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## EXPLORING PARADIGMS OF CRIME REDUCTION:

An empirical longitudinal study

RESEARCH DEPARTMENT OF CHILDREN AND FAMILIES

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Crime Reduction:  
An empirical longitudinal study***

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# **EXPLORING PARADIGMS OF CRIME REDUCTION: An empirical longitudinal study**

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# **EXPLORING PARADIGMS OF CRIME REDUCTION: An empirical longitudinal study**

## **ABSTRACT**

Using Danish registers for a 1980 birth cohort of 29,944 males with parental information and following up these cases for 24 years, the study considers four paradigms of crime reduction (parental child-rearing, structural factors around adolescence, locality and individual resources). Focusing on offenders with first-time convictions for shoplifting (n=1,778), for violence (n=1,585) and for burglary (n=1,208), all four paradigms made a contribution to risk of first time offending for all three crimes. The counterfactual analysis indicated that a focus on structural issues within a society may have more widespread benefits, but the assumed causal links need to be further explored. The use of population registers, under controlled conditions, provides an important window on criminal careers.

## **KEYWORDS**

**THEORY TESTING, CRIME RECRUITMENT, RISK OF FIRST OFFENDING, PARENTAL FACTORS, LOCALITY.**

# EXPLORING PARADIGMS OF CRIME REDUCTION: An empirical longitudinal study

## INTRODUCTION

Over the past century or so, criminology has been the crucible for generating various theories about criminal behaviour. Some seem to be out-dated although never quite dead. The arcane theories of Lombroso, for instance, have routinely been used to demonstrate to students the dangers of biological determinism. However, more recently, perhaps in response to an increasing interest in the possible relationship of genetics and crime, the rehabilitation of Lombroso has begun. Gatti and Verde (2004), for instance, stressed that there were many more facets and sophistication to Lombroso's work than most commentators had appreciated. In short, criminological theories appear in various guises, may be applauded or may be condemned at different times.

Theories can be classified in various ways. However, some classifications may be more useful than others in focusing upon particular issues. In considering perspectives that may be relevant to crime reduction, Hope (2000) and others (e.g. Kahn, 1968) have implicitly identified at least four paradigms, each with its own explanation of crime and potential relevance to crime reduction:

### **1. *Parental child rearing methods***

This paradigm focuses on parental child-rearing methods and disadvantages during adolescence as providing the background for deviant behaviour. Parental drug or alcohol abuse, teenage motherhood, divorce, and problematic parenting are considered as precursors of later youth criminal behaviour (e.g. Farrington, 1994a, b). In terms of crime reduction, the focus is on early developmental prevention, for instance, on child rearing methods and, thus, the necessity of implementation of the delinquency prevention programmes as early as possible in the child's life (Farrington, 1994b).

### **2. *Structural factors relating to the family during adolescence***

While the first paradigm has a largely psychological thrust in considering adverse factors that are within the behavioural repertoire of the individuals involved and so are, in theory at least, potentially modifiable, there are other factors that are more obviously beyond the immediate control of the family or provide evidence of the family being in a different structural position within society. Such structural factors relate to parental employment and poverty and the parents' possession of educational qualifications. While the boundaries between these two paradigms may be blurred, this paradigm focuses more on factors that tend to be emphasised by sociologists (e.g. Pitts and Hope, 1997).

### **3. *The geographical segregation paradigm***

The focus here is that criminal behaviour is linked to localities/neighbourhoods and only to a lesser extent linked to individual characteristics (e.g. Sampson et al., 2005). In terms of crime reduction, the stance of this paradigm focuses on *community* crime prevention, a perspective oriented toward social control, instead

of aiming at changing the motivation and predispositions of offenders (Lewis and Salem, 1981)

#### **4. *Individual resource deficits***

This paradigm explains juvenile delinquency by their present individual resources, e.g. the offenders' own lack of education, poverty, or unemployment (Pitts and Hope, 1997). In terms of crime reduction, it tries to deal with the issue by increasing the individual's resources through education, training and employment.

While an impressive list, no classification is likely to be exhaustive. There will be other candidates attempting explanations that, in turn, have potential implications for crime reduction. So, for example, one can construct a paradigm which emphasizes the importance of the contemporary situation and opportunities as the most essential factors instead of individual resources or background (e.g. Clarke, 1980). With this approach the change from local grocers' shops to supermarkets, for instance, is regarded as a pivotal factor when increased incidences of shoplifting are to be explained. In terms of crime reduction, it is argued, for example, that screening measures introduced at airports have reduced the incidence of airline hijackings (Clarke, 1980). Limiting to four paradigms largely relates to pragmatism in the sense that variables – relevant to the four paradigms – can be extracted from the dataset chosen for the study, while there is, for instance, no information on situations and opportunities which would be relevant to situational theory.

In considering four paradigms there are profound considerations at stake. In brief, do these apparently competing paradigms make specific or independent contributions to the explanation of criminal behaviour and, thus, to crime reduction? So, for example, is geographical segregation (paradigm 3) just a spurious factor without any unique explanatory power in itself, besides statistical correlations with other well-known risk factors, such as poverty, lack of education, high unemployment etc. An analysis of this kind of issue is crucial for both theoretical and practical reasons.

In terms of considering the theoretical force of the various paradigms, the point is that, if they are not independent, then they cannot truly be regarded as competing. They are simply different faces of the same coin. In practical terms, understanding the relationships between the various paradigms helps to identify the most appropriate focus in attempting to reduce crime. If theories are not, indeed, competing but are simply different faces of the same coin, then it simply becomes a tactical decision of how to best tackle the crime issue. In contrast, if there are independent explanations of crime and criminal behaviour, then the way to tackle crime and its counterpart, crime reduction, becomes much more complex in strategic terms.

In theorising about crime there has been a tendency to consider the onset of offending behaviour in general. This approach may conflate many differences. The start of one form of criminal activity may have rather different precursors than the onset of another type of criminal activity.

In this study we chose to focus upon three crimes which have widespread prevalence. They are essentially crimes open to all in the sense that they can be committed by anyone unlike, say, embezzlement (where employment is a pre-requisite) or drunk-driving (where access to a car is a pre-requisite). With no such structural constraints,

the interest is whether the various paradigms have the same explanatory power for each of these three offences. In short, are there different triggering factors for the three offences?

## **METHODOLOGY**

A range of methods has been used to study crime and criminal behaviour. Participant observation, community studies, studies of victims and self reported criminal behaviour based on surveys among selected groups such as convicted criminals and prisoners (Smith, 1997); all have their strengths and weaknesses. However, in studying crime rates and the factors that contribute to these rates, the scope narrows. Certainly longitudinal studies of crime have the potential to clarify the timing and sequencing of important risk factors. Furthermore, Sampson and Laub (1992) maintain that the quantitative measurement of event history analyses has the additional advantage of addressing key limitations of past research. This can be done by reanalysing data archives in different historical and macro level contexts. In this way we perhaps begin to approach a methodology which is potentially generalisable irrespective of time and place.

Focusing on risk factors has its problems. There are both practical and theoretical issues to confront. So, for example, some risk factors (e.g. parental substance abuse; child-in-care) are comparatively infrequent and so are convictions for some crimes. Therefore, it takes large samples to study some associations in order to disentangle potential confounding effects. For this reason *national* birth cohorts that provide large numbers to analyse are particularly helpful. In the present paper we probe a *national* cohort of males born in 1980 and who were registered with Population Statistics and thus living in Denmark on 1 January 1994; this cohort was followed up to the end of 2003. Hence, it excludes all males born in Denmark in 1980 but who emigrated or died prior to the ‘census date’ of January 1, 1994. Hence, the series includes males born in 1980 who immigrated into the country before 1994.

For this study national administrative registers with information based on each individual’s contact with public services, together with their parents and other family members, were linked together by the use of a unique personal identity number<sup>1</sup>. After all the information had been linked, the personal identity numbers were erased in order to preserve anonymity. None of the participants was contacted, thus sensitive information was preserved without disturbing the involved individuals. Certainly the exercise provided a very rich data source.

Risk factors may not be readily transferable to theoretical concepts. Hedstrom and Swedborg (1998) usefully remind that “the identification and analysis of social mechanisms is of crucial importance for the progress of social science theory and research” (1998: 7). Similarly, Sorensen (1998) emphasises that the increasing use of survey analysis and statistical techniques has fostered the development of a variable-centred type of theorising that only pays scant attention to explanatory mechanisms. Recognising these dangers (to which we will return later), the chosen risk factors (which are defined in Appendix A) are shown in Table 1 in terms of their relevance to the various paradigms identified earlier. It needs here to be noted that the variable ‘Danish citizenship’ has not been assigned to a paradigm. While it could be incorporated into either paradigm 1 or 2, we have chosen to keep this variable distinct.

(Table 1 around here)

Although a rich dataset, the availability of appropriate data is always a constraint. Hence, some of the paradigms are represented by a fuller list of risk factors than others. Therefore, if a paradigm fails to show independence, then this may be because the available risk factors do not fully reflect the virtues of the paradigm and so one may not be able to readily pronounce the demise of a particular paradigm.

The outcome factors were the three offences of interest – violent offences, shoplifting, and burglary. Analyses were carried out using the total national birth cohort which includes 29,944 males, and their parents<sup>2</sup>. Among those born in the year 1980, the number of males who by the end of 2003 were convicted of shoplifting was 1,778, those convicted of violence was 1,585, while there were 1,208 convicted of burglary. For the crime of shoplifting, the numbers seem low but one needs to recognise that the focus here is on convictions - lesser crimes, such as shoplifting, are likely to have court diversionary procedures, such as warnings and cautions to prevent a court appearance. For each offence, the occasion of their *first* conviction for that offence is considered. Convicted males could be members of more than one of these three series.

The risk factors are assumed to act on the outcome factors in one of three ways. Type I factors act on the risk in the year following the risk event being recorded. Thus, being unemployed in 1990 will be a risk factor for a conviction in the following year and no other. Type II factors have an effect in the year following and all subsequent years. For example, a family separation which occurred in 1988 will act as a risk factor for all subsequent years from 1989 to 2003. Finally, a type III risk factor acts for all years of the study. These events, when they are identified in the register, are taken to be indicative of long-term behaviour both before and after the risk event. For example, domestic violence discovered in 1985 is assumed to be present before that year and will have an effect in all years of the study. Each risk factor was assigned to one of the three types, with the resulting classification shown in Table 2.

## STATISTICAL METHODS

Data has been analysed by the discrete-time Cox model (cf. Allison, 1982; Breslow, 1992). An individual's event history from the age of 15 years for the period 1995-2003 (inclusive) is broken up into a set of discrete time units (calendar years) in which an event (offence) either did or did not occur<sup>3</sup>. The data is analysed separately for each offence.

For each offence, every individual is observed until an event occurs or the observation is censored either because it was outside the age limits, because of death, or the individual is lost for observation for other reasons. Consequently, individual histories did not contribute data after the first offence. Pooling the non-censored years of all individuals, the person-years made up the controls. The controls (years at risk) were constructed by the total birth cohort of 29,944 men who were living in Denmark in 1994. The number of person-years varied depending on the offence in focus<sup>4</sup>.

For each offence, we fitted a sequence of discrete time models. First we considered models with a single risk factor, giving an estimate of the effect of that factor unadjusted for all other risk factors. We then used a stepwise regression procedure to



identify a final discrete time model consisting of all significant risk factors ( $p < 0.05$ ) for each of the offences. This provides an estimate of the effect of the risk factor adjusted for all other significant risk factors.

Counterfactual simulations (e.g. Canache et al, 2000) were then carried out in order to quantify how many of the total number of offenders (e.g. 1,778 shoplifters, 1,208 burglars, or 1,585 violent men) are “caused” by a given risk factor. We used a slightly modified version of the methodology applied in Hussain (2002, chapter 3). First a base simulation was run where each teenager in the series kept his actual characteristics and then the estimated probability of the event taking place was calculated from the final model. Next a counterfactual simulation was run where the risk factor of interest was assumed not to be present. For each time period and for each member of the series, the probability of the event in the counterfactual case was calculated from the final estimated models using existing characteristics for all other risk factors but with the risk factor of interest absent. Summing the estimated probabilities of first time offending over all person-years for the entire series for both the base and counterfactual simulations gave the estimated number of offenders under both scenarios. The difference in these numbers provided the estimated reduction in offending if a given risk factor is assumed not to be present and assuming that the relationship is directly causal.

## **RESULTS**

Results reflect both the outcomes and the measures used. For each offence of interest, Table 2 displays both the unadjusted odds ratios for each risk factor separately and the final model in a stepwise regression analysis. Almost without exception the unadjusted odds ratios for each factor are statistically highly significant and provide succour for each theoretical explanation. The exception is that attempted suicide – that is, as recorded in official records - is not significant as a precursor of burglary but is so for the other two offences. However, the numbers of attempted suicides are small for all the three offences.

In considering the factors included in the final model for each offence (the column in bold in Table 2), there is much detail but the overriding and important finding is that variables relevant to each of the four paradigms under focus are significant for each offence. In other words, it seems that one cannot readily jettison any of the paradigms as they contribute to the explanatory power for each offence. Having said that, however, a hierarchy of importance among the paradigms begins to emerge for this set of data.

(Table 2 around here)

Of the 28 variables included in the analysis, 19 feature in one or other of the final models for the three offences of shoplifting, burglary and violence. In fact, variations between the final models are few – fourteen of the variables feature in all three final models. It perhaps needs to be added in parenthesis that Danish citizenship as a separate variable remains in each of the final models. The variable does not readily link in with a particular paradigm but the results indicate that citizenship is not a variable that can be overlooked.

Of the variations in the three final models, parental poverty seems important as a precursor to burglary but not in relation to the other offences. In contrast, the father being convicted seems a precursor to shoplifting and violence but not to burglary. For shoplifting, the impact of the mother (either as a risk or protective factor – i.e. being teenage mother or the mother having a vocational qualification) - is not evident as a precursor to shoplifting but is for the other two offences. Similarly, being drug addicted seems relevant as an explanatory variable for shoplifting and burglary but not for violence. Hence, there are nuances between the final models produced separately for the three offences. However, how do these results impact upon the value of the various paradigms in attempting to explain the onset of these various types of criminal behaviour?

From the odds ratios displayed in Table 3, it is evident that all the paradigms remain active in potential explanatory terms. However, developing the counterfactual reduction in convictions analysis further opens up new features. To shed further light on the estimates, we next take the prevalence of a given risk factor into account. That is done by running individual counterfactual simulations applying the estimated parameters and assuming that a given risk factor was eliminated, while holding all other background variables constant.

(Table 3 around here)

The results of these simulations are presented in Table 3, but converted into actual numbers in relation to the total cohort. An example may clarify. In the first row domestic violence is the variable under consideration. If we assume that no male in the cohort had domestic violence as a social background characteristic, the implication is that an estimated 53 males would avoid the risk of shoplifting. Similarly, this assumption of no domestic violence in the background would remove the risk of burglary for 72 males, and violent crimes would be reduced by 111 males. While the analysis has some face validity in showing that the elimination of domestic violence is likely to be more important in reducing violence than the other two offences, there are dangers in this type of analysis. In brief, one needs to suspend reality, for the approach assumes that the significant variables are causally related to the outcome variables, whereas in reality it is unlikely that any relationship is directly causal. Domestic violence, for example is measured by hospital admissions and by convictions for violent crime. If all parents, through a massive hypothetical national intervention programme, could be persuaded to change their behaviour so that violent convictions and hospital admissions for domestic violence were reduced to zero, it is probable that this would not totally remove the home risk to the child from this source; as domestic conflict may well exist among these parents. In statistical terms, the important causal relationship is likely to be to a latent risk factor (domestic conflict) rather than its measured more serious manifestation (domestic violence). Nevertheless, suspending reality for a moment does produce some interesting insights.

The tendency in research is, of course, to be seduced by the more highly significant variables but these may be only relevant for a small proportion of the population. The alternative approach is to consider significant variables that affect a much larger proportion of the population. By converting the results into actual numbers one can more quickly identify the variables that seem to affect a much larger proportion of the

population. In this way parental unemployment and education and the potential offenders' own education begin to feature very strongly.

The other important insight provided by Table 3 is that different variables may make a different impact in relation to different offences. We have taken the view that any variable with less than 50 males likely to be affected does not make a sizeable impact. Hence, the mother being a teenager – when other variables are taken into account – seems to have a very limited potential impact.

The differences are instructive. So, for example, as already stated, domestic violence seems more closely associated with violence than the other offences. Similarly, being a child in care (that is, 'looked after children') seems more closely associated with burglary although the numbers relating to the other two offences are still sizeable. In contrast, family separation seems to be more associated with shoplifting although the other offences are sizeably represented. While the analysis is rather speculative, there seems little to suggest that particular paradigms are more closely related to particular offences; it is at the variable level that the differences seem to emerge.

The single factor which relates to the highest reduction in crime rates by this analysis is graduation. Indeed, if all these males in the birth cohort had been to high school, the assumption begins to emerge that the risk of burglary would be reduced to one third of the current actual level. Also violence would be halved, while shoplifting would be reduced by 39%. It all sounds rather remarkable. However, the assumed causal relationship may well be flawed. In the final analysis, of course, one needs to embrace rather than suspend reality. Nevertheless, we hope that the present analysis provides some clues regarding the variables that are both significant and potentially have wide application.

## **DISCUSSION AND CONCLUDING REMARKS**

The history of criminology has been replete with theorists, such as Lombroso, Sutherland, Merton and, more recently, Hirschi and Gottfredson, trying to present general theories which purportedly explain all criminal behaviour. These attempts to what Soothill (2005) calls 'capturing criminology' are doomed. Crime and criminal behaviour are too complex to be explained by just one perspective. A more sensible approach is to recognise that there are various paradigms – or explanatory frameworks – which are essentially competing. In fact, they all have some kind of 'face validity' in the sense of appearing to make some contribution to explaining crime and criminal behaviour. The task is to try to unpack these various contributions so that one can answer two questions.

Firstly, are the paradigms which are the focus of this paper independent paradigms or frameworks, that is, do they make a specific contribution which is not 'explained' by the other paradigms? Certainly the evidence presented suggests that each paradigm is likely to make an independent contribution to an explanation.

After considering the issue of independence, the second issue concerns the specific contributions that each paradigm makes to the total picture. In short, some paradigms may explain more than others. Certainly with our approach – and particularly aided by the counterfactual analysis – it would seem that there is likely to be more widespread benefit in focusing on structural issues within a society which have

widespread impact (such as unemployment and the lack of vocational qualifications) rather than the more individual deficits (such as a psychiatric disorder or drug addiction) that may affect much fewer people. In fact, this reflects the classical debates that are much more familiar within health care than in debates about crime reduction. In health care whether structural improvement in society will bring more health gains than individualised treatment has been well rehearsed. McKeown who maintains that “doctors have always tended to overestimate the effectiveness of their intervention” (1998: 31) argues that “improvement in health is likely to come in future, as in the past, from modification of the conditions which lead to disease, rather than from intervention in the mechanism of disease after it has occurred” (1998: 33). In other words, in early Victorian society when the infrastructure was limited, the gain in health terms from the introduction of a sewerage system was immeasurably greater than the interventions of doctors in health care. But later the balance may have changed when different sort of illnesses and diseases became evident. This is the type of debate that we need to engage more fully in in the area of crime. Meanwhile, the interim message is that there is no universalism in the sense that a set of results in a particular context will produce a universal truth. In other words, it seems likely that in some contexts particular paradigms will explain more than others. But there is also a more philosophical issue to consider which focuses on the nature of explanation.

Hedström and Swedberg have produced a powerful reminder of the limitations of the type of analysis that has been undertaken in this paper. Their example relates to ‘class’:

Despite the common sociological rhetoric of describing class as a ‘determinant’ of various individual traits and behaviours, class in and of itself obviously cannot influence an individual’s income or health. A ‘class’ cannot be a causal agent because it is nothing but a constructed aggregation of occupational titles. A statistical association between ‘class’ and income, or ‘class’ and health, tells us that individuals from certain ‘class’ have lower incomes or worse health than others, but it says nothing about why this is the case. (Hedström and Swedberg, 1998: 11)

Our analysis fails to meet the Hedström and Swedberg target of identifying the social mechanisms – as, indeed, does all analysis that simply displays risk factors. There is, of course, scope to speculate about social mechanisms using the results of the analysis. So, for example, the Danish citizenship variable – which is not incorporated directly in any of the paradigms under consideration – shows markedly different results for different outcomes. The odds ratios were higher for offences with greater visibility (e.g. violence and shoplifting) compared to an offence (e.g. burglary) where citizenry is unlikely to be a factor in terms of whether an offence is notified to the police. This hints that a discriminatory mechanism may be at play here. However, as Hedström and Swedberg also remind, Arthur Stinchcombe once noted, “a student [of sociology] who has difficulty of thinking of at least three sensible explanations of any correlation that he is really interested in should probably choose another profession” (Stinchcombe, 1968: 13). Or, more prosaically, Hedström and Swedberg note, “Simply making up an ad hoc story tailored to a specific case does not constitute an acceptable explanation” (1998: 11).

Nevertheless, on the basis of the evidence produced in this demonstration study, we are confident in making the following assertions:

1. All the paradigms examined seem likely to make a contribution towards explaining crime and criminal behaviour in Denmark. Whether or not that is true for other countries needs, however, to be empirically examined in those other contexts.
2. Variables, rather than paradigms, seem to have stronger links with particular offences. So, for example, under the 'Parental Child Rearing' paradigm, domestic violence has a stronger link to violence, 'looked after children' with burglary and family separation with shoplifting.
3. This type of approach fails to make serious inroads into identifying the social mechanisms that seem to effect the identified associations so to fully explain the development of criminal behaviour.

Our conclusions are probably not popular ones, for in providing a recipe for reducing crime we simply rehearse the familiar refrain that crime and criminal behaviour are complex phenomena to explain. However, on a more positive note after recognising that the 'easy fix' or a 'magic bullet' are not on offer, we can say that criminological theorising has broadly been on the right lines. The paradigms discussed in this paper all seem to be relevant. Hence, the trick is to move away from notions of theoretical imperialism (that is, that one paradigm will explain all) towards understanding the particular 'mixes' of variables that are relevant to particular outcomes of interest. We focused upon three crimes of widespread prevalence – namely, shoplifting, violence and burglary – and which are crimes that are essentially open to all in the sense that they can be committed by anyone. In fact, the profiles of these three sets of offenders have much overlap (indeed, some persons will be in each of three offence sets) but, nevertheless, the differences are sufficiently evident to suggest that there may also be different triggering factors for each of the offences. Other offences which could have been considered may have more readily demonstrated our claim of difference – 'drunk driving', for instance, seems unlikely to have a paradigm which emphasises poverty as high among its hierarchy of paradigms, for one needs to own or hire a car in order to be convicted of 'drunk driving'<sup>5</sup>.

The problem is a complex one, but our message is a simple one. Although there may well be quite considerable similarities, each country needs to effect an analysis on the factors that are relevant to their own profile of crime. It is inappropriate to think that what is relevant in the United States (which has the highest output of criminological information) will necessarily be relevant in another country/context. Similarly, within each country, there needs to be a recognition that explanatory variables that may be relevant to one type of crime may not be relevant or perhaps become less important with respect to another type of crime. Until those tasks are carried out in a systematic manner, the pre-requisites for understanding ways of reducing crime have not been completed.

With the availability of population registers and the possibility, under controlled conditions, of record linkage, Denmark provides a remarkable social laboratory for probing these issues. It offers the opportunity for the focus on a whole population – therefore large numbers – using some standard measures which have been collected (more or less) consistently over time. A prospective study of this kind avoids recall

bias and the other problems of retrospective studies. However, the material is limited to 'official' information which is collected by administrators. Also, of course, the procedures only provide limited types of information. Nevertheless, Denmark provides a remarkable social laboratory for considering criminal careers and the testing of theories of crime reduction.

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**Table 1: The relationship of risk factors and paradigms**

RISK FACTORS	PARADIGMS			
	1	2	3	4
<b><i>Social background</i></b>				
Parental substance abuse	X			
Parental mental illness	X			
Domestic violence	X			
Parental suicidal behaviour	X			
Child abuse or neglect	X			
<b><i>Family background</i></b>				
Child in care ('looked after children')	X			
Family separation	X			
<b><i>Intergenerational transfer</i></b>				
Mother teenager	X			
Mother convicted	X			
Father convicted	X			
<b><i>Educational qualifications of parents</i></b>				
Mother has vocational qualification		X		
Father has vocational qualification		X		
<b><i>Parental employment and poverty</i></b>				
Parental unemployment > 21 weeks		X		
Poverty (<40% of median income)		X		
Parental disability pension		X		
<b><i>Disadvantaged area</i></b>				
Disadvantaged area			X	
Rented housing (not self-owner)			X	
<b><i>Individual resources</i></b>				
Unemployment > 21 weeks				X
Didn't pass basic schooling level				X
Not in process of training or education				X
Graduated				X
Poverty (<50% of median level)				X
Psychiatric disorder				X
Attempted suicide				X
Drug addicted				X
Alcohol abuse				X
<b><i>Danish citizenship</i></b>				
Non-Danish				

**Notes:**

Paradigm 1: Parental child rearing methods.

Paradigm 2: Structural factors relating to the family during adolescence.

Paradigm 3: Geographical segregation.

Paradigm 4: Individual resource deficits.

**Table 2: Risk factors before first time conviction for shoplifting, burglary and violence. Unadjusted Odds Ratio for each factor separately and the final stepwise logistic regression model. Males born in 1980, followed from 1981 to 2003 in Denmark.**

Risk factors included	Type	SHOPLIFTING			BURGLARY			VIOLENCE			
		No of convicted persons (n=1,778)	Un-adjusted single factor OR	Stepwise final model OR	No of convicted persons (n=1,208)	Un-adjusted single factor OR	Stepwise final model OR	No of convicted persons (n=1,585)	Un-adjusted single factor OR	Stepwise final model OR	
<b>PARENTAL CHILD REARING METHODS</b>											
<b>Social background</b>											
Parental substance abuse	III	239	2.3***	Ns	197	2.9***	Ns	214	2.3***	Ns	
Parental mental illness	III	375	2.0***	Ns	304	2.5***	Ns	340	2.1***	Ns	
Domestic violence	III	225	2.9***	1.3 **	204	4.1***	1.6***	263	4.1***	1.8***	
Parental suicidal behaviour	II	9	3.2 **	Ns	8	4.4***	Ns	10	4.1***	Ns	
Child abuse or neglect	II	43	2.6***	Ns	34	3.0***	Ns	37	2.5***	Ns	
<b>Family background</b>											
Child in care ('looked after children')	II	414	4.1***	1.8***	404	6.8***	2.1***	389	4.2***	1.5***	
Family separation	II	1122	2.8***	1.6***	818	3.4***	1.5***	1017	2.9***	1.5***	
<b>Intergenerational transfer</b>											
Mother teenager	II	157	2.4***	Ns	141	3.3***	1.3 **	173	3.0***	1.3 **	
Mother convicted	I	26	4.2***	Ns	13	3.0***	Ns	22	4.0***	Ns	
Father convicted	I	49	4.0***	1.7 **	33	3.8***	Ns	45	4.1***	1.6 **	
<b>STRUCTURAL FACTORS RELATING TO THE FAMILY DURING ADOLESCENCE</b>											
<b>Educational qualifications of parents</b>											
Mother has vocational qualification	I	301	0.6***	Ns	137	0.4***	0.7 **	202	0.4***	0.8 **	
Father has vocational qualification	I	228	0.5***	0.8 *	113	0.4***	0.8 *	135	0.3***	0.6***	
<b>Parental employment and poverty</b>											
Parental unemployment > 21 weeks	II	1363	2.8***	1.6***	964	3.3***	1.5***	1248	3.1***	1.5***	
Poverty (<40% of median income)	II	708	1.9***	Ns	579	2.6***	1.2 *	694	2.2***	Ns	
Parental disability pension	II	386	1.9***	Ns	298	2.2***	Ns	378	2.1***	Ns	
<b>GEOGRAPHICAL SEGREGATION</b>											
Disadvantaged area	I	108	3.3***	1.4 **	69	2.9***	1.3 *	104	3.5***	1.5***	
Rented housing (not self-owner)	I	963	2.2***	1.3***	672	2.3***	1.2 **	879	2.3***	1.2 **	

INDIVIDUAL RESOURCE DEFICITS										
Unemployment > 21 weeks	I	109	2.8***	1.7***	128	5.0***	2.0***	120	3.4***	1.3 *
Didn't pass basic schooling level	III	185	5.0***	1.8***	170	6.9***	1.9***	191	5.7***	2.0***
Not in process of training or education	I	575	1.5***	1.2 **	507	2.2***	1.6***	640	2.1***	1.2 **
Graduated	II	218	0.3***	0.6***	78	0.2***	0.3***	182	0.3***	0.4***
Poverty (<50% of median income)	I	332	1.9***	1.6***	314	2.9***	1.8***	315	2.0***	1.4***
Psychiatric disorder	II	97	2.8***	Ns	85	3.6***	Ns	105	3.3***	1.4 **
Attempted suicide	II	4	6.1 **	Ns	2	Ns	Ns	3	4.6 **	Ns
Drug addicted	II	27	4.9***	2.5***	25	7.0***	3.0***	24	4.6***	Ns
Alcohol abuse	II	77	2.1***	1.6***	70	2.8***	1.8***	92	2.8***	1.9***
DANISH CITIZENSHIP										
Non-Danish	I	305	3.4***	2.0***	177	2.7***	1.6***	306	3.9***	2.4***

Note: 'Ns' stands for: 'Not significant'. \* 0.05-level; \*\* 0.01-level; \*\*\* 0.0001-level. Type I: exposed to risk factor the previous year. Type II: exposed to risk factor at least one of the previous years. Type III: risk factor observed for at least one of the years under investigation.

**Table 3: Odds ratio and counterfactual reduction in stepwise regression for the following first-time outcome variables: shoplifting, burglary, and violence convictions according to the Danish Criminal code. Final model in the stepwise regression**

VARIABLES	Odds ratios			Counterfactual reduction in no. of convictions		
	Shop-lifting	Burglary	Violence	Shop-lifting	Burglary	Violence
<b>PARENTAL CHILD REARING METHODS</b>						
<b><i>Social background</i></b>						
Domestic violence	1.3	1.6	1.8	53	72	111
<b><i>Family background</i></b>						
Child in care ('looked after children')	1.8	2.1	1.5	178	205	126
Family separation	1.6	1.5	1.5	391	265	333
<b><i>Intergenerational transfer</i></b>						
Mother teenager	Ns	1.3	1.3	N/a	36	48
Father convicted	1.7	Ns	1.6	18	N/a	16
<b>STRUCTURAL FACTORS RELATING TO THE FAMILY DURING ADOLESCENCE</b>						
<b><i>Educational qualifications of parents</i></b>						
Mother has vocational qualification	Ns	0.7	0.8	N/a	302	285
Father has vocational qualification	0.8	0.8	0.6	248	205	507
<b><i>Parental employment and poverty</i></b>						
Parental unemployment > 21 weeks	1.6	1.5	1.6	497	302	428
Poverty (<40% of median income)	Ns	1.2	Ns	N/a	72	N/a
<b>GEOGRAPHICAL SEGREGATION</b>						
Disadvantaged area	1.4	1.3	1.5	36	12	32
Rented housing (not self-owner)	1.3	1.3	1.2	231	132	127
<b>INDIVIDUAL RESOURCE DEFICITS</b>						
Unemployment > 21 weeks	1.7	2.0	1.3	53	60	32
Didn't pass ground level	1.8	1.9	2.0	89	72	95
Not in process of training or education	1.2	1.6	1.2	89	181	95
Not graduated	1.8	3.3	2.5	693	809	888
Poverty (<50% of median level)	1.6	1.8	1.4	124	133	79
Psychiatric disorder	Ns	Ns	1.4	N/a	N/a	32
Drug addicted	2.5	3.0	Ns	18	12	N/a
Alcohol abuse	1.6	1.8	1.9	36	24	48
<b>DANISH CITIZENSHIP</b>						
Non-Danish	1.8	1.7	2.5	160	60	174

VARIABLES	Odds ratios			Counterfactual reduction in no. of convictions		
	Shop-lifting	Burglary	Violence	Shop-lifting	Burglary	Violence
No. of offenders	1,778	1,208	1,585	1,778	1,208	1,585

Note: 'Ns' stands for 'Not significant'; 'N/a' means 'Not applicable'. Counterfactual reduction is seen as the reduction in incidence that would be achieved if the population had not been exposed by the current risk factor, compared with the current/actual exposure pattern. For instance, the total reduction is 81 per cent or 1,483 fewer persons convicted of shoplifting if all the included risk factors were eliminated.

## APPENDIX A: Risk factors and their definitions

<b>Risk factors</b>	<b>Definition</b>
<b>Social background</b>	
Parental substance abuse	Alcohol abuse or drug abuse (see below)
Parental mental illness	One or both parents admitted to a psychiatric ward according to the Danish Psychiatric Nationwide Case Register.
Domestic violence	Battered adults according to hospitals admissions or parents convicted of a violent crime. Parent exposed to assault, inflicted hams undetermined intent. Victims of violence, which led to hospitalisation and professional assessment of the injury being wilfully inflicted by other persons. <i>Parent convicted for violence:</i> The Criminal Statistic Register includes persons convicted for violence. This category comprises a wide range of criminal behaviour of various degrees of seriousness: manslaughter, grievous bodily harm, violence, coercion and threats. This category does not include accidental manslaughter in combination with traffic accidents, or rape, which belongs to the category of sexual offences.
Parental suicidal behaviour	Parents' suicide attempts according to the National Patient Register and the Danish Psychiatric Nationwide Case Register or suicide according to the Causes of Death Register. Included is also intentional self-harm according to hospitals admissions.
Child abuse or neglect	Adolescents being victims of violence, abuse or neglect, which led to hospitalisation and professional assessment of the injury being wilfully inflicted by other persons.
<b>Family background</b>	
Child in care ('looked after children')	The child is in care at home placement according to the children's acts section or the child is not living together with the parents but in an institution or in a foster home according to the population based register of social assistance to children in care.
Family separation	Family dissolution includes information on all children who had experienced divorce, separation and the death of a parent before they were 18 years old. The Danish Central Population Register (CPR) includes information that connects all children to their parents whether they are married or not.
<b>Intergenerational transfer</b>	
Mother teenager	The mother had been a teenager herself when she gave birth to the boy in focus.
Mother convicted (mother/father)	Convicted violations of The Danish Criminal Code.
<b>Educational qualifications of parents</b>	
Vocational qualification (mother/ father)	Vocational training: All persons who have a vocational training (bricklayer, carpenter, dentist, lawyer, or teacher in a kinder garden). This does not include semi-skilled worker. Information is based on Education statistics or the educational classification module which is population-based, including schooling and educational training for the highest education achieved by the person in focus.

<b>Parental employment and poverty</b>	The number of days unemployed (more than 21 weeks) during a calendar year according to registers of Income Compensation Benefits, Labour Market Research, and Unemployment Statistics. Parental unemployment for one or both parents.
Parental unemployment >21 weeks	Family income was less than 40% of median income in one of the previous years. The poverty status of an individual is decided by the level of consumption possibilities which are approximated by equivalent disposable income defined as disposable income corrected for household composition and size. Here, gross income is the sum of labour earnings, asset flows, imputed value of owner occupied housing, private transfers and public transfers such as sickness benefits, unemployment insurance benefits, pensions and social assistance. Asset flows include income from rent, dividends and value of house ownership. In this study the income concept is equivalent annual household income after transfers and taxes*.
Poverty (<40% of median income)	One or both parents receiving disability pension according to registers of Income Compensation Benefits.
Parental disability pension	A governmental board has pointed out the most disadvantaged housing areas. The housing areas are a part of the subsidized housing sector, consisting of 135 areas. About 200,000 persons or 4 percent of the total population are living in these areas. Each area consists of 1,500 inhabitants, on average. The smallest areas include 30 inhabitants while the largest area includes 14,000 persons (Boligministeriet, 1993; Graversen et al., 1997; Hummelgaard et al., 1997). These disadvantaged housing areas were divided into quintiles and the two most disadvantaged quintiles were in the present study identified as disadvantaged areas in this dichotomized variable. These most disadvantaged areas would then cover about 80,000 inhabitants or 1.6 percent of the total population.
<b>Disadvantaged area</b>	The house or flat is rented.
Disadvantaged area	The definition is based on fulfilling one of the following conditions: <ul style="list-style-type: none"> <li>• If at least one of the parents have Danish citizenship and is born in Denmark.</li> <li>• If there is no information in the registers about any of the parents and the child himself/herself has Danish citizenship and is born in Denmark.</li> </ul> All others are defined as non-Danish.
Rented housing (not self-owner)	The number of days unemployed (more than 21 weeks) during a calendar year according to registers of Income Compensation Benefits, Labour Market Research, and Unemployment Statistics.
<b>Danish citizenship</b>	Compulsory school is 9 years education.
Danish/non-Danish	Not in school, gymnasium, or other education nor vocational training.
<b>Individual resources</b>	Ever been in high school (gymnasium)
Unemployment > 21 weeks	Present family income less than 50% of median income the previous year.
Didn't pass basic schooling level	
Not in process of training or education	
High school	
Poverty (<50% of median level)	

Psychiatric disorder	Admitted to a psychiatric ward according to the Danish Psychiatric Nationwide Case Register.
Attempted suicide	Self-inflicted harm according to hospitals admissions. The definition of suicide attempts also included behaviour that conformed to the following three conditions: (i) Suicide attempts that had led to hospitalisation, (ii) assessment of the trauma being an act of self-mutilation according to the international statistical classification of injuries when discharged from hospital, (iii) the trauma had to be included in a specified list of traumas traditionally connected with suicide attempts: cutting in wrist (carpus), firearm wounds, hanging, self-poisoning with drugs, pesticide, cleaning fluids, alcohol or carbon monoxide.
Drug abuse	Addiction or poisoning by drugs according to hospitals admissions. Mental and behavioural disorder due to use of drugs (e.g. opioids, cannabinoids, cocaine). Dependence on morphine was not included if chronic pain-giving diseases were observed, too. E.g. rheumatoid arthritis and allied conditions, displacement of intervertebral disc, vertebrogenic pain syndrome, or cancer.
Alcohol abuse	According to hospital admissions the following diagnoses were expected to be associated with long-term alcohol abuse: Alcoholic psychosis, alcoholism, oesophageal varices, cirrhosis of liver (alcoholic), chronic pancreatitis (alcoholic), delirium, accidental poisoning by alcohol. Mental and behaviour disorder due to use of alcohol.
<b>Outcome factors:</b>	
Violent offences	The Criminal Statistic Register includes persons convicted for violence. This category comprises a wide range of criminal behaviour of various degrees of seriousness: manslaughter, grievous bodily harm, violence, coercion and threats. This category does not include accidental manslaughter in combination with traffic accidents, or rape, which belongs to the category of sexual offences.
Shoplifting	Acquisitive offences such as shoplifting, stores, kiosk, coin-operated laundry, jeweller, wine shop
Burglary	Acquisitive offences such as break-in shops, offices, banks, break into housing, holiday cottage not burglary into a car.

**Note:** \* The square root of the number of family members is the applied equivalence scale, thus the elasticity of the equivalence scale with respect to household size is  $\frac{1}{2}$ . A number of international comparisons of poverty and inequality applies scales in this range, see e.g. Förster (1995), Atkinson et al. (1995) and Buhmann et al. (1988). The poverty line is 40 per cent of the current year's equivalent income median. This is calculated on the basis of a representative 3 per cent sample of the whole population. Individuals with income less than the poverty line are defined as poor. In EU publications the 60 per cent of median poverty line is utilised, so applying the 40 per cent line means that we here look at severe poverty.



## FOOTNOTES

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<sup>1</sup> The population-based registers used in this study have been described elsewhere (Christoffersen et al, 2003; 2005), but they are essentially Population statistics, Medical register on vital statistics, Unemployment statistics, Educational classification module, Social Assistance Act statistics, Integrated Database for Labour Market Research, Crime statistics, Income compensation benefits, Fertility database, National inpatient register and National psychiatric register.

<sup>2</sup> The children's personal identity number is the key, which links the children to their parents whether they are living together, married, or not. Information from registers has been collected for each calendar year, and information about the child and the parents is combined to one record for each child.

<sup>3</sup> When the discrete time unit is a calendar year, it is difficult to use continuous-time methods, since more than one individual experiences an event in the same time interval. The data is more appropriately considered by a discrete-time model, which allows estimation of parameters by treating each individual history as a set of independent observations. Benefit can be gained from earlier findings where it has been shown that the maximum likelihood estimator can be obtained by treating all the time units for all individuals as though they were independent, when studying first-time events (Allison, 1982).

<sup>4</sup> The total numbers at risk were  $N_s=230,881$  person-years,  $N_b=234,367$  person-years, and  $N_v=233,791$  person-years, when analyzing shoplifting, burglary, or violence, respectively.

<sup>5</sup> There will, of course, be cars stolen where the driver, if caught, may be convicted of 'drunk driving', but this variant of drunk driving is not the major concern of authorities in relation to this crime.