.

Boire, R.G. (1996). *Marijuana law*. Berkeley, CA: Ronin Publishing

Bouchard, M. (2007). A capture-recapture model to estimate the size of criminal populations and the risks of detection in a marijuana cultivation industry. *Journal of Quantitative Criminology*, 23, 221-241.

Bouchard, M., & Nguyen, H. (2010). Is it who you know, or how many that counts? Criminal networks and cost avoidance in a sample of young offenders. *Justice Quarterly*, 27(1), 130-158.

Bouchard, M., Morselli, C. (2013). Opportunity structures of organized crime. In Paoli, L. (Ed). *Handbook of Organized Crime*. Oxford University Press, Oxford.

Bouchard, M., Ouellet, F. (2011). Is small beautiful? The link between risks and size in illegal drug markets. *Global Crime*, 12: 70-86.

Brezina, T., & Topalli, V. (2012). Criminal Self-Efficacy Exploring the Correlates and Consequences of a "Successful Criminal" Identity. *Criminal Justice and Behavior*, 39(8), 1042-1062.

Brownfield, D., Sorenson, A.M. & Thompson, K.D. (2001). Gang membership, race, and social class: A test of the group hazard and master status hypothesis. *Deviant Behavior*, 22: 73-89.

Caulkins, J. P., & MacCoun, R. (2003). Limited rationality and the limits of supply reduction. *Journal of Drug Issues*, 33(2), 433-464.

Caulkins, J., & Reuter, P. (1998). What price data tell us about drug markets. *Journal of Drug Issues*, 28, 593-612.

Cornish, D., & Clarke, R. (1986). Situational prevention, displacement of crime and rational choice theory. In *Situational Crime Prevention: From Theory into Practice*. London. HMSO.

Desroches, F.J. (2005). *The Crime That Pays: Drug Trafficking and Organized Crime in Canada*. Toronto: Canadian Scholar's Press Inc.

Drug Enforcement Administration. (2013). *DEA Programs: Cannabis Eradication.* Retrieved from: http://www.justice.gov/dea/ops/cannabis.shtml.

Eck, J. E. (1993). The threat of crime displacement. *Criminal Justice Abstracts*, 25(3), 527-546).

Erickson, M.L. (1973). Group violations and official delinquency: The group hazard hypothesis. *Criminology*, 11: 127-160.

Erickson, M.L. (1971). The group context of delinquent behavior. *Social Problems*, 19,114-129.

Feyerherm, W. (1980). The group hazard hypothesis: a reexamination. *Journal of Research in Crime and Delinquency*, 17 (1), 58-68.

Fishbein, D., Hyde, C., Eldreth, D., London, E. D., Matochik, J., Ernst, M. & Kimes, A. (2005). Cognitive performance and autonomic reactivity in abstinent drug abusers and nonusers. *Experimental and Clinical Psychopharmacology*, 13(1), 25.

Frosch, D. (2013, November 6). *Measures to Legalize Marijuana Are Passed*. The New York Times. Retrieved from http://www.nytimes.com.

Gallupe, O., Bouchard, M., & Caulkins, J. P. (2011). No change is a good change? Restrictive deterrence in illegal drug markets. *Journal of Criminal Justice*, 39(1), 81-89.

Gibbs, J. P. (1975). *Crime, Punishment, and Deterrence*. New York: Elsevier.

Hakkarainen, P. & Perala, J. (2011). With a little help from my friends-justifications of small-scale cannabis. In T. Decorte, G. Potter & M. Bouchard (eds.), World Wide Weed: Global Trends in Cannabis Cultivation and its Control (pp. 75-90). Surrey, England: Ashgate.

Healy, J. (2014, February 20). *Colorado Expects to Reap Tax Bonanza From Legal Marijuana Sales.* The New York Times. Retrieved from http://www.nytimes.com.

Hindelang, M.J. (1976). With a little help from their friends: Group participation in reported delinquent behavior. *The British Journal of Criminology*, 16(2), 109-125.

Hoffmann, D.E. & Weber, E. (2010). Medical marijuana and the law. *New England Journal of Medicine,* 362,1453-1457.

Hough, M., Warburton, H., Few, B., May, T., Man, L., Witton, J., et al. (2003). *A Growing Market: The Domestic Cultivation of Cannabis*. Layerthorpe, York: Joseph Rowntree Foundation.

Jacobs, B. A. (1996). Crack dealers and restrictive deterrence: Identifying Narcs. *Criminology*, 34(3), 409-431.

Jacques, S., & Allen, A. (2013). Bentham's sanction typology and restrictive deterrence: A study of young, suburban, middle-class drug dealers. *Journal of Drug Issues*, XX(X), 1–19

Kilmer, B., Caulkins, J. P., Pacula, R. L., MacCoun, R. J., & Reuter, P. H. (2010). *Altered State*? RAND Corporation.

Kleck, G., Sever, B., Li, S., & Gertz, M. (2005). The missing link in general deterrence research. *Criminology*, 43(3), 623-660.

Loughran, T. A., Paternoster, R., Piquero, A. R., & Fagan, J. (2013). "A good man always knows his limitations" The role of overconfidence in criminal offending. *Journal of Research in Crime and Delinquency*, 50(3), 327-358.

Maimon, D., Alper, M., Sobesto, B. & Cukier, M. (2014). Restrictive deterrent effects of a warning banner in an attacked computer system. *Criminology*, 52(1), 33-59.

Malm, A. (2006). Marihuana Cultivation in British Columbia: Utilizing spatial and social network analysis to inform evidence-based policy and planning. Unpublished PhD. Dissertation. Simon Fraser University.

Malm, A. E., Kinney, J. B., & Pollard, N. R. (2008). Social network and distance correlates of criminal associates involved in illicit drug production. *Security Journal*, 21(1), 77-94.

Malm, A., Nash, R., & Vickovic, S. (2011). Co-offending Networks in Cannabis Cultivation. In T. Decorte, G. Potter & M. Bouchard (eds.), World Wide Weed: Global Trends in Cannabis Cultivation and its Control (pp. 127-144). Surrey, England: Ashgate.

McCarthy, B. Hagan, J. & Cohen, L.E. (1998). Uncertainty, cooperation, and crime: Understanding the decision to co-offend. *Social Forces*, 77,155–76.

McGloin, J.M. & Nguyen, H. (2012). It was my idea: Considering the instigation of co-offending. *Criminology*, 50(2), 463-494.

Morash,, M. (1984). Establishment of a juvenile police record: The influence of individual and peer group characteristics. *Criminology*, 22(1): 97-111.

Nagin, D. S. (1998). Criminal deterrence research at the outset of the twenty-first century. *Crime & Justice*, 23, 1.

National Drug Intelligence Center. (2009). *Domestic Cannabis Cultivation Assessment 2009.* Retrieved from http://www.justice.gov/archive/ndic/pubs37/37035/indoor.htm.

National Organization for the Reform of Marijuana Laws. (2013). Retrieved from http://norml.org/.

Nguyen, H., & Bouchard, M. (2010). Patterns of youth participation in cannabis cultivation. *Journal of Drug Issues*, 40(2), 263-293.

Nguyen, H., & Bouchard, M. (2013). Need, connections, or competence? Criminal achievement among adolescent offenders. *Justice Quarterly*, 30(1), 44-83.

Nguyen, H., & McGloin, J.M. (2013). Does economic adversity breed criminal cooperation? Considering the motivation behind group crime. *Criminology*, 51(4), 833-870.

Paoli, L., Greenfield, V. & Reuter, P. (2009). *The World Heroin Market: Can Supply be Cut?* New York: Oxford University Press.

Paternoster, R. (1987). The deterrent effect of the perceived certainty and severity of punishment: A review of the evidence and issues. *Justice Quarterly*, 4(2), 173-217.

Paternoster, R. (1989). Decisions to participate in and desist from four types of common delinquency: Deterrence and the rational choice perspective. *Law and Society Review*, 23(1), 7-40.

Paternoster, R. (2010). How much do we really know about criminal deterrence? *The Journal of Criminal Law and Criminology*, 100(3), 765-824.

Piliavin, I., Gartner, R., Thornton, C., & Matsueda, R. L. (1986). Crime, deterrence, and rational choice. *American Sociological Review*, 51, 101-119.

Piquero, Alex R., David P. Farrington, and Alfred Blumstein. 2007. *Key Issues in Criminal Career Research: New Analyses of the Cambridge Study in Delinquent Development.* Cambridge, U.K.: Cambridge University Press.

Potter, G. R. (2010). *Weed, Need and Greed: A Study of Domestic Cannabis Cultivation*. Milespit Hill, London: Free Association Books.

Potter, G. R. (2011). Keeping down the weeds: Cannabis eradication in the developed world. In T. Decorte, G. Potter & M. Bouchard (eds.), *World Wide Weed: Global Trends in Cannabis Cultivation and its Control*, (pp. 257-271). Surrey, England: Ashgate.

Potter, G.R. and Chatwin, C. (2011), Researching cannabis markets online: some lessons from the virtual field. In J. Fountain, V.A. Frank and D.J. Korf (Eds.), *Markets, Methods and Messages. Dynamics in European Drug Research*, (pp. 69 – 84), Lengerich: Pabst Science Publishers.

Reuter, P .(1985). *The Organisation of Illegal Markets: An Economic Analysis*. Washington, D.C.: National Institute of Justice US Department of Justice.

Royston, P. (2005). Multiple imputation of missing values: update of ice. *Stata Journal*, 5(4), 527.

Saltzman, L., Paternoster, R., Waldo, G. P., & Chiricos, T. G. (1982). Deterrent and experiential effects: The problem of causal order in perceptual deterrence research. *Journal of Research in Crime and Delinquency*, 19(2), 172-189.

Schafer, J. L., & Graham, J. W. (2002). Missing data: our view of the state of the art. *Psychological Methods*, 7(2), 147.

Selke, W. L., & Andersson, S. A. (1992). A model for ranking the punitiveness of the states. *Journal of Quantitative Criminology*, 8(2), 217-232.

Sherman, L. W., Smith, D. A., Schmidt, J. D., & Rogan, D. P. (1992). Crime, punishment, and stake in conformity: Legal and informal control of domestic violence. *American Sociological Review*, 57, 680-690.

Tonry, M.H.(1998). *The Handbook of Crime & Punishment*. New York: Oxford University Press.

van Mastrigt, S.B., & Farrington, D.P. (2009). Co-offending, age, gender and crime type: Implications for criminal justice policy. *British Journal of Criminology*, 49, 552–73.

Weathington, B. L., Cunningham, C. J. & Pittenger, D. J. (2010). Research Methods for the Behavioral and Social Sciences. John Wiley & Sons.

Weisheit, R. A. (1992). *Domestic Marijuana: A Neglected Industry*. Westport: Greenwood Press.

Wilkins, C., Bhatta, K., & Casswell, S. (2002). The effectiveness of cannabis crop eradication operations in New Zealand. *Drug and Alcohol Review*, 21(4), 369-374.

Winship, C. & Mare, R.D. (1992). Models for sample selection bias. *Annual Review of Sociology*, 18, 327-350.

Table 1. Descriptive information of sample (non-imputed values)

Variable	Mean	Median	Standard Deviation	Min	Max
Number of plants	20.008	6	66.283	1	1000
Number of co-offenders	.760	0	1.123	0	10
Sanctions:					
State puntiveness (days)	1017.73	480	1563.769	30	7300
State puntiveness (log days)	6.241	6.173	1.149	3.401	8.895
Mandatory minimum?	.810	-	-	0	1
Medical marijuana?	.534	-	-	0	1
Individual experiences:					
Perceived certainty	2.744	2	2.251	0	10
Police contacts	.097	-	.297	0	1
Controls :					
Perceived skill	8.002	8.000	1.854	1	10
Experience (num of crops)	46.327	4	493.190	0	9001
Exp (log num of crops)	.841	.698	.585	0	3.954
Hard drug use	.335	-	-	0	1
Indoor	.802	-	-	0	1
Outdoor	.149	-	-	0	1
Both	.047	-	-	0	1
Age	31.884	28.000	12.128	18	70
White	.829	-	-	0	1
Male	.865	-	-	0	1
Market size (past month users)	9.865	9.730	2.157	6.720	15.610
Legal grower	.112	-	-	0	1

Figure 1. Number of marijuana plants
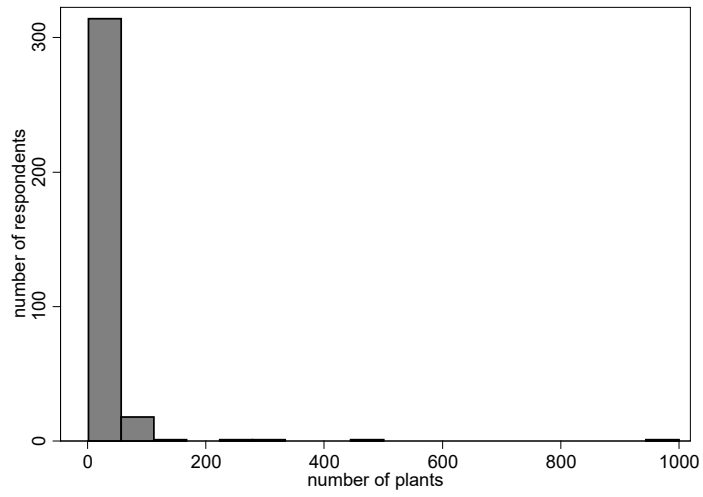
Figure 2. Number of co-offenders
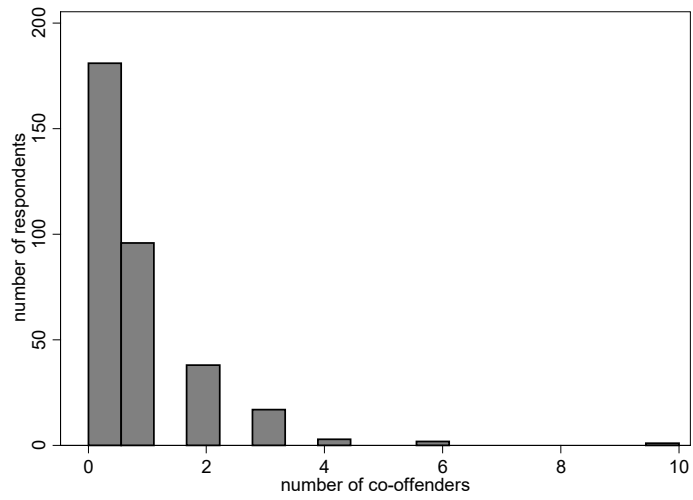
Table 2. Correlation matrix of variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Num plants	1.000																
2. Num co-offenders	0.109*	1.000															
3. State punitiveness	-0.039	0.099*	1.000														
4. Medical marijuana	0.054*	0.062*	0.426*	1.000													
5. Mandatory minimum	0.056*	-0.019	-0.126*	-0.118*	1.000												
6. Perceived certainty	0.092*	0.017	-0.132*	-0.213*	0.156*	1.000											
7. Police contact	0.267*	0.182*	0.052*	0.027	0.057*	0.042	1.000										
8. Perceived skill	0.218*	0.099*	0.067*	0.081*	-0.064*	-0.079*	0.215*	1.000									
9. Experience	0.225*	0.144*	0.009	0.066*	0.048*	0.022	0.257*	0.531*	1.000								
10. Hard drug use	-0.061*	0.094*	0.070*	-0.004	-0.008	0.064*	0.062*	-0.086*	-0.002	1.000							
11. Indoor	-0.137*	0.056*	0.095*	0.059*	-0.109*	-0.091*	-0.059*	0.090*	0.006	-0.006	1.000						
12. Both	0.216*	-0.068*	-0.014	0.004	0.004	-0.001	0.017	0.014	0.040	0.042	-0.454*	1.000					
13. Age	0.001	-0.024	0.013	0.079*	0.012	0.036	0.073*	0.183*	0.272*	-0.249*	-0.047*	-0.033	1.000				
14. White	0.021	0.005	-0.001	0.063*	-0.020	0.073*	0.096*	-0.010	0.058*	-0.014	0.001	0.060*	0.055*	1.000			
15. Male	0.042	0.001	-0.001	-0.070*	0.053*	-0.000	0.071*	0.016	0.042	-0.015	-0.066*	0.049*	-0.089*	-0.015	1.000		
16. Market size	0.023	0.050*	0.444*	0.772*	-0.105*	-0.228*	0.020	0.109*	0.071*	0.021	0.117*	-0.014	0.034	0.051*	-0.022	1.000	
17. Legal grower	0.017	-0.099*	0.106*	0.314*	-0.066*	-0.088*	0.008	0.100*	0.041	-0.014	0.154*	-0.081*	0.098*	-0.014	-0.113*	0.202*	1.000

* p< .05 imputed data

Table 3. Negative binomial regression predicting number of plants (n=337)

Variable	1 Coeff. (SE)	2 Coeff. (SE)	3 Coeff. (SE)	4 Coeff. (SE)	5 Coeff. (SE)	6 Coeff. (SE)
State penalties:						
State punitiveness (log)	-.114 (.061)	-	-	-	-	-.103 (.051)*
Medical marijuana	-	.369 (.139)**	-	-	-	.398 (.191)*
Mandatory minimum	-	-	.577 (.177)**	-	-	.194 (.143)
Individual experiences:						
Perceived certainty	-	-	-	.126 (.030)***	-	.013 (.025)
Police contacts	-	-	-	-	1.649 (.211)***	.914 (.192)***
Controls :						
Perceived skill	-	-	-	-	-	.158 (.036)***
Experience (log num of crops)	-	-	-	-	-	.875 (.107)***
Hard drug use	-	-	-	-	-	-.015 (.120)
Indoor vs. outdoor	-	-	-	-	-	-.194 (.159)
Both vs. outdoor	-	-	-	-	-	.722 (.275)**
Age	-	-	-	-	-	-.007 (.005)
White	-	-	-	-	-	-.034 (.146)
Male	-	-	-	-	-	-.068 (.165)
Market size	-	-	-	-	-	-.041 (.045)
Legal grower	-	-	-	-	-	.545 (.183)**
Chi-square test	3.52	6.90**	9.34**	17.65***	82.71***	270.03***
Pseudo R2	0.001	0.002	0.002	0.006	0.031	0.101
Constant	3.704 (.386)***	2.782(.102)***	2.505(.160)***	2.605(.108)***	2.651(.067)***	1.452(.587)*

*p<.05 **p<.01 ***p<.001

Imputed data

Table 4. Negative binomial regression predicting number of co-offenders (n=338)

Variable	1 Coeff. (SE)	2 Coeff. (SE)	3 Coeff. (SE)	4 Coeff. (SE)	5 Coeff. (SE)	6 Coeff. (SE)
Sanctions:						
State punitiveness (log)	.119(.066)	-	-	-	-	.081 (.074)
Medical marijuana	-	.187 (.154)	-	-	-	.310 (.241)
Mandatory minimum	-	-	-.082(.192)	-	-	-.116 (.190)
Individual experiences:						
Perceived certainty	-	-	-	.013(.033)	-	.018 (.034)
Police contacts	-	-	-	-	.700(.215)**	.548 (.224)*
Controls :						
Perceived skill	-	-	-	-	-	.041 (.049)
Experience (log num of crops)	-	-	-	-	-	.223 (.141)
Hard drug use	-	-	-	-	-	.237 (.161)
Indoor vs. outdoor	-	-	-	-	-	.127 (.223)
Both vs. outdoor	-	-	-	-	-	-.533 (.449)
Age	-	-	-	-	-	-.005 (.006)
White	-	-	-	-	-	-.095 (.206)
Male	-	-	-	-	-	-.112 (.221)
Market size	-	-	-	-	-	-.028 (.055)
Legal grower	-	-	-	-	-	-.825 (.298)**
Chi-square test	3.290	1.47	0.18	0.15	10.05**	31.84**
Pseudo R2	0.069	0.001	0.000	0.000	0.012	0.039
Constant	-1.032(.426)*	-.377(.115)	-.207(.172)	-.309(.120)	-.368(.081)	-1.007 (.763)

*p<.05 **p<.01 ***p<.001
Imputed data

Appendix A.Table 5 Comparison between police contacts

Variable	No police contacts (mean)	Police contacts (mean)	t-test (p value)
Risky activities:			
Participate in property offenses	.016	.030	0.573
Participate in violent offenses	.013	0.00	0.507
Hard drug use	.325	.424	0.255
Cultivation related factors:			
Age first grow	23.402	20.030	0.053
Mentor	.274	.363	0.284
Number of plants (last time)	14.174	73.757	0.000
Hours per week (last time)	10.777	17.709	0.001
Typical proportion of earnings from growing	8.700	24.343	0.000
Earnings from growing (last time)	2607.993	5979.31	0.222