

## ABSTRACT

Title of thesis: TRUANCY AND THE ONSET OF MARIJUANA USE:  
TESTING THE RELATIONSHIP AMONG CHILEAN  
STUDENTS

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Previous research conducted in the United States has shown that truancy increases the risk of marijuana use among adolescents. The current study examines this relationship in Chile. By using a longitudinal study conducted from 2008 to 2011 among school students in 7<sup>th</sup> grade in Santiago, Chile, I test the effect that truancy has on the onset of marijuana use, controlling for a number of potential confounders. The findings support the hypothesis that youths who reported having been truant were more likely to initiate marijuana use. However, I did not find enough support for the hypothesis that youths who reported have skipped schools more days were at a higher risk of initiating marijuana use.

TRUANCY AND THE ONSET OF MARIJUANA USE:  
TESTING THE RELATIONSHIP AMONG CHILEAN STUDENTS

by

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## CHAPTER 1: INTRODUCTION

Truancy, defined as the intentional absence from school without parental authorization (Sälzer, Trautwein, Lüdtke, & Stamm, 2012), is a common behavior during adolescence, with data indicating that in the United States around 11% of the 8<sup>th</sup>-grade students skipped school at least once in the last month (Henry, 2007). In the last decades some warning voices have been raised on the negative consequences that truancy could have in the short and the long term for those who engage in it (Garry, 1996; Henry & Huizinga, 2007b).

Among those potential negative consequences, research studies have shown that truancy is related to involvement in delinquency, initiation and escalation in drug use, and school dropout. Of these, the onset and potential escalation in drug use seems to be particularly relevant, given the negative outcomes in the short and the long term associated with an early initiation to drug use (Henry & Huizinga, 2007a).

In spite of the increasing interest in the relationship between truancy and drug use in the United States, the existing research has a number of methodological problems that limit our understanding of this phenomenon. Small and non-representative samples, the use of cross-sectional designs, and the lack of control for confounders prevent a fuller understanding of this problem. In recent years, new studies using longitudinal data (Henry & Huizinga, 2007a; Henry, Thornberry, & Huizinga, 2009; Henry & Thornberry, 2010) have advanced our comprehension about it, but more research is still needed in order to test the validity of the findings. It is also true that most of the research has been done in the United States (but see Chou, Ho, Chen, & Chen, 2006, McAra 2004), a country where truancy has an illegal connotation that it might not have in other countries, which limits the generalizability of the results.

A key process in the generation of scientific knowledge is the replication of existing findings (King, 1995). By replication we understand not only the re-estimation of the same model with the same data—an underused way to verify the reliability of the results—but also the estimation of the same relationship with other data bases, in other times and other contexts. Similar findings in different contexts allow the researchers and the community to know that a particular finding was not “merely tied” to a particular moment (Bueno de Mesquita, 2003), deepening the understanding of the relationship.

This thesis attempts to contribute to this process, replicating the study done by Henry, Thornberry and Huizinga in 2009 with the aim of estimating the impact that truancy has on marijuana initiation using longitudinal data. It also adds to the existing studies by evaluating the strength of the relationship in another cultural context, specifically, in Chile. In comparing Chile with the United States, there are some cultural and legal differences that could be interesting to keep in mind. As in the United States, *hacer la cimarra* (to “play hooky”) in Chile is a relatively common behavior in adolescence. However, contrary to what happens in the United States, truancy does not have any legal consequence. In fact, truancy is not seen as a delinquent act, to be answered by the juvenile justice system, but as a problem that should be addressed by the school or the parents. The replication of the existing findings (Henry et al., 2009) in a different context will give us a deeper understanding of the relationship between truancy and the onset of marijuana use.



## CHAPTER 2: TRUANCY AND ITS RELATIONSHIP WITH ILLEGAL DRUG USE

### **Truancy: an early signal of problematic behavior**

Mainstream society expects that children and adolescents between five and eighteen years of age spend most of their day in school, which is a central institution of socialization, preceded only by the family. However, a non-trivial proportion of school-age-children and youths are absent from classes on any given day. Frequent or chronic absenteeism could be problematic in terms of educational achievement, but it will not constitute a norm breakdown if it was done with parental authorization. Based on this, we can distinguish between any absenteeism and truancy, defining the latter as the intentional absence from school without parental authorization (Sälzer et al., 2012), which constitutes one of the more common status offenses in the United States (Zhang, Katsiyannis, Barrett, & Willson, 2007).

Using data from the 2003 wave of Monitoring the Future, Henry estimated that about 11% of the 8<sup>th</sup> grade students and 16% of the 10<sup>th</sup> grade students in the United States reported skipping one or more days of school in the past 30 days (Henry, 2007). The proportion of truants did not differ by gender and race, but was strongly related to academic performance and expectations, and with the prevalence of drug use. Similar results were presented in 2000 by the European School Project on Alcohol and Other Drugs (ESPAD) for the United Kingdom. Using a representative sample of the 15-16 year old students, 19% reported have missed at least one day of school in the last 30 days (Hibell, et al., 2000). In a nationally representative survey done in Canada in 2006, 35% of the students between 9<sup>th</sup> and 12<sup>th</sup> grade reported have skipped at least one class in the last four weeks (Pathammavong, Leatherdale, Ahmed,

Griffith, Nowatzki, & Manske, 2011).<sup>1</sup> In Chile, the information collected through the national drug survey of the school population that is conducted every two years by SENDA, the governmental agency in charge of drug policies, shows that 15.5% of the 8<sup>th</sup>-grade students report having skipped at least one day of school during the last year, a percentage that increases to 47.9% for the 12<sup>th</sup>-grade students, percentages that do not differ much by gender. They do differ by school type, with public schools showing a larger proportion of students who have skipped school during their last year (SENDA, 2007). The uniformity of findings across countries reinforces the idea that truancy is a relatively common behavior during school years with an increasing prevalence as youth age, and a common problem for schools to confront.

In fact, truancy has been presented as one of the most serious discipline problems at school (Heaviside, Rowand, Williams, & Farris, 1998), which also correlates with a large group of negative consequences in the short and long term. Truant youths are more likely to perform poorly and more likely to dropout of school (Henry, Knight, & Thornberry, 2012; Alexander, Entwisle, & Horsey, 1997), they are more likely to engage in other types of antisocial behavior such as delinquency (Zhang et al., 2007; Loeber & Farrington, 2000; van der Aa, Rebollo-Mesa, Willemsen, Boomsma, & Bartels, 2009), and drug use (Henry et al., 2009; Bryant & Zimmerman, 2002; Hallfors, Vevea, Iritani, Cho, Khatapoush, & Saxe, 2002), more likely to become pregnant as a teenager and to experience a marital breakdown before age 23 (Hibbett & Fogelman, 1990), and to be unemployed as young adults (Hibbett, Fogelman, & Manor, 1990). As Garry (1996) stated, based on the existing research truancy “may be the beginning of a lifetime of problems for students who routinely skip school”, and “a stepping stone to delinquent and criminal activity”.

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<sup>1</sup> The larger proportion in the case of Canada is probably due to the different way that they use to measure truancy: skip one class, instead of skip a whole day of classes.

Among those factors, a large focus has been put on the relationship between truancy and illegal drug use. Research in different countries has consistently found a positive correlation between these behaviors (Hibell, et al., 2004; Brown, Schulenberg, Bachman, O'Malley, & Johnston, 2001; Bryant & Zimmerman, 2002; Henry, 2007), which has led to the consideration of truancy as a risk factor for substance use (Hawkins, Catalano, & Miller, 1992). This focus on substance use is in part due to the fact that it is one of the strongest correlates of truancy (Vaughn, Maynard, Salas-Wright, Perron, & Abdon, 2013; Hallfors et al., 2002), and that the average age of onset among those who initiate marijuana use is during middle- and high-school years (Henry et al., 2009; SENDA, 2008), the same years when truancy developed.

However, beyond these statistical associations, the focus on illegal substance use also responds to the evidence that highlight the detrimental long-term effects of an early onset in substance use (Loeber & Farrington, 2000), which has been associated with a higher likelihood of drug dependence or abuse (Substance Abuse and Mental Health Administration, 2013), school dropout (Bray, Zarkin, Ringwalt, & Qi, 2000; Roebuck, French, & Dennis, 2004), and involvement in delinquency and criminal behavior (Deitch, Koutsenok, & Ruiz, 2000; McAllister & Makkai, 2003), among other problems. The same relationships have been found in the specific case of marijuana use (Bray et al., 2000; Chatterji, 2006; McAllister & Makkai, 2003), making marijuana use a potential mediator between truancy and those long-term negative effects (dropout, unemployment, etc) and reinforcing the relevance to reduce the risk of an early initiation in drug use through reducing truancy (Bryant & Zimmerman, 2002).

## **The relationship between truancy and drug use: theory and evidence**

### *Theoretical rationality*

Given the problems associated with truancy and with an early onset in drug use, the present study analyzes the effect that truancy has on the onset of marijuana use. Based on the theory, there are a number of reasons to believe that engagement in truant behavior could increase the risk of involvement in drug use.

From a social control perspective (Hirschi, 1969), the natural tendency to commit crime is inhibited by the existence of strong bonds to pro-social individuals and/or pro-social institutions. People with weak bonds will have less constraint and be more likely to engage in antisocial behavior. One of the elements in Hirschi's theory that explain conformity to social norms is involvement in conventional activities: youths who are more involved in these types of activities will have less time and energy to engage in delinquency. The school routine is a clear example of conventional activities, and, therefore, based on the theory it can be hypothesized that time spent in school may reduce the likelihood to engage in deviant behavior. Truancy reflects a disengagement from school and school activities; students who engage in it are in fact outside the school and without the control that school exerts. Following a social control perspective, we would expect that truancy increase the risk of engaging in other kinds of antisocial behaviors, such as marijuana use.

More recently, developmental theories have taken and extended the statement of control theory. Catalano and Hawkins presented school as a primary socialization unit during adolescence that reduces adolescents' delinquency through teachers' informal control and conformity with the school rules (Catalano & Hawkins, 1996). When youths are not bonded to school—truants seem to be an example—they have higher

probabilities of being involved with delinquent peers, which increase the perceived rewards of antisocial behavior resulting in the initiation and/or escalation in drug use and other antisocial behaviors. A similar relation has been hypothesized and tested by interactional theory: the confluence of low commitment to school with bonding to delinquent peers would lead to involvement and escalation in drug use and other problem behaviors (Thornberry, 1987; Thornberry, 2005).

Finally, in their unstructured socializing approach (Osgood & Anderson, 2004; Osgood, Wilson, O'Malley, Bachman, & Johnston, 1996), Osgood and his colleagues explain deviant behavior in terms of the daily routine of activities that lead to opportunities to commit crime. They argue that delinquent behavior and drug use is more likely to occur when adolescents spend unstructured time with peers in the absence of authority figures. Truancy takes students away from the structured time that characterized the school day, giving them more opportunities for deviance. Moreover, during this time the youths are not supervised by an adult figure who could exert social control, which matches the absence of a capable guardian that is behind the original theory (Cohen & Felson, 1979). Finally, the evidence also suggests that students usually skip school in groups (Henry & Thornberry, 2010) and, as the theory proposes, peers may make deviance easier and more rewarding.<sup>2</sup> Therefore, truancy seems to provide the type of setting that Osgood et al. hypothesize will be favorable to the development of deviant acts, such as initiation in drug use (see also van der Aa et al., 2009).

However, it is also true that other theories hypothesize that the relationship between truancy and drug use may be spurious due to shared roots. The problem-

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<sup>2</sup> However, contrary to a differential association theory, they argue that the relationship between unsupervised time and delinquency is independent of having delinquent peers (Haynie & Osgood, 2005).

behavior theory (Jessor, 1987) proposes that those prone to avoid the law are more likely to engage in multiple problem behaviors, which are also reciprocally influenced, generating what they call a “syndrome of deviant behavior”. Therefore, the relationship between truancy and drug use could be the result of a predisposition toward deviance, or the result of low self-control, a permanent feature of the individual developed in the first years of life as has been hypothesized in the general theory of crime propose by Gottfredson & Hirschi (1990). Those who are in school and have low self-control would be more likely to engage in some kind of antisocial behavior, either these status offenses or criminal acts.

From a social learning standpoint, delinquency is the result of a learning process, which is affected by the exposure to definitions favorable to violating the law (Sutherland & Cressey, 1974) and the reinforcement of the acquired definitions (Akers, 1998). During adolescence, individuals are not only highly exposed to peers during school time, those peers also play an important role as a source of social reinforcement and imitation. Both behaviors of interest, engaging in truancy and in marijuana use, could be the effect of the common exposure to delinquent peers that challenge the school norms and the criminal law, making the relationship between them spurious.

Finally, other elements of Hirschi’s social control theory, such as attachment and commitment could be explaining both behaviors, making the relationship between them spurious. Because their lack in commitment, students with lower achievement at school (Vaughn et al., 2013; Bryant & Zimmerman, 2002; Bryant et al., 2000) and lower educational aspirations (Crum, Storr, & Anthony, 2005; Sälzer et al., 2012) are more likely to get involved in problematic behaviors, be it truancy or drug use. The lack of constraint due to lower attachment to the school or lower attachment to

parents (Vaughn et al., 2013; Velleman, Templeton, & Copello, 2005) could also lead to both behaviors.

In summary, although based on the theory we could expect that truancy increases the risk of marijuana use, it is also possible that the association that has been found in the empirical research is merely due to the shared roots of both behaviors.

### *Empirical evidence*

Most of the research that has focused on the relationship between truancy and illicit drug use has found evidence of a positive association (Henry, 2007), in a time order in which the onset in drug use is generally preceded by truancy (Hawkins et al., 1992; Prichard & Payne, 2005).

In their meta-analysis about risk indicators of adolescents' substance use, Hallfors and colleagues conclude that truancy is a better predictor than GPA or sexual activity (Hallfors et al., 2002). Analyzing the results reported in surveys conducted in 28 different communities during a twenty-year period, the authors conclude that adolescents who skipped school are between 2.5 to 4.5 times more likely to report marijuana use in the last month. Similar ranges have been found in a study using the National Survey on Drug Use and Health, where Vaughn et al. estimate that youths who reported higher rates of truancy (four days or more in the last 30 days) and those who reported moderate frequency of truancy (1-3 days last month) were significantly more likely to report marijuana use than non-truant youths (4 and 2.7 times respectively), even after controlling for socio-demographic characteristics (Vaughn et al., 2013).

Similar findings were reported in two of the few studies conducted outside the United States. The first was conducted in Taiwan with a sample of high-risk children.

The study reported that the odds of using any illicit drug were five times higher for truants than for non-truants, and the risk of initiating drug use for the youths who had a truancy experience was 3.9 times higher than those without that experience (Chou et al., 2006). Another study conducted in Edinburgh showed that at age 15 half of those who have been truant reported to have used illegal drugs during the last year, an amount that increases to 66% when they consider only the long-term truants (those who reported had also been truant in previous years) (McAra, 2004).

Although, all these studies consistently show that the odds of using drugs are higher for those who report truancy than for those who do not, most of the existing research has failed to go beyond the establishment of a simple correlation between truancy and illegal drug use (Henry et al., 2009). This is mainly because two of the key elements required to establish a causal relationship are missing: the establishment of the correct temporal order, and the reduction of the sources of spuriousness that may account for the relationship.

Regarding the first issue, it is key to recognize that the relationship between marijuana use and truancy can go from truancy to drug use—as is hypothesized in this study—but may also be reciprocal (Thornberry & Henry, 2009), or go from drug use to truancy (Roebuck et al., 2004). However, all the research presented above is based on cross-sectional studies that do not allow us to know the direction of the relationship between these behaviors: is it not clear whether truancy happens before the use of marijuana or not. Also, in most cases, they used a general measure of prevalence of drug use—either month, year or life prevalence—that does not account for changes in the behavior that may have followed the involvement in truancy. This weakness is also present in the limited research that has tried to show how marijuana use can lead



to an increase in truancy (Engberg & Morral, 2006; Miller & Plant, 1999; Roebuck et al., 2004).<sup>3</sup>

To guarantee that an empirical association between variables is not due to spuriousness is a difficult task in non-experimental research, in which the control for potential confounding becomes a key element for increasing the confidence in the results. However, most of the research that looks into the relationship between truancy and drug use has also failed to control for potential confounding, despite of the fact that existing theories have hypothesized and empirical research has shown that truancy and drug use share a large number of risk factors.

In contrast, some recent research has moved beyond the establishment of a strong association between both behaviors, testing whether involvement in truancy increases the risk of initiating drug use (Henry & Huizinga, 2007a; Henry et al., 2009). In order to disentangle the relationship between these variables, Henry and her colleagues use longitudinal data to guarantee the correct temporal order, and focus on the onset of drug use diminishing the potential bias in the estimates that could be generated given the hypothesized reciprocal effects between drug use and truancy. The studies have consistently shown a strong effect of truancy on the onset of drug use, effect that has remain even after controlling for potential confounding variables.

Using one cohort from the Denver Youth Study ( $N=304$ ), Henry and Huizinga (2007a) estimate the relationship between truancy and onset of drug use (alcohol, tobacco and marijuana). The results show that truancy -measured both as a continuous and as a categorical variable- is a significant predictor of onset for all drugs, and that its effect although diminished, remains robust after controlling for time-independent

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<sup>3</sup> To my knowledge, there are no studies that, using a longitudinal design, have shown that using marijuana—or other illicit drugs—increases the likelihood of becoming a truant. Therefore, all these studies that show that marijuana use increases the risk of truant behavior were based on a cross-sectional design that does not allow the researchers to really know the correct time order.

(gender, race) and time-dependent (i.e., school performance, delinquent peers, parental monitoring) variables. In fact, the odds of initiation in marijuana use are 1.93 times higher for each unit increase in the log number of days truant (Henry & Huizinga, 2007a).

In a similar analysis conducted with data from the Rochester Development Study, Henry, Thornberry and Huizinga arrive at the same conclusion: truancy is a strong predictor of marijuana onset, stronger particularly in earlier adolescence (ages 13 and 14), and with what the authors call a “dose-response effect”, the more days truant, the more likely the student is to engage in marijuana consumption (Henry et al., 2009). Using a similar model to the one used by Henry and Huizinga (2007a), the authors look only to the onset of marijuana use, given the number of negative outcomes that an early onset of marijuana has on the youths’ lives. The results are not only consistent with the one obtained with the Denver sample, they also point to the need of look at truancy as a risk factor for subsequent problem behavior.

### *Hypotheses*

Although more recent and better research confirms the existence of a relationship between truancy and the onset of marijuana use, the strength and robustness of this relationship may still be an open question, particularly because most of the research has been done in the United States (but see McAra 2004, Chou, Ho et al., 2006, both cross-sectional studies), a country where truancy has an illegal connotation which may be driving the relationship, when compared with other countries.

The purpose of this study is to re-examine the previous findings regarding the relationship between truancy and the onset of marijuana use but in a different context.

Specifically, using a longitudinal sample of adolescences in schools in Chile, a country in which truancy, as was stated, is not seen as a criminal justice problem and where this topic has not been investigated. Based on the previous work, this thesis tests two hypotheses:

*Hypothesis 1:* Youth who report being involved in truancy will be more likely to initiate marijuana use, and this relationship will remain after control for common risk factors.

*Hypothesis 2:* Those who skipped school more often are more likely to initiate marijuana use, i.e., the more days a youth reported being truant, the higher the risk of onset of marijuana use.

In both hypotheses I will focus only on marijuana onset, although the effect of truancy on other drugs (Henry & Huizinga, 2007a) and on the escalation in the use of marijuana has been shown in previous research (Henry & Thornberry, 2010). The main reason for this is that this is the first study conducted with Chilean data, and therefore it seems reasonable to look at onset as a first step. Since onset in marijuana use is a clear change in state (going from never having used to use for the first time), and was better measured in the survey—compared with frequency of marijuana use—to look at onset reduces the likelihood of measurement errors and strengthens our confidence in the relationship if it is observed. Regarding the choice of marijuana as the drug of interest, the decision was made because marijuana is the illicit drug most often used in adolescence, a developmental stage that also coincides with the onset of a larger proportion of consumers: 43.6% of those who have use marijuana reported

have used for the first time between 15 and 17 years of age with a median age of 17 years (SENDA, 2008).

### CHAPTER 3: DATA AND METHODOLOGY

This study uses data from the Longitudinal Survey of Drug Use, a four-wave panel study conducted in the Metropolitan region of Santiago, Chile, where about 40% of the Chilean population resides. The goal of the study was to describe the drug use trajectories among Chilean adolescents and to identify risk factors of initiation and escalation in the use of drugs.<sup>4</sup> In order to do so, a survey was conducted starting in 2008, based on a probabilistic sample of adolescents in 7<sup>th</sup> grade in schools. The participants were selected with a stratified, multistage sample design, where the primary sampling units were schools. Schools were stratified by the socioeconomic status determined by the Chilean Ministry of Education (lower, middle and upper SES), and were randomly selected with probability proportional to size within each stratum. Low-SES schools were oversampled. A total of 72 schools were selected. In most of them, all the 7<sup>th</sup>-grade students were included. But, in those schools with more than two classrooms, some of the classrooms were randomly selected in order to obtain a sample of around 5,000 students (165 classrooms out of 223). In each selected classroom, all the students were selected. The sample was representative from the 7<sup>th</sup> grade students in the Metropolitan region of Santiago.

**Table 1:** Population and sample size

SES	Population	%	Original Sample	%	Final Sample	%
Low	5,558	11.4	1,775	35.5	1,680	36
Medium	32,490	66.5	2,424	48.5	2,243	48
High	10,844	22.2	798	16.0	745	16
TOTAL	48,892	100	4,997	100	4,668	100

<sup>4</sup> Being one of the few longitudinal studies that has been done in Chile, and to my knowledge the only one representative of adolescents in schools, only a limited number of publications have been done using this sample (Torche et al. 2012, Valenzuela & Ayala 2011).

The survey was self-administrated in the classrooms and all the students that were in school that day were included, building an original sample size of 4,997 students. The study was conducted from 2008 to 2011, between the months of September and November each year, which in Chile coincided with the last months of the academic year. At each wave, the respondents were asked about their families, academic expectations, peer associations and prevalence and incidence of drug use. All the variables were reported by the students. The study, as it was designed, does not have other sources of information at the individual level. However, in the first wave, the lead teacher of each classroom was asked some general questions regarding academic expectations for the students, discipline and behavioral problems at school, and absenteeism on any given day.

With regard to the sample, 53% of the participants were male, 17% were in a private school in 2008, almost 27% were in a public school and 56% in a voucher school.<sup>5</sup> On average, the students were born in 1995, which coincided with the year of most students in 7<sup>th</sup> grade in Chile. Two thirds of the sample participants lived with both parents, a percentage similar to the 65% reported in 2009 by a national sample of 8<sup>th</sup>-grade students in Chile (SENDA, 2009), and a 66% reported that at least one of their parents finished high school. Chile is a country relatively homogeneous in terms of race and ethnicity. Therefore, no question was asked about this issue.

### **Sample size and attrition**

Some specificities and limitations of the sample should be presented. First, the Chilean Longitudinal Survey of Drug Use, on which the present study is based, was also the base for an estimation of the panel effect—the bias that emerges from having

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<sup>5</sup> The distribution of students by school type in Santiago in 2008 was 18.2% in public schools, 61.4% in voucher schools and 20.3% in private schools.

answered questions in prior waves of a survey—using an experimental design (Torche, Warren, Halpern-Manners, & Valenzuela, 2012). In the first wave, a percentage of the students were randomly selected as a control group ( $N=329$ ), whose questionnaires did not include the drug module.<sup>6</sup> Given the lack of information regarding drug use in wave one for this group and the fact that they were randomly selected and do not differ in all the observable measures (see Torche et al., 2012), I decided to drop those cases from the analysis, limiting my original sample size to  $N= 4,668$ , as it is shown in Table 1.

**Table 2:** Attrition rates

	<i>N</i>	%
2008	4,668	100
2008-2009	4,174	89.4
2008-2009-2010	3,371	72.2
2008-2009-2010-2011	2,643	56.6

Second, as in any longitudinal study there is sample attrition throughout the years. The attrition rates between each wave are presented in Table 2. In the case of this particular study, as the design was done, those who stayed at the same schools were more likely to participate in the following waves and, in fact, less than 60% of the original sample remains in the study at the fourth wave.<sup>7</sup> Further, this proportion differs significantly by school socioeconomic status: from those students who were in low-SES schools, only 46% were still participating at wave four, while 73% of those who were in high-SES schools did.

A comparative analysis shows that those who left the sample at some point during the four years ( $N=2,025$ ) differ from those who stayed ( $N= 2,643$ ) on almost all the variables included in the model: they were more likely to report marijuana use

<sup>6</sup> All the descriptions and analysis of this study are published in Torche et al. (2012)

<sup>7</sup> Although, 80.6% of the original cases have at least three of the four measures ( $N=3,764$ ), in future analysis a multiple imputation procedure could be used with those cases, in order to evaluate the sensitivity of the results.

(11% versus 5%) and truancy (16% and 8%) in the first wave, had lower school performance, school attachment and academic aspirations, reported to be less supervised and less attached to their parents, and also reported in larger proportions to having used alcohol and tobacco. Therefore, the more vulnerable students were also more likely to drop out of the sample throughout the four years. All the comparisons are shown in the Table 3. The only variables that are not significantly different were gender and having been in a voucher school. More analysis about the attrition problem in the context of the statistical method used in this study is discussed in the Limitations section of the Discussion, and the strategy used for dealing with missing data due to non response is discussed in the Missing Data section of the Analytic Strategy.

## **Variables**

### *Dependent variable*

*Marijuana use* was measured as life-time prevalence in the first wave, and frequency of use in the previous year,<sup>8</sup> in the following waves. Using this data, a dichotomous variable was generated that accounted for *onset of marijuana use* between two specific waves (1=if the student used marijuana for first time after the previous wave and up to the current one; 0=if he/she has never used marijuana until that wave). Those who reported having used marijuana in wave one (i.e., initiated marijuana use before wave one) were left-censored at that point, because we could not know the exact time when the event (onset of marijuana use) occurred.

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<sup>8</sup> The categories for the frequency of marijuana use during the last year are *none, 1 or 2 times, 3 to 9 times, 10 to 19 times, 20 to 39 times* and *more than 40 times*. Regardless of the amount, the variable was dichotomized in *none* and *at least one* in order to generate the dependent variable of interest: onset of marijuana use.



**Table 3:** Differences in key measures at the first wave, among those who left the study and those who did not (% in each category)

		Non attrition N=2,643	Attrition N=2,025	
DV	<b>Marijuana use</b>	0.05	0.11	
Key IV	<b>Truancy previous year</b>	0.08	0.16	
Family Factors	<b>Parental attachment</b>	4.41	4.27	
	<b>Parental supervision</b>	3.32	3.19	
	<b>Two-parent house</b>	0.69	0.62	
	<b>Parent with high-school or more</b>	0.69	0.61	
School Factors	<b>School attachment</b>	4.01	3.93	
	<b>GPA</b>	<b>A</b>	0.39	0.27
		<b>B</b>	0.50	0.54
		<b>C</b>	0.12	0.20
	<b>Likely to go to university</b>	0.80	0.72	
	<b>School size</b>	119	112.9	
	<b>School type</b>	<b>Private</b>	0.22	0.11
		<b>Public</b>	0.22	0.34
	<b>Voucher</b>	0.57	0.55	
Peer Factors	<b>Peers' marijuana use</b>	0.11	0.20	
	<b>Peer attitudes against marijuana</b>	0.70	0.65	
Delinquency	<b>Prior in delinquency</b>	0.44	0.51	
	<b>Early onset on theft</b>	0.08	0.08	
	<b>Tobacco use</b>	0.24	0.37	
	<b>Alcohol use</b>	0.22	0.32	
Control	<b>Male</b>	0.53	0.54	
	<b>Year of birth</b>	1995.2	1995	

In blond:  $p < .05$ , two-tailed.

Given the nature of the longitudinal design that follows a cohort of students in 7<sup>th</sup> grade, the variable measures time by waves—which in most cases coincided with school grade—and not by age. This decision allows us to use a comparable time framework with truancy and all the other variables.

### *Key independent variable*

Truancy was measured as a dichotomous variable that accounts for the *prevalence of truancy* during the last year: 1, if the youth reported he/she has played truant at least once during the year before the survey, 0, otherwise. In this study, students report if they have skipped one whole day of school, not just some classes within a day, which is the general meaning that people give in Chile to the act of *hacer la cimarra*.

The variable *frequency of truancy* accounts for the number of times that a student was truant during the last year. It used the following categories: *none, 1 or 2 times, 3 to 9 times, 10 to 19 times, 20 to 39 times and more than 40 times*. The variable was included as a set of dummies, with those who reported no truancy as the reference category.

### *Confounding and Control variables*

Potential confounders were included from four general groups: family, school, peers and delinquency.

Family factors have garnered attention in this research (Henry & Huizinga, 2007a; Vaughn et al., 2013), mainly those associated with supervision, attachment and positive parenting. The last one was not measured in this survey. *Parental attachment* was measured independently for mother and father with two questions: ‘How do you describe the relationship that you have nowadays with your mother/father?’ and ‘When you were a child, did you feel loved by your mother/father?’ The exploratory factor analysis with principal components showed one underlying factor, including the maternal and paternal items, and therefore the four variables were combined in a

single scale.<sup>9</sup> The Cronbach alpha was .69, only marginally lower than the accepted rule (Spector, 1992). *Parental supervision* was measured through a number of different questions: ‘How alert are your parents with respect to what you do at school?’; ‘Do they know your best friends?’; ‘Do they look at what you watch on TV?’; ‘When you go out during the weekends, do your parents know where you are going?’; ‘When you go out, do your parents know with whom you are going?’; and ‘When you go out, do your parents know at what time you will go back?’ The six items were combined in one single scale,<sup>10</sup> with an average Cronbach alpha of .74. Both parental scales have a positive direction, i.e., larger values mean higher attachment/supervision, and were included as time-dependent variables and standardized at the sample mean. Finally, based on previous research (Vaughn et al., 2013), two other measures regarding family factors were included: *family structure* measured by a dummy variable coded as 1, if the youth live with both parents, and 0, otherwise; and *parental education* also as a dummy variable coded as 1, when at least one parent finished high school. Family structure and parental education were included as time-independent variables under the assumption that these structural characteristics do not change in a four-year period.

The role that school plays in the daily lives of youths is another set of variables that we need to control (Gottfredson D. C., 2001; Crum et al., 2005; Bryant et al., 2000). A single scale of *school attachment* was generated from four different items (each of them with a five-point scale): ‘How happy do you come to school usually?’; ‘How important is it for you to get good scores at school?’; ‘How important is it that your

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<sup>9</sup> I recorded as missing data those who answered “Don’t know” or who did not have relationships with some of their parents. Given that Stata use, by default, a pairwise deletion when computing the correlations, this decision does not translate into more missing cases.

<sup>10</sup> An exploratory factor analysis with principal components was conducted to determine the number of components that exist among those items. The analysis showed that only one factor underlies the six items, with loadings from .5002 to .7232.

teacher has a good impression about you?'; and 'Which opinion do you think your teachers have about you as a student?' Although the scale has a Cronbach alpha of .61, all the items included increased the alpha. The variable was included as a time dependent variable standardized at the sample mean. *School performance* was measured by the general GPA that the student reports usually finishing the academic year. The variable was included as two dummy variables representing a B final grade and an A final grade, with C as the reference category. Finally, *educational aspiration*, measured by the question 'Do you think it is likely that you will go to the University?' was recoded as a dummy variable with 1, representing those who reported high aspirations (extremely likely or likely to go to University). Both variables were included as time dependent. Based on the previous research, some school characteristics were also added to the model as time-invariant variables: a standardized measure of *school size* (Finn & Voelkl, 1993), and two dummy variables that account for *school type* (public and private with public voucher, and private as the reference category).<sup>11</sup>

Two measures of peer influence were included in the analysis: one measuring behavior and the other attitudes, both regarding marijuana. *Peers' marijuana use* ('How many of your friends use marijuana?') was included as a dummy variable, with 1 meaning that the youth reported that at least one of their friends use marijuana on a

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<sup>11</sup> School SES was not included because it was highly correlated with parental education (.46) and with public school (.44). The last correlation is expected in the Chilean educational system (Torche, 2005). Therefore, I assume that the construct is measured by both variables already included in the model.

**Table 4:** Operationalization of variables included in the model

	Variable	Timing	Type	
DV	Onset Marijuana	TD	dummy	1= if reported have used marijuana for the first time that year
Key IV	Prevalence Truancy previous year	TD	dummy	1= if reported have been skipped at least one day in the previous year
	Frequency Truancy previous year	TD	set of dummy	0 days (ref), 1-2days, 3-9 days, 10-19 days, 20-39 days, 40 or more days
Family Factors	Parental attachment	TD	scale	How do you describe the relationship that you have nowadays with your mother/father? When you were a child, did you feel loved by your mother/father?
	Parental supervision	TD	scale	How alert are your parents with respect to what you do at school? Do they know your best friends?'; 'Do they look at what you watch on TV? Do they look at what you watch on TV? When you go out during the weekends, do your parents know where you are going? When you go out, do your parents know with whom you are going? When you go out, do your parents know at what time you will go back?
	Two-parent house	TI	dummy	1= if live with both parents in 2008
	Parent with high-school or more	TI	dummy	1= if at least one of your parents has high school or more
School Factors	School attachment	TD	scale	How happy do you come to school usually? How important is it for you to get good scores at school? How important is it that your teacher has a good impression about you? Which opinion do you think your teachers have about you as a student?
	GPA	TD	set of dummies	A, B, C (ref)
	Likely to go to university	TD	dummy	1= if he/she think it is extremely likely or likely he/she will go to the University
	School size	TI	continuous	
	School type	TI	set of dummies	public, voucher, private (ref)
Peer Factors	Peers' marijuana use	TD	dummy	1= if at least one of their friends use marijuana usually; 0= non of them
	Peer attitudes against marijuana	TD	dummy	1= if youth reported that the friends would have said something to avoid that he/she use marijuana
Delinquency	Prior in delinquency	TI	dummy	1= if reported have been involved in any delinquent acts in the first wave
	Early onset on theft	TI	dummy	1= if reported that his/her first theft at 10 or younger
	Tobacco use	TI	dummy	1= if reported tobacco use when was at 7grade
	Alcohol use previous year	TD	dummy	1= if reported alcohol use during the last year
Control	Male	TI	dummy	1= male
	Year of birth	TI	continuous	Year of birth

TD=Time dependent; TI=Time independent

regular basis (each weekend or more).<sup>12</sup> *Peers' attitudes* regarding marijuana use ('If your best friends knew that you use marijuana, do you think that they...') were also dichotomized with 1 meaning that the friends would have said something to stop using marijuana in the hypothetical case that they knew the adolescent used it.<sup>13</sup> The study does not have a measure of friends involve in truancy.

Finally, it is also likely that both behaviors—truancy and marijuana use—are caused by an underlying trait that makes some youth more prone to delinquency (Jessor, 1987; Gottfredson & Hirschi, 1990). A measure of those previously involved in delinquency was generated by the self-report life prevalence of involvement in antisocial behavior based on six different behaviors (painting graffiti or signs in public spaces, damaging other's property, theft, burglary, threatening someone, assault). Given that the same life-prevalence question were asked each year, the variable was included as a time-invariant variable that controls for *prior involvement in delinquency*, which takes a value of 1, if any of the behaviors was reported in the first wave. Although there is not a direct measure of self-control two variables were included based on previous research: a dichotomous indicator of *early involvement in theft*<sup>14</sup> which has been hypothesized to be a "useful index of criminal propensity" (Paternoster, Dean, Piquero, Mazerolle, & Brame, 1997, p. 247), and a measure of reported *tobacco use* in the first wave, an imprudent behavior linked to low self-control (Gottfredson & Hirschi, 1990, p. 90). In addition, and based on the research that pointed to the correlation of alcohol with marijuana use, and with school

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<sup>12</sup> The variable measures how many of the close friends are perceived to use marijuana, by reporting from the participants in the study, and therefore with the same potential reliability problem that was stated by Gottfredson and Hirschi (1990).

<sup>13</sup> The options were: would say something to you not to do that, someone would say something but others would not, would not say anything, you do not know what they would do. Those who answered that they do not know how their friends would react were also recoded as zero, given that the variable is measuring a strong reaction from the friends facing marijuana use, and under the assumption that those who do not know the reaction are probably more dubious regarding the willingness to intervene.

<sup>14</sup> Theft was the only delinquent act—other than drug use and truancy—regarding which was the age of onset measured. The ideal would be to have a measure of age of onset in delinquency.

attainment and dropout (Bray et al., 2000; Roebuck et al., 2004; Duarte & Escario, 2006), a measure of *alcohol use* during the last year was included as a time-varying dummy.

Finally, *gender* (Sälzer et al., 2012; Bryant & Zimmerman, 2002) and *age* (Sälzer et al., 2012; Vaughn et al., 2013)—measured by the year of birth<sup>15</sup>—were included as control variables. The operationalization and descriptive statistics of all the variables are shown in Table 4 and 5, respectively.

### **Analytic Strategy**

The purpose of this thesis is estimating the effect that truancy—measured as prevalence and as incidence—has on the onset in marijuana use. In order to do this, I first present a descriptive analysis of truant students, comparing them with those who did not report have being truant.

Then, I estimate five models using a discrete time survival model. In the estimation of the models I used a general specification for time, by including a set of dummy variables that indicated each time period ( $W_1, W_2, W_3, W_4$ ), which has the advantage of imposing no constraint of the shape of the baseline survival function. Given the small number of time periods included in the model, and the hazard and risk sets in each period, this specification seems to be appropriate (Singer & Willett, 2003).

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<sup>15</sup> Although all the participants in the study were in the same grade in 2008, the ages could vary among them, due, for example, to grade retention. In fact, there is 3% of the original sample who are older than is expected for a 7<sup>th</sup> grade student. Given that age is correlated with truancy and drug use, to control for these differences is important.

**Table 5:** Descriptive statistics\*

		Mean	SD	Alpha	Min	Max	% of missing
DV	Marijuana Use	0.093	0.382		0	1	1.3
Key IV	Prevalence Truancy previous year	0.145	0.350		0	1	4.4
	Frequency Truancy previous year				0	5	4.4
	0 days	0.853	0.352				
	1-2 days	0.092	0.287				
	3-9 days	0.037	0.188				
	10-19 days	0.011	0.106				
	20-39 days	0.003	0.057				
	40+ days	0.004	0.059				
Family Factors	Parental attachment	4.323	0.687	0.69	1	5	0
	Parental supervision	3.227	0.581	0.74	1	4	0
	Two-parent house	0.665	0.471		0	1	0.4
	Parent with high-school or more	0.658	0.474		0	1	3.9
School Factors	School attachment	3.983	0.595	0.61	1	5	0
	GPA				1	3	1.2
	A	0.301	0.458				
	B	0.562	0.495				
	C	0.137	0.343				
	Likely to go to university	0.757	0.429		0	1	1.2
	School size	116.35	73.03		10	319	0
	School type				1	3	0
Private	0.170	0.376					
Public	0.268	0.443					
Voucher	0.561	0.496					
Peer Factors	Peers' marijuana use	0.216	0.406		0	1	8.9
	Peer attitudes against marijuana	0.657	0.474		0	1	1.7
Delinquency	Prior in delinquency	0.470	0.499		0	1	1
	Early onset on theft	0.086	0.281		0	1	0
	Tobacco use	0.298	0.458		0	1	2.9
	Alcohol use previous year	0.344	0.468		0	1	4.4
	Control	Male	0.533	0.499		0	1
	Year of birth	1995.1	0.720		1991	1997	0.2

\* For time dependent variables, the mean, SD, alfa and proportion of missing cases were reported as the average among the three first waves (2008-2010). For time invariant, the statistics in the first wave. The descriptive statistics from the dependent variable are the average for all the four waves for the report of marijuana use.

I first introduce an unconditional survival function in which the only independent variable is a time indicator for each wave, and provides the probability to survive (i.e., not initiate marijuana use) for every single period.



Then four different conditional models were estimated: Model A includes only the independent variable of interest (prevalence of truancy), Model B adds all the covariates, Model C tests for the effect of the incidence of truancy, and finally Model D tests the proportionality assumption of the survival model.

The conditional model takes into account the possibility that individuals have different survival functions based on known attributes (i.e., observed heterogeneity). Those attributes could be introduced in the model as time-invariant or time-varying, so we estimated the probability that a specific individual will survive (i.e., not initiate marijuana use), conditional on whether he/she has not experienced the event yet and his/her values of the attributes at that time (Singer & Willett, 2003).<sup>16</sup>

The conditional model is estimated based on the following equation:

$$\text{logit } h(t_j) = [\alpha_1 W_2 + \alpha_2 W_3 + \alpha_3 W_4] + [\beta X]$$

Where the outcome is the conditional probability of initiating marijuana use in each specific interval; each alpha is a time indicator that acts as an intercept for each time period,<sup>17</sup> and, as a group, they provide the baseline, i.e., the survival function when all the predictors included in the model are zero, in the case of the dummy variables, or at their means, for the standardized measures; and the betas provide the effect of the predictors on the outcome (Singer & Willett, 2003).

The key independent variable—truancy—was included as a dichotomous measure of prevalence during the previous year in Models A, B and D. As was stated in the previous section, the incidence of truancy was measure as a categorical variable and, therefore, in Model C the variable was included as a set of dummy variables, each of

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<sup>16</sup> The fact that the model allows the inclusion of a time-varying predictor does not mean that it tests changes in those predictors. In fact, it compares between individuals with different values of  $X$  in each time period, not changes within individual.

<sup>17</sup>  $W_1$  was discarded in the estimation of the conditional models, given the decision to use lagged time-dependent variables: I cannot know the values of those variables in time 0, previous to the onset of marijuana use. The potential implications of this exclusion are discussed in the Limitations section of the Discussion.

which account for one category: 0 if never in the last 12 months or never in life was the reference; 1, if one or two times, 2, if three to nine times, 3, if ten to 19 times, 4, if 20 to 39 times and 5, if 40 or more times.

All the models were estimated clustering the students by their schools at the first wave, which seems to be particularly relevant in the case of this study given the fact that the classrooms in Chile are mainly stable settings throughout the school years, and that previous research has shown a classroom effect in marijuana use (Araos, Cea, Fernández, & Valenzuela, 2014). In any case, the only differences in the models without clusters were that attachment to school was a marginally but significant predictor of marijuana onset, and that the voucher predictor was reduced to having marginal significance.

The discrete-time survival model has a number of advantages that makes it particularly suitable for this study. A discrete-time survival model allows us to answer the question regarding whether an individual experiences a specific event and when this event occurs by taking into account the timing and the occurrence/non-occurrence of an event (Singer & Willett, 2003). In our case, the event of interest is the first use of marijuana, which has two possible states at any single point in time: either a student has started using marijuana at that time or before, regardless if he/she will still use it after the onset, or he/she has not started yet. This model also allows for the inclusion of time-dependent variables in the estimation of the survival function. Given that truancy might not be a fixed characteristic throughout the school years—those who skipped school one year, do not do it every single year—this feature of the model takes advantage of the panel data in this study, estimating each survival function based on the varying measure of truancy.

Two other features of the discrete-time survival model make it particularly appropriate for this study. First, it allows for a discrete-time specification, which is the case in this survey: time was measured by annual intervals with four waves of data. Second, it accounts for the right censoring of the data; something inevitable in this type of study, especially given the fact that drug use is not a common behavior in light of the short length of data collection. In this case, a 24.6% ( $N=1,150$ ) of the initial sample reported having initiated marijuana use at some point during the four years period.

However, the model makes some assumptions that should be addressed. First, survival analysis assumes proportionality, which means it assumes that the effect of a predictor on the odds of event occurrence is constrained to be the same at each point of time (Singer & Willett, 2003). Therefore, truancy at age 13 is hypothesized to have the same effect on marijuana onset as truancy at age 16. In the case of truancy, it is reasonable to think that this assumption could be violated: theoretically, we could expect that the effect of truancy decreases with age, as truancy becomes more common, something that has been shown in previous research (Henry et al., 2009). In order to evaluate this assumption, interactions between the key predictor (prevalence of truancy in the previous year) and each time indicator were included in the model, and the deviance statistics between both models (with and without interactions) were compared.

Second, the survival model, as any statistical model, might have a problem of state dependence, where the predictor's values at time  $t_j$  are affected by an individual's state at time  $t_j$  (Singer & Willett, 2003). In order to avoid this effect, lagged predictors for all time-dependent variables were included in the model to obtain the correct time order. This decision allows us to more precisely test the

hypothesis of truancy as a risk factor for marijuana use, and confirm the direction of this link. When running the conditional model, all those students who had used marijuana before the beginning of the study—7<sup>th</sup> grade—were excluded (Henry, et al. 2009), following one of the features of the survival analysis, which defines the beginning of time as the initial point when no one has experienced the event (Singer & Willett, 2003). In this sample, 335 students (7.3%) reported having used marijuana at least once during their lives when they were interviewed in the 7<sup>th</sup> grade. Potential consequences of this are discussed in the Limitations section of the Discussion.

#### *Missing data*

As discussed above, as in any longitudinal study, this one has problems with attrition that may lead to biased estimates, given that individual with characteristics associated with drug use were less likely to be retained in the study. In addition to selective sample attrition, missing information on individual items due to non-response could also be problematic. The main analysis was conducted with complete case information. In the case of this study, the use of a listwise deletion method may not be problematic given that for all the variables, except delinquent peers, the proportion of missing cases was less than 5% (Cameron & Trivedi, 2005). The proportion of missing cases for each variable included in the model is presented in Table 4. The obvious drawback of listwise deletion, in addition to possible biases, is the loss of statistical power, which is not a problem in this study given the relatively large sample size.

However, and following Allison (2002), a sensitivity analyses were conducted to evaluate the robustness of the results. The same model was estimated using two different data sets with imputed observations: first, using a mean sample imputation

for each missing value, and then using a conditional mean imputation, based on relevant variables, for those variables with more than 1% of missing cases. Any difference between the three imputation procedures is reported in the Results section.

In the case of the dependent variable, the non-response in marijuana use was imputed as YES in all cases and then as NO in all cases, creating two different data sets. Given that all the non-response in the dependent variable coincide with non-response in other variables, the conditional model run with the imputed dependent variable do not differ from the basic model. The descriptive survival function conditional to truancy is shown in the Appendix (Table 13).

## CHAPTER 4: RESULTS

First, I present descriptive characteristics of truant students, in order to describe those who engage in this behavior based on socio-demographic variables and involvement in other deviant behaviors. Next, the findings from the discrete time survival analysis are presented and the hypotheses are tested. I start with the unconditional survival model that provides descriptive information about the risk of onset in marijuana use throughout the study period. Then, the conditional model is presented as well as the analysis conducted to test the assumptions of the model.

### **Truant characteristics**

In order to characterize truant behavior, a dummy variable was created that takes a value of one when the students reported, in any wave, having skipped school at least once in their lives. Therefore, the variable distinguishes between those who have been truant at least one time ( $N=1,682$ ) and those who never reported having skipped school during the observation period ( $N=2,958$ ).<sup>18</sup> All the variables used in Table 6 were measured in the first wave (2008), so the comparisons are not affected by sample attrition.

In general, the differences between truant youths and non-truants youth follow the expected direction based on previous research (Henry, 2007). A higher proportion of those who reported having been truant used marijuana at least once in or before 7<sup>th</sup> grade, compared to those who had never been truant. A similar pattern is found with

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<sup>18</sup> The same comparisons were calculated with a variable that measures prevalence of truancy only during the four years from the study (year prevalence reported at least in one wave), and also taking into account only those who have the four waves. In the first case, the results are similar in magnitude and the same in terms of significance. When I took into account only those cases that complete the four waves of the study ( $N=2,643$ ), the differences followed a similar pattern in terms of magnitude, and direction, but were different in terms of significance in the case of school size (truants in smaller schools) and type of school (less proportion of non-truants in voucher schools). The differences in school size and voucher schools were significant at a .05 level.

other problematic behaviors, such as tobacco and alcohol use at the same age, and involvement in delinquent acts: in all cases, the proportion of truant youths reporting these acts was at least doubles the proportion of non-truants who reported them. Truant students are also less likely to come from a two-parent home and are more likely to have parents who do not have more than a high school diploma, have on average lower attachment with their parents and are exposed to lower parental

**Table 6:** Differences among those who reported truancy and those who do not (% in each category)\*

		NON- TRUANT (N=2958)	TRUANT (N=1682)	
Marijuana	<b>Marijuana use</b>	0.03	0.15	
Family Factors	<b>Parental attachment</b>	4.45	4.17	
	<b>Parental supervision</b>	3.35	3.08	
	<b>Two-parent house</b>	0.71	0.58	
	<b>Parent with high-school or more</b>	0.69	0.59	
School Factors	<b>School attachment</b>	4.09	3.83	
	GPA	<b>A</b>	0.41	0.2
		<b>B</b>	0.48	0.57
		<b>C</b>	0.1	0.23
	<b>Likely to go to university</b>	0.81	0.68	
	School size	116.7	116	
	School type	<b>Private</b>	0.21	0.1
<b>Public</b>		0.23	0.33	
Voucher		0.56	0.57	
Peers factors	<b>Peers' marijuana use</b>	0.09	0.24	
	<b>Peer attitudes against marijuana</b>	0.72	0.61	
Delinquency	<b>Prior in delinquency</b>	0.38	0.63	
	<b>Early delinquency</b>	0.07	0.12	
	<b>Tobacco use</b>	0.18	0.51	
	<b>Alcohol use</b>	0.18	0.41	
Control	Male	0.54	0.52	
	<b>Year of birth</b>	1995.2	1994.9	

In bold:  $p < .05$ , two-tailed. Test between non-truant and truant

\* All the variables were measured at the first wave. There are 28 cases excluded in this analysis because they did not answer the truancy question in all the different waves. supervision.

The variables related with school follow the same direction: truants have, on average, lower GPA, a lower school attachment, and lower aspirations of going to college. Also, in the expected direction, truant youths are largely represented in public schools. Truant youths reported in a larger proportion of friends who have used marijuana and a smaller proportion of friends that will intervene against marijuana use. Finally, no gender differences were found in the report of truancy.

In summary, truant students show a larger number of risk factors. However, these distributions give as only a descriptive image of those involved in truant behavior. Now, I turn to the discrete-time survival model in order to test the hypotheses of this study.

### **The onset of marijuana use**

In order to analyze the outcome of interest—the onset of marijuana use—I first fitted an unconditional survival model, in which the only independent variable is a time indicator for each wave. The life table gives us the overall survival function for the sample (Table 7). The table shows the risk set in each interval, i.e., the number of students who have not initiated marijuana use before the interval started (third column). It also lists the number of students at each interval that initiated marijuana use (failed) and the number of students that were censored due to attrition after each interval, i.e., those who even when they had not reported they used marijuana, left the sample after that time period. Finally, the last columns contain the hazard function and the survival function. The unconditional hazard function represents the likelihood of being initiation in marijuana use in a given period, conditional on not having reported marijuana use before. The cumulative survival function gives us the



probability that a random selected student will “survive” (i.e., not initiate marijuana use) until that point.

**Table 7:** Life table describing onset of marijuana use<sup>19</sup>

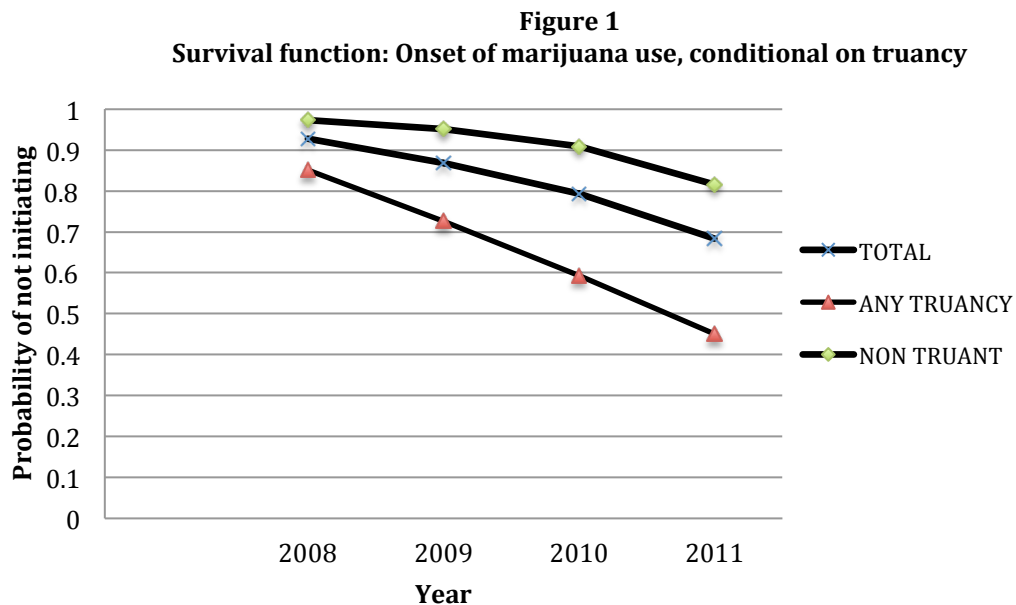
Wave	Grade	Time interval	Number of students entering the interval	Number of student initiated marijuana use	Number of student censored	Hazard Function	Std. Error Hazard	Survival Function	Std. Error Survival
2008	7	[0, 1)	4,668	335	415	0.0718	0.0039	0.9282	0.0038
2009	8	[1, 2)	3,918	251	668	0.0641	0.004	0.8688	0.0051
2010	9	[2, 3)	2,999	262	556	0.0874	0.0054	0.7929	0.0064
2011	10	[3, 4)	2,181	302	1,879	0.1385	0.008	0.6831	0.0081

The probability of not initiating marijuana use by 10<sup>th</sup> grade was .68. In numbers, by 10<sup>th</sup> grade, at least 1,150 of the 4,668 students had started using marijuana, a percentage close to 25%. This percentage does not account for the fact that some of the people who left the study may have initiated marijuana use after dropping out of the sample and, therefore, it is a conservative estimate of the number of 10<sup>th</sup> graders who have already initiated marijuana use. In fact, the percentage is lower than the one obtained in the national study conducted every two years by SENDA. According to SENDA, in 2011, 30.5% of the students in 10<sup>th</sup> grade reported having used marijuana at least one time in their lives (SENDA, 2011).<sup>20</sup> When the sample is restricted only to those students who were present in all four waves, the proportion of marijuana use increased to 29%, a percentage similar to the one obtained by SENDA: 764 students from the 2,643 who completed all the four interviews started using marijuana by the 10<sup>th</sup> grade.

<sup>19</sup> The results with the recoded dependent variable as Yes or No also do not differ significantly. Results show in Table 13 in the Appendix.

<sup>20</sup> Two considerations should be made: first, that the sample in our study were in 9<sup>th</sup> grade in 2011, so we are not comparing measures from the same year when comparing 10<sup>th</sup>-grade students between both studies. And second, that the report of life prevalence of marijuana in the Chilean school population increases significantly 2009 and 2011, going from 27% to 30.5%.

This survival function is graphically depicted in Figure 1. The graph shows that the survival function decreases gradually through the four waves, suggesting a linear effect of time. Given that the unconditional function takes into account all the students presented in the first wave, even those who already experience the event—onset of marijuana use—the initial survival in 2008 is slightly lower than 1.



The graph also shows the differences in the probability of not use marijuana among students who ever reported truancy and those who did not.<sup>21</sup> As expected by the hypothesis of this study, the probability of survival after period 4 of the study for those who reported truancy is almost a half of the probability of survival of those who do not reported truancy (.45 versus .82). However, this difference could be explained by individual characteristics other than truancy. Next, I turn to the conditional model, which includes all the confounding and control variables, in order to better test the hypotheses of this study.

<sup>21</sup> I used the same measures used in the description of truant students: any report of having been truant in their lives, in any of the four periods. The results are similar in magnitude using different measures.

## **The effect of truancy**

A series of four conditional discrete-time survival models were estimated, based on those students who were abstainers in the first wave. Truancy and all the confounding and control variables were included as lagged covariates to obtain the correct temporal order for the hypothesis. The results of the different models are shown in Table 8.<sup>22</sup> Odds ratios are reported in order to facilitate the interpretation.

The first hypothesis of this study is that those students who reported having been involved in truancy are more likely to initiate the use of marijuana, and that this association remains even after controlling for confounding variables. Model A includes only the time indicators and the prevalence of truancy in the previous year. The time indicators are all significant, and, consistent with the hazard function presented in the life table, the risk of initiating the use of marijuana increases from one year to another. Having reported truancy the previous year also has a strong and significant effect: in every wave, those who reported they have been truant are almost three times more likely to initiate marijuana use the following year than those who did not report truancy.

Model B includes all the confounding and control variables. The deviance statistic of the new model indicates that it is a better fit to the data. Moreover, although the effect of truancy decreases considerably in magnitude, it remains significant and in the expected direction, confirming the first hypothesis of this study: those who reported they have been truant in the previous year are 33% more likely to initiate marijuana use than those who did not report truancy, controlling for all the other predictors. Among the confounding variables, almost all the factors related to deviant behavior are significant and larger in magnitude than truancy. Particularly

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<sup>22</sup> The descriptive statistics of the variables, as well as their time varying of time-invariant status are shown in Tables 4 and 5 in the previous section.

interesting is the effect of tobacco use at 7<sup>th</sup> grade, which is by far the largest coefficient in the model. Those students who reported having smoked at least one cigarette at or before 7<sup>th</sup> grade are almost three times more likely to initiate marijuana use each year, even controlling for the other related factors. Two family factors, parental supervision above the sample mean and living with both parents, act as protective factors for the onset of marijuana use. To be in a public or voucher school is associated with a larger likelihood to marijuana onset compared to a private school, an expected relationship given the national statistics regarding marijuana use in Chile (SENDA, 2011). Finally, both peer measures are significantly associated with onset of marijuana use: the odds of marijuana initiation are 1.8 times higher for those who reported having at least one friend who uses marijuana, as compared to those who do not; and the odds of marijuana initiation are lower among those who reported that their friends will have negative attitudes toward marijuana use. None of the other variables were significant in predicting onset in marijuana.<sup>23</sup>

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<sup>23</sup> This model was run with both techniques of missing data: mean and conditional imputation. The results were practically the same. The only difference was in school attachment that was significant in both cases, with similar magnitude. No other differences in significance and no meaningful differences in magnitude were found. Results not reported, but available upon request.

Table 8: Effect of truancy on the initiation of marijuana use (standard error cluster by 72 schools)

		MODEL A	MODEL B	MODEL C	MODEL D
		OR (SD)	OR (SD)	OR (SD)	OR (SD)
W2 (2009)		0.059*** (0.006)	0.020*** (0.007)	0.020*** (0.008)	0.021*** (0.008)
W3 (2010)		0.082*** (0.008)	0.032*** (0.012)	0.033*** (0.011)	0.033*** (0.012)
W4 (2011)		0.134*** (0.013)	0.054*** (0.019)	0.054*** (0.019)	0.052*** (0.019)
Truancy previous year		2.939*** (0.345)	1.33** (0.183)		
	Truancy*W2				1.132 (0.277)
	Truancy*W3				1.223 (0.292)
	Truancy*W4				1.664** (0.356)
Truancy Frequency (Ref=0 days)	1-2 days			1.321* (0.209)	
	3-9 days			1.400* (0.282)	
	10-19 days			1.055 (0.455)	
	20-39 days			1.973 (1.101)	
	40+ days			1.592 (1.477)	
Has used tobacco at 7th grade			2.766*** (0.338)	2.763*** (0.338)	2.793*** (0.343)
Has use alcohol previous year			1.933*** (0.227)	1.936*** (0.228)	1.931*** (0.227)
Report some delinquent act at 7th grade			1.576*** (0.184)	1.574*** (0.183)	1.579*** (0.182)
First theft 10 or less year			0.966 (0.138)	0.972 (0.139)	0.973 (0.139)
Parental attachment			0.999 (0.053)	1.001 (0.054)	0.999 (0.053)
Parental supervision			0.834*** (0.049)	0.832*** (0.049)	0.836*** (0.049)
Live with both parent			0.709*** (0.063)	0.707*** (0.063)	0.707*** (0.063)
Parent finished at least high school			1.024 (0.105)	1.020 (0.107)	1.025 (0.106)
School attachment			0.915 (0.052)	0.917 (0.052)	0.915 (0.052)
GPA (Ref: C)	B		1.194 (0.180)	1.189 (0.179)	1.188 (0.178)
	A		0.969 (0.175)	0.966 (0.173)	0.962 (0.172)
Higher educational aspiration			0.990 (0.105)	0.992 (0.105)	0.987 (0.105)
School size			1.037 (0.042)	1.036 (0.042)	01.036 (0.042)
Type of school (Ref: Private)	Voucher		1.569* (0.372)	1.571* (0.373)	1.564* (0.372)
	Public		1.822** (0.439)	1.822** (0.439)	1.817** (0.439)
At least one friend uses marijuana			1.863*** (0.178)	1.854*** (0.176)	1.860*** (0.178)
Friends will say not to if student uses marijuana			0.705*** (0.072)	0.703*** (0.072)	0.704*** (0.072)
Year of birth			1.001 (0.052)	1.002 (0.053)	0.998 (0.051)
Male			1.117 (0.128)	1.114 (0.129)	1.118 (0.128)
Number of observation		8715	7122	7122	7122
Log likelihood		-2527.356	-1779.587	-1779.232	-1778.511

\*\*\*p<.01; \*\*p<.05; \*p<.1, two-tailed

### **Evaluating the effect of the frequency of truancy**

Students who reported truancy were also asked about how many days they had skipped school during the last year. A second hypothesis of this study is that the more days a youth reports having been truant, the more likely that he or she will initiate the use of marijuana use during the next time period. The frequency of truancy was included as a set of dummy variables, with 0 days truant as the reference category. The results are shown in the third column in Table 8 (Model C).

The effect of days truant is similar in magnitude, no matter how many days the student skipped, and it was only significant when the student reported that he or she had skipped school one to two or three to nine days during the last twelve months. Therefore, it seems that the effect of a larger number of days truant did not differ from the effect of the single measure of prevalence of truancy. This lack of evidence to a different effect based on different amount of days truant could be due to the small number of students who reported larger number of days skipped, which leads to a limited statistical power to detect any effect (see Table 12 in Appendix). The model was also tested with the variable recoded in three categories and using two combinations of days truant: first, as non truant, truant 1-9 days, truant more than 10 days; and second as non truant, truant 1-2 days, and truant more than 3 days. Only in the second case were both categories significantly different from no-days-truant, but with coefficients similar in magnitude. In all the specifications of the frequency of truancy, the confidence intervals from the different categories overlap, confirming the fact that there is no difference in the odds of initiating marijuana use among the

number of days truant. Based on these results, I cannot sustain my second hypothesis.<sup>24</sup>

**The proportionality assumption: is the effect of truancy the same for each grade?**

As stated above, the discrete-time survival model assumes that the effect of each predictor is the same in every period under study (Singer & Willett, 2003). For example, in the case of truancy, it means that engaging in truancy in the 7<sup>th</sup> grade affects the risk of marijuana onset to the same extent as engaging in truancy in the 10<sup>th</sup> grade. In the particular case of truancy, my variable of interest, it is reasonable to think that this assumption could be violated: theoretically we could expect that the effect of truancy decreases with age, something that has been shown in previous research (Henry, et al., 2009). In order to evaluate the assumption, a fourth model including an interaction term between the key predictor (prevalence of truancy in the previous year) and each time indicator was included in the model (Model D, Table 8).

Each interaction represents the effect of truancy in each time period. For example, the odds ratio in the interaction between time two and truancy (OR=1.1) should be interpreted as the effect of having reported truancy in wave one (because of the lag of the variables) on the likelihood of initiating marijuana use in wave two (2009). The main effect of truancy is implicit (Singer & Willett, 2003), and that is why it is excluded from the model, facilitating interpretation.

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<sup>24</sup> The only exception in this pattern was found when I used the conditional mean imputation for the missing cases. In this case, not only did the significance of each category change, but what is particularly interesting is that the increase in odds associated with a high level of truancy: the odds of marijuana initiation of those who reported that they have skipped forty or more days of school during the last twelve months are three times higher than the odds of those who reported not skipping school, controlling for the other factors. However, the confident interval overlaps with the other coefficients, given the magnitude of the standard errors. Again, the lack of evidence could be the result of the limited statistical power.

Contrary to what I expected, the effect of truancy does not differ between waves. In fact, the odds ratio are similar in magnitude and their confidence intervals overlap, indicating a linear effect between truancy and onset in marijuana.<sup>25</sup> Only the interaction between truancy and wave four is significant, meaning that only in the last year the effect of truancy is significant on marijuana initiation. However, the coefficients from the last time period of observation are usually less reliable because the risk set has been reduced over time.

Model B and D (without and with interactions) were compared using a likelihood ratio test: the difference in their deviance statistics—2.15—is under the .05 critical value of a  $\chi^2$  distribution, with two degrees of freedom. So, I failed to reject the null. The more parsimonious specification, assuming proportionality, seems to have a better fit than the more complex model, relaxing this assumption.

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<sup>25</sup> Similar results in terms of magnitude were obtained from the models with mean and conditional means imputations.



## CHAPTER 5: SUMMARY AND DISCUSSION

Truancy has traditionally been seen as a risk factor for other deviant behavior, and existing research has specifically shown that it is associated with the onset of substance use (Henry & Huizinga, 2007a; Henry et al., 2009). The present study provided additional empirical evidence of this relationship by examining the effect that truancy has on the onset on marijuana use in Chile, a different country with a different context than the United States, where most of the existing research has concentrated.

The results of the study show mixed support for its hypotheses. Consistent with the first hypothesis, the present study found that truancy increases the likelihood of initiating marijuana use and that this relationship remains after controlling for a number of factors that previous research has presented as potential confounding variables. This finding brings additional confidence to the existing research, and particularly to the finding that was presented by Henry and colleagues (2009). It seems that the relationship between truancy and marijuana use is not only tied to a particular geographical context, it is also present in a country—Chile—where to be a truant does not have any legal consequence and is seen as a discipline problem that should be addressed by the school or the parents, rather than a delinquent act to be addressed by the juvenile justice system. This is not the case in the United States, where the relationship between truancy and drug use can be analyzed in the larger framework of the association between status offenses and criminal acts.<sup>26</sup> The consistency between the findings presented in this study and previous findings in the American context may imply that the relationship is not driven by the criminalization of the behavior (based on a labeling standpoint); rather there should be other

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<sup>26</sup> Although most truancy cases do not go into juvenile courts, some researcher have reported an increasing use of courts as a way to combat truancy in the United States (Zhang et al., 2007).

mechanisms that explain this association, such as the unsupervised time spent with peers shown by Henry and Thornberry (2010). The study on which this thesis is based, does not allow going deeper in those mechanisms.

Regarding the second hypothesis, the findings show that the number of days that a student reported have skipped school does not make any difference in their odds of initiating marijuana use, an unexpected result. This lack of evidence for the second hypothesis could be due to the small number of students who reported having skipped more than nine days in the last year. When the variable was recorded with one category including all those students who reported more than three day, although the effect was significantly different than those who did not report being truant, the magnitude was similar to those who reported having skipped only one or two days. Based on these findings, it can be concluded that there is a difference between truant and non-truant youth in their probabilities to initiate marijuana use, but differences were not found among truant youths based on the incidence of truancy.

Finally, an interesting finding of this study is the large effect that tobacco use has on the onset in marijuana use.<sup>27</sup> The variable was included as a proxy of low self-control, with a fixed measure of life prevalence in 7<sup>th</sup> grade, when 29% of the students reported having smoked at least a whole cigarette. The present study was not about the role of tobacco use as an early indicator of problematic behavior, but the strong effect that tobacco use has on the onset in marijuana use could be inserted in the context of the changes in risk perception and prevalence that this drug (tobacco) has had during the last years in Chile.

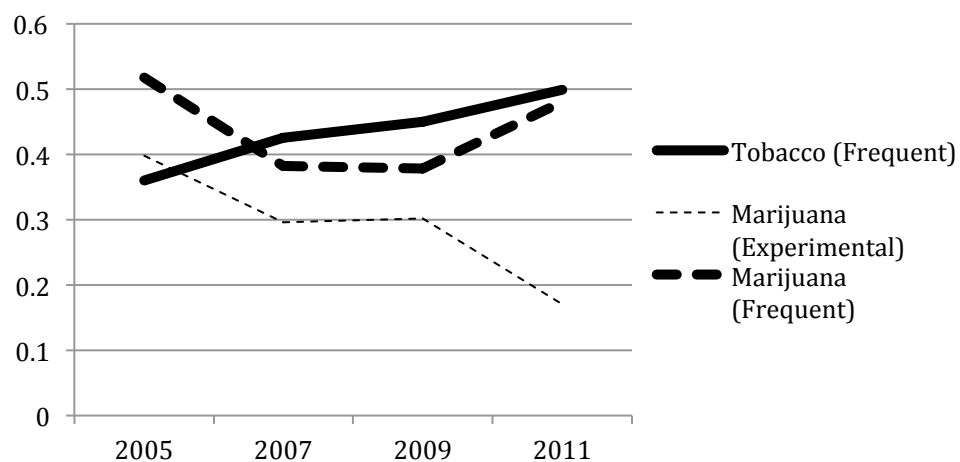
As shown in Figure 2, the risk perception of the frequent use of tobacco has increased constantly since 2005, exceeding substantially the perceived risk of

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<sup>27</sup> I need to thank John Laub for suggesting the inclusion of tobacco use as a measure of self-control.

experimental use of marijuana<sup>28</sup>. Even more, the proportion of students that agree with the statement that frequent use of tobacco has a high risk is almost the same (49.9% versus 48%) as the proportion who agree with the high risk of frequent marijuana use. As expected, this increase in risk perception has been associated with a decrease in the prevalence of tobacco in the population in general, and in the school population more specifically. The National Studies of Drug Use in School Population show that the reported life-time prevalence of tobacco in 8<sup>th</sup> grade has decreased from a 65% in 2001 to a 40.9% in 2011 (SENDA, 2011). Therefore, it is reasonable to believe that those students who report tobacco use at 7<sup>th</sup> grade may be particularly risk prone and problematic students.

**Figure 2: Risk Perception in Chilean School Population, 2005-2011 (% who declared high risk)**



Source: own elaboration based on SENDA (2011)

Another interpretation of the strong effect that tobacco use has on the onset of marijuana could be driven from the literature on the gateway hypothesis, which argues that there are sequences of involvement in drugs, that usually begin with

<sup>28</sup> The risk perception is measured with the following question: ‘How much do you think is the risk a person has when he/she does any of these things?’, with the options: no risk, slight risk, moderate risk, high risk.

tobacco or alcohol and proceed to marijuana and other illicit drugs (Kandel, 2002). The premise is that those individual who use one drug are at greater risk of progressing to another, a progression that starts generally with the more socially acceptable substances (i.e., alcohol and tobacco) (Hawkins, Hill, Guo, & Battin-Pearson, 2002). The role of tobacco use as precursors to the use of illicit drugs, specifically marijuana, has been the focus of a number of research studies in the area, which has shown the positive relation between previous tobacco use and subsequent marijuana use in the United States (Maldonado-Molina & Lanza, 2010) and in Latin America (Valenzuela & Fernandez, 2011). Based on the gateway hypothesis literature, the strong effect that tobacco use has on the subsequent use of marijuana is not only not surprising, but expected and consistent with the previous research that views tobacco use as the first step on a pathway to substance use. In order to better understand this pathway it is key that future research moves from the single measure of early onset in tobacco use that was used in this study and others (Baggio, Studer, Mohler-Kuo, Daeppen, & Gmel, 2013), to a time varying measure of prevalence and intensity of use.

Given that the present study attempts to replicate the study of Henry et al. (2009), some similarities and key differences between the studies should be presented. First, both studies find that truancy increases the risk of onset of marijuana use. However, Henry and colleagues concluded that truancy has not only a main effect on the onset in marijuana use, but also a clear “dose-response” effect, in which the more days a student reported being truant, the more likely he/she was to initiate marijuana use. In the present study, only the effect of truancy as a dichotomous variable was supported, and no differences were found in the likelihood of initiating based on the

reported number of days of truancy. This difference could be due to contextual factors or to measurement issues. The measure of truancy that they used was a percentage of school days skipped by the student, and I used as the primary variable of interest a dichotomous variable that measures prevalence in the last year, and then a set of dummy variables to look into the potential differences that could exist among truant students based on the incidence of this act. The Rochester study used by Henry et al. also used a 6-month interval that made them able to measure the effect of truancy with a shorter lag of time, while I was only able to measure a year-to-year gap, which may be problematic in terms of memory and confidence.

### **Limitations**

The present study has a number of limitations that need to be discussed, first regarding the use of self-report, and second regarding sample selection and attrition.

The study is based on the report of each student about his/her behaviors and attitudes, and as with any self-report, we need to recognize potential validity and reliability problems. However, there is some evidence that makes me less worried in the case of this particular study. Regarding truancy, the self-report is the only way by which we can know that the student was truant. If we define truancy as the intentional absence from school without parental authorization, official records will more likely account for any kind of absenteeism, including those with acceptable reasons (illness), or with parental agreement.<sup>29</sup> Youth know if they had permission or not, so they can assign the correct value to a question about truancy. Moreover, some researchers have

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<sup>29</sup> The lack of reliability of the official records may be particularly significant in the case of Chile. In Chile, the major factor to allocate public funding in the Chilean school system is the number of students that attend school every day (Paredes & Ugarte, 2011), a decision that was taken under the assumption that it will lead schools to promote attendance and reduce dropout. However, critics from this subsidy based on attendance argue that it promotes fraud: schools change their attendance records in order to obtain more resources.

shown that the self-report of truancy is more accurate than reports of GPA and sexual activity (Hallfors, et al., 2002). Regarding the self-report of drug use, research has shown that they have a satisfactory validity (Harrison & Hughes, 1997), especially regarding marijuana use, which has a higher concordance rate with physical tests (Mosher, Miethe, & Hart, 2011).

### *Missingness and attrition*

There are different potential sources of bias in this study. Perhaps the clearest one is the amount of missing information (i.e., do not know answers or not answering specific questions) within observations (i.e., students). As was stated above, I decided to conduct the analysis with participants with complete information, and conduct sensitivity analyses that increase the confidence in the results. Analysis conducted with mean imputation and conditional mean imputation of the independent and control variables led to the same general results, increasing confidence in them. The same conclusion is also obtained based on analysis conducted with the imputed—as yes or as no—dependent variable.

Given the decision regarding missingness and the use of lagged time-dependent variables, the first period of risk (2008) was discarded in the estimation of the conditional probabilities to survive. If those who initiated marijuana use in the first period or before ( $N=335$ ) had different patterns of risk predictors, the results would be biased. As it is shown in Table 9, those students who reported marijuana use in 7<sup>th</sup> grade were significantly different from those who did not in most of the variables used in the estimated models. They had lower levels of attachment to parents and school, were less supervised, came in lower proportion from two-parent households and from more educated families, reported lower grades in school and had a lower

expectation to go to the university. They also were more likely to have friends who used marijuana, reported involvement in other deviant and antisocial behaviors, and were truant in the previous year. Finally, those who reported they had used marijuana in the first wave came in a larger proportion from public schools. They were also significantly older than those who did not report marijuana use in the first wave. Of the 335 students who initiated marijuana use in 2008, 80% were 12 years or older when they first tried marijuana, an age range that coincides with the mean age with which every student started in 7<sup>th</sup> grade. In fact, when I regressed the onset of marijuana use in 2008 on the variables used in the model, none of the family variables and school variables, except for being in a voucher school, were significant.<sup>30</sup> In contrast, having used alcohol and tobacco, having peers that use marijuana, and having been truant increases the odds of reporting marijuana use at 7<sup>th</sup> grade, and having peers with attitudes against marijuana decreases the odds. All these variables may be also related to the age of the student. Finally, those with year of births above the mean (i.e. younger students) were 25% less likely to report marijuana use in the first wave. Given that most of the 335 students who had already begun using marijuana at the beginning of the study were older, and only 16% of them initiated marijuana use before age 12 year, it is likely that the left censoring of the data is largely due to the presence of older people in the sample. In any case, the results should not be generalized to students under 12 years of age or who initiated marijuana use before or in 7<sup>th</sup> grade.

**Table 9:** Differences in key measures at the first wave, among those who reported marijuana in 2008 and those who do not (% in each category)\*

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<sup>30</sup> School size, to be in a public school and to report a C grade as GPA were marginally significant,  $p < .10$ . Results not show but available upon request.

		NO MARIJUANA USER AT 7th GRADE (N=4,277)	MARIJUANA USER AT 7th GRADE (N=335)
Truancy	<b>Prevalence truancy</b>	0.09	0.48
Family Factors	<b>Parental attachment</b>	4.38	3.92
	<b>Parental supervision</b>	3.31	2.79
	<b>Two-parent house</b>	0.68	0.52
	<b>Parent with high-school or more</b>	0.67	0.54
School Factors	<b>School attachment</b>	4.03	3.61
	GPA		
	<b>A</b>	0.36	0.09
	<b>B</b>	0.51	0.54
	<b>C</b>	0.13	0.38
	<b>Likely to go to University</b>	0.78	0.55
	<b>School size</b>	117.7	102.7
	School type		
	<b>Private</b>	0.18	0.05
	<b>Public</b>	0.26	0.36
	Voucher	0.56	0.59
Peers factors	<b>Peers' marijuana use</b>	0.11	0.63
	<b>Peer attitudes against marijuana</b>	0.7	0.42
Delinquency	<b>Prior in delinquency</b>	0.44	0.83
	<b>Early onset on theft</b>	0.08	0.15
	<b>Tobacco use</b>	0.25	0.88
	<b>Alcohol use</b>	0.22	0.81
Control	Male	0.53	0.52
	<b>Year of birth</b>	1995.2	1994.6

In bold:  $p < .05$ , two-tailed. Test between non truant and truant

\*There are 56 students that did not answer the question regarding marijuana in 2008.



Two other sources of bias could be more problematic, leading to caution when interpreting the results. The first one is the problem with the sample frame in wave one. Although the sample frame was based on all the students from the selected classrooms, only those who were in class the day of the survey in 2008 formed the baseline of this study. Those absent were not registered, and no follow-up was done, which introduces potential bias in this study, specially given that the focus is on truancy and truant students are more likely to be absent on the day of the survey (Vaughn et al., 2013).

The best estimation that we can have of this bias is based on the report that the teacher of each classroom gave in 2008. One question asked about the “Average number of students who skip school in a normal day”. The mean number of students reported was 3.4, with a median of 2 and a range from 0 to 20.<sup>31</sup> Not all those cases are truant adolescents; given the question, it includes truants as well as sick students and those with parental permission. However, the number gives us an idea of the number of cases that failed to complete the first wave, having been randomly selected. In most of the cases, this number seems to be non-problematic (from 0 to 2 in 50% of the teachers’ report), but in others it could be (10 teachers reported that 10 or more students failed to go to school on any given day in their classrooms). At the school level, we have the information that was collected the day of the first wave. Based on that, we know that in 19 out of the 72 schools, 20% or more of the students that were registered<sup>32</sup> did not participate in the survey. Comparisons done between those 19

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<sup>31</sup> In secondary education in Chile, the average number of students in a class is 35, and this average varies by school type: private schools have on average 26 students per classroom, and public and voucher schools 37 students per classroom (Arrau, 2005).

In this study, the average number of students per class based on school records was 37 and the average number of students presented in class the day of the survey was 32. However, it is difficult to know how reliable the school records are, especially considering that the survey was conducted during the last months of the academic year and the records are not usually updated during the school year.

<sup>32</sup> Registration based on school records. See previous note.

schools and the others show some significant differences: they have a higher proportion of students who reported having used marijuana at the first wave, and who reported being a truant (.25 versus .17). They are also more likely to be public schools and schools from a medium-low SES. Given the information that we have, we know that this initial variability in the sample might lead to an underrepresentation of the more vulnerable and problematic students.

The second problem is with attrition. As in any panel design, not all those who started the study stayed in it during the whole period. Again, it is difficult to assume that random forces drive attrition in the study, and it is likely that the most truant, and the most problematic students, have been under-represented. However, it is also true that the survival analysis censors those cases that have already initiated the event of interest, and if in fact those who use marijuana are more likely to drop out of the sample, it would not introduce bias in the results insofar as they have dropped out of the sample after their onset. This is not the case. As shown in Table 10, those who left the sample before initiating marijuana use (“censored” by the model) differ from those who stay in on almost all the relevant variables, showing a higher risk of marijuana use based on the results of the model as specified in this study. They also differ, but in the opposite direction, from those who initiate marijuana use at some point during the four waves, whether having dropped out of the study or not. That is, they are at lower risk of being truant and of use marijuana, compared with those who reported marijuana use during the four years.

Therefore, it is impossible to assume that those who left the study without initiating marijuana use do it randomly, a particularly relevant fact, given the model that was estimated. Survival models assume that the random censored observations—those units whose observation was terminated for reasons other than the event of

interest (i.e., onset in marijuana use)—are noninformative, which means that the probability of being censored is the same as the probability of experiencing the event of interest, or, in the case of the discrete time survival analysis, that each interval's risk set is representative of all those individuals who have not experienced the event until that point (Singer & Willett, 2003; Guo, 2010). Violations of this assumption, which seem to be the case in this study, lead to bias in the estimation. However, as Singer & Willett state, when the hazard function increases over time “you are probably safe” (2003:462), because the unobserved heterogeneity leads to a decrease in the function over time.<sup>33</sup>

Based on the comparisons between schools regarding the initial sample selection and the comparisons presented in Table 10 regarding those who left the study without having used marijuana, I can conclude that the present study is likely to be missing students who are more truant and who use or are more likely to use marijuana. Given that truancy and drug use increase the likelihood of being out of the sample, either at the first wave or during the four-year period of the study, the present results are likely to have a downward bias: the estimate of the effect of truancy on the onset on marijuana is lower in this sample than in the parameter from the population. This sample selection would have made it harder to find support for my hypotheses, and therefore, makes me confident with the result that truancy does have an effect on the onset on marijuana use. In any case, results should be interpreted with caution.

As a following step in this research, it will be useful to compare the results with those from an imputed data set using multiple imputation procedures to better account for the uncertainty of the missing data. However, although this method allow us to

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<sup>33</sup> See Table 7 in the Results section.

correct the standard errors—which are less efficient using mean or conditional imputation—it does not avoid the potential bias that comes from sample attrition, given that the assumption of missing at random is difficult to sustain in the data used in this study.

**Table 10:** Differences in key measures at the first wave between those who left the study before have initiating marijuana use (censored), those who left the model because they initiate marijuana use (user); and those who stay without having initiated by wave 4 (stayer) (% in each category)

		<b>Stayer</b>	<b>Censored</b>	<b>User</b>	
		N=1,786	N=1,639	N=1,150	
DV	Marijuana use	0	0	<b>0.29</b>	
Key IV	Truancy previous year	<b>0.04</b>	0.11	<b>0.25</b>	
Family Factors	Parental attachment	<b>4.48</b>	4.34	<b>4.15</b>	
	Parental supervision	<b>3.42</b>	3.26	<b>3.03</b>	
	Two-parent house	<b>0.74</b>	0.65	<b>0.57</b>	
	Parent with high-school or more	<b>0.72</b>	0.62	0.62	
School Factors	School attachment	<b>4.12</b>	3.99	<b>3.82</b>	
	GPA	A	<b>0.49</b>	0.3	<b>0.21</b>
		B	<b>0.46</b>	0.54	0.55
		C	<b>0.08</b>	0.17	<b>0.24</b>
	Likely to go to university	<b>0.83</b>	0.74	<b>0.68</b>	
	School size	<b>119.6</b>	114.3	113.7	
	School type	Private	<b>0.26</b>	0.12	0.11
Public		<b>0.2</b>	0.33	0.3	
	Voucher	0.55	0.55	<b>0.59</b>	
Peer Factors	Peers' marijuana use	<b>0.06</b>	0.13	<b>0.32</b>	
	Peer attitudes against marijuana	<b>0.73</b>	0.69	<b>0.58</b>	
Delinquency	Prior in delinquency	<b>0.35</b>	0.44	<b>0.7</b>	
	Early onset on theft	0.08	0.07	<b>0.13</b>	
	Tobacco use	<b>0.12</b>	0.29	<b>0.6</b>	
	Alcohol use previous year	<b>0.13</b>	0.24	<b>0.5</b>	
Control	Male	0.51	0.54	0.55	
	Year of birth	<b>1995.2</b>	1995.1	1994.9	

In bold:  $p < .05$ , two-tailed. Test between Stayer and Censored; User and Censored

\*There are 93 cases that, although did not drop the study, did not answer to marijuana use, and therefore are missing in this table

## **Implications for research**

Despite the forgoing limitations, the present study makes a unique contribution to the field of problematic behaviors in adolescence, and particularly to the existing research regarding the relationship between truancy and marijuana use. It represents an attempt to replicate existing studies in another cultural context, in order to increase the reliability of the existing findings and advance our understanding concerning the additional risk that truancy brings to the onset of marijuana use.

The results of this study confirm previous longitudinal evidence regarding the effect of truancy on the initiation of marijuana use. The use of onset of marijuana as the outcome and the use of longitudinal data allow me to estimate the change in marijuana use—from non use to use of the drug—that follows participation in truancy, ensuring the correct time order. The relationship remains after control for potential confounding variables, which allows me to rule out a number of possible explanations for the link between truancy and marijuana use. Based on the present study, we know that truancy increases the risk of onset in marijuana use during the first years of secondary education in Chile, as it does in the United States (Henry & Huizinga, 2007a; Henry et al., 2009), a relevant finding given the negative outcomes that have been associated with an early onset on drug use (Loeber & Farrington, 2000).

These results can be inserted in the more general research area regarding the negative consequences of truancy, one of the most serious discipline problems at school. The clearest of these consequences are on educational outcomes. The absence of school—truancy being one kind—is related with lower academic performance (Paredes & Ugarte, 2011), which in turn increases the risk of dropping out of school (Henry et al., 2012), limits access to higher education, and decreases the likelihood of socioeconomic mobility and better professional opportunities (Reid, 2010). However,

as was shown in this study regarding drug use, truancy is also associated with other problematic behaviors that could impact a youth's development and wellbeing (Maynard et al., 2012). Previous research has argued that truancy usually occurs in a broader context of antisocial behaviors (van der Aa et al., 2009), in that it provides an ideal setting of unsupervised and unstructured time spend with peers (Osgood et al., 1996). In this sense, truancy can be seen as an early and powerful sign of problematic behavior, a mark that is feasible to detect in advance, and this study highlights the relevance of intervening in earlier stages to avoid the associated negative outcomes.

The present study also increases our understanding regarding marijuana use in Chile. Consistent with the evidence in the United States (Brown et al., 2001), the results show that previous involvement in antisocial behavior, family factors, and peer influences increase the risk of initiating marijuana use in adolescence. As was stated, particularly interesting is the larger effect that the use of legal drugs (i.e., alcohol and tobacco) has on the onset in marijuana. In contrast, none of the educational predictors were significant, although previous research done in Chile did find a significant association between attachment to school and marijuana use (Araos et al., 2014). It is possible that the effect of individual-level educational variables in the model, particularly school attachment, was mediated by the effect of truancy, a variable that was not incorporated by Araos et al., and has been strongly associated with disengagement from school (Henry et al., 2012).

However, the results of this study do highlight the role of school context, particularly regarding the type of school, a variable that in Chile is correlated with the socioeconomic status of the family in an educational system characterized for being highly segregated (Mizala & Torche, 2012; Hsieh & Urquiola, 2006). More generally, these results also highlight the relevance of the school years, as the developmental

stage when an important proportion of the drug users initiate their use, which is particularly true in the case of marijuana. Schools concentrate a group of children and adolescents together during a large proportion of the year and they are the place where adolescents make most of their friends (Ennett & Bauman, 1993). This fact makes schools a particularly favorable context for peer influence, where deviant peers may find one another and non-deviant youths may be exposed to positive attitudes regarding the use of marijuana and to friends who use the drug. In the case of Chile, this effect could be magnified by the fact that classrooms are a relatively stable setting: most of the students stay in the same school and the same classroom during the fourteen years of schooling (Araos et al., 2014). A recent study conducted in Chile showed that youth exposed to a higher marijuana tolerance at the classroom level has in fact a higher probability of reporting marijuana use (Araos et al., 2014), reinforcing the role that the school context plays in the constraint of antisocial behavior, above and beyond the individual differences and the effect of deviant friends.

One specific mechanism through which schools may limit the likelihood of engaging in problematic behaviors is by restricting the time that youths have without supervision (Gottfredson, 2001). Truancy involves a reduction in supervision in a time that is generally spent with friends, and therefore could increase the likelihood of engaging in drug use. In this sense, truancy provides an ideal setting for engaging in antisocial behavior, as has been hypothesized by Osgood et al. (1996) in their unstructured socializing approach: a time without conventional activities, in absence of adults and conventional authorities, and with friends who are more likely to reinforce deviant behavior, especially outside the boundaries of the school. Although this mechanism has been successfully tested in the American context (Henry &

Thornbery, 2010), with the data available, I cannot test whether the unsupervised time spent with peers mediates the effect of truancy on drug use in Chile.

### **Policy implications**

A better understanding of the relationship between truancy and drug use may also support the implementation of better preventive policies in the drug field.

A general statement could be applied regarding the relevance of implementing programs in schools to prevent or reduce truancy and improve the educational outcomes. However, based on the findings from this study, we know that an effective program of this type would have not only an effect on academic achievement, but might also reduce other problem behaviors, such as drug use. Although this study does not look into other types of deviant behavior, research done in the United States showed that an 80% of the young offenders in jail committed their offenses while being truant from school (Reid, 2010). Therefore, every dollar-*peso*-invested in keeping youths in school may have a substantial payoff, not only in the educational sphere but also in the prevention of other problematic behaviors, with long-term negative consequences.

Truancy has been seen as a first signal of problematic behavior, which initiates early in the life course, and therefore has a number of advantages in regard to prevention programs. First, it is a clear and public risk factor, difficult to hide from the school personnel compared to other factors like child maltreatment (Henry et al., 2009); and second, it usually starts early in life before even a youth engages in other behaviors, increasing the chances of an early intervention. Following the life course premise that early transitions contribute to negative life outcomes (Carbone-Lopez & Miller, 2012), a prompt intervention in a factor that research has shown increases the



risk of drug use, delinquency and school dropout rate, may be particularly beneficial for the individual and the society.

Particularly regarding the generation of prevention programs, because truant students are more likely to get involved in other type of problematic behaviors (Vaughn et al., 2013), it is important to think that interventions could prevent truancy in the context of a multiplicity of associated problems. Along the same lines, programs that attempt to reduce or prevent drug use need to take into account the relationship between truancy—or more generally, school disengagement—and drugs, incorporating an educational-commitment component in them. In this regard, in the last four years, SENDA, the Chilean governmental agency in charge of drug policies, has been working in a multidimensional prevention school-based program—*Chile previene en la escuela*—that attempts to prevent drug use, school violence and school dropout rate. The program was developed following the Communities That Care Program and its risk factor approach (Hawkins, 1999), and to my knowledge is the only program that includes truancy as a targeted risk behavior.

### **Future direction for research**

There exist several directions for future research to refine and further our knowledge regarding the onset on marijuana use and the negative consequences associated with truancy. First, an apparent next step for research is to examine the effect that truancy has on the escalation in marijuana use, following what Henry and Thornberry did in 2010. The evidence regarding the association between truancy and the escalation or growth in substance use over time has been less consistent, with some evidence that shows that truancy leads to an increase in the use of marijuana (Henry & Thornberry, 2010). While other research shows that although truancy

explains the initial level of marijuana use, it is not related to the increase in marijuana use over time (Bryant & Zimmerman, 2002).

Second, as was stated, the relationship between truancy and marijuana use can be explained from more than one perspective. However, only one study has tested some of these theories in order to understand the mechanism that mediates this effect, finding support for the unstructured socializing approach (Henry & Thornberry, 2010). To test competing theories is not only an academic exercise, it is information that could be relevant in order to formulate public policies that allow schools and families to address this problem. Nowadays, most of the schools in Chile and the United States tend to respond to the problem of truancy with disciplinary exclusions (Zhang et al., 2007). If the Osgood et al. (1996) unstructured socializing theory is in fact the prominent mechanism that mediates the relationship between truancy and drug use, these types of policies only give youths more opportunities to engage in antisocial activities, increasing the problem that they are built to control. More research regarding the potential mechanisms could better inform policymakers and schools in order to design and evaluate different ways to discipline those who engage in truancy in a way that could increase their engagement in school and conformity instead of the opposite.

The research has also shown that youths who use marijuana differ from those who do not, even before they initiated marijuana use (Chatterji, 2006; McCaffrey, Liccardo Pacula, Han, & Ellickson, 2010). This study, and most of the studies conducted until now, uses an adolescent school sample, with measures that do not start before 13 years of age. Not only do we know that a number of students have already started to use marijuana before the first wave (7% in this study), we also know that those who start earlier are at higher risk for escalating in the use of drugs

and engaging in other types of antisocial behavior (Anthony & Petronis, 1995; Substance Abuse and Mental Health Administration, 2013). Truancy is also a behavior that might start earlier during the school years (Loeber & Farrington, 2000; Reid, 2014). These facts point to the need to study the relationship between truancy and drug use with earlier measures of individual characteristics, ideally before the onset of truant behavior and drug use.

Finally, previous research consistently points to truant behavior as a problematic behavior that could be seen as a stepping-stone to a larger number of deviant behaviors and negative outcomes (Garry, 1996). The present study brings additional support to this statement, particularly regarding the onset in marijuana use. However, more research should be conducted regarding other potential consequences of truancy. Particularly relevant are the association between truancy and criminal activity, and truancy and school dropout. In their study about dropouts and delinquency, Sweeten and colleagues concluded that most of the relationships between them are driven by pre-existing differences between dropouts and non-dropouts (Sweeten, Bushway, & Paternoster, 2009), and they pointed to the need to study early indicators of dropouts. The findings presented by Henry et al. (2012) are consistent with this statement, showing that school disengagement is a strong predictor of school dropouts, which in turn mediates the relationship between school disengagement and other serious problem behaviors in adulthood (Henry et al., 2012). If more research consistently shows a relationship between truancy and dropouts, schools and related institutions could start using truancy as an early indicator of future dropout, which intervention might reduce the negative consequences that dropout have throughout the life course.

The hope is that the present study encourages this kind of additional research in order to develop a deeper understating of the effect of truancy on the onset of substance use, and, more broadly, on the engagement in other problematic behaviors. I do believe that this kind of research will support the development and implementation of better preventive policies for truancy and for drug use.

## APPENDIX

Table 11. Correlation Matrix

Table 12. Frequency of reported days truant

Table 13. Life table by truant behavior, non-reponse of dependent variable recoded a yes/no

Table 11: Correlation matrix (average correlation across waves)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1 Onset in Mariju	1																					
2 truancy	.136	1																				
3 freq truancy	.130	.872	1																			
4 early_theft	.044	.050	.051	1																		
5 delinq	.187	.119	.105	.288	1																	
6 TOBlife	.243	.176	.175	.070	.251	1																
7 alcohol	.239	.199	.187	.077	.220	.288	1															
8 parent attach	-.094	-.133	-.126	-.051	-.092	-.162	-.151	1														
9 parent superv	-.198	-.197	-.185	-.077	-.237	-.163	-.272	.401	1													
10 family structur	-.119	-.093	-.087	-.040	-.089	-.113	-.094	.196	.091	1												
11 parent_educ	-.006	-.051	-.060	.020	-.005	-.095	.012	-.079	.044	-.031	1											
12 public	.042	.057	.066	-.025	.014	.042	-.055	-.046	-.024	-.062	-.198	1										
13 voucher	.017	.007	.001	-.015	.027	.035	-.007	-.050	-.011	.030	-.084	-.598	1									
14 school size	.003	.019	.009	.000	-.003	-.038	-.050	.028	-.022	.046	.062	-.086	.186	1								
15 GPA	-.091	-.139	-.145	.012	-.114	-.200	-.079	.159	.161	.093	.207	-.071	-.147	.037	1							
16 likely univ	-.066	-.093	-.094	.007	-.058	-.106	-.051	.217	.200	.063	.210	-.120	-.073	.037	.288	1						
17 school attach	-.127	-.166	-.181	-.059	-.170	-.116	-.187	.331	.424	.052	.007	-.027	.030	.000	.245	.249	1					
18 peer attitudes	-.120	-.074	-.074	-.028	-.128	-.055	-.086	.097	.221	.049	.013	-.044	-.009	.016	.078	.083	.195	1				
19 peer use marij	.163	.155	.161	.032	.145	.175	.166	-.126	-.197	-.056	-.069	.035	.028	-.043	-.127	-.117	-.138	-.232	1			
20 gender	.038	-.005	.008	-.020	.102	-.083	-.046	.132	-.099	-.006	.032	.135	-.031	-.004	-.101	-.061	-.100	-.170	.011	1		
21 year birth	-.022	-.037	-.059	.006	-.060	-.113	-.077	.078	.074	.055	.025	.013	.076	.042	.057	.079	.055	-.014	-.038	-.007	1	

**Table 12:** Frequency of reported days truant

	2008	2009	2010
None	3,886	3,448	2,668
1 to 2 times	322	333	374
3 to 9 times	123	153	141
10 to 19 times	36	47	46
20 to 39 times	12	10	17
40 or more times	16	15	9
<i>Missing</i>	<i>273</i>	<i>168</i>	<i>116</i>

**Table 13:** Life table by truant behavior, non-reponse of dependent variable recoded a yes/no

TOTAL		Any truancy			No truancy		
Year		DV as missing	DV as YES	DV as NO	DV as missing	DV as YES	DV as NO
2008	0.9282	0.8341	0.8301	0.8341	0.9648	0.9621	0.9648
2009	0.8688	0.7051	0.6939	0.7043	0.9311	0.9184	0.9311
2010	0.7929	0.5577	0.5386	0.5570	0.8829	0.8633	0.8829
2011	0.6831	0.4137	0.3695	0.4019	0.7839	0.7346	0.7765



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