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Gender differences in offending: implications for risk-focused prevention

David P. Farrington
Kate A. Painter

Home Office Online Report 09/04

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David P. Farrington
Kate A. Painter

Summary

Aims

The main aims of this research are to investigate similarities and differences in risk factors for offending (as measured by convictions) of boys and girls, and to compare criminal careers of males and females in the same families. The main focus is on socio-economic, family and child-rearing risk factors. There have been very few previous large-scale community-based surveys of several hundred boys and several hundred girls where risk factors for offending by boys and girls have been compared. By comparing boys and girls in the same families, many extraneous (e.g. neighbourhood and community) influences on offending are controlled.

The Cambridge Study

This research analyses data collected in the Cambridge Study in Delinquent Development, which is a prospective longitudinal survey of London boys from age eight to age 48. Many previous analyses have been carried out on childhood (age eight to ten) risk factors for offending by these boys. For the first time, this report analyses childhood risk factors for offending by their brothers and sisters, and compares results with those obtained for the boys. Only one previous study (in the United States) has compared risk factors for offending by brothers and sisters. Clearly, brothers and sisters are more comparable than unrelated males and females.

Limitations

The main limitations of this project are that the boys and girls were growing up during the 1960s and 1970s, when conditions were very different from today, and that offending is measured according to convictions. However, risk factors for offending are generally replicable over time and place, and risk factors for official and self-reported offending are generally similar. Other important points are that it is difficult to draw simple conclusions about causes from results obtained with risk factors, and that protective factors are not addressed in this report. This project does not explain why males are more likely to offend than females.

Criminal careers

The analyses are based on 397 families containing 397 study males and their 494 brothers and 519 sisters. The main comparisons are between brothers and sisters, because there is far more information about both risk factors and offending for the Study males. The prevalence of convictions for criminal offences was 44 per cent for brothers and 12 per cent for sisters. Brothers committed offences more frequently: an average of 4.3 per offender, compared with 2.8 for sisters. Whereas brothers disproportionately committed burglary and theft of vehicles, sisters disproportionately committed shoplifting and deception offences. Brothers and sisters were similar in average ages of offending (21.7 for brothers and 21.5 for sisters) and in average ages of onset and desistance, although sisters had shorter criminal careers. Offending tended to be concentrated in certain families, and the probability of a child being convicted increased with the number of other convicted children in a family.

Risk factors for offending

Risk factors for offending, for early onset (before age 17), and for frequent offending were studied. In general, the most important risk factors were similar for brothers and sisters: low family income, large family size, attending a high delinquency rate school, a convicted father, a convicted mother, a delinquent sibling, parental conflict, separation from a parent, harsh or erratic parental discipline and poor parental supervision.

Gender differences

However, there were some gender differences. In particular, socio-economic risk factors such as low social class, low family income, poor housing and large family size predicted offending more strongly for sisters than for brothers. Child-rearing risk factors such as low praise by the parents, harsh or erratic discipline, poor parental supervision, parental conflict, low parental interest in education and low paternal interest in the children were also stronger predictors for sisters than for brothers. In contrast, there was a tendency for parental risk factors such as nervous fathers and mothers and poorly educated fathers and mothers to be more important for brothers than for sisters. Convicted fathers and mothers were equally important predictors for brothers and sisters. There was no tendency for mother risk factors to be more important for sisters and father risk factors to be more important for brothers. It seems likely that new gender-specific theories are needed to explain results obtained here on risk factors for delinquency.

Gender differences in predictive accuracy

In general, risk factors predicted offending by sisters more strongly than offending by brothers. For example, in predicting early onset offending, the percentage of sisters convicted increased from one per cent to 11 per cent according to the absence or presence of low family income, whereas the percentage of brothers convicted increased from 14 per cent to 33 per cent. Even after controlling for other risk factors, partial odds ratios were higher for sisters than for brothers. Arguably, therefore, the strength of causal influence of risk factors on offending is greater for females than for males. Risk scores predicted offending more accurately for sisters than for brothers. For example, in predicting early onset offending, the percentage of sisters convicted increased from two per cent of those with no risk factors to 21 per cent of those with four to five risk factors (out of low family income, large family size, a convicted parent, separation from a parent and poor parental supervision). The percentage of brothers convicted increased from nine per cent of those with no risk factors to 40 per cent of those with four to five risk factors. While the absolute percentage difference was greater for brothers, the proportional percentage increase (which is a better index of the likely causal effect) was much greater for sisters. The fact that convicted sisters were a more extreme fraction of the cohort than convicted brothers accounted for part of the gender difference in predictive accuracy, but not for all of it.

Risk assessment

The present analyses suggest that risk assessment using family factors is likely to be more accurate for females than for males. In this research, the comparison of high and low risk sisters versus high and low risk brothers suggests that risk assessment devices can discriminate more effectively among females than among males. Gender differences in the importance of risk factors should be taken into account in constructing gender-specific risk assessment devices.

Risk-focused prevention

Past research shows that family-based prevention techniques targeting risk factors can be effective in reducing offending. Gender differences in the importance of risk factors should be taken into account in choosing intervention techniques. The present analyses suggest that parent training and parent education techniques, which target parental discipline, parental supervision, parental reinforcement of children (e.g. praising) and parental interest in children are likely to have proportionally more impact in reducing female offending than in reducing male offending (especially early onset offending). Similarly, interventions designed to reduce family poverty are likely to have proportionally more impact in reducing female offending. However, the absolute number of offences reduced is likely to be greater for males than for females because of the higher prevalence of male offending.

Conclusions

Interventions designed to reduce offending should be based on the best possible information about risk factors for offending. We have found that the knowledge base about gender differences in offending is inadequate and have tried to advance this in our report. We hope that this new knowledge will assist in implementing more effective gender-specific intervention techniques.

1. Introduction

Aims

The aim of this research is to investigate whether risk factors for offending are similar or different for males and females in the Cambridge Study in Delinquent Development, and to derive implications for risk-focused prevention. The main comparison is between the brothers and sisters of the boys in the Cambridge Study. Clearly, brothers and sisters in the same families are more comparable than unrelated males and females, because many extraneous (e.g. neighbourhood and community) factors are held constant. There have been previous studies of siblings and twins to investigate genetic and family environmental influences on delinquency (e.g. Rowe, 1986; Rowe *et al.*, 1992) and previous comparisons of delinquent and non-delinquent siblings in the same families (e.g. Jones *et al.*, 1980; Reitsma-Street *et al.*, 1985). However, there seems to be only one previous study that has compared brothers and sisters on risk factors for offending, by Rowe *et al.* (1995). Previous research on risk factors (and many other topics) in the Cambridge Study has analysed only the boys.

The main objectives of this research can be summarised as follows:

1. To investigate similarities and differences in childhood risk factors for offending by boys and girls.
2. To compare criminal careers of males and females.
3. To draw out implications for future research, policy and practice, and especially for risk-focused prevention.

Risk factors for offending

This research investigates socio-economic, family and child-rearing risk factors for offending by boys and girls. Hitherto, much longitudinal research on risk factors for offending has concentrated on males, because they commit most of the serious predatory and violent offences. Only recently have comparisons been made between males and females in large-scale longitudinal surveys of community samples (e.g. Moffitt *et al.*, 2001). The neglect of risk factors for females has resulted in substantial gaps in our understanding of the causes of male versus female offending which may hamper the development of differential preventive strategies, especially those based on targeting risk factors.

Developmental criminology and criminal career research has concentrated on three main issues: the development of offending and antisocial behaviour, risk factors at different ages, and the effects of life events on the course of development (Farrington, 2002a). The present research investigates similarities and differences in the development of offending: in the prevalence of offending by boys and girls, the frequency of offending, the ages of onset and desistance, in lengths of criminal careers, and in types of offences committed. It also compares risk factors for offending by boys and girls.

Many risk factors for offending are well established, especially for males. These include impulsivity, attention problems, low school attainment, poor parental supervision, parental conflict, an antisocial parent, teenage mothers, large family size, low family income and coming from a broken home. Less well established is whether these factors impact differentially on boys and girls within the same families. Yet, it is well documented that girls offend seldom and boys offend often. Particular attention is paid in this report to the impact of socio-economic, family and child-rearing risk factors on the criminal careers of females compared to males.

Key research questions to be addressed

1. In what ways do developmental features of offending, such as age of onset, duration or intensity (frequency and seriousness), differ between males and females?
2. Does female offending have the same causes and obey the same theories as male offending?
3. Are the relationships between childhood risk factors and offending similar for boys and girls?

- 3a. Are socio-economic risk factors more important for boys or for girls? (Which socio-economic risk factors?)
- 3b. Are family risk factors more important for boys or for girls? (Which family risk factors?)
- 3c. Are child-rearing risk factors more important for boys or for girls? (Which child-rearing risk factors?)
- 3d. Are characteristics of mothers (e.g. convicted mothers, teenage mothers, nervous mothers) more predictive of female offending, while characteristics of fathers (e.g. convicted fathers, nervous fathers) are more predictive of male offending?
- 4. Is risk-focused prevention (identifying and tackling risk factors for offending) likely to be more effective for males or for females?

2. Previous research on risk factors for boys and girls

Explaining gender differences in offending

A consistent theme to emerge from developmental criminology is that males are more likely to offend than females and that male offending is more serious, persistent and violent (Lanctot and LeBlanc, 2002). Most research on risk factors for delinquency has been based on males. Despite the clear discrepancy in offending, there is little authoritative empirical evidence or widespread agreement about whether the risk factors which influence male offending are similar to or different from those which influence female offending. For the most part, existing studies of male and female offending are unsatisfactory. Previous research has been characterised by poor measurement of few risk factors, inadequate sample sizes, poor quality designs and weak analytic techniques. A notable exception to this is a high quality longitudinal study which makes comparisons between males and females with regard to risk factors (Moffitt *et al.*, 2001).

Despite the paucity of relevant research, the criminological literature is replete with explanations for the difference between male and female offending rates (Lanctot and LeBlanc, 2002). Some researchers have endeavoured to explain this in terms of different socialisation experiences in childhood and adolescence. Arguably, females are socialised better and have stronger internal inhibitions against offending. Others have focused on neurological, biological or hormonal differences between males and females. More recently, differences in offending have been explained by reference to differences between male and female social cognitive processes (Bennett *et al.*, 2002). Gender differences have been approached from a variety of perspectives, from biological models to social control, power control and feminist theories.

Some scholars have suggested that common theories and risk factors apply to both males and females but others have argued that early predictors of male delinquency are less effective when applied to females (Lanctot and LeBlanc, 2002). Some studies suggest that differences in offending rates can be explained by the fact that males possess more risk factors - such as impulsiveness or poor parental supervision - than their female counterparts (Rowe *et al.*, 1995). It has also been proposed that females might have to pass a higher threshold of risk before becoming involved in criminal and antisocial behaviour, or in other words that they are less influenced by or have more resilience against risk factors.

Comparisons of risk factors for boys and girls

Our aim was to review studies comparing relationships between family risk factors and delinquency for males and females. Consequently, we tried to identify the major large-scale community-based surveys in which family risk factors for delinquency were analysed separately for males and females. Surprisingly few studies of this kind have been carried out. Table 2.1 summarises key features of the 13 major studies that we found. These were carried out in six countries (United States, England/Wales, New Zealand, Norway, Sweden and Finland).

For inclusion in our review, we set a minimum sample size of 500 persons in total. A study had to be based on a reasonably representative community sample; we excluded research projects based only on adjudicated delinquents (e.g. Datesman and Scarpitti, 1975) or case-control studies (e.g. a comparison of court or clinic samples with control samples, such as Offord, 1982). We focused on measures of delinquency (especially property and violent offences), excluding studies of substance use (e.g. Smith and Paternoster, 1987) or of minor deviant acts such as truancy and running away (e.g. Barton and Figueira-McDonough, 1985). Where there was a choice between a clear delinquency scale and a measure of minor deviance (e.g. Storvoll and Wichstrom, 2002), we focused on results obtained with the delinquency scale. However, we did include the measure of "conduct disorder" of Moffitt *et al.*, (2001) because most of the items on this scale were delinquent acts.

Table 2.1: Large-scale community surveys comparing risk factors for delinquency of boys and girls

Author and Date	Sample Size	Age	Design	Criterion of Offending
Simons <i>et al.</i> (1980)	1913F 2012M	12-17	State-wide sample of public school children in Iowa. Cross-sectional.	SD
Canter (1983)	807F 918M	11-17 (later followed up)	U.S. national sample. (National Youth Survey) Longitudinal.	SD
Riley and Shaw (1985)	373F 378M	14-15	National sample in England/Wales. Cross-sectional.	SD
Johnson (1986, 1987)	331F 319M	15	Boys and girls from all high schools in Seattle. Cross-sectional.	SD, OD
Cernkovich and Giordano (1987)	423F 401M	12-19	Boys and girls from probability sample in U.S. Northern Metropolitan area. Cross-sectional.	SD
Weintraub and Gold (1991)	1300	11-18	U.S. national sample (National Survey of Youth). Cross-sectional.	SD
Graham and Bowling (1995)	910F 738M	14-25	National sample in England/Wales. Cross-sectional.	SD
Rantakallio <i>et al.</i> , (1995)	5757F 6007M	25	Children in North Finland born in 1966. Longitudinal.	OD
Rowe <i>et al.</i> , (1995)	425F 411M (2 siblings in each of 418 families)	10-16	Telephone survey in Arizona. Cross-sectional.	SD
Martens (1997)	220F 282M	13-14	Questionnaire in 5 schools in Orebro (Sweden). Cross-sectional.	SD
Flood-Page <i>et al.</i> , (2000)	4848	12-30	National sample in England/Wales. Cross-sectional.	SD
Moffitt <i>et al.</i> , (2001)	510F 527M	Age at start of Study = 3 Follow-up at 5, 7, 9, 11, 13, 15, 18, 21	Longitudinal study of health, development and behaviour of birth cohort in Dunedin, New Zealand.	CD
Storvoll and Wichstrom (2002)	9342	12-17	National school sample in Norway. Cross-sectional.	SD

Notes: F = No. of females initially. M = No. of males initially. SD = Self-reported delinquency. OD = Official delinquency. CD = Conduct disorder.

Table 2.1 shows that almost all studies were based on self-report measures of offending. The measure of official delinquency used by Johnson (1986) was also based on self-reports. Unfortunately, in most cases the family risk factors were also based on the youth's self-report. This raises a number of problems, of which the most obvious are that the youth's report of family risk factors may be inaccurate and that relationships between family risk factors and delinquency may artefactually reflect a common self-report bias (e.g. a willingness to admit undesirable features).

In order to be included, a study had to measure at least one of the following family risk factors (see Farrington 2002c); (a) criminal parents or delinquent siblings; (b) parental characteristics such as teenage or working mothers or poorly educated or nervous parents; (c) large family size; (d) child-rearing methods (e.g. poor supervision, harsh or inconsistent discipline, parental rejection, low parental involvement with the child); (e) abuse or neglect; (f) parental conflict or disrupted families. Results obtained with these risk factors, and with family socio-economic status, are presented. As mentioned, we only included studies that reported results separately for males and females, whether or not they carried out multivariate analyses. Studies that only reported interaction effects in regression analyses (e.g. age-gender-delinquency interactions by Seydlitz, 1991) were not included.

Measuring strength of association

Most studies measured the strength of association between risk factors and delinquency either using the product-moment correlation (r), chi-squared in contingency tables, or weightings in multiple regression equations. Unfortunately, all of these measures are affected by prevalence. Because males are more likely to commit offences than females, the strength of relationships for males may (artefactually and incorrectly) appear to be greater.

As an example, consider the classic research by Rivera and Widom (1990) on the link between childhood abuse/neglect and later violent offending. This study was not included in Table 2.1 because of its case-control design; abused/neglected cases were compared with matched controls. Rivera and Widom (1990) found that 19.2 per cent of abused males were arrested for violence, compared with 13.5 per cent of controls, a significant difference (chi-squared = 4.79, $p < .05$); while 3.4 per cent of abused females were arrested for violence, compared with 2.4 per cent of controls, a non-significant difference (chi-squared = 0.72). Consequently, "abused/neglected males were at greater risk of committing a violent offence" (p.24) but "adult females who were abused and neglected were not more likely to commit a violent offence than non-abused females" (p.30).

This conclusion depends on the statistical measure of association used (chi-squared, which is mathematically related to r in 2 x 2 tables). If instead we calculate Relative Risk, we find that abused males were 42 per cent more likely to be violent than controls, whereas abused females were also 42 per cent more likely to be violent than controls. Similarly, the Odds Ratio (see later) was 1.5 for both males and females. Using these statistics, we would conclude that child abuse was similarly related to later violence for males and females.

Interestingly, six years later Maxfield and Widom (1996) found that 28 per cent of abused males had now been arrested for violence, compared with 24 per cent of controls (Odds Ratio = 1.2, n.s.) while eight per cent of abused females were arrested for violence, compared with four per cent of controls (Odds ratio = 2.4, $p < .05$). Hence:

"Abused or neglected females were at an increased risk of arrest for violence as juveniles and as adults, whereas this relationship was barely significant for abused and neglected males compared to control males... These findings contrast with those reported in earlier analyses in which abused and neglected males were at an increased risk for violence but females were not." (p.393).

We would emphasise that, in comparing associations for males and females, it is important to use measures (such as the Odds Ratio) that are not affected by prevalence, and not to use measures (such as chi-squared, r and weightings in multiple regression) that are affected by prevalence.

Results of comparisons

In general, the studies reviewed in Table 2.2 found that the most important risk factors for delinquency were similar for boys and girls. Important risk factors for boys and girls included:

- parental criminality
- harsh or inconsistent parental discipline
- poor parental supervision
- low parental attachment and involvement
- parental conflict and broken families
- young mothers

These risk factors have been reported and replicated in many other studies (see e.g. Farrington, 2002a).

While most risk factors in Table 2.2 predicted delinquency for both males and females (or not, in some cases) there were some differences. In particular, Canter (1983), Moffitt *et al.* (2001) and Storvoll and Wichstrom (2002) all concluded that correlations between family factors and delinquency tended to be higher for males than for females. However, since all used a measure of association that is affected by prevalence, it is difficult to know how far these conclusions are a consequence of this statistical artefact.

Table 2.2: Results of large-scale community surveys comparing risk factors for delinquency of boys and girls

Author and Date (measure)	Key Findings
Simons <i>et al.</i> , (1980) (r)	- Parental rejection equally related to SD for M and F.
Canter (1983) (r)	- Low family involvement and low parental influence related to SD for M and F - Higher correlations between family variables and SD for M compared to F - Higher SD in broken families for M compared to F
Riley and Shaw (1985) (c)	- Poor parental supervision related to SD for M and F, but more strongly for F - Low paternal attachment related to SD for M and F - Large family size, low social class and working mothers not related to SD for M or F
Johnson (1986, 1987) (A, r)	- Broken families not related to SD for M or F - Broken families related to OD for M and F - Parental approval related to SD for M and F (more for M) - Closeness to father related to SD for M, not F - Hostility to mother related to SD for M, not F
Cernkovich and Giordano (1987) (B)	- Poor parental supervision more related to SD for M compared to F - High parent-child conflict more related to SD for F compared to M
Weintraub and Gold (1991) (B)	- Poor parental supervision related to SD for M, not F
Graham and Bowling (1995) (c)	- Poor parental supervision related to SD for M and F - Low attachment to family related to SD for M and F - Broken families related to SD for M and F - Family size not related to SD for M or F - Low social class related to SD for F, not M - Delinquent sibling related to SD for M and F - Relationships generally stronger for F than M

Rantakallio <i>et al.</i> (1995) (L)	<ul style="list-style-type: none"> - Low social class related to OD for M and F, but especially for F - Teenage mother related to OD for M, not F - Working mother not related to OD for M or F - Broken families related to OD for M and F
Rowe <i>et al.</i> (1995) (r)	<ul style="list-style-type: none"> - Correlates of SD similar for M and F - Low parental affection related to SD for M and F - Poor paternal supervision related to SD for F, not M - M exposed to more risk factors than F (especially individual and peer factors)
Martens (1997) (B)	<ul style="list-style-type: none"> - Poor parental supervision related to SD for M and F - Low social class not related to SD for M or F - Single parent families related to SD for M, not F - Family size not related to SD for M or F
Flood-Page <i>et al.</i> (2000) (c)	<ul style="list-style-type: none"> - Low social class related to SD for M and F - Weak attachment to parents related to SD for M and F, but more strongly for F - Broken families related to SD for M and F - Poor parental supervision related to SD for M and F - Low family involvement related to SD for M and F
Moffitt <i>et al.</i> (2001) (r)	<ul style="list-style-type: none"> - Young mothers related to CD for M and F - Parental criminality related to CD for M and F - Mother's IQ related to CD for M, not F - Mother's neuroticism related to CD for M and F - Harsh and inconsistent discipline related to CD for M and F - Family conflict related to CD for M and F - Single parent families related to CD for M and F - Low social class related to CD for M and F - Poor relationship with parents related to CD for M and F - Generally, the same risk factors predict CD in M and F - However, correlations between family factors and CD were usually higher for M than F
Storvoll and Wichstrom (2002) (B)	<ul style="list-style-type: none"> - Broken families related to SD for M and F - Low attachment to parents related to SD for M and F - Poor parental supervision related to SD for M and F - All relationships stronger for M than F

Notes: M = Males, F = Females, SD - Self-reported delinquency.
OD = Official delinquency, CD = Conduct disorder
r = product-moment correlation; B = weightings in multiple regression;
A = analysis of variance; c = chi-squared/contingency tables;
L = logistic regression weightings

In contrast, Graham and Bowling's (1995) results indicate that relationships were stronger for females than for males. At least, that is our conclusion based on their percentages on p.34; Graham and Bowling merely reported significance tests, not measures of strength of effect. For example, they found that 55 per cent of females with delinquent siblings were offenders, compared with 17 per cent of the remainder; and 68 per cent of males with delinquent siblings were offenders, compared with 46 per cent of the remainder. These percentages clearly indicate that the relationship was stronger for females. Riley and Shaw (1985) reported similar results for their main measure of parental supervision: 55 per cent of poorly supervised females were delinquent, compared with 29 per cent of well supervised females; and 56 per cent of poorly supervised males were delinquent, compared with 41 per cent of well supervised males. Again, this relationship was stronger for females. Unfortunately, Riley and Shaw did not report percentage figures for other risk factors, only significance levels.

There are also signs in the third large-scale English survey, by Flood-Page *et al.*,(2000), that family risk

factors may be more strongly related to offending by females compared to males. The authors say that this was true for weak attachment to parents (p.33) and it seems likely to be true also for poor parental supervision (p.34). Therefore, while in most cases the relevant figures are not presented in the reports, it is plausible that family factors may be more strongly related to female delinquency in all three large-scale English self-reported delinquency surveys.

The most impressive of the studies in Table 2.2 are those by Rowe *et al.*, (1995) and Moffitt *et al.*, (2001). Rowe *et al.*,(1995) investigated siblings in 418 families (two siblings per family), comprising 135 brother pairs, 142 sister pairs and 141 mixed-sex sibling pairs. Their data were collected in a telephone survey. They concluded that the correlates of delinquency were similar for boys and girls, and that delinquency was greater for boys because boys were exposed to more risk factors. However, most of the risk factors they studied were individual (e.g. sociability, anger, emotionality, impulsivity) and peer factors (e.g. peer delinquency, peer achievement, peer popularity). At least some of these factors could have been measuring the same underlying construct as delinquency.

The most rigorous and thorough research project in Table 2.2 is the Dunedin study in New Zealand, conducted by Moffitt *et al.*,(2001). This is also the most relevant to our research. The study involved 1037 boys and girls who were followed from age three to age 21. An important feature of the study was its examination of the impact of nine family risk factors and seven maternal risk factors on antisocial behaviour by girls and boys. Moffitt *et al.*, (2001) found that boys and girls whose mothers were uncaring and critical, who experienced harsh or inconsistent discipline, who were socio-economically disadvantaged, who had multiple child minders and who spent long periods of time with one parent (usually the mother) were at greater risk of becoming antisocial or delinquent. Similarly, criminal parents, young mothers, neurotic mothers, and mothers with poor reading levels predicted delinquency for boys and girls (Moffitt *et al.*, 2001, Table 8.1).

There were some differences in risk factors. A low IQ of the mother predicted delinquency of boys but not girls, as did high residential mobility of the family. Later in life, a conflictual relationship with parents at age 15 was more strongly correlated with conduct disorder of girls than of boys. However, in this case, it is difficult to determine what is the cause and what is the effect. As the authors note:

“It is possible that conduct-disordered behaviour, which violates female gender-stereotypes and also signals that a daughter may be at risk for pregnancy, disrupts smooth parent-child relations more for 15-year-old daughters than for sons” (Moffitt et al., 2001, p.154).

This brief review shows that the knowledge base about risk factors for delinquency by girls compared with boys is weak. Whether relationships between family factors and delinquency are stronger for girls or boys is not clear. Few large-scale community studies have been carried out, few of these had a longitudinal design, few measured both self-reported and official delinquency, and few had independent measures of family factors and delinquency. In most projects, risk factors were not measured before delinquency, making it difficult to establish causal order. More prospective longitudinal research is needed on criminal careers and risk factors for males and females. A poor knowledge base is likely to lead to poor policy and practice. This report aims to advance knowledge by investigating socio-economic, family and child-rearing risk factors for offending by boys and girls in the Cambridge Study in Delinquent Development.

3. The Cambridge Study in Delinquent Development

The Cambridge Study is a prospective longitudinal survey of the development of offending and antisocial behaviour in 411 males. At the time they were first contacted in 1961-62, these males were all living in a working-class inner-city area of South London. The sample was chosen by taking all the boys who were then aged eight to nine and on the registers of six state primary schools within a one-mile radius of a research office that had been established. Hence, the most common year of birth of these males was 1953. In nearly all cases (94%), their family breadwinner at that time (usually the father) had a working-class occupation (skilled, semi-skilled or unskilled manual worker). Most of the males were white (97%) and of British origin.

The study was originally directed by Donald J. West, and it has been directed since 1982 by David P. Farrington, who has worked on it since 1969. It has been mainly funded by the Home Office. The major results can be found in four books (West, 1969, 1982; West and Farrington, 1973, 1977) and in summary papers by Farrington and West (1990), Farrington (1995) and Farrington (2002b). These publications should be consulted for more details about the risk factors measured in this report.

Aims

The original aim of the Cambridge Study was to describe the development of delinquent and criminal behaviour in inner-city males, to investigate how far it could be predicted in advance, and to explain why juvenile delinquency began, why it did or did not continue into adult crime, and why adult crime usually ended as men reached their twenties. The main focus was on continuity or discontinuity in behavioural development, on the effects of life events on development, and on predicting future behaviour. The Cambridge Study was not designed to test any one particular theory about delinquency but to test many different hypotheses about the causes and correlates of offending. One reason for casting the net wide at the start and measuring many different variables was the belief that theoretical fashions changed over time and that it was important to try to measure as many variables as possible in which future researchers might be interested. Another reason for measuring a wide range of variables was the fact that long-term longitudinal surveys were very uncommon, and that the value of this particular one would be enhanced if it yielded information of use not only to delinquency researchers but also to those interested in alcohol and drug use, educational difficulties, poverty and poor housing, unemployment, sexual behaviour, aggression, other social problems, and human development generally.

The Cambridge Study has a unique combination of features:

- a. Eight personal interviews with the males have been completed over a period of 24 years, from age eight to age 32;
- b. The main focus of interest is on offending, which has been studied from age ten to age 40;
- c. The sample size of about 400 is large enough for many statistical analyses but small enough to permit detailed case histories of the boys and their families;
- d. There has been a very low attrition rate, since 94 per cent of the males still alive provided information at age 32;
- e. Information has been obtained from multiple sources: the males, their parents, teachers, peers, and official records;
- f. Information has been obtained for a wide variety of theoretical constructs, including intelligence, personality, parental child-rearing methods, peer delinquency, school behaviour, employment success, marital stability, and so on.

Risk factors at different ages

A major aim in this survey was to measure as many risk factors as possible that were alleged to be causes or correlates of offending. The males were interviewed and tested in their schools when they were aged about eight, ten, and 14, by male or female psychologists. They were interviewed in a research office at about 16, 18 and 21, and in their homes at about 25 and 32, by young male social science graduates. They are currently being interviewed at age 46. At all ages except 21 and 25, the aim was to interview the whole sample, and it was always possible to trace and interview a high proportion: 389 out of 410 still alive at age 18 (95%) and 378 out of 403 still alive at age 32 (94%), for example. The tests in schools measured

individual characteristics such as intelligence, attainment, personality, and psychomotor impulsivity, while information was collected in the interviews about such topics as living circumstances, employment histories, relationships with females, leisure activities such as drinking and fighting, and offending behaviour.

In addition to interviews and tests with the males, interviews with their parents were carried out by female social workers who visited their homes. These took place about once a year from when the boy was about eight until when he was aged 14-15 and was in his last year of compulsory education. The primary informant was the mother, although many fathers were also seen. The parents provided details about such matters as family income, family size, their employment histories, their child-rearing practices (including attitudes, discipline, and parental disharmony), their degree of supervision of the boy, and his temporary or permanent separations from them. Also, when the boy was aged twelve, the parents completed questionnaires about their child-rearing attitudes and about his leisure activities.

The teachers completed questionnaires when the boys were aged about eight, ten, twelve and 14. These furnished data about their troublesome and aggressive school behaviour, their attention deficits, their school attainments and their truancy. Ratings were also obtained from the boys' peers when they were in the primary schools about such topics as their daring, dishonesty, troublesomeness and popularity.

For the present analyses, each variable was dichotomised, as far as possible, into the "worst" quarter of males (e.g. the quarter with lowest income or lowest intelligence) versus the remainder. This was done in order to compare the importance of different variables and also to permit a "risk factor" approach. Because most variables were originally classified into a small number of categories, and because fine distinctions between categories could not be made very accurately, this dichotomising did not usually involve a great loss of information. The one-quarter/three-quarters split was chosen to match the prior expectation that about one-quarter of the boys would be convicted as juveniles. Variables were not included in the analysis if more than about ten per cent of the sample were not known on them.

An important objective of this report is to derive implications for risk-focused prevention, which aims to identify the key risk factors for offending and implement prevention programmes to tackle them. A major problem is to establish which risk factors are causes and which are merely markers or correlated with causes (Farrington, 2000). It is also desirable to establish mediators (intervening causal processes) between risk factors and outcomes (Baron and Kenny, 1986). Ideally, interventions should be targeted on risk factors that are causes; interventions targeted on risk factors that are markers will not necessarily lead to any decrease in offending. The difficulty of establishing causes, and the co-occurrence of risk factors, encourages interventions that target multiple risk factors. However, there is also evidence that integrated or multi-modal intervention packages are more effective than interventions that target only a single risk factor (Wasserman and Miller, 1998).

Protective factors

Risk-focused prevention includes protective factors. Ideally, risk and protective factors should be identified and then risk factors should be reduced while protective factors are enhanced. However, both the definition and existence of protective factors are controversial. On one definition, a protective factor is merely the opposite end of the scale to a risk factor. Just as a risk factor predicts an increased probability of offending, a protective factor predicts a decreased probability. However, to the extent that explanatory variables are linearly related to offending, researchers may then object that risk and protective factors are merely different names for the same underlying construct.

Another possible definition of a protective factor is a variable that interacts with a risk factor to minimise the risk factor's effects (Rutter, 1985). Such interactive variables are often termed "moderators" (Baron and Kenny, 1986). If poor parental supervision predicted a high risk of offending only for males from low income families, and not for males from high income families, then high income might be regarded as a protective factor counteracting the effects of the risk factor of poor parental supervision. This report does not attempt to identify such interactive effects. Problems associated with the definition of protective factors may be alleviated by focusing on resilience or psychosocial skills and competencies. More research is needed to identify protective factors, linked to the use of interventions targeted on protective factors.

Searching criminal records

Searches were carried out in 1994 in the central Criminal Record Office (National Identification Bureau) in New Scotland Yard in London to try to locate findings of guilt of the boys and of their biological relatives (fathers, mothers, brothers and sisters). At that time, the NIB contained records of all relatively serious offences committed in Great Britain or Ireland, and also acted as a repository for records of minor juvenile offences committed in London. The NIB microfiche collection was replaced by the Police National Computer (PNC) in May 1995. All indictable and standard list offences were recorded together with some other offences such as obstructing the police and prostitution (offences against the Street Offences Act 1959, Section 1). Nearly all motoring offences (driving without a licence or under the influence of alcohol, speeding) were excluded, as were other minor non-indictable offences (e.g. drunkenness, common assault). There were some changes in coverage of NIB over time, usually as a result of the passage of new laws; for example, driving while disqualified was not normally recorded in the 1960s but was recorded in the 1990s (offences against the Road Traffic Act 1972, Section 99b).

Few offences committed outside England, Wales, Scotland, Northern Ireland or the Republic of Ireland were recorded in NIB. If a British subject emigrated to a country which was a member of Interpol and was then convicted there, there was some likelihood that NIB in London would be contacted, because the foreign country might want to know if the person had a prior criminal record in the United Kingdom. If NIB was informed that a British subject had been convicted in some other country, they would make up a criminal record file, whether or not the person had any previous record in the United Kingdom. Hence, there was some likelihood that convictions sustained abroad by emigrated persons would be recorded in NIB, and we did find some examples of these.

We have systematic information about emigration only for Study males up to age 32. Up to that age, 18 had emigrated. In the case of the emigrated Study males, applications were made to search their criminal records in the eight countries where they had settled, and searches were actually carried out in four countries. Since most Study males did not emigrate until their twenties, and the emigrants had rarely been convicted in England, it is likely that the criminal records are quite complete for the Study males. They may be less complete for other relatives, although generally their brothers and sisters also did not emigrate until their twenties.

Generally, our information about officially-recorded offending is more complete for Study males than for other family members. In particular, more sources were searched for Study males, including local authority children's departments, police juvenile bureau records and British Transport Police records. Also, the Study males were repeatedly interviewed and asked about their convictions. Whenever someone informed us about a conviction record that we did not have, we would search for it, for example in local court or police records. We counted all offences which were normally recorded in NIB, even though in some cases they were not actually recorded in NIB for some Study males.

As mentioned, the latest searches of criminal records took place throughout 1994, when the Study males, brothers and sisters were all aged 40 on average. As before, a project research secretary was able to inspect the files (microfiches) directly to note down the police descriptions of all offences committed, the dates of commission of offences, the names of other persons involved, as well as the dates of convictions and sentences awarded. We are very grateful to the Home Office and NIB staff for their cooperation in this endeavour. The PNC has less complete coverage of old records. When the microfiche collection was discontinued in May 1995, back records were transferred to the PNC only when people incurred new convictions.

Up to 1994, 164 of the 411 Study males (40%) were convicted, compared with 209 of their 480 brothers who were searched (44%) and 63 of their 519 sisters who were searched (12 per cent: see Farrington *et al.*, 1998). In this report, the recorded age of offending is the age at which an offence was committed, not the age on conviction. There can be delays of several months or even more than a year between offences and convictions, making conviction ages different from offending ages. Offences are defined as acts leading to convictions, and only offences committed on different days were counted. Where two or more offences were committed on the same day, only the most serious one was counted. Most court appearances arose from only one offending day; the 760 recorded offences of the 164 convicted Study males up to age 40 corresponded to 686 separate occasions of conviction.

The percentage of brothers convicted was not significantly different from the percentage of Study males convicted (chi-squared = 1.20, 1d.f., n.s.). This suggests that the repeated interviews with the Study males did not have any effect on their prevalence of offending.

Limitations of the present project

This project has many strengths, including its prospective longitudinal design, its large community samples of males and females in the same families, and its measurement of a wide range of risk factors. However, it also has limitations. In particular, the boys and girls were mostly born in the early 1950s and hence were growing up in the 1960s and 1970s, when conditions were very different from today. How far the same risk factors would apply to boys and girls today is an empirical question. Interestingly, Farrington and Loeber (1999) systematically compared risk factors for delinquency for the boys in the Cambridge Study and in the Pittsburgh Youth Study (who were growing up in the 1990s) and found that most results were replicated. *Also, Vazsonyi et al. (2001) reported that risk factors for offending were similar across four different countries.*

Other limitations of the present study are the reliance on convictions to measure offending and the fact that the risk factors were measured for the boys, not for the brothers and sisters. It is difficult to be sure how far risk factors were related to official processing rather than offending behaviour, since males and females may be treated differently by the police and courts. However, for the Study males, risk factors for official and self-reported offending were very similar (Farrington, 1992).

4. Convictions of boys, brothers and sisters

Because there were 14 pairs of brothers (including five pairs of twins) among the Study males, the 411 Study males were members of only 397 different families. In order to avoid counting the same family more than once, one Study male from each pair of brothers (each younger brother and one randomly selected member from each twin pair) was eliminated and counted as a brother. This left 397 Study males in the analysis and increased the number of brothers to 494. Only family members who survived at least to age twelve and who had sufficient identifying particulars (name and date of birth) were searched in criminal records. Of 494 brothers, 232 (47.0%) were older than the Study male. Of 519 sisters, 243 (46.8%) were older than the Study male.

Convictions

Table 4.1 shows the prevalence of convictions. 155 out of 397 Study males (boys) were convicted, or 39 per cent; 218 out of 494 brothers were convicted, or 44 per cent; and 63 out of 519 sisters were convicted, or 12 per cent. As expected, the prevalence of offending was lower for sisters. The 397 boys were convicted for 741 different offences (1.9 each), while the 494 brothers were convicted for 941 offences (also 1.9 each), and the 519 sisters were convicted for 175 offences (0.3 each). The average number of offences per offender was higher for boys (4.8) and brothers (4.3) than for sisters (2.8). Table 4.2 shows the types of offences committed by boys, brothers and sisters. The offence categories were as follows:

1. Burglary, breaking and entering;
2. Theft and taking motor vehicles;
3. Shoplifting;
4. Other theft, including theft of and from cycles, from machines, and from employers;
5. Fraud, forgery, deception, receiving stolen property, going equipped to steal;
6. Assault, wounding, homicide, robbery, threatening behaviour;
7. Possessing an offensive weapon;
8. Drug offences;
9. Criminal damage, arson;
10. Other, including sexual offences, driving while disqualified, prostitution.

Table 4.1: Convictions of boys, brothers and sisters

	Boys	Brothers	Sisters
No. searched	397	494	519
No. convicted	155	218	63
% convicted	39	44	12
No. offences	741	941	175
Per person	1.9	1.9	0.3
Per offender	4.8	4.3	2.8

Note: Convictions were counted for offences committed up to December 31, 1993.

Table 4.2: Types of offences committed

Type	Boys	Brothers	Sisters
Burglary %	124 (17)	187 (20)	11 (6)
Theft of vehicle %	108 (15)	122 (13)	7 (4)
Shoplifting %	55 (7)	52 (6)	49 (28)
Other theft %	145 (20)	231 (25)	35 (20)
Deception %	112 (15)	114 (12)	47 (27)
Violence %	96 (13)	108 (11)	15 (9)
Weapons %	18 (2)	26 (3)	0 (0)
Drugs %	19 (3)	18 (2)	1 (1)
Vandalism %	28 (4)	46 (5)	6 (3)
Other %	36 (5)	37 (4)	4 (2)
Total Offences	741	941	175

The most common types of offences committed by the boys were other theft (20%), burglary (17%), theft of vehicles (15%), deception (15%) and violence (13%). The most common types of offences committed by brothers were very similar: other theft (25%), burglary (20%), theft of vehicles (13%), deception (12%) and violence (11%). In contrast, the most common types of offences committed by sisters were shoplifting (28%), deception (27%) and other theft (20%). Sisters were disproportionately likely to commit shoplifting and deception offences and disproportionately unlikely to commit burglary and thefts of vehicles.

Ages of offending

Table 4.3 shows the ages at which different offences were committed. For these age cohorts, juveniles legally became adults in the criminal justice system at age 17. The median age of offending was 19 for boys, 20 for brothers and 21 for sisters. Half of all offences were committed between 16 and 25 for boys, 16 and 26 for brothers, and 17 and 26 for sisters. The average age of offending was 21.1 for boys, 21.7 for brothers and 21.5 for sisters. The peak age of offending was 17 for boys and brothers and 19-21 for sisters. Hence, there were not great differences between boys, brothers and sisters in average ages of offending. Average ages were higher than peak ages because the age-crime curve is skewed (Farrington, 1986).

Table 4.3: Age on offending

Age	Boys	Brothers	Sisters
8-13 %	60 (8)	94 (10)	16 (9)
14-16 %	150 (20)	156 (17)	25 (14)
17-20 %	234 (32)	243 (26)	44 (25)
21-25 %	115 (16)	203 (22)	45 (26)
26-30 %	87 (12)	118 (13)	32 (18)
31-35 %	64 (9)	72 (8)	8 (5)
36-40 %	31 (4)	35 (4)	3 (2)
41 or more %	0 (0)	20 (2)	2 (1)
Total offences	741	941	175
Peak	17	17	19-21
25th percentile	16	16	17
Median	19	20	21
75th percentile	25	26	26
Mean	21.1	21.7	21.5

Table 4.4 shows the ages of onset of offending (the age on the first conviction). The peak age of onset was 14 for boys, 15 for brothers, and 14 for sisters. The median age of onset was 16 for boys, 17 for brothers, and 18 for sisters. The average age of onset was 18.5 for boys and brothers and 19.9 for sisters. A quarter of boys did not begin offending until after age 25, and a quarter of brothers and sisters did not begin offending until after age 26. Again, therefore, ages of onset of boys and brothers were quite similar, although sisters began their criminal careers a little later.

Table 4.5 shows the ages of the last conviction. This might be termed the age of “desistance” although of course many of these people had not truly desisted from offending by December 1993. The most common peak ages of “desistance” were between 18 and 22. The median age of “desistance” was 24 for boys and brothers and 22 for sisters.

The average age of “desistance” was 25.9 for boys, 25.1 for brothers, and 24.3 for sisters. A quarter of boys had their last offence after age 32, a quarter of brothers had their last offence after age 30, and a quarter of sisters had their last offence after age 29. Again, therefore, ages of desistance of boys and brothers were similar, but sisters ended their criminal careers a little earlier.

Table 4.4: Age of onset of offending

Onset	Boys	Brothers	Sisters
8-13 %	35 (23)	52 (24)	10 (16)
14-16 %	48 (31)	56 (26)	14 (22)
17-20 %	40 (26)	55 (25)	15 (24)
21-25 %	11 (7)	24 (11)	11 (17)
26-30 %	6 (4)	19 (9)	11 (17)
31 or more %	15 (10)	12 (6)	2 (3)
Total offenders	155	218	63
Peak	14	15	14
25th percentile	14	14	14
Median	16	17	18
75th percentile	20	21	23
Mean	18.5	18.5	19.9

Table 4.5: Age of last conviction (“desistance”)

“Desistance”	Boys	Brothers	Sisters
8-16 %	18 (12)	34 (16)	10 (16)
17-20 %	37 (24)	47 (22)	14 (22)
21-25 %	29 (19)	41 (19)	13 (21)
26-30 %	19 (12)	44 (20)	17 (27)
31-35 %	32 (21)	28 (13)	5 (8)
36 or more %	20 (13)	24 (11)	4 (6)

Total offenders	155	218	63
Peak	19	18-21	18-22
25th percentile	19	18	18
Median	24	24	22
75th percentile	32	30	29
Mean	25.9	25.1	24.3

Persistent offenders

Table 4.6 shows the total numbers of offences committed. As mentioned, the average number of offences per offender was 4.8 for boys, 4.3 for brothers, and 2.8 for sisters. Hence, sisters committed fewer offences on average. The fraction committing only one offence was 32 per cent of boys, 39 per cent of brothers, and 46 per cent of sisters. The distribution of numbers of offences was highly skewed; ten per cent of boys committed twelve or more offences, while ten per cent of brothers committed eleven or more offences, and ten per cent of sisters committed six or more offences.

Table 4.6: Total number of offences committed

Number	Boys	Brothers	Sisters
1	49	86	29
2	31	42	13
3	12	24	7
4-5	19	23	7
6-10	25	21	5
11-15	7	8	1
16-20	10	6	1
21 or more	2	8	0
Total offenders	155	218	63
25th percentile	1	1	1
Median	2	2	2
75th percentile	6	4	3
90th percentile	12	11	6
Mean	4.8	4.3	2.8
No. "chronics"	24	24	14
% "chronics"	15	11	22

The “chronic” offenders were defined as those committing half of all offences in each category. Of the boys, 24 (15% of offenders, or 6% of all boys) each committed ten or more offences and in total committed 361 of the 741 crimes of the boys (49%). Of the brothers, 24 (11% of offenders, or 5% of all brothers) each committed ten or more offences and in total committed 456 of the 941 crimes of the brothers (48%). Of the sisters, 14 (22 % of the offenders, or 3% of all sisters) each committed four or more offences and in total committed 99 of the 175 crimes of the sisters (57%). Therefore, chronic sisters each committed fewer offences than chronic boys or chronic brothers.

Table 4.7 shows the duration of criminal careers (the time between the first and last conviction). The average duration was 7.4 years for boys, 6.6 years for brothers, and 4.4 years for sisters. Therefore, the average duration of criminal careers was lower for sisters. Again, the distribution of career durations was highly skewed. A quarter of boys had a career duration greater than 14.3 years, while the career duration was greater than 11.2 years for a quarter of brothers and greater than 5.5 years for a quarter of sisters. For 15 boys, 21 brothers and three sisters, the career duration already exceeded 20 years.

It seems likely that more offences were recorded per boy than per brother (with the consequent greater length of criminal careers of boys compared with brothers) because more sources were searched for Study males. Hence, brothers are more comparable than Study males are to sisters.

Table 4.7: Duration of criminal careers

Duration	Boys	Brothers	Sisters
0 (1 offence)	49	86	29
up to 5 years	35	38	17
over 5-10 years	18	32	5
over 10-15 years	23	25	5
over 15-20 years	15	16	4
over 20 years	15	21	3
Total offenders	155	218	63
25th percentile	0	0	0
Median (years)	4.3	2.5	0.1
75th percentile	14.3	11.2	5.5
Mean (years)	7.4	6.6	4.4

5. The concentration of offending in families

Farrington *et al.*, (1996a) reported on how far convictions were concentrated in families in the Cambridge Study. Two-thirds of the families included at least one convicted person. On average, there were 1.5 convicted persons out of 5.5 persons in each family. Only six per cent of the families accounted for half of all the convictions. Convictions of one family member were strongly related to convictions of every other family member. Similar results were obtained in the Pittsburgh Youth Study (Farrington *et al.*, 2001).

In both generations, the majority of convicted females mated with convicted males in the Cambridge Study. About three-quarters of convicted fathers and convicted mothers had a convicted child. Same-sex relationships within and between generations were stronger than opposite-sex relationships. Very little of the association between convictions of family members was attributable to co-offending. It was concluded that offending was strongly concentrated in families and tended to be transmitted from one generation to the next.

It might be expected that the number of siblings convicted would increase with the number of siblings in a family. However, the percentage of siblings convicted did not always increase steadily with the number of siblings in a family. Table 5.1 shows that the percentage of brothers convicted was highest (53.1%) in families with three brothers. However, the percentage of boys convicted was highest (77.8%) in families with six or more brothers. Again, the percentage of sisters convicted was highest (23.0%) in families with three sisters, as was the percentage of boys convicted (69.0%).

When brothers and sisters were added, there was more of a tendency for the percentage of siblings convicted to increase with the number of siblings in a family. Table 5.1 shows that the percentage of siblings convicted was highest (45.6%) in families with ten or more siblings, as was the percentage of boys convicted (70.0%). The probability of a boy being convicted was similar in families with no siblings and one sibling, and also similar in families with two or three siblings. This probability was greatest in families with four or more siblings.

Table 5.1: Numbers of brothers and sisters vs. convictions

	No. in family	No. of families	No. of siblings	No. sibs convicted	% Sibs convicted	% Boys convicted
Brothers	0	153	0	0	0	32.7
	1	113	113	44	38.9	36.3
	2	74	148	59	39.9	40.5
	3	32	96	51	53.1	62.5
	4-5	16	71	31	43.7	43.8
	6-9	9	66	33	50.0	77.8
	Total	397	494	218	44.1	39.0
	Sisters	0	117	0	0	0
1		147	147	7	4.8	34.0
2		78	156	16	10.3	39.7
3		29	87	20	23.0	69.0
4-5		17	71	13	18.3	58.8
6-9		9	58	7	12.1	55.6
Total		397	519	63	12.1	39.0
Siblings		0	53	0	0	0
	1	90	90	15	16.7	28.9
	2	102	204	34	16.7	38.2
	3	66	198	51	25.8	36.4
	4	34	136	37	27.2	52.9
	5-6	26	146	57	39.0	61.5
	7-9	16	125	35	35.3	56.3
	10-14	10	114	52	45.6	70.0
	Total	397	1013	281	27.7	39.0

In the families, convicted sons tended to coincide with convicted daughters. Of the 397 families, 153 contained no brothers, 117 contained no sisters, and 53 contained neither brothers nor sisters. Table 5.2 shows that the probability of a boy being convicted increased with the number of brothers convicted, from 26.8 per cent of those with unconvicted brothers to 81.8 per cent of those with three or more brothers convicted. Similarly, the percentage of families with a sister convicted increased from 6.7 per cent of those containing unconvicted brothers to 47.4 per cent of those containing three or more convicted brothers.

Table 5.2: Inter-relationship of offending by siblings

Brothers	No.	% Boy convicted	% Sister convicted*
None	153	32.7	7.2
None convicted	112	26.8	6.7
1 convicted	81	46.9	20.7
2 convicted	29	65.5	25.0
3-6 convicted	22	81.8	47.4
Sisters			% Brother convicted**
None	117	33.3	42.2
None convicted	236	37.7	52.4
1 convicted	30	50.0	75.0
2-4 convicted	14	85.7	100.0

Notes: Based on families.

* in families with at least one sister

** in families with at least one brother

The percentage of boys convicted also increased with the number of sisters convicted, from 37.7 per cent of those with unconvicted sisters to 85.7 per cent of those with two or more sisters convicted. Similarly, the percentage of families with a brother convicted increased from 52.4 per cent of those containing unconvicted sisters to all of those containing two or more convicted sisters.

In Table 5.3, the boys and their brothers are grouped together as male children, and the number of convicted male children is compared with the number of convicted female children (sisters). It can be seen that 91.6 per cent of families with no male siblings convicted (109 out of 119) also had no female siblings convicted. Conversely, in the 37 families with three or more male siblings convicted, a quarter (9) also had two or more female siblings convicted.

Table 5.3: Number of sisters and male children convicted

No. male children convicted	No. sisters convicted			Total
	0	1	2-4	
0	109	10	0	119
1	78	8	2	88
2	26	7	3	36
3-7	23	5	9	37
Total	236	30	14	280

Note: Based on families. Excludes 117 families containing no sisters.

6. Risk factors for convictions

Measuring predictive efficiency

Risk factors measured when the boys were aged eight to ten were investigated. The most important of these are shown in Table 6.1, together with their relationships with convictions of the boys. For example, 60 per cent of Study males from large-sized families (with five or more children) were convicted up to age 40, compared with 33 per cent of the remainder (odds ratio =3.1, $p < .05$). The odds ratio (OR) is the best measure of strength of effect (predictive efficiency) to use here, because it is not affected by the marginal distributions (e.g. prevalence) of predictor or outcome variables (Fleiss, 1981; Farrington and Loeber, 2000). Unfortunately, measures based on chi-squared or the product-moment correlation (here, phi) are affected by marginal distributions (Smith, 1996). Because males have a higher prevalence of offending than females, relationships between risk factors and offending might appear (artefactually) to be higher for males if these measures were used.

The odds ratio is simply the odds of conviction in the presence of a risk factor divided by the odds of conviction in the absence of the risk factor. For example, 45 of the 85 boys from low income families (52.9%) were convicted, compared with 110 of the 312 boys from other families (35.3%); see Table 6.1. The odds of conviction given a low income family = $45/40$ (1.125), while the odds of conviction given any other family = $110/202$ (0.545). The OR = $1.125/0.545$ or 2.07, with a 95 per cent confidence interval of 1.27 to 3.36. Since this confidence interval does not include the chance value of 1, this OR is statistically significant. The OR is better than Relative Risk or RR (here, 52.9%/35.3%, or 1.50) because RR is affected by prevalence. In general, RRs for males would be less than RRs for females, because the fraction convicted in the absence of the risk factor (the denominator of RR) is considerably higher for males.

Predicting convictions of boys

Twenty-one risk factors were studied. There was a great deal of data reduction 30 years ago to reduce the number of measured variables to a small number of the most important risk factors that were not too closely intercorrelated. For example, an erratic job record of the father was closely related to low family income, and low family income was chosen as the more important risk factor. The 21 risk factors are considered to be the most important socio-economic, family and child-rearing variables that might apply to all children in a family. Individual factors (e.g. high impulsivity) are more specific to the boy.

Table 6.1: Risk factors for convictions of boys

	Per cent Convicted			
Risk factor	Non risk	Risk	Odds ratio	Phi
Socio-economic				
Low social class	37	47	1.5	.073
Low family income	35	53	2.1*	.149*
Poor housing	31	54	2.6*	.221*
Large family size	33	60	3.1*	.233*
High delinquency school	36	59	2.5*	.180*
Family				
Convicted father	32	62	3.3*	.252*
Convicted mother	36	67	3.5*	.170*
Delinquent sibling	37	64	3.1*	.161*
Teenage mother	36	51	1.9*	.134*
Working mother	39	31	0.7	-.075
Nervous father	38	42	1.2	.035
Nervous mother	35	45	1.5	.100
Poorly educated father	28	43	1.9*	.147*
Poorly educated mother	36	38	1.1	.021
Child-rearing				
Low paternal interest in children	38	41	1.2	.022
Low interest in education	37	50	1.7	.099
Parental conflict	34	51	2.1*	.153*
Separated from parent	34	58	2.7*	.205*
Harsh discipline	35	45	1.5	.091
Poor supervision	34	56	2.4*	.171*
Low praise	39	36	0.9	-.024

* p <.05

In Table 6.1, the 21 risk factors are divided for convenience into three categories: socio-economic, family and child-rearing. This categorisation is arguable. For example, large family size and parental conflict could be regarded as family factors. Attending a high delinquency rate school is included as a socio-economic factor in order to avoid having a fourth category of school factors. Most of the family factors (except having a delinquent sibling) refer to characteristics of the mother or father. In general, characteristics of the parents (convicted, teenage, nervous, poorly educated) are harder to change than socio-economic or child-rearing factors. All of the risk factors were measured when the boy was aged eight to ten.

Table 6.1 shows that the most important risk factors for convictions of the boy were a convicted mother (OR = 3.5), a convicted father (OR = 3.3), a delinquent sibling (OR = 3.1), large family size (OR = 3.1), separation from a parent, usually the father (OR = 2.7), poor housing (OR = 2.6), attending a high delinquency rate school (OR = 2.5) poor parental supervision (OR = 2.4), low family income (OR = 2.1) and parental conflict (OR = 2.1). These risk factors are well known and have been used in risk assessment and to guide risk-focused prevention. In general, an OR of 2.0 or greater indicates a strong relationship (Cohen, 1996). Having a full-time working mother (OR = 0.7) was negatively related to offending.

For comparability, the product-moment (phi) correlations are also shown in Table 6.1. They produce exactly the same results in showing which risk factors are significant predictors of the boys' delinquency. However, there are some differences in results which are attributable to differences in prevalence. In

particular, a convicted mother is a stronger predictor than a convicted father according to the OR (3.5 as opposed to 3.3) but not according to the phi correlation (.170 as opposed to .252). This is because the prevalence of a convicted mother (33 boys) is much lower than the prevalence of a convicted father (91 boys). The OR is a better and more meaningful measure of predictive efficiency. It might be interpreted roughly as the increase in risk (e.g. three times) associated with each risk factor.

Most of the variables listed in Table 6.1 apply equally to all children in a family. Thus, a low income family or a convicted parent will be experienced not only by the boy but also by his brothers and sisters. If the boy attends a high delinquency rate school, it is likely that his brothers and sisters attend the same school. However, two variables (harsh discipline and poor supervision) may be more specific to the boy. Discipline is likely to be more harsh, and supervision is likely to be less close, for boys than for girls, but we only know the discipline received by the Study male.

Predicting convictions of brothers and sisters

Table 6.2 shows risk factors for convictions of brothers. The overall conviction rate was 44 per cent (218 out of 494) compared with 39 per cent (155 out of 397) for the boys. In general, predictive relationships were weaker for brothers than for the boys. The strongest predictors of offending for brothers were parental conflict (OR = 2.3), a convicted father (OR = 2.2) and attending a high delinquency rate school (OR = 2.0). These were the only strong relationships with odds ratios of two or greater. The “delinquent sibling” variable was adjusted to ensure that each brother with this risk factor had a delinquent sibling (before the boy was aged ten). Only convictions of older siblings were included in this variable.

Table 6.3 shows risk factors for convictions of sisters. The overall conviction rate was 12 per cent (63 out of 519). It can immediately be seen that predictive relationships were much stronger for sisters than for brothers, and stronger for sisters even than for the boys. This was true for phi correlations as well as for odds ratios. The strongest predictors of offending for sisters were a delinquent sibling (OR = 4.7; again adjusted), low family income (OR = 4.1), attending a high delinquency rate school (OR = 3.9), low

Table 6.2: Risk factors for convictions of brothers

Risk factor	Per cent Convicted		Odds ratio	Phi
	Non-risk	Risk		
Socio-economic				
Low social class	44	43	1.0	-.011
Low family income	37	54	1.9*	.161*
Poor housing	42	46	1.2	.042
Large family size	36	51	1.8*	.144*
High delinquency school	39	56	2.0*	.157*
Family				
Convicted father	37	57	2.2*	.189*
Convicted mother	42	57	1.8*	.107*
Delinquent sibling	42	56	1.8*	.107*
Teenage mother	40	53	1.7*	.122*
Working mother	45	33	0.6	-.086
Nervous father	41	50	1.5	.079
Nervous mother	40	52	1.6*	.112*
Poorly educated father	41	44	1.1	.027
Poorly educated mother	35	44	1.5*	.084
Child-rearing				
Low paternal interest in children	43	48	1.2	.038
Low interest in education	40	52	1.6*	.103*
Parental conflict	38	57	2.1*	.161*

Separated from parent	41	52	1.6*	.098*
Harsh discipline	43	46	1.2	.036
Poor supervision	41	51	1.5*	.091*
Low praise	41	52	1.6	.080

* $p < .05$

parental interest in education (OR = 3.9), large family size (OR = 3.8), low praise by the parents (OR = 3.5), low paternal interest in the children (OR = 3.4), parental conflict (OR = 3.1), harsh or erratic discipline (OR = 3.1), a convicted father (OR = 2.9), a convicted mother (OR = 2.7), poor housing (OR = 2.2), low social class according to the occupational prestige of the family breadwinner (OR = 2.1) and poor parental supervision (OR = 2.0). Fourteen risk factors were strong predictors for sisters, compared with only three for brothers and ten for the boys.

Comparing odds ratios for convictions

Table 6.4 shows odds ratios for the boys, brothers and sisters, so that they can be compared directly. Of course, since the risk factors were measured for the boys, it would be expected that the strength of relationships would generally be greatest for the boys.

As predicted, the magnitudes of odds ratios were clearly higher for the boys than for their brothers (higher in 15 cases, the same in two cases, lower in four cases). It was less expected that the magnitudes of odds ratios were clearly higher for sisters than for brothers (higher in 17 cases, the same in one case, lower in three cases). Remarkably, odds ratios also tended to be higher for sisters than for the boys (higher in 13 cases, the same in one case, lower in seven cases).

The (ranked) odds ratios for the boys correlated .62 ($p = .003$) with the odds ratios for brothers and .36 (ns) with the odds ratios for sisters. The odds ratios for brothers correlated .55 ($p = .009$) with the odds ratios for sisters. Therefore, in general, the most important risk factors for brothers tended to be the most important risk factors for sisters.

All of the seven most important risk factors for brothers (low family income, large family size, high delinquency rate school, convicted father, convicted mother, delinquent sibling, parental conflict) were also among the eleven most important risk factors for sisters.

Table 6.3: Risk factors for convictions of sisters

Risk factor	Convicted		Odds ratio	Phi
	Per cent Non risk	Risk		
Socio-economic				
Low social class	10	19	2.1*	.114*
Low family income	6	22	4.1*	.230*
Poor housing	8	17	2.2*	.129*
Large family size	6	19	3.8*	.201*
High delinquency school	8	26	3.9*	.234*
Family				
Convicted father	8	21	2.9*	.174*
Convicted mother	11	24	2.7*	.133*
Delinquent sibling	8	30	4.7*	.251*
Teenage mother	11	16	1.6	.075
Working mother	12	12	0.9	-.008
Nervous father	11	17	1.6	.071
Nervous mother	11	16	1.5	.068
Poorly educated father	14	12	0.8	-.029
Poorly educated mother	9	13	1.5	.056
Child-rearing				
Low paternal interest in children	10	28	3.4*	.188*
Low interest in education	8	25	3.9*	.232*
Parental conflict	8	22	3.1*	.191
Separated from parent	10	18	1.9*	.098*
Harsh discipline	8	21	3.1*	.188*
Poor supervision	10	18	2.0*	.112*
Low praise	9	27	3.5*	.183*

However, there were some noteworthy differences between risk factors for brothers and sisters. In particular, the socio-economic factors low social class and poor housing predicted offending for sisters but not for brothers. Low social class was also not important for boys, although poor housing was important for boys. Also, the child-rearing factors low paternal interest in children, low parental interest in education, harsh or erratic parental discipline, and low praise by the parents were much more important risk factors for sisters than for brothers (or boys).

Table 6.4: Strength of relationships for convictions (odds ratios)

	Boys (397)	Brothers (494)	Sisters (519)
Socio-economic			
Low social class	1.5	1.0	2.1*
Low family income	2.1*	1.9*	4.1*
Poor housing	2.6*	1.2	2.2*
Large family size	3.1*	1.8*	3.8*
High delinquency school	2.5*	2.0*	3.9*
Family			
Convicted father	3.3*	2.2*	2.9*
Convicted mother	3.5*	1.8*	2.7*
Delinquent sibling	3.1*	1.8*	4.7*
Teenage mother	1.9*	1.7	1.6
Working mother	0.7	0.6	0.9
Nervous father	1.2	1.5	1.6
Nervous mother	1.5	1.6*	1.5
Poorly educated father	1.9*	1.1	0.8
Poorly educated mother	1.1	1.5*	1.5
Child-rearing			
Low paternal interest in children	1.2	1.2	3.4*
Low interest in education	1.7	1.6*	3.9*
Parental conflict	2.1*	2.1*	3.1*
Separated from parent	2.7*	1.6*	1.9*
Harsh discipline	1.5	1.2	3.1*
Poor supervision	2.4*	1.5*	2.0*
Low praise	0.9	1.6	3.5*
Geometric mean	1.9	1.5	2.4

Note: *p<.05

Was there any evidence that father variables were more important for brothers (and boys), whereas mother variables were more important for sisters? A convicted father and a convicted mother were important risk factors in all three cases. A teenage mother, a nervous mother, a nervous father and a poorly educated mother were marginally important (equally) for brothers and sisters, and a working mother was not important in all cases. The main differences were that a poorly educated father was important for boys (but not for brothers and sisters) and low paternal interest in the children was important for sisters but not for brothers or boys. However, there was no sign of a specific link between father variables and brothers or between mother variables and sisters.

In attempting to summarise a set of ORs, the geometric mean is more appropriate than the arithmetic mean. The geometric mean is obtained by averaging logarithms of ORs. Because it is a ratio, an OR of two is symmetrically opposite to an OR of 0.5. Taking logarithms makes these ORs symmetrically opposite ($\ln[2] = 0.693$; $\ln[0.5] = -0.693$). Table 6.4 shows that the mean OR was 1.9 for boys, 1.5 for brothers and 2.4 for sisters. ORs for sisters were significantly greater than ORs for brothers ($t = 5.37$, $p < .001$) and ORs for boys ($t = 2.18$, $p = .042$). ORs for boys were significantly greater than ORs for brothers ($t = 2.89$, $p = .009$). Therefore, risk factors predicted convictions more strongly for sisters than for boys or brothers.

Implications for risk-focused prevention

The stronger effect of risk factors for sisters compared with brothers has important implications for risk-focused prevention of females compared with males. To illustrate this, consider the risk factor of low family income; 22 per cent of sisters from low income families (42 out of 191) were convicted, compared with 6.4 per cent of sisters from higher income families (21 out of 328). Hence, two-thirds of convicted sisters came from low income families. In contrast, 53.7 per cent of brothers from low income families (109 out of 203) were convicted, compared with 37.5 per cent of brothers from higher income families (109 out of 291). Hence, half of convicted brothers came from low income families.

Let us assume that low income causes offending and that the risk factor of low income can be eliminated by risk-focused prevention. The implication of this for sisters would be that the 191 sisters who were formerly in low income families would now have the same conviction rate as the remainder (6.4%). Hence, only twelve would be convicted instead of 42, and the number of convicted sisters would be reduced by 30 or by 48 per cent. For brothers, the 203 who were formerly in low income families would now have the same conviction rate as the remainder (37.5%). Hence, only 76 would be convicted instead of 109, and the number of convicted brothers would be reduced by 33 or by 15 per cent.

Because risk factors are more strongly related to offending for females than for males, risk-focused prevention would have a much greater effect in reducing the percentage of females who were offenders than in reducing the percentage of males who were offenders (48% compared with 15% here). However, the absolute number of male offenders could be reduced more than the absolute number of female offenders (by 33 compared with 30 here).

These general conclusions would still apply even if some of the above assumptions were changed. For example, they would still apply if the causal effect of the risk factor were less or if risk-focused prevention were less effective (e.g. reducing the prevalence of the risk factor by half rather than eliminating it). These conclusions would apply to any risk factor that predicted convictions more strongly for females than for males. Of the risk factors listed in Table 6.4, those that are related most strongly to sisters and are most modifiable are socio-economic ones (low family income, poor housing, large family size) and child-rearing ones (low paternal interest in children, low parental interest in education, parental conflict, harsh or erratic discipline, poor parental supervision and low praise).

In light of the predictive efficiency of convicted parents and delinquent siblings, a marked reduction in the number of offenders could also have delayed and indirect effects in reducing offending by other children or by the next generation.

Multivariate analyses and logistic risk scores

It is difficult to know how many of the risk factors shown in the tables have causal effects on offending, or what are the causal mechanisms linking risk factors and offending. In non-experimental research, it is often considered that a risk factor is a cause of offending if (a) the risk factor is statistically correlated with offending, (b) the risk factor precedes offending, and (c) the relationship between the risk factor and offending holds up after controlling for other risk factors (possible confounders). Hence, independent predictors of offending are most likely to be causes.

Table 6.5: Logistic regression analyses for convictions

	LRCS	p	POR
Boys			
Large family size	20.99	.0001	2.1
Separated from parent	14.85	.0001	2.2
Convicted father	7.57	.006	2.0
Poor housing	5.74	.017	1.8
Delinquent sibling	5.19	.023	2.6
Poorly educated father	3.12	.078	1.6
Brothers			
Convicted father	14.01	.0002	1.8
Parental conflict	7.64	.006	1.8
Teenage mother	5.76	.016	1.6
Nervous mother	4.44	.035	1.6
Sisters			
Delinquent sibling	18.85	.0001	2.5
Low praise	13.41	.0002	3.1
Parental conflict	7.11	.008	2.1
High delinquency school	5.53	.019	1.9
Low family income	3.23	.072	1.9

Notes: LRCS = likelihood ratio chi-squared
 POR = partial odds ratio

Logistic regression analyses were carried out to investigate the independent predictors of convictions. A forward stepwise method was used, beginning with the significant predictors. Table 6.5 shows the results. For the boys, the most important predictors of convictions were large family size, separation from a parent, a convicted father, poor housing, a delinquent sibling and a poorly educated father. For brothers, the most important predictors were a convicted father, parental conflict, a teenage mother, and a nervous mother. For sisters, the most important predictors were a delinquent sibling, low praise, parental conflict, a high delinquency rate school and low family income. Table 6.5 shows the partial odds ratios of each risk factor (controlling for all other risk factors) in the final models. The partial odds ratios were greater for sisters than for brothers, suggesting that risk factors had greater causal effects for sisters.

Risk scores were calculated for each person according to the weightings of each variable in the final logistic regression equation. Each logistic risk score is essentially a predicted probability that the person will be convicted (based on their risk factors). Table 6.6 shows the relationship between risk scores and the actual percentage of people convicted. In each case (boys, brothers and sisters), the risk scores are divided into five categories as equally as possible.

The percentage of boys convicted increased from 16.9 per cent of those with a risk score less than .2 to 71 per cent of those with a risk score of .55 or greater. The percentage of brothers convicted increased from 24.1 per cent of those with a risk score less than .3 to 68.3 per cent of those with a risk score of .53 or greater. The percentage of sisters convicted increased from 4.4 per cent of those with a risk score less than .05 to 37.1 per cent of those with a risk score of .25 or greater. Of course, sisters had lower risk scores because of their lower prevalence of convictions.

ROC curves

The best measure of strength of relationships in 5 x 2 tables like those shown in Table 6.6 is the area

under the ROC curve or AUC (Verhulst and Koot, 1992, pp. 53-54; Farrington et al., 1996b, pp. 515-517). The 5 x 2 chi-squared value is not sensitive to the ordering of the percentages. For example, for brothers in Table 6.6, the chi-squared value would be the same if the 49.3 per cent of 75 and 38.9 per cent of 95 figures had the reverse (expected) ordering.

Table 6.6: Logistic risk scores for convictions

Risk score	No.	% Conv.
Boys		
<.2	59	16.9
.2<.3	101	25.7
.3<.4	68	35.3
.4<.55	57	49.1
.55+	62	71.0
Brothers		
<.3	133	24.1
.3<.4	75	49.3
.4<.5	95	38.9
.5<.53	86	50.0
.53+	60	68.3
Sisters		
<.05	160	4.4
.05<.08	77	10.4
.08<.14	61	6.6
.14<.25	51	19.6
.25+	62	37.1

Note: Risk score = Predicted proportion of people convicted
Area under the ROC Curve:
Boys = .722, Brothers = .663, Sisters = .758.
OR: Boys = 5.5, Brothers = 3.5, Sisters = 6.5

The ROC curve plots the probability of a “hit” (e.g. the percentage of delinquents identified at any cut-off point) versus the probability of a “false positive” (e.g. the percentage of non-delinquents identified at the same cut-off point). The area under the ROC curve was used by Mossman (1994) in a meta-analysis of the prediction of violence as a “succinct and commonly used method for summarizing overall discriminating power” (p.785). The area under the ROC curve, like the odds ratio, is a measure of strength of relationship unaffected by changes in sample size and row and column totals (prevalences). The AUC has a simple and meaningful interpretation (Fergusson *et al.*, 1977): it is equivalent to the proportion of correct predictions in a 2 x 2 table, where chance = .50 and perfect discrimination = 1.0.

The best-fitting ROC curves were calculated by maximum likelihood techniques, assuming underlying normal distributions, using the ROCFIT software of Charles E. Metz. The advantage of using this method is that each AUC has an associated standard deviation (sd), so that AUC values can be compared statistically. For the boys, AUC = .722 (sd = .029); for brothers, AUC = .663 (sd = .027); for sisters, AUC = .758 (sd = .039). The AUC for sisters was significantly greater (t = 2.88, p<.004) than the AUC for brothers, showing that risk scores predicted convictions significantly better for sisters than for brothers. The AUC for boys was also significantly greater (t = 2.11, p = .035) than the AUC for brothers.

A simpler measure of predictive efficiency can be obtained by contrasting the high risk group with the

remainder. For the boys, 71 per cent of 62 with the highest risk scores were convicted, compared with 30.9 per cent of the remaining 285 low risk boys (OR = 5.5). For the brothers, 68.3 per cent of 60 high risk persons were convicted, compared with 38.3 per cent of 389 low risk persons (OR = 3.5). For the sisters, 37.1 per cent of 62 high risk persons were convicted, compared with 8.3 per cent of 349 low risk persons (OR = 6.5). This analysis again indicates that predictive efficiency was much greater for sisters than for brothers.

Points risk scores

Unfortunately, risk scores based on logistic regression equations capitalise on chance differences in the construction sample and over-estimate the likely predictive efficiency in a new (validation) sample (see e.g. Farrington and Tarling, 1985). A better indication of likely predictive efficiency in a new sample can be obtained by choosing risk factors on an *a priori* basis and giving each a weight of 1 in a risk score. The five of these variables that most likely would have been included in a risk score in the 1960s are: low family income, large family size, a convicted parent (father or mother), separation from a parent and poor parental supervision. Points risk scores (from 0 to 5) were calculated for boys, brothers and sisters, according to how many of these risk factors they possessed. While this risk score is illustrative, conclusions obtained with it are likely to apply to many other points risk scores.

Table 6.7 shows how far these points risk scores predicted convictions for boys, brothers and sisters. The percentage of boys convicted increased from 24.2 per cent of those with no risk factors to 79.2 per cent of those with four or five risk factors (AUC = .697, sd = .030). The percentage of brothers convicted increased from 31.9 per cent of those with no risk factors to 63.3 per cent of those with four or five risk factors (AUC = .635, sd = .026). The percentage of sisters convicted increased from 5.9 per cent of those with no risk factors to 34.3 per cent of those with four or five risk factors (AUC = .717, sd = .039). The AUC for sisters was again significantly greater ($t = 2.48$, $p = .013$) than the AUC for brothers. Also, the AUC for boys was significantly greater ($t = 2.21$, $p = .027$) than the AUC for brothers. These results suggest that predictive efficiency would be substantial in new samples.

Contrasting the high risk group with the remainder, 79.2 per cent of 24 high risk boys were convicted, compared with 36.5 per cent of 373 low risk boys (OR = 6.6); 63.3 per cent of 90 high risk brothers were convicted, compared with 39.9 per cent of 404 low risk brothers (OR = 2.6); 34.3 per cent of 67 high risk sisters were convicted, compared with 8.8 per cent of 452 low risk sisters (OR = 5.4). There were relatively more high risk brothers and sisters than high risk boys because high risk families (which tended to be large) contributed a disproportionate number of brothers and sisters.

Throughout these analyses, predictions for sisters were more accurate than predictions for brothers. The differential accuracy of prediction can be further illustrated by contrasting the two highest risk groups in Table 6.7 with the remainder. Of the 137 highest risk sisters, 36 were convicted (26.3%), compared with 27 of the remaining 382 (7.1%; OR = 4.7). Conversely, the majority of convicted sisters (57.1%) were drawn from the quarter of the sample (26.4%) in the highest risk groups. For brothers, the comparable figures were: 59.4 per cent of 170 highest risk persons were convicted, compared with 36.1 per cent of the remaining 324 (OR = 2.6); 46.3 per cent of convicted brothers were drawn from the third of the sample (34.4%) in the highest risk groups.

Table 6.7: Points risk scores for convictions

Risk Score	No.	% Conv.
Boys		
0	178	24.2
1	98	42.9
2	62	45.2
3	35	65.7
4-5	24	79.2
Brothers		
0	138	31.9
1	88	38.6
2	98	39.8
3	80	55.0
4-5	90	63.3
Sisters		
0	152	5.9
1	107	5.6
2	123	9.8
3	70	18.6
4-5	67	34.3

Note: Risk score = No. of risk factors out of 5.

Area under the ROC Curve:

Boys = .697, Brothers = .635, Sisters = .717

OR: Boys = 6.6, Brothers = 2.6, Sisters = 5.4

Policy implications

One possible inference that may be drawn from Table 6.7 (and indeed from the previous Tables in this chapter) is that these socio-economic and child-rearing risk factors are relatively more important in explaining offending of sisters compared with brothers. In the absence of these risk factors, very few sisters were convicted. In Table 6.7, less than six per cent of sisters with 0 or 1 risk factor out of five were convicted, and in Table 6.3 no more than ten per cent of sisters in the non-risk category of each socio-economic and child-rearing factor were convicted. In contrast, in Table 6.7 about one-third of brothers with 0 out of 5 risk factors were convicted, and in Table 6.2 between 35 per cent and 45 per cent of brothers in each non-risk category were convicted.

It might therefore be suggested that other (e.g. biological, individual, neighbourhood) risk factors might be relatively more important in producing convictions of males than in producing convictions of females, and conversely that convictions of females might be dramatically reduced by effective risk-focused prevention targeting socio-economic and child-rearing risk factors. These reductions would be proportionally far greater for females than for males. Further research, comparing males and females, measuring a wider range of risk factors and implementing risk-focused prevention would be needed to test these ideas more adequately.

Another important implication of Table 6.7 (and previous Tables in this Chapter) is that risk assessment is likely to be more useful for females than for males. Thirty-seven per cent of convicted sisters were among the highest risk 13 per cent of sisters (67), whereas only 26 per cent of convicted brothers were among the highest risk 18 per cent of brothers (90). Hence, targeting high risk females would have a relatively bigger

impact on female crime, in comparison with the impact on male crime of targeting high risk males. On the other hand, false positive rates were higher for sisters; only 34 per cent of the highest risk sisters were convicted, compared with 63 per cent of the highest risk brothers. However, this is largely a function of the higher prevalence of male offending. The comparison of highest and lowest risk sisters (34% compared with 6% convicted) versus highest and lowest risk brothers (63% compared to 32% convicted) suggests that risk assessment devices can discriminate more effectively among females than among males.

How far could the number of offenders be reduced by effective risk-focused prevention? In order to compare brothers and sisters, assume that all higher risk persons (with 3 - 5 risk factors) are changed into lower risk persons (with 0-2 risk factors) and that conviction rates of lower risk persons are unchanged. For brothers, the 170 previously higher risk persons would now have a conviction rate of 36.1 per cent, meaning that an estimated 61 of them would be convicted instead of 101. This would prevent 40 convicted persons (18% of all convicted brothers). For sisters, the 137 previously higher risk persons would now have a conviction rate of 7.1 per cent, meaning that an estimated 10 of them would be convicted instead of 36. This would prevent 26 convicted persons (41% of all convicted sisters).

This analysis indicates again that effective risk-focused prevention would cause a much greater proportional reduction in female offending (41%) than in male offending (18%), because risk factors are more strongly related to female offending than to male offending. It is likely that this general conclusion would be reached no matter how the analysis was carried out. However, effective risk-focused prevention would cause a greater absolute reduction in offending by males. In this example, the absolute reduction in convicted males (40) is about 50 per cent greater than the absolute reduction in convicted females (26).

These analyses are based on a number of assumptions about how risk-focused prevention might operate. To the extent that these assumptions are true, the main conclusion is that prevention efforts targeting socio-economic and child-rearing factors might take an enormous "bite" out of female crime, with a large proportional reduction in the number of female offenders. However, because of the greater prevalence of male crime, it is likely that the absolute number of male offenders would decrease more than the absolute number of female offenders.

7. Risk factors for early onset

The previous analyses focused on risk factors for convictions at any age, but it is also important to study risk factors for early onset convictions. When the boys, brothers and sisters were young, juveniles became adults (for the purposes of court processing) on the seventeenth birthday. It is therefore logical to define early onset convictions as those occurring before age 17. About half of convicted boys (83 out of 155, or 54%) and convicted brothers (108 out of 218, or 50%) had an early onset, compared with 24 out of 63 convicted sisters (38%). From now on, only brothers and sisters will be compared (not boys), because of the interest in comparable males and females. The boys are less comparable, because far more information was collected about their risk factors and offending. The following analyses contrast the early onset offenders with the remainder of the sample, including non-offenders. However, it must be pointed out that these analyses are limited by the small number of early onset sisters (24).

Risk factors for brothers and sisters

Table 7.1 shows risk factors for early onset convictions of brothers. In general, predictive relationships were stronger for early onset than for convictions of brothers. The strongest predictors of early onset for brothers were low family income (OR = 3.2), parental conflict (OR = 3.0), a convicted father (OR = 2.7), large family size (OR = 2.6), a convicted mother (OR = 2.3), attending a high delinquency rate school (OR = 2.2), low parental interest in education (OR = 2.1), harsh or erratic parental discipline (OR = 2.1) and a poorly educated mother (OR = 2.0). Low family income and harsh or erratic parental discipline were more important for early onset than for convictions of brothers.

Table 7.2 shows risk factors for early onset convictions of sisters. The strongest predictors of early onset for sisters were low family income (OR = 13.4), low paternal interest in children (OR = 5.6), low parental interest in education (OR = 5.6), a delinquent sibling (OR = 5.3), attending a high delinquency rate school (OR = 4.7), large family size (OR = 4.5), parental conflict (OR = 4.5) and low praise by the parents (OR = 4.0). In general, the most important risk factors for early onset tended to be the same as for convictions of sisters, but the strength of relationships was greater for early onset. Low family income was a particularly important risk factor for sisters; 21 girls from 191 low income families (11%) had an early onset, compared with only three girls from 328 other families (1%). Conversely, 88 per cent of early onset sisters came from low income families.

Table 7.1: Risk factors for early onset of brothers

	Per cent		Odds ratio
	Non-risk	Risk	
Socio-economic			
Low social class	21	26	1.3
Low family income	14	33	3.2*
Poor housing	17	27	1.8*
Large family size	14	29	2.6*
High delinquency school	18	32	2.2*
Family			
Convicted father	16	34	2.7*
Convicted mother	19	36	2.3*
Delinquent sibling	20	31	1.8*
Teenage mother	18	29	1.8*
Working mother	24	9	0.3*
Nervous father	19	30	1.8*
Nervous mother	18	30	1.9*
Poorly educated father	18	24	1.5
Poorly educated mother	13	24	2.0*
Child-rearing			
Low paternal interest in children	20	28	1.6
Low interest in education	18	31	2.1*
Parental conflict	16	37	3.0*
Separated from parent	19	30	1.9*
Harsh discipline	17	31	2.1*
Poor supervision	18	30	1.9*
Low praise	20	30	1.7

* p<.05

Table 7.2: Risk factors for early onset of sisters

Risk factor	Per cent		Odds ratio
	Non risk	Risk	
Socio-economic			
Low social class	3	10	3.2*
Low family income	1	11	13.4*
Poor housing	3	6	2.3
Large family size	2	8	4.5*
High delinquency school	3	11	4.7*
Family			
Convicted father	3	8	3.0*
Convicted mother	4	10	2.6
Delinquent sibling	3	13	5.3*
Teenage mother	4	6	1.3
Working mother	5	2	0.5
Nervous father	4	7	1.9
Nervous mother	5	4	0.9
Poorly educated father	5	5	0.9
Poorly educated mother	3	5	1.5
Child-rearing			
Low paternal interest in children	3	15	5.6*
Low interest in education	2	12	5.6*
Parental conflict	2	10	4.5*
Separated from parent	4	8	2.4*
Harsh discipline	2	9	4.4*
Poor supervision	3	8	3.2*
Low praise	3	11	4.0*

* p<.05

Comparing odds ratios for early onset

Table 7.3 shows ORs for the brothers and sisters, so that they can be compared directly. It can immediately be seen that the mean OR was greater for sisters (2.8) than for brothers (1.8). These means are greater than the mean ORs for predicting convictions (2.4 and 1.5, respectively). ORs for early onset convictions of sisters were significantly greater than for early onset convictions of brothers ($t = 3.40$, $p = .003$).

Table 7.3: Strength of relationships for early onset (odds ratios)

	Brothers (494)	Sisters (519)
Socio-economic		
Low social class	1.3	3.2*
Low family income	3.2*	13.4*
Poor housing	1.8*	2.3
Large family size	2.6*	4.5*
High delinquency school	2.2*	4.7*
Family		
Convicted father	2.7*	3.0*
Convicted mother	2.3*	2.6
Delinquent sibling	1.8*	5.3*
Teenage mother	1.8*	1.3
Working mother	0.3*	0.5
Nervous father	1.8*	1.9
Nervous mother	1.9*	0.9
Poorly educated father	1.5	0.9
Poorly educated mother	2.0*	1.5
Child-rearing		
Low paternal interest in children	1.6	5.6*
Low interest in education	2.1*	5.6*
Parental conflict	3.0*	4.5*
Separated from parent	1.9*	2.4*
Harsh discipline	2.1*	4.4*
Poor supervision	1.9*	3.2*
Low praise	1.7	4.0*
Geometric mean	1.8	2.8

Note: * $p < .05$

The (ranked) ORs for sisters correlated .42 ($p = .060$) with the ORs for brothers. As before, the most important risk factors for brothers tended also to be the most important risk factors for sisters. Low family income, large family size, attending a high delinquency rate school, harsh or erratic parental discipline, low parental interest in education and parental conflict were among the eight most important risk factors for both brothers and sisters.

Again, however, there were some noteworthy differences. As with convictions, low social class of the family was a significant predictor of early onset for sisters but not for brothers. Low family income was outstandingly important for sisters. Low paternal interest in children was far more important for sisters than for brothers, and low praise by the parents was important for sisters but not for brothers. Conversely, the parental characteristics of a nervous mother and a poorly educated father were more important for brothers than for sisters.

Multivariate analyses and logistic risk scores

Table 7.4 shows the results of logistic regression analyses carried out to determine the most important independent predictors of early onset offenders. For the brothers, the most important predictors were low family income, parental conflict, a convicted father, a nervous mother and a teenage mother (under 20 when she had her first child). For the sisters, the most important predictors were low family income and

low praise by the parents. The fact that there were only two significant predictors for sisters probably reflects the small number of early onset cases (only 24 out of 519 sisters).

As before, risk scores were calculated for each person according to the weightings of each variable in the final logistic regression equation. Table 7.5 shows the relationship between these logistic risk scores and the actual percentage of people with early onset convictions. It was intended to divide the risk scores into five categories as equally as possible, but there were only four categories for sisters (because the risk score was based on only two variables).

Table 7.4: Logistic regression analyses for early onset

	LRCS	p	POR
Brothers			
Low family income	22.92	.0001	2.1
Parental conflict	10.43	.001	2.2
Convicted father	6.46	.011	1.8
Nervous mother	4.06	.044	1.7
Teenage mother	3.49	.062	1.6
Sisters			
Low family income	25.10	.0001	15.5
Low praise	4.35	.037	3.1

Notes: LRCS = likelihood ratio chi-squared
 POR = partial odds ratio

The percentage of brothers with early onset convictions increased from 6.6 per cent of those with a risk score less than .1 to 45.2 per cent of those with a risk score of .34 or greater (AUC = .713, sd = .031). The percentage of sisters with early onset convictions increased from 0.7 per cent of those with a risk score less than .01 to 22.6 per cent of those with a risk score of .1 or greater (AUC = .853, sd = .042). Based on the AUC, predictive efficiency was significantly greater for sisters than for brothers (t = 3.78, p = .0002).

As before, a simpler measure of predictive efficiency was obtained by contrasting the high risk group with the remainder. For the brothers, 45.2 per cent of 84 with the highest risk scores had early onset convictions, compared with 15.6 per cent of 365 lower risk persons (OR = 4.5). For the sisters, 22.6 per cent of 31 with the highest risk scores had early onset convictions, compared with only 2.8 per cent of 435 lower risk persons (OR = 10.3). This comparison again indicates that predictive efficiency was greater for sisters.

Table 7.5: Logistic risk scores for early onset

Risk score	No.	% Early onset
Brothers		
<.1	106	6.6
.1<.14	87	16.1
.14<.22	85	21.2
.22<.34	87	20.7
.34+	84	45.2
Sisters		
<.01	267	0.7
.01<.05	33	0.0
.05<.1	135	7.4
.1+	31	22.6

Note: risk score = predicted proportion of people with early onset convictions.
 Area under the ROC curve: brothers = .713, sisters = .853
 OR: brothers 4.5, sisters 10.3

Points risk scores

In order to derive a more realistic indication of predictive efficiency in a new sample, points risk scores (derived as before) were also compared with early onset convictions, and the results are shown in Table 7.6. The percentage of brothers with early onset convictions increased from 9.4 per cent of those with no risk factors to 40 per cent of those with four or five risk factors (AUC = .702, sd = .029). The percentage of sisters with early onset convictions increased from two per cent of those with no risk factors to 20.9 per cent of those with four or five risk factors (AUC = .787, sd = .063). The AUC for sisters was almost significantly greater than the AUC for brothers ($t = 1.73$, $p = .084$).

When the highest risk group was contrasted with the remainder, 40 per cent of 90 brothers with high risk scores had early onset convictions, compared with 17.8 per cent of the remaining 404 (OR = 3.1); and 20.9 per cent of 67 sisters with the highest risk scores had early onset convictions, compared with only 2.2 per cent of the remaining 452 (OR = 11.7). The discrimination for sisters was remarkable; lower risk sisters were very unlikely to have early onset convictions. Again, this might suggest that other risk factors were relatively unimportant for sisters. The majority of early onset sisters (58.3%) came from the one-eighth of the sample who were in the highest risk group.

Table 7.6: Points risk scores for early onset

Risk score	No.	% Early onset
Brothers		
0	138	9.4
1	88	12.5
2	98	20.4
3	80	35.0
4-5	90	40.0
Sisters		
0	152	2.0
1	107	0.9
2	123	2.4
3	70	4.3
4-5	67	20.9

Note: risk score = no. of risk factors out of 5.

Area under the ROC curve: brothers = .702, sisters = .787

OR: brothers 3.1, sisters 11.7

Risk-focused prevention

In order to illustrate how far the number of offenders might be reduced by risk-focused prevention, let us assume that all highest risk persons (with risk scores of four to five) could be changed into lower risk persons. For brothers, the 90 previously highest risk persons would now have an early onset rate of 17.8 per cent, meaning that an estimated 16 of them would have an early conviction instead of 36. This would prevent 20 early onset brothers (19% of early onset brothers). For sisters, the 67 previously highest risk persons would now have an early onset rate of 2.2 per cent, meaning that only one of them would have an early conviction instead of 14. This would prevent 13 early onset sisters (54% of early onset sisters). Again, therefore, this analysis shows that effective risk-focused prevention would cause a much greater proportional reduction in female offending than in male offending (54% compared with 19%), but there would be a greater absolute reduction in male offending (20 compared with 13).

8. Risk factors for frequent offending

Are convicted sisters more extreme?

So far, it has been found that risk factors predict offending more accurately for sisters than for brothers. The statistical measures of predictive efficiency were carefully chosen so that they were not artefactually influenced by differences in prevalence. Nevertheless, the gender difference in predictive efficiency could still be influenced by prevalence. Arguably, the 63 convicted sisters may be more distinctive and extreme in a variety of ways than the 218 convicted brothers, and the greater predictive accuracy may be a consequence of extremeness rather than gender. In order to investigate this, the 63 convicted sisters should be compared with an approximately equal number of the most frequently convicted brothers. In any case, it is interesting to investigate how far risk factors for frequent offending are similar to or different from risk factors for offending in general.

The sisters who were convicted were more extreme on the points risk score. Of the 63 convicted sisters, 23 (36.5%) had four or five risk factors, compared with 57 of the 218 convicted brothers (26.1%). These percentages were substantially, but not significantly, different (chi-squared = 2.58, n.s.).

For the brothers, the most frequent offenders were the 66 with four or more convictions; 27 of these (40.9%) had four or five of the risk factors. Hence, the frequently convicted brothers were similar to the convicted sisters not only in extremeness (the fraction of the cohort) but also in numbers of risk factors. For the sisters, the most frequent offenders were the 34 with two or more convictions; 16 of these (47.1%) had four or five of the risk factors. As expected, frequently convicted sisters were more extreme in numbers of risk factors than convicted sisters. The following analyses contrast the frequent offenders with the remainder of the sample, including non-offenders.

As expected, early onset (before age 17) tended to be associated with frequent offending, especially for brothers. For the brothers, 80.3 per cent of the frequent offenders had an early onset, compared with 36.2 per cent of the remaining offenders (OR = 7.2). For the sisters, 44.1 per cent of the frequent offenders had an early onset, compared with 31 per cent of the remaining offenders (OR = 1.8, ns.).

Risk factors

Table 8.1 shows risk factors for frequent offending of brothers. The strongest predictors were parental conflict (OR = 3.3), low family income (OR = 3.1), a convicted mother (OR = 3.1), a convicted father (OR = 2.9), a poorly educated mother (OR = 2.5), large family size (OR = 2.4), poor parental supervision (OR = 2.4) and low praise by the parents (OR = 2.4). As expected, the most important risk factors for frequent offending tended to be the same as for early onset, and the strength of relationships were similar for frequent offending and early onset.

Table 8.2 shows risk factors for frequent offending of sisters. The most important risk factors were low family income (OR = 5.3), low parental interest in education (OR = 5.1), a delinquent sibling (OR = 4.9), attending a high delinquency rate school (OR = 4.2), large family size (OR = 3.9), harsh or erratic parental discipline (OR = 3.9) and a convicted father (OR = 3.8). Again, the most important risk factors for frequent offending tended to be the same as for early onset, and again the strength of relationships were similar for frequent offending and early onset.

Table 8.3 shows ORs for brothers and sisters, so that they can be compared directly. The mean OR was significantly greater for sisters (2.7) than for brothers (2.0: $t = 3.22$, $p = .004$). These mean ORs for frequent offending were similar to the mean ORs for early onset for sisters (2.7) and brothers (1.8).

The (ranked) ORs for sisters correlated .40 ($p = .070$) with the ORs for brothers. As before, the most important risk factors for brothers tended also to be the most important risk factors for sisters. Low family income, large family size, a convicted father, a convicted mother, a delinquent sibling, parental conflict and low praise by the parents were among the ten most important risk factors for both brothers and sisters.

Table 8.1: Risk factors for frequent offending of brothers

Risk factor	Per cent		Odds ratio
	Non risk	Risk	
Socio-economic			
Low social class	12	17	1.5
Low family income	8	21	3.1*
Poor housing	10	17	1.9*
Large family size	8	18	2.4*
High delinquency school	11	20	2.0*
Family			
Convicted father	9	22	2.9*
Convicted mother	11	28	3.1*
Delinquent sibling	12	23	2.2*
Teenage mother	11	18	1.7*
Working mother	15	3	0.2*
Nervous father	11	21	2.2*
Nervous mother	11	19	1.8*
Poorly educated father	9	14	1.8
Poorly educated mother	7	15	2.5*
Child-rearing			
Low paternal interest in children	11	19	1.9
Low interest in education	11	19	2.0*
Parental conflict	9	24	3.3*
Separated from parent	11	20	2.1*
Harsh discipline	11	18	1.8*
Poor supervision	10	21	2.4*
Low praise	11	22	2.4*

*p<.05

As before, low social class was a more important risk factor for sisters than for brothers. Low family income was more important for sisters than for brothers, but the difference was not as startling as with early onset. While large family size, attending a high delinquency rate school, a delinquent sibling, low paternal interest in children, low parental interest in education, harsh or erratic discipline and low praise by the parents were more important for sisters, they were also important for brothers. Conversely, a nervous father and a poorly educated mother were more important predictors for brothers.

Table 8.2: Risk factors for frequent offending of sisters

Risk factor	Per cent frequent		Odds ratio
	Non risk	Risk	
Socio-economic			
Low social class	5	13	3.0*
Low family income	3	13	5.3*
Poor housing	4	9	2.1*
Large family size	3	11	3.9*
High delinquency school	4	15	4.2*
Family			
Convicted father	4	13	3.8*
Convicted mother	5	16	3.4*
Delinquent sibling	4	18	4.9*
Teenage mother	5	10	1.9
Working mother	7	5	0.7
Nervous father	6	9	1.5
Nervous mother	5	9	1.9
Poorly educated father	6	7	1.3
Poorly educated mother	4	7	1.8
Child-rearing			
Low paternal interest in children	5	15	3.1*
Low interest in education	3	15	5.1*
Parental conflict	4	13	3.1*
Separated from parent	6	10	1.9
Harsh discipline	3	12	3.9*
Poor supervision	4	11	2.8*
Low praise	5	14	3.3*

* p<.05

Table 8.3: Strength of relationships for frequent offending (odds ratios)

	Brothers (494)	Sisters (519)
Socio-economic		
Low social class	1.5	3.0*
Low family income	3.1*	5.3*
Poor housing	1.9*	2.1*
Large family size	2.4*	3.9*
High delinquency school	2.0*	4.2*
Family		
Convicted father	2.9*	3.8*
Convicted mother	3.1*	3.4*
Delinquent sibling	2.2*	4.9*
Teenage mother	1.7*	1.9
Working mother	0.2*	0.7
Nervous father	2.2*	1.5
Nervous mother	1.8*	1.9
Poorly educated father	1.8	1.3
Poorly educated mother	2.5*	1.8
Child-rearing		
Low paternal interest in children	1.9	3.1*
Low interest in education	2.0*	5.1*
Parental conflict	3.3*	3.1*
Separated from parent	2.1*	1.9
Harsh discipline	1.8*	3.9*
Poor supervision	2.4*	2.8*
Low praise	2.4*	3.3*
Geometric mean	2.0	2.7

Note: *p<.05

Convicted sisters versus frequently convicted brothers

In order to investigate whether ORs for sisters were greater than ORs for brothers purely because the sisters were a more extreme group, the ORs for frequent offending by brothers were compared with the ORs for convictions by sisters (Table 8.4). The two sets of ORs correlated .41 ($p = .068$). The extremeness of 66 frequent brothers and 63 convicted sisters should be similar. However, the mean OR for sisters was still greater (2.4 as opposed to 2.0), although not significantly so ($t = 1.68$, ns).

Table 8.4: Convicted sisters versus frequently convicted brothers (odds ratios)

	Brothers (494)	Sisters (519)
Socio-economic		
Low social class	1.5	2.1*
Low family income	3.1*	4.1*
Poor housing	1.9*	2.2*
Large family size	2.4*	3.8*
High delinquency school	2.0*	3.9*
Family		
Convicted father	2.9*	2.9*
Convicted mother	3.1*	2.7*
Delinquent sibling	2.2*	4.7*
Teenage mother	1.7*	1.6
Working mother	0.2*	0.9
Nervous father	2.2*	1.6
Nervous mother	1.8*	1.5
Poorly educated father	1.8	0.8
Poorly educated mother	2.5*	1.5
Child-rearing		
Low paternal interest in children	1.9	3.4*
Low interest in education	2.0*	3.9*
Parental conflict	3.3*	3.1*
Separated from parent	2.1*	1.9*
Harsh discipline	1.8*	3.1*
Poor supervision	2.4*	2.0*
Low praise	2.4*	3.5*
Geometric mean	2.0	2.4

Note: *p<.05

Comparing results obtained with the 21 risk factors, ORs were greater for convicted sisters than for frequently convicted brothers for all five socio-economic factors. Low social class, low family income, large family size and attending a high delinquency rate school predicted convicted sisters more strongly than frequently convicted brothers. ORs were substantially greater for convicted sisters for four of the child-rearing variables. Low paternal interest in children, low parental interest in education, harsh or erratic parental discipline and low praise by the parents predicted convicted sisters more strongly than frequently convicted brothers. The same was true for a delinquent sibling, but a convicted father and a convicted mother were equally predictive of convicted sisters and frequently convicted brothers. However, the ORs were greater for frequently convicted brothers for most of the remaining family variables. A poorly educated father and mother, and a nervous father and mother, predicted frequently convicted brothers more strongly than convicted sisters. Working mothers were significantly negatively related to frequently convicted brothers.

It can be concluded that part of the reason why risk factors predict female offending better than male offending is because female offenders were a proportionally more extreme fraction of the cohort. However, a gender difference remains; even after controlling for extremeness, socio-economic and child-rearing factors were still better predictors for females. Conversely, parental characteristics (a nervous or poorly educated father or mother) were still more important for males, and convicted parents were still equally important for males and females.

Attributable risk and RIOC

Since the prevalence of convicted sisters and frequently convicted brothers was almost identical, it is useful to measure Attributable Risk for both. Attributable Risk (AR) is a meaningful measure of predictive efficiency. It measures the fraction of an outcome (here, convicted persons) that is attributable to the risk factor (Fleiss, 1981, p.75), on the assumption that the risk factor has a causal effect.

For example, 43 of the 203 brothers in low income families (21.2%) were frequently convicted. The 2 x 2 table was as follows:

Not FC FC

Not LFI	268	23
LFI	160	43

where FC = frequently convicted
LFI = low family income

Since 23 of the 291 brothers (7.9%) who were not in low income families were convicted, the chance expectation (if the risk factor had no effect) is that 16 (7.9%) of the 203 brothers in low income families would be frequently convicted. Therefore, 27 (43-16) of the 66 frequently convicted brothers were attributable to the risk factor of low family income and Attributable Risk is calculated as follows:

$$AR = \frac{27}{66} = .41$$

Hence, 41 per cent of convicted persons are attributable to the risk factor of low family income; or conversely, if the risk factor of low family income could be eliminated, the number of convicted persons would decrease by 41 per cent (Fleiss, 1981, p.76). Again, this statement depends on the risk factor having a causal effect, but AR gives a useful indication of the relative importance of different risk factors in relation to the total crime problem. Ideas of Attributable Risk inspired our previous analyses of the policy implications of risk-focused prevention.

Since the denominator of AR is the prevalence of the outcome (here, frequently convicted brothers), AR is affected by this prevalence. AR is not very useful when the prevalence of the outcome exceeds the prevalence of the risk factor. When the prevalence of the risk factor exceeds the prevalence of the outcome (as with frequently convicted brothers and convicted sisters), AR is mathematically identical to Relative Improvement Over Chance (RIOC: Loeber and Dishion, 1983). RIOC measures predictive efficiency in a 2 x 2 table as follows:

$$RIOC = \frac{\text{Total correct} - \text{Chance correct}}{\text{Maximum correct} - \text{Chance correct}}$$

For frequently convicted brothers, total correct = 43 (predicted, convicted) plus 268 (not predicted, not convicted) = 311. Chance correct = 27.1 (predicted, convicted) plus 252.1 (not predicted, not convicted) = 279.2. Maximum correct occurs when all 66 frequently convicted brothers were predicted, in which case all 291 not-predicted brothers would be not frequently convicted. Hence, the maximum correct is 357. Therefore:

$$RIOC = \frac{311 - 279.2}{357 - 279.2} = .41$$

RIOC indicates the improvement of the prediction over chance expectation, expressed as a proportion of the maximum possible improvement over chance expectation (given the row and column totals). RIOC is mathematically identical to the phi (product-moment) correlation divided by its maximum possible value given the row and column totals (the prevalence of predicted and convicted persons). Hence, RIOC is a better measure of predictive efficiency than phi or any other measure based on chi-squared (Farrington and Loeber, 1989), since it corrects for the dependence of these measures on the prevalence of risk

factors and outcomes. AR and RIOC vary between zero (chance expectation) and one (maximum possible predictability, given the prevalence of predicted and convicted persons).

Attributable risk for males versus females

Table 8.5 shows ARs for convicted sisters versus frequently convicted brothers. The mean ARs were not significantly different (.232 for sisters, .214 for brothers). The two sets of ARs were significantly correlated ($r = .467$, $p = .033$), showing that the most important risk factors for brothers and sisters tended to be similar.

Table 8.5: Convicted sisters versus frequently convicted brothers (attributable risk)

	Brothers (494)	Sisters (519)
Socio-economic		
Low social class	.087	.164
Low family income	.408	.473
Poor housing	.267	.331
Large family size	.376	.515
High delinquency school	.208	.374
Family		
Convicted father	.347	.302
Convicted mother	.184	.133
Delinquent sibling	.132	.309
Teenage mother	.163	.124
Working mother	-.136	-.010*
Nervous father	.178	.105
Nervous mother	.180	.123
Poorly educated father	.310	-.107
Poorly educated mother	.490	.259
Child-rearing		
Low paternal interest in children	.100	.202
Low interest in education	.174	.370
Parental conflict	.294	.326
Separated from parent	.182	.136
Harsh discipline	.173	.372
Poor supervision	.230	.180
Low praise	.138	.199
Mean	.214	.232

Note: * $p > .05$; all other values significant.

However, there were differences. In particular, socio-economic factors were more important predictors for convicted sisters. AR was particularly high for sisters for large family size (.515) and low family income (.473). Hence, if large family size had a causal effect, 51.5 per cent of convicted sisters would be attributable to large family size, and the number of convicted sisters could be decreased by 51.5 per cent if this risk factor could be eliminated. The comparable figure for frequently convicted brothers was 37.6 per cent. Nineteen per cent of sisters from large families were convicted compared with 5.9 per cent from smaller families, or conversely 75.6 per cent of convicted sisters came from large families. Twenty-two per cent of sisters from low income families were convicted compared with 6.4 per cent from higher income families, or conversely 66.7 per cent of convicted sisters came from low income families.

Similarly, child-rearing factors were more important for convicted sisters, especially low paternal interest in children, low parental interest in education, harsh or erratic discipline and low praise. Of the family factors, only a delinquent sibling was more important for convicted sisters. A nervous father or mother, and a poorly educated father or mother, were more important for frequently convicted brothers. A convicted father and a convicted mother were also somewhat more important for frequently convicted brothers.

Multivariate analyses and logistic risk scores

One limitation of AR is that it does not take account of multivariate relationships among risk factors. Table 8.6 shows the results of logistic regression analyses carried out to determine the most important independent predictors of frequently convicted brothers and sisters. For brothers, the most important predictors were parental conflict, a convicted mother and father, and a working mother (which was negatively related). For sisters, the most important predictors were low parental interest in education, a convicted father and attending a high delinquency rate school. The partial odds ratios were greater for sisters, again suggesting that the causal effects of risk factors were greater for females.

As before, risk scores were calculated for each person according to the weightings of each variable in the final logistic regression equation. Table 8.7 shows the relationship between these logistic risk scores and the actual percentage of frequently convicted brothers and sisters. The results for convicted sisters (see Chapter 6) are also presented, so that they can be compared with frequently convicted brothers. The risk scores were divided into five categories as equally as possible.

Table 8.6: Logistic regression analyses

	LRCS	p	POR
Freq. convicted brothers			
Parental conflict	13.95	.0002	2.5
Convicted mother	8.61	.003	1.9
Convicted father	4.10	.043	1.9
Working mother (-)	4.30	.038	0.3
Freq. convicted sisters			
Low interest in education	17.81	.0001	3.3
Convicted father	10.51	.001	3.1
High delinquency school	8.02	.005	3.1

Notes: LRCS = Likelihood ratio chi-squared
 POR = Partial odds ratio

The percentage of frequently convicted brothers increased from 3.7 per cent of those with a risk score less than .06 to 33.3 per cent of those with a risk score of .20 or greater (AUC = .733, sd = .039). These results are similar to those obtained with convicted sisters, where the percentage convicted increased from 4.4 per cent to 37.1 per cent (AUC = .758, sd = .039). The AUC for convicted sisters was not significantly greater than for frequently convicted brothers. The percentage of frequently convicted sisters increased from 2.1 per cent of those with a risk score less than .02 to 24.1 per cent of those with a risk score of .15 or greater (AUC = .785, sd = .042).

As before, a simpler measure of predictive efficiency was obtained by contrasting the highest risk group with the remainder. For brothers, 33.3 per cent of 72 with the highest risk scores were frequently convicted, compared with 8.6 per cent of 373 lower risk persons (OR = 5.3). The corresponding OR for convicted sisters was higher (OR = 6.5; 37.1 per cent compared with 8.3 per cent). For frequently convicted sisters, 24.1 per cent of 54 with the highest risk scores were frequently convicted, compared with five per cent of 383 lower risk persons (OR = 6.1). All these analyses show that predictive efficiency was greater for convicted sisters than for frequently convicted brothers, but greatest of all for frequently convicted sisters.

Table 8.7: Logistic risk scores

Risk score	No.	% Conv.
Convicted sisters		
<.05	160	4.4
.05<.08	77	10.4
.08<.14	61	6.6
.14<.25	51	19.6
.25+	62	37.1
Freq. convicted brothers		
<.06	54	3.7
.06<.08	182	6.6
.08<.14	85	11.8
.14<.20	52	15.4
.20+	72	33.3
Freq. convicted sisters		
<.02	191	2.1
.02<.05	95	4.2
.05<.10	41	4.9
.10<.15	56	16.1
.15+	54	24.1

Notes: Area under the ROC curve:

Convicted sisters = .758, Frequently convicted brothers = .733,
 Frequently convicted sisters = .785

OR: Convicted sisters = 6.5, Frequently convicted brothers = 5.3,
 Frequently convicted sisters = 6.1

Points risk scores

As before, points risk scores were also related to frequently convicted brothers and sisters, in order to obtain a more realistic indication of predictive accuracy in new samples. Table 8.8 shows that the percentage of frequently convicted brothers increased from 4.3 per cent of those with no risk factors to 30 per cent of those with four or five risk factors (AUC = .718, sd = .035).

Table 8.8: Points risk scores

Risk score	No.	% Conv.
Convicted sisters		
0	152	5.9
1	107	5.6
2	123	9.8
3	70	18.6
4-5	67	34.3
Freq. convicted brothers		
0	138	4.3
1	88	12.5
2	98	5.1
3	80	21.3
4-5	90	30.0
Freq. convicted sisters		
0	152	2.6
1	107	2.8
2	123	2.4
3	70	11.4
4-5	67	23.9

Note: Risk score = No. of risk factors out of 5.

Area under the ROC curve:

convicted sisters .717, Freq. convicted brothers .718,

Freq. convicted sisters .763

OR: convicted sisters 5.4, Freq. convicted brothers 4.0,

Freq. convicted sisters 7.6

This level of predictive accuracy was almost identical to that obtained with convicted sisters, also shown in Table 8.8 (AUC = .717, sd = .039). The percentage of frequently convicted sisters increased from 2.6 per cent of those with no risk factors to 23.9 per cent of those with four or five risk factors (AUC = .763, sd = .050).

Contrasting the highest risk group with the remainder, 30 per cent of 90 brothers with the highest risk scores were frequently convicted, compared with 9.7 per cent of the remaining 404 (OR = 4.0). The corresponding OR for convicted sisters was higher (OR = 5.4; 34.3% compared with 8.8%). Also for the sisters, 23.9 per cent of 67 with the highest risk scores were frequently convicted, compared with four per cent of the remaining 452 (OR = 5.4). Therefore, predictive efficiency for convicted sisters was again higher than for frequently convicted brothers.

Risk-focused prevention

In order to illustrate how far the number of offenders might be reduced by risk-focused prevention, let us assume that all high risk persons (with risk scores four to five) could be changed into low risk persons. For brothers, the 90 previously high risk persons would now have a frequent conviction rate of 9.7 per cent, meaning that an estimated nine of them would be frequently convicted instead of 27. This would prevent 18 frequently convicted brothers (27% of frequently convicted brothers). For convicted sisters, the 67 previously high risk persons would now have a conviction rate of 8.8 per cent, meaning that six of them would be convicted instead of 23. This would prevent 17 convicted sisters (27% of convicted sisters). Hence, effective risk-focused prevention would have a similar effect in reducing frequently convicted brothers and convicted sisters.

Notwithstanding this result, most of the analyses in this chapter suggest that predictive efficiency was greater for convicted sisters than for frequently convicted brothers. Hence, it might be concluded that the fact that convicted sisters were a more extreme group than convicted brothers might explain part of the difference between them in predictive accuracy, but not all of it.

9. Conclusions and policy implications

The key feature of this research is its comparison of brothers and sisters in the same families, and we will concentrate on the results of this comparison here.

Criminal careers

As expected, the prevalence of convictions was greater for brothers than for sisters (44% as opposed to 12%). Furthermore, brothers committed offences more frequently: an average of 4.3 per offender, compared with 2.8 for sisters. More brothers were frequent offenders: 66 brothers (30% of offenders) had four or more convictions, compared with only 14 sisters (22% of offenders). Conversely, for sisters, 46 per cent of offenders had only one conviction, compared with 39 per cent of brothers. The types of offences committed by brothers and sisters differed. Whereas brothers disproportionately committed burglary and theft of vehicles, sisters disproportionately committed shoplifting and deception offence.

Brothers and sisters were more similar in ages of offending. Their average ages of offending were almost identical (21.7 for brothers, 21.5 for sisters). The median age of offending was 20-21 for both, and the inter-quartile range was from 16-17 to 26 for both. The age of the first conviction was similar, although sisters were slightly older (mean age 19.9, as opposed to 18.5 for brothers). Similarly, the age of the last conviction was similar, although sisters were slightly younger (mean age 24.3, as opposed to 25.1 for brothers). Hence, sisters had shorter criminal careers (4.4 years on average, compared with 6.6 years for brothers).

Offending tended to be concentrated in certain families. In general, the probability of a sibling being convicted increased with the number of other convicted children in a family.

Risk factors for offending

In general, the most important risk factors for offending, for early onset (before age 17), and for frequent offending were similar for brothers and sisters: low family income, large family size, attending a high delinquency rate school, a convicted father, a convicted mother, a delinquent sibling, parental conflict, separation from a parent, harsh or erratic parental discipline and poor parental supervision.

However, there were some important differences. In particular, socio-economic risk factors such as low social class, low family income, poor housing and large family size predicted offending more strongly for sisters than for brothers. Child-rearing risk factors such as low praise by the parents, harsh or erratic discipline, poor parental supervision, parental conflict, low parental interest in education and low paternal interest in the children were also stronger predictors for sisters than for brothers. In contrast, there was a tendency for parental risk factors such as nervous fathers and mothers and poorly educated fathers and mothers to be more important for brothers than for sisters. Convicted fathers and mothers were equally important predictors for brothers and sisters. There was no tendency for mother risk factors to be more important for sisters and father risk factors to be more important for brothers.

In general, risk factors predicted offending by sisters more strongly than offending by brothers. For example, in predicting early onset offending, the percentage of sisters convicted increased from one per cent to 11 per cent according to the absence or presence of low family income, whereas the percentage of brothers convicted increased from 14 per cent to 33 per cent. Even after controlling for other risk factors, partial odds ratios were higher for sisters than for brothers; for low family income predicting early onset offending, the partial odds ratios were 15.5 for sisters and 2.1 for brothers. Arguably, therefore, the strength of causal influence of risk factors on offending is greater for females than for males.

Risk scores predicted offending more accurately for sisters than for brothers. The points risk score provides the most realistic indication of predictive accuracy. In predicting early onset offending, the percentage of sisters convicted increased from two per cent of those with no risk factors to 21 per cent of those with four to five risk factors. The percentage of brothers convicted increased from nine per cent of those with no risk factors to 40 per cent of those with four to five risk factors. While the absolute percentage difference was greater for brothers, the proportional percentage increase (which is a better index of the likely causal effect) was much greater for sisters.

Part of the reason why risk factors predicted convicted sisters better than convicted brothers was because convicted sisters were a more extreme fraction of the cohort (only 12%, compared with 44% of brothers who were convicted). In order to investigate whether the gender difference in predictability was entirely due to the gender difference in extremeness, the 63 convicted sisters were compared with 66 frequently convicted brothers (with four or more convictions). In general, predictive accuracy was still greater for sisters, although not significantly so. However, there were still marked gender differences in the predictability of different risk factors. Socio-economic and child-rearing factors were still more important for sisters, and parental characteristics were still more important for brothers.

Existing theories about gender differences in offending would not explain results obtained here on risk factors for delinquency. Existing theories do not predict that socio-economic and child-rearing factors are more important for females, that parental characteristics are more important for males, and that criminal parents are equally important for both males and females. Similarly, existing theories do not suggest that other (e.g. biological, individual, neighbourhood) risk factors may be relatively more important for males. There is a great need to formulate new theories about gender differences in offending which can explain existing results, and then to test them in new studies.

It is important to point out that the present project does not explain why females are less likely to offend than males, commit different types of offences, and have shorter criminal careers. Because of the design of the project (comparing brothers and sisters), we do not know whether the males were more likely than the females to possess risk factors such as impulsiveness or delinquent peers. This project provides information about relationships between family risk factors and offending for males and females but does not explain different levels of offending by males compared to females.

Future needed research

Ideally, new prospective longitudinal surveys should be mounted to investigate criminal careers and risk factors for offending of males and females in the present day. These should ideally begin with a birth cohort, and should compare males and females in the same and different families. A wide range of risk factors should be measured. However, it would be many years before the results of such surveys would be available. Another possibility would be to collect new data on risk factors and offending data in an ongoing prospective survey such as the Avon Longitudinal Study.

It would also be valuable to interview the children of the Cambridge Study males. The males themselves and their female partners are currently being interviewed at about age 46 to 48. Information about their children is being collected, and there are about 500 male and female children who will be aged 13 to 30 in 2003. These children could be interviewed to collect self-report data on their offending and antisocial behaviour, and their criminal records could be searched. This information about offending could be related to the wealth of data collected on their parents over the years to study risk factors for offending by the male and female children, and to investigate how far the risk factors in the Study male's generation still apply in their children's generation. This would provide prospective longitudinal data on risk factors for self-reported and official offending in today's conditions, within a relatively short time period.

Policy implications for risk-focused prevention

The basic idea of risk-focused prevention is very simple: identify the key risk factors for offending and implement prevention programmes to tackle them. This idea avoids the difficult question of which risk factors have causal effects. The assumption is that, if all modifiable risk factors are targeted, the intervention programme will be effective because at least some of the risk factors will be causes. Past research shows that family-based prevention techniques can be effective (see e.g. Farrington and Welsh, 1999), and that multi-modal programmes are most effective (Wasserman and Miller, 1998). Protective factors may also be important, but they are not addressed here.

It is unclear how far absolute as opposed to relative values of risk factors matter. For example, absolute levels of poverty and family size vary over time and place, but these risk factors are highly replicable predictors of offending (e.g. Farrington and Loeber, 1999). Therefore, in reducing offending, it may be more important to reduce variability in poverty or family size than to reduce absolute levels. This suggests that interventions are likely to be most effective if they are narrowly targeted and improve the lot of the most needy or deprived people relative to the remainder, and least effective if they are universally targeted

and improve everyone to the same degree.

Risk assessment can be used in deciding who should receive scarce intervention resources. The present analyses suggest that risk assessment using family factors is likely to be more accurate for females than for males. In this research, the comparison of high and low risk sisters with high and low risk brothers suggests that risk assessment devices can discriminate more effectively among females than among males. Gender differences in the importance of risk factors should be taken into account in constructing gender-specific risk assessment devices.

Gender differences in the importance of risk factors should also be taken into account in choosing intervention techniques. Based on particular assumptions about risk-focused prevention, the present analyses suggest that parent training and parent education techniques, which target parental discipline, parental supervision, parental reinforcement of children (e.g. praising) and parental interest in children are likely to have proportionally more impact in reducing female offending than in reducing male offending. Similarly, interventions designed to reduce family poverty are likely to have proportionally more impact in reducing female offending (especially early onset offending). However, the absolute number of offences reduced is likely to be greater for males than for females, because of the higher prevalence of male offending.

Research is needed on whether the benefit:cost ratio of interventions in monetary terms is greater for males or females. If this calculation is only based on reductions in crimes committed, then interventions may be more cost-effective for males. However, if other outcomes are also included (e.g. welfare, employment, health, education, crimes by the next generation), it is less clear that the benefit:cost ratio would be greater for males. Also, a marked reduction in the number of female offenders could have delayed effects in reducing offending by the next generation.

Interventions designed to reduce offending should be based on the best possible information about offending. We have found that the knowledge base about gender differences in offending is inadequate and have tried to advance this in our report. We hope that this new knowledge will assist in implementing more effective gender-specific risk assessment and intervention techniques.

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Home Office
Research, Development and Statistics Directorate
Communication Development Unit
Room 264
50 Queen Anne's Gate
London SW1H 9AT

Tel: 020 7273 2084 (answerphone outside of office hours)

Fax: 020 7222 0211

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