# ASSESSING RISK OF RECIDIVISM AMONG JUVENILE OFFENDERS: THE RECIDIVISM RISK INSTRUMENT

# TECHNICAL REPORT

## October 2012

# Acknowledgements

Founded in 1991, LeCroy & Milligan Associates, Inc. is a consulting firm specializing in social services and education program evaluation and training that is comprehensive, research-driven and useful. Our goal is to provide effective program evaluation and training that enables stakeholders to document outcomes, provide accountability, and engage in continuous program improvement.

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# BACKGROUND TO THE STUDY

The past four decades have been witness to an increasing interest in risk assessment in the corrections field. Risk assessment is based on the calculation of statistical relationships between offender characteristics and outcomes such as recidivism. The process of risk assessment involves estimating an individual's likelihood of continued involvement in delinquent behavior, based on the relationship of specific characteristics to delinquency (Gottfredson & Moriarty, 2006; Krysik & LeCroy, 2002). Several trends have contributed to the increased popularity of risk assessment. A steady increase in the number of juveniles that were entering the juvenile justice system has heightened the demand for rehabilitation services. This increased demand for services combined with their high cost has prompted efforts to target services, based on a systematic assessment of need, to those at the high end of the risk continuum, while reducing efforts aimed at those on the low end. The assignment of low risk cases to intensive services may not only be a waste of scarce resources, but may in fact be criminogenic (Andrews et al. 1986).

Statistical risk assessment is increasingly being used to replace assessments based on "clinical" judgments which are subjective and less accurate than statistical instruments. Actuarial/statistical risk instruments generally classify youth as low-, medium-, or high-risk for recidivism by estimating an offender's likelihood of reoffending based on their similarity to others who have recidivated in the past. Accordingly, the goal of statistical risk instruments is to identify a group of offenders with different rates of recidivism and focus intensive treatment interventions on those offenders with the greatest risk of returning to custody.

Research has shown that a small number of offenders contribute disproportionately to the crime rate. For instance, research on two cohorts of first-time juvenile delinquents in Orange County, California found that approximately 10% of the juveniles accounted for over one-half of all subsequent offenses (Kurz & Moore, 1993). Based on these findings, Orange County developed a risk-based intervention strategy that emphasizes risk rather than crime seriousness. The recognition that a relatively few individuals commit the majority of crimes has prompted a more streamlined approach to the early identification of the most persistent juvenile offenders. The purpose of identifying high-risk juveniles early in their criminal careers is to provide them with cost effective prevention and treatment services. In Orange County, the chronic offender population averages nearly 20 months of incarceration within 6 years of their first offense, making the cost of incarceration alone $44,000 per individual *in 1993 dollars* (Kurz & Moore,

1993). At the rate of approximately 500 new chronic juvenile offenders per year, the estimated cost for incarceration in Orange County is $22 million per cohort. A reduction in placement would result in significant cost savings.

Further, there is reason to suspect that predictors of recidivism for boys differ from predictors of recidivism for girls (Emeka & Sorensen, 2009). For example, Plattner and colleagues (2009) identified sex specific predictors of recidivism among a sample of incarcerated youth. For boys, the strongest predictors for recidivism were age at first incarceration and presence of oppositional defiant disorder. For girls, the strongest predictors for recidivism were dysthymia (protective factor) and generalized anxiety disorder. Consistent with previous work, early aggressive or disruptive behavior was not a good predictor of later delinquency for girls.

The most common problem encountered in risk prediction research is data limitations. Data limitations constrain the potential for sophisticated and more appropriate statistical approaches to analysis. There are two basic sampling issues that lead to limitations in the data. First, the size of the sample is critical. In terms of how big the sample should be, Jones (1996) recommends at least 500, half for estimation and half for validation. If a large number of variables are being tested in multivariate statistical analysis, it is common practice to ensure that the sample includes at least 10 subjects for each predictor variable considered (Norman & Streiner, 1986). Second, the sample must be representative of the population to whom the instrument will be applied; therefore, it should be a random sample. Even if a sample is large and appropriately drawn, serious problems may still emerge. The patterns found in one sample can lead to overestimating patterns that might exist in other samples. Representativeness can encompass the variables of age, gender, race and ethnicity, regional area, and time period (Jones, 1996).

Criticism of several studies has revolved around the use of only one sample for estimation, and the subsequent failure to test the accuracy of the derived model on an independent *validation* sample (Krysik & LeCroy, 2002; Schwalbe, 2007). The primary purpose of using a separate sample for validation is to test the extent that empirically derived relationships persist across samples. When the risk assessment instrument is validated on the same sample from which it was estimated, the rate of correct classification is naturally much higher. Thus, the use of at least two samples is recommended, one for estimation and one or more for validation. The lack of differentiation on the criterion variable is always more apparent during validation than the construction of the instrument. The prediction instrument developed on a selective sample is often applied to a population containing a wider range of risk than that of those individuals originally studied. Under such circumstances, the best policy is to identify a random sample that is as closely related as possible to the population of interest. If this is not possible, it may be

useful to examine empirically differences between the original sample and the population of interest.

Invariably the best laid plans are constrained by the quality of the data available. Often this problem is not recognized, or it may be noticed and not addressed. The main effect of missing data is to reduce the size of the sample at the stage of multivariate analysis. How this problem is dealt with depends in part on how much data is missing, and how important the particular variables afflicted are thought to be as predictors. If there are few missing values and the data are missing completely at random, then the analysis should be based on those cases with a complete set of variable values (Jones, 1996). Other than a reduced sample size, this complete case approach poses no problems. An alternative approach that makes use of available information is to include all cases that have values for a specified group of variables. This available-cases approach has the significant disadvantage that statistics such as means and variances are based on samples of different sizes. A third approach is the imputation of missing values. This involves the estimation of missing values based on those data that are available (Little & Rubin, 1987).

In instances where a person's risk-level is assessed at more than one point in time, it is necessary to move away from a reliance on variables that remain constant toward more dynamic indicators. Static indicators can be historical (e.g., parent criminality) or ascribed (e.g., gender or race). As individuals can exercise no control over static factors, they are insensitive to change over time. The repeated use of these same variables can result in individuals being censured over and over for the same attributes. Psychiatric measures, response to supervision or institutionalization, employment, and family situation, are examples of dynamic factors. One risk assessment instrument involving dynamic factors is offered by Baird (1984). He has developed an initial risk assessment instrument and a reassessment instrument. His reassessment instrument retains the most significant initial predictors such as age at first adjudication, prior criminal behavior, and institutional placements of more than 30 days, and adds to this dynamic factors such as response to supervision and the use of community resources. Dynamic factors introduce a stronger element of judgment or discretion into the classification process. Underwood (1979) cautions that the inclusion of subjectively scored items may provide opportunity for personal biases to be passed off as scientific judgment.

The goal in risk assessment is to choose the smallest number of variables with the greatest predictive validity. This goal, however, can be modified by the issue of face validity. Burnham (1990) argues that decision makers feel uncomfortable with only a limited set of data items and require a range of information, most of which they do not take into account. He differentiates

between *information*, that which leads to predictive efficacy; and *noise*, those items necessary for the instrument to be supported by the user. Most commonly, prediction models include both individual and environmental variables as predictors. Ideally, the pool of possible predictors is theoretically derived, with one variable representing each theoretical construct, and each of the selected variables tested for validity and reliability. In practice, prediction in the area of criminality is constrained by poorly defined theory. Given these cautions, we turn our attention toward key predictor variables supported in the literature.

**Key Predictor Variables**

The Office of Juvenile Justice and Delinquency Prevention has identified a set of risk and protective factors related to delinquency for children age six through adolescence (U.S. Department of Justice and Delinquency Prevention). These risk factors include:

• extreme economic deprivation,
• community disorganization and poor neighborhood attachment,
• transitions and mobility,
• availability of firearms,
• media portrayals of violence,
• family management problems,
• family conflict,
• parental attitudes favorable toward crime or involvement in crime,
• early and persistent antisocial behavior,
• academic failure,
• lack of commitment to school,
• rebelliousness and alienation,
• association with peers who engage in delinquency,
• early initiation of delinquent and violent behaviors, and
• constitutional factors (low intelligence, hyperactivity, and attention deficit disorder).

Protective factors, i.e., those factors thought to decrease risk include:
• social bonding to a positive role model,
• healthy beliefs, and
• clear standards.

For a juvenile parolee population, Baird, Storrs, and Connolly (1984) identified eight items that were shown to be predictive of recidivism:

• age at first adjudication,
• prior delinquent behavior,
• number of prior commitments to juvenile facilities,
• drug or chemical abuse,
• family relationships,
• school problems, and
• peer relationship problems.

In his classic study, Greenwood (1982) developed a reoffending prediction score based on seven items:

• incarceration of more than half of the 2-year period preceding the most recent arrest,
• a prior conviction for the crime type that is being predicted,
• a juvenile conviction prior to age 16,
• commitment to a state or federal juvenile facility,
• heroin or barbiturate use in the 2-year period preceding the current arrest,
• heroin or barbiturate use as a juvenile, and
• employment for less than ½ of the 2-year period preceding the current arrest.

Employing a 0 or 1 scoring theme, Greenwood was able to discriminate between recidivists such that the low risk group (0 or 1 point) had a median annual offense rate of 1.4%, compared with a rate of 92.9% for the high risk group (4 or more points).

More recently, Vicent, Chapman & Cook (2011) conducted a study to validate the SAVRY which  comprises six items defining protective factors (that may lower the likelihood of risk) and 24 items defining risk factors (that may increase the likelihood of risk). Risk items are coded on the basis of clear statements in the manual describing the conditions under which a case receives a low, moderate, or high rating on each item, and protective-factor items are rated as present or absent. The risk items are divided conceptually into three domains: Historical (10 items), Social/Contextual (six items), and Individual/Clinical (eight items). The Historical items primarily are static in nature, and the Individual/Clinical and Social/Contextual items primarily are dynamic.

Beyond these, other studies point to a number of potential predictors of crime for juveniles and adults. Some of these include:

• early onset of problem behavior (Mitchell & Rosa, 1981),
• parenting and family management problems (Riley & Shaw, 1985),
• family size and structure (West, 1981),
• parental or sibling criminality (Farrington, 1983),
• delinquent peers (Reiss, 1986),
• alcohol use (Gottfredson, 1984),
• gender (Hindelang, Hirschi, & Weis, 1981),
• personality (McCord & McCord, 1964), and
• a history of opiate use (Gottfredson & Ballard,1964).


## THE CURRENT STUDY

The project purpose was to revalidate the Dynamic Risk Instrument (DRI) using variables resident in the Criminogenic and Protective Factors Assessment (CAPFA) 2. Special considerations included: 1) whether girls should be included with the boys in a recidivism risk instrument or if they should be addressed separately in a new model, and 2) whether substance abuse, gang affiliation, violence history, education, and employment factors should be addressed in a new model.

The method followed five steps recommended in the literature as necessary to the successful development and implementation of any risk assessment instrument (Gottfredson & Snyder, 2005; Krysik & LeCroy, 2002 ):

1. Clearly defining the behavior to be predicted (the outcome measure)
2. Identifying a set of potentially predictive variables
3. Measuring relations between the predictor variables and outcome measure to construct the risk model
4. Testing the relations/model in an independent validation sample
5. Applying the model in situations for which it was developed (i.e., implementation of the risk tool)

## DATA

The data were provided by the research and development staff at the Arizona Department of Juvenile Corrections (ADJC). Each juvenile completed the CAPFA 2. The CAPFA gathers information from 12 domains with respect to various familial, social, psychological, environmental, and attitudinal factors. Juveniles released during the 2009 and 2010 years were included in the current study ($N = 1,987$).

## DEPENDENT VARIABLE OR OUTCOME MEASURE

Identifying the outcome measure defines the standard for selecting predictors and testing the validity of the results (Gottfredson & Snyder, 2005). The primary dependent variable or outcome measure was recidivism or within 12 months. Recidivism is measured by return to custody at Arizona Department of Juvenile Corrections (ADJC) for either a technical violation or new offense. Recidivism also includes juvenile offenders who are released and then sentenced to the Arizona Department of Corrections. This outcome measure is commonly used by ADJC.

## INDEPENDENT VARIABLES OR PREDICTOR VARIABLES

The independent or predictor variables used in the final model were as follows:

*Age at First Adjudication* is the age at first adjudication. The original label assigned to this category was "a_ageadj". This was coded as 1 (less than 14 years old) and 0 (else).
*Total Number of Referrals* is the number of referrals. The original label assigned to this variable was "Referrals". This was coded as 1(1 referral), 2 (2 referrals), and so on.

*Number of Suspensions* is the total number of suspensions from school . The original label assigned to this variable was "s6_11_0_0". This was coded as 1 (never), 2 (1 or 2 times), 3 (3 or more times).

*Mother Past Incarcerated* indicates the juvenile's mother incarceration history. The original label assigned to this variable was "f8_3_1_6 " . This was coded as 1 (Yes) and 2 (No).

*Parent Past Incarcerated* is the juvenile's incarceration history of either parent. The original label assigned to this variable was "Parent_incar ". This was coded as 0 (never incarcerated) and 1 (history of incarceration).

*Firearm Use* is whether a firearm was used by the juvenile. The original label assigned to this field was "a4_4_0_0". This was coded as 1 (never), 2 (carried a firearm), 3 (threatened a person with a firearm), 4 (used a firearm against a person).

*History of Running Away or Getting Kicked Out of Home* is the number of times a juvenile ran away or was kicked out from home. The original label assigned to this field was "f8_5_0_0". This was coded as 1 (No history of running away or being kicked out), 2 (3 or less instances of running away/kicked out), 3 (4 to 7 instances of running away/kicked out), 4 (Over 7 instances of running away/kicked out).

*Gang Involvement* is whether the juvenile is formally involved in a gang. The original label assigned to this field was "Gang Involvement". This was coded as 1 (Juveniles that were recorded as gang members) and 0 (Juveniles that were not recorded as gang members).

*Behavior: Destroys Property/Steals* is how often a juvenile destroyed property or stole. The original label assigned to this field was "f8_26_10_0". This was coded as 1 (always), 2 (occasionally), 3 (never).

*Age at First Expulsion* is the age at first expulsion from school. The original label assigned to this category was "s6_14_0_0". This was coded as 1 (never expelled from school), 2 (6 to 10yrs old), 3 (11 to 15yrs old), 4 (16 to 18yrs old).

*Felony Class* is the class of the felony of the juvenile. The original label assigned to this field was "Felony Class". Scores range from 1 (severe offense) to 7 (minor offense).

## RESULTS

Empirical validation of the recidivism risk instrument followed six steps as recommended in the literature as necessary to the successful development and implementation of any prediction study:

1. The outcome variable was operationalized as recidivism within 12 months of release.

2. A set of potentially predictive items was specified to include all of those items available on the current DRI, items of special consideration, and other items available in the CAPFA 2.

3. Tests for bivariate relationships between the outcome variable (recidivism within 12 months) and the individual predictor variables were conducted using a random sample (an estimation

sample) of all active juveniles in the ADJC system in 2009 and 2010 using the (CAPFA) 2. Individuals were randomly assigned to one of two groups: an estimation sample (60% of the population) and a validation sample (the remaining 40%). Random assignment was employed to produce two equivalent groups. The estimation sample is used to determine the predictive power of the variables. The validation sample, in contrast, was drawn for the purpose of testing the predictive efficacy of the assessment instrument, as predictions are always more accurate when tested on the samples from which they were constructed than when tested on independent samples. Table 1 compares the estimation and validation samples.

*Table 1. Juveniles' Background Characteristics across Estimation and Validation Sample*

| Characteristic | Estimation Sample $n$= 1192 (60%) | Validation Sample $n$=795 (40%) |
|---|---|---|
| **Recidivism at 12 months** | 398 (33.4%) | 250 (31.4%) |
| **Gender** | | |
| Male | 1041 (87.3%) | 712 (89.6%) |
| Female | 151 (12.7%) | 83 (10.4%) |
| **Ethnicity** | | |
| Caucasian | 365 (30.6%) | 204 (25.7%) |
| African American | 144 (12.1%) | 85 (10.7%) |
| Native American | 58 (4.9%) | 48 (6.0%) |
| Hispanic | 571 (47.9%) | 427 (53.7%) |
| Asian | 5 (.4%) | 0 (0%) |
| Other | 4 (.4%) | 4 (.5%) |
| Mexican National | 42 (3.5%) | 26 (3.3%) |
| **Age** | | |
| At release | 17.00 (*SD*=.93) | 16.98 (*SD*=.95) |
| At first referral | 13.10 (*SD*=1.95) | 13.23 (*SD*=1.86) |

Note: No significant differences across groups for age, gender, or recidivism.

4. Then, the juveniles were separated into two groups: males and females. Bivariate relationships were tested separately for males and females. Bivariate correlations were assessed using Pearson's Product Moment Correlation to determine the Point Biseral Correlation (given that the recidivism variable is a discrete dichotomy, $r_{pb}$). A Spearman's Rho Correlation was also conducted for when the assumption of normality was not met and when both predictors were ordinal.

Based on the extent of missing data and the results of the bivariate relationships, the number of predictor variables was reduced to include only those which were significantly related to the outcome ($p < .05$), and which were consistently reported (less than 10% of missing data) as per the recommendation of Jones (1996) because they were unreliable (see Tables 2 and 3). Further, correlation matrices, including the variables that were retained for each gender, were examined to assess the likelihood of multicollinearity. Multicollinearity exists when predictor variables are highly correlated with one another. Ideally, predictor variables will be strongly correlated with the criterion (recidivism), but largely independent of each other, which means that each contributes uniquely to the overall risk score (Jones, 1996).

*Table 2. Bivariate Correlations of the Significant Predictor Variables with Recidivism at 12 months in the Estimation Sample by Gender (n = 1192)*

| | Girls (*n* = 151) | | Boys (*n* = 1041) | |
|---|---|---|---|---|
| | Pearson Correlation Coefficient (p value) | Variable Label | Pearson Correlation Coefficient (p value) | Variable Label |
| **DRI variables** | | | -.181 (.000), *n*=1041 | AgeAtFirst Referral |
| | | | .150 (.000), *n*=1041 | ReferralCountAtFirstCommit |
| | | | .089 (.004), *n*=1041 | Welfare |
| | | | .077 (.013), *n*=1041 | Respect for Authority |
| | | | .061 (.048), *n*=1041 | Level of Change |
| | | | .093 (.003), *n*=1041 | ParentUseofAlcohol |
| | .165 (.043), *n*=151 | ParentUseOfDrugs | | |
| | .202 (.013), *n*=151 | ParentIncarcerationHistory | Rho .070 (.024), *n*=1041 | ParentIncarcerationHistory |
| | | | .098 (.002), *n*=1041 | LevelOfResistance |
| **Substance Use** | | | .069 (.026), *n*=1039 | Substance Dependent |
| | | | -.111 (.000), *n*=1039 | N_A (No Substance Abuse) |
| | | | -.082 (.008), *n*=1038 | alchol cont fam confl-history (1=yes, 2=no) |
| | | | -.067 (.032), *n*=1038 | alchol intfe prosocial friends-history  (1=yes, 2=no) |
| | | | -.125 (.000), *n*=1038 | use drug-history  (1=yes, 2=no) |
| | | | -.077 (.013), *n*=1038 | drug intfe prosocial friends-history (1=yes, 2=no) |
| | | | -.094 (.003), *n*=1038 | drugs crim behavior-history (1=yes, 2=no) |
| | | | -.063 (.043), *n*=1038 | drugs crim behavior-current (1=yes, 2=no) |
| | | | *.111 (.000), n=1041* | *marij use (1=yes, 2=no)* |
| | | | -.135 (.000), *n*=970 | marij age 1st |
| | | | .089 (.006), *n*=970 | marij during offense (1=yes, 2=no) |
| | | | *.079 (.011), n=1041* | *inhalants use (1=yes, 2=no)* |
| | | | .084 (.007), *n*=1041 | history participating (5=problem, no treatment) |
| | | | -.085 (.006), *n*=1041 | no problem (alc/drug) (1=yes, 2=no) |
| | | | .099 (.001), *n*=1038 | juvenile attitude (5=uncooperative) |
| | | | .088 (.004), *n*=1038 | interview assessment (5=high priority) |

| | | | -.075 (.016), *n*=1041 | uses alcohol and drugs (3=never) |
|---|---|---|---|---|
| **Violence** | -.276 (.004), *n*=108 | *witnessed intentional violence inv/acquaintance* | | |
| | .265 (.001), *n*=151 | *No Reports of violent behaviors* | | |
| | | | .104 (.001), *n*=1038 | Intentionally cased physical injury (1=never) |
| | .186 (.023), *n*=150 | firearm Use | .091 (.003), *n*=1038 | firearm Use (4=used firearm against person) |
| | | | .088 (.005), *n*=1038 | over-react w/inappropriiate force or anger (1=never) |
| | | | .093 (.003), *n*=1038 | belief in phys aggression to resolve disagreement (1=never) |
| | | | .114 (.000), *n*=1038 | view of actions/intentions of others (1=easily tolerate) |
| | | | .133 (.000), *n*=1038 | interviewers assessment (5=high prority) |
| | | | .100 (.001), *n*=1038 | juvenile attitude toward changing aggressive beh's (5=uncooperative) |
| | | | -.079 (.011), *n*=1041 | destroys property/steals (3=never) |
| **School** | | | -.061 (.048), *n*=1041 | Records requested (1=no, 2=yes) |
| | | | .120 (.000), *n*=1041 | Special education Svs (1=no, 2=yes) |
| | Rho -.173 (.036), *n*=147 | *School Behavior Problems (1=no, 5=severe)* | .063 (.042), *n*=1030 | School Behavior Problems (1=no, 5=severe) |
| | -.170 (.039), *n*=148 | *Number of Suspensions* | .137 (.000), *n*=1041 | Number of suspensions (1=0, 3=3+) |
| | -.270 (.001), *n*=148 | *Number of Expulsions* | | |
| | | | -.068 (.029), *n*=1035 | Reading comprehension |
| | | | -.091 (.003), *n*=1035 | Math comprehension |
| | | | -.078 (.013), *n*=1030 | written expression |
| | | | -.063 (.043), *n*=1041 | current reading comprehension level (1=grades 1-3, 4= grades9-12) |
| | | | .064 (.038), *n*=1041 | believes education is important part of life (3=does not believe) |
| | | | .063 (.043), *n*=1041 | juvenile is close to teacher or coaches (3=not |

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| | Value (left) | Label (left) | Value (right) | Label (right) |
|---|---|---|---|---|
| | | | | close) |
| | -.211 (.010), n=148 | Involved in School Activities (5=no involvement) | | |
| | | | .102 (.001), n=1041 | believes school provides an encouraging env. (3=does not believe) |
| | | | .061 (.048), n=1041 | Attitude toward improving education (5=uncooperative to change) |
| **Family** | | | -.062 (.046), n=1041 | mother raised youth (1=yes, 0=no) |
| | | | -.104 (.001), n=960 | mother alcohol (1=yes, 2=no) |
| | -.171(.046), n=137 | mother drugs (1=yes, 2=no) | -.078 (.016), n=958 | mother drugs (1=yes, 2=no) |
| | | | -.101 (.002), n=958 | mother beh health (1=yes, 2=no) |
| | -.184 (.031), n=137 | mother past incarcerated (1=yes, 2=no) | -.126 (.000), n=954 | mother past incarcerated (1=yes, 2=no) |
| | | | -.116 (.000), n=958 | mother non-violent crim behavior (1=yes, 2=no) |
| | | | -.077 (.017), n=953 | mother violent crim beh (1=yes, 2=no) |
| | .234 (.004), n=151 | other relatives raised youth | | |
| | -.164 (.047), n=148 | youth's relative living in home | | |
| | | | -.081 (.009), n=1041 | AntSocHome (scale, 3=never) |
| | | | .120 (.000), n=1041 | History of running away or getting kicked out |
| | | | .077 (.013), n=1041 | History of being a victim of neglect |
| | | | -.090 (.004), n=1041 | runs away (3=never) |
| | | | .079 (.011), n=1041 | what assistance has family received in the past: counseling |
| | | | -.061 (.049), n=1041 | what assistance has family received in the past: none |
| | | | .074 (.017), n=1041 | what assistance does family want now? (family counseling) |
| | .180 (.027), n=151 | what assistance does family want now? (housing) | | |
| | | | .062 (.044), n=1041 | level of conflict within the family: no conflict (1=no conflict, 0=conflict) *constructed scale was n.s. |
| | .159 (.051), n=151 | placement (1=yes, 0=no) | | |
| | | | -.083 (.007), n=1041 | Independent living (1=yes, 0=no) |

| | | | | |
|---|---|---|---|---|
| | | | .090 (.004), *n*=1041 | Return to family – family services needed (1=yes, 0=no) |
| **Peers** | .190 (.019), *n*=151 | gang involvement with gangnet and social influences | .133 (.000), *n*=1041 | gang involvement with gangnet and social influences |
| | | | -.075 (.016), *n*=1041 | peers/companions spent time with: pro-social peers (1=yes, 0=no) |
| | .176 (.030), *n*=151 | peers/companions spent time with: gang member/affiliation (1=yes, 0=no) | .094 (.003), *n*=1041 | peers/companions spent time with: gang member/affiliation (1=yes, 0=no) |
| | | | .082 (.008), *n*=1041 | role of peers in offense (4=crimes with peers) |
| | | | .070 (.024), *n*=1041 | admiration of peers anti-social peers (3=admires) |
| | | | .098 (.002), *n*=1041 | resistance to anti-social peer influence (5=leads) |
| | | | *Rho .068 (.028), n=1041* | *Recruiting Supportive role models (5=none)* |
| | | | *Rho -.069 (.026), n=1041* | *Currently in a romantic relationship (1=no, 2=yes, 3=yes & person is anti)* |
| | .161 (.050), *n*=148 | Juveniles attitude for changing peer relationships | | |
| | .172 (.036), *n*=148 | interviews assessment | .116 (.000), *n*=1041 | interviews assessment |
| | | | -.066 (.033), *n*=1041 | associates w/negative peers (3=never) |
| **Behavioral Health** | | | *-.074 (.017), n=1039* | *sexual abuse (1a) (1= no, 3=yes, evidence)* |
| | | | .062 (.045), *n*=1041 | Concerns regarding youth: history of suicidal behavior (1=yes, 0=no) |
| | | | .078 (.011), *n*=1041 | Concerns regarding youth: mental health concerns |
| | | | -.078(.012), *n*=1041 | Concerns regarding youth: none |
| | | | .079 (.011), *n*=1041 | Self-harm (4=multiple incidents) |
| | | | .097 (.002), *n*=1041 | History of conduct disorder before age 10 (3=strong evidence) |
| | | | .073 (.019), *n*=1041 | Mental health txt (5=requires evaluation) |
| | | | .068 (.029), *n*=1041 | Juveniles willingness to address mental health issues (5=uncooperative) |
| | | | .062 (.046), *n*=1041 | Interviewers assessment (MH high priority) |
| | | | .072 (.020), *n*=1041 | Past diagnoses (1=no, 2=yes) |
| | | | .064 (.043), *n*=991 | BASC-SRP T-Score: Attitude to School |
| | | | .112 (.000), *n*=991 | BASC-SRP T-Score: Attitude to Teacher |

| | | | | |
|---|---|---|---|---|
| | | | .097 (.002), *n*=991 | BASC-SRP T-Score: School Maladjustment |
| | | | .070 (.028), *n*=991 | BASC-SRP T-Score: Atypicality |
| | | | .073 (.021), *n*=990 | BASC-SRP T-Score: Social Stress |
| | | | .084 (.008), *n*=990 | BASC-SRP T-Score: Clinical Maladjustment |
| | | | .074 (.021), *n*=991 | BASC-SRP T-Score: Depression |
| | | | .100 (.002), *n*=991 | BASC-SRP T-Score: Sense of Inadequacy |
| | | | -.065 (.041), *n*=985 | BASC-SRP T-Score: Relations with parents |
| | | | -.088 (.006), *n*=985 | BASC-SRP T-Score: Self Reliance |
| | | | -.065 (.041), *n*=984 | BASC-SRP T-Score: Personal Adjustment Composite |
| **Other** | -.169 (.038), *n*=151 | Felony class | | |
| | .167 (.040), *n*=151 | 1physical_health_problems | | |
| | | | .153 (.000), *n*=1041 | # of Referrals |
| | | | Rho .061 (.048), *n*=1041 | Number of Prior Adjusdications |
| | | | Rho .062 (.046), *n*=1041 | regularly attends job |
| | | | .086 (.006), *n*=1041 | Interpreter needed |
| | | | -.107 (.001), *n*=1041 | Primary spoken language |
| | | | -.104 (.001), *n*=1041 | Primary written language |

*Note.* Only bivariate relationships that were significant at *p*<.05 are presented. Data that had more than 10% of the sample missing were excluded. This yielded a minimum sample of 136 girls and 937 boys. Correlations that were in the opposite direction than anticipated are italicized and were excluded from further analyses.

*Table 3. Variable Labels of Significant Predictors of Recidivism at 12 months in the Estimation Sample by Gender (n = 1192)*

|  | Girls (*n* = 151) | | Boys (*n* = 1041) | |
|---|---|---|---|---|
|  | **Variable Name** | **Variable Label** | **Variable Name** | **Variable Label** |
| **DRI variables** |  |  | AgeAtFirst Referral<br>ReferralCountAtFirstCommit<br>Welfare<br>Respect for Authority<br>Level of Change<br>ParentUseofAlcohol | AgeAtFirst Referral<br>ReferralCountAtFirstCommit<br>Welfare<br>Respect for Authority<br>Level of Change<br>ParentUseofAlcohol |
|  | ParentUseOfDrugs<br>ParentIncarceratio<br>nHistory | ParentUseOfDrugs<br>ParentIncarcerationHistory | ParentIncarcerationHistory<br>LevelOfResistance | ParentIncarcerationHistory<br>LevelOfResistance |
| **Substance Use** |  |  | a2_1_2_0<br>a2_1_7_0<br>a2_2_3_1<br>a2_2_4_1<br>a2_3_1_1<br>a2_3_4_1<br>a2_3_6_1<br>a2_3_6_2<br>*a2_4_6_1*<br>a2_4_6_2<br>a2_4_6_6<br>*a2_4_10_1*<br>a2_7_0_0<br>a2_8_1_0<br>a2_9_0_0<br>a2_10_0_0<br>f8_26_9_0 | Substance Dependent<br>N_A (No Substance Abuse)<br>alchol cont fam confl-history<br>alchol intfe prosocial friends-history<br>use drug-history<br>drug intfe prosocial friends-history<br>drugs crim behavior-history<br>drugs crim behavior-current<br>*marij use*<br>marij age 1st<br>marij during offense<br>*inhalants use*<br>history participating<br>no problem (alc/drug)<br>juvenile attitude<br>interview assessment<br>uses alcohol and drugs |
| **Violence** | *a4_1_3_0* | *witnessed intentional violence inv/acquaintance* |  |  |

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| | | | | |
|---|---|---|---|---|
| | *a4_2_1_0* | *No Reports of violent behaviors* | | |
| | | | a4_3_0_0 | Intentionally cased physical injury |
| | a4_4_0_0 | firearm Use | a4_4_0_0 | firearm Use |
| | | | a4_6_0_0 | over-react w/inappropriiate force or anger |
| | | | a4_8_0_0 | belief in phys aggression to resolve disagreement |
| | | | a4_9_0_0 | view of actions/intentions of others |
| | | | a4_11_0_0 | interviewers assessment |
| | | | a4_10_0_0 | juvenile attitude toward changing aggressive beh. |
| | | | f8_26_10_0 | destroys property/steals |
| **School** | | | s6_2_0_0 | Records requested |
| | | | s6_6_0_0 | Special education Svs |
| | *s6_10_0_0* | *School Behavior Problems* | s6_10_0_0 | School Behavior Problems |
| | *s6_11_0_0* | *Number of Suspensions* | s6_11_0_0 | Number of suspensions |
| | *s6_13_0_0* | *Number of Expulsions* | | |
| | | | s6_17_1_0 | Reading comprehension |
| | | | s6_17_2_0 | Math comprehension |
| | | | s6_17_3_0 | written expression |
| | | | s6_18_0_0 | current reading comprehension level |
| | | | s6_20_0_0 | believes education is important part of life |
| | | | s6_21_0_0 | juvenile is close to teacher or coaches |
| | *s6_22_0_0* | *Involved in School Activities* | | |
| | | | s6_23_0_0 | believes school provides an encouraging env. |
| | | | s6_25_0_0 | Attitude toward improving education |
| **Family** | | | f8_3_1_1 | mother raised youth |
| | | | f8_3_1_3 | mother alcohol |
| | f8_3_1_4 | mother drugs | f8_3_1_4 | mother drugs |
| | | | f8_3_1_5 | mother beh health |
| | f8_3_1_6 | mother past incarcerated | f8_3_1_6 | mother past incarcerated |
| | | | f8_3_1_8 | mother non-violent crim behavior |
| | | | f8_3_1_9 | mother violent crim beh |

| | | | | |
|---|---|---|---|---|
| | f8_3_7_1 | other relatives raised youth | | |
| | f8_12_12_1 | Youth's Relative - Living in Home | | |
| | | | AntSocHome | AntSocHome |
| | | | f8_5_0_0 | history of running away or getting kicked out |
| | | | f8_6_0_0 | History of being a victim of neglect |
| | | | f8_26_8_0 | Runs away |
| | | | f8_19_1_0 | what assistance has family received in the past: counseling |
| | | | f8_19_5_0 | what assistance has family received in the past: none |
| | | | f8_20_1_0 | what assistance does family want now? (family counseling) |
| | f8_20_2_0 | what assistance does family want now? (housing) | | |
| | | | *f8_25_1_0* | *level of conflict within the family:  no conflict* |
| | f8_34_2_0 | placement | | |
| | | | f8_34_3_0 | independent living |
| | | | f8_34_6_0 | return to family – family services needed |
| **Peers** | Gang_involvement | gang involvement with gangnet and social influences | Gang_involvement | gang involvement with gangnet and social influences |
| | | | s9_1_2_0 | peers/companions spent time with: pro-social peers |
| | s9_1_4_0 | peers/companions spent time with: gang member/affiliation | s9_1_4_0 | peers/companions spent time with: gang member/affiliation |
| | | | s9_4_0_0 | role of peers in offense |
| | | | s9_7_2_0 | admiration of peers anti-social peers |
| | | | s9_8_0_0 | resistance to anti-social peer influence |
| | | | *s9_9_0_0* | *Recruiting Supportive role models* |
| | | | *s9_10_0_0* | *Currently in a romantic relationship* |
| | s9_13_0_0 | Juveniles attitude for changing peer relationships | | |
| | s9_14_0_0 | Interviews assessment | s9_14_0_0 | interviews assessment |

| | | | | |
|---|---|---|---|---|
| | | | f8_26_14_0 | associates w/negative peers |
| **Behavioral Health** | | | *s5_1_0_0* | *sexual abuse* |
| | | | f8_14_1_0 | concerns regarding youth: history of suicidal behavior |
| | | | f8_14_4_0 | Concerns regarding youth: mental health concerns |
| | | | f8_14_5_0 | Concerns regarding youth: none |
| | | | b13_2_0_0 | Self-harm |
| | | | b13_8_0_0 | History of conduct disorder |
| | | | b13_10_0_0 | Mental health txt |
| | | | b13_12_0_0 | Juveniles willingness to address mental health issues |
| | | | b13_13_0_0 | Interviewers assessment |
| | | | b13_14_0_0 | Past diagnoses |
| | | | b13_23_1_0 | BASC-SRP T-Score: Attitude to School |
| | | | b13_23_2_0 | BASC-SRP T-Score: Attitude to Teacher |
| | | | b13_23_4_0 | BASC-SRP T-Score: School Maladjustment |
| | | | b13_23_5_0 | BASC-SRP T-Score: Atypicality |
| | | | b13_23_8_0 | BASC-SRP T-Score: Social Stress |
| | | | b13_23_10_0 | BASC-SRP T-Score: Clinical Maladjustment |
| | | | b13_23_11_0 | BASC-SRP T-Score: Depression |
| | | | b13_23_12_0 | BASC-SRP T-Score: Sense of Inadequacy |
| | | | b13_24_1_0 | BASC-SRP T-Score: Relations with parents |
| | | | b13_24_4_0 | BASC-SRP T-Score: Self Reliance |
| | | | b13_24_5_0 | BASC-SRP T-Score: Personal Adjustment Composite |
| **Other** | FelClass | Felony Class | | |
| | @3_1_0_0 | 1physical_health_problems | | |
| | | | Referrals | # of Referrals |
| | | | NbrPriorAdjudication | Number of Prior Adjusdications |
| | | | f8_26_2_0 | regularly attends job |
| | | | f8_10_1_0 | interpreter needed |
| | | | f8_10_2_0 | primary spoken language |

| f8_10_3_0 | primary written language |
|---|---|

*Note.* Only labels of bivariate relationships that were significant at $p<.05$ are presented. Data that had more than 10% of the sample missing were excluded. This yielded a minimum sample of 136 girls and 937 boys. Correlations that were in the opposite direction than anticipated are italicized and were excluded from further analyses.

Consultation with ADJC resulted in the consideration of additional variables based on their previous experience in the field (see Table 4).

*Table 4. Bivariate Correlations of the Predictor Variables identified a priori with Recidivism at 12 months in the Estimation Sample by Gender (n = 1192; Girls on the top half, Boys on the bottom half).*

| | | Recidivism at 12 months | Age at first Adjudication | # of Referrals | felclass | Substance/Alcohol problem | Attending School | number of suspensions | gang involvement | Resistance to anti-social peer influence | one or both parents have been incarcerated | one or both parents have used drugs | Substantiated abuse | History of prostotiton | Firearm Use |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recidivism at 12 months | Correlation | 1 | .124 | -.067 | -.169* | .104 | -.124 | -.170* | .190* | .056 | .155 | .231** | .013 | .126 | .186* |
| | Sig. | | .129 | .413 | .038 | .206 | .134 | .039 | .019 | .501 | .058 | .004 | .876 | .223 | .023 |
| | N | | 151 | 150 | 151 | 151 | 148 | 148 | 151 | 148 | 151 | 151 | 148 | 95 | 150 |
| Age at first Adjudication | Correlation | .154** | 1 | .204* | .067 | .054 | -.163* | .009 | .141 | -.114 | .027 | -.110 | -.002 | -.045 | -.054 |
| | Sig. | .000 | | .012 | .415 | .512 | .047 | .913 | .084 | .169 | .743 | .177 | .982 | .668 | .508 |
| | N | 1041 | | 150 | 151 | 151 | 148 | 148 | 151 | 148 | 151 | 151 | 148 | 95 | 150 |
| # of Referrals | Correlation | .153** | .290** | 1 | .051 | .103 | -.088 | -.074 | .107 | .172* | -.083 | -.150 | -.015 | .024 | -.181* |
| | Sig. | .000 | .000 | | .533 | .209 | .291 | .372 | .193 | .037 | .312 | .067 | .855 | .822 | .027 |
| | N | 1041 | 1041 | | 150 | 150 | 147 | 147 | 150 | 147 | 150 | 150 | 147 | 94 | 149 |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| felclass | Correlation | **.024** | .016 | .128** | 1 | .007 | -.147 | .127 | -.022 | .117 | -.118 | -.006 | .072 | .027 | .008 |
| | Sig. | .438 | .609 | .000 | | .931 | .075 | .125 | .789 | .156 | .150 | .939 | .387 | .795 | .923 |
| | N | 1041 | 1041 | 1041 | | 151 | 148 | 148 | 151 | 148 | 151 | 151 | 148 | 95 | 150 |
| Substance/Alcohol problem | Correlation | **.107**** | .064* | .189** | .195** | 1 | .090 | -.010 | -.012 | .156 | .104 | .030 | -.051 | .151 | .024 |
| | Sig. | .001 | .039 | .000 | .000 | | .279 | .906 | .885 | .058 | .202 | .718 | .540 | .144 | .767 |
| | N | 1039 | 1039 | 1039 | 1039 | | 148 | 148 | 151 | 148 | 151 | 151 | 148 | 95 | 150 |
| Attending School | Correlation | **-.032** | -.049 | .026 | .052 | .059 | 1 | .021 | -.080 | .115 | .039 | -.003 | -.124 | .039 | -.088 |
| | Sig. | .309 | .117 | .405 | .092 | .059 | | .802 | .334 | .162 | .634 | .972 | .132 | .713 | .288 |
| | N | 1041 | 1041 | 1041 | 1041 | 1039 | | 148 | 148 | 148 | 148 | 148 | 148 | 92 | 148 |
| number of suspensions | Correlation | **.137**** | .194** | .179** | .085 | .177** | -.015 | 1 | .189* | .039 | -.029 | -.192* | .185* | -.108 | .154 |
| | Sig. | .000 | .000 | .000 | .006 | .000 | .637 | | .022 | .635 | .729 | .020 | .024 | .307 | .061 |
| | N | 1041 | 1041 | 1041 | 1041 | 1039 | 1041 | | 148 | 148 | 148 | 148 | 148 | 92 | 148 |
| gang involvement | Correlation | **.133**** | .074* | .156* | .023 | .188** | .031 | .131** | 1 | .196* | .030 | -.061 | .078 | -.093 | .323** |
| | Sig. | .000 | .017 | .000 | .455 | .000 | .311 | .000 | | .017 | .715 | .460 | .344 | .373 | .000 |
| | N | 1041 | 1041 | 1041 | 1041 | 1039 | 1041 | 1041 | | 148 | 151 | 151 | 148 | 95 | 150 |
| Resistance to anti-peers | Correlation | **.098**** | .060 | .130** | .062 | .187** | .073* | .134** | .194** | 1 | .018 | .005 | -.093 | -.037 | .024 |
| | Sig. | .002 | .054 | .000 | .045 | .000 | .019 | .000 | .000 | | .828 | .947 | .261 | .725 | .775 |
| | N | 1041 | 1041 | 1041 | 1041 | 1039 | 1041 | 1041 | 1041 | | 148 | 148 | 148 | 92 | 148 |
| incarcerated parents have been | Correlation | **.060** | .087** | .067* | .015 | .033 | .056 | .027 | .020 | -.009 | 1 | .507** | .115 | .079 | .109 |
| | Sig. | .051 | .005 | .030 | .622 | .293 | .070 | .393 | .510 | .767 | | .000 | .166 | .446 | .186 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| incarcerated parents used drugs | N | 1041 | 1041 | 1041 | 1041 | 1039 | 1041 | 1041 | 1041 | 1041 | | 151 | 148 | 95 | 150 |
| | Correlation | .065* | .109** | .077* | .044 | .061* | .058 | -.009 | .114** | .049 | .552** | 1 | -.135 | .135 | .033 |
| | Sig. | .037 | .000 | .013 | .155 | .049 | .061 | .768 | .000 | .112 | .000 | | .103 | .190 | .689 |
| | N | 1041 | 1041 | 1041 | 1041 | 1039 | 1041 | 1041 | 1041 | 1041 | 1041 | | 148 | 95 | 150 |
| Substantiated abuse | Correlation | -.015 | .061* | -.081** | -.116** | -.244** | -.043 | -.026 | -.131** | -.093** | .036 | -.042 | 1 | -.185 | .169* |
| | Sig. | .639 | .048 | .009 | .000 | .000 | .165 | .398 | .000 | .003 | .250 | .176 | | .077 | .040 |
| | N | 1041 | 1041 | 1041 | 1041 | 1039 | 1041 | 1041 | 1041 | 1041 | 1041 | 1041 | | 92 | 148 |
| History of prostitution | Correlation | | | | | | | | | | | | | 1 | .125 |
| | Sig. | | | | | | | | | | | | | | .229 |
| | N | | | | | | | | | | | | | | 94 |
| Firearm Use | Correlation | .091** | -.006 | -.005 | -.025 | .117* | .051 | .062* | .182** | .088** | .021 | .061 | -.015 | | 1 |
| | Sig. | .003 | .846 | .862 | .429 | .000 | .102 | .047 | .000 | .005 | .500 | .051 | .626 | | |
| | N | 1038 | 1038 | 1038 | 1038 | 1038 | 1038 | 1038 | 1038 | 1038 | 1038 | 1038 | 1038 | | |

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Navy blue = significantly predicts recidivism

Red = significantly predicts recidivism in the wrong direction

Green = More than 10% of the sample is missing

This reduced set of variables was then entered in a stepwise logistic regression equation, using the same random sample as above, to determine a reduced set of best predictors. Once the best model was determined using stepwise logistic regression, another regression equation was run with simultaneous entry of the predictor variables. This second model was used to provide the maximum likelihood coefficient associated with each statistically significant predictor.

Logistic regression is the preferred statistical procedure to use when attempting to predict a discrete outcome such as recidivism versus non-recidivism from a set of predictor variables that may be continuous, discrete, dichotomous, or a mixture (Norman & Streiner, 1986; Vogt, 1993). Logistic regression answers the same questions as discriminant analysis. Unlike discriminant analysis, however, logistic regression is more flexible because it makes no assumptions about the distribution of the predictor variables (i.e., the predictor variables do not have to be normally distributed, linearly related to the dependent variable, or of equal variance in each group). Unlike the statistical procedure called Logit, the predictor variables do not have to be discrete in a logistic regression analysis.

In logistic regression, the data are transformed by taking their natural logarithms so as to reduce nonlinearity (Norusis, 1992). Maximum likelihood methods are used instead of the more commonly known least-squares method to calculate the log istic coefficients. Logistic coefficients are selected that would make the sample data most likely to have been observed. The logistic coefficients are called *maximum likelihood coefficients* and have a different interpretation than least squares regression coefficients found in linear regression techniques.

In linear regression, the coefficient tells the amount of change expected in the dependent variable for a one-unit change in the independent variable. In logistic regression, the coefficient can be interpreted as the change in the log odds of being in the category of interest on the dependent variable (the category coded as 1), associated with a one-unit change in the independent variable, controlling for all other predictors in the model (Demaris, 1992; Norusis, 1992). Analogous to the coefficient produced by linear regression, the logistic coefficient can be interpreted with regard to direction, relative magnitude, and statistical significance (Nichols-Casebolt & Garfinkel, 1991). A positive coefficient increases the odds of being in the category of interest (recidivism) and a negative coefficient decreases the odds.

The goodness of fit test is used to choose the model that does the best job of prediction with the fewest predictors. The Log-likelihood statistic is analogous to the residual sum of squares in multiple regression. It is an indicator of how much unexplained information there is after the model has been fitted. Large values indicate poorly fitting statistical models.

$$\text{log} - \text{likelihood} = \sum_{i=1}^{N} \left[ Y_i \ln \left( P(Y_i) \right) + \left( -Y_i \right) \ln \left( -P(Y_i) \right) \right]$$

Using the log-likelihood for different models we can compare models by looking at the difference between their log-likelihoods and testing for statistical significance.

$$\chi^2 = 2 \left[ LL(New) - LL(Baseline) \right] \qquad \qquad df = k_{new} - k_{baseline}$$

The final logistic model is presented in Tables 5 and 6 for females and males, respectively.

*Table 5. Logistic Regression Model Using Simultaneous Entry Predicting Recidivism at 12 months for Girls for 3$^{rd}$ Model, (Estimation Sample, n=148, 3 missing cases).*

| | B | SE | Wald | Df | Sig | Exp(B) | 95% CI for Exp(B) |
|---|---|---|---|---|---|---|---|
| **Age of First Expulsion** (1=n/a, 2=6-10yrs, 3=11-15yrs, 4=16-18yrs) s6_14_0_0 STATIC | -.619 | .212 | 8.514 | 1 | **.004** | .539 | .355-.816 |
| **Parent Incarcerated** (0=No, 1=Yes) Parent_incar STATIC | 1.015 | .396 | 6.584 | 1 | **.010** | 2.760 | 1.271-5.995 |
| **Gang Involvement** (0=not involved, 1=involved in a gang) DYNAMIC | .935 | .428 | 4.780 | 1 | **.029** | 2.548 | 1.102-5.894 |
| **Felony Class** (1=severe offense to 7=minor offense) STATIC | -.305 | .148 | 4.256 | 1 | **.039** | .737 | .552-.985 |
| **Firearm Use** (1=0, 2=carried a firearm, 3=threatened a person w/firearm, 4=used firearm against person) a4_4_0_0 STATIC | .474 | .263 | 3.248 | 1 | .072 | 1.606 | .959-2.688 |
| Constant | .738 | .994 | .551 | 1 | .458 | 2.093 | |

*Note.* Model: -2 Log likelihood (df=5) = 157.509, Pseudo R$^2$ (Nagelkerke)= .268
X$^2$ = 6.288, $p > .05$ (Hosmer and Lemeshow Test)

*Table 6. Logistic Regression Model Using Simultaneous Entry Predicting Recidivism at 12 months for Boys for 3<sup>rd</sup> Model, (Estimation Sample, n=951, 90 missing).*

| | B | SE | Wald | Df | Sig | Exp(B) | 95% CI for Exp(B) |
|---|---|---|---|---|---|---|---|
| **Age at First Adjudication** (1=less than 14 years old, 0 = else) a_ageadj STATIC | .798 | .245 | 10.643 | 1 | **.001** | 2.221 | 1.375-3.588 |
| **Total Number of Referrals** (Number of Referrals) Referrals STATIC | .034 | .013 | 6.819 | 1 | **.009** | 1.035 | 1.009-1.061 |
| **Number of Suspensions** (1=0, 2=1 or 2, 3=3+) s6_11_0_0 STATIC | .299 | .114 | 6.896 | 1 | **.009** | 1.349 | 1.079-1.687 |
| **Mother Past Incarcerated** (1=Yes, 2=No) f8_3_1_6 STATIC | -.435 | .168 | 6.735 | 1 | **.009** | .647 | .466-.899 |
| **Firearm Use** (1=0, 2=carried a firearm, 3=threatened a person w/firearm, 4=used firearm against person) a4_4_0_0 STATIC | .235 | .095 | 6.137 | 1 | **.013** | 1.265 | 1.050-1.524 |
| **History of Running Away or Getting Kicked Out of Home** (1=never, 2=1-3, 3=4-7, 4=8+ instances) f8_5_0_0 STATIC | .152 | .068 | 4.975 | 1 | **.026** | 1.164 | 1.019-1.329 |
| **Gang Involvement** (0=not involved, 1=involved in a gang) DYNAMIC | .318 | .150 | 4.488 | 1 | **.034** | 1.375 | 1.024-1.845 |
| **Behavior: Destroys Property/Steals** | -.192 | .099 | 3.759 | 1 | .053 | .825 | .679-1.002 |

| | | | | | | |
|---|---|---|---|---|---|---|
| (1=always, 2=occasionally, 3=rarely/never) f8_26_10_0 DYNAMIC | | | | | | |
| Constant | -2.215 | .559 | 15.701 | 1 | .000 | .109 |

*Note.* Model: -2 Log likelihood (df=8) = 1120.618, Pseudo $R^2$ (Nagelkerke)= .115
$X^2 = 7.152$, $p > .05$ (Hosmer and Lemeshow Test)

5. The predicted probabilities using the maximum likelihood coefficients produced by the logistic regression equation were then used to predict recidivism in the validation sample (an independent random sample of juveniles, i.e., the remaining 40% of the sample). Using the estimation procedures developed on one sample (the estimation sample) with an independent sample (the validation sample) is referred to as cross-validation. Without it, there can be little confidence in the utility of the prediction method.

$$P = \frac{\exp(b_0 + b_1 X_1 + \ldots b_n X_n X_n)}{1 + \exp(b_0 + b_1 X_1 + \ldots b_n X_n X_n)} (100)$$

The findings are presented for females (Table 7) and males (Table 8).

Table 7. *Recidivism Using Predicted Probabilities for Girls for 3rd Model (n=82, 1 missing).*

| Probability of Recidivism | Risk Classification | Number of Cases (%) | Subsequent Recidivism |
|---|---|---|---|
| 0 - .2499 | Low-Moderate | 32 (39.0)[a] | 6.3% |
| .25 - .4499 | Moderate-High | 41 (50.0)[b] | 39.0% |
| .45 plus | High | 9 (11.0)[b] | 55.6% |
| **Total** | | | 28.0% |

*Note.* Differences between risk classification groups by subsequent recidivism are significant based on z-tests of proportions at *p*<.05. Alphabetical letters indicate which groups are significantly different from each other (i.e., same letters indicate the groups were not significantly different from each other). High risk group recidivated at 8.8 times that of low-moderate risk group and 1.4 times that of moderate-high risk group.

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Table 8. *Recidivism Using Predicted Probabilities for Boys for 3<sup>rd</sup> Model (n=652, 60 missing).*

| Probability of Recidivism | Risk Classification | Number of Cases (%) | Subsequent Recidivism |
|---|---|---|---|
| 0 - .1999 | Low-Moderate | 165 (25.3)[a] | 9.7% |
| .20 - .4999 | Moderate-High | 413 (63.3)[b] | 36.6% |
| .50 plus | High | 74 (11.3)[c] | 54.1% |
| Total | | 652 (100) | 31.7% |

*Note.* Differences between risk classification groups by subsequent recidivism are significant based on z-tests of proportions at *p*<.05. Alphabetical letters indicate which groups are significantly different from each other (i.e., same letters indicate the groups were not significantly different from each other). High risk group recidivated at 5.6 times that of the low-moderate risk group and 1.5 times that of the moderate-high risk group.

6. Contextual issues that would affect implementation of a recidivism risk instrument such as perceptions around usefulness and utility were assessed in meeting with the research and development team at the Arizona Department of Juvenile Corrections. Together, a final recidivism risk instrument was developed for females and males, respectively.

## CONCLUSIONS

The current system has facilitated the collection of a large amount of data on each juvenile that is easily accessible for purposes of validation research. Subsequent analysis to determine a set of items that were most predictive of risk produced results that were consistent with the literature. This is not to imply that the remaining items on the current risk assessment instrument are not important in assessing a juvenile's need for treatment, or to assess danger to themselves or society, but these items (5 for girls, 8 for boys) provide the most efficient and effective avenue to predict risk for subsequent offense within one year of release.

For **girls**, items that were more predictive in order of predictive ability are:
 Age at First Expulsion
 Parent Past Incarcerated
 Gang Involvement
 Felony Class
 Firearm Use

For **boys**, items that were more predictive in order of predictive ability are:
 Age at First Adjudication
 Total Number of Referrals
 Number of Suspensions
 Mother Past Incarcerated

Firearm Use

Runaway

Gang Involvement

Destroys Property/Steals

The two models identified by our analysis exhibited a degree of predictive validity that meets conventional standards of risk assessment research. Well-designed instruments are typically able to identify a group of high risk- offenders whose probability of selection is four to five times higher than low-risk offenders (Wagner, et al., 1994). In our analysis, Girls in the highest risk group recidivated 8.8 times that of the lowest risk group, boys in the highest risk group recidivated 5.6 times that of the lowest risk group. Gottfredson (1987) reported that in criminology, the generally poor quality of data, combined with the highly random nature of criminal behavior, ensures that prediction research rarely explains more than 15% to 20% of the outcome variance, and may never do much better than 30%. Outcome variance refers to the amount of variability in recidivism that can be explained by or attributed to predictor variables. That is, our best models on recidivism typically have small to moderate effect sizes, reaching a ceiling of approximately 30%. The two models met or exceeded those standards. In our analysis, the model for the boys predicted 12% of the outcome variance and the model with girls predicted 27% of the outcome variance (i.e., small to moderate effect sizes) which is the maximum predictive ability in recidivism research. Actuarial tools have been shown to consistently outperform practitioner and professional clinical assessments (Lowenkamp, Holsinger, and Latessa, 2001; Van Voorhis and Brown, 1997). These tools are able to account for a wide variety of background factors that subjective or professional assessments cannot capture. For this reason, agencies are able to employ these tools with a great deal of confidence knowing they can efficiently and validly identify high-risk youth.

## RECOMMENDATIONS

1. Adopt the recommended procedure for assessing juveniles' risk for recidivism throughout the course of treatment. This would require programming into the current information system the predicted probability equations using the maximum likelihood coefficients corresponding to the variables that were determined to be the most predictive for male and female juveniles. This would produce a percentage of risk for subsequent offense for each juvenile. The programming must include a differentiation between missing data and scores of zero. The score should not be interpreted if there is 80% or more of the data on the risk assessment items missing (i.e., more than 1 out of 5 items).

2. Decrease the data collection burden by decreasing the number of items on the current risk assessment instrument to include only those items that are predictive of risk, those items that are

important for needs assessment and service planning, and those items that are important for the consideration of community standards. The revised instrument should indicate through subheadings and grouping, which items are used for predicting risk of recidivism, which are used for case planning according to individual need, and which are for community standards.

3. In assessing the items to be retained for the risk assessment, information from the literature review should be considered. For example, the literature review recommended that domains of substance abuse, family relationship, emotional stability (suicide), school attendance and behavior, peer relationships, health and hygiene, intellectual ability, and learning disabilities be considered in assessing need for case planning.

4. Plan for and carry out subsequent empirical validation of the risk assessment instrument on a regular basis (yearly or every two years).The first occurrence of validation for the revised system requires two full years of implementation (one year of active cases, and one full year of follow-up). The predictive validity of the items used to predict risk can change over time as juveniles and their families change. Thus it is important to validate the instrument to assess its predictive validity over time, and to calculate the predicted probabilities used to predict subsequent risk. The cross-validation method which uses independent estimation and validation samples should be used for subsequent validation research.

5. Continue efforts to match risk-level with treatment planning and evaluate outcomes in terms of subsequent referral.

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