An Analysis of Intra-individual Variability in Criminal Propensity

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The purpose of this study is to provide an analysis of human behavior change. More specifically, this analysis will provide an examination of how criminal propensity changes over the life course. Criminal propensity will be defined as "the likelihood that someone will commit a crime." This is an important area of study. One of the primary purposes of the criminal justice system is to try to create lower levels of criminal propensity in the population. This has been a difficult task. One of the primary problems seems to be that we know very little about how and why criminal propensity changes over time. It is hoped that the present analyses will provide some answers to the questions about how and why criminal propensity changes.

It is proposed that criminal propensity has two dynamics, or "patterns of change." There is a long-term dynamic and a short term dynamic. These dynamic patterns are also known as "trait" and "state" patterns (Eysenck, 1983), or population heterogeneity and state dependence (Nagin, & Paternoster, 2000). Traits are stable between person differences in behavior (Allport, 1931). States are (a) reversible, (b) changing in level more rapidly than traits, and (c) possibly related to a different pattern of variables than those involved in a trait, perhaps cutting across traits (Cattell, 1966; p. 357). Criminal propensity is part trait because it is relatively stable and varies substantially between individuals, with some people being very likely to commit a crime, and other people being not likely to commit a crime. Criminal propensity is part state because people may be more likely to commit crimes at one time and less likely to commit crimes at other times.

Although rank order differences in criminal propensity between individuals of the same age are relatively stable, there is a tendency toward a mean level reduction in criminal propensity over the life course. People tend to commit more crimes while young, and to commit fewer

crimes as they age (Hirschi, & Gottfredson, 1983). The general tendency toward less crime with age is an average tendency however, and at the individual level, trait levels of criminal propensity may increase or decrease over periods of several years.

The premise that criminal propensity is an enduring behavioral trait that varies substantially between individuals is not a new idea. Yochelson and Samenow (1976; 1977) suggested that criminal offenders have a criminal personality, and this personality trait is very hard to change. Criminal career researchers found that an offender committing crimes today will probably be committing crimes for another 10 years (Blumstein, Cohen, Roth, & Visher, 1986). Gottfredson and Hirschi (1990) suggested that criminal offenders have lower self-control than non-criminals do. Lower levels of self-control are associated with increased levels of criminal propensity (Pratt, & Cullen, 2000), and there is evidence that between individual differences in self-control are relatively stable over periods of several months and years (Arneklev, Cochran, & Gainey, 1998; Burt, Simons, & Simons, 2006; Hay, & Forrest, 2006). Turner, & Piquero, 2002; Winfree, Taylor, He, & Esbensen, 2006). These sources provide consistent evidence that between individual differences in criminal propensity are relatively stable over time.

This is not to argue that criminal propensity is completely stable. Mean levels of criminal propensity decline over the life course for most adults. Beginning with the work of Quetelet (1931/1984) and his studies of crime at the population level, it was determined that there is a steady increase in the propensity for crime through adolescence and young adulthood, and then a steady decline in criminal propensity over the adult life course. This feature of criminal behavior has become known as the age-crime curve (Hirschi, & Gottfredson, 1983). If relative between individual stability is combined with the age-crime curve, criminal propensity is a trait with stable between individual differences and a mean population level that is declining as people age.

The population pattern of steady decline does not mean that every individual follows the same criminal trajectory. Ezell and Cohen (2005) and Bushway, Thornberry, and Krohn (2003) provide evidence that there are multiple group trajectories for criminal propensity. These group patterns suggest that there are general trends that offenders follow.

The premise that criminal propensity fluctuates in short periods seems to be somewhat in opposition to the long-term stability premise. Stability and variability in the same feature seems somewhat counter intuitive. How can something be stable and fluctuate at the same time? The solution to this mystery to propose that there is a "state" component to criminal propensity. Other personality traits are also subject to short-term fluctuation (Fleeson, 2001). The problem, from a measurement standpoint, is in determining which is changing, the state or the trait.

The proposition that criminal propensity has a state component is not a new idea. The general term to describe within individual fluctuation is "intra-individual variability" Nesselroade, 1991). Horney, Osgood, and Marshall (1995) found a significant level of intra-individual variability in offender's criminal behavior. Their data suggested that criminal propensity varied with changes in local life circumstances, which included getting a job, being married, or abusing drugs or alcohol. Other authors have also suggested that there is within individual variability in criminal propensity, although there have been various names suggested for this pattern. Glaser (1964) noted that criminal behavior follows a "zig-zag path" between crime and non-crime, and more recently, Piquero (2004) discussed the evidence that criminal behavior can be "intermittent." Whatever this fluctuation is called, there is a growing body of evidence that there is instability in criminal propensity.

The purpose of this paper is to explore the relationship between the stable trait and unstable state aspects of criminal propensity. Are the two related? Sampson and Laub (1993)

had suggested that changes in life circumstance might lead to long-term changes in criminal propensity. Very little is known about how states affect traits however. An attempt will be made to explore some of the issues involved in tying the state and trait aspects of criminal propensity together.

The Problems with the Study of Change

There are several problems inherent in any attempt to make sense of the relationship between the trait and state aspects of criminal propensity. These can be broken down into 1) the temporal problem, 2) the level of analysis problem, the 3) complexity problem, and 4) the latent variable problem. Without attention to these problems, it will be extremely difficult to make sense of how criminal propensity changes.

The temporal problem occurs because there are multiple temporal scales at which change is occurring. Bronfenbrenner and Morris (1998) suggested that changes in behavior can occur at the microtime (immediate), mesotime (days and weeks), and macrotime (lifespan) levels. It is not difficult to imagine that criminal propensity can vary from minute to minute at the microtime scale. If the police are sitting in a car watching the front door, the level of criminal propensity for burglary goes down considerably. Similarly, changes at the mesotime level are also easy to imagine. If a person has a job, is married, and not on drugs, their level of criminal propensity is probably lower than when they lose their job, get divorced, and spend their time using drugs with criminal friends. These changes do not occur immediately, but happen over many months. Changes at the macro-time level are more difficult to understand. These changes are probably the result of many changes at the microtime and mesotime levels. They are much smaller in magnitude and difficult to detect with all of the short term changes that are occurring.

The level of analysis problem is due to the fact that, although researchers ultimately want to understand how individuals change, individuals are extremely idiosyncratic, unpredictable, and very difficult to study. Each individual's behaviors are slightly different than all of the other individual's behaviors. The typical method avoiding the problems associated with studying individuals has been to change the focus to the study of groups of individuals. This is problematic because the group level of analysis can provide only general data about the average trend for a group. Individual data is usually filtered out as "noise" or "error" (Watson, 2004) and ignored. This makes it next to impossible to determine what is happening at the individual level. More information is needed about how individuals change their behavior.

The complexity problem is similar to the problems created because each individual is not like any other. However, the complexity problem arises because each person changes from moment to moment and the person is not like his or her self at other points in time. A person's behavior at a certain point in time may have some similarities to the behavior at other points, but there is also a fair amount of difference. The differences in individual behavior vary over the micro meso and macro time scales. Differences within the individual arise because of a complex mixture of different causes. Hundreds and thousands of different factors go into human decisions and separating out the different causes is difficult if not impossible.

The latent variable problem occurs because the constructs that scientists are interested in are generally not measurable directly. Criminal propensity is not measurable directly. There are a number of measurable attributes of the person that are associated with people that have high criminal propensity. These factors can be measured and used to give an indication of the level of criminal propensity, but criminal propensity can't be measured directly.

In order to overcome these problems, one must examine the individual dynamics of criminal propensity. Dynamics are "patterns of change." Many aspects of dynamics can be examined. The temporal dynamics of a phenomena can be examined to determine how fast something changes. The group dynamics can be explored to determine what the average changes are. The individual dynamics can be examined to see how a person's behavior changes over time. The covariates of dynamic changes can be examined to determine what causes change. A list of the possible qualities of dynamics that can be studied are shown in Table 1. By studying the various aspects of change, a picture can be developed that indicates what is changing and how change occurs.

Table 1: Dynamic Qualities of Interest

Quality	**Types**	**Measurement**
Level	Risk level, Age Cohort	Initial Value, Mean
Size	Point to Point, Average	Change scores, Mean, S.D., Max, Range
Direction	Point to Point, Average	+/- Sign
Time	Short, Medium, Long	Minutes, Hours, Days, Months, Years
Rate	Individual / Group	Size Change / Unit time, Trend
Pattern	Linear, Nonlinear	Regression, Model fit
Structure	Structured / Unstructured	Ability or failure to fit structural equation
Stability	High / Low	Likelihood of change
Reliability	High / Low	Stability of change
Cause	Static / Dynamic	Correlation, Covariation

The Current Study

This study provides an opportunity to look at the dynamic qualities of criminal propensity. This effort is motivated by previous findings by Arnold (2008). In this study, a number of techniques were used to study changes in criminal propensity of offenders on probation over a four-year period. Criminal propensity was measured with the Level of Service Inventory – Revised (LSI-R; Andrews, & Bonta, 1995), a popular measure of recidivism risk. A technique called individual growth curve modeling (Singer, & Willett, 2003) was used to look at

how individual change occurred over time. A sample of twelve individual growth curves is shown in Figures 1.2 to 1.12 on the next page. The risk levels were measured on eight occasions. The straight lines were plotted using ordinary least squares (OLS) regression. There are two fit lines, one that uses all 8 data points and one that skips the first data point. There were some interesting aspects of these individual criminal propensity plots that bear further study.

If one examines the direction of change from point to point, it becomes apparent that many of the shorter-term changes in criminal propensity are reversible and unreliable. A positive change is often followed by a negative change and vice versa. When examining the longer term trends, there were seven growth curves that show a long term decline (1, 2, 3, 4, 5, 8, & 12) and five growth curves that show an increase in risk (6, 7, 9, 10, & 11).

Only 5 of the 12 plots had a large enough slope and small enough variation about the OLS fit line to be characterized as a significant linear trajectory (1, 2, 4, 7, and 8). Four out of the five linear plots had a decrease in risk over time. The other plots were examined to determine whether there was some other structural equation that provided a better fit, but no match was found. For instance, quadratic, cubic, and higher order models were tried, but there was no apparent pattern to these plots. They are unstructured "nonlinear" trajectories.

In general, the size of the changes from point to point appeared to be smaller for offenders with a declining growth curve and larger for the offenders with an increasing growth curve. The correlation rate between the range of the short-term changes and the slope of the OLS fit line was moderate and positive ($r = .27$). This suggested that as the size of the short-term changes increased, the likelihood increased that the long-term risk level was increasing. From these results, it was hypothesized that perhaps large short-term changes in criminal propensity lead to long-term risk increases and small and gradual changes lead to risk decreases.

Figure 1.1: Sig. Dec. 1-8, & 2-8

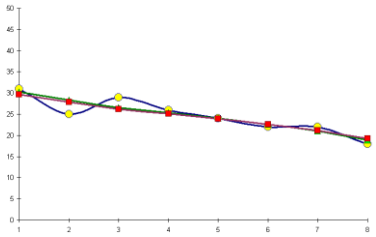


Figure 1.2: Sig. Dec. 1-8, & 2-8

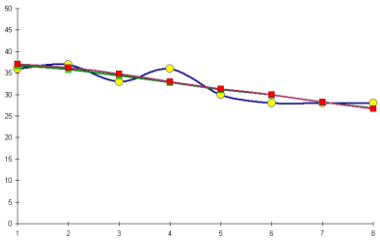


Figure 1.3: NS OLS Trend

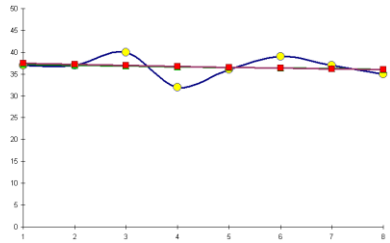


Figure 1.4: Sig. Dec. 2-8 Only

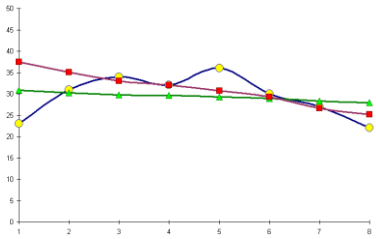


Figure 1.5: NS OLS Trend

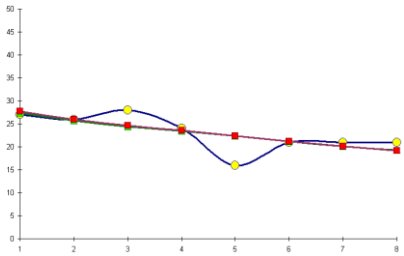


Figure 1.6: NS OLS Trend

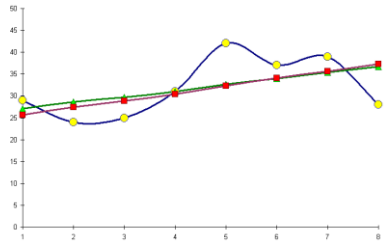


Figure 1.7: Sig. Inc. 2-8 Only

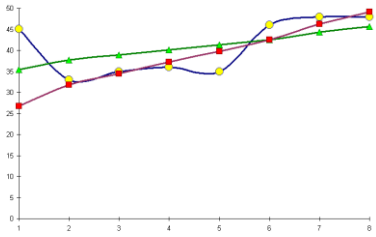


Figure 1.8: Sig. Dec. 1-8, & 2-8

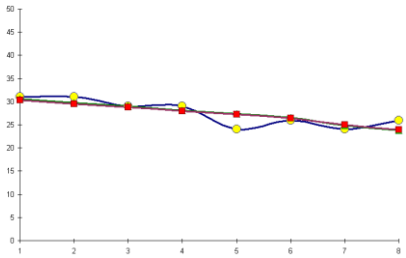


Figure 1.9: NS OLS Trend

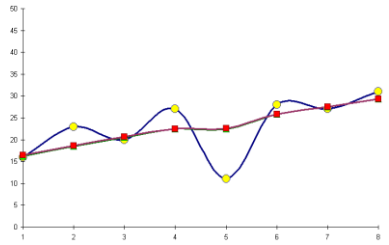


Figure 1.10: NS OLS Trend

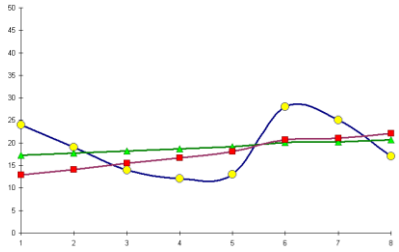


Figure 1.11: NS OLS Trend

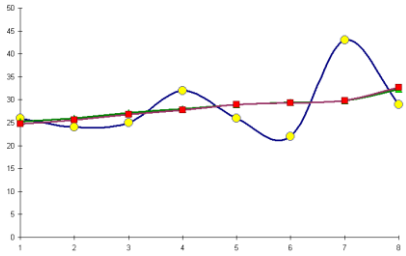
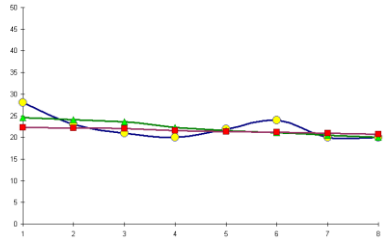


Figure 1.12: NS OLS Trend



It seems that an important thing to consider when looking at these growth curves is that gains and losses probably have different causes. The LSI-R is a composite measure of several dynamic domains in the offender's life. These include employment, housing, finances, drug and alcohol use, mental health status, and attitude toward supervision. It would seem to be that getting a job is not the same as losing a job. Getting into treatment and quitting drugs is not the same as starting to use drugs again. Gains and losses would appear to have different causes.

It is possible that adopting a criminal lifestyle is easier than adopting a prosocial lifestyle. In this were so, one would expect larger increases than decreases. It did appear that this was the case. Increases tended to occur at a faster rate than decreases in recidivism risk. However, if one looks at some of the short-term downward slopes for offenders that are have increases in risk over the long-term; some declines in risk are very steep. For instance, in Figure 1.11, the offender had three periods of rather sharp declines in criminal risk level before having a rather large relapse. In figure 1.10 there were four periods of decline. These data suggest that there may be something different about offenders with large changes in criminal propensity in short periods. Does rapid change in the short term lead to an increased likelihood of a long-term increase in criminal propensity? Since most criminal justice interventions appear to be designed to produce rapid declines in risk level, it seemed that the answer to this question could be rather important.

Consistency in Human Behavior

The literature on trait change contains numerous discussions of the issues involved in trying to determine the relationship between traits and states. Nesselroade (1991) has suggested that there is a distinction between "intra-individual change," which is a relatively stable change

in a trait, and "intra-individual variability," which is a relatively unstable and reversible change of state. The question is, how can one determine the relationship between the two?

There is a growing body of evidence that suggests that an important piece of the puzzle about intra-individual variability is a human behavior trait called "consistency" (For a review, see Hultsch, Strauss, Hunter, & MacDonald, 2008). Evidence suggests that there are measurable differences between individuals in the levels of intra-individual variability. In terms used by developmental psychologists, there is inter-individual variation in the level of intra-individual variability. Some individuals are more consistent and have less state level variability than others have. With repeated measurements, consistent individuals tend to be more similar to themselves from test to test. Inconsistent individuals are more likely to have larger changes in their responses to behavioral tests in shorter periods.

There are a number of questions regarding consistency. Is consistency a sign of health or illness? If one considers consistency in sports, higher levels of consistency are related to higher performance levels (Slifkin, & Newell, 1998). For instance, a basketball player that can consistently place the basketball in the hoop from 30 feet away is considered to be a higher performing athlete than a player that cannot perform consistently.

Another question regarding consistency is whether it varies with age. Roberts and DelVecchio (2000) found that personality traits tend to become more stable with age. This suggests greater consistency. Hultsch and MacDonald (2004) suggest that declines in reaction time that adults experience as they age may be associated with increases in individual variability. In other words, inconsistency in reaction time increases with age. One area that should be tested is whether consistency in criminal propensity increases with age, and whether the changes in consistency are associated with changes in level.

Methodological Issues

Measurement of intra-individual variability is generally done through creation of an intra-individual variability index (Ram, & Gerstorf, 2009). Ram and Gerstorf (2009) suggested the creation of an intra-individual standard deviation (iSD) that consists of the standard deviation of the repeated measurement scores. While the iSD works fine as a measure of variability if the trait being measured is not changing over time, if there is actual trait change over time, the change in trait can confound the measurement of the change in state. If there are real changes in state, a detrended measure of intra-individual variability is required.

The issues related to the measurement of inter-individual variability when there is a change in the underlying trait during the measurement period were discussed by Allaire and Marsiske (2005). If the person has developmental change during the time that the repeated assessments are collected, they suggested a four-step process be used to determine the level of intra-individual variability. Their method is presented here with the only modification being that Allaire and Marsiske, (2005) used both a linear and quadratic slope and only a linear slope is used in these analyses. The quadratic term was needed because there was a learning curve effect for the measures being analyzed. Based upon the inspection of the data collected by Arnold (2008), it would appear that a linear trajectory fits some offender risk trajectories. The trajectories for the offenders that had nonlinear change did not have any discernible structure. Since no power terms increased the level of fit, a linear model is probably the best choice.

The four steps involved in creating a detrended measure of intra-individual variability are as follows, 1) compute an intercept and slope for each individual using OLS in order to find the estimated trend over time, 2) calculate the predicted values for each time point using the intercept and slope and the actual assessment times, 3) calculate the distances from the predicted

line for each time point, and 4) calculate the standard deviation of the differences. The final statistic is an inter-individual standard deviation of the residuals (iRSD).

One of the problems with the measurement of change is due to issues related to reliability. Measures of change can be highly unreliable because the scores are fluctuating. The problems with reliability have two primary sources, measurement unreliability and subject unreliability. Measurement unreliability can be encountered from a variety of sources. Shadish, Cook, and Campbell (2002; p. 55) suggest nine different problems that might cause errors in measurement when measuring something on two occasions. These include regression to the mean and problems due to changing instrumentation. In this study, raters make judgments about offenders. If the rater changes between assessments, the measurement of change can possibly be unreliable. There may also be real changes in offender state that are due to temporary reversible factors. Since it is difficult to determine whether any one of the possible problems in measurement occurred, change scores can be highly unreliable.

Because there is unreliability in measures of traits, a metric for change is needed when comparing measurements made at two points in time. The primary question is, how big of a change in score is needed before it can be assumed that an actual change occurred? Fortunately, there is an easy answer to this question. Jacobson and Truax (1991) developed a reliable change index (RCI) that provides an numeric estimate of the score change needed to achieve a "clinically significant change." The standard confidence level for the RCI value is 95%, which provides a 95% confidence level that the change was clinically significant.

Although the RCI can provide a reasonable metric for change, the point-to-point fluctuations in score data can still lead to erroneous conclusions about the true trajectory of the person. If a person has a 5-point drop from assessment 1 to assessment 2 in three months, can

we conclude that their rate of change is going to be 20 points in one year? If the scores are fluctuating, this is unlikely.

Singer and Willett (2003) suggested another solution to the fluctuation problem. Their suggestion was to use multiple points for analysis of trends in a process called "individual growth curve modeling" with three or more data points. Although individual growth curve modeling can theoretically be done with data at two time points, if there are three or more time points, methods such as ordinary least squares (OLS) regression can be used to fit a straight line through the points and get a better idea of the general trend in a person's trajectory.

In the analyses in this study, OLS regression will be used to calculate individual slope estimates. There are some potential issues with using OLS for trying to determine trends in time series data. There is a possibility that the data points could be correlated with each other and this would violate the assumptions of OLS regression and lead to unreliable error statistics (Blalock, 1979; Mizon, 1995). While this may be a potential problem, it is not clear that there is an adequate alternative to OLS for the type of individual growth curve analyses used in this study. It appears that OLS provides the best linear estimate of individual trajectories, even though the estimates of the standard errors may not be accurate.

In order to avoid statistical estimation problems, wherever possible, maximum likelihood estimation of group trends is used. Singer and Willett (2003) had indicated that maximum likelihood estimation could be preferable to OLS in some instances. Mplus (Muthén, & Muthén, 1998-2010) was used to provide maximum likelihood estimates of intercept and slope values for groups of offenders. An attempt to use Mplus for individual trajectory estimates revealed that Mplus provided erroneous estimates for individual slopes. For that reason, OLS regression was used to calculate individual slopes and Mplus was used for group slope estimation.

METHODS

Participants

The participants used in this study were selected from a list of 57,473 criminal offenders that had been placed on probation in England from 2005 to 2006. Criminal propensity data had been collected on each offender with the Offender Assessment System (OASys; Howard, Clark, & Garnham, 2006; Ministry of Justice, 2009). The OASys is a recidivism risk and treatment needs assessment instrument developed by the home office. The offender population was 86.8% male, 30.6 years old (s.d. = 9.97), and had a mean risk level of 45.4 out of a possible 100 points (s.d. = 18.82). The sole selection criteria for inclusion in the current study was that offenders had to have been assessed at least three times before October 2009. The total sample size was 38,318 offenders. The selected sample was 86.8% male, 30.5 years old (s.d. = 9.76), and had a slightly higher risk level than the general population (Mean = 47.1, s.d. = 18.5). The offenders excluded from the study because of an insufficient number of repeat measures tended to be slightly older (Mean = 30.9 years old, $p < .001$), and had a lower mean risk level (Mean risk = 41.6, $p < .001$).

Procedure

The offenders were interviewed and a records check was conducted by their probation officers in order to fill out the OASys assessment. The offenders were reassessed at a mean 5 month interval (s.d. = 5.5 months), with a median reassessment interval of 3 months. The home office provided the data in an encrypted format and the data was imported into SPSS.

Measures

The OASys dataset contained the answers to 112 questions about the offenders. The list of variables is shown in Appendix 1. The questions answered on the OSAys can be grouped into thirteen categories, 1) criminal history, 2) offense details, 3) accommodations, 4) education, training, and employability, 5) financial management and income, 6) relationships, 7) lifestyle and associates, 8) drug misuse, 9) alcohol misuse, 10) emotional wellbeing, 11) thinking and behavior, 12) attitudes, and 13) general health. Two separate risk scores were computed from the sums of sets of the question scores, 1) the OASys General Reoffending Predictor (OGP100) and 2) the OASys Violence Predictor (OVP100). The risk scores used in these analyses were from the OGP100. Scores can range from 0 to 100 with actual scores ranging from 2 to 98.

A number of measures were computed for each offender using the aggregate function in SPSS. These included individual mean risk levels (iM), individual risk level standard deviations (iSD), and means and standard deviations for all of the separate question answers for the 112 OASys responses (See Appendix 1). The file was split by offender ID and the slope and intercepts were calculated for each individual risk trajectory using ordinary least squares regression (OLS) by regressing Risk on Age. From the slope, a binary variable representing desistance was created by coding the variable a 1 if the slope was negative and a 0 if the slope was greater than or equal to zero. To calculate the individual residual standard deviation (iSD) a multistep process was used. 1) The residual risk scores were calculated by first creating a predicted value for each time point using the OLS slope and intercept and the formula Predicted Risk = Individual Intercept + Individual Slope * Age at assessment. 2) the residual values were calculated for each time point by subtracting the predicted value from the actual value. 3) The aggregate function in SPSS was used to calculate the iRSD value for each offender.

Clinically Significant Change

In order to determine the level of change needed to produce a clinically significant change in offending rates, the Reliable Change Index (RCI) for the OASys was calculated using the methods recommended by Jacobson and Truax (1991). The formula for the RCI at a 95% confidence interval is RCI = 1.96 * SQRT(2) * SQRT(1- r_{1-2}) * $s.d._1$, where r_{1-2} is the correlation rate between the OASys time 1 and time 2 scores in a period of no expected change, and $s.d._1$ is the standard deviation for the first set of OGP scores. The OGP scores with 10-90 days between assessments were used to calculate r_{1-2} = .985, and found the value of $s.d._1$ = 18.81. This provided an RCI of 6.4, which indicated that the offenders who changed more than 6 points could be assumed to have a clinically significant change in offending rates.

Data Analysis

The iSD and iRSD variables were converted to categorical variables in order to examine what the effects of various size levels had on desistance and age. A series of crosstabs were created in SPSS using the means analysis to determine the mean levels of desistance and age for seven levels of the iSD and iRSD variables. The iRSD levels were used to create a set of dummy variables that were used as part of two separate latent growth curve models in Mplus to determine whether offenders with higher consistency (lower iRSD values) had significantly different change trajectories than those with lower consistency (higher iSD and iRSD values).

RESULTS AND DISCUSSION

Desistance Levels for Consistent and Inconsistent Offenders

The iSD and iRSD values were calculated in SPSS. The iSD value provided the individual standard deviation of the risk scores for each individual. Because the iSD value would be confounded with long term change if there were actual change occurring, the iRSD value was used to provide a detrended standard deviation of the changes in risk. Both measures were split into eight levels representing relatively equal fractions of the sample. The mean levels of desistance were calculated for each level of the iSD and iRSD variables. The results are shown in Table 2. A small fraction (7%) of the offenders had no change in their risk scores. More than half of the sample (58%) was desisting. Offenders with higher consistency (lower iSD and iRSD values) were substantially more likely to be desisting. The levels of desistance for offenders with the smallest levels of change were between 75% for the lowest level of the iSD to 79% for the lowest level of the iRSD. It is interesting to note that consistency appears to be a measure of the likelihood of desisting, but inconsistency does not appear to be a measure of the likelihood of not desisting unless the inconsistency is relatively large. Offenders with the highest levels of inconsistency had slightly less than a 50% chance of desisting. These results suggest that offenders with a high level of consistency have a higher propensity to desist.

Table 2: Percent Desisting by iSD and iRSD Level

iSD Level	% N (38,318)	% Desisting	iRSD Level	% N (38,318)	% Desisting
No Change	7	0	No Change	7	0
>0 to 1	17	75	> 0 to .5	21	79
>1 to 2	19	68	> .5 to 1	16	72
>2 to 3	17	63	> 1 to 1.5	13	64
>3 to 4	12	60	> 1.5 to 2	10	60
>4 to 5	9	59	> 2 to 2.5	8	54
>5 to 6	6	54	> 2.5 to 3	6	51
>6	12	50	> 3	18	45
Total	100	58	Total	100	58

Given that the iSD and iRSD variables both provided similar results, the iRSD variable will be used in the calculations that follow. The fact that the OLS trend has been removed from the measure will make it possible to compare the levels of consistency with change statistics without worrying that the level of consistency measure is also measuring long term change.

Levels of consistency by Starting Risk Level

One of the findings in the literature on intra-individual variability is that higher levels of fluctuation in a measure are associated with poorer outcomes (Hultsch, MacDonald, Hunter, Levy-Bencheton, & Strauss, 2000; Nesselroade, & Salthouse, 2004). In the present study, a poorer outcome would be a higher risk level. The Means procedure in SPSS was used to calculate the mean starting risk level for offenders in each category of the iRSD variable. The results are shown below in Table 3. As intra-individual variability increases, so does the mean risk level. This finding is consistent with studies that indicate that intra-individual variability is a sign of an underlying problem. Note that the most consistent offenders have the lowest risk level, even though from a rehabilitation standpoint, they would be appear to be failures because no progress is occurring.

Table 3: Mean Starting Risk Level by Consistency Level (IRSD)

iRSD Level	%N (38,318)	Starting Risk Level Mean	S.D.
No Change	7.3	39.95	19.60
> 0 to .5	21.4	40.74	18.82
> .5 to 1	16.0	44.31	18.29
> 1 to 1.5	12.6	48.50	17.90
> 1.5 to 2	10.1	51.23	17.43
> 2 to 2.5	8.1	51.55	16.79
> 2.5 to 3	6.4	52.28	16.60
> 3	18.2	52.95	16.34
Total	100	47.11	18.50

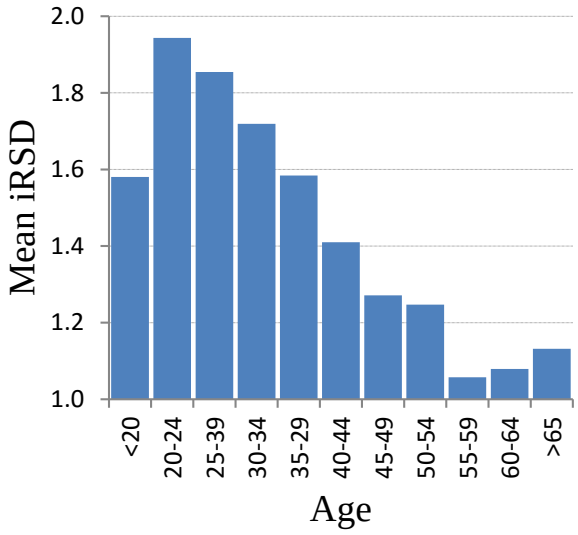
Levels of Consistency by Age

One of the questions in the research on consistency is whether consistency varies by age. The offenders were divided into eleven age groups with 5 year intervals in the middle and open intervals at each end. The mean levels of consistency as measured with the detrended iRSD variables were calculated for each age level. The results are shown in Table 4 and plotted in Figure 1. It appears that there is a general trend for consistency to increase with age. However, there are inflections at both ends of the age range. The offenders that are less than 20 appear to be substantially more consistent than offenders in the 20-24 year old range. The offenders that are over 60 appear to be slightly less consistent than offenders in the 55-59 year old range. There are very small numbers in these older age ranges (200-500 offenders) and so this may be a statistical anomaly. The pattern shown in Figure 1 is somewhat distorted because of the restricted range of values shown, but it appears that there is a definite nonlinear pattern to the relationship between age and consistency.

Table 4: Mean iRSD levels by Age

Age	%N (38,318)	Mean IRSD	S.D.
<20	6.07	1.58	1.61
20-24	26.56	1.94	1.77
25-39	20.36	1.85	1.80
30-34	15.89	1.72	1.78
35-29	12.99	1.58	1.71
40-44	8.80	1.41	1.57
45-49	4.49	1.27	1.53
50-54	2.29	1.25	1.47
55-59	1.33	1.06	1.29
60-64	.73	1.08	1.35
>65	.48	1.13	1.17
Total		1.71	1.73

Figure 1: Mean iRSD levels by Age



Rate of Change by Level of Consistency

The data indicated that the likelihood of a decrease in risk is much higher for offenders with higher consistency. However, the offenders with the highest consistency levels are those with no change in risk at all. This suggests that even though there may be some improvement for consistent offenders, it might be small in magnitude. If offenders are only attempting small changes, it would seem that they should have lower rates of change. Offenders with lower consistency could be making bigger efforts to change and may have higher rates of change. The rates of change were calculated by consistency level. A latent growth curve model was set up in Mplus with a set of dummy variables representing seven category levels of the iRSD variable. There were six .5 categories that ranged from 0 to 3 and one category representing all offenders with iRSD values over 3. The omitted category consisted of all offenders with no change in risk. The base model was set to calculate the linear slope and intercept for the changes in risk level by age. The resulting slope and intercept were regressed on the seven categorical variables representing the levels of consistency. The results are shown in Table 5. The average reduction in risk was just over .5 points per year. Based upon a Reliable Change Index (RCI) for the OASys of 6 points, this indicates that it will be over eleven years before the average offender has a significant reduction in risk level.

Table 5: Risk Trajectories for Seven Levels of Consistency (iRSD)

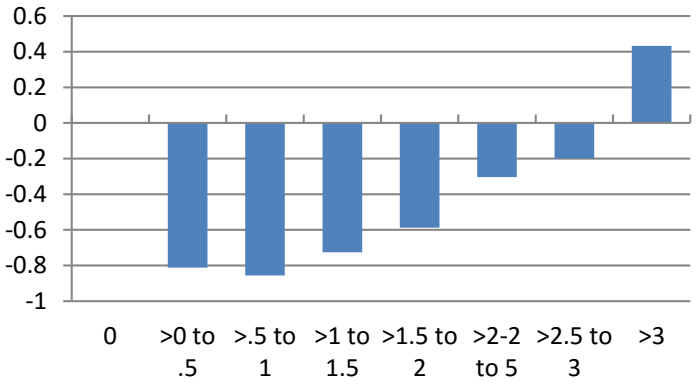
	%N	Intercept			Slope		
Category	(38,318)	Estimate	S.E.	Est./S.E.	Estimate	S.E.	Est./S.E.
Mean		58.478	1.695	34.493	-.507	.055	-9.186
No Change	7.3						
>0 to .5	21.4	7.900	1.935	4.084	-.305	.064	-4.802
>.5 to 1	16.0	11.211	1.990	5.633	-.349	.066	-5.299
>1 to 1.5	12.6	11.390	2.043	5.575	-.219	.068	-3.235
>1.5 to 2	10.1	9.684	2.099	4.614	-.081	.070	-1.165
>2-2 to 5	8.1	2.879	2.166	1.329	.203	.072	2.797
>2.5 to 3	6.4	1.153	2.268	.508	.307	.076	4.026
>3	18.2	-14.338	1.906	-7.523	.940	.063	14.912

There is a significantly greater decrease in risk for offenders with lower variability (higher consistency) and a significantly greater increase in risk for offenders with higher variability (lower consistency). The slope values for the categories indicate the difference from the mean slope. The estimated intercepts and slopes for each category from Mplus were calculated from the mean value and placed in Table 5. The slope values are plotted in Figure 2. It appears that the rate of decrease increases slightly between the first two levels. The mean reduction in risk changes from -.812 to -.856 as consistency increases from the 0 to .5 range to the .5 to 1 range. As offenders become less consistent, the mean slope increases until offenders with an iRSD value of over three have a mean rate of change in risk that is increasing over time. Note that completely consistent offenders have no change in risk level. These data suggest that the largest decreases in risk require a small amount of inconsistency. Large amounts of variability appear to lead to a tendency for offenders to experience an increase in risk. The fact that these data represent all offenders that are both increasing and decreasing presents a problem because it is not clear if there are differences between offenders that are increasing in risk and those that are decreasing in risk.

Table 6: Intercept and Slope by Consistency Level (iRSD)

iRSD Category	Intercept	Slope
>0 to .5	41.61	-.812
>.5 to 1	43.58	-.856
>1 to 1.5	47.73	-.726
>1.5 to 2	50.23	-.588
>2-2 to 5	52.09	-.304
>2.5 to 3	53.53	-.200
>3	57.35	.433

Figure 2: Change in Risk per Year by Consistency Level (iRSD)



Variation in Slope for Desisting vs. Non-Desisting Offenders

In the preceding analyses, the offenders were placed in categories based upon the amount of variability in risk level they exhibited around a trend line trajectory calculated in OLS. The net result was that offenders with lower variability (higher consistency in their change trajectory) tended to have reductions in risk and offender with higher variability tended to have increases in risk. As a check, a regression model was calculated in SPSS with the OLS slope as the dependent variable and the same categories that were used in Table 6 as the independent variables. The results found in SPSS were similar, which suggests that both methods provide similar results.

In the following analyses, an attempt was made to determine if changes in slope varied for offenders with increases in risk vs. decreases in risk. As was mentioned previously, it would seem logical to assume that it is easier to lose a job than get a job. An increase in risk represents multiple failures in the offender's lives, while a decrease represents several positive changes. It is reasonable to assume that increases and decreases in risk might follow separate patterns.

Because there is a ten category limitation in Mplus latent growth curve models, the iRSD variable was split into 10 categories with 1 point ranges. Offenders with iRSD values of over 4 points were placed in an open category. The resulting set of dummy variables consisted of two sets of variables, 5 binary variables representing offenders with various levels of consistency and increasing risk, and 5 binary variables representing offenders with various levels of consistency and decreasing risk. Offenders with no change in risk were omitted from the Mplus model as a reference category.

The model was run in Mplus and the results were placed in Table 6. Both increasing and decreasing slopes grow in magnitude as the level of inconsistency increases. There were many

more offenders in the first and second decreasing risk categories than in the first two increasing risk categories. This suggests that it is difficult to make small changes when increasing in risk. This is consistent with the hypothesis that there is a difference between decreases and increases in risk. The differences in numbers of offenders were not apparent for the higher levels of iRSD.

Table 7: Intercept and Slope Values by Consistency Level (iRSD) and Desistance Status

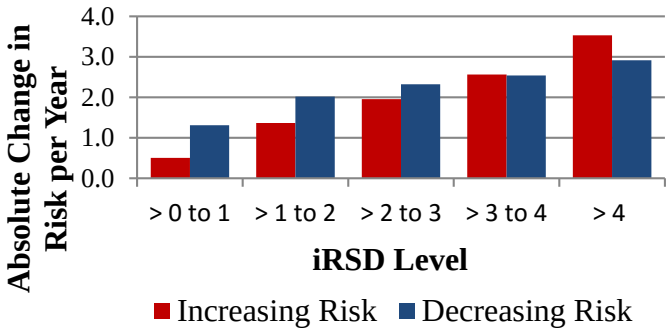
	%N	Intercept			Slope		
	(38,318)	Est.	S.E.	Est./S.E.	Est.	S.E.	Est./S.E.
Mean	100	58.39	1.525	38.277	-0.514	0.047	-10.828
No Change	7.29						
Decreasing							
> 0 to 1	28.47	21.395	1.68	12.737	-0.795	0.053	-15.038
> 1 to 2	14.04	47.334	1.783	26.542	-1.504	0.057	-26.435
> 2 to 3	7.64	59.049	1.921	30.732	-1.807	0.062	-29.159
> 3 to 4	3.97	69.82	2.179	32.042	-2.027	0.071	-28.632
> 4	4.25	82.629	2.111	39.136	-2.401	0.069	-35.011
Increasing							
> 0 to 1	8.97	-23.181	1.959	-11.834	1.02	0.062	16.446
> 1 to 2	8.57	-44.562	1.905	-23.392	1.879	0.061	30.913
> 2 to 3	6.86	-59.715	1.936	-30.848	2.468	0.062	39.64
> 3 to 4	4.29	-75.318	2.101	-35.844	3.079	0.069	44.786
> 4	5.64	-102.271	1.97	-51.917	4.044	0.064	63.144

The slope values for the categories reflect differences from the mean, which makes direct interpretation difficult. In order to determine what the differences were in slope magnitude for each level of consistency, the absolute slope values were computed and placed in Table 7. The absolute slope values were plotted in Figure 3. It appears that there are differing patterns of changes in risk trajectory for offenders with the highest and lowest levels of consistency. Offenders with high consistency that are experiencing a decrease in risk tend to have higher rates of change than offenders with high consistency that are increasing in risk. Offenders with low consistency (high variability) tend to have higher rates of increase than the rate of decrease.

Table 8: Absolute Values of Risk Slopes by Consistency Level (iRSD)

iRSD Level	Slope		Ratio
	Increasing	Decreasing	Inc / Dec
> 0 to 1	.51	1.31	.39
> 1 to 2	1.37	2.02	.68
> 2 to 3	1.95	2.32	.84
> 3 to 4	2.57	2.54	1.01
> 4	3.53	2.92	1.21

Figure 3: Absolute Values of Risk Slopes by Consistency Level (iRSD)



CONCLUSIONS

The purpose of this study was to determine if it was possible to find a relationship between short-term state changes in criminal propensity and long-term trait changes. There was a possibility that a concept called intra-individual variability might provide some connection between the trait and state aspects of criminal propensity. The literature had suggested that offenders with low levels of intra-individual variability are more consistent, and therefore higher functioning, than offenders with high levels of intra-individual variability. It was posited that higher consistency (lower intra-individual variability) would be associated with larger long-term reductions in criminal propensity.

In this study, the original concept of consistency was modified slightly, and a new concept, which will be called "consistent change" was introduced. It appears that consistent changers have a greater likelihood of reductions in risk. The theory behind the proposition that the size of the intra-individual variability and long-term trend might be related was that small and steady changes in life circumstances are easier to maintain than large changes. In addition, it was suggested that there might be a difference between increases and decreases in criminal propensity. There should be a difference between increasing and decreasing levels of criminal propensity because an increase in criminal propensity probably has different root causes than a decrease.

One of the purposes for the first set of calculations was to determine if there was any appreciable difference in accuracy when switching from a simple measure of consistency to a detrended measure of consistency. The simple consistency measure consisted of the standard deviation of the risk scores (iSD). The detrended measure of consistency consisted of the standard deviation of the residual differences between the risk scores and the values predicted by an OLS trend line (iRSD). In both measures, a smaller value indicated a higher level of

consistency. It appeared that both measures of consistency have a similar relationship with desistance. Desistance is more likely when the consistency level is high (low intraindividual variability). It is suggested that the iRSD value is superior because it was not confounded with possible long-term changes in criminal propensity. If the goal is to find a relationship between intra-individual variability and intra-individual change, the measures should be mathematically separate. The iRSD variable meets this requirement.

The dependent variable in the first set of calculations was a variable called desisting. The desisting indicator was a binary variable that was coded a one when the OLS slope was negative, and zero otherwise. As can be seen in Table 2, the iRSD variable appeared to have a greater ability to distinguish between offenders with decreases and increases in risk. Consistent with the hypothesis that consistency was a sign of better functioning, 79% of offenders with a small iRSD value (< .5 points) had a decrease in long-term criminal propensity. It appeared that consistent change is a protective factor for offenders. Although substantially more offenders with high consistency had long term reductions in criminal propensity, offenders with a low consistency values (iRSD > 3) tended to only be slightly more likely to have a long-term increase in risk. High consistency was associated with a substantially higher likelihood that there would be long term reductions in risk, but low consistency did not seem to associated with a substantially higher likelihood of risk increases.

A set of calculations was done to determine whether intra-individual variability was a sign of poorer performance. In Table 3, the starting risk levels were calculated by level of intra-individual variability. Offenders with higher consistency (lower levels of intra-individual variability) are also lower in risk. This finding is consistent with studies that suggest that higher intra-individual variability can indicate problems (cf., Nesselroade, & Salthouse, 2004).

The next set of calculations was designed to determine whether there was a relationship between age and consistency. In Table 4, a general trend was found for consistency to increase with age. However, the results appear to follow an S shaped pattern. The very young offenders (< 20 years old) were more consistent than offenders in the 20-24 year old range. It is not clear why this was occurring. It could be that a sizable fraction of young offenders are adolescent limited offenders (Moffitt, 1993) that do not have the same problems as older offenders. The general trend was for consistency to increase from age 20 to 50. Offenders in the 50-54 year old range were the most consistent. It appeared that offenders older than 55 started to become slightly less consistent with age. This result is similar to the results found in some of the reaction time research. It appears that older people begin to be less consistent as they age.

These results could provide a possible connection to the reductions in criminal behavior as people age. If offenders become more consistent with age, and consistency is associated with a greater likelihood of decreases in risk, there may be some association between increases in consistency and higher levels of desistance with age. Or, the relationship could be spurious.

The next set of analyses was designed to determine if the average change in risk level over the long term was associated with the levels of intra-individual variability. Consitent with the predictions provided by the age-crime curve, there was a general .507 point reduction in criminal propensity per year. This is a very slow rate however, as a six point change is needed in order for the change to be clinically significant. Offender with greater consistency (lower levels of intra-individual variability), had larger negative rates of change than offenders with low levels of consistency (higher levels of intra-individual variability). The offenders with the lowest consistency tended to have a positive rate of change in risk. These results are consistent with the hypothesis that consistency is associated with better performance.

Since it was difficult to tell if there were differences in rates of change between offenders that were increasing or decreasing in risk levels over the long term at varying levels of consistency, an interaction term was created between the consistency measure and the desisting variable. This resulted in ten categories of consistency. Five categories represented offender that were increasing in risk and five categories represented offenders that were decreasing. The category widths were 1-point intervals of the iRSD variable from 0 to 4 and open categories for iRSD values over 4.

It appeared that offenders at each consistency level had different mean rates of change, depending upon whether the offenders that had increases or decreases in risk. In both cases, whether the offenders were increasing or decreasing in risk, the level of change varied by level of variability. This suggests that a certain amount of variability is inherent in the change process. If there is a lot of variability, there can be a lot of change, and if there are small amounts of variability, there can be little change. However, as the variability increases, the rate of change for offenders with increases in risk grows at a faster rate than the rate of change for offenders with decreases in risk. From the results in Table 7, it is apparent that if the numbers of offenders with increases and decreases in risk are compared by risk level, the odds of an offender having a decrease in risk are substantially higher for offenders with high levels of consistency (low variability). In addition, the magnitude of the decreases are higher than the magnitude of the increases for offenders with higher consistency.

Overview

From these data, it appears that there is some type of relationship between short-term fluctuation in criminal propensity and long-term change. The details of this relationship appears to be that when offenders have small amounts of fluctuation in the short term, the mean rate of long-term change is negative, and when offenders have large amounts of fluctuation in the short term, the mean rate of long-term change is positive. The reasons for this relationship are not exactly clear.

In attempt to determine if there were differences between offenders with high consistency and offenders with low consistency, correlation coefficients were calculated between the iRSD value for each individual and the standard deviations and means of the individual item scores. The results were placed in Appendix 1. There is some variation in the size of the correlations, which suggests that there are individual differences between offenders with high and low consistency. The correlations between the iRSD and the standard deviations of the item values provide a measure of how both covary with each other. The correlations between the iRSD and the mean item values provide a measure of the direction and strength of the relationship between the iRSD values and the average level of the item variables.

It appears that housing, employment, financial problems, drug problems, and attitude variables tend to be positively correlated with the iRSD values. There does not appear to be a very strong relationship between offenders with alcohol related problems and consistency. Age at first conviction and age at first police contact are both negatively correlated with the iRSD values, which suggests that there is something about offenders that get in trouble at a young age that makes them less likely to maintain consistent levels of change.

Study Limitations

The present study was limited because the long-term changes were calculated over a period of four years. This might not be a long enough period to represent the eventual trajectory for these offenders. The fact that the overall level of the group trajectory was negative suggests that all offenders eventually desist. There may be intermediate dynamics between the monthly dynamics found in the short-term changes and the long-term life span dynamics that occur over decades.

There were no experimental conditions in this study and so it is not clear what is causing the relationship between intra-individual variability and the longer trend.

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Appendix 1: Correlation Between iRSD Value and Individual Item SD and Mean Statistics

Question	r - iRSD- SD	r -iRSD - Mean
1.3 Total current offences	.336	.061
1.4 Any burglary	.153	.103
1.5 Court appearances aged <18	.148	.081
1.5 Number of Court appearances aged <18	.117	.070
1.6 Court appearances aged 18+	.325	.144
1.6 Number of Court appearances aged 18+	.387	.115
1.7 Age at first conviction	.096	.067
1.7 Age at first conviction	.116	-.137
1.8 Age at first police contact	.117	.095
1.8 Age at first police contact	.122	-.144
1.9 Previous custody aged <21	.170	.104
1.9 Number of previous custodies aged <21	.101	.082
1.10 Previous custody aged 21+	.235	.111
1.10 Number of previous custodies aged 21+	.191	.093
1.11 Any breach	.222	.198
1.12 Offending versatility	.258	.145
1.12 Number of offense types	.301	.146
2.2A - Carrying or using a weapon	.189	.024
2.2B - Any violence or threat of violence or coercion	.243	-.009
2.2C - Excessive use of violence or sadistic violence	.102	.005
2.2D - Arson	.043	.012
2.2E - Physical damage to property	.212	.049
2.2F - Sexual element to offending	.074	.003
2.7 - Were there other offenders involved?	.265	.056
2.7 - Number of others involved	.107	-.038
2.7 - Peer group influences	.221	.049
2.9a Sexual motivation	.068	.002
2.9b Financial motivation	.239	.118
2.9c Addiction / perceived needs	.246	.180
2.9d Emotional state of the offender	.234	-.023
2.9e Racial motivation or hatred of other identifiable group	.073	.002
2.9f Thrill seeking	.139	.043
2.9g Other	.102	-.003
2.10 Disinhibitors - alcohol use	.204	-.040
2.10 Disinhibitors - emotional states	.213	-.011
2.10 Disinhibitors - use of pornography	.017	-.014
2.10 Disinhibitors - drug use	.268	.190
2.10 Disinhibitors - non-compliance with medication	.048	.016
2.10 Disinhibitors - traumatic life events	.101	-.018
2.10 Disinhibitors - psychiatric problems	.072	.007

Appendix 1 – Continued

Question	r - iRSD- SD	r -iRSD - Mean
3.3 Currently no fixed abode	.353	.160
3.4 Suitability of accommodation	.383	.168
3.5 Permanence of accommodation	.380	.190
3.6 Suitability of location of accommodation	.391	.175
4.2 Employment status	.195	.155
4.3 Employment history	.228	.170
4.4 Work-related skills	.225	.126
4.5 Attitude to employment	.276	.099
4.6 School attendance	.178	.107
4.7 Reading/writing/numeracy	.152	.036
4.8 Learning difficulties	.122	.031
4.9 Any qualifications	.172	.036
4.10 Attitude to education/training	.215	.063
5.2 Financial situation	.290	.120
5.3 Financial management	.296	.128
5.4 Illegal earnings	.315	.151
5.5 Over reliance on others	.281	.132
5.6 Severe impediment to budgeting	.314	.121
6.1 Current relationship with family	.270	.113
6.2 Criminal family member	.163	.074
6.3 Experience of childhood	.197	.116
6.4 Current relationship with partner	.221	.019
6.5 Criminal partner	.151	.054
6.6 Previous relationship experience	.211	.077
6.7 Evidence of domestic violence / partner abuse - Perpetrator	.137	.029
6.7 Evidence of domestic violence / partner abuse - Victim	.089	.023
7.1 Community integration	.320	.149
7.2 Activities encourage offending	.447	.172
7.3 Influenced by criminal peers	.317	.164
7.4 Manipulative lifestyle	.271	.111
7.5 Recklessness/risk taking behaviour	.310	.134
8.4 Current drug misuse	.323	.206
8.5 Level of use of main drug	.411	.147
8.6 Injecting drugs	.261	.149
8.7 Drug-related violence	.188	.139
8.8 Motivation to tackle drugs	.398	.140
8.9 Drugs major part of lifestyle	.411	.160

Appendix 1 – Continued

Question	r - iRSD- SD	r -iRSD - Mean
9.1 Current alcohol use	.207	.007
9.2 Binge drinking	.193	.012
9.3 Previous alcohol use	.198	.046
9.4 Alcohol-related violence	.165	.042
9.5 Motivation to tackle alcohol misuse	.199	.021
10.1 Coping/depression	.245	.052
10.2 Current psychological problems	.196	.020
10.3 Social isolation	.221	.057
10.4 Attitude to self	.236	.068
10.5 Suicide/self-harm	.177	.060
10.6 Current psychiatric problems	.131	.015
10.7a - Evidence of childhood behavioural problems	.147	.092
10.7b - History of severe head injuries, fits, periods of unconsciousness	.063	.009
10.7c - History of psychiatric treatment	.084	.020
10.7d - Ever been on medication for mental health problems in the past	.118	.028
10.7e - Previously failed to co-operate with psychiatric treatment	.059	.028
10.7f - Ever been a patient in a Special Hospital or Regional Secure Unit	.052	.015
10.7g - Currently receiving psychiatric treatment or psych assessment	.080	.005
11.1 Interpersonal skills	.225	.071
11.2 Impulsivity	.277	.117
11.3 Temper control	.239	.060
11.4 Aggressive/controlling behaviour	.234	.055
11.5 Problem recognition	.283	.087
11.6 Problem solving	.280	.108
11.7 Awareness of consequences	.270	.073
11.8 Achieves goals	.315	.145
11.9 Understands others' views	.276	.090
11.10 Concrete/abstract thinking	.272	.082
12.1 Pro-criminal attitudes	.307	.131
12.2 Discriminatory attitudes	.162	.046
12.3 Attitude to staff	.243	.106
12.4 Attitude to supervision	.331	.170
12.5 Attitude to community/society	.281	.118
12.6 Understands motivation for offending	.278	.044
12.8 Motivation to address offending	.315	.145
13.1 General health concerns	.170	.010