# Gender Differences in Risk Factors for Violence: An Examination of the Predictive Validity of the Structured Assessment of Violence Risk in Youth

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The research literature on predicting violence is particularly lacking in specifying risk factors for violence in adolescent girls. The recently developed Structured Assessment of Violence Risk in Youth [SAVRY; Borum et al., 2006] shows promise as it is empirically derived and incorporates dynamic factors in its assessment of risk. To date, there exists little information attesting to the reliability and validity of the SAVRY, and few investigations of the SAVRY's utility across gender. This study investigated the SAVRY in a sample of 144 high-risk adolescents (80 males and 64 females), focusing on gender discrepancies in the predictive utility of the measure. Results indicate that the SAVRY moderately predicts violent and non-violent reoffending in the entire sample, and also suggest that the SAVRY operates comparably across gender. Although not precluding the existence of gender-specific domains of risk, current results suggest that validated risk factors in boys hold relevance for the prediction of violence and delinquency in girls. Aggr. Behav. 36:390–404, 2010. © 2010 Wiley-Liss, Inc.

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## INTRODUCTION

Youth violence is regarded as a serious public health issue that has gained national attention. Between 1988 and 1994, the United States witnessed a 50% increase in total juvenile arrests for violent crimes [Howell et al., 1995; Snyder et al., 1996]. In Canada, from 1997 to 2006, violent crime rates among youth increased by 12%, representing a 30% increase from 1991 [Milligan, 2006]. Charges of simple assault accounted for the bulk of this increase, while rates of serious youth violence in Canada (e.g. homicide and sexual assault) have remained largely consistent for the past three decades [Bromwich, 2002]. More recent rates of juvenile arrests for violent crimes in the United States have also been decreasing [Snyder, 2003], but have remained above the averages recorded in the early to mid-1980s.

Given that many acts of violence are not detected by official statistics, data from self-report studies are also informative. Data from the Youth Risk Behavior Survey indicated that 44% of boys and 27% of girls reported being in a physical fight at least once in the past year, whereas 23% of boys and 12% of girls reported committing at least one previous act of assault [Centers for Disease Control and Prevention, 2004]. In a large survey of Canadian youth aged 12–15 years, 18% of males and 8% of females reported committing at least one act of violent delinquency over the past year, while more than 25% reported experiencing chronic victimization at school [Savoie, 2006]. These figures are alarming considering the deleterious consequences on the physical and mental health of both victims and perpetrators of youth violence [Cooley-Quille et al., 1995; Fehon et al., 2001].

## Precursors and Correlates of Youth Violence

In light of these figures, assessing and reducing violence risk among youth have emerged as high-priority objectives [Zimring, 1998]. Increasing knowledge surrounding the precursors of youth violence represents an essential step in this regard, as well as in the development of empirically based prevention and intervention approaches. Several large-scale, longitudinal research studies [e.g. Pittsburgh Youth Study; Loeber et al., 1998; Seattle Social Development Project; Herrenkohl et al., 2000; Cambridge Study in Delinquent Development; Farrington et al., 2006; Jyvaskyla Longitudinal Study of Personality and Social Development; Kokko and Pulkkinen, 2005; Pulkkinen, 1992; Individual Development and Adaptation Study; Bergman and Andershed, 2009; Magnusson, 1988; Columbia County Longitudinal Study; Eron et al., 1991; Huesmann et al., 2009; and the Dunedin Study; Moffitt et al., 2001], have identified risk factors at the individual, family, school, peer, and community levels that predict violence and criminality. Variables such as previous violence, early onset behavioral problems, poor academic performance, peer delinquency, and community disorganization consistently emerge as predictors of future violence and also show utility in distinguishing adolescent-limited from more persistent delinquency [Loeber et al., 2005; Stouthamer-Loeber et al., 2002]. These findings are consistent with earlier meta-analytic studies examining variables that are linked to violent and non-violent reoffending among juveniles [e.g. antisocial attitudes and peers, conduct problems, academic difficulties, poor parental supervision, and poor parent–child relations; Loeber and Dishion, 1983; Simourd and Andrews, 1994].

Unfortunately, few studies have included a sufficient number of females to investigate the moderating role of gender on other risk factors for violence. The Pittsburgh and Cambridge studies referred to above examined boys only, whereas the Seattle Social Development Project, the Jyvaskyla Longitudinal Study of Personality and Social Development, and the Columbia County Longitudinal Study included girls. However, analyses from these latter studies were mostly limited to examining gender as a main effect [e.g. whether being male increases the odds of engaging in future violence; Herrenkohl et al., 2000], rather than investigating whether gender moderates the relationship between risk factors and future outcomes. Studies that have examined gender in this manner generally report few differences between males and females and find that the same variables predict violence and delinquency for both males and females [e.g. experiencing or witnessing violence; Blum et al., 2003, antisocial peers and attitudes; Simourd and Andrews, 1994]. Therefore, it seems likely that well-established risk factors for violence in boys would also have relevance for girls. At the same time, newer research points to additional domains of risk which appear uniquely associated with female aggression [e.g. trauma, victimization, and dysfunctional relationships; Salisbury and Van Voorhis, 2009], as well as differences in the strength of traditionally "male" predictors when applied to high-risk females [e.g. early conduct problems; Fergusson et al., 2006, psychopathic traits; Odgers et al., 2005].

In addition to risk factors, the identification of protective mechanisms—defined as processes or variables that interact with risk factors to reduce the probability of a negative outcome [Stouthamer-Loeber et al., 2002]—has been cited as an important goal for research and practice [Herrenkohl et al., 2003]. Unfortunately, the study of protective factors has not progressed at the same rate as the corresponding literature on risk, despite its relevance for understanding the well-documented phenomenon of desistance from antisocial behavior in late adolescence [Stouthamer-Loeber et al., 2004]. To date, factors that have been shown to mitigate risk for violence in youth include involvement in prosocial activities (e.g. religious services), bonds with prosocial adults and peers, effective parental supervision and family management, school involvement and academic achievement, high intelligence and a resilient temperament [Herrenkohl et al., 2003; Hoge et al., 1996; Rutter, 2001].

Despite the scope of research on risk and protective factors, findings have been slow to translate into reliable risk assessment schemes for adolescents. Existing risk assessment instruments have been criticized on the basis that they are not developmentally sensitive, or sufficiently sensitive to dynamic factors that change over time [Borum, 2000]. Furthermore, the majority of current risk assessment instruments do not factor in gender-relevant information but rather assume that the factors contributing to violence operate in a similar manner across males and females. However, this assumption has not been empirically tested via prospective studies including sufficient numbers of female participants. This limitation will affect the validity of existing risk assessment tools with adolescent females, given their reliance on risk factors that have demonstrated utility in all-male

samples. The possibility remains that qualitatively different risk factors are required to predict violence among females or that similar risk factors carry differential significance in male and female samples.

## Existing Measures of Adolescent Risk

Several instruments have recently been developed for use in child and adolescent samples that incorporate multiple known risk factors and which are gaining empirical support. The Early Assessment Risk List for Boys [EARL-20B; Augimeri et al., 2001] and Girls [EARL-21G; Levene et al., 2001] provide a structured approach to assessing relevant domains of risk in children under 12 years of age who are exhibiting disruptive behavior problems. A notable strength of the EARL instruments is that gender is explicitly considered as evidenced by the separate versions for boys and girls. Although the EARL-20B and EARL-21G share 19 of 20 items, the EARL-21G omits one item (contact with authority) and incorporates two additional items that hold relevance for female aggression: the caregiver–daughter relationship and sexual development [Augimeri et al., 2005]. Children classified as high-risk on the EARL are found to exhibit higher levels of adolescent aggression and antisocial behaviors [Augimeri et al., 2001; Enebrink et al., 2006; Levene et al., 2004]. At present, however, there are no published studies comparing the predictive validity of the male and female versions of the EARL.

Only a portion of tools developed for use with adolescents is geared toward predicting violence and delinquency in high-risk or juvenile justice samples. The Youth Level of Service/Case Management Inventory [YLS/CMI; Hoge and Andrews, 2002] has accumulated evidence regarding its reliability and validity in forensic and community samples [e.g. Jung and Rawana, 1999; Schmidt et al., 2005; Thompson and Putnins, 2003], although findings are not uniformly favorable [e.g. Marczyk et al., 2003]. The YLS/CMI is also purported to have validity across age, race, and gender; however, several recent studies have found lower predictive utility for recidivism in females [Bechtel et al., 2007; Onifade et al., 2008; Schmidt et al., 2005]. The Psychopathy Checklist: Youth Version [PCL:YV; Forth et al., 2003], while not expressly designed as a risk assessment tool, has accumulated research demonstrating that male youth who score highly engage in increased levels of aggressive and delinquent behaviors, and recidivate violently in a shorter period of time than youth with lower scores [Corrado et al.,

2004; Gretton et al., 2004; Kosson et al., 2002]. At the same time, there is evidence indicating the PCL:YV is *not* a useful predictor of aggression in girls, particularly once other gender-relevant risk factors are accounted for [e.g. victimization; Odgers et al., 2005]. A meta-analysis by Schwalbe [2007] found a moderate effect size ($r = .25$, area under the ROC curve (AUC) $= 0.64$) for the overall predictive validity of various risk assessment instruments (including the YLS/CMI and PCL:YV) in juvenile justice settings. In this review, gender did not moderate the pattern of effect sizes across studies (28% of the aggregate sample was female).

Most recently, the Structured Assessment of Violence Risk in Youth [SAVRY; Borum et al., 2006] was developed to assess risk for violence in adolescents. The SAVRY is a list of 24 static (i.e. historical) and dynamic (i.e. amenable to change) risk factors based on a comprehensive review of the scientific literature. The SAVRY includes six protective factors that target aspects of positive functioning (e.g. strong commitment to school, attachments to prosocial peers and adults) and are thought to mitigate the effects of existing risk factors. To date, evidence indicates the SAVRY predicts both general and violent recidivism, with AUCs ranging from 0.64 to 0.81 [Catchpole and Gretton, 2003; Dolan and Rennie, 2008; Welsh et al., 2008], and also predicts institutional violence, with AUCs ranging from 0.71 to 0.86 [Lodewijks et al., 2008a,b]. With respect to the risk domains, studies have found that the Historical risk factors are not predictive, whereas the Social/Contextual and Individual/Clinical domains fare better with respect to predicting institutional misbehaviors and recidivism [AUC ranging from 0.66 to 0.88; Lodewijks et al., 2008a,b]. There is evidence that the protective factors on the SAVRY offer incremental utility over the total risk score [e.g. Lodewijks et al., 2008a], although other investigators have failed to replicate this finding for violent recidivism [Dolan and Rennie, 2008]. The SAVRY performed comparably to the PCL:YV in one study [Catchpole and Gretton, 2003], while it contributed more to the prediction of recidivism when compared with the PCL:YV and YLS/CMI in two others [Dolan and Rennie, 2008; Welsh et al., 2008]. When both the SAVRY total score and summary risk rating are examined, the latter performs as well as, and sometimes better than, the mathematical summation of scores [e.g. Lodewijks et al., 2008a; McEachran, 2001].

The few studies that have examined gender suggest comparable predictive ability for violent

recidivism [AUC = 0.78 in males and 0.80 in females; Meyers and Schmidt, 2008] and institutional violence [AUC = 0.71 in males and 0.72 in females; Gammelgard et al., 2008]. An unpublished dissertation [Fitch, 2004] reported a high correlation ($r$ = .72) between the SAVRY total score and an index of community violence in a sample of 35 girls (the corresponding correlation in boys was .50). The remaining studies either did not include female participants or did not analyze gender by way of separate receiver operating characteristic (ROC) analyses or a moderation model [e.g. Welsh et al., 2008].

## This Study

The construction of developmentally and gender-sensitive violence risk assessment instruments remains an important goal, particularly in light of growing demands for risk assessments in youth, paired with the increasing number of adolescent females entering the juvenile justice system for violent offenses [Hoyt and Scherer, 1998; Statistics Canada, 2001]. Across existing tools, the investigation of validity separately for males and females is needed to assess whether the same tools are appropriate for both genders, or whether gender-specific domains of risk need to be included in order to optimize prediction. Additionally, many previous studies have utilized retrospective/postdictive designs, creating a need for truly prospective designs. This study addresses these gaps in the literature by examining gender differences in the predictive validity of the SAVRY within a longitudinal framework. We also assessed the degree to which similar protective factors serve to buffer males versus females' level of risk for violence.

On the basis of previous research and theory, we expected the SAVRY to show moderate predictive power in relation to violent and non-violent recidivism in both males and females. We further expected that the SAVRY summary risk rating (i.e. low, moderate, or high; akin to structured professional judgments (SPJ) of risk) would perform comparably to a summed total score in terms of prediction. Specific predictions were not made regarding the predictive ability of the SAVRY domains (i.e. Historical, Individual/Clinical, Social/Contextual) due to the primary focus of this paper on gender differences in general risk prediction, a topic that has been rarely addressed in previous research. Although we did not test specific predictions regarding gender differences in the predictive value of the SAVRY domains, we completed

exploratory analyses to such effects. It should also be noted that the practice of computing summed scores for the SAVRY domains does not reflect how the instrument is used clinically. The domains comprise risk factors that group together thematically (as opposed to statistically), and are used to help arrive at a professional judgment of overall risk. Nevertheless, deriving these scores provides an additional route through which to investigate the predictive ability of the SAVRY, and also facilitates comparisons across different risk assessment tools and previous research. Finally, consistent with clinical usage and interpretation of the SAVRY, we hypothesized that the protective factors would be associated with lower levels of recidivism and would offer incremental value beyond the risk score.

## METHOD

### Participants and Procedure

Participants at Time 1 included 144 adolescents (80 males, 64 females) between the ages of 12 and 18 years (M = 15.5, SD = 1.5) gathered from custody centers (54%), a mental health assessment center (44%), and probation offices (2%) in western Canada. The ethnic composition of the sample included 67% Caucasian, 23% Aboriginal, and 10% of youth of other ethnicity. Seventeen percent of youth had at least one previous contact with the mental health system, whereas 53% had one or more previous entries into the correctional system. Thirty-eight percent stated that they were not currently under the legal care of their biological parents (the most common legal guardians listed were extended family members, foster parents, and social workers). The custody and mental health assessment centers serve highly similar groups of youth. The gender composition did not differ across the two settings ($\chi^2$ = 0.04, $P$ > .05); however, youth in custody were significantly older than youth in the mental health setting ($F$(1,177) = 87.58, $P$ < .01). Results from regression analyses further confirmed that location (i.e. custody versus mental health) did not moderate the relation between the SAVRY and outcome. The interaction between location and SAVRY scores was non-significant across all outcomes with two exceptions: the SAVRY historical and total scores were predictive of self-reported non-violent offenses in the mental health sample only (odds ratio (OR) = 1.51 and 1.32, $P$ < .05, for the historical and total scores, respectively; the corresponding ORs were .88 and .98, $P$ > .05, in the custodial sample).

One hundred thirty-two youth in custody were invited to participate in the study. Of these, parent/legal guardians refused consent for 28 youth (21%), five youth refused consent (4%), and one youth withdrew partway through the study (<1%). Furthermore, 19 of these youth (14%) did not receive SAVRY ratings due to insufficient collateral information to code the measure or because the youth did not complete a research interview. We invited 102 youth from the mental health assessment center to participate. Of these, 19 youth refused consent (19%) and two youth withdrew partway through the study (2%). Sixteen of these youth (16%) did not receive SAVRY ratings for the same reasons listed above. The gender and age composition of youth who did not participate in the study was not significantly different from youth who consented to participate (for gender, $\chi^2 = 0.31$, $P > .05$; for age, $F(1,226) = .78$, $P > .05$). Attempts were made to enroll every new female admission to the custody and assessment centers who were then matched on the basis of age with a male youth. Exclusionary criteria for this sample comprised (a) an IQ below 70, or (b) any significant Axis I psychotic symptomatology. Youth agreeing to participate completed individual assessments comprised of semi-structured clinical interviews, computerized diagnostic assessments, and self-report measures. Youth were informed that their responses to all questionnaires would be kept confidential to the extent provided under the law (i.e. disclosures of intended self or other harm would result in a breach of confidentiality) and that the data collected would be used for research purposes only. Ethics approval was obtained from the university and institutional review boards before the start of the study.

Official arrest data were collected 24 months after the youth's Time 1 participation. At this time, a total of 43 youth (30%) had been charged with one or more new violent offenses, while 72 youth (50%) had been charged with at least one new non-violent offense. Approximately half of the sample had spent fewer than 30 days in custody during the follow-up window, while 75% had spent fewer than 6 months in custody. Self-report data collection was conducted via phone interview at least 22 months from the youth's Time 1 participation ($M = 26.0$, $SD = 3.6$). Of the total sample ($N = 144$), 83 (42 males and 41 females) were successfully contacted by phone. Attrition was primarily related to difficulties in tracking youth rather than refusal to participate (only two youths refused to participate). Of this sample, 39 youth (47%) reported engaging in at least one violent offense over the follow-up period, whereas 54 (65%) reported engaging in at least one non-violent offense. There were no systematic differences on demographic variables (i.e. age, gender, and ethnicity) nor on the variables of interest (i.e. SAVRY, recidivism) between those youth who had versus had not completed a follow-up phone interview at Time 2.

## Measures

**Structured Assessment of Violence Risk in Youth (SAVRY).** The SAVRY [Borum et al., 2006] is a 30-item guide designed to assess risk for violence in adolescents aged 12 to 18 years. The SAVRY includes 10 historical (e.g. past violence and child maltreatment), 6 Social/Contextual (e.g. peer delinquency, community disorganization), and 8 Individual/Clinical (e.g. substance use, impulsivity) risk factors, and 6 protective (e.g. prosocial involvement) factors. Each risk item is rated on a 3-point scale (1 = low, 2 = moderate, 3 = high), whereas the protective factors are rated dichotomously (0 = absent, 1 = present). The SAVRY follows the SPJ model of risk assessment such that the evaluator generates a summary risk rating of low, moderate, or high. For research purposes, continuous total and domain scores may be examined by summing the relevant items within each domain.

One of three graduate students who received formal training in the administration and coding of the SAVRY completed assessments based on a semi-structured interview and file review. Previous studies using the SAVRY have reported interrater reliability estimates ranging from .77 to .96 for the summary risk rating and from .62 to .98 for the domain scores [Catchpole and Gretton, 2003; Dolan and Rennie, 2008; Lodewijks et al., 2008a; Meyers and Schmidt, 2008; Welsh et al., 2008]. In this study, using single-rater intraclass correlation coefficients for a two-way random effects model with absolute agreement, interrater reliability ($n = 19$, 13%) was .94 for the SAVRY total score and .73 for the summary risk rating. Interrater reliabilities for the domain scores were as follows: Historical = .92, Social/Contextual = .34, and Individual/Clinical = .92. Mean and standard deviations for the SAVRY domains as well as correlations between the SAVRY and recidivism are presented in Table I. The percentage of youth that fell into each risk classification (i.e. low, moderate, and high) was 15, 51, and 34%, respectively. There were no significant differences in risk classification between males and females, $\chi^2(1) = 1.53$, $P = .22$.

**TABLE I. Mean, Standard Deviations, and Intercorrelations for the SAVRY and Recidivism Variables**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | $M_M$ (SD) | $M_F$ (SD) | Range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Historical | – | | | | | | | | | | 20.41 (3.47) | 20.16 (3.40) | 10–30 |
| 2. Social/Contextual | .40** | – | | | | | | | | | 12.33 (2.05) | 12.64 (1.88) | 6–18 |
| 3. Individual/Contextual | .43** | .40** | – | | | | | | | | 18.59[a] (3.14) | 17.06 (2.83) | 8–24 |
| 4. Protective | −.18* | −.30** | −.46** | – | | | | | | | 1.00 (1.14) | 1.14 (1.32) | 0–6 |
| 5. Total score | .83** | .69** | .80** | −.39** | – | | | | | | 51.33 (6.90) | 49.86 (6.34) | 24–72 |
| 6. Summary risk rating | .49** | .34** | .63** | −.28* | .64** | – | | | | | 2.25 (.67) | 2.11 (.69) | 1–3 |
| 7. # Violent offenses (SRO-R) | .24* | .04 | .47** | −.18 | .36** | .33* | – | | | | 2.15[a] (2.23) | .75 (1.25) | 0–6 |
| 8. # Non-violent offenses (SRO-R) | .27* | .16 | .46** | −.23* | .41** | .29* | .67** | – | | | 2.35[a] (1.70) | 1.35 (1.61) | 0–5 |
| 9. # Official violent offenses | .23* | .07 | .14 | .09 | .20* | .15 | .31* | .24* | – | | 1.04 (2.13) | .73 (1.65) | 0–11 |
| 10. # Official non-violent offenses | .34** | .22* | .35** | −.08 | .40** | .32** | .44** | .47** | .29** | – | 3.66[a] (5.04) | 1.65 (3.51) | 0–25 |

[a]Male and female mean differ at $P < .01$. Male $N = 42, 80$ (self-reported, official); female $N = 41, 64$ (self-reported, official). $M_M$, male mean; $M_F$, female mean.
*$P < .05$; **$P < .001$.

**Self-Report of Offending, Revised (SRO-R).**
The Self-Report of Offending [Huizinga et al., 1991] was adapted for use in this study based on the more widely studied Self-Report of Delinquency [Piquero et al., 2002]. This scale has been shown to produce results consistent with official measures of delinquency [Elliott et al., 1987], and it demonstrates functional invariance across gender and ethnicity [Knight et al., 2004]. The current measure included 15 items, largely comparable to those found in large-scale high-risk and normative studies, assessing the youth's involvement in violent (e.g. assault and weapons charges) and non-violent (e.g. narcotics and property crimes) offenses over the past 24 months. Mean and standard deviations are presented in Table I.

**Official arrest data.** Official arrest data were accessed through the Ministry of Children and Family Development official records system in Canada (CORNET) 24 months after Time 1 and coded for violent (e.g. assault and sexual offenses) and non-violent (e.g. drugs and theft) recidivism. Mean and standard deviations for the number of new offenses are presented in Table I.

The distribution of data for self-reported and official recidivism (i.e. SRO-R and CORNET) was positively skewed as a result of the fact that many youth had few or no new charges during the follow-up window. Therefore, a dichotomous variable was created to reflect whether a youth had *ever* engaged in a violent or non-violent offense over the last two years. Although the use of dichotomized variables potentially reduces the variability of frequency scores, this method often increases the interpretability of results without affecting substantive findings [Farrington and Loeber, 2000]. Additionally, the use of binary variables reduces potential for error that could result from violating the assumption of normality in statistical tests when the data are skewed.

## RESULTS

### Predictive Validity of the SAVRY

Binary logistic regression analyses were computed to assess the effects of the SAVRY and gender in predicting violent and non-violent recidivism (both self-reported and official). In each case, the SAVRY total score and gender were entered in the first block followed by the interaction term between these variables in the second block. Equivalent results emerged when using the SAVRY summary risk rating (i.e. low, moderate, and high) in place of the total score in the regression analyses for all outcomes. Due to the fact that categorical variables can produce falsely significant results, particularly when examining interaction terms [Maxwell and Delaney, 1993], results using the SAVRY total score are reported. A second set of analyses was

conducted in the same manner to examine the effects of the SAVRY domains (i.e. historical, social/contextual, individual/clinical, protective) and gender. Models that controlled for the amount of time a youth spent in custody during the follow-up window revealed no significant differences from models where this variable was not controlled.

Logistic regression produces odds ratios (ORs) associated with each predictor value. The OR for a predictor is defined as the relative amount by which the odds of the outcome increase (OR greater than 1.0) or decrease (OR less than 1.0) when the value of the predictor variable is increased by 1.0 units. The ORs reported below reflect the probability of a new violent or non-violent offense occurring, for every unit increase in the SAVRY. As shown in Table II, the SAVRY total score was predictive of self-reported violent (OR = 1.15; $P < .01$) and non-violent (OR = 1.17; $P < .01$) reoffending. A significant effect also emerged for gender (OR = 2.85, 3.50; $P < .05$ for violent and non-violent offenses, respectively), indicating that males were approximately three times more likely to self-report a new violent or non-violent offense at follow-up. The SAVRY total score was also associated with a higher likelihood of

official recidivism (OR = 1.12, 1.13; $P < .01$ for violent and non-violent charges, respectively), and there was a significant effect of gender for non-violent recidivism only (OR = 2.99; $P < .01$).

The interaction term between the SAVRY total score and gender was significant for self-reported non-violent offenses only, OR = 1.65, $P < .05$. This interaction is graphically depicted in Figure 1; for ease of interpretation, the SAVRY summary risk rating is used along the x-axis. These results indicate that male youth engaged in a greater number of non-violent offenses, and that the SAVRY predicted non-violent recidivism more robustly in males when compared with females. As expected from these results, the correlation coefficient between the SAVRY and non-violent recidivism was significantly positive in males ($r = .48$, $P < .01$), whereas it was weaker and non-significant in females ($r = .22$, $P > .05$). In contrast, the SAVRY was comparably associated with violent recidivism in males and females ($rs = .21$ and $.19$, $P > .05$, for males and females, respectively). In all cases, the Hosmer–Lemeshow goodness of fit statistic was non-significant, suggesting that the regression models adequately fit the data. The percentage of cases classified correctly

**TABLE II. Prediction of Violent and Non-Violent Offenses: SAVRY Total Score**

| Variable | Model/step $\chi^2$ (P) | Wald | P | Exp (B) | 95% CI for Exp (B) Lower | Upper |
|---|---|---|---|---|---|---|
| *Self-report violent* | | | | | | |
| Step 1 | | | | | | |
|   Gender | 17.91 | 4.46 | .04 | 2.85 | 1.08 | 7.52 |
|   SAVRY total | (<.001) | 10.15 | .001 | 1.15 | 1.06 | 1.26 |
| Step 2 | | | | | | |
|   Gender × SAVRY | 1.24 (.27) | 1.20 | .27 | 1.11 | 0.92 | 1.33 |
| *Self-report non-violent* | | | | | | |
| Step 1 | | | | | | |
|   Gender | 20.11 | 5.52 | .02 | 3.50 | 1.23 | 9.95 |
|   SAVRY total | (<.001) | 10.41 | .001 | 1.17 | 1.06 | 1.28 |
| Step 2 | | | | | | |
|   Gender × SAVRY | 9.49 (.002) | 4.38 | .04 | 1.65 | 1.03 | 2.63 |
| *Official violent* | | | | | | |
| Step 1 | | | | | | |
|   Gender | 15.94 | 0.46 | .50 | 1.30 | 0.61 | 2.78 |
|   SAVRY total | (<.001) | 12.81 | <.001 | 1.12 | 1.05 | 1.19 |
| Step 2 | | | | | | |
|   Gender × SAVRY | 0.02 (.90) | 0.02 | .90 | 0.99 | 0.87 | 1.13 |
| *Official non-violent* | | | | | | |
| Step 1 | | | | | | |
|   Gender | 28.61 | 8.46 | .004 | 2.99 | 1.43 | 6.26 |
|   SAVRY total | (<.001) | 15.50 | <.001 | 1.13 | 1.07 | 1.21 |
| Step 2 | | | | | | |
|   Gender × SAVRY | 1.85 (.17) | 1.81 | .18 | 1.09 | 0.96 | 1.24 |

*Note.* The $\chi^2$ value reported at Step 1 represents the value for the entire model, whereas the value reported at Step 2 reflects the Step $\chi^2$ associated with the addition of the interaction term to the model. CI, confidence interval.
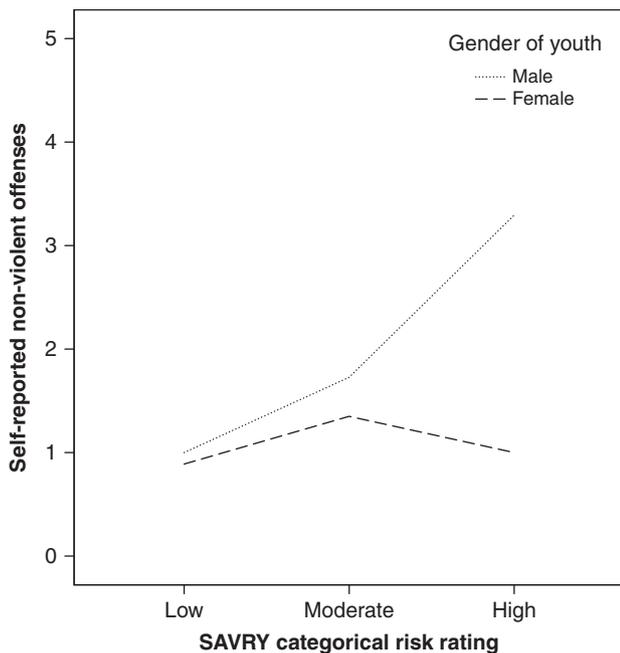
**Fig. 1. SAVRY total score predicting non-violent reoffending, by gender.**

by the model using the SAVRY total score and gender (i.e. Step 1) was as follows: 71% (self-reported violent offenses), 72% (self-reported non-violent offenses), 69% (official violent recidivism), and 72% (official non-violent recidivism). The classification rates did not improve at Step 2 of the model (corresponding values: 70, 74, 69, and 69%).

With respect to the SAVRY domains, the Historical risk factors predicted both self-reported (OR = 1.21, 1.26, $P < .01$ for violent and non-violent, respectively) and official (OR = 1.17, 1.21, $P < .01$ for violent and non-violent, respectively) recidivism. Similarly, the Individual/Clinical factors predicted both self-reported (OR = 1.43, 1.39, $P < .01$ for violent and non-violent, respectively) and official (OR = 1.32, 1.27, $P < .01$ for violent and non-violent, respectively) recidivism. In contrast, the Social/Contextual factors predicted official non-violent recidivism only, OR = 1.25, $P < .05$. There were no significant gender interactions, suggesting that the SAVRY domains predicted violence and delinquency comparably for males and females. The Hosmer–Lemeshow goodness of fit statistic was again non-significant for each model.

With the exception of official non-violent recidivism (OR = .71, $P < .05$), the protective factors on the SAVRY were not significantly associated with a decreased odds of reoffending (Table III). Furthermore, the non-significant interaction between the protective factors and gender suggest that these factors exert a comparable effect for both male and female youth. To investigate whether the protective factors offered incremental value beyond the SAVRY total score, a hierarchical logistic regression was calculated using a backwards elimination procedure. Step one contained the SAVRY risk and protective scores (reverse scored), whereas step two removed the protective factors, leaving only the total risk score in the equation. In all cases, removal of the protective factors failed to make a difference, as indicated by a non-significant change in −2 log likelihood after the removal of the protective factor score for each outcome ($\Delta\chi^2(1) = 1.45$, 0.22, 0.73, and 0.64, $P > .05$; for violent and non-violent self-reported and official recidivism, respectively). This suggests that the protective factors do not offer significant value beyond the effects of the SAVRY risk score.

## Predictive Accuracy of the SAVRY

We next examined the diagnostic accuracy of the SAVRY total and domain scores via ROC analyses. Despite the widespread use of ROC analyses in violence prediction research, these analyses are calculated for numerical ''scores,'' and therefore, may be an imprecise validity index for SPJ instruments as they are intended to be used in practice [Borum et al., 2010]. Nevertheless, ROC analyses are less impacted by base rates and are therefore valuable when investigating low frequency behaviors such as violence. ROC curves plot the association between sensitivity (the true-positive rate) and 1—specificity (the false-positive rate) for all possible cut-off scores on the measure of interest. The AUC is an index of the measure's overall accuracy, and can range from 0 to 1.0 where 0.5 indicates chance-level accuracy, greater than 0.5 indicates above-chance accuracy, and less than 0.5 indicates below-chance accuracy. Streiner and Cairney [2007] recommend the following guidelines for interpretation: AUCs between 0.50 and 0.70 are low, AUCs between 0.70 and 0.90 are moderate, and AUCs over 0.90 are high. In the behavioral and social sciences, some have suggested that AUCs above 0.70 should be considered high [Douglas et al., 1999] and note that values higher than this are rarely seen in the violence prediction literature.

The AUCs for the SAVRY with respect to committing *any* violent or non-violent offense (i.e. either self-reported or official) are listed in Table IV. In males, the SAVRY summary risk rating, total and domain scores demonstrated low to moderate diagnostic efficiency for violent (.59 to .75) and

**TABLE III. Prediction of Violent and Non-Violent Offenses: SAVRY Protective Score**

| Variable | Model/step $\chi^2$ ($P$) | Wald | $P$ | Exp ($B$) | 95% CI for Exp ($B$) Lower | Upper |
|---|---|---|---|---|---|---|
| *Self-report violent* | | | | | | |
| Step 1 | | | | | | |
|    Gender | 5.64 (.06) | 5.22 | .02 | 2.83 | 1.15 | 6.92 |
|    SAVRY Pr | | 0.21 | .64 | 0.92 | 0.64 | 1.32 |
| Step 2 | | | | | | |
|    Gender × SAVRY | 0.13 (.72) | 0.13 | .72 | 0.88 | 0.43 | 1.79 |
| *Self-report non-violent* | | | | | | |
| Step 1 | | | | | | |
|    Gender | 8.50 (.01) | 6.52 | .01 | 3.53 | 1.34 | 9.31 |
|    SAVRY Pr | | 1.51 | .22 | 0.79 | 0.55 | 1.15 |
| Step 2 | | | | | | |
|    Gender × SAVRY | 1.42 (.23) | 1.40 | .24 | 0.63 | 0.30 | 1.35 |
| *Official violent* | | | | | | |
| Step 1 | | | | | | |
|    Gender | 1.63 (.44) | 1.10 | .30 | 1.47 | 0.71 | 3.03 |
|    SAVRY Pr | | 0.43 | .51 | 0.90 | 0.67 | 1.23 |
| Step 2 | | | | | | |
|    Gender × SAVRY | 0.05 (.83) | 0.05 | .83 | 0.94 | 0.51 | 1.72 |
| *Official non-violent* | | | | | | |
| Step 1 | | | | | | |
|    Gender | 15.47 | 9.37 | .002 | 2.99 | 1.48 | 6.03 |
|    SAVRY Pr | (<.001) | 5.00 | .03 | 0.71 | 0.53 | 0.96 |
| Step 2 | | | | | | |
|    Gender × SAVRY | 1.05 (.31) | 1.05 | .31 | 0.74 | 0.41 | 1.32 |

*Note.* The $\chi^2$ value reported at Step 1 represents the value for the entire model, whereas the value reported at Step 2 reflects the Step $\chi^2$ associated with the addition of the interaction term to the model. Pr, number of protective factors; CI, confidence interval.

**TABLE IV. Diagnostic Efficiency of the SAVRY**

| | Males AUC (SE) | 95% CI | Females AUC (SE) | 95% CI |
|---|---|---|---|---|
| SAVRY summary risk rating | | | | |
|   Violent | 0.64 (.07) | .51–.77 | 0.72 (.07) | .58–.87 |
|   Non-violent | 0.69 (.06) | .57–.81 | 0.67 (.07) | .54–.81 |
| SAVRY total | | | | |
|   Violent | 0.69 (.06) | .57–.81 | 0.72 (.08) | .57–.87 |
|   Non-violent | 0.76 (.06) | .64–.89 | 0.65 (.07) | .51–.79 |
| SAVRY historical | | | | |
|   Violent | 0.63 (.07) | .50–.76 | 0.66 (.08) | .50–.81 |
|   Non-violent | 0.73 (.06) | .62–.85 | 0.59 (.07) | .45–.73 |
| SAVRY social/contextual | | | | |
|   Violent | 0.59 (.07) | .47–.72 | 0.56 (.08) | .40–.72 |
|   Non-violent | 0.64 (.07) | .51–.78 | 0.58 (.07) | .44–.72 |
| SAVRY individual/clinical | | | | |
|   Violent | 0.75 (.06) | .63–.86 | 0.69 (.08) | .54–.84 |
|   Non-violent | 0.72 (.06) | .59–.84 | 0.67 (.07) | .53–.80 |

*Note.* AUC, area under the curve; SE, standard error; CI, confidence interval.

non-violent (.64 to .76) reoffending. More specifically, there was low accuracy with respect to violent recidivism (with the exception of the Individual/Clinical domain), whereas there was low to moderate accuracy with respect to non-violent recidivism. In females, the SAVRY summary risk rating, total and domain scores also demonstrated low to moderate diagnostic efficiency for violent (.56 to .72) and non-violent (.58 to .67) reoffending. More specifically, there was low accuracy with respect to violent and non-violent recidivism for all SAVRY domains, whereas the SAVRY total score and summary risk rating evidenced moderate accuracy for violent recidivism.

## DISCUSSION

Existing research in the area of juvenile violence risk assessment has been criticized on several fronts. First, there has been little emphasis on the validation of instruments that possess dynamic risk factors despite that the inclusion of such factors is regarded as essential for the assessment of risk in adolescents. Second, few efforts have been made to investigate gender differences and to assess whether risk factors operate comparably across males and females or whether separate domains of risk are warranted. Finally, only a handful of studies have adopted

prospective designs. This study addresses many of these limitations by examining the predictive validity of the SAVRY in a sample of high-risk male and female youth. We measured violent and non-violent reoffending at a two-year follow-up via self-report and official records in order to gain a thorough index of recidivism.

## Predictive Ability of the SAVRY

Results suggest that the SAVRY is significantly associated with violent and non-violent reoffending as measured by self-report or official arrest records. Although several studies have found SPJ risk ratings (akin to the summary risk rating on the SAVRY) to be superior when compared with actuarial methods [de Vogel et al., 2004; Douglas et al., 2003], results from this study suggest that the SAVRY risk rating and total score performed comparably in terms of prediction. Consistent with existing studies [e.g. Catchpole and Gretton, 2003; Dolan and Rennie, 2008; Welsh et al., 2008], results from the ROC analysis suggest that the SAVRY predicts these outcomes with a moderate degree of accuracy.

The SAVRY domains were also associated with reoffending. Specifically, the Historical and Individual/Clinical domains were significantly and uniquely related to violent and non-violent recidivism, and showed moderate levels of predictive accuracy in the context of ROC analyses (the latter finding was typically confined to males and non-violent recidivism, however). In contrast, the Social/Contextual domain was unrelated to most of the outcome variables and showed low predictive accuracy for both violent and non-violent recidivism. These findings are partially consistent with those of Dolan and Rennie [2008] who reported non-significant correlations and AUC values for the Social/Contextual and Individual/Clinical risk factors in predicting violent recidivism. These findings are also consistent with the study by Gammelgard et al. [2008] who reported lower AUC values for the Social/Contextual domain when compared with the remaining risk factors. These results may be attributable to the poor interrater reliability characterizing the Social/Contextual domain. Several items included in this domain (e.g. stress and poor coping, lack of personal support) may be more difficult to assess reliably when compared with those items within the Historical and Individual/Clinical domains. Further specification of the items in this domain may prove helpful in this respect.

With the exception of official non-violent recidivism, the protective factors on the SAVRY were not significantly associated with decreased odds of reoffending over the follow-up period. This is inconsistent with the study by Lodewijks et al. [2008b] but in accordance with the findings of Dolan and Rennie [2008]. One potential reason for the lack of significant effects concerns the distribution of protective factors within the current sample. As may be the case for many high-risk samples, few youth in this study possessed any of the protective factors listed on the SAVRY. Youth who participated in this study often came from environments characterized by significant family disruption (as noted above, 38% were not currently under the legal care of their biological parents) and few opportunities for pro-social activities. The restricted range and variance surrounding the protective domain may have attenuated the relationships witnessed between these factors and outcome. Future studies should consider investigating a broader scope of variables that may serve as buffers for violent behavior while at the same time sampling from a variety of populations to obtain greater variability. In addition to the simple absence of a risk factor, other protective factors that are not explicitly included on the SAVRY include social connectedness [i.e. the perception that others care about, understand, and pay attention to you; Resnick et al., 1997], parental monitoring [Slovak and Singer, 2001], and neighborhood cohesion [Sampson and Lauritsen, 1994]. Furthermore, although lower risk samples (e.g. community dwelling youth) will evidence fewer incidences of serious violence, they may also exhibit more protective variables thereby increasing the likelihood that meaningful relationships could be detected if present. Rating the quality of protective factors (i.e. low, moderate, and high) in addition to simple frequency may also provide greater insights into their ability to buffer against existing risk factors.

## Does Gender Influence the Predictive Validity of the SAVRY?

Results from this study suggest that the SAVRY operates equivalently across gender. With the exception of self-reported non-violent reoffending, gender did not moderate the relationship between the SAVRY and reoffending. This is consistent with the findings of Meyers and Schmidt [2008], as well as Gammelgard et al. [2008], who found that the SAVRY predicted violent recidivism and institutional violence comparably for boys and girls. These results are also consistent with the broader literature suggesting greater similarities than differences in the developmental course [e.g. Fontaine et al., 2008] and

risk factors [Simourd and Andrews, 1994] associated with aggression and delinquency in males and females. The SAVRY protective factors, while not predictive of lower recidivism generally, also appeared to function equivalently across gender. With respect to the ROC analyses, although there were more AUC values falling within the low range for females, the overall magnitude of differences in the values across gender were small. Taken together, these findings suggest that validated risk factors such as those appearing on the SAVRY operate in an equivalent manner across gender, and offer preliminary support for the SAVRY (primarily the total and summary risk rating) in adolescent females.

At the same time, growing research points to specific risk factors that appear particularly relevant for female aggression [e.g. trauma, victimization, and dysfunctional relationships; Odgers et al., 2005; Salisbury and Van Voorhis, 2009]. This is not inconsistent with the findings reported in this study, but rather suggests that violence prediction may be further optimized in females by attending to these variables. For example, there is evidence that incorporating relationships into explanatory models of girls' aggression is important. It is well known that physical forms of violence are much less common among girls versus boys, while social and relational forms of aggression (e.g. spreading rumors, gossip) are more equally visible across the genders [Underwood, 2003]. Research also shows that female aggression is more likely to ensue in the context of romantic or family relationships [Straus and Ramirez, 2007] and that the victims of girls' violence are more likely to be an acquaintance, friend, or partner compared with boys [Archer, 2000]. Furthermore, experiences of maltreatment and rejection within close relationships appear to have a particularly adverse effect on the psychological and emotional functioning of girls [Moretti et al., 2001]. Taken together, these findings emphasize the need to understand the role of relationships—particularly those in which girls experienced trauma or abuse—to understand their aggression.

In light of this, the SAVRY may benefit from including risk factors that are more relationally oriented. For example, the EARL-21G incorporates items, such as the caregiver–daughter relationship and sexual development, that are specific to female aggression [Augimeri et al., 2005]. Although the SAVRY includes childhood maltreatment as a risk factor, sexual abuse is not included in this definition, which may be particularly relevant for girls. Longitudinal studies have yet to assess whether sexual abuse is a unique predictor of later violence among females; nevertheless, high rates of sexual abuse figure prominently in the profiles of high-risk girls and research has consistently shown higher rates of sexual abuse among justice involved girls when compared with boys [Chesney-Lind and Shelden, 2004; Corrado et al., 2000; McClellan et al., 1997]. The finding that the SAVRY predicted recidivism comparably across gender also does not preclude the existence of gender differences in the types of violence committed by girls versus boys, and the possibility that distinct risk factors are required to predict such "gendered" outcomes. Future studies should consider using expanded measures of offending that include alternate forms of violence in which females are more likely to be involved (e.g. domestic violence).

Finally, it is possible that similar risk factors exist for boys and girls but that these factors carry differential significance across gender. Unfortunately, previous studies in the field have not included an adequate number of girls in their samples, and even fewer have conducted the statistical analyses necessary to determine whether the same variables possess comparable predictive capacity across gender [e.g. multiple group structural equation modeling; see Fergusson et al., 2006 for a notable exception]. The lack of research surrounding this issue is reflected in the fact that, to date, the vast majority of risk assessment tools assume that individual risk factors contribute equally to the overall risk score for males and females. An item response theory approach is designed to examine whether items within a measure function equivalently across groups and may be a first step toward addressing this issue.

## Limitations and Implications for Research, Policy, and Practice

This study has several limitations that warrant caution in the interpretation of findings. First, the sample size was modest when split by gender and was also reduced for the self-report portion of the follow-up. However, there were no significant differences in terms of risk rating or recidivism between youth who had versus had not been contacted at Time 2, suggesting that the findings may be a conservative test of the SAVRY's predictive validity. Second, the low reliability of the SAVRY Social/Contextual domain tempers the findings using these risk factors. Future studies may consider the inclusion of other social/contextual items relevant to both males and females, particularly ones that lend themselves to greater

standardization in coding (e.g. crime rate in the youth's community, attitudes toward racial and other forms of discrimination, presence of government programs designed to support at risk families, quality of local schools and recreational facilities). Third, although this study was prospective in nature, a more robust test of the SAVRY's functioning would involve multiple administrations longitudinally to investigate whether changes in its dynamic factors correspond to changes in a youth's overall risk level and recidivism.

The SAVRY is a relatively new tool that has yet to accumulate a large body of research concerning its utility for predicting violence across various settings and samples. Nevertheless, the growing body of existing research has been consistent in its findings concerning the predictive utility and incremental validity of the SAVRY. In light of these promising findings, future research should continue to investigate the SAVRY across a range of settings and samples that include sufficient numbers of male and female youth to analyze gender differences. A greater balance in focus with regards to risk and protective factors is also warranted in future research, as the latter are equally relevant to constructing risk assessment instruments and designing effective prevention and intervention approaches.

It is also relevant to note that the SAVRY was originally designed as a tool to aid in the determination of violence risk. However, results from this study suggest that the SAVRY was equally predictive of violent and non-violent reoffending during the follow-up period. Few research studies have differentiated risk factors for violent versus non-violent criminal behavior, and it is not clear that any of the current assessment tools used with adolescents are effective at distinguishing risk for violent versus non-violent recidivism. As such, a greater degree of specificity in outcomes (i.e. risk for *what*) is called for in future research. At the same time, established risk factors for violence are often found to have predictive value for non-violent delinquency [e.g. school problems; Maguin and Loeber, 1996], and youth who engage in antisocial behaviors, whether they are violent or non-violent, are found to have similar risk profiles [Loeber et al., 2007]. In light of these findings, risk assessment tools such as the SAVRY may perhaps be expanded and utilized as a risk protocol for violent and non-violent delinquency.

Finally, it is evident that the need for accurate assessments of risk in adolescent females is growing, as evidenced by recent increases in rates of official violent offending in this population [Puzzanchera et al., 2003; Statistics Canada, 2001], as well as increased rates of entry into juvenile detention facilities [Hoyt and Scherer, 1998]. The finding that high-risk and incarcerated girls experience mental health problems at a significantly higher rate than their male counterparts [Teplin et al., 2002], as well as increased economic and social marginalization as adults [Giordano et al., 2004], underscores the costs of not accurately assessing and intervening with this segment of the population. Unfortunately, this need has yet to be met by current research as evidenced by the lack of empirically validated risk assessment tools for adolescent females. Current findings are consistent with other studies suggesting that risk factors validated with males may have utility in females. However, in light of research suggesting that unique factors are associated with female violence [Chesney-Lind, 1997; Gilligan and Wiggins, 1988], studies that assess the relative power of these variables versus traditionally "male" risk factors are required to determine whether separate measures of risk for males and females are warranted.

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