Cannabis Cultivation and Detection: A Comparative Study of Belgium, Finland, and Denmark

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Abstract

Research on cannabis cultivation has identified several factors associated with a grower's likelihood of detection by law enforcement. However, these studies are difficult to compare, as they drew from different data sources and methods, and have focused on only one geographical location. This article revisits the issue of detection using a large sample of cannabis cultivators recruited in three countries: Belgium (n = 659), Denmark (n = 560), and Finland (n = 1,296). Respondents were recruited in the context of a self-reported online survey conducted successively in each country between 2006 and 2008. Multivariate analyses suggest several country-specific similarities and differences. Importantly, the Finnish growers reported being arrested significantly more often than Belgians or Danes. The probability that Finnish growers would be arrested increased with time spent growing, the size of the cultivation site, and when respondents did not work alone. In Denmark, the risks increased with the size of the cultivation-related network, but decreased when respondents started growing later in life. In Belgium, no cultivation-related characteristics were associated with detection. The results indicate that the risks of apprehension for cannabis cultivation are typically country-specific. These findings are discussed in the context of country specific policies in regards to cannabis.

Key words: cannabis; cannabis cultivation; arrest; detection; drug policy

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Introduction

Current perspectives regarding the control and policing of cannabis production are controversial, especially in light of discussions of a liberalization of cannabis policies in many Western countries. The backdrop to these discussions is the nearly ubiquitous nature of domestic cultivation which progressed in virtually every developed country worldwide over the past few decades (Decorte, Potter, & Bouchard, 2011). Responding to this process of globalization, Bouchard, Potter, and Decorte (2011) emphasized the need for comparative research in different geographical locations so that more decisive conclusions can be drawn and used to inform policy. They further argued that simply implementing a standardized policy would be inappropriate considering the amount of variability that exists between types of growers and environments.

Before envisioning alternatives, however, a thorough understanding of current policies is needed. Examining issues related to the detection of growers – from assessing the challenges associated with detection (Potter, 2011) to estimating the rate of detection (Bouchard, 2008; Wilkins, Bhatta, & Casswell, 2002) or understanding who gets detected (Bouchard & Nguyen, 2010) – is a first step in this direction. In an attempt to identify country-specific attributes and variables significantly related to detection, the current study revisits the link between domestic cannabis cultivation and arrest.[1] The study draws from the three existing surveys of cannabis growers in Europe at time of writing. Using a large sample of domestic (primarily) small-scale cannabis cultivators active in Belgium (n = 659), Denmark (n = 560), and Finland (n = 1,291),

the study examines the role of relevant variables identified from previous research and introduces additional measures thought to be influential.

Cannabis Cultivation and Detection

Before indoor-soil and indoor-hydroponic equipment was developed in the 1980s, cannabis cultivation occurred primarily outdoors (Bouchard, 2007; Toonen, Ribot, & Thissen, 2006). While cannabis is a particularly hardy crop, which has the ability to thrive in the most unfavorable climates, a grower may decide to use indoor or indoor-hydroponic techniques because the likelihood of being detected is higher for outdoor sites (Bouchard, 2007). In fact, whereas 19 to 37 percent of outdoor sites are detected by law enforcement in Quebec (Bouchard, 2007) and New Zealand (Wilkins et al., 2002), the same is true for less than 10 percent of indoor sites (Bouchard, 2007). However, despite having higher detection rates than indoor sites, outdoor grow sites result in an arrest less often (12-14% for outdoor vs. 26-95% for indoor), thus suggesting that the loss of one's crop(s) is the primary cost being incurred by growing outdoors (Bouchard, 2007; Bouchard & Nguyen, 2010; Potter, 2010). Size also matters. Bouchard (2007) showed that large outdoor sites are more visible and thus, more likely to be detected. The positive association was also noticed for indoor sites, although with much smaller detection rates.

Other factors found to be important include the amount of experience growers may have, and the size of their cultivation-related networks (Bouchard & Nguyen, 2010). For example, Bouchard and Nguyen (2010) found that the number of years spent growing cannabis was a significant predictor of arrest for adolescent growers. Because only adolescents were surveyed, the finding was attributed to the longer exposure to potential detection. It is unclear whether

those results would hold for adult populations, or other geographical locations where cannabis cultivation is less ubiquitous. The authors also found that size of cultivation-networks matter, but not always in the expected direction. While knowing many more adolescents involved in cultivation was a risk factor for detection, being embedded in an adult cultivation network was associated with reduced odds of arrest (Bouchard & Nguyen, 2010). The mentorship provided by older growers, and the more peripheral role occupied by adolescent growers in adult networks, were suggested by the authors as potential explanations for those findings.

An important limitation of prior research is the relative scarcity of geographical locations that have been examined. Although qualitative examinations of detection avoidance exist (e.g., Potter, 2011), individual factors associated with detection have only been analyzed in a specific rural region of Quebec where cannabis cultivation is ubiquitous (Bouchard & Nguyen, 2010). Policy contexts may also matter, something we turn to below.

Context: Cannabis market and policy in Belgium, Denmark, and Finland

Table 1 presents differences between the three countries under study in terms of cannabis market size and policy.[2] According to recent EMCDDA figures, 5.1, 5.5, and 3.6 percent of Belgium, Denmark, and Finland's surveyed population used cannabis in the preceding 12 months, respectively. Lacking information about the growers' cultivation techniques (e.g., indoor vs. outdoor growing) and the consumers' use (e.g., frequency, amount, etc.), which would make estimating the market size easier, we follow previous research and assume that on average users consume roughly 100 grams of cannabis per year (Bouchard, 2008; Pudney, Badillo, Bryan, Burton, Conti, & Iacovou, 2006). Generalizing the aforementioned percentages to the countries' entire population, we see that last year cannabis users in Belgium consumed far more

(~ 54,000 kg) than those in Denmark (~ 30,000 kg) and Finland (~ 19,000 kg). By taking the number of cannabis-related seizures as a portion of the total drug offenses, the Belgian market again seems most mature with 53.9 percent of its drug offenses being cannabis seizures—in comparison to Denmark (47.8%) and Finland (34.1%).[3] The three markets also demonstrate differences regarding the type and quantity of cannabis production. From the seizure data, herbal cannabis clearly emerges as the preference in Belgium, while the same is true of resin in Denmark; yet, in Finland, there appears to be an even split between the two.

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TABLE 1

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From a policy standpoint, Belgium appears to be the least repressive of the three countries. This is evident by the changes in legislation that occurred in 2003 and 2004, which made the possession of three grams by adults and the cultivation of one female plant for personal use tolerable (not meaning 'decriminalized') offenses (Decorte, 2007; EMCDDA, 2011a). This legislative shift separated cannabis from other drugs and granted prosecution more discretion regarding the enforcement of cannabis-related offenses (Decorte, 2007; EMCDDA, 2011a).

Alternatively, Denmark's stance against cannabis became more repressive in the late 1990s when the government enhanced legislation (Frank, 2008), which "focus[ed] on use- and prevalence reduction by applying a zero-tolerance approach to the enforcement of the law" (Møller, 2008, p. 122). The shift in policy prompted deliberate attacks on areas and entities known for having higher rates of cannabis distribution (Asmussen & Moesby-Johansen, 2004; Asmussen, 2007; Møller, 2008). In 2004, the attorney general circular that had depenalised possession of up to 10 grams of cannabis since 1969 was removed, and changes to legislation

made possession of any amount of cannabis punishable by a minimum of a fine. Additional changes included harsher penalties for distributing to minors and possession of harder drugs (Frank, 2008, 2009). The increased severity of cannabis legislation that occurred at this time (2003-2004) likely produced the high number of misdemeanors that occurred between 2004 and 2006 (Møller, 2010).

Finally, Finland's stance against cannabis seems the most repressive. As of 2004, Finland is one of the only EU countries to consider personal use of cannabis a criminal offense (EMCDDA, 2005). In fact, using, possessing, and trying to acquire drugs in a lesser amount are considered drug-user offenses and carry a sentence ranging from a fine to six months imprisonment (Kainulainen, 2006). While the legislation in Finland demonstrates its hard stance against drugs, the essential point is that the restrictive Finnish policies are actually implemented strictly (Kainulainen, 2009). For example, a recent study showed that over 70 percent of cannabis-related cases, mostly containing drug user offences, prosecuted in district courts are sanctioned with a fine, while imprisonment—usually conditional (suspended) imprisonment—is the second most common sanction. It was also found that courts rarely waive the implemented punishment (Kainulainen, 2006).

The differences in policies as well as those found in the relative maturity of the cannabis industries found in Belgium, Denmark, and Finland serve as the backdrop to the current study, which compares the factors associated with detection in samples of growers recruited in all three countries.

Methods

Research Procedure and Sample

Current and former cannabis cultivators completed a self-report online survey in three countries: Belgium (n = 659), Denmark (n = 560), and Finland (n = 1,296). The questions used to construct the current survey were developed in Belgium in an initial phase of research that used a semi-structured questionnaire and face-to-face interviews with cannabis cultivators. The Belgian researchers used findings from the interviews to create a 54-item survey, which asked participants about their demographics, cultivation techniques, reasons for and concerns about growing cannabis, and involvement in other risky/criminal behavior. The survey was first posted online in Belgium where data collection transpired from May to August, 2006 then, after minor adaptations to the local situation, it was posted online in Denmark and Finland where data was collected from June to November, 2008 and May to June, 2009, respectively. The survey was also posted with a description of the study's purpose and the rights guaranteed to participants.

Both online and offline techniques were used to recruit participants. Decorte (2010a) describes these methods (for Belgium) and data sensitivity analyses in more detail (pp. 346-350). In Belgium the recruitment process included sending emails to staff and students at the University of Ghent (roughly 35,000) and advertising the survey (www.ugent.be/re/strafrecht-criminologie/en/research/isd) in three Flemish newspapers, specialized Internet sites, the well-known *Highlife* magazine, and by distributing more than 5,000 flyers. Additionally, interviews were conducted with the lead investigator, Tom Decorte, and broadcasted on radio and television stations in Belgium. In Finland, a variation of Decorte's survey was provided through Webropol and made accessible through the National Institute for Health and Wellfare Webpage

(www.thl.fi/kukka). In Denmark, a similar edition of the survey was provided using SurveyXact and made available through the Centre for Alcohol and Drug Research Web page (www.crf.au.dk). In Finland and Denmark, participants were recruited by passing out flyers to cannabis using populations at major events and educational institutions, and through specialized cannabis websites (Hakkarainen, Frank, Perälä, & Dahl, 2011). Additionally, interviews were conducted with the lead investigator (i.e., Decorte) and broadcasted on radio and television stations. This also happened in Denmark, media coverage gave lots of respondents.

Placing the survey online provided the researchers with an opportunity to reach a hidden population that may have concerns about revealing its identity, given the deviant nature of cannabis cultivation and, to a lesser extent, cannabis use. However, despite its advantages two methodological limitations were identified during the data collection and coding phases. First, because advertisement for the survey focused on specialty websites and discussion boards, potential participants were able to discuss the survey with one another. While creating dialogue in online forums can positively affect participant involvement by promoting the study (Barratt & Lenton, 2010) and increasing group solidarity and identity through self-disclosure (Galegher, Sproull, & Kisler, 1998), Hakkarainen et al. (2011) also note that it provides pessimists with an opportunity to deter other potential participants. Second, the self-report online survey might have produced biases from repeat responses by the same participants. Although the potential for repeat responses is an inherent limitation of online methodologies (e.g., participants can avoid issues of IP address tracking by using multiple computers or employing one of many available IP anonymizers), the researchers tried to mitigate this possibility during the data-coding phase. Decorte (2010a) checked the IP addresses for Belgian respondents, but due to the sensitive and incriminating nature of the study the IP addresses could not be collected and reviewed in Finland

and Denmark (Hakkarainen et al., 2011). Nevertheless, it is likely that the extensive and time-consuming nature of the survey deterred most participants from completing the survey multiple times (Hakkarainen et al., 2011).

Variables

Dependent Variable

To measure risk of arrest/detection, participants were asked 'have you ever been arrested for cannabis cultivation?' with a dichotomous and mutually exclusive (Yes/No) response option.

Independent Variables

The study includes 10 independent variables selected from prior studies on cultivation detection (e.g., Bouchard, 2007; Bouchard & Nguyen, 2010), and classified in one of four ways: 'growing experience,' 'age started growing,' 'growing techniques and network,' or 'importance of reason to grow'. The following section describes each variable and their response options.

Growing experience.

Participants were asked about the number of harvests they had completed prior to taking the survey. Response options included '0-5 harvests' (reference category), '6-10 harvests,' and '11+ harvests'. The second measure of experience regards the growers' success after completing their first harvest. Participants were asked, 'how many times have you experimented unsuccessfully before your first successful harvest?' and responses could have included 'I succeeded my first time (reference group),' or 'I was not successful my first time'.

Age started growing.

This variable asked participants what their age was at the time of their first harvest. Responses were 'younger than 18,' (reference group), '18-25,' and '26+'.

Growing techniques and network.

Participants were asked to describe their frequency of involvement in the growing process in one of three ways: 'Daily,' 'Not daily, but more than once a week,' or 'Once a week or less' (reference group). Next, participants indicated the type of grow site they use. Three options were available (Outdoor, Indoor, and Greenhouse) and they were not considered mutually exclusive. Thus, participants could have indicated using none, all three, or any combination of the three. Few respondents reported using more than one method, and exploratory analyses showed that doing so was not found to be associated with detection. The number of plants grown was included as the third cultivation measure because of its relevance to the risk of arrest and detection in previous research. Responses could have included '1-5 plants' (reference group), '6-20 plants,' or '21+ plants'. Regarding the network measures, we introduce a variable that asked participants whether they grow alone. The response option was dichotomous—they grow/grew either alone (reference group) or they did not. The second network measure addresses the number of other growers known. Possible response options included '0-5 growers,' (reference group) '6-10 growers,' or '11+ growers'.

Importance of reason to grow.

The final two independent variables are the 'Importance of growing for personal use' and the 'Importance of growing to give to friends'. Both variables were coded on a 5-point *Likert* scale ranging from 'Very unimportant' to 'Very important'. Prior to analysis, the variable was dichotomized so that growers who felt it was 'very important' or 'important' were coded

together and growers who felt it is 'very unimportant,' 'unimportant' or 'neither important or unimportant' (reference group) were coded together.

Control Variables

We incorporate four control variables. These include the different countries (Belgium, Denmark, and Finland), gender (female = reference group), living situation (living alone vs. not living alone) where 'living alone' is the reference, and age of first cannabis use. Age of first cannabis use was coded as 'younger than 16' (reference category), '16-17,' and '18+'. Differences between the countries were acquired by running the model two times with different reference categories.[4]

Analytic Approach

The study included four analyses. First, missing data analysis and multiple imputations were performed to generate values for missing data points. Second, bivariate chi-square analyses and frequency distributions were generated to provide statistics about each of the variables in relation to arrest. Third, four multivariate binary logistic regression models – one predicting detection for each country individually and a general model including all growers (n = 2,515)— were used to identify the best predictors of arrest for the countries specifically and for all growers more broadly. Lastly, the general model (n = 2,515) was analyzed again with all significant interaction effects included.

Missing Data

Multivariate analyses indicated a substantial proportion of the sample would be lost by deleting cases with missing values. Therefore, multiple imputation (MI) models were constructed to

replace the missing values. Missing data departed from the assumption of "missing completely at random" (MCAR), and a further analysis of missing patterns suggested that the data are not monotone missing either. As a result, it was necessary to use a Markov Chain Monte Carlo (MCMC) procedure in order to obtain a monotone missing pattern (Horton & Lipsitz, 2001, p. 264).[5] Subsequently, variables containing missing data were imputed using regression techniques.[6] In total, five imputations were computed using the MCMC procedure and an additional one using regression techniques.[7] Once the imputation process terminated, five complete data sets were generated and analyzed using traditional statistical analyses.[8]

Results

Table 2 presents frequency distribution and chi-square indices. First, we find that 12.0 percent of all respondents had been arrested. Country-specific analyses show that Finns (19.4%) reported being arrested more often than Danes (5.2%) and Belgians (3.2%). Age at first harvest was found to be significantly associated with arrest (χ^2 (n = 2,293) = 7.02, $p < .05$), with younger growers being more likely to report having been arrested. In fact, the largest proportion of growers that had been arrested in our sample was between the ages of 18 and 25 and started using cannabis between the ages of 16 and 17.

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TABLE 2

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Growing technique and network measures were also significantly associated with arrest. The amount of time spent growing cannabis was found to be a positive predictor of arrest, with

the largest disparity in arrest rates occurring between those that grew on a daily basis and those who did not (16.7% vs. 9.1%). Site size also had an association to arrest. Growers that managed commercial-level sites reported being arrested twice as often as growers with smaller sites (22.1% vs. 11.1%). For site locations, we found a significant association for indoor sites only, but the arrest rates were relatively similar for all three. Regarding network measures, cooperative growing was not associated with the risk of apprehension, but cannabis network size was. Specifically, when respondents knew 11+ growers their arrest rate was higher than when they knew fewer than 11 (16.7% vs. 9.1%).

Multivariate Analyses

Table 3 presents findings from the country specific logistic regression models. The entire sample (n = 2,515) was analyzed first (Table 4) while the remaining three focused on individual countries. Results indicate what the bivariate analysis alluded to: Belgians are the least likely to be arrested and Finns are the most likely. Comparatively, Finns are 2.20 (1.71-2.83, $p < .001$) times more likely than Belgians and 2.45 (1.92-3.11, $p < .001$) times more likely than Danes to be arrested. Each of the control variables showed significance. Notably, females (OR = .76, .61-.95, $p < .05$), growers living alone (OR = .83, .72-.96, $p < .05$), and growers that started using cannabis between the ages of 16 and 17 (OR = 1.25, 1.04-1.51, $p < .05$) were all significantly more likely to have been arrested than the reference categories. Cultivation experience was significant when we compared growers who failed their first time to those who were successful (OR = 1.29, 1.11-1.50, $p < .001$) and those who completed 11+ harvests to those that completed 5 or fewer (OR = 1.46, 1.13-1.87, $p < .01$). Additionally, we found that site size was significant when growers cultivated 21+ plants (1.80, 1.38-2.37, $p < .001$). The only network measure that significantly increased a grower's probability of arrest was network size; when respondents knew

11+ growers they were 79.0 percent more likely to have been arrested (1.48-2.18, p < .001). Finally, growing cannabis to support personal use was the only motive that affected the likelihood of arrest.

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TABLE 3

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Country-specific analyses (Table 3) indicate several differences. For example, gender and living situation remained significantly associated with arrest for Finland only. 'First use of cannabis' showed that starting between the ages of 16 and 17 increased the risk of arrest for Finland (OR = 1.35, 1.09-1.66, $p < .01$), but starting to use cannabis after the age of 18 was now significant for all three countries. Thus, while starting cannabis use during adulthood, rather than adolescence, increased the probability of arrest for Belgians (OR = 2.83, 1.06-7.54, $p < .05$) and Danes (OR = 2.30, 1.12-4.71, $p < .05$), it reduced the probability for Finns (OR = .72, .56-.94, $p < .05$).

The two measures of experience remained significant for Finland when country-specific analyses were performed. Whereas unsuccessfully completing the first harvest did not have an effect on the likelihood of arrest for Belgians and Danes, it increased Finnish growers' likelihood of arrest by 41.0 percent (1.17-1.71, $p < .001$). While a respondent's success following the first harvest provided useful information about Finns only, the growers' experience completing multiple harvests better predicted arrest for Danish and Finnish growers. On par with model 1, both Danish and Finnish growers had a higher likelihood of reporting having been arrested when they had completed 11+ harvests – most probably simply the effect of time.

Growing technique and network measures also showed variability when countries were analyzed separately. First, whereas not growing alone failed to show significance in the general model, it now emerges as a good predictor of arrest in Finland, showing that the decision to not grow alone increased the probability of arrest. Second, Finnish (OR = 1.73, .1.37-2.17, $p < .05$) and Danish (OR = 2.37, 1.15-4.86, $p < .05$) growers were more likely to be apprehended when they knew more (11+) growers. Third, the size of the cultivation site remained significant in Denmark and Finland. When Finnish growers cultivated 21+ plants, they were more likely to be arrested than when they cultivated between 1 and 5. Note that the odds ratio was higher in Denmark (OR = 3.76, 1.99-7.10, $p < .001$) when respondents grew 21+ plants. Finally, location did not appear to play a role in the general model, but greenhouse growing emerged as a good predictor of risk reduction in Denmark (OR = .46, .22-.97, $p < .05$). Finally, while the motives to grow were not found to be associated with detection in Belgium and Denmark, it was found that Finnish growers who found that growing for personal was "important" had a higher likelihood of having been arrested, compared to others.

In the final analysis, we created interaction effects where it was suspected that the specific pattern in one country was affecting the general model more than the other two. Each interaction effect was tested separately and only significant interactions were retained for the final model. Table 4 shows the general model before and after adding the significant interaction effects. Notably, their inclusion enhanced model fit on every measure and changed several findings from the general model. For instance, the onset of cannabis use at 16-17 loses significance after inclusion of the Finland specific interaction terms. The effect of later onset (18+) on detection for Finland is now illustrated in table 4. Similarly, when the interaction between success of first harvest and Finland was included, the main effect again loses its

significance, confirming that Finland was the main driver of the general effect. Finally, the model including interaction terms illustrates the Denmark specific finding that medium-size cultivation sites (6-20 plants) decrease the likelihood of detection compared to smaller ones. The interaction term model provides the better fit to the data, especially given the differential sample sizes, and country-specific patterns noticed in Table 3.

Discussion

The different approaches to cannabis control implemented in each of the three countries provide a unique opportunity to assess the effects of drug policy in practice. For example, Finland is one of the few countries in the EU unwilling to decriminalize cannabis use, despite the fact that many Finns use and cultivate it (EMCDDA, 2005; Hakkarainen et al., 2011; Hakkarainen & Perälä, 2011). Denmark's relatively harsh stance against cannabis has produced a number of undesirable effects as well. Notably, Møller (2008) recognized that the cannabis market in Denmark would respond to changing police tactics through a number of processes (i.e., replacement, displacement, violence/crime and restructuring). Thus, a pertinent question for growers interested in detection-avoidance and legislatures interested in cannabis control is *what factors are likely to increase the probability of apprehension*?

At its most general level, the current study finds that the factors associated with detection are country-specific. For example, unsuccessfully completing the first harvest increased the probability of arrest in our general model, but country-specific analyses and interaction effects showed that Finnish growers were the only ones affected by this circumstance. Similarly, whether a respondent cultivated alone or with others was not found to be a good predictor when we examined respondents from all three countries simultaneously, but Finnish growers who grew with others as opposed to growing alone demonstrated a higher probability of arrest when

assessed independently. This study's findings failed to establish any significance regarding location, except for the use of a greenhouse in Denmark, which significantly reduced the probability of arrest. This is an interesting finding, especially in light of the opposite findings reported by Bouchard and Nguyen (2010) for adolescent growers in Quebec. The difference in the age of the samples may be a key factor, as none of the adolescent growers in Quebec were expected to own the indoor place in which they were working. The adult Danish respondents who grew in a greenhouse may have been able to invest in detection-avoidance techniques, especially given the typically larger size of their operation. The existence of "enclaves" where growers seem to be systematically protected from detection despite being involved in operations which normally carry higher risks of detection is both an empirical challenge to uncover, and a fruitful area for future research.

Beyond the factors associated with detection in our sample, the finding that Finnish growers in this sample were three to six times more likely to have reported being arrested requires more attention. Although our study aims are too modest to be able to test those hypotheses with any certainty, we believe there are three potential reasons explaining the large difference in the rates found for Finnish respondents compared to others. First, Finnish policy would be more repressive than the other two countries. Although the official numbers presented in Table 1 do not appear to show anything remarkable from a policy standpoint, it could be the case that the population of growers in Finland is small enough that those arrests fall on a relatively smaller pool of active growers. The use of capture-recapture methods on arrest data could help answer this question (Bouchard, 2007). In any case, qualitatively, Finnish policy does appear to be more repressive than in the two other countries, something that hasn't altered the *general* trend of a rapidly expanding cannabis industry in Finland (it could have influenced the

shape of the *specific* trend, something that is hard to verify). It is unlikely, however, to be so much more repressive than the other two countries that policy, alone, explains the gap in arrest rates. Second, the comparatively high rate of arrest found in the Finnish sample would be the result of sampling biases. That is, the difference lies in the composition of the three samples, where the sampling strategy used for the Finnish survey would have been more likely to attract growers who have been arrested. There are some indications that the Finnish sample is, in some respects, significantly different than the other two (younger, more inexperienced, embedded in larger networks, and involved in smaller sized operations, see Appendix), though it is impossible to know if any of the samples are representative of the growers in their respective countries in the first place. A different sampling strategy in Finland could also have created a situation like this, where, somehow, arrested growers in Finland were that much more likely to hear about, and fill in the survey. Although the recruitment strategies cannot be exactly similar and have been adapted to the situation found in each country, nothing points towards a specific aspect that would have favored the recruitment of arrested growers in Finland compared to other countries. Instead, we feel that a third explanation, combining the first two, is the most plausible story. According to that scenario, the presence of higher baseline arrest rates in Finland created an additional incentive for arrested growers to participate in the survey. The fact that those growers are relatively young and inexperienced in the first place makes them ideal candidates to be found in online cannabis forums. One thing that points in this direction is the mere size of the Finnish sample: 1,296 respondents, more than both the Belgian and Danish samples combined. This is so despite the relatively smaller cannabis market found in Finland compared to others (Table 1). The fact that those novice growers were detected early may have increased their motivations to

participate in such a survey, exacerbating an initial discrepancy between Finland and the other countries.

Limitations

The current study discusses a number of strengths provided by the data, but there are limitations that must be acknowledged as well. First, missing values were observed for a number of variables. While we were able to perform MI processes for nearly every variable with missing values, one desired control variable (Age) had only seven percent of the responses for Belgian growers, thus performing MIs was not possible. Second, because data were collected in different countries it is also possible that the recruited samples are very different, which may be an explanation for some country-specific findings. Third, the study acknowledges the limitations inherent to self-report and online methodologies. Although the original authors controlled for many of these limitations during the data-coding phase, there may still be methodological biases from each of the three countries (e.g., repeat responses).

Finally, and perhaps most importantly, the study design cannot uncover the temporal ordering of detection in relation to many of the important predictor variables used in this study.[9] The issue arises because we use a lifetime measure of detection, while at the same time considering what growers "currently" or "most commonly" do. The possibility exist, for example, that growers were detected in time 1, switched methods after detection, making the association between their current method of choice and detection spurious. The same could be said of time spent growing, or size of the cultivation site. The limitation cannot be overcome in the current design, something we hope to address in future research on the topic. However, the limited prior research that looked into the dynamics of change in cultivation careers did not

identify large within-individual changes (Bouchard, 2008; Decorte et al., 2011), especially with the population targeted in online surveys. Growers tend to start small and stay small (Hammersvik, Sandberg, & Pedersen, 2012), as is the case with many businesses – illegal or otherwise (see also Bouchard & Ouellet, 2011). As for methods, of 20 interviewed growers, Bouchard (2008) noted that four (20%) used both indoor and outdoor methods at some point in their careers, and most did so simultaneously (outdoor in the summer months, indoor in the other seasons). The likelihood of growers switching methods is small enough to conjecture that the probability of both 1) a switch in methods and 2) a detection not occurring with the current method of choice occurring is also small enough not to affect the substantive findings presented here.

Conclusion

From this study, we find that the best predictors of arrest are country-specific. It may be the case that within the countries we have identified three different types of growers. However, it may also be possible that the differences between countries are due to the disparate drug policies being implemented, which seems apparent considering the highest arrest rate occurs in the country with the most repressive policies (i.e., Finland) and the lowest arrest rate occurs in the country with the most liberal policies (i.e., Belgium). Despite these differences in drug policy and control, the international trend in domestic small-scale cannabis cultivation has continued to mature. For example, albeit having the most restrictive policies, there is strong evidence to suggest that Finland's domestic production of cannabis is increasing and that countries such as Belgium are achieving self-sufficient domestic production (Decorte, 2010b; Hakkarainen et al., 2011; Hakkarainen, Perälä, & Metso, 2011).

These findings also suggest an adaptive element in Denmark, where growers are more efficient at managing larger sites, while maintaining lower arrest rates than what would be expected considering the government's approach to cannabis control. Although, it is likely that, in practice, these repressive policies are implemented with more lenience for small-scale cultivation and personal use. Nevertheless, as a first attempt at identifying differences and similarities in predicting arrest between countries, this study confirms the basic premise discussed in Decorte et al. (2011)—that, while reaching omnipresence, the approach to cannabis cultivation and its control is not consistent across the globe. The findings identified in this study highlight the importance of considering national and international differences, which should be taken into consideration when discussing and developing cannabis control policies in the future.

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Table 1. Country-specific Cannabis Trends and Policy

	Belgium (2008)	Denmark (2008)	Finland (2006)
Population[a]	10,666,866	5,475,791	5,300,484
% that used cannabis in past 12 months[b]	5.1%	5.5%	3.6%
# of drug offences[c]	40,357	18,692	14,286
# of cannabis seizures (% of drug offences)[d]	21,752 (53.9%)	8,927 (47.8%)	4,868 (34.1%)
# of seizures (herbal)[e]	16,831 (41.7%)	562 (3.0%)	2,269 (15.9%)
Weight in kg (herbal)[f]	4,891 kg	171 kg	33 kg
# of resin seizures[g]	4,921 (12.2%)	8,365 (44.8%)	2,599 (18.2%)
Weight in kg (resin)[h]	1,529	2,914	283
Annual weight (kg) consumed by past year users[i]	54,401.0	30,116.9	19,081.7

[a] Population estimates obtained from Eurostat (2012). [b] Belgium (age: 15-64, n = 6,792; EMCDDA, 2011b); Denmark (age 16-64, n = 3,408; EMCDDA, 2010); Finland (age 15-64, n = 2,802; Hakkarainen & Metso, 2007). [c] EMCDDA (2011c). [d] Computed as follows: # of seizures (herbal) + # of seizures (resin). [e] EMCDDA (2011d). [f] EMCDDA (2011e). [g] EMCDDA (2011f). [h] EMCDDA (2011g). [i] Computed as follows: $= (Population * \%\ that\ used\ cannabis\ in\ past\ 12\ months) * 0.1kg\ (i.e., 100g)$.

Table 2. Frequency Distributions and Bivariate Analyses

	Complete Sample		Arrested		
Variables	N	# Reporting Arrest	Yes	Comparative Group	χ^2
Overall arrest rate	2,356		12.0(12.4)		
Country	2,515	2,356			122.08***(640.62***)
Belgium			3.2(4.4)	15.1(15.3)	
Denmark			5.2(5.2)	14.0(14.5)	
Finland			19.4(19.7)	4.1(4.7)	
Gender (Male)	2,385	2,345	12.3(12.1)	16.3(15.9)	2.75(12.82***)
Age	1,898	1,863			6.71*
<25			13.9	16.0	
26-35			18.1	13.5	
36+			12.6	15.4	
First use of Cannabis	2,348	2,299			7.38*(34.84***)
<16			11.2(11.2)	13.4(13.2)	
16-17			15.3(14.8)	11.2(11.2)	
18+			11.2(11.2)	13.2(13.0)	
Living situation—I live alone	2,243	2,215	16.7(16.1)	10.8(10.5)	15.37***(81.31***)
Growing Experience					
Number of harvests	2,282	2,205			55.06***(305.82***)
0-5 harvests			9.0(9.3)	19.7(20.2)	
6-10 Harvest			16.6(17.5)	11.2(11.5)	
11+ Harvests			22.9(23.4)	10.2(10.8)	
Successful first harvest	2,200	2,079	11.7(11.3)	15.7(15.2)	7.36**(38.20***)
Age started growing	2,421	2,293			7.02*(34.43***)
<18			11.6(11.9)	12.7(12.6)	
18-25			13.7(13.7)	10.6(10.7)	
26+			9.1(8.9)	13.1(13.1)	
Growing Techniques and Network					
Time spent on the growing process	2,379	2,273			34.53***(177.52***)
Once a week or less			5.2(5.9)	13.3(13.3)	
More than once a week			10.0(10.0)	14.5(14.6)	
Daily			16.7(16.7)	9.1(9.2)	
Do you grow alone?—Alone	1,902	1,794	10.5(12.79)	9.1(11.22)	.48(4.85*)
Number of growers known	2,258	2,227			159.91***(850.60***)
0-5 growers			6.6(6.5)	21.4(20.8)	
6-10 growers			14.0(13.8)	12.6(12.1)	
11+ growers			29.0(29.0)	8.6(8.5)	
Location					
Outdoor	2,515	2,356	11.5(11.8)	12.5(13.0)	.93(4.26*)
Indoor	2,515	2,356	8.3(9.0)	13.4(13.7)	8.95**(50.85***)
Greenhouse	2,515	2,356	9.5(9.9)	12.3(12.7)	1.05(7.90**)
Number of plants grown	2,383	2,301			28.61***(148.80***)
1-5 plants			10.5(10.5)	16.1(15.9)	
6-20 plants			13.4(13.2)	12.2(12.2)	
21+ plants			22.1(22.2)	11.1(11.3)	
Reason to Start Growing					
For personal use	2,459	2,325	11.9(12.0)	14.3(14.8)	2.95┼(11.29***)
To give to friends	2,421	2,296	12.9(12.7)	12.1(12.4)	.04(.19)

Note: 'Yes' indicates the percentage of people who reported being arrested from the group identified in the rows. 'Comparative group' represents the percentage of people who were arrested from the remaining categories. Numbers outside parentheses indicate results for unimputed data; results inside parentheses were obtained after the imputation process (n = 12,575). 'Age' is not included in the chi square analysis after MI, because only 7% of participants reported their age in Belgium.

┼ p < .10. * p < .05. ** p < .01. ***p <.001.

Table 3. Logistic Regressions—Country Specific.

	Belgium (n = 659)	Denmark (n = 560)	Finland (n = 1,296)
Variable	OR(CL)	OR(CL)	OR(CL)
Gender (female=0)	2.07(.70,6.13)	.82(.42,1.57)	.70(.54,.93)*
Living situation (I live alone=0)	.59(.34,1.05)┼	.95(.59,1.53)┼	.83(.71,.98)*
First use of Cannabis (<16=0)			
16-17	.41(.16,1.07)┼	1.09(.58,2.04)	1.35(1.09,1.66)**
18+	2.83(1.06,7.54)*	2.30(1.12,4.71)*	.72(.56,.94)*
Growing Experience			
# of harvests (0-5 harvests=0)			
6-10 Harvests	.32(.07,1.48)	.91(.40,2.08)	1.15(.86,1.55)
11+ Harvests	2.38(.77,7.40)	1.96(1.01,3.81)*	1.47(1.08,2.00)*
Successful harvest (1st time=0)	.88(.51,1.49)	.95(.59,1.53)	1.41(1.17,1.71)***
Age started growing (<18=0)			
18-25	1.17(.60,2.31)	1.27(.69,2.33)	1.12(.88,1.42)
26+	.89(.32,2.46)	.50(.23,1.10)┼	1.19(.82,1.73)
Growing Techniques & Network			
Time spent growing (1≥ week=0)			
More than once a week	1.00(.44,2.30)	1.04(.56,1.93)	.95(.67,1.34)
Daily	1.27(.53,3.05)	.96(.59,1.53)	1.39(.98,1.97)┼
Grow alone (yes=0)	.69(.31,1.50)	1.14(.57,2.29)	1.42(1.15,1.75)**
# of growers known (0-5=0)			
6-10 growers	1.35(.63,2.90)	.44(.16,1.19)	1.02(.86,1.20)
11+ growers	1.29(.46,3.62)	2.37(1.15,4.86)*	1.73(1.37,2.17)*
Location (no=0)[b]			
Outdoor	1.11(.66,1.89)	1.09(.67,1.77)	1.02(.79,1.32)
Indoor	1.52(.88,2.64)	1.04(.60,1.80)	.97(.76,1.25)
Greenhouse	1.13(.59,2.19)	.46(.22,.97)*	.79(.54,1.15)
# of plants grown (1-5 plants=0)			
6-20 plants	1.02(.50,2.09)	.44(.20,.96)*	1.07(.81,1.41)
21+ plants	1.86(.76,4.54)	3.76(1.99,7.10)***	1.41(.98,2.03)┼
Importance of reason to start (Unimportant=0)			
For personal use	.72(.38,1.35)	1.55(.51,4.76)	1.31(1.07,1.62)*
To give to friends	1.09(.50,2.35)	.90(.57,1.41)	1.14(.96,1.35)
Model Fit	**Belgium**	**Denmark**	**Finland**
-2LL	174.27	179.29	1110.89
Hosmer and Lemeshow(p) (df = 8)	4.91(.77)	7.34(.50)	9.21(.33)
AUC & (Max-rescaled R^2)	.80(17.57%)	.86(27.24%)	.75(20.56%)

Note: Because PROC MIANALYZE does not provide aggregated model fit indices, the most conservative imputed data set fit statistics are reported.

[a]Reference groups are identified in parentheses. [b] Locations are not mutually exclusive.

┼ p < .10. * p < .05. ** p < .01. *** p < .001.

Table 4. Logistic Regressions—All Three Countries with Interaction Effects

Variable	All 3 Countries (n = 2,515) OR(CL)	All 3 Countries with Interaction Terms (n =2,515) OR(CL)
Country (Belgium=0)		
Denmark	.90(.65,1.25)	.81(.57-1.14)
Finland	2.20(1.71,2.83)***	2.15(1.66-2.79)***
(Denmark=0) to Finland	2.45(1.92,3.11)***	2.66(2.00-3.5)***
Gender (female=0)	.76(.61,.95)*	.79(.63-.98)*
Living situation (I live alone=0)	.83(.72,.96)*	.83(.72-/96)*
First use of Cannabis (<16=0)		
16-17	1.25(1.04,1.51)*	1.24(.92-1.17)
18+	.85(.68,1.06)	1.13(.82-1.57)
Growing Experience		
# of harvests (0-5 harvests=0)		
6-10 Harvests	1.05(.83,1.33)	1.08(.85-1.37)
11+ Harvests	1.46(1.13,1.87)**	1.44(1.12-1.86)**
Successful harvest (1st time=0)	1.29(1.11,1.50)***	1.18(.95-1.46)
Age started growing (<18=0)		
18-25	1.08(.93,1.26)	1.11(.91-1.36)
26+	1.04(.77,1.40)	.98(.72-1.33)
Growing Techniques & Network		
Time spent growing (1≥ week=0)		
More than once a week	.89(.69,1.14)	.88(.69-1.14)
Daily	1.24(.98,1.59)┼	1.25(.97-1.62)┼
Grow alone (yes=0)	.88(.70,1.10)	.93(.75-1.16)
# of growers known (0-5=0)		
6-10 growers	1.02(.83,1.25)	1.01(.82-1.23)
11+ growers	1.79(1.48,2.18)***	1.79(1.47-2.18)***
Location (no=0)[b]		
Outdoor	1.03(.89,1.19)	1.01(.88-1.17)
Indoor	1.01(.84,1.21)	1.03(.85-1.24)
Greenhouse	.80(.60,1.06)	.78(.59-1.04)┼
# of plants grown (1-5 plants=0)		
6-20 plants	.94(.76,1.18)	.73(.50-1.06)
21+ plants	1.80(1.38,2.37)***	2.27(1.63-3.18)***
Importance of reason to start (Unimportant=0)		
For personal use	1.21(1.01,1.46)*	1.20(.99-1.45)┼
To give to friends	1.08(.88,1.31)	1.10(.94-1.28)
Interaction Effects		
Finland*First used cannabis (16-17)		1.09(.80-1.48)
*First used cannabis (18+)		.65(.48-.88)**
*Successful first time		1.19(.97-1.45)┼
Belgium*First use cannabis (16-17)		.56(.24-1.32)
Denmark*# of plants grown (6-20 plants)		.68(.47-.99)*
*# of plants grown (21+ plants)		1.53(1.10-2.11)*
Model Fit	**All 3 Countries**	**All 3 Countries with Interaction Terms**
-2LL	1549.58	1524.55
Hosmer and Lemeshow(p-value) (df = 8)	10.44(.24)	9.38(.31)
AUC & (Max-rescaled R^2)	.80 (23.95%)	.81(25.59%)

Note: Because PROC MIANALYZE does not provide aggregated model fit indices, the most conservative imputed data set fit statistics are reported.

[a]Reference groups are identified in parentheses. [b] Locations are not mutually exclusive.

┼ p < .10. * p < .05. ** p < .01. *** p < .001.

Appendix: Frequency Distribution and Chi-square Analyses for Differences between Countries

Variables	Belgium (n = 659)	Denmark (n = 560)	Finland (n = 1,296)	χ^2
Arrested for Cannabis Cultivation	3.2	5.2	**19.4**	122.01***
Gender—Male	88.5	90.9	92.5	7.80*
Age				504.62***
<25	37.8	24.6	**63.4**	
26-35	**51.1**	27.3	30.8	
36+	11.1	**48.0**	5.8	
First use of Cannabis				122.61***
<17	**83.7**	**72.4**	**63.8**	
18-25	15.0	23.6	34.3	
26+	1.3	4.0	1.9	
Living situation—I live alone	19.5	31.6	41.9	81.37***
Growing Experience				
Number of harvests				174.38***
No harvests yet	6.5	5.2	13.9	
1 Harvest	25.3	14.8	17.7	
2-5 Harvests	**51.5**	**37.8**	**42.9**	
6-10 Harvests	10.3	15.0	14.8	
11+ Harvests	6.5	27.3	10.7	
Failed harvest before first success? –Successful 1st	61.6	70.2	73.5	25.44***
Age started growing				146.59***
<18	31.9	22.9	19.8	
18-25	**54.0**	**47.0**	**68.8**	
26+	14.2	30.1	11.3	
Growing Techniques and Network				
Time spent on the growing process				142.88***
Once a week or less	14.0	21.8	4.3	
More than once a week	**47.6**	**43.7**	46.0	
Daily	38.4	34.5	**49.7**	
Do you grow alone or with others?—Alone	72.7	80.1	80.5	14.18**
Number of growers known				110.17***
0-5 growers	**72.1**	**67.6**	**49.5**	
6-10 growers	18.8	17.3	23.8	
11-20 growers	6.0	8.8	15.8	
21+ growers	3.2	6.3	10.9	
Location				
Outdoor	57.4	54.8	38.1	83.21***
Indoor	54.8	30.7	11.2	426.75***
Greenhouse	14.3	15.4	4.8	72.39***
Number of plants grown				227.93***
1-5 plants	**66.0**	37.8	**73.9**	
6-20 plants	25.5	**40.2**	18.7	
21+ plants	8.5	22.0	7.4	
Reason to Start Growing				
For personal use	74.0	93.6	87.4	98.15***
To give to friends	12.4	45.4	30.9	147.05***

Note: Chi-square distributions presented without multiple imputations. Figures presented in each of the three 'country' columns are percentages.
* p < .05. ** p < .01. ***p <.001.

Endnotes

[1] In this study, both 'detection' and 'arrest' have the same meaning. Because the main outcome variable asks respondents whether they have been arrested, it is often referred to as such.

[2] Market size estimates are difficult to locate, although Kilmer and Pacula's (2009) best estimates for 2005 indicate that the Belgium, Denmark, and Finland retail cannabis markets were 40,900, 19,000, and 11,300 kg, respectively. To gauge the current market, we use the most recent (complete) figures reported by EMCDDA—2006 for Finland and 2008 for Belgium and Denmark.

[3] Unfortunately, determining the extent to which these seizures were recorded as drug offenses is difficult, but the figures do provide a context in which to gauge the various markets.

[4] Age is excluded as a covariate (in the final analyses) because less than seven percent of Belgians responded.

[5] MCMC is a stochastic process that produces parameter estimates by obtaining a posterior distribution using information from the variables included in the analysis (Gilks, Richardson, & Spiegelhalter, 1996). Using the PROC MI command in SAS 9.2, the MCMC procedure imputed values for missing data until reaching a monotone missing pattern.

[6] Following Allison (2002, 2009) and Shafer's (1997) recommendations, models were developed including predictors, covariates, and dependent variables in the analyses, as well as highly correlated auxiliary variables.

[7] Five imputed data sets were generated using the MCMC procedure then, using the five imputed data sets, an additional imputation was conducted using regression techniques. This does not impute a sixth data set, but rather performs the regression techniques (that have a

monotone missing pattern) on the five imputed data sets. As a result, the final analysis includes five separate imputed data sets.

[8] PROC MIANALYZE is a useful technique for examining and making inferences about parameter estimates and the effects of missing data. Using the algorithms developed by Rubin (1987), SAS 9.2 computes within and between-variance for the datasets and produces a 'total variance' score; when the imputed models are correctly identified, SAS provides consistent parameter estimates and their standard errors (Horton & Lipsitz, 2001). To verify the validity of these estimates, MI output provides approximations for the fraction of missing information (FMI) and its influence on the interpretation of parameter estimates (Horton & Lipsitz, 2001; Shafer, 1997).

[9] The authors wish to thank one of the anonymous reviewers of *Drugs: Education, Prevention, and Policy* for encouraging us to address this issue directly in the paper.