Rediscovering Quetelet, Again: The "Aging" Offender and the Prediction of Reoffending in a Sample of Adult Sex Offenders

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Abstract: This study explored the role of age at release on the risk of reoffending using a sample of sex offenders. It examined whether the risk of reoffending, assessed using actuarial tools, should be adjusted according to the offender's age at the time of release. The sample comprised 553 offenders, all of whom were consecutive admissions to a Canadian federal penitentiary. Scores on the Static-99 as well as age at release were included in successive nested prediction models using Cox-regression. Receiver operating characteristic (ROC) curves and Allison's R2 were computed to assess the predictive accuracy of the models and the strength of the association between the covariate measures of general and violent/sexual reoffending. Results showed that overall predictive accuracy observed across models was fair at best. Generally, age of onset and age at release improved the prediction accuracy over and above the scores on the Static-99. In fact, by itself, age at release showed a predictive accuracy comparable to that of the actuarial tool. The results suggest that risk assessors should adjust the risk of reoffending based on the offender's age at release. The implications of this study are discussed in light of the age–crime curve literature and the risk management of sex offenders in the community.

Keywords: Cox-regression, age, recidivism, sex offender, onset, risk assessment, Static-99, survival analysis

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Ever since Quetelet (1836) first observed that "*Le penchant au crime, vers l'âge adulte, croît assez rapidement; il atteint un maximum et décroît ensuite jusqu'aux dernières limites de la vie*" (original in italics) (p.86)[1], the relationship between age and crime has been one of the most robust and stable empirical findings of criminological research (Hirschi & Gottfredson, 1983; Thornberry, 1997). Though the relationship is well known, over the past decades, it has been one of the most debated issues among criminologists. The age–crime curve has been debated in various contexts ranging from its theoretical importance (Farrington, 2005; Greenberg, 1985; Hirschi & Gottfredson, 1983), its meaning (Farrington, 1986; Gottfredson & Hirschi, 1986; Moffitt, 1993), its methodological repercussions (Hirschi & Gottfredson, 1995; Lauritsen, 1998), and the policy implications of the age–crime relationship (Blumstein, Cohen, & Farrington, 1988; Gottfredson & Hirschi, 1986; Piquero, Farrington, & Blumstein, 2003; Tittle, 1988). The debate began in the early 1980s with the contrasting interpretation of the age–crime curve proposed by propensity theorists and criminal career researchers. Four issues were central to the debate: the theoretical relevance of distinguishing the various criminal career parameters, the validity of the invariant age–crime relationship, the necessity of using longitudinal over cross-sectional data, and the stability of offending over time. Propensity theorists argued that the age–crime curve is invariant across individuals (Hirschi & Gottfredson, 1983). According to them, aggregate data show that individuals are characterized by a peak in offending in adolescence, followed by a subsequent gradual decrease in offending frequency. All individuals were said to follow this trend to different degrees. The main variations in onset, frequency, and persistence were all said to be the result of the same stable between-individual differences across life course (Hirschi & Gottfredson, 1983; Gottfredson & Hirschi, 1990). Hence, the mechanisms responsible for

[1] "Towards adulthood, the criminal propensity increases rather rapidly, it reaches a peak and then it decreases until the last limits of life." (Translation by the first author)

an early onset, higher offending frequency, and a longer criminal career were described as the result of the higher static criminal propensity.

Arguments raised by propensity theorists have been criticized on many grounds. Criminal career researchers first argued that the age–crime curve was not invariant (Farrington, 1986). In order to better understand the meaning of the age–crime curve (Blumstein, Cohen, Roth, & Visher, 1986), criminal career researchers distanced themselves from propensity theorists by distinguishing participation (i.e., proportion of criminally active individuals) and offending frequency (i.e., the number of crimes committed by active offenders). According to criminal career researchers, the age–crime curve reflects changes in prevalence across age groups, with more individuals being criminally active during adolescence than in any other age period (Blumstein et al., 1988; Farrington, 1986). Key to the debate of criminal career researchers, and contrary to what propensity theorists had proposed earlier, is the argument that offending frequency does not typically follow the age–crime curve (Blumstein et al., 1988). This conclusion raised the possibility that the criminal justice system could identify and incapacitate high-rate chronic offenders (Piquero et al., 2003). For Gottfredson and Hirschi (1986, 1990), by the time the criminal justice system identifies career criminals, they are no longer as criminally active as they were in adolescence because of the inexorable age effect, thus seriously compromising the impact of any incapacitating efforts. Until recently, these theoretical, empirical, methodological, and policy considerations had not been echoed in the field of risk assessment and the prediction of reoffending in adult sex offenders.

In recent years, convicted sex offenders have been under much scrutiny by a criminal justice system that is increasingly concerned with protecting the community, with preventing future victimization, and with incapacitating dangerous offenders. One of the main assumptions has been that current expertise has sufficient and accurate evidence to identify the risk of reoffending (La Fond, 2005). Risk assessment tools typically include risk factors that are said to measure the stable propensity to commit a crime over a long term period (Hanson & Thornton, 2000; Quinsey, Harris, Rice, &

Cormier, 1998). By using risk assessment tools, the focus has been on the offender, which makes it easier to identify and isolate the risk of the most dangerous offenders (Janus, 2003). Typically, those instruments have used key markers that have been shown to be linked to recidivism, which includes risk factors ranging from the general criminal history, sexual offending history, characteristics of the index crime, to sociodemographic factors. In the USA, sexual violent predator laws were gradually introduced in the early 1990s to confine, for an indefinite period, dangerous sex offenders soon to be released from prison (Lieb, Quinsey, & Berliner, 1998). Upon their release, other measures, such as registration and community notification laws, have been implemented to deter offenders from reoffending, to facilitate police investigation, and to promote community vigilance (Simon, 1998). Similarly, in Canada, since the mid-1990s, dangerous offender legislation, long term supervision orders, community notifications, and peace bonds (or 810 orders) have all emerged to give the criminal justice system several legal dispositions for controlling the criminal behavior of high risk sexual offenders (Petrunik, 2003). These measures have been implemented in order to increase the protection of residents by incapacitating high risk sex offenders and by managing the risk of other sex offenders returning to the community. Many of the dispositions used have targeted sexual recidivists, that is, those presenting a long-lasting criminal career, often after lengthy periods of incarceration. This process of screening, assessing, and identifying high risk sex offenders led many researchers to question the role of age and aging on the risk of reoffending, which in turn quickly led to an important controversy reminiscent of the age–crime debate between propensity theorists and criminal career researchers.

The Age–Crime Curve Debate Revisited

Researchers generally agree that only a minority of sexual offenders reoffend after their prison release. Studies have shown that the base rate of sexual reoffending is about 10% for an average follow-up period of five years, the base rate increasing to about 20% when followed for an average of 20 years (Hanson, Morton, & Harris, 2003). The possible mitigating role of the offender's age on

sexual reoffending has received increased attention in recent years (Barbaree, Blanchard, & Langton, 2003; Doren, 2006; Fazel, Sjöstedt, Långström, & Grann, 2006; Hanson, 2002, 2006; Harris & Rice, 2007; Prentky & Lee, 2007; Thornton, 2006). A few empirical studies investigated the role of the offender's age on the risk of reoffending at the time of his prison release, and many consistent results were revealed across these studies. First, empirical studies showed an inverse significant relationship between the age at release and the risk of sexual and violent reoffending. In fact, a meta-analysis conducted with a large sample of sex offenders showed that the effect size of age at release was in the low -.10 for sexual recidivism, in the mid -.20 for nonsexual violent reoffending, and in the mid -.10 for general reoffending (Hanson & Bussière, 1998). These results suggest that the age effect might be more pronounced for violent reoffending compared with other types of reoffending. Second, it is generally accepted that sexual offenders in their early 20s represent the group most likely to sexually reoffend. This can be shown by the addition of items that reflect the offender's age using current actuarial risk assessment tools for sex offenders (Hanson & Thornton, 2000; Quinsey et al., 1998). However, these actuarial instruments differ as to the cutoff age at which the risk is considered to be higher (i.e., being less than 25, 27, 30 years old, etc.). Third, researchers reported that older offenders present a very low risk of sexual reoffending. Offenders in their 50s show a significant decline in risk of reoffending compared with offenders in their 20s and 30s (Barbaree et al., 2003). In fact, data indicated that sexual recidivism rates are as low as 2% over a five-year period for offenders aged 60 and older (Hanson, 2006; see also Thornton, 2006). Fourth, researchers found that the risk of reoffending decreases steadily, as the offender's age increases from the time of his release (Barbaree, Langton, & Blanchard, 2007; Barbaree et al., 2003). The linear decrease was found for sexual (Barbaree et al., 2003; Hanson, 2002; Prentky & Lee, 2007; Thornton, 2006) and violent reoffending (including sexual offenses) (Fazel et al., 2006). Although a downward linear trend appears to characterize the risk of reoffending as the offender's age at release increases, other findings suggest otherwise.

Researchers generally agree on the recidivism rates of the younger adult offenders and older offenders, but there is controversy about the age effect occurring for other offenders. Three main points have been at the core of the debate about the link between aging and reoffending in adult offenders: (1) identification of the age at which the risk of reoffending peaks; (2) how to best represent the trend in risk of reoffending between the youngest and the oldest group; and (3) the possibility of differential age–crime curves of reoffending. One hypothesis states that, when excluding the youngest and oldest group of offenders, age at release and the risk of sexual recidivism might be best represented by a plateau. Thornton (2006) argued that the inverse correlation revealed in previous studies may have been the result of the differential reoffending rates of the youngest and oldest age groups, rather than a steadily declining risk of reoffending. In this regard, one study presented sample statistics suggesting a plateau between the early 20s and the 60s+ age groups (Langan, Schmitt, & Durose, 2003). No statistical analyses were reported between the groups, thus limiting possible conclusions for that hypothesis. Another hypothesis suggested there might be a curvilinear relationship between age at release and sexual recidivism, at least for a subgroup of offenders. Hanson (2002) found evidence of a linear relationship for rapists and incest offenders, and a curvilinear relationship was found for extrafamilial child molesters (see also Prentky & Lee, 2007). Whereas the former two groups showed higher recidivism rates in young adulthood (i.e., 18–24), the latter third group appeared to be at increased risk when released in the subsequent age bracket (i.e., 25–35). This led researchers to conclude that, although rapists are at highest risk in their 20s, the corresponding period for child molesters appears to be in their 30s. These results, however, have been criticized on methodological grounds, such as the use of small samples of offenders, the presence of a small base rate of sexual reoffending, the use of uneven width of age categories to describe the data, the failure to control for the time at risk after release, and the number of previous convictions for a sexual crime (Barbaree et al., 2003; Thornton, 2006).

Propensity, Maturation and the Prediction of Reoffending

The controversy over the age effect led researchers to question whether risk assessors should consider the offender's age at the time of prison release, and if so, how the adjustment should be done (Barbaree et al., 2007; Doren, 2006; Hanson, 2006; Harris & Rice, 2007). Subsequently, two prominent schools of thought emerged, and two main hypotheses have been used to describe and explain the roles of propensity, age, and reoffending in sexual offenders: (1) the static-maturational hypothesis and (2) the static-propensity hypothesis.

The Static-Maturational Hypothesis. This hypothesis suggests that sex offenders' risk of reoffending is subject to a maturation effect, as this risk typically follows the age–crime curve (Barbaree et al., 2007; Hanson, 2006). Importantly, the maturation hypothesis is based on the assumption of a stable propensity to reoffend, but the offending rate can change over life course. In other words, the rank ordering of individuals (between-individual differences) on a continuum of risk to reoffend remains stable, but the offending rate decreases (within-individual changes) in a similar fashion across individuals. It was determined that the offender's age at release contributes significantly to the prediction of reoffending, over and above scores of various risk factors said to capture sex offenders' propensity to reoffend. Multivariate analyses showed that when controlling for prior criminal history, the rate of sexual reoffending decreases by about 2% for every one-year increase of the offender's age at release (Thornton, 2006). Adjusting for sociodemographic and criminal history factors, Meloy (2005) replicated this finding for probation failure and for nonsexual reoffending, but not for sexual reoffending. This could be explained by the low base rate of sexual reoffending for this sample (i.e., 4.5%). Other studies indicated that age at release contributes significantly to the prediction of reoffending, even after adjusting for actuarial scores (Barbaree et al., 2003; Hanson, 2006). Similar to Thornton (2006), Hanson (2006) reported that after adjusting for the scores on Static- 99, the risk of sexual reoffending decreased by 2% for every one-year increase in age after release. No interaction effects were found between scores of the Static-99 and age at release. Though these preliminary results

provide evidence in favor of the maturational hypothesis, many questions remain unanswered. The key question is whether sex offenders identified as high risk are also subject to an age effect. Because previous studies did not test the maturational hypothesis separately for high risk offenders, and considering that high risk sex offenders constitute only a small minority of all convicted sex offenders, researchers might have been limited in finding a differential age effect.

The Static-Propensity Hypothesis. The second hypothesis suggests that, by using historical and relatively unchangeable factors, adult sex offenders can be distinguished based on their likelihood of reoffending. The main assumption is that criminal propensity is stable over life course, and therefore, risk assessment tools should only be used for measuring the full spectrum of this propensity. An important point of contention for the static-propensity standpoint is whether younger offenders at high risk to reoffend, according to risk assessment tools, show the same or similar recidivism rates as older offenders with the same risk to reoffend and according to the same risk assessment tools. According to the static-propensity hypothesis, older offenders with high scores on risk assessment tools represent the same risk of reoffending as younger offenders with similar scores (Doren, 2004; Harris & Rice, 2007). For static-propensity theorists, the only age factor that risk assessors should include are those reflecting a high propensity to reoffend, such as the age of onset of the criminal activity. For example, Harris and Rice (2007) argued that the effect of aging on recidivism is small. In fact, they argued that age of onset is a better risk marker for reoffending than age at release. In other words, those who start their criminal career earlier in adulthood show an increased risk of reoffending. Their findings showed that age at release did not provide significant incremental predictive validity over actuarial risk assessment scores (i.e., violence risk appraisal guide [VRAG]) and age of onset. This could be partly explained by the fact that age of onset and age at release were strongly related, that is, early onset offenders are more likely to be released younger than late-onset offenders. The high covariance between these two age factors might have limited researchers in finding a statistical age at release effect in multivariate analyses. To our knowledge, this is the only study that has simultaneously examined the predictive accuracy of

actuarial scores, age of onset, and age at release. These analyses, however, were conducted using logistic regression, therefore not controlling for the passage of time and the effect of right censoring. Furthermore, looking at the predictive validity of the VRAG and the sex offender risk appraisal guide (SORAG) (Quinsey et al., 1998), Barbaree et al. (2007) found that after correcting for age at release, the predictive accuracy of instruments decreased significantly (VRAG, AUC = .67–.61; SORAG, AUC = .70–.65), suggesting that an age effect was embedded in the risk assessment score. Recall that the development of actuarial tools has been achieved by identifying risk factors that are empirically linked to sexual reoffending. If the risk of reoffending peaks when offenders are in their 20s, it stands to reason that characteristics of this age group are most likely to be captured and included in actuarial tools. Consequently, as Hanson (2006) suggested, scores of risk assessment tools might be more accurate with younger offenders, but overestimate the risk of older offenders.

Aim of the Study

Whereas propensity theorists reiterated the crucial role of between-individual differences in predicting reoffending, researchers who favor the maturational effect emphasized the role of within-individual variations as offenders grow older. Results from previous studies have not clarified the relative importance of static propensity, age of onset, and age at release in predicting the risk of reoffending. Policy implications are significant, as sex offenders tend to be considered as a homogeneous group by both the criminal justice system and victims' rights advocates, in spite of the heterogeneity of their behavior, their offending history, and their risk of reoffending (Lussier, Proulx, & LeBlanc, 2005). Therefore, the present study has several aims. First, can we reliably predict the risk of reoffending in a sample of convicted sexual offenders released from prison? It is commonly believed that static propensity is responsible for the tendency to reoffend, and that propensity can be measured through risk assessment tools. We focus here on the Static-99, a risk assessment tool that has been widely used to identify high risk offenders (Hanson & Thornton, 2000), and we examine here to what extent this tool can identify recidivists after their prison release. Second, our study aims to clarify the

role of age in the prediction of reoffending; and more specifically, to examine the possibility that reoffending is a dynamic process influenced by the effect of age across life course and the unfolding of the criminal career. We thus examine the respective roles of age of onset and age at release on the likelihood of reoffending. Of importance, we aim to determine: (1) whether there is a significant relationship between age factors and reoffending; (2) if so, whether this relationship is linear or curvilinear; (3) whether age factors improve the predictive accuracy of reoffending over and above the scores on the Static-99; and (4) whether age factors have an impact on the risk of reoffending independently of the propensity level of the offenders. We test the two main hypotheses characterizing the role of age on sexual offenders' risk of reoffending: the maturational hypothesis, and the propensity hypothesis. Contrary to many empirical investigations of the age–sexual crime debate, the analytical strategy used here includes the use of Cox-regression, a statistical technique that controls for the passage of time and, consequently, of aging.

Methodology

Sample

The sample included 553 adult males convicted of a sexual offense, and who were all incarcerated at the Regional Reception Centre in the province of Quebec, a maximum security federal institution run by the Correctional Service of Canada. They were all subject to consecutive admissions between April 1994 and June 2000 at the Regional Reception Centre, which admits, for the purpose of assessing risk and treatment needs, all individuals sentenced to a minimum of two years in Quebec. The average stay in this institution is about six weeks, allowing for completion of correctional assessment procedures prior to the offender's transfer to an institution suited to his risk level and treatment needs. The participation rate was very high (93%), making this sample quite unique as it closely matched the entire population of offenders who received a federal prison sentence for a sex crime in Quebec between 1994 and 2000. The most common convictions for this sample were in order of prevalence: sexual assault (59.0%), sexual interference (14.8%), sexual assault with a weapon (10.0%), invitation

to sexual touching (9.5%), incest (8.1%), anal intercourse (7.7%), and aggravated sexual assault (6.8%). The average prison sentence was 4.38 years (s = 3.54) (life sentence was coded here as 25 years). In total, 71.4% of this sample had a prior conviction for any crime, and on an average, had been convicted 4.5 times (s = 4.0) for any crime. Their criminal histories showed that, on an average, they were charged for 3.4 (s = 7.5) property crimes, 2.8 (s = 5.3) nonsexual violent crimes, and 4.1 (s = 4.2) sexual crimes. Note that the criminal activity of this sample has been extensively described elsewhere (Lussier, LeBlanc, & Proulx, 2005).

Procedures

Data used to measure age of onset were drawn from a semi-structured interview that was conducted with each research subject as part of another study on the offending process of sexual offenders. Each subject was interviewed only once by a member of the research team unaware of the research questions and hypotheses. Participation in this study was strictly voluntary, and subjects signed a consent form indicating that the information gathered would be used for research purposes only. Interviewers were all graduate students in criminology and psychology, and who were trained by a licensed forensic psychologist to conduct semi-structured interviews using a computerized questionnaire. Moreover, as subjects granted access to their correctional files, official sources of information (e.g., police reports, victim statements, psychological assessments, etc.) were also used to validate information that was obtained in the interview. When disagreements were found between information gathered during the semi-structured interview and those collected from official files, official data were used.

Measures

Control Variables. In the present study, three control variables were used as covariates in the prediction model (Table 1): (1) ethnicity, (2) educational achievement, and (3) social assistance. The vast majority of subjects in our sample, 88.9%, were Caucasian; the remainder of our subjects were Black, Aboriginal, or Hispanic. For the purpose of statistical analysis, this variable was dichotomized

as follows: (0) Caucasian and (1) non-Caucasian. Educational achievement refers to the highest level of schooling completed (0 = High school completed; 1 = High school not completed). The majority of our sample (57.3%) had not completed high school. Social assistance refers to the offender's status at the time of his last arrest prior to incarceration, which was the case for 36.1% of our sample. The variable was coded as follows: (0) offender not on social assistance and (1) offender on social assistance.

--Insert Table 1--

Static-99. The propensity was measured using a risk assessment tool, the Static-99, developed by Hanson and Thornton (2000). The instrument has since been used with a wide variety of sex offender samples in different settings (Barbaree, Seto, Langton, & Peacock, 2001; Harris et al., 2003; Nunes, Firestone, Bradford, Greenberg, & Broom, 2002). The Static-99 was designed specifically for sex offenders and is composed of 10 historical factors (or static risk factors) empirically linked to recidivism: (1) the offender being less than 25 years old; (2) having lived with an intimate partner for at least two years; (3) an index offense for a nonsexual violent crime; (4) a prior record for a nonsexual violent crime; (5) the number of prior sex offense convictions; (6) the number of prior sentencing dates; (7) any non-contact sex offenses; (8) any unrelated victims; (9) any stranger victims; and (10) any male victims. Scores on the Static-99 can vary between 0 and 12. Using the total score on the Static-99, Hanson and Thornton (2000) categorized sex offenders' risk of recidivism as follows: (1) low risk: scores between 0 and 1; (2) medium-low risk: scores between 2 and 3; (3) medium-high risk: scores between 4 and 5; (4) high risk: scores of 6 and over[2]. In the present study, the sample showed a mean score of 2.72 (s = 2.00; range = 0–9). Furthermore, based on Hanson and Thornton's (2000) original categorization, our sample was composed of 31.0% of low risk, 36.7% medium-low risk, 23.7%

[2] Using these criteria, Hanson and Thornton (2000) found that for a follow-up period of about five years, the sexual recidivism rates varied between 5% and 6% for low risk, between 9% and12% for medium-low risk, between 26% and 33% for medium-high risk, and 39% for high risk sex offenders. On the other hand, the violent recidivism rates were, respectively, 6–11%, 17–22%, 36–42%, and 44%. The predictive accuracy of the Static-99 using the area under the curve (AUC) has been shown to be .71 (95% CI; 0.68–0.74) for sexual recidivism, whereas the correlation was 0.33 (95% CI; 0.28–0.38).

medium-high risk, and 8.5% high risk offenders. This distribution is very similar to that of the sample used by Hanson and Thornton (2000).

Age at First Crime. Age at first offense was operationalized using two different measures, each having different strengths and limitations. We first used a self-reported measure of age of onset of general criminal activity, which was completed during the semi-structured interview. The measure was composed of three categories reflecting three distinct developmental periods and current theoretical developmental frameworks (Moffitt, 1993; Thornberry, 2005): (1) childhood onset (before age 13); (2) adolescence onset (between age 13 and 17); and (3) adult onset (age 18 and older)[3]. Results showed that 16.5% reported a childhood onset, 21.6% reported an adolescence onset, and 62.9% reported an adult onset of offending. It is difficult to compare these results as we are unaware of any other studies containing a self-reported age of general offending in sexual offenders. Harris and Rice (2007) reported that about 20% of their sample of sex offenders had been arrested before age 16. We also used an official age of onset measure for general offending using data from the Canadian Police Information Centre (CPIC) operated by the Royal Canadian Mounted Police (RCMP). Despite some exceptions to this statement[4], the CPIC database does not include official data on youth offending (i.e., under 18 years old). Therefore, this official measure of age of onset suffers from left censoring. In spite of this limitation, the predictive validity has been shown in a previous study (Lussier et al., 2005). The mean official age of onset for this sample was 30.45 (s = 13.29; range = 16–75), which is congruent with previous studies (Harris & Rice, 2007). The self-reported and the official age of onset were moderately correlated ($r = .36$, $p < .001$; see Table 2; Spearman's Rho = .44, $p < .001$), suggesting some continuity between the two measures. Moreover, the scores on individual items of the Static-99 were strongly related to the offender's age of onset (Appendix A). Results were similar whether official or the self-

[3] In keeping with Harris and Rice (2007), we also used a self-reported indicator measuring being arrested as a minor. The indicator was strongly correlated to the other self-reported indicator ($r = -.51$, $p < .001$) and did not add to the prediction of general or violent reoffending. Therefore, this variable was not included in the current study.

[4] Youth offenses carry an expiry date and once that date has expired (the expiry date varies according to the severity of the offense), the charges are removed from the criminal record and cannot be accessed. When an individual has been found guilty of a subsequent crime as an adult before the end of the expiry date, the youth offenses are treated as adult charges.

reported measure was used, although the items were somewhat more strongly related to our official measure of onset. Early onset offenders had more prior sentences, more sex crime convictions, more convictions for nonsexual violence, were more likely to have unrelated victims, and they were also younger at the time of the assessment, and more likely to have lived with a partner for at least two years.

--Insert Table 2--

Age at Release. Age at release corresponds to the offender's age at the time of release from prison. The mean age of the sample at the time of release was 42.62 (s = 12.07; range = 20–77). This average is somewhat higher than what was reported in previous studies, which have typically reported that offenders' age at release was in the mid-30s (Mean = 37.9, Hanson, 2006; Mean = 40.1; Sjosted & Langstrom, 2001; Mean = 35.3, Thornton, 2006). Among other things, this could be the result of the sample and the length of prison sentence (i.e., federal sentence). Discrepancies are difficult to explain based on the available data from previous studies, as this information is not typically described. On an average, our sample had spent 3.73 years (s = 1.74; range = 2–12) incarcerated. As shown in Table 2, there was a substantial correlation between age at release and the official age of onset ($r = .65$, $p < .001$). Therefore, younger offenders at release were also those with an earlier official age of onset and vice versa. Furthermore, younger offenders, at the time of their prison release, had fewer convictions for sex crimes and non-contact sex crimes, and were less likely to have offended against a male victim (Appendix A). On the other hand, younger offenders had more convictions for a violent crime; they were more likely to have committed a sex crime against unrelated and stranger victims, and to have lived with a partner for at least two years.

Follow-Up Period and Recidivism. The follow-up period refers to the period of time for which the offender was at risk of reoffending. A date of discharge was first determined for each of the offenders included in the study. Moreover, in June 2004, data on recidivism were collected for every offender, thus marking the end of the follow-up period. Of the 553 offenders, 32 had not been released

at the end of the study (5.8%), leaving us with 521 offenders. The mean follow-up period was 55.7 months (s = 24.0), or about four and a half years. The length of the follow-up period was influenced, among other things, by: (1) the date of admission; (2) the length of the prison sentence; (3) the length of stay in prison; and (4) whether an offender had reoffended prior to the end of the follow-up period. Recidivism refers here to the presence of a new conviction during the follow-up period. Two measures of recidivism were used for the present study. First, general recidivism refers to convictions for any crime following prison release; the general recidivism was 23.7%. Second, violent/sexual recidivism includes all convictions for any violent and/or sex crimes following prison release. In accordance with previous studies on recidivism (Quinsey et al., 1998), we combined violent and sexual recidivism considering the low sexual recidivism rate for this sample (5.3%), and the fact that some sex crimes might appear as violent crime in police data due to plea bargaining. During the follow-up period, 15.2% of our sample was reconvicted for a violent/sexual crime. As seen in Table 3, recidivism rates varied significantly across age groups. This effect was present for both general and violent/sexual recidivism. A downward trend reminiscent of the age–crime curve was found for both the offender's official age of onset and his age at release. Among offenders released in their 20s, the proportion of recidivists was particularly high for both general and violent/sexual recidivism (58.1% and 36.5%). This linear effect did not seem to be present when looking at the self-reported age of onset, where a curvilinear effect appeared to be present, more specifically for general reoffending.

--Insert Table 3--

Analytical Strategy

Cox-Regression. Empirical analyses of the role of age at release on reoffending have used mainly two types of multivariate statistical techniques: logistic regression and Cox-regression. Cox-regression (or Cox proportional hazards) is a statistical technique that allows for examining whether survival time (i.e., not reoffending) is influenced by some factors. Cox-regression controls for censored data, something that cannot be achieved through logistic regression. In the present study, right

censoring is important because it refers to nonrecidivist cases who might reoffend given a longer follow-up period. Recidivism studies have favored using Cox-regression, because not controlling for the length of the follow-up period could create biases in assessing and interpreting parameter estimates. Using SPSS 15.0, a series of Cox-regression analyses were performed to determine the association between each of the covariates and our measures of reoffending[5].

Predictive Accuracy. There is no general consensus as to the best way to estimate the explained variance of nonlinear models. In order to arrive at an estimate of predictive accuracy of the Cox-regression models analyzed, we used two different indicators: (1) Allison's R2formula and (2) receiver operating characteristic (ROC) curve analyses. Allison (1995) proposed a simple formula for nonlinear prediction models, which can be applied to Cox-regression analyses. This formula allows one to examine how well the covariates of a Cox-regression model can predict the outcome. Allison (1995) warned that the R2 obtained from this formula cannot be interpreted as the proportion of explained variance of the dependent variable by the covariates, but rather as an indicator showing how strongly the covariates are related to the outcome. The formula can be computed as follows:

$$R^2 = 1 - e^{(-G/n)}$$

where e is a constant (the base of the natural log), –G is the difference between the log likelihood chi-square statistic for the smaller model (e.g., without the covariates), and the log likelihood chi-square statistic for the larger model (e.g., including the covariates), and n is the sample size for the analysis.

[5] Before conducting those analyses, we inspected the following two assumptions: (a) proportionality of hazards, and (b) linearity of the covariates. First, we examined the proportionality of hazards to ensure that the effect of the covariates is constant over time. Following a procedure outlined by Grambsch & Therneau (1994), for each of the covariates, Schoenfeld residuals (or partial residuals) were plotted (y-axis) against time of survival period (x-axis). A loess smoothing curve was analyzed to inspect whether the residuals are randomly distributed across time (i.e., close to the reference line or 0 on the y-axis), thus suggesting proportionality of the covariates. Next, we tested the assumption of linearity between our continuous covariates (i.e., score on the Static-99, age at release, and the official age of onset) and our two measures of recidivism. Although the assumption of linearity is not necessary for survival analysis, when present, it results in greater power, better prediction, and fewer problems associated with the outliers (Tabachnick & Fidell, 2007). Therefore, we examined the assumption of linearity between each of the covariates and the log hazard rate of recidivism using the Martingale residuals (Therneau, Grambsch, & Fleming, 1990). A created baseline hazard rate was thus computed using Cox-regression for each of the two measures of recidivism without including any of the covariates. The standardized residuals of the baseline function for general recidivism and violent recidivism were then plotted on a graph with each of covariates using a loess smooth curve.

The accuracy of the prediction model was also examined using the ROC curve (Zweig & Campbell, 1993). The ROC curve allows one to examine, simultaneously on a plot, the sensitivity (i.e., the ability to identify true positives or recidivists), and the specificity (i.e., ability to identify true negatives or nonrecidivists) for a given instrument or a given prediction model[6]. Swets (1988) suggested that values of area under the ROC curve (AUC) between .50 and .70 provide low predictive accuracy; values from about .70 to .90 provide moderate accuracy useful for some purposes, whereas higher values present high predictive accuracy. All the functions derived from the Cox-regression model tested were analyzed using the ROC curves, and AUC values were computed using SPSS 15.0.

Prediction Models. We ran a series of Cox-regression models to examine the respective impact of static-propensity, age of onset, and age at release on reoffending. The models were adjusted for potential confounding factors (i.e., ethnicity, social assistance, and education level) and included the following: (1) (Model 1) a baseline model to assess the role of the Static-99; (2) (Model 2) a nested model where our two measures of age of onset were added to Model 1 in order to determine whether this age marker further improves the predictive accuracy of reoffending; (3) (Model 3) a nested model where age at release is added to Model 2 to examine whether this age factor provides meaningful information over and above static-propensity and age of onset.

Results

Predictive Accuracy of Single Indicators

To establish the baseline accuracy of the predictors, we ran a series of ROC curves on each of the four main covariates (Table 4). Using a series of ROC curve analyses, we looked at (1) the accuracy of the predictors (without adjusting for censoring) and (2) the accuracy of the predictors while adjusting for censoring and length of the follow-up period using survival curves adjusted for the

[6] One way to interpret the results of the ROC curve is to look at the area under the ROC curve (AUC), which provides information about the ROC curve using a single value. The AUC provides an estimate of the relative improvement of the prediction model over chance (i.e., 50%, or .50). The AUC varies between .00 and 1.00, with values closer to 1.00 indicating perfect prediction of both true positives and true negatives. For example, an AUC value of .70 for a risk assessment tool means that a randomly selected offender from the group of recidivists has a higher score on the risk assessment tool than a randomly selected offender from the group of nonrecidivists 70% of the time.

respective covariate. In total, four predictors were tested: scores on the Static-99; self-reported age of onset; official age of onset; and age at release. When not adjusting for covariates, the AUC were considered to be poor to fair, varying between .60 (self-reported age of onset) and .73 (age at release). All four ROC curves were significant at $p < .001$ indicating that these four risk factors provided a significant improvement of prediction over chance alone. When adjusting for time at risk, the AUC were fair, varying between .70 (self-reported age of onset) and .75 (official age of onset). Similarly, all ROC curves, after adjusting for time at risk, provided a significant improvement at $p < .001$ of prediction over chance alone. Of interest, the official age of onset and age at release fare as good if not better than Static-99, both with and without adjusting for time at risk. The overall predictive accuracy seemed to be affected by time at risk, thus reinforcing our decision to use Cox-regression over other types of multivariate analyses not controlling for right censoring and time at risk. The only exception to this trend was age at release, which showed comparable predictive accuracy, whether or not it was adjusted for time at risk.

--Insert Table 4--

Testing the Age Effect

General Recidivism. First, the models were tested with general reoffending (Table 5). Model 1, or the baseline model, showed a pseudo-R2 of 6.8% with an AUC of .72 (95% CI = .67–.77). After adjustment of the control variables, scores on the Static-99 were significantly related to reoffending. For every one-unit increase on the Static-99, the hazard rate of reoffending increased by 22% (OR = 1.22; 95% CI = 1.14–1.31). Looking at Model 2, when adding measures of age of onset, the pseudo-R2 increased to 9.6%, while the AUC increased to .76 (95% CI = .71–.81). Scores of the Static-99 (OR = 1.15; 95 % CI = 1.06–1.25) remained a significant predictor of the hazard rate of reoffending as well as the official age of onset (OR = .96; 95% Cl = .93–.98). Therefore, for every one-year unit increase of the age of onset, the risk of reoffending decreased by about 4%. Clearly, the addition of the age of onset, even when controlling for Static-99, added significantly to the predictive accuracy of reoffending

[$X^2(3) = 23.26$, $p < .001$]. For Model 3, adding age at release to the previous model significantly increases the pseudo- R^2 to 10.7% [$X^2(1) = 6.04$, $p < .05$], and the AUC to .77 (95% CI = .73–.82). Only two predictors were statistically significant: the scores on the Static-99 (OR = 1.19; 95% CI = 1.09–1.31), and age at release (OR = .97; 95% CI = .95–1.00). In other words, for every one-unit increase of the scores on the Static-99, the recidivism rate increased by 19%, whereas every one-year increase of age at release was associated with a decrease of 3%. The addition of age at release to the prediction model had an impact on age of onset, which became marginally significantly related to recidivism.

--Insert Table 5--

In a subsequent model (not shown here), we tested the curvilinear effect of age at release. In order to test for the curvilinear effect, we added a quadratic and a cubic effect for age at release to Model 3, which was the best fitting model. The model was significant [–2 Log ML = 1102.55; $X^2(10) = 59.29$, $p < .001$], but this was not a significant improvement over and above Model 3 without the quadratic and cubic terms [$X^2(2) = 1.74$, ns]. The model showed a pseudo-R^2 of 10.9%, and an AUC of .78 (95% CI = .73–.83). Whereas the linear effect for age at release remained significant (OR = .51; 95% CI = .27–.96, $p < .05$), so did the quadratic effect (OR = 1.02; 95% CI = 1.00–1.03, $p < .05$), and the cubic effect (OR = 1.02; 95% CI = 1.00–1.03, $p < .05$). Other than age at release, only scores on the Static-99 were statistically significant (OR = 1.20; 95% CI = 1.08–1.32, $p < .001$).

Violent/Sexual Reoffending. Next, we examined the same three models and their accuracy in predicting violent/sexual reoffending (Table 5). Overall, the pseudo-R^2 varied between 6.5% (Model 1) and 8.6% (Model 3), whereas the AUC varied from .72 (Model 1) to .77 (Model 3). Scores on the Static-99 were significantly related to reoffending in all three models tested, with an odds ratio varying between 1.26 (Model 2) and 1.33 (Model 3). In Model 2, the addition of measures of age of onset did not significantly improve the prediction model [$X^2(3) = 4.77$, ns]. In fact, scores on the official measure of age of onset (OR = .98, $p < .10$) were only marginally significantly related to reoffending. On the

other hand, in Model 3, findings showed that age at release improved the predictive accuracy of reoffending, over and above scores on the Static-99 [$X^2(1) = 8.32$, $p < .01$]. In fact, age at release in Model 3 showed an odds ratio of .95 (95% CI = .93–.99), thus for a one-year increase, the violent/sexual recidivism rate dropped by about 5%. Furthermore, quadratic and cubic effects for age at release were added to Model 3 and both terms were statistically nonsignificant.

Discussion

Sexual Offenders' Risk of Reoffending

Base Rate of Recidivism and the Offender's Age. If recidivism is used as a measure of desistance, then desistance is the norm for older offenders. Our findings contrast with the fact that, until recently, the offender's age has generally been overlooked by researchers. We concur with others (Barbaree et al., 2008; Wollert, 2006) by suggesting that the base rate of reoffending for age categories should be seriously considered when determining criminal justice interventions. This result has important implications for sentencing strategies used with sex offenders, which often rely on long term incapacitation or intensive community supervision. La Fond (2005) argued that mandatory minimum and lifetime sentencing laws in the USA (i.e., three strike laws) are overinclusive in identifying dangerous sex offenders because only the offender's criminal history is used to determine the level of risk. Failing to take the offender's age into account could overestimate the risk of reoffending for older offenders. Specific legal dispositions such as civil commitment, intensive supervision, and community notification are often imposed on older sex offenders who have lengthy criminal records (Barbaree et al., 2007). Indeed, most cases reviewed for civil commitment (Levenson & Morin, 2006) as well as those subject to the highest level of community notification involved offenders in their 40s (Zevitz, 2006). Similarly, in Canada, sex offenders returning to the community and subject to intensive supervision (i.e., 810 orders) were also found to be in their 40s (Lussier, Deslauriers-Varin, & Ratel, 2010). End-of sentence review committees should consider the offender's age before imposing legal dispositions that could disrupt the offender's ability to successfully reintegrate the community

(Levenson, D'Amora, & Hern, 2007). This is not to say that age should be the only factor used to identify high risk sex offenders. Our results show that the offender's age at release is one of the many factors to be considered in assessing the risk of reoffending. In keeping with Tonry's (2004) observations, our findings do not justify prioritizing age over past criminal record. This could create situations in which older offenders with lengthy criminal records would receive no "aggravating points" on an actuarial table. Findings suggest that both actuarial risk and age at release independently and significantly helped to identify recidivists and nonrecidivists. Our findings do suggest that, at a minimum, the combination of actuarial risk assessment tools and age at release should be considered when making decisions about the use and intensity of criminal justice interventions.

Actuarial Prediction of Recidivism. The current study included the Static-99, which is one of the most widely used risk assessment tools for predicting recidivism among sex offenders (Doren, 2004). The instrument is based on a series of items that measure the static propensity to reoffend. The rank ordering of individuals on the continuum of scores provided by the instrument is said to indicate the likelihood of reoffending. Empirical studies have shown that the Static-99 is one of the most accurate instruments available to predict general, violent (including sexual), and sexual reoffending with a sample of sex offenders (Barbaree et al., 2001; Nunes et al., 2002)[7]. When looking specifically at the Static-99, ROC curve analyses showed AUC in the mid .60s, which should be considered low but within the range of what has been reported in previous studies that used this instrument to predict

[7] It could be argued that an actuarial tool such as the VRAG (Quinsey et al., 1998) would have been more appropriate for this study considering that we did not look specifically at sexual recidivism. In that regard, Hanson and Thornton (2000) reported that the predictive accuracy observed for sexual recidivism was virtually identical to that of violent (including sexual) recidivism (AUC = .69). Nunes et al. (2002) also reported near identical results for the prediction of sexual (AUC = .70) and violent (including sexual) (AUC = .69) recidivism using the Static-99. Furthermore, the Static-99 has been shown to have comparable predictive accuracy to that of the VRAG, an instrument designed specifically to predict violent reoffending. For example, Barbaree et al. (2001) reported AUC of .77 (general recidivism) and .69 (violent/sexual recidivism) for the VRAG, while for the Static-99, the AUC were .71 (general recidivism) and .70 (violent/sexual recidivism). Scores reported for the Static-99 were therefore in line with those first presented by Hanson and Thornton (2000). Harris et al. (2003), however, reported more discrepancies between the Static-99 (AUC = .60 and .67) and the VRAG (AUC = .70–.77) in their predictive accuracy of violent (including sexual) recidivism, which could be explained by the presence of significant missing data needed to score all items of the Static-99. Taken together, based on the scientific evidence available, it appears that when using the Static-99, the predictive accuracy for sexual recidivism is comparable to that of violent (including sexual) recidivism.

violent recidivism (including sex crimes) (e.g., Hanson & Thornton, 2000; Harris et al., 2003; Nunes et al., 2002). However, both the passage of time and age factors appeared to be an integral part of understanding the risk of reoffending. When controlling for time at risk and the passage of time using Cox-regression analyses, the predictive validity of the Static-99 increased to the low .70s. Therefore, not specifying the duration of the period for which the prediction is made when assessing the risk could result in a biased evaluation. Moreover, predictive accuracy was further improved by controlling for the offender's age of onset and age at release. The current findings suggest that the predictive accuracy of sex offenders' recidivism could be improved by taking into account the age effect. Those results are in line with previous studies emphasizing the importance of age effects and increasing the prediction accuracy over and above scores on current risk assessment tools (Barbaree et al., 2003; Hanson, 2006; Harris & Rice, 2007). Several recommendations have been made in recent years to account for the age effect when conducting risk assessment.

Age of Onset and Actuarial Adjustment. Harris and Rice (2007) suggested that age of onset should be used to improve the actuarial prediction of reoffending over and above age at release. Propensity theorists have argued that an early onset of criminal activity is another manifestation of a strong inclination to offend. Our findings offer some empirical support for this conclusion. Indeed, when not adjusting for covariates, subjects who self-reported that their age of onset was younger than 18 years had recidivism rates about twice as high as subjects who self-reported an adult onset. More striking results were found when looking at the official age of onset: those starting before age 21 had a 40% general recidivism rate, and a 24% violent recidivism rate, whereas those starting past age 40 had general and violent recidivism rates below 5%. In fact, ROC curve analyses demonstrated that the official age of onset showed predictive accuracy comparable to that of the total score on the Static-99. Furthermore, and in line with Harris and Rice (2007), when entered into multivariate statistical analyses, age of onset improved the predictive accuracy of reoffending over and above scores of the Static-99. If age of onset is merely another manifestation of a static criminal propensity (Gottfredson &

Hirschi, 1990), then the Static-99 is not a complete measure of this propensity to reoffend. It could also be argued that age of onset is not just another manifestation of static propensity, but rather reflects a dynamic process by which the consequences of the early activation of offending limits access to resources through conventional means (e.g., criminal record, incarceration, labeling) (Nagin & Paternoster, 2000). In the current study, age of onset improved the predictive accuracy after adjusting for actuarial scores, but its importance disappeared after controlling for the offender's age at release. Therefore, sex offenders tend not to reoffend as they age, regardless of the age at which criminal activity was initiated. This raises the possibility that, once criminal activity is initiated, a dynamic process takes place that is not accounted for by actuarial tools. Hence, using age of onset instead of age at release is not supported by our findings.

Policy Implications

Age at Release and Actuarial Adjustments. Hanson (2006) concluded that there was little justification for adjusting Static-99 scores for offenders younger than 40 years old at the time of their release. No specific recommendations were made for older offenders, although Hanson (2006) recognized their low recidivism rates, especially for those over the age of 60. The findings of our study suggest a tendency to desist from reoffending over time, regardless of the age at which offenders initiated their official criminal career. This result is in line with the maturational hypothesis that emphasizes the inexorable effect of age on reoffending (Barbaree et al., 2007). On an average, this sample of offenders was in their forties at the time of release. It is usually understood from the age–crime curve that offenders have long desisted before that age or are in the process of desisting (Piquero et al., 2003; Sampson & Laub, 2005). As suggested by proponents of the maturational hypothesis (Hanson, 2006; Barbaree et al., 2007), the importance of taking into account the offender's age at the time of release was supported by empirical evidence[8]. Indeed, reoffending was clearly high for those

[8] The correlation between the offender's age at release and age at sentence was extremely high [$r(513) = .99$, $p < .001$] (something also observed by Thornton, 2006). This correlation can be explained by the relative homogeneity of the sample

released prior to age 30, with general and violent/sexual recidivism rates of 58% and 36%, respectively. Past age 50, general and violent/sexual recidivism rates were barely higher than 10%. It was not surprising then to observe that, by itself, the offender's age at release showed a predictive accuracy comparable to that of the scores of the Static-99. This result is noteworthy and underscores the importance of the age effect to that of the actuarial tool. The current study highlights the fact that the risk of general and violent/sexual reoffending steadily decreased across age groups after controlling for the passage of time and actuarial scores. In fact, multivariate analyses showed that age at release improved the prediction of general and violent/sexual reoffending, over and above scores of Static-99. When an age at release effect was found, it was mainly a linear one. Congruent with previous observations (Hanson, 2006; Thornton, 2006), after adjusting for the scores on Static-99, for every one-year increase in age, recidivism rates dropped 3% for general and 4% for violent/sexual reoffending. This age effect should be reflected in the actuarial risk assessment of sex offenders[9]. Recall that the Static-99 already controls for the offender's age (i.e., being less than 25 years old). This adjustment, however, did not sufficiently account for the age effect across our sample of offenders. Hanson's conclusion regarding offenders under age 40, therefore, is not warranted by our results.

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in terms of: (1) the conviction for which they were sampled (i.e. sex crime); (2) the length of their prison sentence (i.e., at least two years), and; (3) the time actually spent in prison. Because of the high correlation, both variables could not be included in the same Cox-regression analysis as this would result in a problem of multicolinearity. Consequently, to assess the effect of age at sentence, the same statistical analyses conducted in the study were run but replacing age at release with age at sentence (the results are not shown here). Not surprisingly, the results were virtually the same. Hence, we cannot conclude from this study that the age effect found is the result of aging in prison.

[9] Because the sexual reoffending rate was very low, multivariate statistical analyses could not be performed to investigate the age effect on sexual recidivism specifically. The low base rate of sexual recidivism observed in the current study would inflate the standard errors of the population parameter estimates, thus leading to biased results. For description purposes, we looked at bivariate statistical analyses which suggest similar trends for sexual reoffending as those observed for general and violent/sexual recidivism. The small group of sexual recidivists ($n = 27$) were significantly younger at the time of their prison release ($X = 37.0$; $SD = 11.3$ vs. $X = 42.9$, $SD = 12.0$) while also showing higher scores on the Static-99 ($X = 4.0$; $SD = 2.5$ vs. $X = 2.6$, $SD = 1.9$) compare to the other offenders included in the study [Age at release: $t(511) = 3.59$, $p < .01$; Static-99: $t(511) = 2.46$, $p < .05$]. Although the 20–29 age category represented only 14% of the total sample at the time of the prison release, they represented about 33% of sexual recidivists. Note that all sexual recidivists were less than 60 years old at the time of their prison release. Furthermore, the group of sexual recidivists were also more likely to report a childhood-onset of delinquency [$X2(2) = 9.2$, $p < .01$]. No other statistical differences were found between sexual recidivists and the other offenders. Because of the small number of sexual recidivists and the fact that we could not control for time at risk, these results should be interpreted with caution.

Older Offenders and Actuarial Adjustments. In a series of empirical studies, Barbaree and colleagues (Barbaree et al., 2007; Barbaree et al., 2008) concluded that the use of the actuarial tools with older offenders might be problematic by design. The main argument was that actuarial tools might be tapping characteristics of younger offenders because they represent the age group most likely to reoffend. As a result, an age effect might be statistically embedded in the items selected to create the actuarial tool. Barbaree's work has shown that several items composing the VRAG and the SORAG were statistically related to age at release. When correcting for the age effect embedded in the items of those actuarial tools, the predictive accuracy significantly decreased, suggesting that the instrument might not be working equally well for offenders across age categories. In line with those observations, the present study found empirical evidence that the items of the Static-99 might be better at capturing the risk factors of younger antisocial sex offenders because most items were inversely related to age at release, especially items related to general criminal activity and violence. This general rule cannot be applied, however, to subjects with an extensive sexual criminal history of offending against male victims because they tend to be older at the time of their release. This was also observed by Barbaree et al. (2007), who argued that this pattern of association between risk factors and age at release could reflect individual differences between younger sexual aggressors of women and typically older sexual aggressors of children. Consistent with this observation, sexual aggressors of children with male victims tend to have a higher number of sexual convictions and also show more evidence of sexual deviance (e.g., sexual compulsivity) compared to sexual aggressors of women who, on the other hand, are more likely to show evidence of antisociality (Lussier, Leclerc, Cale, & Proulx, 2007).

This raises the possibility that different risk factors might be operating for different age groups or at different stages of the criminal career. Actuarial tools are based on the assumption that all offenders fit one pathway of offending, where offenders are differentiated on a quantitative continuum of risk. We found much heterogeneity as to the age at which the criminal activity started, the age at which the first criminal charges were laid, and the offender's age at the time of his prison release.

Hence, some offenders might be in the activation phase (offending is becoming more frequent and diversified), some in the aggravation phase (where there is an increase in the seriousness), and others might be desisting (offending is gradually slowing down; Lussier, 2005). The complexity of the unfolding of the criminal activity and the aging process, therefore, are unlikely to be captured by a single actuarial tool. Empirical research should address this heterogeneity by looking at the pattern of reoffending for various offending trajectories of sex offenders and the associated risk factors.

The findings of this study should be interpreted in light of a number of methodological limitations. First, because the research design was cross-sectional, we cannot generalize our findings as evidence of within-individual changes of risk of reoffending relative to offenders' aging. Our findings suggest, however, that between-individual differences in age have an impact on the risk of general and violent (including sexual) reoffending. This effect was truly independent of the offender's age of onset, thus affecting both early onset and late onset offenders. Second, the recidivism rates observed in the study were somewhat below what was reported in previous empirical studies based on sample of convicted sex offenders. Discrepancies might be explained by the fact that our sample is based on a correctional rather than a psychiatric sample of sex offenders. Recall that our sample (or quasi-population) is representative of a general prison population of convicted sex offenders having received a minimum federal sentence of two years. Empirical studies based on very large correctional samples of sex offenders have shown comparable figures for sexual and violent recidivism (Langan et al., 2003; Meloy, 2005; Sample & Bray, 2003). Third, it is likely that those reoffending rates underestimate the true rates because only official data were used in the current study. Furthermore, the official measure of recidivism used (i.e., conviction) might result in lower rates than those based on arrests or charges. Official data are subjected to various methodological limitations because they can be influenced by the offender's ability to remain undetected, to citizens' willingness to report a crime, to police efficiency in solving crimes as well as their recording practices and categorization of the offense. Fourth, our study did not look specifically at sexual recidivism but a composite measure of nonsexual violent and sexual

recidivism. Consequently, the base rate of sexual recidivism was too low to perform multivariate statistical analyses. A longer follow-up period would have been necessary to examine sexual recidivism specifically.

Conclusion

The findings of this study were generally consistent with Quetelet's original observation about the age–crime curve. Most sex offenders do not reoffend sexually after being released from prison and the current study provides additional evidence of this observation. Congruent with the findings of Kruttschnitt, Uggen, and Shelton (2000), this is further evidence against the argument that sex offenders respond to nothing but long term imprisonment and intensive community supervision. All offenders eventually desist, albeit at a different rate (Sampson & Laub, 2005). By itself, age at release was as good a predictor of reoffending as the score of the Static-99, an actuarial tool designed to determine the risk of reoffending in sexual offenders. These results suggest that age at release should be an important component considered by risk assessors when considering cases for long term incapacitation and intensive community supervision. As suggested by Tittle (1988), it is plausible that even if the age–crime association is quite general, it is not necessarily invariant and some offenders might deviate from that pattern. Hence, it is possible that the age effect might not operate the same way for individuals characterized by different offending trajectories. Future studies should examine whether the age–crime curve is present for sex offenders characterized by different offending trajectories and whether the age effect has the same impact on sexual recidivism across these groups. The results of the current study have to be interpreted with the understanding that the risk of reoffending was relatively low and mostly nonsexual, combined with the fact that the predictive accuracy obtained, although statistically significant, was not very impressive. Therefore, these results do not provide empirical evidence for a strategy of selective incapacitation aimed at sex offenders, but rather highlight our limited understanding of the role of aging and the process of desistance in sex offenders.

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Table 1. Descriptive data

Quantitative data	Mean (SD)	Range
Age of onset (official)	30.45 (13.29)	16–75
Age at release	42.62 (12.07)	20–77
Time spent incarcerated (years)	3.73 (1.74)	2–12
Static-99 (total score)	2.69 (2.12)	0–12
Length of follow-up (months)	54.84 (23.27)	1–131
Qualitative data		**Prevalence (%)**
Age of onset (self-reported)		(0) Childhood = 16.5 (1) Adolescence = 21.6 (2) Adulthood = 62.9
Social assistance		(0) No = 63.9 (1) Yes = 36.1
Education (High School)		(0) Completed = 42.7 (1) Not completed = 57.3
Ethnic origin		(0) Caucasian = 88.9 (1) Non-Caucasian = 11.1
General recidivism		(0) No = 77.3 (1) Yes = 23.7
Violent/sexual recidivism		(0) No = 84.8 (1) Yes = 15.2
Sexual recidivism		(0) No = 94.7 (1) Yes = 5.3

Table 2. Correlation matrix

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Social assistance	—									
2. Low education	.18***	—								
3. Ethnic origin	.05	.08	—							
4. SR age of onset	−.24***	−.06	.03	—						
5. OFF age of onset	−.35***	−.03	−.07	.36***	—					
6. Age at release	.26***	.05	−.21***	.34***	.65***	—				
7. Static-99	.19***	.03	−.03	−.25***	−.44***	−.10*	—			
8. Follow-up (Mths)	.07	.12**	.05	.00	−.01	−.12**	−.13**	—		
9. General recidivism	.18***	.09*	.04	−.15**	−.29***	−.33***	.21***	.26***	—	
10. Vio/sex recidivism	.14***	.09*	.04	−.14**	−.19***	−.25***	.20***	.18***	.75***	—

*$p < .05$; **$p < .01$; ***$p < .001$.

Note: "SR" refers to self-reported data. "Vio/sex" refers to violent/sexual recidivism. "OFF" refers to official data. "Mths" refers to number of months. Sample size varies between 507 and 514 because of missing data.

Table 3. Recidivism rates according to the offender's age

Age factors	General recidivism	Violent/sexual recidivism
Age of onset (self-reported)		
Childhood (*n* = 86)	30.2	22.1
Adolescence (*n* = 112)	37.5	21.4
Adulthood (*n* = 320)	17.5	10.9
Age of onset (official)		
16–20 (*n* = 171)	39.8	24.0
21–30 (*n* = 152)	25.7	15.8
31–40 (*n* = 90)	13.3	11.1
41 and older (*n* = 102)	3.9	2.9
Age at release		
20–29 (*n* = 74)	58.1	36.5
30–39 (*n* = 147)	27.9	19.0
40–49 (*n* = 154)	16.9	8.4
50–59 (*n* = 87)	12.6	10.3
60 and older (*n* = 51)	2.0	0.0

Note: Not adjusted for time at risk.

Table 4. Predictive accuracy of Static-99, age of onset, and age at release

Predictors	AUC	SE	*p*-value	95% CI
General reoffending				
Static-99	.65	.03	.000	.60–.70
Adjusted for time at risk	.72	.03	.000	.66–.77
Age at release	.73	.03	.000	.68–.78
Adjusted for time at risk	.73	.03	.000	.67–.78
Age of onset (official)	.71	.02	.000	.66–.75
Adjusted for time at risk	.75	.02	.000	.70–.80
Age of onset (self-reported)	.60	.03	.001	.54–.66
Adjusted for time at risk	.70	.03	.000	.65–.75
Violent/sexual reoffending				
Static-99	.66	.02	.000	.60–.71
Adjusted for time at risk	.70	.03	.000	.63–.76
Age at release	.71	.03	.000	.65–.77
Adjusted for time at risk	.70	.03	.000	.63–.76
Age of onset (official)	.64	.03	.000	.58–.70
Adjusted for time at risk	.69	.03	.000	.63–.76
Age of onset (self-reported)	.59	.03	.000	.52–.66
Adjusted for time at risk	.64	.03	.000	.60–.73

Note: Adjustments for time at risk were conducted using Cox-regression analyses. The ROC curves presented in the figure represent only those adjusted for time at risk.

Table 5. Propensity, age of onset, age at release and reoffending using Cox-regression analyses

	General reoffending			Violent/sexual reoffending		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	Odds (95% CI)	Odds (95% CI)	Odds (95% CI)	Odds (95% CI)	Odds (95% CI)	Odds (95% CI)
Baseline model						
Education	1.13 (.77–1.67)	.99 (.66–1.48)	1.03 (.69–1.54)	1.32 (.80–2.18)	1.26 (.75–2.11)	1.36 (.80–2.30)
Ethnic origin	1.00 (.58–1.71)	.87 (.51–1.50)	.70 (.40–1.24)	1.08 (.56–2.08)	1.00 (.51–1.93)	.71 (.36–1.43)
Social assistance	1.27 (.86–1.90)	1.02 (.67–1.53)	1.02 (.68–1.54)	1.23 (.74–2.03)	1.06 (.63–1.78)	1.06 (.63–1.80)
Static-99	1.22*** (1.14–1.31)	1.15** (1.06–1.25)	1.19*** (1.09–1.31)	1.32*** (1.19–1.46)	1.26*** (1.12–1.41)	1.33*** (1.17–1.50)
Age of onset (Self-Report)						
Childhood	—	.85 (.51–1.42)	.76 (.45–1.29)	—	1.03 (.55–1.91)	.87 (.46–1.66)
Adolescence	—	1.51^{+} (.98–2.33)	1.38 (.89–2.15)	—	1.31 (.74–2.30)	1.14 (.64–2.03)
Age of onset (Official)	—	.96** (.93–.98)	.97+ (.94–1.00)	—	.98+ (.95–1.00)	1.00 (.97–1.04)
Age at release	—	—	.97* (.95–1.00)	—	—	.96** (.93–.99)
Model Fit						
−2 Log ML	1138.52	1114.74	1108.70	712.57	707.80	699.48
X^2 (d*f*), *p*-value	35.95 (4)***	51.73 (7)***	57.55 (8)***	34.01 (4)***	36.63 (7)***	45.28 (8)***
Improvement	—	(M1–M2) 23.26 (3)***	(M2–M3) 6.04 (1)*	—	(M1–M2) 4.77 (3), ns	(M2–M3) 8.32 (1)**
R^2	.068	.096	.107	.065	.070	.086
AUC (95% CI)	.72 (.67–.77)***	.76 (.71–.81)***	.77 (.73–.82)***	.71 (.64–.77)***	.72 (.66–.78)***	.74 (.68–.81)***

$^{+}p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.
Note: AUC = Area under the curve.

Appendix A. Correlations Between Age of Onset, Age at Release and Individual Static-99 Items

Variables	Number of prior convictions sexual offenses	Four or more prior sentencing occasions	Convictions for noncontact sex offenses	Index nonsexual violence	Prior convictions for nonsexual violence	Male victims	Unrelated victims	Stranger victims	Less than 25 years old	Lived with partner for at least two years
Age of onset (SR)	−.17**	−.22**	−.04	−.08	−.28**	.06	−.18**	−.08	−.25**	−.12**
Age of onset (OFF)	−.24**	−.55**	.05	−.09*	−.50**	.16**	−.26**	−.22**	−.29**	−.19**
Age at release	.10*	−.02	.27**	−.13**	−.24**	.18**	−.20**	−.29**	−.51**	−.27**

*$p < .05$; **$p < .01$; ***$p < .001$.

Note: "SR" refers to self-reported data. "OFF" refers to official data.