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ABSTRACT

Building Human or Criminal Capital? School Peer Effects on Future Offending¹

To analyze whether there are causal peer effects in criminal behavior among young students in upper secondary education. We follow four cohorts of Danish students (N=27,525) when they complete 9th or 10th grade and start upper secondary vocational education with new peers. The exogenous variation in the proportion of new peers with criminal records between cohorts within the same school and program is used to identify causal peer effects. Our analysis finds important and significant nonlinear peer effects. Students who enter a program with new peers who have a high crime propensity are 1.8 percentage points more likely to be charged with a criminal offence within 12 months of commencing vocational education. However, students with a history of repeated offenses, who enter a program with new peers with a low crime propensity, reduce their probability of future offending from 31.5 percentage points to 18 percentage points. The results support the notion that students in upper secondary vocational education might build criminal capital by interacting with schoolmates with prior charges. Yet, our study also shows that a new low-crime peer group in upper secondary education can have a positive influence to students with a history of criminal offenses.

JEL Classification: I23, K14

Keywords: peer effect, crime, education

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1 Introduction

It is well-established that improving education can yield a reduction in crime (Lochner and Moretti 2004).² In light of this knowledge, a seemingly obvious policy path would be to ensure that at-risk adolescents, previously involved in juvenile crime, undertake education to reduce their risk of recidivism and enhance life course outcomes, such as employment and income. Enrolment in upper secondary education during young adulthood could be a turning point that enhances the interactions with prosocial peers and increases the probability of desistance from crime in line with other transitions such as employment and marriage (Sampson and Laub 1993). One possible reservation against this policy, however, would be the risk of young delinquents influencing classmates to engage in criminal behavior.

Over the years, an extensive criminological literature has demonstrated the significance of deviant peers (e.g. Akers et al. 1979; Elliott and Menard 1996; Haynie 2001; Matsueda and Anderson 1998; McGloin 2009; Thornberry et al. 1994; Warr 2002). Within this large body of empirical research, there has long been a focus on peer influence among friends in primary and secondary school. But, what happens when adolescents complete lower secondary education (9th/10th grade), and change schools and peer group upon entering upper secondary education? This transition typically takes place at the ages of 16–20 when we know that the age–crime curve peaks and the trajectories of adolescent-limited and life-course persistent offenders part ways (Moffitt 1993). Peer relations are of great importance during these formative years, as parents’ influence decreases and acceptance and status in peer group becomes more important during adolescence (Young and Weerman 2013). This study contributes to the existing literature by investigating peer influence at the influential transition to upper secondary education and using exogenous variation in the composition of school peer group to identify causal peer effects.

Identification of peer effects in non-experimental settings is particularly difficult (Manski 1993), and the methodological debates on how to separate peer influence from selection effects are ongoing within the different fields of the social sciences (e.g. Angrist 2014; Paternoster et al. 2013; Shalizi and Thomas 2011; Young et al. 2014).³ The vast majority of criminological studies of peer effects rely on self-report data, focus on friendship relations, and have applied both cross-sectional and longitudinal designs.⁴ The standard methods in the criminological studies of peer influence are still multivariate statistical models (Paternoster et al. 2013).

² Lochner and Moretti (2004) established a causal link. Other causal studies have followed, e.g. Hjalmarsson, Holmund, and Lindquist (2015); Machin et al. (2011); and Merlo and Wolpin (2015). For a recent review of the education and crime literature see Hjalmarsson and Lochner (2012).

³ Some of the debate in the criminological literature is based on different theoretical positions, most notable the critics pointed out by Gottfredson and Hirschi (1990), who argue that peer effects are only spuriously related to delinquency due to measurements errors and selection effects.

⁴ The methodological discussions among criminologist also includes debates about the ‘right’ way to measure exposure to deviant peers, in particular whether to rely on perceptual or self-reported measures of peer attitudes and behaviors (e.g. Haynie and Osgood 2005; Young and Weerman 2013; Zhang and Messner 2000).

These studies include covariate adjustment for delinquency propensity, using, for example, measures of self-control or prior delinquency, (e.g. Matsueda and Anderson 1998; McGloin 2009), longitudinal data on friendships to account for the causal ordering (e.g. Elliott and Menard 1996; Weerman 2011; Young and Weerman 2013), and social network analysis (e.g. Haynie 2001; Haynie 2002; Haynie and Osgood 2005; Young et al. 2014). More rigorous methods have not yet been applied to address the methodological challenges of identifying causal peer influence in non-experimental settings. Recent research suggests that prior studies may have overestimated the relationship between individual and peer deviance, when research designs do not account for individuals' self-selection into homophily friendships (Young et al. 2014).

A range of criminological theories about peer effects and delinquency exist and, among these, the social learning theories (Akers 1998; Sutherland and Cressey 1960) have found support in a large number of empirical studies (Pratt et al. 2010). In this theoretical perspective, exposure to deviant peers is assumed to prompt higher levels of delinquency due to the association with deviant attitudes and norms, direct modelling of criminal behavior, and indirect reinforcement effects. Although these theories have been subject to a very large body of empirical work, the role of school or classmate peers, which is a natural peer group for adolescents, are still underexposed, as friend networks have been the primary focus. The notion that peer influence may work in larger social networks in schools is, however, not new. A few studies, for example, Payne and Cornwell (2007), Rees and Pogarsky (2011), and McGloin et al. (2014), show that the behavior of both friends and schoolmates is associated with delinquent behavior. We contribute to previous research with a study that explores the effect of criminal behavior in a broader peer group among older students who leave lower secondary school, enter high school, and are likely to form new social networks (and friendships) among the new peers in upper secondary education.

This study employs a new research strategy to identify peer influence on criminal behavior in school settings by analyzing the effects of the composition of school peers. Our methodological approach builds on the large economic literature that has investigated peer effects in education (see Eppele and Romano (2011) and Sacerdote (2011) for recent reviews). We use a quasi-experimental setup, and analyze the effects of peers with prior criminal charges on future offending by comparing students from adjacent cohorts in the same program within the same school. This identification strategy, which exploits within school and across cohort variation in peer groups, is new to the criminological literature, but has previously been applied in several different studies of peer effects on educational attainment (e.g. Bifulco et al. 2011; Hanushek et al. 2003; Hoxby 2000; Lavy and Schlosser 2011). When investigating peer effects, the individuals' self-sorting into groups and friendships complicates the identification of causal peer effects, as it becomes difficult to disentangle the peer influence from the selection effect. In this study, we use information from multiple school cohorts to compare individuals who enter the same program at the same school, the only difference being that they finish 9th/10th grade in different cohorts, and therefore encounter (slightly) different compositions of peers in upper secondary

education. The quasi-experimental design, with a mix of fixed effects (school, program and school specific time trends) in conjunction with attributes of the data, such as change of school (and peer group) between lower and upper secondary school, enables us to address the methodological challenges in a new way and investigate whether school peers influence future offending.

The empirical analyses use a large dataset (N=27,525) constructed from population-based administrative register data for the years 1980–2014, and includes all Danish students (and their parents) enrolled in lower and upper secondary schooling. We analyze records from four consecutive cohorts of students who finished their compulsory schooling (9th/10th grade) in 2008 to 2011 and enroll in upper secondary vocational education and training (VET) directly from lower secondary school. The dataset includes information on all official charges, convictions, and sanctions (from 1980 to 2014), and is only subject to attrition caused by death or migration. Using administrative records for the entire Danish population of students, we are able to control for a very large set of covariates among the individuals, their families, and their school peers (in both 9th/10th grade and upper secondary education).

As a natural starting point, we initially estimate linear-in-means models, and then extend prior research by investigating a range of different heterogeneous peer effects.⁵ First, we study whether school peers pose a risk or protective factor to future offending depending on the proportion of students with prior criminal charges. The transition to upper secondary education with new peers opens the possibility of both positive and negative effects, and begs the question of the existence of a nonlinear relationship in peer effects. We follow previous research (e.g. McGloin 2009; Rees and Zimmerman 2016) highlighting prior delinquency as an important moderator of the peer influence, and investigate whether nonlinear peer effects are linked to students' prior crime history. Second, we explore the possibility of crime-specific peer effects inspired by research documenting causal peer effects among offenders in juvenile correction facilities and first time prisoners (Bayer et al. 2009; Damm and Gorinas 2016). These studies find that recidivism, after having served time with someone who has a history within the same type of crime, is reinforced through a peer effect. Third, we construct gender- and ethnicity-specific peer measures to analyze whether school peers with the same gender and ethnic background influence students more than the average proportion of peers with prior criminal charges.

We find no significant impact of the peer group when we look at the average effects of the proportion of students with prior charges on the probability of upper secondary schooling students' offending during the first 12 months after enrolment. However, once we allow for nonlinear peer effects combined with interaction

⁵ The focus on heterogeneous peer effects is evident in the literature of peer effects on academic achievements; Burke and Sass (2013), Cooley (2010), Epple et al. (2002), Hoxby and Weingarth (2006), and Lavy et al. (2012) all find that classmate peer effects may differ across an ability gradient. Heterogeneous classmate peer effects along observable gradients such as gender or race have also been found, e.g. Fryer and Torelli (2010) and Hanushek et al. (2009).

terms for the student's own criminal history, a significant peer group influence is found. The effect only shows in classes with the highest level of students with prior charges, with a medium group as reference. Interaction terms are included in order to answer the empirical question of whether classmate peers in upper secondary vocational education pose a risk or protective factor to students' criminal behavior. We find a causal protective factor: students with history of offending benefit from entering a program with new peers and a low proportion of students with a criminal history (lowest quartile of programs, 0-10 percent of the students with prior charges). This finding demonstrates that the nonlinear peer effects, in part, are moderated by students own criminal history. Inspired by the large body of friendship studies, we are compelled to also investigate the importance of a narrower peer group definition, therefore, we only focus on peers of same gender and/or ethnicity. Following the same line of reasoning, we also investigate whether peer effects are crime-specific, however, in this case, our results are inconclusive, as the findings are sensitive to model restrictions. In contrast, the gender- and ethnicity-specific peer group measures provide statistically significant average peer group effects, although the difference to the baseline results is relatively small.

The paper is organized as follows. In the next section, data, our sampling procedure, and the institutional settings are described. In section 3, we explain the identification strategy for isolating the impact of peers from other potential explanations or confounding factors, as well as the various model specifications. Subsequently, in section 4, we report all the empirical results. In section 5, we discuss the results and, finally, in section 6, some concluding remarks and a future agenda are provided.

2 Institutional Settings and Data

In Denmark, upper secondary education consists of two main tracks: vocational education and training (VET) and general upper secondary education. Programs in the general track are academic and last 2–3 years, and their main purpose is to prepare and qualify students for higher education. In the vocational track, programs last 3.5 years on average. The vocational programs are based on a dual training system with a combination of school-based modules and in-company practical apprentice training. Upon completion, the students can undertake skilled employment in the labor market. Twelve programs exist in the Danish VET-system.⁶ They all start out with a basic training program, which typically last 20–30 weeks, and cover approximately 110

⁶ The list of different programs is:

- (1) Commercial trade: sales assistant, national mail service employee, bank clerk, office clerk.
- (2) Building and construction: bricklayer, plumber, glazier, woodworker.
- (3) Transport and logistics: truck driver, driver.
- (4) Mechanics: motor mechanic, bicycle mechanic.
- (5) Building and citizen services: building caretaker, security guard, and receptionist.
- (6) Media production: media graphic designer, photographer.
- (7) Food production and catering: baker, cook, butcher, miller, waiter.
- (8) Production and developments: blacksmith, toolmaker, industrial operator.
- (9) Electric and IT: electrician, IT supporter.
- (10) Styling: hairdresser, cosmetician, nail technician.
- (11) Animal and plants: farmer, gardener.
- (12) Health and care: social and health care assistant.

different vocational professions. The basic programs are school-based whereas the remaining education is a mix of in-company training (50-70 percent) and school periods (30-50 percent). To continue from the basic to the main program, VET-students normally have to obtain an apprentice contract with a private firm.⁷

2.1 *Administrative Data*

The empirical analysis is based on administrative register data provided by Statistics Denmark. We build a dataset cutting across 12 different administrative registries, including official information from the Crime Statistics Register, the Register of Social Assistance to Children and Youth, and the Register of Prescriptions of Medicinal Products. A unique personal identifier enables us to match the detailed information on this wide range of registries for *all* individuals and their families. The information includes demographic and socio-economic information, as well as crime and education history. The datasets from the Danish Criminal Registry hold all official criminal records from 1980 to 2014 in Denmark, and contain information on charges, convictions, and sentences, including the type, date, and place of offense. The education data holds information on all entries in the Danish educational system. Transitions in the school system and identification of pupils and students' schoolmates is possible through cohort and program identifiers.

2.2 *Sample restrictions*

The empirical analysis is based on a sample of four consecutive cohorts of pupils in ninth or tenth grade in lower secondary school during the years 2007/2008 to 2010/2011. We restrict the sample to individuals who enter an upper secondary VET-program directly from lower secondary school. The requirement that our sampled individuals make a direct transfer from lower to upper secondary education is necessary in order to keep track of each individual's initial conditions, and hence limit the potential effects from other peers that could turn up had they taken a sabbatical year or a job in the year after lower secondary school. VET-schools often have enrolment several times a year, but more than 90 percent commence in August, and we limit the sample to students who leave lower secondary in June and continue to a VET-program in August. We further restrict the sample to the 10 technical basic programs with similar structure, and thereby exclude Commercial and Health & Care programs, which have markedly different characteristics. Dropout rates from vocational education are very high, partly due to a shortage of apprentice contracts. Landing such a contract can be particularly difficult for students with criminal records, and we, therefore, restrict the analyses to the period of the basic programs as students in the main programs reflect a selected group of the source population of VET-students.

The analytic framework in this study uses the variation in the proportion of students with a criminal charge within the same VET-school and program across different cohorts to identify peer effects. Hence, we exclude records from students who are enrolled in a program at a school, which is not represented in the dataset

⁷ It is possible for students to deviate from the rule. In particular, in some of the programs, students can undertake a school-apprenticeship.

in at least two consecutive years. Furthermore, we exclude students enrolled in programs with an annual enrolment of less than 10 students in a particular school, as well as records from a few schools in the years 2008–2009 that, for example, due to school fusions, change the administrative registration of pupils. Table 1A in the appendix shows how these sample selection criteria affect the number of observations. The sample requirements leave us with a sample of 27,525 students, who start up in one of 82 schools, divided into 10 programs.

2.3 *The Peer Group Measure*

The peer group in upper secondary vocational education is defined as students who commence the same VET-program (for example Mechanic, Building or Styling) in August the same year. The number of students and programs vary between the different schools (see Table 1), and the size of the peer groups differ.⁸ We cannot rule out that, for example, the large colleges and programs might have more than one class within the same VET-program, and hence, conservatively, we refer to schoolmates or school peers throughout the article, although our cohort and program specific peer group are more narrowly determined, and in some cases are constituted by classmates. For the 27,525 students who enrolled in vocational education in the years 2008–2011, we include information on all their peers in the VET-program, irrespective of whether they have been out of the educational system for one reason or another. In principle, peer groups come in many forms and the choice of peer group is, therefore, subject to some discretionary choice. The purpose of this study is to understand whether an individual's schoolmates influence his or her behavior with respect to crime. Hence, for each individual in our sample, the peer group is defined as the group of fellow students in the same VET-program, irrespective of whether they transit directly or have been out of the educational system. We measure the characteristics of their peers before entering the VET-program and calculate the proportion of peers with prior criminal charges within every program and cohort at the different schools. We only include peers' records of criminal charges two years back. This restriction implies that we measure prior criminal behavior in a similar manner to students entering directly from 9th or 10th grade (usually they are 17 years old and the official criminal records go back to age 15). Furthermore, the peer measure is constructed as a 'leave-out-mean' for each individual in the sample, so that, for each individual, it reflects the proportion of schoolmates with prior criminal charges (excluding that individual). In the empirical analyses, we are interested in exploring heterogeneous peer effects, and, inspired by prior research documenting the significance of crime type and individual characteristics, we construct two extra types of peer measures. First, we construct gender-, ethnicity-, as well as gender and ethnicity-specific peer measures, in which only peers with the same characteristics as the individual are included in the calculation of the proportion of peers with a prior criminal charge. Second, we construct crime-specific peer measures, calculated as the proportion of school peers with a specific type of

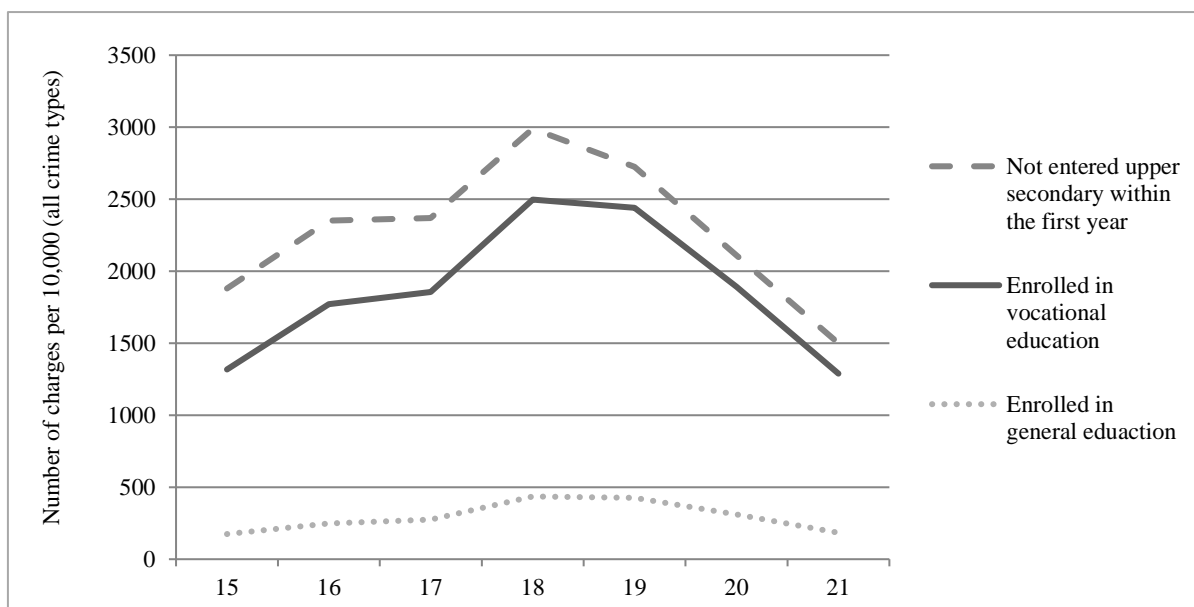
⁸ To take account of potential differences according to the size of the peer group we include a variable for the number of students in the specific VET-program, cohort and college in the empirical analyses.

prior charge. This includes the 3 overall categories: penal code offenses, traffic offenses, and special law offenses, as well as the largest subcategories: burglary, theft, violent, and drug offenses. The extra peer measures are included in the analyses, in section 4.2 and 4.3, respectively.

2.4 A First Look at the Data

The purpose of this paper is to analyze whether there are peer effects in criminal behavior among students. Therefore, we focus on a group of students who complete lower secondary education (9th or 10th grade) and continue in the educational system by entering an upper secondary vocational education. Figure 1 demonstrates how the age–crime curve peaks in adolescence and that Danish VET-students are far more involved in criminal behavior than students in general education. This underlines the motivation for investigating peer influence among students in VET-schools, as they are very likely to meet new peers with prior criminal behavior, and at time in their life when offending rates are at the highest level.

Figure 1. Age-crime-curve for four cohorts of Danish students from 9th/10th grade in 2008-2011, by enrollment in upper secondary education within the first year.



In the empirical analyses, we look at students who enroll in upper secondary vocational education directly from 9th or 10th grade, and our sample includes 10 different technical programs, 82 schools, and cohorts from 2008 to 2011, with 848 different ‘classes’ in total. On average, the percentage of students with a prior criminal charge is 16 percent in the vocational education programs in our sample. Across schools and programs, differences are found in the proportion of students with prior charges, while, over time, the distribution of students with prior criminal charge varies little (see Table 1).

Table 1. Proportion of Students with Prior Criminal Charge and number of students, by School, Program and Cohort

	Mean	Std.	10% percentile	90% percentile	Number of schools	Number of records*
All offense types	0.16	0.09	0.05	0.29	82	848
Penal code offenses	0.09	0.06	0.00	0.17	82	848
Traffic offenses	0.09	0.07	0.00	0.18	82	848
Special law offenses	0.03	0.04	0.00	0.08	82	848
Program:						
Animals and plants	0.09	0.07	0.01	0.17	18	60
Building	0.19	0.07	0.11	0.28	38	134
Building and citizen services	0.14	0.07	0.05	0.24	8	23
Electric & IT	0.12	0.06	0.05	0.20	42	145
Food production and catering	0.12	0.05	0.05	0.17	25	91
Mechanic	0.21	0.07	0.12	0.31	37	140
Media production	0.08	0.04	0.04	0.15	12	40
Production & development	0.19	0.10	0.09	0.30	40	144
Styling	0.04	0.05	0.00	0.11	7	21
Transport	0.27	0.10	0.16	0.40	14	50
Cohort:						
2008	0.16	0.10	0.05	0.30	53	168
2009	0.17	0.09	0.06	0.29	74	218
2010	0.16	0.09	0.05	0.28	82	235
2011	0.16	0.09	0.05	0.26	82	227
Number of students	63	55	16	129	82	848

Note: * The number of records refer to the number of schools multiplied with the number of programs and cohorts.

As mentioned, a variety of relevant characteristics is available for the analysis. About 50 percent of the students enroll in the programs ‘Building’ and ‘Mechanics’, while the other most important programs are ‘Electrics’ (15 percent), ‘Food’ (13 percent), and ‘Animals & plants’ (9 percent). The remaining 16 percent enroll in the programs ‘Production’, ‘Media’, ‘Transport’, ‘Styling’, or ‘Building services’, see Table 2. About 50 percent of the students entered the VET-program after 9th grade and the other 50 percent took the optional 10th year before commencing upper secondary education.

The number of charges is relatively high. For instance, 11 percent of the students have been charged with one (or more) criminal offense before entering the VET-program. Overall, 6 percent of the students had been charged with a penal code offense, 6 percent with a traffic offense, and 1 percent with a special law offense. It is also important to note the relatively low socio-economic background of many of these students. For instance, 20 percent of the students have parents who were unemployed or outside the labor market, and almost 30 percent of the parents had primary or lower secondary as their highest education level. Among both mothers and fathers, we find high rates of psychotropic drugs use, as well as high rates of prior convictions (mothers 6 percent and fathers 18 percent). Finally, 12 percent of the VET-students were charged with a criminal offense during the 12-month follow-up period.

Table 2. Descriptive Statistics (mean and standard error) for the Sample, Selected Variables

		Mean	Std. overall
<i>Upper secondary education:</i>	Building	0.27	0.45
	Mechanic	0.23	0.42
	Building service	0.00	0.06
	Animal & Plants	0.09	0.28
	Styling	0.01	0.09
	Food	0.13	0.33
	Media	0.03	0.18
	Production	0.08	0.27
	Electric	0.15	0.36
	Transport	0.01	0.10
<i>Demographics:</i>	Male	0.84	0.37
	Native Dane	0.94	0.24
	Nuclear family	0.55	0.50
<i>Primary school (PS):</i>	Primary school - 2007/08	0.20	0.40
	Primary school - 2008/09	0.27	0.44
	Primary school - 2009/10	0.27	0.45
	Primary school - 2010/11	0.26	0.44
	Last year PS - 9th grade	0.51	0.50
	Last year PS- 10th grade	0.49	0.50
	Age - last year primary school	15.37	0.74
<i>Crime history (age 15 to start US):</i>	Charged criminal offense (all)	0.11	0.32
	Charged penal law (all)	0.06	0.24
	Violent offense	0.02	0.13
	Theft	0.03	0.18
	Burglary	0.01	0.10
	Charged traffic offense (all)	0.06	0.23
	Charged special law (all)	0.01	0.11
	Drug offense	0.01	0.08
	Number of criminal charges	2.16	2.85
	Age at first offense	15.56	0.64
<i>Socio-economic characteristics:</i>	Mother employed	0.80	0.40
	Father employed	0.81	0.40
	Mother's gross income (2005 prices)	233,631	100,696
	Father's gross income (2005 prices)	298,997	210,078
	Mother primary and lower secondary school	0.29	0.45
	Father primary and lower secondary school	0.29	0.45
<i>Social problems in the family:</i>	Teenage motherhood	0.05	0.21
	Teenage fatherhood	0.04	0.20
	Mother criminal conviction (excl. traffic off.)	0.06	0.24
	Father criminal conviction (excl. traffic off.)	0.18	0.39
	Mother use psychotropic medication	0.47	0.50
	Father use psychotropic medication	0.36	0.48
	Student use psychotropic medication	0.07	0.25
	Student ADHD prescriptive drugs	0.03	0.17
	Child placed in care	0.04	0.19
<i>Outcome:</i>	Preventive intervention in the family	0.07	0.25
	Charged with offense 12 months (all)	0.12	0.32
	Charged with penal offense 12 months	0.04	0.21
	Charged with traffic offense 12 months	0.07	0.26
	Charged with special law offense 12 months	0.02	0.14
Number of observations		27,525	

3 Analytic Framework

As in any other study of peer effects, a primary concern is how to separate peer effects from other possible effects. Following a detailed description of our identification strategy, we present and discuss the model used to estimate the parameters of interest.

3.1 Identification of Peer Effects

To analyze peer influence in non-experimental settings is particularly difficult as ‘Birds of a feather flock together’, which makes it difficult to disentangle the peer effect from the selection effect (also called the correlated effect) (Manski 1993). Individuals sort themselves into neighborhoods, schools, and friendships with peers that have similar characteristics, which implies that the individuals in peer groups are likely to behave in similar ways, even before ever interacting with each other. In this study, we analyze peer effects among schoolmates in upper secondary education and students in the same school may have similar propensities (high or low) to engage in criminal activities because they have similar socioeconomic backgrounds. If we do not address the non-random ‘matching’ of individuals to their peers, we pose the risk of identifying spurious peer effects solely attributed to the correlated effect (Shalizi and Thomas, 2011).

In the absence of random assignment of students to classmate peers, we argue that, conditional on school, and program fixed effects and school-specific time trends, there is a random proportion of peers with a prior criminal charge in any given cohort within the same school and program. In this way, we address the fact that the composition of students in upper secondary education varies systematically between different schools and programs, and only use the within-school variation in schoolmates with prior charges between successive cohorts to identify peer effects. In addition, the individual’s own criminal history and other characteristics are included as controls. Hence, we include lagged individual outcome as a control variable, which will also serve as control for unobservable individual fixed effects. To further strengthen this identification strategy, we utilize the fact that our sampled individuals have to change peer group from their lower secondary school to the upper secondary school and, oftentimes but not always, there will be some former peers (from 9th and/or 10th grade) that follow along into the new school peer group (see Table 3).

Table 3. Peers from Primary School in the same VET-College and Program

	Observations	Per cent
No peers	14,520	52.75
One peer	5,669	20.60
Two peers	3,085	11.21
Three peers	1,539	5.59
Four or more peers	2,712	9.85
Total	27,525	100.00

Moreover, identification of peer effects is difficult because of the simultaneity problem; or what Manski (1993) refers to as the reflection problem. The problem arises because it is difficult to separate the effect the group has on the individual from the effect the individual has on the group. Here, however, this problem is handled by the fact that the peer's criminal behavior is measured *prior* to the peer group formation, since we observe their criminal behavior in lower secondary school. Time-lagged peer behavior need not be exogenous to contemporaneous behavior if peers from the school peer group were also in the lower secondary peer group. Therefore, we use the information on peers from 9th and 10th grade to include two extra subsamples in the empirical analyses, first, restricting the population to the approximately 73 percent of the students who have only one peer-person overlapping, and, second, to the 53 percent of the students who have a completely new group of peers. These sample restrictions strengthen our identification strategy by limiting concerns about self-selection and reinforcing the distinction between the individual and the prior criminal behavior in the new peer group.

Furthermore, correlated unobservables and/or measurement errors in variables can also hamper the identification of peer effects. For instance, students in the same school will have similar socio-economic backgrounds or experience the same (bad) teacher in lower secondary education, and these correlated experiences may be part of why they end up in criminal activity. The correlated unobservables are handled through the extensive use of fixed effects (year, school and program), as well as school-specific time trends. The variation left in the data to drive the peer effect parameter is, therefore, within school and program cohort-to-cohort variation.⁹ The measurement errors in variables problem is generally thought not to be an issue with the Danish administrative register data, which has very high quality standard.¹⁰

Finally, it is relevant to note that the empirical models and the identification strategy are designed to separate the peer effects from potential selection effects, but this does not imply that we can separate the so-called endogenous and exogenous peer effects. As described by Manski (1993), the endogenous peer effect is the propensity of an individual to behave in some way that varies with the prevalence of that behavior in the individual's group. The exogenous peer effect is the propensity of an individual to behave in a certain way depending on the characteristics of the individual's group. Similarly to most studies of peer effects, we cannot distinguish between whether potential peer effects are endogenous, and the individual is more likely to engage in criminal activities because of peers' criminal behaviors, or the peer effects are exogenous and the individual is affected by the socioeconomic composition of peers. To minimize the influence from other characteristics of the peer group being captured in the peer effects parameter of criminal behavior, we include a range of different variables of the peer group characteristics (the proportion of: male students, non-western immigrants,

⁹ Several other studies rely on a similar approach including Ammermueller and Pischke (2009), Angrist and Lang (2004), Gould et al. (2009), and Lavy and Schlosser (2011).

¹⁰ However, some offenses are never detected and some offenders never apprehended. Clearly, our data are not immune to this fundamental problem.

students who use ADHD medicine, students who use psychotropic drugs, students who have been placed in care or have experienced preventive interventions, students of teenage moms, students of single parents, and students with parents outside the labor market) in the models.

3.2 Estimated Model

The outcome variable is offending (measured with official criminal charges) within the first 12 months after entering the basic program in a VET-school. A natural baseline modelling approach, therefore, is to use an ordered probit or similar type of model that acknowledge the discrete nature of the outcome. However, for simplicity, and in line with the existing research in this field, we first estimate a linear-in-means model with the following specification:

$$D_{ipst} = \alpha_p + \beta_s + \gamma_t + \partial_{st} + \theta D_{iLS,t} + \delta_1 X_{ipst} + \delta_2 X_{(-i)pst} + \pi P_{(-i)pst} + \varepsilon_{ipst} \quad (1)$$

where i denotes individuals, p denotes program, s denotes school, t denotes time, and LS denotes lower secondary school. D_{ipst} is criminal (Delinquent) behavior of individual i , in program p , in school s , at time t (1 if the student has a criminal charge within 1 year from enrollment and otherwise 0). α_p is a fixed effect for program p , β_s is a fixed effect for school s , γ_t is a set of year dummies, and ∂_{st} is a school-specific linear time trend. The term $D_{iLS,t}$ measure the individuals' records of criminal charges in lower secondary school and, in this sense, it serves as a lagged individual outcome, which expectedly captures (a large part of) unobserved individual fixed effects. $D_{iLS,t}$ is discretized into three distinct groups (0 if no prior charge, 1 if one prior charge and 2 if more than one prior charge). X_{ipst} is a matrix of other control variables related to the student (individual and family characteristics), and $X_{(-i)pst}$ is a matrix of peer characteristics in program p , in school s , at time t , excluding individual i . $P_{(-i)pst}$ is the proportion of students at school s in program p and cohort t with a prior charge, excluding student i . ε_{ipst} is the error term.

The coefficient of interest is π , the parameter for the peer group effect. In the linear-in-means model here, it captures the effect of the average proportion of peers with prior criminal charge on the individual's own criminal activity. In the absence of nonlinear effects, this parameter is of great interest. Model (1), therefore, constitutes our baseline specification. However, with nonlinear effects, and possibly even effects of opposite signs, the specification in model (1) is insufficient, and may purge statistically significant effects. Extensions of model (1) are, therefore, relevant in order for us to investigate whether classmate peers in upper secondary education pose a risk or proactive factor for future offending, and if this influence depends on student's prior criminal history. Hence, in line with Burke and Sass (2013), Carrell et al. (2013), and Hoxby and Weingarth (2006), we estimate a two-way interaction model:

$$\begin{aligned}
D_{ipst} = & \alpha_p + \beta_s + \gamma_t + \partial_{st} + \theta D_{iLst} + \delta_1 X_{ipst} + \delta_2 X_{(-i)pst} + \pi_{low} \times \mathbb{1}(low \text{ crime peer group}) \\
& + \pi_{high} \times \mathbb{1}(high \text{ crime peer group}) + \rho_1 \mathbb{1}(D_{iLst} = 1) \times \mathbb{1}(low \text{ crime peer group}) \\
& + \rho_2 \mathbb{1}(D_{iLst} = 1) \times \mathbb{1}(high \text{ crime peer group}) + \rho_3 \mathbb{1}(D_{iLst} = 2) \\
& \times \mathbb{1}(low \text{ crime peer group}) + \rho_4 \mathbb{1}(D_{iLst} = 2) \times \mathbb{1}(high \text{ crime peer group}) \\
& + \varepsilon_{ipst}
\end{aligned} \tag{2}$$

In addition to model (1), the peer group measure is divided into three levels in model (2). The 25 percent of the programs with the lowest proportion of students with prior criminal charges is named ‘low crime peer group’, the middle 50 percent of the programs are left out as reference group, and the 25 percent of the programs with the highest proportion of students with prior criminal charges is named ‘high crime peer group’. The sign $\mathbb{1}$ signifies an indicator variable equal to 1 if the subsequent term in brackets is fulfilled. In other words, we include indicators for the proportion of peers with prior charges (parameters π_{low} and π_{high}), as well as interactions between these indicators and the individual’s own criminal history (parameters ρ_1, ρ_2, ρ_3 and ρ_4). Specification (2) is useful, in that it allows for nonlinearity in the effect of peers and the individual’s prior history of offending.

3.3 Diagnostic Test of Identification Assumption

The identifying assumption is that across different cohorts within the same school and program the variation in (new) schoolmates with a criminal charge is as good as random. Following Bayer et al. (2009) we investigate whether this assumption holds on observable characteristics by performing a test of whether the peer group measure is uncorrelated to students’ individual characteristics. First, we estimate a simple OLS-model with all the individual covariates on criminal charges within the one year from enrollment in the VET-program (the outcome variable in the empirical analysis). This regression model, with school and program fixed effects, predicts the probability of criminal behavior based on students’ individual characteristics and the result is reported in table A2 in the Appendix. Second, we include the predicted values from the first regression as the outcome variable in a new set of regression models and include the peer group measure as the explanatory variable. Table 4 reports the results from these estimations where we gradually include fixed effects specifications (columns I–IV) for each of the three study populations.

Table 4. Regression models: effects of peer group measure on predicted values for students' charge(s) with one year from enrollment in vocational education

	I	II	III	IV
<i>Full sample:</i>				
Peer effects: schoolmates with prior charge	0.228*** (0.007)	0.182*** (0.021)	0.030+ (0.016)	0.018 (0.018)
Observations	27,525	27,525	27,525	27,525
<i>Maximum one peer from 9th/10th grade:</i>				
Peer effects: schoolmates with prior charge	0.231*** (0.008)	0.180*** (0.021)	0.034+ (0.017)	0.025 (0.019)
Observations	20,189	20,189	20,189	20,189
<i>No peers from 9th/10th grade:</i>				
Peer effects: schoolmates with prior charge	0.229*** (0.009)	0.173*** (0.022)	0.029 (0.018)	0.017 (0.020)
Observations	14,520	14,520	14,520	14,520
School fixed effects	No	Yes	Yes	Yes
Program fixed effects	No	No	Yes	Yes
School specific time trends	No	No	No	Yes

Notes: Robust standard errors clustered by school are reported in parentheses and + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Table 4 report correlations between the peer group measure and predicted values from the first regression, which captures all the variation in subsequent criminal behaviour explained by students' observable characteristics. In specification I the coefficients are significant for all three samples, and, as these models do not include any fixed effects, these results underlines that sorting of students across VET-schools and program are strongly correlated to students' individual characteristics. The correlations decrease substantially when we include school and program fixed effects in specifications II and III, and in specification IV representing the preferred baseline model specification there are no significant correlation. Hence, when we add school and program fixed and school specific time trends, the variation of the peer group (within school and program) is uncorrelated to students' observable characteristics in all three sample populations. These test results support the central identifying assumption in our design and corroborate a causal interpretation of peer effects reported in the empirical analyses.

4 Results

The empirical analyses explore the impact of classmate peers on reported offending (measured as charges) within 1 year from enrolment among students in upper secondary education. We begin by analyzing linear peer effects and then investigate a range of different heterogeneous effects. Table 4 shows the results from the baseline model with stepwise inclusion of control variables and fixed effects, which gives rise to the four columns I–IV. The four model specifications are estimated for three different populations (the left-most column). In the upper part, we estimate models for the full sample of 27,525, while, in the middle and lower parts, we restrict the sample according to the number of former classmate peers from 9th and 10th grade that enroll in the same upper secondary school program at the same point in time. We do this for two reasons. First, our sample size is modest when it comes to statistical identification of peer effects, which are often found to be relatively small. Hence, restricting the sample to those with no prior peers, while econometrically the correct and conservative approach, is costly as it reduces our sample by almost 50 percent. The second reason is that there may be relevant information to be found in the comparison between the estimated parameters in these different populations.

Table 5. Baseline Regressions: Peer Effects on Charge(s) within 1 year from the start of the Upper Secondary Education Program for the Three Sample Populations

	I	II	III	IV
<i>Full sample:</i>				
Peer effects: schoolmates with prior charge	0.463*** (0.047)	0.175*** (0.051)	0.117* (0.051)	0.121* (0.053)
Observations	27,525	27,525	27,525	27,525
<i>Maximum one peer from 9th/10th grade:</i>				
Peer effects: schoolmates with prior charge	0.457*** (0.048)	0.171** (0.056)	0.108+ (0.056)	0.122* (0.060)
Observations	20,189	20,189	20,189	20,189
<i>No peers from 9th/10th grade:</i>				
Peer effects: schoolmates with prior charge	0.454*** (0.053)	0.156** (0.058)	0.091 (0.062)	0.100 (0.063)
Observations	14,520	14,520	14,520	14,520
Year dummies	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes
Program fixed effects	No	Yes	Yes	Yes
School specific time trends	No	No	No	Yes
Control variables	No	No	Individual, family & peer	Individual, family & peer

Notes: The dependent variable is charge(s) within 1 year from the start of the upper secondary education program. Robust standard errors clustered by schools is in parentheses and + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Control variables: child background (gender, ethnicity, family status), child crime history (age at conviction, type of offense, number of prior convictions), family background (parents' employment status, income and education level) plus indicators of social problems (teenage parents, parents with convictions, use of psychotropic medication, use of ADHD medicine, preventive interventions in the family and child place in care) and peer characteristics (number of students, proportion of male students, non-western immigrants, students who use ADHD medicine, students who use psychotropic medication, students placed in care or experienced preventive interventions, students of teenage moms, students of single parents and students with parents outside the labor market).

In model specification I, the parameter estimate for the impact of the peer group for the full sample is 0.463 and highly statistically significant. In this specification, program fixed effects, school specific time trends, and our extensive set of control variables are excluded. These are gradually included in models II–IV (as indicated in the lower panel of Table 4). For the full sample, the parameter of interest, the average impact of the peer group, changes greatly across specifications but stabilizes in models III–IV around a point estimate of 0.12. The interpretation of this estimate is that a 10 percentage points increase in the proportion of criminal peers increases the probability of offending by 1.2 percentage points. For the full sample, this estimate is highly significant. When the sample is restricted to the 20,189 students with a maximum of one peer following from 9th/10th grade to the upper secondary school program, we find virtually identical results for the peer

parameter estimates across all four specifications. However, once the sample is reduced to the 14,520 students with no prior peers in their new peer group, the point estimate decreases slightly and the standard errors increase (due to the smaller sample) in all four specifications. Consequently, the parameter of interest becomes insignificant in model specifications III–IV. Because the results in the baseline model are sensitive to population restrictions, we cannot draw conclusions about the influence of classmate peer based on these results alone.

4.1 *Nonlinear Peer Effects*

The transition from lower to higher secondary education with a new school setting and new school peers can influence adolescents' criminal behavior in both positive and negative ways. Moreover, the direction of the peer influence could be moderated by the student's own criminal history. In order to investigate whether nonlinearities exist and the peer effects differ between classes with low, medium, and high levels of students with prior charges, we extend the baseline model and estimate model 2 (as described in section 3). The peer group measure now enters as an indicator for whether the peer group has a low level of students with a criminal history or a high level (with medium level as reference group). A 'low' level is, here, defined as programs in the lowest 25 percent (with 0-10 percent of the students with prior charges) and a 'high' level is programs in the highest 25 percent (with more than 22 percent of the students with prior charges). The student's own criminal history from lower secondary schooling, i.e., the lagged outcome variable, is included in the table here, as are the interaction terms between the student's criminal history and the type of peer group.¹¹ The nonlinear models is, once again, estimated for all three samples (See Table 6).

A number of interesting and important results arise from these nonlinear specifications. The indicator variable for peer influence is significant for school programs where the proportion of peers with a history of crime is in the top 25 percent, i.e., included in the 'high crime peer group'. Students with peers in this group are approximately 1.8 percentage points more likely to offend during the first 12 months after starting in upper secondary schooling in comparison to the reference group of students with peers in the medium crime group. Unsurprisingly, a peer group with low crime levels has no impact on future offending (within 12 months). The point estimate for this group is virtually zero and very insignificant. The parameter for the student's criminal history from lower secondary schooling, the lagged outcome, is estimated to be very high and very significant across all three subsamples. This is to be expected. Students with one prior charge are approximately 12 percentage points more likely to offend during the first 12 months in upper secondary education in comparison to the reference group of students with no prior charge, and students with 2 or more prior charges are approximately 30 percentage points more likely to offend in the first 12 months after enrolment.

¹¹ The lagged outcome variable is also included in the baseline specification but not shown in Table 4.

Table 6. Nonlinear Peer Effects and Interactions with Crime History

	Samples:			
	All	All	Max.one prior peer	No prior peers
Low crime peer group (<9.8% with prior charge)	-0.002 (0.007)	-0.003 (0.007)	0.001 (0.007)	0.003 (0.007)
Medium crime peer group (ref.)	-	-	-	-
High crime peer group (<22% with prior charge)	0.018** (0.007)	0.018** (0.007)	0.022** (0.008)	0.018+ (0.010)
No prior charge (ref.)		-	-	-
One prior charge		0.102*** (0.012)	0.121*** (0.017)	0.117*** (0.021)
More than one prior charge		0.254*** (0.019)	0.303*** (0.022)	0.315*** (0.026)
No prior charge* Low crime peer group (ref.)		-	-	-
One charge* Low crime peer group		0.020 (0.027)	-0.014 (0.031)	-0.030 (0.037)
More than one charge* Low crime peer group		-0.016 (0.041)	-0.119** (0.044)	-0.135** (0.049)
No prior charge* High crime peer group (ref.)		-	-	-
One charge* High crime peer group		0.002 (0.022)	-0.018 (0.030)	-0.003 (0.040)
More than one charge* High crime peer group		0.000 (0.032)	-0.042 (0.037)	-0.023 (0.044)
Year dummies	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes
Program fixed effects	Yes	Yes	Yes	Yes
School specific time trends	Yes	Yes	Yes	Yes
Control variables	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer
Observations	27,525	27,525	20,189	14,520

Notes: The dependent variable is charge(s) within 1 year from the start of the upper secondary education program in all regressions. Robust standard errors clustered by schools is in parentheses and + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Control variables include: child background (gender, ethnicity, family status), child crime history (age at conviction, type of offense, number of prior convictions), family background (parents' employment status, income and education level), plus indicators of social problems (teenage parents, parents with convictions, use of psychotropic medication, use of ADHD medicine, preventive interventions in the family and child place in care) and peer characteristics (number of students, proportion of male students, non-western immigrants, students who use ADHD medicine, students who use psychotropic medication, students placed in care or experienced preventive interventions, students of teenage moms, students of single parents and students with parents outside the labor market).

More importantly for our study is whether there are any interaction-effects between the individual's prior criminal behavior and the proportion of peers with a criminal history. We find that students who, upon enrolment, have more than one prior charge, and who enter a program with a low level of schoolmates with prior charges, markedly reduce their probability of future offending. For the two subsamples with no or maximum one peer from 9th and/or 10th grade in the new peer group (the two right-most columns in Table 6), this parameter is estimated to be -0.135 (-0.119 when up to one prior peer is allowed), and highly statistically significant. The same parameter estimate is much smaller and insignificant when estimated for the full sample. All the other interaction terms between individual's prior charge and the peer group are small and insignificant for all specifications. The interpretation of these results is that, while students with more than one prior charge can be expected to have a higher probability of future offending, this 'individual fixed effect' is mitigated if the student enters a *new* group of school peers with low crime propensities. Entering a program with new peers with low crime levels reduces the probability of offending for students with more than one prior charge, from 31.5 percentage points to 18.3 percentage points (the sum of the two indicator variables and the interactions term. i.e. $0.003 + 0.315 + (-0.135)$). This result is (one of) the first causal estimates of how the change to a new and positive environment of 'good' school peers, i.e., programs with low levels of students with prior charges, can help adolescents with a history of offending leave the criminal pathway.

4.2 *Gender and Ethnicity Specific Peer Groups*

Class- or schoolmates constitute a natural choice of peer group for adolescents, but only a few previous studies have investigated the impact of these peer groups on delinquency (e.g. McGloin et al. 2014; Payne and Cornwell 2007; Rees and Pogarsky 2011). The vast body of criminological research focuses on peer influence in friendship. In particular, adolescents form homophily friendships based on similarities like gender and ethnicity (e.g. Weerman 2011; Young et al. 2014). The latter group, ethnicity, is also applied by Damm and Dustmann (2014) using Danish data for young first-time prisoners. Inspired by the large number of studies that show associations between (smaller) peer groups of individuals with similar characteristics and future criminal behavior, we include peer group measures based on the individual's gender and/or ethnicity. The gender and/or ethnicity specific peer measures are constructed so that only students with the same characteristics are included when calculating the proportion of peers with prior criminal charges. We estimate model specification IV for all three subsamples (see Table 7).

Table 7. Gender and Ethnicity Specific Peer Effects

	Samples:		
	All	Max. one prior peers	No prior peers
Gender specific peer effects	0.114* (0.045)	0.127* (0.052)	0.111* (0.052)
Ethnicity specific peer effects	0.104* (0.041)	0.105* (0.046)	0.090+ (0.052)
Gender and ethnicity specific peer effects	0.100** (0.037)	0.106* (0.041)	0.093* (0.044)
Year dummies	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes
Program fixed effects	Yes	Yes	Yes
School specific time trends	Yes	Yes	Yes
Control variables	Individual, family & peer	Individual, family & peer	Individual, family & peer
Observations	27,525	20,189	14,520

Notes: The dependent variable is charge(s) within 1 year from the start of the upper secondary education program in all regressions. Robust standard errors clustered by schools is in parentheses and + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Control variables include: child background (gender, ethnicity, family status), child crime history (age at conviction, type of offense, number of prior convictions), family background (parents' employment status, income and education level), plus indicators of social problems (teenage parents, parents with convictions, use of psychotropic medication, use of ADHD medicine, preventive interventions in the family and child place in care) and peer characteristics (number of students, proportion of male students, non-western immigrants, students who use ADHD medicine, students who use psychotropic medication, students placed in care or experienced preventive interventions, students of teenage moms, students of single parents and students with parents outside the labor market).

When we include gender and ethnicity specific measures of prior criminal behavior in the peer group, the estimates for the average peer group impact becomes statistically significant (to varying degrees) across all three populations. The point estimates are all in the range 0.093 to 0.127 and are very stable across the different types of peer group definition and choice of sample. On one hand, these results underscore the notion that 'relevant peers' and not simply 'peers' matter. However, on the other hand, the point estimates found here are very close to the point estimates found in the baseline (see Table 5).

4.3 *Crime Specific Peer Effects*

Several important studies have found substantial peer effects moderated through specific types of crime. For instance, Bayer et al. (2009) find that the influence of peers in juvenile correctional facilities primarily exists among individuals who already have some experience with a specific type of crime. In a similar study based on Danish data, Damm and Gorinas (2016) investigate recidivism among young first-time offenders and find signs of crime specialization, whereby inmates reinforce crime behavior within a given type of crime, whereas new types of criminal behavior are not reinforced. Given these results, it also becomes relevant to investigate crime-specific peer effects in our context. Hence, we include crime-specific peer measures, calculated as the proportion of schoolmates with specific type of prior charges, and only look at whether it affects future offending within the same category. Again, for completeness, the models have been estimated for all three subsamples, but, given the many parameters, we only show the results from the full sample (see Table 8). Results from the restricted samples are included in the appendix (Table A3 and A4).

Property crimes and traffic offenses are the most prevalent types of offending among students in vocational education (see Table 2). However, neither burglary nor traffic offenses appear to be driven by peer effects. Instead, we find suggestive evidence that drug offenses may, in part, be influenced by peer effects. In the full sample, as well as in the sample in which maximum one peer from 9th and 10th grade continues in the new peer group, we find that the proportion of schoolmate peers with prior drug offenses increases the probability of the students committing drug offenses. However, while stable across the two larger subsamples, the point estimates decrease and becomes insignificant in the most restricted sample, where no prior peers from 9th and 10th grade enter the new peer group. On balance, given the eminent risk of simultaneity (the reflection problem), we cannot conclude that there is a significant effect here.

Table 8. Crime Specific Peer Effects on Different Types of Reported Offending within 1 year

	<i>Dependent variable:</i>						
	Penal code offenses				Special law offenses		Traffic
<i>Leave-out-mean of prior offense:</i>	All	Violence	Theft	Burglary	All	Drug	All
Penal code offenses	0.062 (0.046)						
Violent offenses		0.069 (0.056)					
Theft			0.061 (0.039)				
Burglary				-0.005 (0.040)			
Special law offenses					0.093 ⁺ (0.056)		
Drug offenses						0.131** (0.049)	
Traffic offenses							0.090 (0.056)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Program fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School specific time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer
Observations	27,525	27,525	27,525	27,525	27,525	27,525	27,525

Notes: The dependent variable is charge(s) within 1 year from the start of the upper secondary education program in all regressions. Robust standard errors clustered by schools is in parentheses and + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Control variables include: child background (gender, ethnicity, family status), child crime history (age at conviction, type of offense, number of prior convictions), family background (parents' employment status, income and education level), plus indicators of social problems (teenage parents, parents with convictions, use of psychotropic medication, use of ADHD medicine, preventive interventions in the family and child place in care) and peer characteristics (number of students, proportion of male students, non-western immigrants, students who use ADHD medicine, students who use psychotropic medication, students placed in care or experienced preventive interventions, students of teenage moms, students of single parents and students with parents outside the labor market).

5 Discussion

In this paper, we seek to understand whether school peers with delinquent backgrounds pose a risk to their non-delinquent schoolmates, so that, instead of building human capital, the upper secondary students, rather, build up criminal capital. The transition from lower to upper secondary education is a significant step in adolescents' life courses, as it not only reflects central decisions about future employment, but also includes changing schools and classmates at an important time in young people's lives. To some students, the change of school environment and new peers can be a turning point, to others, a VET-school can provide more 'bad company' to those already on the wrong side of the law.

We find that students who enter a VET-program alongside many peers with a high crime propensity are more likely to be charged with a criminal offense within 12 months of commencing the upper secondary school program. On a more positive note, we also find that students with more than one prior charge are less likely to commit further offenses if they enter a program where their new schoolmates have a low crime level. These findings suggest that this new low-crime peer group can serve as a protective factor against reoffending, although the protective factor is not strong enough to fully counter the individual fixed effect captured by their own prior offending record. Interestingly, and in line with for example Rees and Zimmerman (2016), we find that the nonlinear peer effects, in part, are moderated by students own prior delinquency.

One of the core concepts in social learning theory is differential association, which stresses that social interactions have different effects on individuals' behavior depending on their frequency, duration, priority, and intensity (Akers 2001; Sutherland and Cressey 1960). Our study examines peer influence among schoolmates, which is an extension of the typical peer group definition within the criminological tradition, but an interesting social group to investigate, both from a theoretical and a methodological point of view. The school peers in upper secondary education are a 'natural' peer group for adolescents, which frames many of their social interactions. The school setting defines a larger group of individuals with whom they have interactions of high frequency and long duration, but possibly in most cases with relatively low intensity and priority. As outlined by Akers (2001:195), *'The most important of these groups are the primary ones of family and friends, though they may also be secondary and reference groups'*. Our findings coincide with these theoretical expectations of other and less intimate social groups being influential on adolescents' criminal behavior. Despite differences in methodological approach, our results are in line with the few previous studies showing that delinquent behavior is associated with both friends' and schoolmates' delinquency (McGloin et al. 2014; Payne and Cornwell 2007; Rees and Pogarsky 2011). Moreover, it is important to note that our findings, at the same time, suggest that individual characteristics like gender and ethnicity are significant aspects, not only to (delinquent)

friendships formations (Weerman 2011; Young et al. 2014), but also in relation to peer effects among schoolmates. This finding suggest that not all school peers are of equal importance, and students' orientation towards different individuals or subgroups within the classes/cohorts could be driven by the same individual similarities that create homophily friendships.

The focus on schoolmate peers in this study is important from a methodological standpoint, as it provides an opportunity to exploit the exogenous variation in the composition of students across cohorts within the same school and program. The methodological strategy is new to the criminological literature, but has been applied in economics for years, in order to identify causal peer effects on educational outcomes. The use of quasi-experimental design in this paper illustrates the importance of analyzing peer effects with research methods that carefully address the selection of students across schools. In our case, we would have overestimated the peer effects among Danish students in upper secondary education considerably had we not used the fixed effects strategy to account for students' non-random self-sorting across schools and programs.

In her seminal paper, Moffitt (1993) argue for the existence of two types of offenders: adolescence-limited offenders and life-course persistent offenders. Fortunately, most belong to the former group. Still, with stakes as high as the risk of life-long criminal careers, understanding school-crime peer effects is even more important, as peers can potentially alter the life trajectory. In this light, the finding that individuals with more than one prior charge are, to some extent, sheltered against further recidivism is encouraging, and has an important message to policy makers. Broadly speaking, the findings in this study are relevant to practitioners in the Danish prison and probation service working with offenders post-release. Oftentimes, probation officers can 'prescribe' enrolment in education as part of the release programs for young ex-offenders. Furthermore, knowledge on classmate peer effects in crime is relevant from a policy or social planning perspective, as mixing of students within and across schools (at least to some extent) can be influenced by school leaders, and probation offers can encourage enrolment in schools away from previous bad company.

6 Concluding remarks

The departure of this study was the question of whether students in upper secondary education build human or criminal capital. The enrolment in upper secondary vocational education and training entails that students acquire knowledge, skills, abilities, etc., in order to undertake skilled employment in the labor market upon graduation. However, at the same time, there is a risk of negative peer influence that could include learning techniques to commit crimes, as well as definitions in favor of breaking the law. The results from our study give some support to the notion that Danish students in upper secondary vocational education can build criminal capital by interacting with schoolmates with prior charges. Yet,

our study also shows that new school peers in upper secondary education can have a positive influence on students with a history of criminal offenses. We have come some way in exploring schoolmate peer effects on criminal behavior with more rigorous methods, however, we concur with Paternoster et al. (2013) that there is a need for more research applying experimental or quasi-experimental strategies, as studies on causal peer effects in crime remain limited, especially in criminology.

7 References

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8 Appendix

Table A1. Sample selection, students who left 9th/10th grade in 2008 to 2011 and enrolled in a technical program at a VET-school within one year.

	Observations	Percentage
Records excluded from the empirical analyses:		
Students who do not enroll in VET-school in August	6,709	18,98
Students enrolled at schools with less than 10 students in the program	362	1,02
Students enrolled at schools that change registration number	313	0,97
Student enrolled at schools and programs that do not have two adjacent cohorts	440	1,24
Records included in the empirical analyses	27,525	77,87
Total	35,349	100,00

Table A2. OLS-regression: prediction of students' characteristics on charge within one year from enrolment in vocational education

<i>Demographics:</i>	Female (ref.)	-	
	Male	0.069***	(0.006)
	Native Danes (ref.)	-	
	Non-western immigrant	0.039**	(0.012)
	Immigrant western countries	-0.013	(0.020)
	Nuclear family (ref.)	-	
	Parent living with new partner	0.010 ⁺	(0.006)
	Single parent	0.001	(0.006)
	Not living with parents	0.020	(0.016)
<i>Primary school (PS):</i>	Last year PS 9th grade (ref.)	-	
	Last year PS- 10th grade	-0.024***	(0.005)
	Age - last year primary school	-0.013***	(0.003)
	Ordinary school (ref.)	-	
	Boarding school	-0.013**	(0.005)
	GPA-Average-Danish-Marks	-0.004***	(0.001)
	GPA-Average-Danish-Exams	-0.003**	(0.001)
	GPA-Average-Math-Marks	-0.004**	(0.001)
	GPA-Average-Math-Exams	-0.002	(0.001)
<i>Crime history (age 15 to start US):</i>	Missing GPA	-0.023*	(0.009)
	No prior charge (ref.)	-	
	One prior charge	0.191	(0.198)
	Two prior charges	0.285	(0.201)
	Three prior charges	0.309	(0.195)
	Four or more prior charges	0.416*	(0.195)
	Traffic law (ref.)	-	
	Charged special law	0.067*	(0.026)
	Charged traffic offense	-0.009	(0.019)
<i>Socio-economic characteristics:</i>	Age at first offense	-0.006	(0.013)
	Mother employed (ref.)	-	
	Mother unemployed	-0.005	(0.010)
	Mother outside labor market	-0.004	(0.006)
	Father employed (ref.)	-	
	Father unemployed	0.001	(0.012)
	Father outside labor market	-0.002	(0.007)
	Mother's gross income (2005 prices)	0.000*	(0.000)
	Father's gross income (2005 prices)	0.000	(0.000)
	Mother Primary/low sec edu. (ref.)	-	
	Mother vocational education	0.010 ⁺	(0.006)
	Mother general upp. sec. education	-0.006	(0.009)
	Mother higher education(short/medium/long cycle)	0.004	(0.007)
	Father Primary/low sec edu. (ref.)	-	
	Father vocational education	-0.001	(0.004)
	Father general upp. sec. education	0.001	(0.011)
	Father higher education(short/medium/long cycle)	-0.003	(0.006)
	Missing information (mother) in the year before US	0.052*	(0.022)
	Missing information (father) in the year before US	-0.004	(0.025)

<i>Social problems in the family:</i>	Teenage motherhood	0.004	(0.012)
	Teenage fatherhood	0.008	(0.024)
	Mother criminal conviction (excl. traffic off.)	0.023*	(0.011)
	Mother suspended prison sentence	-0.003	(0.026)
	Mother prison sentence	-0.004	(0.034)
	Father criminal conviction (excl. traffic off.)	0.015*	(0.007)
	Father suspended prison sentence	0.006	(0.010)
	Father prison sentence	0.012	(0.012)
	Mother 1-2 prescriptions psychopharmaca	0.003	(0.005)
	Mother plus 2 prescriptions psychopharmaca	0.002	(0.004)
	Father 1-2 prescriptions psychopharmaca	0.011*	(0.005)
	Father plus 2 prescriptions psychopharmaca	0.011*	(0.005)
	Student use of psychopharmaca	-0.001	(0.010)
	Student ADHD prescriptive drugs	0.043*	(0.016)
	Child placed in care	0.016	(0.013)
	Preventive intervention in the family	0.030**	(0.011)
	Not registered (mother)	-0.083+	(0.045)
	Not registered (father)	-0.011	(0.032)
<i>Upper secondary Education(US):</i>	Enter vocational education 2008	0.012+	(0.007)
	Enter vocational education. 2009 (ref.)	-	
	Enter vocational education. 2010	0.005	(0.006)
	Enter vocational education. 2011	0.005	(0.005)
	School fixed effects	Yes	
	Program fixed effects	Yes	
	School specific time trends	No	
	Sample size	27525	

Notes: Robust standard errors clustered by school are reported in parentheses and + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Table A3. Crime Specific Effects on Different Types of Reported Offending within 1 year, Sample: Max. 1 Peer from 9th or 10th Grade

	<i>Dependent variable:</i>						
	Penal code offenses				Special law offenses		Traffic
<i>Leave-out-mean of prior offense:</i>	All	Violence	Theft	Burglary	All	Drug	All
Penal code offenses	0.029 (0.049)						
Violent offenses		0.081 (0.051)					
Theft			0.040 (0.045)				
Burglary				-0.019 (0.045)			
Special law offenses					0.119* (0.056)		
Drug offenses						0.119* (0.058)	
Traffic offenses							0.098 (0.066)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Program fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School specific time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer
Observations	20,189	20,189	20,189	20,189	20,189	20,189	20,189

Notes: The dependent variable is charge(s) within 1 year from the start of the upper secondary education program in all regressions. Robust standard errors clustered by schools is in parentheses and + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Control variables include: child background (gender, ethnicity, family status), child crime history (age at conviction, type of offense, number of prior convictions), family background (parents' employment status, income and education level), plus indicators of social problems (teenage parents, parents with convictions, use of psychotropic medication, use of ADHD medicine, preventive interventions in the family and child place in care) and peer characteristics (number of students, proportion of male students, non-western immigrants, students who use ADHD medicine, students who use psychotropic medication, students placed in care or experienced preventive interventions, students of teenage moms, students of single parents and students with parents outside the labor market).

Table A4. Crime Specific Effects on Different Types of Reported Offending within 1 year, Sample: No Peers from 9th or 10th Grade

	<i>Dependent variable:</i>						
	Penal code offenses				Special law offenses		Traffic
<i>Leave-out-mean of prior offense:</i>	All	Violence	Theft	Burglary	All	Drug	All
Penal code offenses	0.018 (0.057)						
Violent offenses		0.067 (0.066)					
Theft			0.062 (0.056)				
Burglary				-0.012 (0.055)			
Special law offenses					0.080 (0.071)		
Drug offenses						0.094 (0.067)	
Traffic offenses							0.066 (0.066)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Program fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School specific time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer	Individual, family & peer
Observations	14,520	14,520	14,520	14,520	14,520	14,520	14,520

Notes: The dependent variable is charge(s) within 1 year from the start of the upper secondary education program in all regressions. Robust standard errors clustered by schools is in parentheses and + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Control variables include: child background (gender, ethnicity, family status), child crime history (age at conviction, type of offense, number of prior convictions), family background (parents' employment status, income and education level), plus indicators of social problems (teenage parents, parents with convictions, use of psychotropic medication, use of ADHD medicine, preventive interventions in the family and child place in care) and peer characteristics (number of students, proportion of male students, non-western immigrants, students who use ADHD medicine, students who use psychotropic medication, students placed in care or experienced preventive interventions, students of teenage moms, students of single parents and students with parents outside the labor market).