Validation of Risk Matrix 2000 for Use in Scotland

Report Prepared for the Risk Management Authority

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EXECUTIVE SUMMARY

Background

Risk Matrix 2000 is a statistically derived risk assessment instrument for use with convicted male sex offenders. It comprises two scales, Risk Matrix Sex and Risk Matrix Violence, which provide an estimate of the long term likelihood of reconviction for a sexual or a non-sexual violent offence, assigning individuals to Low, Medium, High and Very High risk categories. It is a fundamental component of the systematic sex offender risk assessments carried out in England and Wales by the prison, probation and police services, and is used by police forces throughout the UK, including Scotland. Other agencies in Scotland have also in recent years begun to include Risk Matrix 2000 in their sex offender risk assessment protocols.

In spite of its widespread and officially sanctioned use in the United Kingdom, Risk Matrix 2000 has not been subject to any form of rigorous evaluation, and its empirical foundation is thin. The original validation studies, mainly carried out in respect of a cohort of sex offenders released from prisons in England and Wales in 1979 and another in 1980, have not been peer reviewed, their methodology and analyses have not been published, and only limited data from them is available. There is also a paucity of other studies examining the performance of the instrument; these generally report poorer outcome than that described in the validation studies, but they suffer from small sample sizes and selective study populations. Furthermore, Risk Matrix 2000 has not been validated in a Scottish setting.

According to the validation studies carried out in England and Wales, the accuracy of Risk Matrix is in the 'moderate' range, similar to that reported for other, similar types of risk assessment instrument used with sex offenders. However, because of variations in the base rate of reconviction in different jurisdictions, more information than just accuracy data is needed to determine whether findings from one setting can be generalised to another. In particular, measures such as Likelihood Ratios (which are an assessment of the likelihood that a recidivist will be placed in a particular risk category compared with the likelihood that a non-recidivist will be placed in that same category) allow for risk categories to be compared across populations, regardless of base rates of reconviction. This type of consideration is particularly pertinent for present purposes, as it is relevant to the issue of whether the findings of Risk Matrix 2000 evaluations in England can be readily applied in Scotland.

Aims of the study

The study described in this report examines the reliability, validity and interpretation of findings when Risk Matrix 2000 is used in a large Scottish sample. More specifically, it is intended to:

- determine the association between Risk Matrix risk levels and reconviction rates for sex offenders in a Scottish setting;
- establish whether the properties of Risk Matrix 2000, when applied to a Scottish sex offender population, are similar to its properties as described in the England and Wales validation studies reported in Thornton et al (2003).

To achieve these goals requires:

- an assessment of how well Risk Matrix ranks offenders in terms of their levels of risk;
- establishing the probability of reconviction associated with each Risk Matrix category;
- describing the properties of the scale in a manner which can be compared between populations independent of the base rate of reconviction.

Taken together, these factors address the overall objective of the study, which is to establish the extent to which, and indeed whether, Risk Matrix 2000 can contribute to the systematic risk assessment of sex offenders in Scotland, and thereby assist in their management.

Study population

The study cohort is comprised of all sex offenders released from Scottish prisons between 1996 and 2001, amounting to 1029 individuals. Using records obtained from the Scottish Prison Service and the Scottish and English Criminal Records Offices, Risk Matrix ratings and criminal conviction follow-up data were obtained for 771 individuals (75%) in respect of Risk Matrix Sex (RMS), and for 974 individuals (95%) in respect of Risk Matrix Violence (RMV); absence of information from the missing cases is not thought to have biased the findings reported here. Average length of follow-up was approximately 8.5 years. There was a minimum five year follow-up for all offenders.

Reliability

Although all of the data was collected by a single researcher, 40 cases were scored independently by a second rater. For both RMS and RMV there was complete agreement in risk categories in 36 of 40 cases (90%). Kappa was 0.84 for RMS and 0.85 for RMV, indicating a high degree of inter-rater reliability.

Risk Categories

Offenders were distributed across the four risk categories as follows:

Risk	Risk Matrix	Sex	Risk Matrix	Violence
category				
	n	%	n	%
Low	279	36.2	390	40.0
Medium	312	40.5	322	33.1
High	117	15.2	176	18.1
Very High	63	8.2	86	8.8
Total	771	100	974	100

Compared with the England and Wales 1979 validation study, the Scottish RMS sample contained a higher proportion of men in the Low risk category, while the England and Wales sample had proportionally more offenders in the High and Very High risk groups.

For RMV, the distribution of offenders between categories was similar in the two cohorts.

Reconviction rates

<u>Risk Matrix Sex</u>

Of the 771 offenders in the RMS sample, 116 (15.0%) were reconvicted of a sexual offence at *any* time following their release from prison, while 83 (10.8%) were reconvicted of a sexual crime within 5 years of their prison release. This compares with a 19.6% five year sexual reconviction rate for the 1979 England and Wales cohort.

The five year reconviction rate for each RMS category is shown in the table below. There is a significant increase in reconviction rates from Low to Medium to High categories, with no overlap in confidence intervals in terms of both the proportions of men reconvicted and the higher odds of reconviction. The difference between the High and Very High groups, although in this same direction, is not statistically significant because of the relatively small number of offenders in the latter category. Survival analyses showed that the distinction between risk groups was maintained throughout the entire period of follow-up, again with the exception of a clear difference between High and Very High risk groups. Odds Ratios show the increase in the odds of reconviction for each ascending risk category.

RMS category	% (n)	95% CI	Od	ds Ratio	95% CI
Low	2.9 (8)	1.2 – 5.6			
Medium	9.9 (31)	6.9 - 13.8	Medium v Low	3.7**	1.7 - 8.2
High	21.4 (25)	14.3 - 29.9	High v Medium	2.5*	1.4 - 4.4
Very High	30.2 (19)	19.2 - 43.0	Very High v High	1.6	0.8 - 3.2
Total	10.8 (83)	8.7 - 13.2			
** p = .001 * p < .01	I	I	ll .		

Differences between risk groups were apparent by one year. Although the actual numbers reconvicted were low, a significantly higher proportion of men in the Very High risk group had been reconvicted of a sexual offence within a year of prison release compared with those rated as High risk, and similarly, significantly more men in the High risk group had been reconvicted of a sexual offence within this time compared with men in the Medium risk group. These differences remained significant at two years.

accuracy (RMS)

In terms of predictive accuracy, the AUC was 0.73 (95% CI 0.68 to 0.78), well within the moderate range typically described for risk assessment instruments of this type. This compared with an AUC of 0.75 in the England and Wales 1979 sample.

seriousness of reconvictions (RMS)

Although the likelihood of reconviction varied between the risk categories, the seriousness of reoffence did not, basing this judgement on sentences received. Sentencing information was available for 103 of the 116 sexual reconvictions that took place over the entire follow-up period – differences in sentence severity did not differ significantly between the four risk groups, but when the Low and Medium groups are collapsed into a single category and the High and Very High groups into another, the lower risk category is found to have received a significantly higher proportion of more severe sentences.

<u>Risk Matrix Violence</u>

At five years follow-up 120 of the 974 offenders (12.3%) in the RMV sample had recidivated with a non-sexual violent offence, while 176 (18.1%) were reconvicted for a non-sexual violent crime during the entire follow-up period. There are no reports of five year violent reconviction rates for RMV in the literature with which to compare.

The five year reconviction rate for each RMV risk category is shown in the table below. There is a significant increase in reconviction rates between Low, Medium and High risk categories, and only a small overlap in the confidence intervals between the High and Very High groups; there is no overlap in confidence intervals in respect of the higher odds of reconviction for ascending risk categories. Survival analyses showed that the distinction between risk groups was maintained throughout the entire follow-up period.

RMV category	% (n)	95%CI	Od	ds Ratio	95% CI
Low	3.1 (12)	1.6 - 5.3			
Medium	10.2 (33)	7.2 – 14.1	Medium v Low	3.6***	1.8 – 7.1
High	23.9 (42)	17.8 - 30.9	High v Medium	2.7***	1.7 – 4.5
Very High	38.4 (33)	28.3 - 49.5	Very High v High	2.0*	1.1 – 3.5
Total	12.3 (120)	10.3 - 14.6			
*** p < .0001 * p = .01			I		

As with RMS, differences in reconviction rates between risk categories were apparent from year one, with significant differences emerging between High and Medium risk groups by this time, and which were maintained at two years follow-up.

accuracy (RMV)

Regarding predictive accuracy, the AUC was 0.76 (95% CI 0.71 to 0.80). This compared with an AUC of 0.78 for the 1980 England and Wales 10 year follow-up, and an AUC of 0.80 for the 1979 England and Wales 19 year follow-up (although independent calculation suggests that the AUC in the latter study was in fact 0.76).

seriousness of reconvictions (RMV)

Disposals were available for 162 of the 176 non-sexual violent reconvictions that took place during the follow-up period. Just 15 (9.2%) resulted in prison sentences of a year or more, suggesting that most of these offences were not of a serious nature. There were five life sentences, 4 of which were received by men in the Medium risk Group and one by a Low risk offender.

Comparison with the 1979 England and Wales cohort

In spite of a significant difference in the five year base rate of reconvictions between the 1996-2001 Scottish and the 1979 England and Wales cohorts, reconviction rates for individual RMS categories were consistent between the two groups, with the exception of a lower sexual recidivism rate found in the Scottish Very High risk category. This difference is likely to have been a function of the lower base rate of reconviction in the Scottish cohort. Likewise, two year reconviction rates for individual RMV categories were similar between the Scottish and a 1990s England and Wales cohort, with the exception of a much higher rate of reconviction in the Scottish High Risk category (although in this case the difference may be genuine).

In respect of RMS, the Likelihood Ratios (LR) for each category was also in the same range between the cohorts, with the exception of the High risk group (and nearly in the RMS Medium risk one); in the case of RMV, there was a difference between medium risk categories when the Scottish sample was compared with a 10 year England and Wales follow-up from 1980, and high risk categories when compared with the two year 1990s follow-up. These results suggest that it is in this middle area of Medium and High risk offenders that Risk Matrix may be less stable. Overall, however, the instrument appeared to perform similarly across the two settings.

The Odds Ratios between adjacent risk categories in respect of reconviction were broadly similar in the two cohorts. The exception was in the High versus Medium RMV Scotland-1980 England and Wales comparison, which may be the result of the RMV medium group varying between the groups as shown by the different Likelihood Ratios.

Conclusion

The aim of this study was to determine how well Risk Matrix performs this task in Scotland. In brief, it found that Risk Matrix 2000 is indeed valid for use in Scotland. It was effective in classifying sex offenders in Scotland in terms of their risk of recidivism for both sexual and non-sexual violent offending. Risk categories were distinct from each other (although the boundary between High and Very High risk individuals was less clear because of the relatively low numbers of offenders in the latter group), and the four risk categories successfully ranked offenders according to their recidivism risk. The predictive accuracy of the two primary scales, Risk Matrix Sex and Risk Matrix Violence, was in the moderate range, with AUCs in the mid-seventies, similar to that reported for other, more complicated risk assessment instruments of a similar type.

Risk Matrix is probably best viewed as a screening tool, identifying individuals who require further assessment because of their increased risk of reconviction. Other approaches will then be necessary to determine *current*, as opposed to *long term* risk, as well as the potential consequences of a reoffence – these include structured dynamic risk assessments, guided clinical judgment, and psychometrics, amongst others. This overall process will in turn help advise strategies for managing individual offenders, whether for sentencing (including considerations for Orders of Lifelong Restriction), release from custody, or for community management by way of protocols developed through multi-agency public protection arrangements (MAPPA). Risk Matrix 2000, therefore, should be seen as the first step in an assessment process, not a substitute for the assessment process itself; to be effective, it must been seen as part of a wider package.

Interpretation of Risk Matrix outcomes

Because of the large and comprehensive nature of the study population, which encompasses a high proportion of all sex offenders released from Scottish prisons between 1996 and 2001, and because of the discriminative capacity of the scale as demonstrated in this report, the findings reported here can be used to interpret the meaning of Risk Matrix assessments in Scotland when used with released prisoners, and by extension with sex offenders in Scotland generally, in the following manner:

Regarding numbers of offenders per risk category:

- for RMS, about three quarters of offenders would be expected to score as Low or Medium risk, about 15% as High risk, and less than 10% as Very High risk;
- for RMV, about three quarters of offenders would again be expected to score as Low or Medium risk, from 15-20% as High risk, and again less than 10% as Very High risk.

In terms of *reconviction risk*, reasonable approximations of <u>five year</u> reconviction rates are:

RMS		
Low	less than 5 %	(1 in 20)
Medium	10%	(1 in 10)
High	20 - 25%	(1 in 4 to 1 in 5)
Very High	33%	(1 in 3)

- The odds of a Medium risk offender recidivating are about 4 times that of a Low risk offender;
- The odds of a High risk offender recidivating are about 2.5 times that of a Medium risk offender;
- The odds of a Very High risk offender recidivating are about 1.5 times that of a High Risk offender.

RMV		
Low	less than 5 %	(1 in 20)
Medium	10%	(1 in 10)
High	25%	(1 in 4)
Very High	40%	(2 in 5)

- The odds of a Medium risk offender recidivating are about 3.5 times that of a Low risk offender;
- The odds of a High risk offender recidivating are about 3 times that of a Medium risk offender;
- The odds of a Very High risk offender recidivating are about twice that of a High Risk offender.

In respect of the general *specificity and sensitivity* of the scale:

- for RMS, an offender who recidivates is over three times as likely to be rated as Very High risk compared with an offender who does not, and over two times as likely to be rated as High risk;
- for RMS, an offender who does *not* recidivate is over four times as likely to be rated as Low risk compared with an offender who does.
- for RMV, an offender who recidivates is over four times as likely to be rated as Very High risk compared with an offender who does not, and over two times as likely to be rated as High risk;
- for RMV, an offender who does *not* recidivate is about four and a half times as likely to be rated as Low risk compared with an offender who does.

Recommendations

1. Although Risk Matrix is a reasonable straightforward instrument, training in its use is essential if it is to be scored accurately. There should be a

requirement that those carrying out Risk Matrix assessments receive appropriate training.

- 2. A means of quality assuring Risk Matrix scores is necessary and should be put in place if it is not already established.
- 3. Relevant information needed to score Risk Matrix should be routinely included in reports prepared by criminal justice social workers, and included in prison files.
- 4. The base rate of sexual and non-sexual violent reconvictions in sex offenders should be monitored in order to ensure that the reconviction approximations reported here remain valid.
- 5. Consideration should be given to continuing the follow-up of the data set used in this study to obtain 10 and 15 year reconviction rates for Risk Matrix categories.

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follow-up

INTRODUCTION

Background

Risk Matrix 2000 is a statistically derived risk assessment instrument for use with convicted male sex offenders. It provides an estimate of their long term likelihood of reconviction for a sexual or a non-sexual violent offence, assigning individuals to Low, Medium, High and Very High risk categories. It is a fundamental component of the systematic sex offender risk assessments carried out in England and Wales by the prison, probation and police services, and it forms the basis of initial management decisions within Multi-agency Public Protection Arrangement (MAPPA) protocols. Risk Matrix 2000 categories are also included on the Violent and Sex Offenders Register (ViSOR), a national police intelligence data base used by police forces throughout the UK, including Scotland, where it provides an easily assessable quantification of an offender's risk. Other agencies in Scotland have also recently begun to include Risk Matrix 2000 in their sex offender risk assessment protocols.

In spite of its widespread and officially sanctioned use in the United Kingdom, however, Risk Matrix 2000 has not been subject to any form of rigorous evaluation. The main validation study used to support it – a 19 year follow-up of 429 sex offenders released from prisons in England and Wales in 1979 – has not been subject to peer review, nor has its methodology or analysis been more than scantily described (Risk Matrix Scoring Guide (Thornton, unpublished), and Thornton et al (2003)). Furthermore, although the sample is said to be "nationally representative", it in fact includes only offenders who could be "successfully traced", with no information provided about either the numbers of or reasons for missing cases. While two other studies are also referred to in Thornton et al (2003), one involving 647 sex offenders released from prisons in England and Wales "in the early 1990s" and followed for two years, the other of 311 sex offenders released in 1980 and followed for four years, again little information is provided except for basic outcome and accuracy data.

Risk Matrix 2000 has not been validated in a Scottish setting. Indeed, apart from the three studies referred to above, there are only a small number of other evaluations reported in the literature, all of which have significant limitations. They also generally report poorer outcomes than those described in Thornton et al (2003):

Craig et al (2007) carried out a study of 85 sex offenders referred to an English forensic psychiatry service between 1992 and 1995 and followed-up for between two and ten years. Although they found a high level of predictive accuracy in respect of non-sexual violent reconvictions (AUCs¹ of 0.86 and 0.87), outcome in respect of sexual reconviction was much less impressive (AUCs of between 0.59 and 0.68, compared with 0.75 to 0.85 reported by Thornton et al (2003)). However, the number of subjects in this study are so low that one must be extremely cautious in interpreting or accepting its findings, with the confidence intervals around them (which are not reported) likely to be excessively wide. Indeed, although they report results for a 10 year follow-up, just four offenders appear to have been followed for that long.

¹ See page 5 for the meaning of AUC.

In addition, no data is provided regarding numbers of offenders or outcome in respect of the different risk categories.

Craissati and Beech (2004), in the only other published English study, evaluated Risk Matrix 2000 in 310 sex offenders managed by the probation service and resident in two London boroughs, followed-up for an average of four years (although only 235 could be rated). Just nine individuals were reconvicted for sexual offences and four for non-sexual violent offences, making any attempt to assess predictive accuracy impossible. Risk Matrix categories, however, were associated with 'any failure' of community supervision (AUC = 0.70), and with what is referred to as 'sexually risky behaviour' (AUC = 0.65), although the reliability of these soft measures and their relationship to the reconviction outcome for which Risk Matrix is designed is unclear.

Knight and Thornton (2007) evaluated Risk Matrix 2000, as well as a number of other risk assessment instruments, in a sample of 566 sex offenders who had either been assessed or treated at the Massachusetts Treatment Center, a facility for the detention of men defined as "sexually dangerous". Follow-up was reported for three, ten and fifteen years. The ability of Risk Matrix 2000 to predict recidivism was limited (AUCs for sexual reconviction were between 0.63 and 0.67, and for non-sexual violent reconviction they were no better than chance, in the 0.50s). This data, however, was based on referrals made to the Treatment Center between 1959 and 1984, and the extent to which the study population resembles modern sex offenders is unclear. In addition, the nature of the sample is such that most of those in it will have fallen at the high end of the risk spectrum, which means that the evaluation may relate more to being able to distinguish between high risk sex offenders rather than to the more heterogeneous group of sex offenders that is typically encountered in practice.

An unpublished Canadian study (Kingston et al) followed-up 280 convicted child molesters for an average of 11.2 years. Although moderate predictive accuracy was reported (the AUC for sexual reconviction was 0.65 and for non-sexual violent reconviction 0.71), 54% of the sample were incest offenders, limiting the extent to which its findings can be generalised. More importantly, however, because of limitations in the information available to the researchers, one of the seven variables that contribute to the scoring of Risk Matrix (convictions for non-contact sex offences) was not used in the determination of Risk Matrix categories, which though discounted by the authors will have meant that the Risk Matrix scores are likely to be inaccurate.

Based on the above, it is clear that the empirical foundation for Risk Matrix 2000 is thin. In addition to a paucity of studies, the Risk Matrix evidence base suffers from small sample sizes, selective study populations, and a lack of published data of the type that would allow for independent review. From a Scottish perspective, it remains to be demonstrated that Risk Matrix functions as expected in this setting.

Risk Matrix 2000

Risk Matrix 2000 is for use with males aged 18 and over who have been convicted of, or cautioned for, at least one sexual offence committed after the age of 16. It is composed of two main scales: Risk Matrix Sex (RMS), designed to predict sexual reconvictions, and Risk Matrix Violence (RMV), used in the prediction of convictions for non-sexual violence. A third scale, Risk Matrix C, combines the RMS and RMV scales to provide a prediction for sexual *or* non-sexual violence reconviction.

Risk Matrix Sex is composed of seven variables that relate to an offender's history. The determination of RMS categories is a two step procedure:

Step One combines information regarding:

- age
- previous sex offence sentencing occasions
- previous sentencing occasions for all criminal offences

to reach a preliminary risk rating;

Step Two modifies the Step One preliminary rating depending on the presence of four 'aggravating factors':

- any male victim ever
- any stranger victim ever
- any non-contact sex offence ever
- whether or not the offender has ever lived in a cohabiting relationship for more than two years (referred to both as 'never married' and 'single')

Risk Matrix Violence is composed of just three variables, which are combined in a single step:

- age
- previous non-sexual violence offence sentencing occasions
- any convictions for burglary

The variables referred to above are defined in the Risk Matrix Scoring Guide (Thornton, unpublished).

Both RMS and RMV are divided into four risk categories. The Scoring Guide describes these as "ordinal groupings along the risk continuum with the higher numbered categories representing relatively higher levels of risk", but which for "heuristic purposes" are labelled as Low, Medium, High and Very High risk.

Based on the 1979 England and Wales prison cohort referred to above (Thornton et al, 2003), the Scoring Manual provides the following estimation of recidivism per risk level:

RMS risk category	5 year	10 year	15 year
	%	%	%
Low	3	6	7
Medium	13	16	19
High	26	31	36
Very High	50	55	59

RMV	5 year	10 year	15 year
risk category			
	%	%	%
Low	4	5	5
Medium	12	14	19
High	27	34	39
Very High	47	57	59

No confidence intervals are given, and it is not possible to determine from this data the extent to which the individual risk categories are distinct from each other, and if so by what margin.

Because of variations in the base rate of reconviction in different settings, without further analysis it is not possible to generalise from this data to other jurisdictions, or to compare studies. This is recognised in the Scoring Guide, which notes that the recidivism rates it describes, "reflect the jurisdiction, the era in which these offenders were at risk, and the duration of the follow-up", adding that, "Varying any of these parameters would likely lead to different reconviction rates". However, even given different base rates, it is still possible to determine an instrument's discriminative properties, independent of the offender group on which it is tested, for example by examining more closely the relative differences between categories and the degree of precision within them (Mossman, 2006). This is discussed in more detail below.

The evaluation of risk assessment instruments

Research evaluations have repeatedly demonstrated that statistically derived (i.e., actuarial) assessment measures outperform both clinical judgement and structured risk assessment in determining the longer term likelihood of recidivism when considering populations of offenders (Grove & Meehl, 1996; Monahan, 1996; Grove et al, 2000; Doren, 2002; Hanson & Morton-Bourgon, 2007). In addition to Risk Matrix, there are a number of other measures of this type that have been applied to sexual offending, the best know of which are Static 99, the Sex Offender Risk Appraisal Guide (SORAG), the Minnesota Sex Offender Screening Tool – Revised (MnSOST-R), and the Rapid Risk Assessment for Sex Offense Recidivism (RRASOR).

The accuracy of these instruments is typically assessed using Receiver Operating Characteristic (ROC) statistics (Mossman, 1994). This is to avoid the potential for illusionary accuracy when the base rates of a targeted outcome are low. For example, if the base rate of recidivism in a sample of offenders is 10%, then simply by saying that no offenders will recidivate will result in correct predictions 90% of the time, impressive accuracy but useless in practice. By taking into account correct predictions of both recidivism and non-recidivism, ROC analyses deal with this problem.

An ROC graph plots the true positive rate for a test or instrument (that is, it's sensitivity, or for present purposes its success in detecting recidivists) against its false positive rate (1 minus its specificity, or its mistaken identification of individuals as recidivists when they are not). The resulting Area Under the Curve (AUC) of this graph provides a measure of accuracy that is independent of the base rate of the targeted outcome in the sample, in our case reconviction rate. An AUC of 0.5 amounts to chance accuracy (i.e., the test has no predictive value), AUCs of less than 0.5 are indicative of worse than chance performance, while an AUC of 1 represents perfect prediction. AUCs in the range of 0.60 to 0.80 are considered to represent 'moderate' predictive accuracy. The risk assessment instruments referred to above are typically found to fall within this 0.60 to 0.80 range (Barbaree et al, 2001; Hanson & Morton-Bourgon, 2007; Langton et al, 2007).

As Mossman (2006) demonstrates well, however, AUCs, although good at describing the accuracy of an assessment tool in a particular population and its ability to rank subjects in it according to their relative risk of recidivism, do not provide sufficient information to determine whether or not an instrument functions in a similar manner in different populations. Nor does a finding that an instrument is accurate in one population mean that translations can be made regarding reconviction rates for specific risk categories to other populations – for example, because Very High risk individuals recidivate at a rate of 60% in one population does not mean they will do so at a similar rate in another. This is because differing base rates of recidivism between populations (which are influenced by the nature of the offenders in the population as well as by external factors such as detection rates and prosecution policies) make judgements about the stability of an instrument's performance between populations difficult.

Mossman (2006) argues that in addition to accuracy rates, it is important to look at other measures indicative of a scale's performance in order to be able to interpret its outcome meaningfully. In particular, he recommends the use of Likelihood Ratios, which are a measure of the likelihood that a recidivist will be placed in a particular risk category compared with the likelihood that a non-recidivist will be placed in that same category². Thus, one would expect the Likelihood Ratio for individual risk categories to be similar across populations, regardless of base rates of reconviction, if the assessment instrument is functioning in a similar way between them. In other words, a consideration of Likelihood Ratios allows for a determination of whether or not risk categories are stable across populations. These considerations are particularly

² The Likelihood Ratio as applied in the current study is equal to the number of recidivists in a risk category as a proportion of total recidivists in the population, divided by the number of non-recidivists in that risk category as a proportion of the total number of non-recidivists in the population.

pertinent for present purposes, as they are relevant to the issue of whether the findings of Risk Matrix 2000 evaluations in England can be readily applied in Scotland.

Aims of the study

The study described in this report sets out to examine the reliability, validity and interpretation of findings when Risk Matrix 2000 is used in a large Scottish sample. More specifically, it is intended to:

- determine the association between Risk Matrix risk levels and reconviction rates for sex offenders in a Scottish setting;
- establish whether the properties of Risk Matrix 2000, when applied to a Scottish sex offender population, are similar to its properties as described in the England and Wales validation studies reported in Thornton et al (2003).

To achieve these goals requires:

- an assessment of how well Risk Matrix ranks offenders in terms of their levels of risk;
- establishing the probability of reconviction associated with each Risk Matrix category;
- describing the properties of the scale in a manner which can be compared between populations independent of the base rate of reconviction.

Taken together, these factors address the overall objective of the study, which is to establish the extent to which, and indeed whether, Risk Matrix 2000 can contribute to the systematic risk assessment of sex offenders in Scotland, and thereby assist in their management.

METHOD

Identification of offenders

From its database, the Scottish Prison Service (SPS) identified 1223 offenders released from Scottish prisons between 1996 and 2001 who had either been convicted of a sex offence, or whose index offences were considered to have a clear sexual motivation to them. An end-date of 2001 for prison release was chosen to allow sufficient time for there to be a minimum follow-up of five years for every offender. Because the computerised database used by the SPS commenced in 1996, it was not possible to systematically identify sex offenders released before that year.

Of the 1223 prisoners, 194 were removed from the sample for the following reasons:

- no evidence of sexual offending was found in 158 men when their records were examined
- neither prison nor criminal records could be located for 18 men
- the sexual offences of 9 individuals were committed when they were under the age of 16 (Risk Matrix applies only to men with sex offence convictions from 16 years of age or older)
- 5 had been released from prison outside the 1996-2001 study period
- 4 were known to have died within the minimum five year follow-up period

This left 1029 men in the study population, which we believe represents the entire cohort of sex offenders released from Scottish prisons between 1996 and 2001.

The number of sex offenders released from prison each year is shown in Table 1. It can be seen that many fewer offenders were released in 2001 compared with the preceding years. We are unable to determine whether this is an anomaly or whether it reflects an error in case identification by the SPS.

Table 1: Number of sex offenders released per year between 1996 and 2001 (where an offender reoffended and was released twice during this period, only the first prison release is counted).

Year	Number	%
1996	157	15.3
1997	209	20.3
1998	220	21.4
1999	197	19.1
2000	191	18.6
2001	55	5.3
Total	1029	100

Ethnicity could not be determined in 202 cases (19.6%), although we believe that most of these 202 men were white Scottish. In the 827 cases for whom ethnicity was recorded, 820 (99%) were Caucasian, of whom 95% were born in Scotland.

Power calculation

Assuming recidivism rates and a distribution of offenders across risk categories similar to those described in the 1979 England and Wales validation study (Thornton et al, 2003), it was calculated that a sample size of 1000 would be needed to achieve confidence intervals under \pm 10% in respect of reconviction rates, and \pm 3.5-5% in respect of estimates of sensitivity and specificity; a sample size of 500 would expand the confidence interval around the smallest category, Very High risk, to \pm 15% (the others would be \pm 6-8%), and confidence intervals for sensitivity and specificity to \pm 5-8%. A sample size of 500 offenders was therefore considered to be the *minimum* required to ensure reasonably narrow confidence intervals.

The original aim of the study was to evaluate the accuracy of Risk Matrix 2000 over follow-up periods of both five and ten years. It can be seen from Table 1 above, however, that ten year follow-up is possible for many fewer than the required 500 offenders, making the intended ten year evaluation non-viable. Instead, only a five year follow-up period is examined in detail, although one and two year follow-up periods are also described, and follow-up longer than five years is taken into account using survival analysis techniques.

Data collection

Data with which to calculate Risk Matrix scores was obtained by a single research worker from prison records provided by the SPS. Where insufficient information was available from the files attempts were made to obtain further data from Criminal Justice Social Work departments, although in the event the amount of material collected from this source was limited.

Criminal records were obtained from the Scottish and English Criminal Records Offices. This was used both to determine reconvictions, and as a check on information regarding offending history contained in the prison records. In cases where there was disagreement between the two sources the Criminal Record was preferred.

Missing information and final sample size

Risk Matrix Sex (RMS)

Of the 1029 offenders in the study population, RMS risk categories were calculated for 803 men (78%). It was not possible to do so for the remaining 226 individuals because of missing information relating to one or more variables as follows (see page 3 for a list of the relevant variables):

- lack of basic Step 1 information: 23
- lack of sufficient Step 2 information: 203

In terms of missing information needed to complete Step 2, in 183 cases (90%) no Step 2 data at all was available, and in 15 (7%) just one of the four variables could be ascertained. Whether or not the offender met the criteria for 'Single', the only non-criminal variable, was missing in 201 of the 203 cases. Although there were an additional six cases in which Step 2 information was missing, five of these men already scored as Very High risk on Step 1 which meant that the absence of Step 2 information had no effect on risk category, and one scored as High risk on Step 1 but had two known aggravating factors, making the two that were unknown redundant.

Follow-up reconviction data was available for 771 of the offenders for whom Risk Matrix Sex categories could be calculated (96% of those with RMS scores and 75% of the study population).

Arrival at the final sample size for Risk Matrix Sex is illustrated in Figure 1.



Figure 1: The **Risk Matrix Sex** study population.

In order to examine whether offenders included in the study differed significantly from those for whom either RMS could not be calculated or for whom reconviction follow-up data was not available, Step One scores for the 771 offenders in the study population were compared with Step One scores in the 235 men for whom this information was available (that is, 91% of the 258 sex offenders for whom missing information meant that they could not be included in the RMS study population). The results are shown in Table 2 – no cases score as Very High risk in the 'missing' group because a Very High risk rating at Step 1 automatically results in a full RMS rating of Very High risk. Excluding the Very High risk Step One cases, the two groups were

found to differ, with more cases in the 'missing' group rated as Medium and less as Low on Step 1 (*chi square* = 5.95, df=2, p=0.05).

Table 2: Comparison of **Step One** categories between the 771 offenders in the study population and the 235 offenders for whom full **RMS** information was not available (missing cases). See text for discussion of differences between the two groups.

Step One Category	Study Population		Missing Cases	
	n	%	n	%
Low	300	39	74	32
Medium	350	45	129	55
High	106	14	32	14
Very High	15	2	-	-
Total	771	100	235	100

Based on the figures in Table 2, it may be that offenders for whom data was not available were of slightly higher risk than the sample population. However, the men in the study group had been sentenced to longer periods of imprisonment for the offences preceding their release: 612 (79.5%) served sentences of one year or more compared with 143 of the 249 (57.4%) missing cases for whom sentence length was known (chi square = 46.52, df = 1, p < .0001), suggesting that the index offences of many of those in the 'missing' group were less serious than they were for the study population.

The ages of the two groups did not differ significantly, with a mean of 41.7 (sd 13.8) in the study population and a mean of 40.0 (sd 15.5) in the 'missing' cases.

As described in the Results section of this report, reconviction rates did not differ significantly between the study population and the 'missing' cases.

Risk Matrix Violence (RMV)

Of the 1029 offenders in the study population, an RMV risk category was calculated for 1004 men (98%) – because RMV is comprised of just three variables (see page 3), less information is required for it than for RMS, and hence there are many fewer missing cases than there were with RMS. A risk category could not be determined for the remaining 25 individuals because of missing information regarding their criminal histories.

Follow-up reconviction data was available for 974 of the offenders for whom Risk Matrix Violence categories could be calculated (97% of those with RMV scores and 95% of the study population).

Arrival at the final sample size for Risk Matrix Violence is illustrated in Figure 2.

Figure 2: The Risk Matrix Violence study population.



Because of the small number of missing RMV cases, no further analyses were undertaken comparing the RMV study population with the RMV missing cases.

<u>Reliability</u>

All of the data was collected by a single researcher. Forty cases were scored independently by a second rater (DG). For RMS, there was complete agreement in risk categories in 36 of 40 cases (90%), and similarly, there was full agreement in 36 of the 40 cases for RMV. Kappa for RMS was 0.84, and for RMV 0.85, indicating a high degree of inter-rater reliability.

RESULTS

Analysis of reconviction rates was approached in two ways: first, looking at reconviction up to 5 years after release, and second, using techniques from survival analysis to describe time to reconviction taking into account variations in follow-up time. As referred to in the Methods section above, there was an insufficient number of offenders in the sample to allow for a meaningful ten year follow-up.

The time at risk of reconviction has been calculated as the time between release from prison and the date of a first reconviction for a sexual (or violent) offence, or the time between the prison release date and 30 June 2007 if no reconvictions are recorded. As referred to in the Methods section, four men died after release from prison (two within a few days of release and two within about 3 years of release), and they have not been included in the analysis.

The findings are complicated by the fact that an offender reconvicted for a general or a violent offence and sentenced to prison is not at risk of committing a further sexual offence during this period of imprisonment (or similarly, if reconvicted and sentenced for a sexual offence, he is not at risk of committing a further violent offence), and this 'not-at-risk' period should be taken into account. In the 771 men included in the **RMS** analysis:

- 69 received prison sentences of less than 12 months for a non-sexual offence
- 13 received prison sentences of between 12 and 36 months for a non-sexual offence
- 9 received prison sentences of over 36 months for a non-sexual offence

In the 974 men included in the RMV analysis:

- 65 received prison sentences of less than 12 months for a non-violent offence
- 29 received prison sentences of between 12 and 36 months for a non-violent offence
- 17 received prison sentences of over 36 months for a non-violent offence

To take account of this information requires reliable data on the lengths of imprisonment actually served by the reoffenders rather than the sentences imposed, but this data was not available to us. However, while this issue needs to be borne in mind when interpreting the findings reported below, the impact is unlikely to be large, as in the case of RMS only 22 men (3%) received prison sentences of over a year, and just 46 men (5%) did so in the case of RMV. It should also be noted that virtually all of the risk assessment studies in the literature suffer from this same limitation, including the 1979 England and Wales study on which Risk Matrix 2000 is based.

Distribution of RMS and RMV categories

Table 3 shows the distribution of RMS categories across the cohort, comparing it with the 1979 cohort of sex offenders released from prison in England and Wales used in the Risk Matrix validation study (Thornton et al, 2003). It can be seen that the

Scottish sample contains a higher proportion of men in the Low risk category, while the England and Wales sample has proportionally more offenders in the High and Very High risk groups.

in the 1979 Englar	nd and Wa	les cohor	t. The differ	ence be	etween the two groups	is is
significant (chi squ	uare = 52.	7, $df = 3$,	p < 0.001).			
I	1006	2001	Scotland		1070 England and	Walas

Table 3: Distribution of **RMS** risk categories in the 1996-2001 Scotland sample and

	1990 = 2001 Scotland			1979 Eligialiu aliu	vv ales
Risk				-	
category	n	%	95% CI	n	%
Low	279	36.2	32.8 - 39.7	87	20.3
Medium	312	40.5	37.0 - 44.0	166	38.7
High	117	15.2	12.7 – 17.9	121	28.2
Very High	63	8.2	6.3 – 10.5	55	12.8
Total	771	100		429	100

Table 4 shows the distribution of RMV categories, again comparing them with the 1979 cohort of sex offenders released from prison in England and Wales. Unlike Risk Matrix Sex, the distribution of the population in terms of risk category is not significantly different.

Table 4: Distribution of **RMV** risk categories in the 1996-2001 Scotland sample and in the 1979 England and Wales cohort. The difference between the two groups is not significant (chi square = 6.48, df = 3, p = 0.09).

	1996 –	2001	Scotland	1979 England and	Wales
Risk				-	
category	n	%	95% CI	n	%
Low	390	40.0	37.0 - 43.2	151	35.7
Medium	322	33.1	30.1 - 36.1	130	30.7
High	176	18.1	15.7 - 20.6	96	22.7
Very High	86	8.8	7.1 – 10.8	46	10.9
Total	974	100		423	100

Reconviction rates

<u>Risk Matrix Sex</u>

The follow-up period for reconviction for sexual offences ranged from just over 5 to approximately 12 years, with a median follow-up time of 8.5 years. The quickest reconviction recorded was 9 days after prison release.

Of the 771 offenders in the RMS sample, 116 (15.0%) were reconvicted of a sexual offence at *any* time following their release from prison, while 83 (10.8%) were reconvicted of a sexual crime within 5 years of their prison release. This compares with a 19.6% five year sexual reconviction rate for the 1979 England and Wales cohort (Risk Matrix manual and D. Thornton personal communication), and a 27.7% reconviction rate over 19 years (Thornton et al, 2003).

Table 5 shows the five year reconviction rates for each of the RMS risk categories. It can be seen that there is a significant increase in reconviction rates from Low to Medium to High categories, with no overlap in the confidence intervals in terms of both the proportions of men reconvicted and the higher odds of reconviction. The difference between the High and Very High groups, although in this same direction, is not statistically significant because of the relatively small number of offenders in the latter category, which makes the estimate of differences more imprecise (i.e., the confidence interval is wider). The Odds Ratios show the increase in the odds of reconviction for each ascending risk category.

RMS					
category	% (n)	95% CI	Od	ds Ratio	95% CI
Low	2.9 (8)	1.2 - 5.6			
Medium	9.9 (31)	6.9 – 13.8	Medium v Low	3.7**	1.7 – 8.2
High	21.4 (25)	14.3 - 29.9	High v Medium	2.5*	1.4 - 4.4
Very High	30.2 (19)	19.2 - 43.0	Very High v High	1.6	0.8 - 3.2
Total	10.8 (83)	8.7 - 13.2			
** p = .001 * p < .01	I	I	II.		

Table 5: Five year sexual reconviction rates by RMS category, and Odds Ratios comparing reconvictions between adjacent categories.

Another way to consider this data is by determining the Likelihood Ratio (LR) for each of the risk categories. As described on page 5 above, the LR is the probability of an individual falling within the group if he is a recidivist, compared with the probability of him falling within it if he is not. It can be seen from Table 6, for example, that an offender who is reconvicted within five years is over three and a half times as likely to be rated as Very High risk compared with an offender who is not reconvicted; on the other hand, a recidivist offender is only a quarter as likely to be rated Low risk compared with a non-recidivist. The LRs provide further evidence for the distinctiveness of each risk category. Table 6: Likelihood Ratios in respect of an offender being reconvicted for a sexual offence within five years for each **RMS** category (confidence intervals calculated as described in Mossman, 2006).

RMS		
category	Likelihood Ratio	95% CI
Low	0.24	0.13 - 0.48
Medium	0.91	0.68 - 1.23
High	2.25	1.54 - 3.29
Very High	3.58	2.20 - 5.83

In spite of a significant difference in the five year base rate of reconvictions between the 1996-2001 Scottish and the 1979 England and Wales cohorts, the reconviction rates for the individual categories are consistent between the two groups, with the exception of the lower sexual recidivism rate found in the Very High risk category in the 1996-2001 Scotland cohort (30%), which falls outside the 95% confidence interval for the Very High risk group in the 1979 England and Wales validation study (Table 7).

Table 7: Comparison of sexual reconviction	rates per RMS risk category between the
1979 England and Wales and the 1996-2001	l Scotland cohorts, five year follow-up.

	1979	England	& Wales	1996-2001 Scotland
RMS category	number in group	% (n) reconvict.	95% CI	% (n) reconvict.
Low	87	3.4 (3)	0.7 – 9.8	2.9 (8)
Medium	166	13.3 (22)	8.5 – 19.4	9.9 (31)
High	121	25.6 (31)	18.1 – 34.4	21.4 (25)
V. High	55	50.9 (28)	37.1 - 64.7	30.2* (19)
Total	429	19.6 (84)	15.9 - 23.7	10.8 (83)

*outside 95% confidence interval

The Odds Ratios between adjacent risk categories for the 1996-2001 Scottish and 1979 England and Wales samples are broadly similar, with the Scottish Odds Ratios all within the 95% confidence intervals of the latter (Table 8). This is consistent with the instrument performing in a similar manner in Scotland irrespective of the difference in base rates of reconviction.

Table 8: Comparison of the Odds Ratios for sexual reconviction in adjacent **RMS** risk categories between the 1979 England and Wales and 1996-2001 Scotland cohorts, five year follow-up.

	1979	Eng. & Wales	1996-2001 Scotland
	Odds Ratio	95% CI	Odds Ratio
Medium v Low	4.3	1.2 - 14.7	3.7
High v Medium	2.3	1.2 - 4.1	2.5
V. High v High	2.8	1.4 - 5.5	1.6

The Likelihood Ratios (LR) for each category are compared between the England and Wales validation study and the 1996-2001 Scotland cohort (Table 9). It can be seen that the LRs for the Scottish offenders fall within the 95% confidence intervals for all categories with the exception of the High risk group, although the Medium risk group only just.

Table 9: Comparison of the Likelihood Ratios between the 1979 England and Wales and 1996-2001 Scotland cohorts for each RMS category, five year follow-up.

	1979	Eng & Wales	1996-2001 Scotland
RMS category	LR	95% CI	LR
Low	0.15	0.05 - 0.45	0.24
Medium	0.63	0.43 - 0.92	0.91
High	1.41	1.02 - 1.97	2.25*
Very High	4.26	2.66 - 6.83	3.58

*outside 95% confidence interval

In order to quantify the predictive accuracy of the scale, receiver operating characteristic (ROC) analysis was used (for a description of this, see page 5). The AUC for the 1996-2001 Scottish cohort is 0.73 (95% CI 0.68 to 0.78), which falls within a range typically described as "moderately accurate". The AUC for the 1979 England and Wales cohort was a not dissimilar 0.75. The curves from both studies are plotted in Figure 3, from which two observations can be made:

- the contours of the curves are similar, indicating that the tool is performing in a like manner in terms of the way in which the risk categories differ between themselves in the two populations;
- the 'operating points' (representing the cut-off points between risk categories) differ to some extent, suggesting that in Scotland Risk Matrix will produce a greater number of false positive predictions.

Figure 3: ROC curves based on **RMS** categories and 5 year conviction rates for sexual offences in the 1996-2001 Scotland and 1979 England and Wales cohorts.



As referred to above, in total 116 offenders (15.1%) were reconvicted of a sexual offence at some point following their release from prison. Using the variable lengths of follow-up available for the 771 offenders over the full period of follow-up, the proportion of men reconvicted for sexual offences in each RMS category is illustrated on a Kaplan-Meier plot in Figure 4. Log-rank tests showed a significant difference in the proportions reconvicted in all four RMS categories (chi square = 64.7, df = 3, p < .0001). When consecutive categories are compared, there is a statistically significant difference in reconviction rates for Low v Medium and Medium v High, but not for High v Very High:

	chi square	p
Low v Medium	12.0	0.0005
Medium v High	15.3	0.0001
High v Very High	0.6	0.43

Figure 4: Sexual reconvictions per RMS categories during the entire follow-up period available for each offender in the sample.



It can be seen from Figure 4 that the rate of reconviction varies between the risk groups from very early on. Although the actual numbers reconvicted are low, at one year, a significantly higher proportion of men in the Very High risk group were reconvicted of a sexual offence compared with those rated as High risk (chi square = 5.01, df = 1, p = .03; OR 3.2), and similarly, significantly more men in the High risk group were reconvicted of a sexual offence compared with the Medium risk group (chi square = 4.05, df = 1, p = .04; OR 3.2). The difference remained significant at two years for both Very High compared with High (chi square = 4.11, df = 1, p = .04; OR 2.5), and High compared with Medium risk groups (chi square = 5.26, df = 1, p = .02; OR 2.7). This is illustrated in Table 10.

Table 10: One and two year sexual reconviction rates by **RMS** category.

		one year reconviction	two year reconviction
RMS category	n	% (n)	% (n)
Low	279	0.4 (1)	1.4 (4)
Medium	312	2.2 (7)	4.5 (14)
High	117	6.8 (8)	11.1 (13)
Very High	63	19.0 (12)	23.8 (15)
Total	771	3.6 (28)	6.0 (46)

seriousness of reconvictions

Although the likelihood of reconviction varied between the risk categories, the seriousness of reoffence did not, at least if a judgement of this is based on the sentence received. Sentencing information was available for 103 of the 116 sexual reconvictions that took place over the entire follow-up period (Table 11). While differences in sentence severity did not differ significantly between the four risk groups, if the Low and Medium groups are collapsed into a single category and the High and Very High groups into another, the lower risk category is found to have received a higher proportion of more severe sentences compared with the higher risk one (chi square = 5.85, df = 1, p = .05). Furthermore, of four Life Sentences that were associated with reconvictions, three were received by offenders in the Medium risk group, while one went to a Very High risk offender.

Table 11: Comparison of reconviction sentence length between RMS risk categorie	S
(n = 103 sexual reconvictions for which sentences are known).	

	Non-custodial or prison < 1 year	Custodial 1 to 3 years	Custodial 3 years or more
RMS category	% (n)	% (n)	% (n)
Low	63.6 (7)	0	36.4 (4)
Medium	59.5 (22)	10.8 (4)	29.7 (11)
High	71.9 (23)	15.6 (5)	12.5 (4)
Very High	69.6 (16)	17.4 (4)	13.0 (3)
Total	66.0 (68)	12.6 (13)	21.4 (22)

missing reconviction data

As described in the Methods section above, 235 offenders were excluded from the RMS analysis because of missing data, although Step One RMS scores could be calculated for them. Reconviction data was available for 203 of these individuals. Over 5 years, 21 (10.3%) were reconvicted for a sexual offence, and 27 (13.3%) were reconvicted of a sexual offence over the entire follow-up period. This was not significantly different from the 10.8% five year and 15.0% total reconviction rate for the study cohort.

<u>Risk Matrix Violence</u>

The follow-up period for reconviction for violent offences ranged from just over 5 to 11.6 years, with a median follow-up time of 8.4 years. The most rapid reconviction was 18 days following release.

At five years follow-up 120 of the 974 offenders (12.3%) in the RMV sample had recidivated with a non-sexual violent offence; 176 (18.1%) were reconvicted for a non-sexual violent crime through the course of the whole follow-up period.

Table 12 shows the five year violent reconviction rates for each of the RMV categories. It can be seen that there is a significant increase in reconviction rates between Low, Medium and High risk categories, and only a small overlap in the confidence intervals between the High and Very High groups; there is no overlap in confidence intervals in respect of the higher odds of reconviction for ascending risk categories.

RMV category Low	% (n) 3.1 (12)	<u>95%CI</u> 1.6 – 5.3	Od	ds Ratio	95% CI
Medium	10.2 (33)	7.2 – 14.1	Medium v Low	3.6***	1.8 – 7.1
High	23.9 (42)	17.8 - 30.9	High v Medium	2.7***	1.7 – 4.5
Very High	38.4 (33)	28.3 - 49.5	Very High v High	2.0*	1.1 – 3.5
Total	12.3 (120)	10.3 - 14.6			
*** p < .0001 * p = .01	· · · · · ·				

Table 12: Five year violent reconviction rates by **RMV** category, and Odds Ratios comparing reconvictions between adjacent categories.

Likelihood Ratios in relation to an offender being reconvicted for a non-sexual violent offence within five years are shown in Table 13. The results are similar to those for RMS, and again are indicative of distinct risk categories.

Table 13: Likelihood Ratios in respect of an offender being reconvicted for a nonsexual violent offence within five years for each **RMV** category (confidence intervals calculated as described in Mossman, 2006).

RMV category	Likelihood Ratio	95% CI
Low	0.23	0.13 - 0.40
Medium	0.81	0.60 - 1.10
High	2.23	1.67 – 2.98
Very High	4.43	3.00 - 6.55

There are no reports of five year non-sexual violent reconviction rates for RMV in the literature. Thornton et al (2003) describe 10 year rates for a sample of sex offenders released from prisons in England and Wales in 1980 (as well as a 19 year follow-up of a 1979 cohort), which are compared with those for the Scottish 1996-2001 five year follow-up in Table 14. Thornton et al (2003) also report 2 year rates for a different sample of prisoners, in this case sex offenders released from English and Welsh prisons at unspecified dates in the 1990s (Table 15). Although the different follow-up periods makes comparison problematic, it is of interest that the Scottish cohort appears to recidivate at a lower rate over ten years, but at a higher rate over two. It is also of interest, however, that in both comparisons it is only the High risk group where the differences are statistically significant.

Table 14: Comparison of non-sexual violence reconviction rates per RMV risk
category between the 1996-2001 Scotland (5 year follow-up) and the 1980 England
and Wales cohort (10 year follow-up).

	1980	England	& Wales	Scotland
RMV category	number in group	% (n) reconvict.	95% CI	% (n) reconvict.
Low	62	4.8 (3)	1.0 - 13.5	3.1 (12)
Medium	149	6.7 (8)	3.0 - 12.8	10.2 (33)
High	104	33.7 (35)	24.7 - 43.6	23.9* (42)
V. High	26	50.0 (13)	29.9 - 70.1	38.4 (33)
Total	311	19.0 (59)	14.8 - 23.8	12.3 (120)

*outside 95% confidence interval

Table 15: Comparison of two year non-sexual violence reconviction rates per **RMV** risk category between the 1996-2001 Scotland and a 1990s England and Wales cohort.

	1990s	England	& Wales	Scotland
RMV category	number in group	% (n) reconvict.	95% CI	% (n) reconvict.
Low	297	0	0-1.2	1.0 (4)
Medium	218	2.8 (6)	1.0 - 5.9	4.6 (15)
High	100	3.0 (3)	0.6 - 8.5	14.8* (26)
V. High	32	18.8 (6)	7.2 - 36.4	23.3 (20)
Total	647	2.3 (15)	1.3 – 3.8	6.7 (65)

*outside 95% confidence interval

The small number of reoffenders at two years, with the associated wide confidence intervals limits the meaning of any direct comparison between the 1996-2001 Scottish cohort and the 1990s England and Wales sample. Comparisons were therefore made between with the 1980 England and Wales ten year follow-up, although caution is needed given the varying follow-up periods. It can be seen from Table 16 that the Odds Ratios between High and Medium risk categories differed between the cohorts, suggesting that the instrument may have performed differently in the way it assigned individuals to at least one of these groups in the two cohorts (Table 16).

Table 16: Comparison of the Odds Ratios for non-sexual violence reconviction in adjacent **RMV** risk categories between the 1980 England & Wales cohorts and 1996-2001 Scotland.

	1980 Eng 10 year	& Wales follow-up	1996-2001 Scotland
	Odds Ratio	95% CI	Odds Ratio
Medium v Low	1.4	0.4 - 5.5	3.6
High v Medium	7.0	3.1 – 16.1	2.7^{*}
Very High v High	2.0	0.8 - 4.7	2.0

*outside 95% confidence interval

The Likelihood Ratios in relation to an offender being reconvicted for a non-sexual violent offence, however, are very similar for the two groups, apart from the Medium risk group, which suggests that it may be in respect of this category that the discriminative properties of RMV were less stable (Table 17). In spite of the wide confidence intervals for the two year follow-ups, the LR differed significantly between the High risk groups in these two cohorts (LR = 0.61, CI 0.22 – 1.71 in the 1990s England and Wales cohort compared with an LR of 2.42 in the Scottish cohort).

Table 17: Comparison of the Likelihood Ratios between the 1979 England and Wales and 1996-2001 Scotland cohorts for each **RMV** category, five year follow-up.

	1980	Eng & Wales	1996-2001 Scotland
RMV category	LR	95% CI	LR
Low	0.22	0.07 - 0.67	0.23
Medium	0.24	0.13 - 0.47	0.81*
High	2.17	1.62 - 2.90	2.23
Very High	4.27	2.09 - 8.73	4.43

*outside 95% confidence interval

The AUC for the 1996-2001 Scottish cohort is 0.76 (95% CI 0.71 to 0.80). This compares with the AUC of 0.78 reported by Thornton et al (2003) for the 1980 England and Wales 10 year follow-up, and an AUC of 0.80 for the 1979 England and Wales 19 year follow-up (although a recalculation of the data gives an AUC of 0.76). The three curves are illustrated in Figure 5.

Figure 5: ROC curve based on RMV categories and 5-yr reconviction rates for violent offences in the 1996-2001 Scotland five year follow-up, the 1979 England and Wales 19 year follow-up, and the 1980 England and Wales 10 year follow-up.



It can be seen from Figure 5 that, as with RMS, the contours of the curves are much less similar than they were for RMS, with the main variation taking place in respect of the Medium risk category. Like RMS, the cut-off points between risk categories also differs for the1996-2001 Scotland cohort.

The proportion of men convicted of violent offences over the full period of follow-up for each RMV category, taking into account variable follow-up times, is illustrated in Figure 6 below using survival analysis techniques. Log-rank tests showed a significant difference in the proportions reconvicted in all four RMV categories (chi square =126.3, df = 3, p < .0001). Similarly, there was a significant difference between all three pairs of consecutive categories:

	<u>chi square</u>	p
Low v Medium	11.7	0.001
Medium v High	22.7	< 0.0001
High v Very High	5.8	0.02





Differences in reconviction rates between High and Medium groups became apparent by one year follow-up, with significant differences present at both one (chi square = 13.98, df = 1, p < .001; OR = 5.6) and two years (chi square = 14.35, df = 1, p .001; OR = 3.6).

seriousness of reconvictions

The majority of reconvictions for non-sexual violent offending were not of a severe nature, using sentence length as a guide. Disposals were available for 162 of the 176 violent reconvictions that took place during the follow-up period. Just 15 (9.2%) resulted in prison sentences of a year or more. There were five life sentences, 4 of which were received by men in the Medium risk Group and one by a Low risk offender.

DISCUSSION

Summary of findings

Risk Matrix 2000 was found to be effective in classifying sex offenders in Scotland in terms of their risk of recidivism for both sexual and non-sexual violent offending. Risk categories were distinct from each other (although the boundary between High and Very High risk individuals was less clear because of the relatively low numbers of offenders in the latter group), and the four risk categories successfully ranked offenders according to their recidivism risk. The predictive accuracy of the two primary scales, Risk Matrix Sex and Risk Matrix Violence, was in the moderate range, with AUCs in the mid-seventies, similar to that reported for other, more complicated risk assessment instruments of a similar type (Barbaree et al, 2001; Hanson & Morton-Bourgon, 2007; Langton et al, 2007).

Because of the large and comprehensive nature of the study population, which encompasses a high proportion of all sex offenders released from Scottish prisons between 1996 and 2001, and because of the discriminative capacity of the scale as demonstrated in this report, the findings reported here can be used to interpret the meaning of Risk Matrix assessments in Scotland when used with released prisoners, and by extension with sex offenders in Scotland generally, in the following manner:

Regarding numbers of offenders per *risk category*:

- for RMS, about three quarters of offenders would be expected to score as Low or Medium risk, about 15% as High risk, and less than 10% as Very High risk;
- for RMV, about three quarters of offenders would again be expected to score as Low or Medium risk, from 15-20% as High risk, and again less than 10% as Very High risk.

In terms of *reconviction risk*, reasonable approximations of <u>five year</u> reconviction rates are:

RMS		
Low	less than 5 %	(1 in 20)
Medium	10%	(1 in 10)
High	20 - 25%	(1 in 4 to 1 in 5)
Very High	33%	(1 in 3)

- The odds of a Medium risk offender recidivating are about 4 times that of a Low risk offender;
- The odds of a High risk offender recidivating are about 2.5 times that of a Medium risk offender;
- The odds of a Very High risk offender recidivating are about 1.5 times that of a High Risk offender.

RMV		
Low	less than 5 %	(1 in 20)
Medium	10%	(1 in 10)
High	25%	(1 in 4)
Very High	40%	(2 in 5)

- The odds of a Medium risk offender recidivating are about 3.5 times that of a Low risk offender;
- The odds of a High risk offender recidivating are about 3 times that of a Medium risk offender;
- The odds of a Very High risk offender recidivating are about twice that of a High Risk offender.

In respect of the general *specificity and sensitivity* of the scale:

- for RMS, an offender who recidivates is over three times as likely to be rated as Very High risk compared with an offender who does not, and over two times as likely to be rated as High risk;
- for RMS, an offender who does *not* recidivate is over four times as likely to be rated as Low risk compared with an offender who does.
- for RMV, an offender who recidivates is over four times as likely to be rated as Very High risk compared with an offender who does not, and over two times as likely to be rated as High risk;
- for RMV, an offender who does *not* recidivate is about four and a half times as likely to be rated as Low risk compared with an offender who does.

Reliability in scoring Risk Matrix

Inter-rater reliability in scoring Risk Matrix was high, with a kappa in the mideighties. There was complete agreement between two raters in respect of risk categories in 36 of 40 cases (90%) for both RMS and RMV. This was slightly higher than that reported by Knight and Thornton (2007) in their Massachusetts study.

While this degree of inter-rater reliability is respectable, given the small number of variables involved and their apparent simplicity one might have expected greater concordance between raters. In the Massachusetts study much of the error was reported to relate to file information that was "confusing" or "thin" and, in spite of the raters being well trained, misapplication of scoring rules. In the current study, similar causes were found, with mistakes resulting, for example, from one of the raters missing historical information that was not readily apparent in the files, or from simple mistake (for example, failing to include the index offence in the total number of sexual offence sentencing occasions).

In about a quarter of cases is was not possible to score RMS at all because of missing information. Files often did not contain summaries of offending histories, and where

they did they frequently contained little more than offence names, making it impossible to determine anything about the victim. This was surprising given that there were Criminal Justice Social Work reports about the majority of men. The variables required to score Risk Matrix, however, are fairly basic, and if this instrument is to be used on a widescale basis in Scotland it would make sense for the relevant information to be routinely documented in the files of offenders.

Although simple, there are a number of common errors that raters make in scoring Risk Matrix, particularly when they are inexperienced. Those carrying out the ratings, therefore, need to be properly trained (as opposed to just relying on the manual) and supervised, with a quality assurance mechanism included in the process.

Comparison with Risk Matrix performance in England and Wales

This study has found that Risk Matrix 2000 performed well in Scotland in its ability to rank offenders relative to each other in terms of their likelihood of reconviction. This does not, however, address the question of the instrument's stability over different settings, which is influenced (and obscured) by variations in their base rate of reconviction (Mossman, 2006). Reconviction rates for sexual offences have fallen in England and Wales since the 1979 Risk Matrix validation study (Friendship and Thornton, 2001), and it is not surprising that the 11% five year reconviction rate found in the 1996-2001 Scottish cohort was significantly less than the nearly 20% five year reconviction rate of the 1979 England and Wales sample.

In spite of the difference in the base rate of reconviction, the five year reconviction rates in the Low, Medium and High categories for Risk Matrix Sex in Scotland were in the same range as those reported in the 1979 England and Wales study. The base rate effect, however, was apparent in respect of the Very High risk group, where the 30% sexual reconviction rate in Scotland was significantly less than the 51% found in England and Wales.

Although the reconviction rate for the Very High risk group differed in the two cohorts, the similarity in their Likelihood Ratios (that is, the likelihood that a recidivist would be ranked as Very High risk compared with that of a non-recidivist being ranked as Very High risk) is indicative that the 'meaning' of Very High risk was consistent in two populations. Indeed, it was in the RMS High risk group, and nearly in the Medium risk one, that differences in Likelihood Ratios emerged, suggesting that it is in this middle area that Risk Matrix may have performed in a less stable manner in the two cohorts.

This was also the case for Risk Matrix Violence, although comparisons were more difficult because of the lack of published five year non-sexual violence reconviction rates, and had to be made between unequal follow-up lengths (and thus must be treated with caution). Here Medium risk groups differed in respect of their Likelihood Ratios in one comparison and High risk groups in another. Regardless, as with RMS, it appears that if the instrument is performing differently in the two populations then it is in the middle categories where this occurs.

In summary, Risk Matrix 2000 does seem to perform in a reasonably stable manner across settings in the UK, which means that generalisations can be made from the findings of one area to those of another, but in the absence of more studies caution is needed in respect of offenders in the Medium and High risk groups.

Risk Matrix 2000 as a screening tool

Risk Matrix provides an estimate of the likelihood of reconviction for a sexual or nonsexual violent offence over a timescale of years. Although individuals in higher risk categories recidivate at a quicker rate, Risk Matrix cannot be used as an indicator of the imminence of reoffending, nor does it have anything to say about the seriousness of any subsequent offence. Indeed, while the likelihood of reconviction varies between risk categories, it was found that the seriousness of the reoffence does not, and if anything a greater proportion of more serious sexual reoffences (using sentence length as a criteria) appear to have been committed by individuals in the lower risk groups. Risk Matrix is also silent on the potential for an escalation in offence seriousness.

Given these considerations, Risk Matrix is probably best viewed as a screening tool, identifying individuals who require further assessment because of their increased risk of reconviction. Other approaches will then be necessary to determine *current*, as opposed to *long term* risk, as well as the potential consequences of a reoffence – these include structured dynamic risk assessments, guided clinical judgment, and psychometrics, amongst other. This overall process will in turn help advise strategies for managing individual offenders, whether for sentencing, release from custody, or for community management by way of protocols developed through multi-agency public protection arrangements (MAPPA). Risk Matrix 2000, therefore, should be seen as the first step in an assessment process, not a substitute for the assessment process itself; to be effective, it must form part of a wider package.

As with any screening tool, a decision must be made regarding thresholds for action. Set it low and more recidivists will be included, but at the cost of a high rate of false positives and a less efficient use of resources; set it high and fewer non-recidivists will fall into the net, but so too will fewer recidivists. Based on the findings from the 1996-2001 Scottish cohort, about a quarter of offenders rate as High and Very High risk on RMS, but they account for over a half of the sexual reconvictions with one recidivist for every three men who do not recidivate; in comparison, the Low and Medium risk groups combined account for three quarters of offenders but less than half of the reconvictions with just one recidivist for every 14 non-recidivists. The scale of the distinction is illustrated in Figure 7. The same considerations apply for RMV.

Figure 7: Comparison between number of offenders in combined RMS lower and upper risk categories, and the number of reconvictions for the combined groups.



Focussing resources on the higher risk groups, therefore, would mean that resources would be better targeted than if no screening took place. However, it must still be borne in mind that nearly half of the reconvictions will relate to offenders in the lower risk groups. Lower risk does not mean no risk. But the aim is not to predict recidivism, nor is it to differentiate between recidivists and non-recidivists *per se*. Instead, like any screening tool, the role of Risk Matrix is to identify a group of higher risk individuals who require further assessment.

Risk Matrix 2000 and Orders for Lifelong Restriction

As a screening tool, Risk Matrix can also play a role in the assessment of offenders in relation to Orders for Lifelong Restriction (OLR). These Orders are available to the High Court at the time of conviction where an offender has committed a sexual, violent or life endangering offence, but only where "there is a likelihood that he, if at liberty, will seriously endanger the lives, or physical or psychological well-being, of members of the public at large³".

The degree of 'likelihood' necessary for the imposition of an OLR is not specified. Although there is no assumption that it must be at a level of 'more likely than not', given the potential restrictions on an individual's liberty one would expect the threshold to be reasonably high. It is therefore arguably more important that the threshold should be set so that those receiving an OLR truly represent a significant risk of reoffending, rather than that no offender for whom such an Order might be appropriate is missed. If that is the case, then one might expect assessments for OLRs

³ Criminal Justice (Scotland) Act 2003, at 210E.

to be carried out only on offenders who score as High or Very High risk on Risk Matrix 2000, unless there is a compelling reason to assess a lower risk individual (one would not, for example, ignore an offender's threats to reoffend just because he was rated as Medium risk on Risk Matrix). Again, however, it must be emphasised that Risk Matrix would represent just one component, associated with 'likelihood', of a much more comprehensive assessment package.

Limitations

In terms of Risk Matrix Sex (RMS), full ratings and reconviction information were unavailable for 25% of the cohort. It is possible that this data was missing because of some form of selection bias that potentially may have influenced the results. A higher proportion of offenders in the 'missing' group had received sentences of imprisonment of under one year for the index offence that preceded prison release, and it may be that their shorter sentences were related to difficulties in locating their prison files. However, the risk category profile of the missing cases was broadly similar to the study sample based on Step One rating, and there was no significant difference in terms of either their five year or total sexual reconviction rates. Regardless, as the number of sexual reconvictions in the missing cases amounted to just 21, barring a highly skewed distribution of reconvictions it is unlikely that these missing cases will have had a marked impact on the results.

In the case of Risk Matrix Violence (RMV), full ratings and reconviction histories were obtained for nearly 95% of the sample, and the issue of missing cases did not arise.

On a more general note, research such as this is wholly dependent first, on the quality of information found in the files, and then on the accuracy with which that information is recorded for the study. In terms of the former, it was not unusual for inconsistencies to be noted when more than one data source was available, suggesting that errors in the documentation were not uncommon. In respect of the latter, the inter-rater reliability check indicated that up to a 10% error rate in the recording of information may have occurred. The magnitude and impact of these factors on the findings reported here is difficult to quantify, but they are likely to have worsened rather than improved the results.

Although the sample size in this study was large and inclusive, it is still rooted in place and time. The comparisons with the England and Wales data were reassuring in terms of the stability of the performance of Risk Matrix (albeit more so for RMS than for RMV), but significant changes in reconviction rates in the future will affect the interpretation of results reported here. Furthermore, it must be remembered that reconviction is not equivalent to reoffending, and attempts to quantify the association between them are highly speculative.

CONCLUSION AND RECOMMENDATIONS

There has been a good deal of reference in this report to the 'predictive accuracy' of Risk Matrix 2000. This is because establishing how well an instrument such as this 'predicts' reconviction is the only currency by which it can be appraised. When used in practice, however, the requirement is not one of prediction, but of assessment, distinguishing higher from lower risk individuals so that further evaluation can be targeted on a smaller group of offenders. The aim of this study was to determine how well Risk Matrix performs this task in Scotland. In brief, it found that Risk Matrix 2000 is indeed valid for use in Scotland.

If Risk Matrix 2000 is to be used to greatest effect, the following recommendations should be considered:

- 1. Although Risk Matrix is a reasonably straightforward instrument, training in its use is essential if it is to be scored accurately. There should be a requirement that those carrying out Risk Matrix assessments receive appropriate training.
- 2. A means of quality assuring Risk Matrix scores is necessary and should be put in place if it is not currently established.
- 3. Relevant information needed to score Risk Matrix should be routinely included in reports prepared by criminal justice social workers, and included in prison files.
- 4. The base rate of sexual and non-sexual violent reconvictions in sex offenders should be monitored in order to ensure that the reconviction approximations reported here remain valid.
- 5. Consideration should be given to continuing the follow-up of the data set used in this study to obtain 10 and 15 year reconviction rates for Risk Matrix categories.

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