

# Assessment

## **Predictive Properties of the Violence Risk Scale-Sexual Offense Version as a Function of Age**

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Predictive Properties of the Violence Risk Scale-Sexual Offense Version as a Function of Age

For Peer Review

### Abstract

The present study examined the discrimination and calibration properties of Violence Risk Scale-Sexual Offense version (VRS-SO) risk and change scores for sexual and violent recidivism as a function of age at release, on a combined sample of 1,287 men who had attended sexual offense specific treatment services. The key aim was to examine to what extent VRS-SO scores can accurately discriminate recidivists from non-recidivists among older cohorts, and if the existing age-related adjustments in the instrument adequately correct for increasing age. VRS-SO risk and change scores showed consistent properties of discrimination for sexual recidivism across the age cohorts, via Area Under the Curve (AUC) and Cox regression survival analysis, as demonstrated through fixed effects meta-analysis. Calibration analyses, employing logistic regression, demonstrated that age at release was consistently incrementally predictive of violent, but not sexual, recidivism after controlling for individual differences on static and dynamic risk factors. E/O index analyses demonstrated that predicted rates of sexual recidivism from VRS-SO scores, particularly when employed with Static-99R, were not significantly different from those observed among age cohorts; however, calibration was weaker for general violence. Implications for use of the VRS-SO in sexual recidivism risk assessment with older offenders are discussed.

*Key words:* VRS-SO, sexual recidivism, change, risk assessment, age

### Methodological Disclosure

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study

### Predictive Properties of the Violence Risk Scale-Sexual Offense Version as a Function of Age

The assessment of risk for further offending among those convicted of a sexual offense has been a major focus of research over the past three decades, culminating in the development and validation of a number of specially designed instruments. Such instruments, for example Static-99 (Hanson & Thornton, 1999, 2000), Stable 2007 (Hanson, Harris, Scott, & Helmus, 2007), and Violence Risk Scale-Sexual Offense version (VRS-SO; Wong, Olver, Nicholaichuk, & Gordon, 2003, 2017), offer structured protocols to rate subjects across an array of factors associated with recidivism, and derive and interpret an overall score or risk categorization linked to an estimate of recidivism. Risk instruments are sometimes revised as knowledge accumulates with further research, and one area that has been a recent focus of risk tool revision (e.g., the development of the revised Static-99R; Helmus, Thornton, Hanson, & Babchishin, 2012) is the relevance of the age of the individual being assessed, and how to best incorporate age into risk assessments. The impetus for such developments has been the growing literature bases regarding a number of relevant age-related phenomena, including: an inverse link between advancing age and criminal propensity; developmental changes that occur with age that hold relevance for sexual behavior and risk; the empirical impact of aging on sexual recidivism rates; and the weaker performance of some psychometric risk tools observed among older populations, suggesting that age may not have been adequately accounted for. These literatures are briefly reviewed below.

#### **Age and Desistence from Sexual Violence across the Lifespan**

The association between age and general criminal propensity is a well-documented phenomenon, with Lussier and Healey (2009, p. 828) describing it as “one of the most robust and stable empirical findings of criminological research.” Specifically, an inverse association has consistently been observed, in which criminal behaviour decreases with advancing age across the lifespan following a peak in adolescence (Farrington, 1986). For instance, a landmark longitudinal study of over 60 years duration (Sampson & Laub, 2003) concluded that even among those showing early propensity, eventual

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desistance from crime was the norm: Tracking long-term offending patterns of 480 males identified during childhood as “delinquent,” involvement in crime was found to decline across the lifespan (taking into account subject mortality). The average age of desistance, defined as age at last arrest, varied for different offense types; however, beyond the age of 50 rates were consistently very low. Recently, Bekbolatkyzy, Yerenatovna, Maratuly, Makhatovna, and Beaver (2019) analysed longitudinal data from a nationally representative sample of youth to investigate potential causal mechanisms behind the “aging out” effect, finding some support for the impact of both peer group and self-control.

Studies such as the above exploring crime rates across the lifespan have not tended to investigate sexual offending specifically; however, the link between age and recidivism (i.e., sexual re-offending) among those convicted of sexual offenses has been explored. Following an earlier meta-analytic finding by Hanson and Bussière (1998) of an overall small inverse correlation ( $r = -.13$ ) but with notable variability across studies, Hanson (2002) carried out an updated meta-analysis, in which a pooled sample of 4,673 sex offenders from 10 studies was divided into subtypes based on victim type (adults, intrafamilial or extrafamilial children). Hanson’s analyses confirmed a linear decline in recidivism rates with increasing age across the whole sample, finding an identical overall correlation magnitude as that reported by Hanson and Bussière ( $r = -.13$ ). Differential patterns of desistance were apparent between the subgroups, with those who targeted adult victims showing a steady decline in risk from around the age of 40 years, but a later decline for those targeting children, from around 50 years. Individuals who were released past the age of 60 years showed very low rates of recidivism regardless of victim type (3.8%, relative to the sample base rate of 17.5%).

Several studies subsequent to Hanson’s (2002) meta-analysis have found the same apparently robust inverse relationship between age and sexual recidivism. For instance, Skelton and Vess (2008) explored the link alongside consideration of actuarial risk level among an entire population of all first releases from New Zealand prisons for contact sexual offences across a 15-year period ( $N = 5,880$ ).

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3 Skelton and Vess found a decline in sexual reoffending past the age of 50 across risk categories, but also  
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5 that estimations of risk based on a static scale continued to differentiate sexual reoffending likelihood  
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7 even amongst the oldest cohorts. More recently, Nicholaichuk, Olver, Gu, and Wong (2014) explored the  
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9 age-recidivism phenomenon further, drawing data from three years of federal incarceration sexual  
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11 offending sentence completions from across Canada ( $N = 2,401$ ), with a select focus on the cohort aged  
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13 50 years or older at release ( $N = 542$ ) for specific analyses. Among the wider sample, in line with  
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15 previous research, a steady decrease in sexual recidivism with increasing age at release was observed,  
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17 with a significant small to moderate inverse relationship found overall (Cramer's  $V = -0.16$ ). The sexual  
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19 recidivism base rate was significantly lower among the over-50 cohort (5.6%) relative to those aged  
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21 under 50 at release (14.8%). When the sample was stratified based on a brief actuarial scale devised  
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23 from six static risk variables available in the dataset, across the majority of risk bands sexual recidivism  
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25 was lower for the older cohort, with observed rates between a quarter and two-thirds less than the  
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27 younger cohort. By way of exception, the group of over-50s who scored in the highest risk band  
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29 exhibited a high rate of sexual recidivism (40.0%); however, it is important to note this group was small  
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31 in numbers ( $n = 20$ , eight of whom were reconvicted). Other studies (e.g., Rettenberger, Briken, Turner,  
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33 & Eher, 2015; Thornton, 2006) have reported more complex relationships between age and sexual  
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35 recidivism as opposed to a simple linear decline, though nonetheless found substantially reduced rates  
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37 after the age of 60.  
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44 What explanatory mechanisms could be at work to account for the decline in sexual risk with  
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46 advancing age? In discussing this question, Hanson (2002) highlighted three key possibilities: sex  
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48 drive/deviant sexual interests, self-control, and offending opportunity. Regarding sex drive, reduced  
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50 frequency of sexual behavior in general has long been associated with older age in cross-sectional  
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52 surveys (e.g., Call, Sprecher, & Schwartz, 1995; Matthias, Lubben, Atchison, & Schweitzer, 1997), with  
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54 Call et al. (1995) finding sharp declines commencing from age 50. DeLamater and Moorman (2007)  
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3 explored whether this effect may be due to factors other than age per se, such as relationship factors  
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5 (e.g., duration, satisfaction), health problems and associated treatments, and attitudes, finding that  
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7 although controlling for a range of biological, psychological, and social variables did reduce the strength  
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9 of the relationship, age remained significantly associated with the frequency of the majority of sexual  
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11 behaviours across both genders. It is likely that age-related hormonal changes are behind this decline,  
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13 with androgen (e.g., testosterone) levels known to decline steadily between middle adulthood into older  
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15 age (e.g., Feldman et al., 2002). As noted by Hanson (2002), to the extent that deviant interests are a key  
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17 feature of a person's sexual life, which is the case for some but not all who have sexually offended,  
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19 persistence or otherwise of offending risk would likely reflect changes in the individual's sex drive per se.  
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21 Further, the availability of opportunities to sexually offend may also contribute to age-related decreases  
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23 in risk: Hanson (2002) noted that consistent with his meta-analytic findings, recidivism opportunities for  
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25 those who have offended against adult victims are likely to decline gradually with age due to lifestyle  
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27 changes, while between their late 20s through to early 40s is the age bracket when opportunities to  
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29 offend against children are likely to be highest (i.e., due to men most commonly having their own  
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31 children and associating with other young families during this period). Finally, regarding self-control,  
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33 given that factors such as low self-control and impulsivity are correlates of sexual recidivism (e.g.,  
34  
35 Hanson & Bussière, 1998), and that self-control abilities have been shown to be higher amongst older  
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37 (compared to younger) adults (Isaacowitz, Vaillant, & Seligman, 2003), it may be that improvements in  
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39 self-control are a further causal mechanism behind declining sexual re-offending rates with age, as  
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41 suggested by Hanson (2002).  
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#### 47 **Age Related Considerations in Sexual Violence Risk Assessment**

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50 Helmus et al. (2012) argued that while it may be desirable to understand the reasons or  
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52 mechanisms behind the correlation between age and recidivism, such knowledge is not strictly  
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54 necessary for the purpose of risk assessment; rather, it is the empirical association between a factor and  
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3 the outcome of interest that is key. Given the robust empirical link between increasing age and declining  
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5 sexual recidivism, an important question for researchers and practitioners is therefore what impact a  
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7 subject's age may have on the accuracy of risk assessment tools, and particularly whether estimated  
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9 rates linked to particular scores remain valid for older individuals. To date, only limited research has  
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11 been undertaken to explore this issue. Hanson (2006) carried out a study on the performance of the  
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13 Static-99 (Hanson & Thornton, 1999, 2000) using a combined sample of  $N = 3,425$ , finding that age at  
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15 release added significantly to the prediction of sexual recidivism across all risk levels after accounting for  
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17 Static-99 scores. Predictive accuracy in terms of relative risk was found to be similar across age groups:  
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19 areas under the receiver operating characteristic curve (AUC) ranged between .66 and .82 with  
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21 overlapping confidence intervals. With possible values ranging from 0 to 1.0 representing the probability  
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23 that a randomly selected recidivist would have a higher risk score than a randomly selected non-  
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25 recidivist, AUC values of .556, .643, and .714 correspond to small, medium, and large effects,  
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27 respectively (Rice & Harris, 2005). With respect to absolute risk, however, those in the older age  
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29 brackets (i.e., from 40 to 50 years and older) showed lower rates of sexual recidivism than what would  
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31 be expected based on their Static-99 risk category (based on norms published in Harris, Phenix, Hanson,  
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33 & Thornton, 2003), meaning that the tool over-estimated absolute risk among these cohorts, across risk  
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35 levels. This was particularly marked for the 60 and older age bracket. The author concluded that  
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37 evaluators using this tool should take advanced age into account when estimating risk, a  
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39 recommendation echoed by Lussier and Healey (2009) based on their later analyses of a Canadian  
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41 sample of 533 sexual offenders.  
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48 More recently, a revised version (Static-99R) was developed, as a means of more robustly  
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50 improving predictive accuracy amongst older subjects (Helmus et al., 2012). On the basis of updated  
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52 analyses with an expanded pooled dataset ( $N = 8,390$ ) indicating that age at release was (negatively)  
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54 incrementally predictive after controlling for the original version total score, and that applying the  
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original age weights resulted in overestimating recidivism among those aged 50 and older, it was determined that revision was necessary. The revised tool, Static-99R, incorporating revised age weights (in which up to three points are subtracted to account for the effect of advancing age on risk), was demonstrated to provide a substantially better fit for those 50 and older than the original tool in terms of absolute recidivism estimates when compared to observed rates (Helmus et al., 2012). In contrast, in a study exploring the links between different measures of age and sexual recidivism risk (Rice & Harris, 2014), the authors concluded that no adjustments were warranted on the basis of age at release when an actuarial risk tool encompassing an item for age at time of offending was used, such as the Sex Offender Risk Appraisal Guide (SORAG; Quinsey, Harris, Rice, & Cormier, 2006). The variation in findings across studies underscores the importance of investigating the issue of whether age-related adjustments or revisions may be necessary across different risk tools.

### **Dynamic Risk Measures and the Effects of Age**

Within the past 15-20 years, the field of sexual recidivism risk assessment has witnessed a proliferation in dynamic risk measures, in recognition of the potential for risk to change and the concordant need for measures that can inform service planning and evaluate changes in risk from treatment or other change agents. Relevant examples include Stable 2007 (Hanson, Harris, Scott, & Helmus, 2007), the Violence Risk Scale-Sexual Offense version (VRS-SO; Wong, Olver, Nicholaichuk, & Gordon, 2003, 2017), and the Sex Offender Treatment Information and Progress scale (SOTIPS; McGrath, Lasher, & Cumming, 2012). Results of meta-analysis support the predictive accuracy of dynamic measures for sexual recidivism at a magnitude that is comparable to static tools, with area under the receiver operating curve (AUC) values (estimated from Cohen's *d*) of approximately .68 to .69 reported (Hanson & Morton-Bourgon, 2009; van den Berg et al., 2018). As such, applying the aforementioned Rice and Harris (2005) guidelines, extant static and dynamic measures have broadly moderate accuracy for sexual recidivism, and individual studies further tend to show dynamic measures to be incrementally

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3 predictive of sexual recidivism after controlling for static scores (Hanson, Helmus, & Harris, 2015;  
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5 McGrath et al., 2012; Olver et al., 2007). Dynamic tools, however, have not undergone the same level of  
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7 scrutiny as static measures, such as Static-99R specifically, in terms of how their predictive properties  
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9 and applications may be impacted by advancing age.  
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**Current Study and Rationale**

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14 Amidst the growing aging correctional population across international jurisdictions (e.g., Boe,  
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16 Nafekh, Vuong, Sinclair, & Cousineau, 2003; Dawes, 2009; Handtke, Bretschneider, Wangmo, & Elger,  
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18 2012), including an increasing prosecution of men who have historical sexual offenses, it is becoming  
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20 increasingly commonplace for evaluators to be assessing men well into their middle age and senior  
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22 years for sentencing and release decisions. Although the research has demonstrated precipitously  
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24 declining base rates of recidivism associated with aging, examination of the predictive properties of  
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26 sexual violence risk tools, particularly dynamic measures, with older offenders has been remarkably  
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28 scant. This includes: i) to what extent risk scores can adequately differentiate recidivists from non-  
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30 recidivists among older offenders (i.e., discrimination); and ii) what recidivism base rates are associated  
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32 with risk scores on existing tools among older offenders (i.e., calibration); that is, do existing tools  
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34 adequately account for increasing age?  
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39 As such, the present study sought to examine the predictive properties (discrimination and  
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41 calibration) of risk and change scores from a dynamic tool—the VRS-SO—among different adult age  
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43 groups from a large multinational treated sexual offender sample used to establish and cross validate  
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45 the tool (see Olver et al., 2018). The work is necessary to: i) begin filling a gap in the risk assessment field  
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47 about the role and relevance of increasing age on dynamic risk assessment, and ii) specifically examine  
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49 the predictive properties of the VRS-SO with different age groups, particularly older offenders in order  
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51 to inform clinical and psycholegal applications of the VRS-SO with this age group. **We examine both**  
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sexual and violent recidivism given the importance of the assessment and management of risks for both outcomes, and given that age-related changes are associated with a declining frequency of each.

The following hypotheses were proposed:

1. Rates of sexual and violent recidivism will show age related declines, with the lowest rates observed in men age  $\geq 60$  years.
2. VRS-SO static, dynamic (pre and post), and change scores, and Static-99R scores, will each predict sexual and violent recidivism and show adequate properties of discrimination across different age cohorts.
3. Properties of discrimination will also be demonstrated for VRS-SO factor scores (pre, post, change) across age cohorts.
4. Positive changes (i.e., reductions) in risk, measured by the VRS-SO, will be associated with decreases in sexual and violent recidivism, after controlling for baseline risk (i.e., static and dynamic risk factors), irrespective of age group.
5. Calibration analyses will demonstrate that VRS-SO risk and change scores (or alternatively, Static-99R and VRS-SO scores) will remain incrementally associated with sexual and violent recidivism at fixed follow-ups after controlling for age at release. The association between age at release and recidivism is expected to weaken with increasingly stringent controls for risk and change.
6. E/O indices will demonstrate acceptable calibration between expected and observed rates of sexual recidivism generated from logistic regression models based on either the VRS-SO (risk and change scores) or the Static-99R and VRS-SO combined (dynamic risk and change scores), within different age groups. Given that age-related calibration has been weaker for violent recidivism for sexual violence risk tools (Helmus et al., 2012), greater E/O disparities are anticipated.

## Method

### Samples and Procedure

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3 The present study employed four combined samples of incarcerated men convicted for sexual  
4 offenses who received sexual offense specific treatment services. The VRS-SO was rated from  
5 pretreatment and posttreatment information on each of the samples (three archival and retrospective,  
6 one prospective) in their entirety and recidivism data were obtained from updated official criminal  
7 record sources. All VRS-SO ratings were completed blind to recidivism outcome and usually by different  
8 coders, who were graduate or undergraduate research assistants trained in the measures by one or  
9 more members of the VRS-SO development team; the exception was raters for the prospective sample,  
10 who were frontline service providers (see sample descriptions below). By necessity, coders for the  
11 retrospective samples would have exposure to pretreatment and posttreatment information for the  
12 cases, as this is needed to complete change ratings; however, posttreatment information was not  
13 reviewed until following the completion of pretreatment ratings, and for the bulk of cases that had  
14 electronic files, pretreatment and posttreatment information were stored in separate folders. The  
15 combined sample yielded 1,287 cases with complete VRS-SO pretreatment and posttreatment ratings  
16 (valid protocols with missing items were prorated following manual instructions), recidivism data, and  
17 age at release. The samples and further coding procedures are described as follows.

18  
19 **Clearwater Sex Offender Program I.** A sample of 321 consecutive admissions to the Clearwater  
20 High Intensity Sex Offender Program (Correctional Service of Canada, CSC) from 1983-1997 (Olver,  
21 Wong, Nicholaichuk, & Gordon, 2007). Historically, the Clearwater Program has been a 6 to 8-month  
22 program ( $M = 8.0$  months,  $SD = 2.9$ ) that provided services for high-risk need men, although this sample  
23 has some heterogeneity in risk and need level as earlier admissions (e.g., 1980s) predated the risk-need-  
24 responsivity model (Andrews, Bonta, & Hoge, 1990) which informed later admissions decisions;  
25 however, most admissions still tended to have substantive psychological concerns or treatment needs.  
26 VRS-SO ratings were completed retrospectively from detailed institutional files by trained coders and  
27 recidivism information (convictions) was obtained from the Canadian Police Information Centre (CPIC).

VRS-SO and Age

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3 The sample was followed up 17.7 years ( $SD = 4.3$ ) of which 320 men had 5-year outcome and 314 had  
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5 10-year outcome.  
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8 **Kia Marama Program.** A sample of 218 completers of New Zealand's Kia Marama Program for  
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10 child sex offenders from 1993-2000 at Rolleston Prison (Beggs & Grace, 2010, 2011). VRS-SO ratings  
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12 were completed retrospectively by that study's first author (Beggs) and a trained postgraduate research  
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14 assistant from detailed institutional files and recidivism information (convictions) was obtained from a  
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16 nationwide database. Although Kia Marama is one of New Zealand's high intensity programs ( $M = 9.4$   
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18 months,  $SD = 3.7$ ), the sample from the specified time period could be characterized as broadly  
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20 moderate risk overall and was statistically lower risk on the VRS-SO and Static-99R than Clearwater I  
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22 (Olver, Beggs Christofferson, Grace, & Wong, 2014). The sample was followed up 12.3 years ( $SD = 1.8$ ) of  
23  
24 which 218 men had 5-year outcome and 187 had 10-year outcome.  
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28 **National Sex Offender Program.** A sample of 570 treated men who had attended CSC's National  
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30 Sex Offender Program (NaSOP) between 2000-2008 in one of the low ( $M = 2.2$  months,  $SD = 1.5$ ,  $n =$   
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32  $165$ ), moderate ( $M = 5.2$  months,  $SD = 0.6$ ,  $n = 121$ ), or high ( $M = 9.1$  months,  $SD = 2.1$ ,  $n = 211$ ) intensity  
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34 streams; information regarding program intensity was not available for  $n = 73$  (12.8%) cases. A given  
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36 stream was designated for low, moderate, or high risk cases respectively, per Andrews et al's (1990) risk  
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38 principle (Olver, Nicholaichuk, Kingston, & Wong, 2014). VRS-SO ratings were available from all five of  
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40 CSC's regions, with the study having greatest access to ratings from the two institutions within its  
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42 resident province: one of which (Riverbend Institution) ran a low intensity program and had  
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44 predominantly low risk men, while the other was a high intensity program (Clearwater) with  
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46 predominately high risk men. Two cases in the NaSOP sample did not have exact age at release  
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48 information decreasing this subsample to  $n = 568$  for age related analyses. VRS-SOs were rated  
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50 prospectively pretreatment and posttreatment by treatment service providers who were trained on the  
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52 measure by members of the VRS-SO development team or designates. VRS-SO ratings were extracted  
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3 from electronic files, treatment reports, or hard copies of score sheets. Recidivism data (charges and  
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5 convictions) were obtained from CPIC. The recidivism data were updated in 2015 to generate a total  
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7 follow-up of 10.2 years ( $SD = 2.4$ ) of which 564 men had 5-year outcome, and 307 had 10-year outcome.

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10 **Clearwater Sex Offender Program II.** A sample of 180 consecutive admissions to the Clearwater  
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12 High Intensity Sex Offender Program from 1997-2001 ( $M = 6.8$  months,  $SD = 2.4$ ), who were  
13  
14 subsequently released to the community (Sowden & Olver, 2017). These were broadly high risk-high  
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16 need men and the sample did not overlap with the Clearwater participants from the NaSOP sample.  
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18 VRS-SO ratings were completed retrospectively by that study's first author (Sowden) and trained  
19  
20 undergraduate coders on the basis of detailed information from institutional files; recidivism  
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22 information (convictions) was obtained from CPIC. The sample was followed up 9.1 years ( $SD = 3.2$ ) of  
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24 which 168 men had 5-year outcome and 105 had 10-year outcome.  
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## 27 28 Measures

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30 **Static-99R.** The Static-99R (Helmus et al., 2012) is a revision of Hanson and Thornton's  
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32 (1999/2000) original tool with an updated age weighted item. The instrument is a 10-static item  
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34 empirical actuarial sexual violence risk measure comprised of sexual and nonsexual offense history and  
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36 offender and victim demographic variables. The measure was originally developed from four  
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38 international samples in 1999, while the most recent iteration including the revised age weighted item  
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40 (scored: 1 < age 35; 0 age 35-39; -1 age 40-59; -3 age  $\geq 60$ ) is based on meta-analysis of 24 samples.  
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42 Possible scores range from -3 to 12. Meta-analytic research from these studies (Helmus et al., 2012) for  
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44 Static-99R in the prediction of sexual recidivism has demonstrated large in magnitude predictive  
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46 accuracy ( $AUC = .72$ ,  $k = 24$ ,  $N = 8,390$ ).  
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50 **VRS-SO.** The VRS-SO is a sexual violence risk assessment and treatment planning tool comprising  
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52 7 static and 17 dynamic items. Each item is rated on a four-point (0, 1, 2, 3) scale, with higher item  
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54 scores presenting increased risk for sexual violence; all items are weighted equally. The measure was  
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3 developed from the Clearwater sample referenced previously (Olver et al., 2007) initially in 1999 and  
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5 successively revised in subsequent years with the addition of new samples and developments in the  
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7 field. Although the VRS-SO age at release item is not differentially weighted from the other items as with  
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9 Static-99R, the item is scaled in a manner that assigns a higher risk score to younger ages and lower  
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11 scores to older ages (scored: 3 < age 25; 2 age 25-34; 1 age 35 to 44; 0 age  $\geq$  45). While Static-99R  
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13 assigns relatively heavy weight in the reverse direction to older age and comparatively less increasing  
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15 weight to younger ages (score range from 1 to -3), the VRS-SO instead assigns a comparatively heavier  
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17 risk rating to younger ages but a lower risk rating with increasing ages (score range of 3 to 0). As such,  
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19 both age at release items adjust for increasing age with similar ranges; **the major difference in scaling on**  
20  
21 **this item between the VRS-SO and Static-99R, is that is that the VRS-SO makes no distinctions after age**  
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23 **45 whereas Static-99R has one more threshold after age 40 (at age 60).**  
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28 Dynamic items with a 2 or 3 rating are considered criminogenic, treatment targets, and  
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30 prioritized for treatment, while items with 0 or 1 ratings are low risk items. The items can be summed to  
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32 generate static, dynamic, and total (static + dynamic) scores ranging from 0-21 (static), 0-51 (dynamic),  
33  
34 and 0-72 (total). Factor analyses of the VRS-SO dynamic items have demonstrated that the items can be  
35  
36 arranged into three oblique factors termed Sexual Deviance (e.g., sexually deviant lifestyle, sexual  
37  
38 compulsivity, deviant sexual preference), Criminality (e.g., interpersonal aggression, substance abuse,  
39  
40 impulsivity), and Treatment Responsivity (e.g., cognitive distortions, insight, treatment compliance); the  
41  
42 factor domains are employed for case conceptualization and treatment planning (Olver et al., 2007). The  
43  
44 VRS-SO dynamic items are designed to assess change from treatment or other change agents across  
45  
46 multiple time points through a modified application of the stages of change (SoC) model. Five stages  
47  
48 have been operationalized for each of the 17 dynamic items: precontemplation, contemplation,  
49  
50 preparation, action, and maintenance. Progression from one stage to next is credited with a 0.5-point  
51  
52 deduction, two stages, 1-point and so on; the one exception is progress from precontemplation to  
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3 contemplation in which no point deduction is awarded given that there is no behavioral change. SoC  
4  
5 ratings are only given to 2 or 3 rated items. A change score is then computed by summing change  
6  
7 ratings. On the VRS-SO, ratings at time 1 are often referred to as pretreatment ratings, while ratings at  
8  
9 time 2 are similarly referred to as posttreatment.  
10

11  
12 An Excel workbook, termed the “VRS-SO Calculator” (Mundt, 2015) has been developed for the  
13  
14 VRS-SO applying the results of logistic regression to calculate 5 and 10-year rates of sexual and violent  
15  
16 recidivism associated with specific VRS-SO risk and change scores (Olver et al., 2018). The calculator can  
17  
18 be accessed online for free at <https://psynergy.ca/vrs-so>. The logistic regression equations were  
19  
20 generated from all cases from the four aforementioned Canadian and New Zealand samples ( $N = 913$ )  
21  
22 with a minimum of 10 years follow-up post-release. A prediction model has also been developed for the  
23  
24 Static-99R to be used in combination with VRS-SO pretreatment dynamic and change scores, in lieu of  
25  
26 the VRS-SO static score.  
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29  
30 **Recidivism.** Sexual recidivism was defined as a new criminal charge or conviction post-  
31  
32 assessment for a sexually motivated offense, contact or non-contact. Three of the samples employed  
33  
34 criminal convictions in the operationalization of sexual recidivism, while the NaSOP sample also included  
35  
36 charges. Violent recidivism was defined as any new criminal conviction (all samples) for a person-  
37  
38 involved offense whether it was sexual (e.g., sexual assault, invitation to sexual touching) or nonsexual  
39  
40 (e.g., nonsexual assault, homicide, robbery) in nature. For the Canadian samples, outcome data were  
41  
42 obtained from a national criminal record database (CPIC) as noted previously, which is a federal service  
43  
44 that registers criminal charges and convictions across the country; New Zealand has a similar system.  
45  
46 Although shortcomings endemic to the field of recidivism research (re: undetected recidivists) equally  
47  
48 apply to official sources of recidivism and these are not error free, data sources such as CPIC are among  
49  
50 the most comprehensive and reliable in the world.  
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### 53 54 **Planned Analyses** 55 56 57 58 59 60



## VRS-SO and Age

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3 The analyses proceeded in several phases. SPSS 25.0 was used as the default for all analyses  
4 unless otherwise indicated. First, we conducted age group comparisons through a one-way MANOVA  
5 with Tukey beta post hoc comparisons on Static-99R and VRS-SO scores using the following age at  
6 release categories: < 30, 30-39, 40-49, 50-59, and  $\geq 60$ . We used this grouping to not only stratify age  
7 but also in an effort to maximize the cell size for each group, and hence power. Second, we then  
8 compared the five age bands on sexual and violent recidivism outcomes over 5 and 10-year fixed and  
9 unfixed follow-ups through chi square analysis (hypothesis 1).  
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19 Third, we conducted an extensive set of discrimination analyses, beginning with computing AUC  
20 statistics for VRS-SO and Static-99R among the five age bands for 5-year and 10-year sexual and violent  
21 recidivism (hypothesis 2). The lone exception was for the age 60+ group for which we did not fix the  
22 follow-up given that there would be so few recidivists as a result ( $n_{\text{recid}} = 2$  fixed vs. 5 unfixed) that the  
23 AUCs would be unstable. AUC magnitudes were interpreted using the Rice and Harris (2005) guidelines.  
24 To examine variation in AUC magnitude across the age groups, we conducted fixed effects meta-analysis  
25 of AUCs for Static-99R and VRS-SO risk scores using MedCalc version 19.0.6 (MedCalc Software bvba,  
26 Ostend, Belgium, 2019). We report the Q statistic and  $I^2$  as measures of effect size heterogeneity, and  
27 hence, significant variation in AUC magnitude across the age groups. Significant Q values indicate  
28 significant heterogeneity in effect size, while  $I^2$  values are indexes of percent variability ranging from 0 to  
29 100, with values of 25%, 50%, and 75% representing small, medium, and large variability, respectively  
30 (Higgins, Thompson, Deeks, & Altman, 2003). A lack of significant variation in the discrimination  
31 properties of VRS-SO and Static-99R scores between age groups in terms of AUC magnitudes would be  
32 represented by non-significant Q and/or low  $I^2$  values.  
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50 Fourth, given the role of the VRS-SO dynamic factor domains in case formulation and service  
51 planning, their predictive properties as a function of age are important properties of the tool. Seldom,  
52 however, are release and sentencing decisions made on the basis of individual instrument domains, and  
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## VRS-SO and Age

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3 as such, the primary consideration was to examine whether these domains were capable of  
4  
5 discriminating recidivists from non-recidivists between the different age groups, and hence their risk  
6  
7 relevance. For these analyses, we elected to use Cox regression survival analyses for pretreatment,  
8  
9 posttreatment, and change scores on the three dynamic factor domains in the prediction of sexual and  
10  
11 violent recidivism among the age bands and simply reported the hazard ratio (HR, denoted as  $e^B$ ) for  
12  
13 each analysis (hypothesis 3). Cox regression controls for individual differences in follow-up time as a  
14  
15 survival analytic technique that includes both a binary frequency dimension (i.e., yes-no recidivism) and  
16  
17 a temporal dimension (i.e., time to recidivism), identifying recidivists at their time of recidivism and  
18  
19 censoring non-recidivists at the expiration of their follow-up time. The HRs represent the percent  
20  
21 change in the hazard of an unwanted outcome (such as recidivism) for every one-unit increase in the  
22  
23 predictor variable; values above 1.0 are interpreted to mean that a predictor is associated with  
24  
25 increased recidivism, while values below 1.0 mean increasing scores on the predictor are associated  
26  
27 with decreased recidivism. For the change score analyses, residualized change scores were used, that is,  
28  
29 controlling for pretreatment score, given that the magnitude of the pretreatment score will constrain  
30  
31 how much an individual can change in a given domain; regressing the change score on the pretreatment  
32  
33 score and obtaining the residual represents the amount of change variance unconstrained by  
34  
35 pretreatment score (Beggs & Grace, 2011). To formally examine variability in HR magnitudes between  
36  
37 the age groups, we conducted fixed effects meta-analysis for risk and change scores on each of the  
38  
39 factor domains, reporting the overall effect as well as the Q and  $I^2$  statistics. Meta-analysis of HRs was  
40  
41 done using Comprehensive Meta-Analysis 2.0 (Borenstein, Hedges, Higgins, & Rothstein, 2005).  
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48 Fifth, the final set of discrimination analyses entailed examining the incremental validity of risk  
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50 and change scores to sexual and violent recidivism among the five age groups through Cox regression  
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52 survival analysis (i.e., to what extent are changes in risk incrementally predictive of changes in recidivism  
53  
54 when controlling for baseline or pretreatment risk score). Controls for baseline risk involved either  
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3 entering the VRS-SO pretreatment total score followed by the change score, or the Static-99R and  
4  
5 pretreatment dynamic scores, followed by the change score; for space considerations only the last step  
6  
7 of the analyses are reported. The analyses are particularly critical, as they would serve to examine if  
8  
9 changes in risk measured by the tool are associated with decreased recidivism, even among older  
10  
11 offenders, after controlling for baseline risk and individual differences in follow-up time. Given that  
12  
13 some of the analyses would be underpowered due to low base rates and smaller cell sizes for older age  
14  
15 groups, variability in HR magnitudes across age groups were formally examined through fixed effects  
16  
17 meta analysis (hypothesis 4).  
18  
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21 The final set of analyses examined the calibration properties of the VRS-SO as a function of age;  
22  
23 specifically, the extent to which the recidivism estimates of the VRS-SO apply across age groups and  
24  
25 most notably to older offenders, given their lower rates of recidivism. Logistic regression modelling was  
26  
27 employed using a 10-year fixed follow-up for both 5 and 10-year sexual recidivism, the basis for the VRS-  
28  
29 SO normative sample (Olver et al., 2018). Logistic regression, unlike Cox regression, does not account for  
30  
31 individual differences in follow-up time, and thus follow-ups need to be mechanically fixed, such that  
32  
33 only cases with sufficient follow-up time (e.g., 5 years, 10 years etc.) are included and cases are counted  
34  
35 as recidivists only if they reoffended within the time window. In logistic regression,  $B_0$  represents the log  
36  
37 odds of the recidivism base rate where the predictors equal 0, while  $B_1$  values represent the change in  
38  
39 the likelihood of a binary event (e.g., recidivism) between adjacent scores on the predictor. The logistic  
40  
41 function  $\frac{e^{B_0 + B_1 \times \text{Score}}}{(1 + e^{B_0 + B_1 \times \text{Score}})}$  (Tabachnick & Fidell, 2007) can then be used to generate estimates of recidivism  
42  
43 over a defined follow-up for individual scores (or combinations of scores) on a predictor.  
44  
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49 Although sexual recidivism is the outcome for which the tool is predominantly used, we also  
50  
51 examined violent recidivism given that VRS-SO recidivism estimates are also available and of interest for  
52  
53 this outcome. The analyses utilized the normative sample with 10-years follow-up, given that it is this  
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55 subgroup from which the normative recidivism estimates were derived, and against which age would  
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3 need to demonstrate incremental prediction of outcome controlling for other predictors. For these  
4  
5 analyses, we examined the extent to which age at release uniquely predicted 5-year and 10-year sexual  
6  
7 recidivism: i) controlling for VRS-SO pretreatment total and change score (i.e., model 5 in the VRS-SO  
8  
9 calculator) or, ii) after controlling for Static-99R, VRS-SO pretreatment and change scores (i.e., model 6  
10  
11 of the calculator). If age at release did not uniquely predict sexual recidivism in the normative sample  
12  
13 over and above the covariates in these regression models, then a reasonable argument can be advanced  
14  
15 that the recidivism estimates generated by the tool apply across age groups (hypothesis 5). Age squared  
16  
17 was entered in a final block in these analyses to examine if the association between age and recidivism  
18  
19 was nonlinear.  
20  
21

22  
23 Logistic regression was then used to compare observed rates of sexual and violent recidivism  
24  
25 over 5 and 10-year follow-ups among the different age groups, to those rates predicted by either the  
26  
27 VRS-SO or VRS-SO and Static-99R score combinations referenced previously (hypothesis 6). This was  
28  
29 done through the E/O index, in which the number of recidivists expected from VRS-SO score  
30  
31 combinations generated via the logistic function, are compared to the actual number of recidivists  
32  
33 observed within a given age group (Hanson, 2017). The logistic function can generate recidivism  
34  
35 probabilities for all individual cases within a sample, and then these probabilities can be summed across  
36  
37 all cases within a reference group (e.g., age cohort) to generate the would be number of recidivists  
38  
39 expected for that group on the basis of their VRS-SO and/or VRS-SO Static-99R score combinations  
40  
41 alone. E/O values over 1.0 represent the overprediction of recidivism by the expected rates, values  
42  
43 under 1.0 represent underprediction of recidivism, and values close to 1.0 represent strong calibration.  
44  
45 The E/O index is significant when the 95% confidence intervals do not overlap with 1.0 (Rockhill, Byrne,  
46  
47

48  
49  
50 Rosner, Louie, & Colditz, 2003): 95% CI of  $\frac{E}{O}$  index =  $\left(\frac{E}{O}\right)e^{\left(+/- 1.96\sqrt{\frac{1}{O}}\right)}$   
51  
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## 53 Results

### 54 Age Group Comparisons on Risk and Need

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3 Table 1 reports age group comparisons on Static-99R and VRS-SO scale component scores via  
4 one-way MANOVA (Pillai's Trace = .45,  $F [44, 5096] = 14.51, p < .001$ ) with Tukey beta post hoc  
5 comparisons. On the Static-99R, men < 30 and 30s scored significantly higher than remaining age  
6 groups, while  $\geq 60$  men scored significantly lower than all groups. A similar pattern was found for VRS-  
7 SO static scores, although the  $\geq 60$  and 50s groups did not significantly differ. In terms of dynamic  
8 scores, there were no significant age-related differences on dynamic total scores (pre or post) and the  
9 only significant group difference on change was < 30 scoring lower than the 40s group. For the three  
10 dynamic factor domains, there were no significant age-group differences on Treatment Responsivity;  
11 however, for Sexual Deviance, the 40s, 50s, and  $\geq 60$  groups all scored significantly higher than the < 30  
12 and 30s groups, while the reverse was observed for the Criminality factor (i.e., the two youngest age  
13 groups scored the highest).

### 24 **Age Group Comparisons on Recidivism**

25  
26 Table 2 reports base rates of 5-year, 10-year, and overall sexual and violent recidivism for the  
27 five age groups. The < 30 and 30s groups had significantly higher rates of sexual and violent recidivism  
28 than the older three age groups, irrespective of follow-up. The 40s group had significantly higher rates  
29 of general violent recidivism than the  $\geq 60$  group across each follow-up, and higher rates of 10-year  
30 violence than the 50s group. There were no significant differences among the three oldest cohorts in  
31 base rates of sexual recidivism irrespective of follow-up.

### 32 **Predictive Accuracy of VRS-SO Scores among Age Groups**

33  
34 Tables 3 and 4 report the results of ROC analyses and fixed effects meta-analysis for the  
35 prediction of sexual and violent recidivism by Static-99R and VRS-SO static, dynamic, and total scores  
36 over fixed 5 and 10-year follow-ups. Given the very small number of recidivists for the  $\geq 60$  group, we  
37 did not fix the follow-up for analyses of this age cohort. Both static measures evinced moderate to high  
38 predictive accuracy for 5 and 10-year sexual recidivism across the age groups, although the < 30 group  
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3 had small in magnitude AUCs for Static-99R. Both sets of measures significantly predicted sexual  
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5 recidivism at one or more follow-ups in the 50s and  $\geq 60$  cohorts, although the Static-99R did not attain  
6  
7 significance with the  $\geq 60$ . Results of fixed effects meta-analysis demonstrated the pattern in AUC  
8  
9 variability across age groups was not significant, although for 10-year sexual recidivism  $I^2$  values were  
10  
11 closer to moderate. Dynamic scores demonstrated consistency in AUC magnitude across the age groups  
12  
13 in the prediction of sexual recidivism as evidenced by non-significant Q and small  $I^2$  values.  
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16  
17 For general violence, Static-99R and the VRS-SO static significantly predicted violent recidivism  
18  
19 irrespective of outcomes for all age groups, with the exception of 10-year violence for the 50-59 group.  
20  
21 Fixed effects meta analysis demonstrated some variability in AUC magnitudes for the static measures in  
22  
23 the prediction of 5-year violence, and significant variability for 10-year violence. VRS-SO dynamic and  
24  
25 total scores significantly predicted violence with moderate to high accuracy across the age groups, with  
26  
27 fixed effects meta analysis demonstrating no significant variation in prediction magnitude.  
28  
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31 Tables 5 and 6 report the results of a series of univariate Cox regressions conducted for the VRS-  
32  
33 SO dynamic factor score domains across the five age groups in the prediction of sexual and violent  
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35 recidivism, respectively. Scrutiny of the hazard ratios (HRs) showed some fluctuations in magnitude and  
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37 most frequently attaining significance for the  $< 30$ , 30s, and 40s groups. The results of fixed effects  
38  
39 meta-analysis, however, demonstrated generally minimal and non-significant variability in HR  
40  
41 magnitudes across age groups for all but Treatment Responsivity pretreatment factor scores;  
42  
43 posttreatment Treatment Responsivity and Criminality change scores also showed small to moderate  
44  
45 but non-significant variation. For general violence, the results of fixed effects meta-analysis  
46  
47 demonstrated that each of the three domains, with the exception of pretreatment Sexual Deviance,  
48  
49 scores significantly predicted this outcome overall; significant variability in HR magnitudes across age  
50  
51 groups was found only for Criminality change scores.  
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#### 54 **Changes in Risk and Associations with Recidivism as a Function of Age**

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3 The final set of discrimination analyses examined the association between changes in risk as  
4 measured by the VRS-SO dynamic total scores with changes in recidivism between the age groups; the  
5 previous section (Tables 5 and 6) outlined such associations between changes on the three factors and  
6 possible decreased recidivism. Tables 7 and 8 report the results of incremental validity analyses for VRS-  
7 SO dynamic change total scores controlling for baseline risk, in the prediction of sexual and violent  
8 recidivism, respectively. Regression models controlling for VRS-SO pretreatment total scores (models 1-  
9 5) are presented in the top half, Static-99R and VRS-SO pretreatment dynamic models (6-10) are in the  
10 bottom half. For models 1-5, VRS-SO pretreatment scores and change score HRs were in the expected  
11 direction for each age cohort, and significantly associated with their targeted outcome overall. Results  
12 of fixed effects meta-analysis demonstrated little variability in HR magnitude for the change scores  
13 across the age groups, but moderate variability for VRS-SO pretreatment scores. This pattern was  
14 repeated for Static-99R and VRS-SO pretreatment dynamic score associations with sexual recidivism,  
15 both of which showed moderate variability ( $I^2$ ) in HR magnitude across the age groups, while change  
16 score HRs were stable and did not have significant variability.  
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34 Similar trends were observed for the prediction of violent recidivism (Table 8). Fixed effects  
35 meta-analysis demonstrated that change score HR magnitudes showed minimal and non-significant  
36 variability across age groups in the prediction of decreased general violence after controlling for  
37 baseline risk, whether this employed the VRS-SO (models 1-5) or the combined Static-99R-VRS-SO  
38 models (models 6-10). VRS-SO pretreatment total scores showed also stability in the prediction of  
39 general violence across the age groups. Greater variation was observed for the risk predictor variables  
40 for models 6-10. Specifically, Static-99R HR magnitudes showed significant and large in magnitude  
41 variability in the prediction of general violence across age groups, particularly for the < 30 group, while  
42 VRS-SO dynamic pretreatment HRs had small in magnitude variation. Taken together, the results  
43 demonstrate that VRS-SO and Static-99R scores showed some age-related variation in effect size  
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magnitude, but only after controlling for change, while change score HRs were stable in their unique associations with outcome, controlling for pretreatment risk.

### **Calibration of VRS-SO Risk and Change Scores as a Function of Age**

**Logistic regression.** The final set of analyses examined the calibration properties of VRS-SO and Static-99 scores as a function of age. This began with formal examination of incremental prediction of age at release for 5 and 10-year sexual and violent recidivism (minimum 10-year follow-up for both outcomes) controlling for Static-99R and VRS-SO risk and change scores in the VRS-SO normative sample ( $N = 913$ ). The results of logistic regression are reported in Tables 9 (sexual recidivism) and 10 (violent recidivism). The first block, which is essentially the VRS-SO calculator model referenced previously (minus two cases which did not have exact age information) demonstrated VRS-SO pretreatment total (i.e., static + dynamic) scores and change scores to be uniquely associated with sexual recidivism across both follow-ups. When age was added in the second block all three covariates independently predicted sexual recidivism; the addition of age squared to examine a possible nonlinear association did not consistently add to prediction. For the Static-99R and VRS-SO (pretreatment dynamic and change) models, the three variables incrementally predicted sexual recidivism in the expected directions but age at release was not significantly incrementally predictive when entered in the second block, nor was the squared age term when entered in the third block.

Two variations on these models were run to examine the effect of adding static and dynamic scores as a single covariate (e.g., VRS-SO pretreatment total) or when they are examined as separate covariates (e.g., Static-99R and pretreatment dynamic scores), on the association of age with recidivism. These analyses were secondary and are reported in the supplemental materials. When the VRS-SO static and pretreatment dynamic items were entered as separate covariates, followed by change and age at release, age at release was no longer independently significantly predictive of 5 or 10-year sexual recidivism. By contrast, when Static-99R and pretreatment dynamic scores were summed to create a



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3 single quantity and entered as a single covariate followed by change and age at release, age at release  
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5 became uniquely predictive of outcome. This finding and its implications are elaborated further in the  
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7 Discussion, but in short, it was apparent that the risk mitigating effects of the age variable within each of  
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9 the static tools is diluted when it becomes absorbed into a larger aggregate measure through being  
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11 combined with the VRS-SO dynamic score. This suggests that the VRS-SO age at release item (S1) at a  
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13 bare minimum adequately corrects for increasing age, but the effect is attenuated when the static score  
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15 is combined with dynamic score to generate a much larger quantity with the VRS-SO total score.  
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19 The results examining the incremental association between age at release and violent recidivism  
20  
21 controlling for sexual violence risk and change are reported in Table 10. In these analyses, all risk,  
22  
23 change, and age at release covariates (Blocks 1 and 2) were uniquely predictive of 5 and 10-year violent  
24  
25 recidivism. This was irrespective of whether the Static-99R was substituted for the VRS-SO static, or  
26  
27 whether baseline risk was examined as a single vs. multiple covariates. In contrast to the sexual  
28  
29 recidivism analyses in which the age at release squared term was not significant (suggesting a linear  
30  
31 association with sexual recidivism), for violent recidivism, it was significant for the majority of analyses  
32  
33 suggesting a possible nonlinear association between age at release and violence.  
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37 **E/O Indices.** Table 11 (sexual recidivism) and 12 (violent recidivism) report calibration results  
38  
39 from calculation of E/O indices and 95% CIs that compare the expected number of recidivists for a given  
40  
41 age group as predicted from their VRS-SO scores (with or without Static-99R), to the actual number of  
42  
43 recidivists observed within that age group. The E/O indices employ the same predictor models akin to  
44  
45 those illustrated in Block 1 of Tables 9 and 10, although for the purposes of the exercise all available  
46  
47 cases were examined (per Helmus et al., 2012) and exact  $B_1$  and  $B_0$  values used are presented in the  
48  
49 table notes. As seen in Table 11, none of the E/O index values were significant for the Static-99R-VRS-SO  
50  
51 model in the prediction of 5 and 10-year sexual recidivism, meaning that the rates of sexual recidivism  
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53 predicted by test scores for each of the age groups did not depart substantially from those observed  
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3 within each group from the sample. There was some underprediction for 30s men and more substantial  
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5 overprediction for  $\geq 60$  group, which reduced with the longer follow-up. For the VRS-SO scores only, the  
6  
7 measure significantly underpredicted sexual recidivism for the 30s group but no other E/O index values  
8  
9 were significant. Although the index was not significant for the oldest cohort, there were still three  
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11 times as many recidivists predicted for this group than what was observed, even though the predicted  
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13 rate of recidivism was still considerably lower than the other age cohorts.  
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16  
17 Table 12 paints a different picture in terms of calibration for general violent recidivism. Broadly,  
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19 any disparities seen in the prediction of sexual recidivism for the age groups was magnified for the  
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21 prediction of violence. For the Static-99R-VRS-SO model, some underprediction was evident for the  
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23 younger cohorts and overprediction for the older cohorts, with the E/O index attaining significance for  
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25 the 50s group at both follow-ups. For the VRS-SO model, underprediction was significant for the younger  
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27 age groups and overprediction was significant for the older age groups, being most pronounced for the  $\geq$   
28  
29 60 group. This is not surprising given that the VRS-SO was not developed to assess risk for general  
30  
31 violence, and the weaker age-related calibration for general violence relative to that for sexual  
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33 recidivism is consistent with the pattern of age-related calibration findings for Static-99R (Helmus et al.,  
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35 2012).  
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### 39 Discussion

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41 The current study examined the discrimination and calibration properties of VRS-SO risk and  
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43 change scores as a function of age. This was done both to fill an existing gap in dynamic risk instrument  
44  
45 research examining the role and relevance of age, and specifically how this may inform clinical and  
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47 psycholegal applications of the VRS-SO, particularly with older offenders.  
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49

#### 50 Discrimination Properties of VRS-SO Scores as a Function of Age

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52 Discrimination analyses (AUC and Cox regression) demonstrated that VRS-SO risk and change  
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54 scores could differentiate sexual and violent recidivists with acceptable accuracy across age groups,  
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3 even the oldest cohort, consistent with previous discrimination findings with actuarial sexual recidivism  
4 risk tools (Hanson, 2006). The results of fixed effects meta-analysis demonstrated that the variability in  
5 AUC magnitudes for sexual or violent recidivism across the age groups was generally not significant,  
6 particularly for the dynamic scores. The results of discrimination analysis also supported the change  
7 properties of VRS-SO scores across age groups, with changes in risk showing inverse associations with  
8 decreased sexual and violent recidivism controlling for baseline risk. As with the AUC findings, despite  
9 mild fluctuations in hazard ratio magnitudes for residual change scores across the age cohorts, the  
10 results of fixed effects meta-analysis demonstrated that the variability in effect size magnitude was not  
11 significant and generally small in magnitude, particularly for the aggregate change score.  
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### 23 **Age-Related Calibration Properties of VRS-SO Scores**

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25 The older age groups in the current study showed the lowest rates of sexual and violent  
26 recidivism than the younger cohorts as expected. The results of logistic regression and E/O index  
27 analyses were used to examine to what extent VRS-SO scores capture increasing age, how this translates  
28 into recidivism estimates, and to what extent predicted rates of recidivism from VRS-SO scores (with or  
29 without Static-99R) align with those observed within each of the age groups. The results of logistic  
30 regression demonstrated that both models uniquely predicted sexual and violent recidivism after  
31 accounting for age at release. In turn, age at release was no longer significantly associated with sexual  
32 recidivism in the integrated VRS-SO-Static-99R model although it remained significant for the VRS-SO  
33 only model. Age at release was consistently significantly associated with violent recidivism irrespective  
34 of regression model.  
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47 Age-related calibration was directly examined through E/O indices, which reinforced these  
48 findings. Calibration was strongest for sexual recidivism in that E/O indices were not significant within  
49 each of the age groups for either model for 18 of the 20 analyses; there was slight underprediction of  
50 sexual recidivism for younger age groups and more noticeable (but not significant) overprediction for  
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3 the  $\geq 60$ s group. Importantly, both models predicted successively lower rates of sexual recidivism as a  
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5 function of increasing age. Any age-related disparities in calibration, however, were magnified for  
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7 general violence in the same direction from the sexual recidivism, with approximately half of E/O indices  
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9 attaining significance and overprediction being greatest in the  $\geq 60$ s group. Taken together, the results  
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11 demonstrate stronger age-related calibration of the VRS-SO for sexual recidivism, particularly when used  
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13 with Static-99R, compared to its weaker calibration for general violence especially with older offenders.  
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15 This is not surprising given that the VRS-SO (and Static-99R) were developed to assess risk for sexual  
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17 recidivism, while other risk-relevant considerations not captured by these tools account for individual  
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19 variation in propensity to violence, including age.  
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23 A caveat to the E/O index is that it can amplify the magnitude of differences when the observed  
24  
25 number of recidivists is very small, making calibration look worse than it may actually be; this might be  
26  
27 most pronounced for older groups. A means to address this would be to supplement the E/O index with  
28  
29 a variation on it such as E – O index (David Thornton, personal communication, September 18, 2019).  
30  
31 For instance, in the  $\geq 60$  group, with two observed sexual recidivists over a fixed 10-year follow-up ( $2/76$   
32  
33 = 2.6%) and an expected number of 5 recidivists (divided by 76 = 6.6%) based on the VRS-SO only, this  
34  
35 generated an E/O index of 2.5 amounting to overprediction by two and a half times as many recidivists.  
36  
37 By contrast this would generate an E – O index value of  $(5 - 2) = 3$  recidivists or  $(6.6\% - 2.6\%)$  or 4%. This  
38  
39 is much different than if the number of observed sexual recidivists was 50; a corresponding E/O index of  
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41 2.5 would translate into an E – O index of  $(125 - 50) = 75$ , or overprediction by 75 additional recidivists,  
42  
43 a substantial disparity. Using the present study data, the magnitude of disparities, at least for sexual  
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45 recidivism, are more consistent between the age cohorts (ranging from about 1% to 5%). As such,  
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47 further examination of the E – O index and extension to further samples in future research is warranted  
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49 as a variant on this important index of calibration.  
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#### 54 **Accounting for Increased Age in Sexual Violence Risk Assessment**

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3 The VRS-SO can be used clinically either on its own or in combination with Static-99R substituted  
4 in place for the VRS-SO static items, via the online “calculator” noted previously, in which 5 and 10-year  
5 estimates for sexual or violent recidivism, associated with specific risk and change scores, can be  
6 obtained through use of the logistic function. While the recidivism estimates are not stratified or  
7 adjusted based on advancing age, applications of the VRS-SO account for age by: 1) the age items on the  
8 respective tools (i.e., Static-99R or VRS-SO static), and 2) changes captured on the dynamic items that  
9 may be attributable to the forces of aging.  
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There was some evidence that age influences calibration for sexual recidivism and that some regression models may more fully account for the effects of increasing age on risk reduction than others. Supplemental analyses further indicated that the age correction in prediction models may be influenced by the manner in which the covariates are entered. For instance, when VRS-SO static and dynamic items were examined as separate covariates, age at release no longer incrementally predicted sexual recidivism; however, when VRS-SO pretreatment dynamic and Static-99R scores were combined into a single quantity, age at release was incrementally predictive. This may be that the age correction of shorter static instruments becomes diluted when added onto part of a longer scale; however, such conclusions need to be tempered in light of the post hoc nature of these analyses, and cannot be assumed to be stable, absent replication.

In this work, we examined the potential for reweighting the age at release item on the VRS-SO through adding additional negative weights for advancing ages; however, we found that this did not alter the trend of age continuing to be predictive when the static and dynamic total were entered as a single quantity, nor did it substantially improve age correction even when static and dynamic scores were entered as separate covariates. A potential revision of the VRS-SO’s age at release item will remain a future consideration for the instrument’s development group pending further research and compelling data. A further possibility may involve adding age at release as a separate covariate to the logistic

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3 function of the VRS-SO calculator to provide more comprehensive adjustment for age; however, this is  
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5 tempered by data demonstrating age at release not to be consistently incrementally predictive of sexual  
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7 recidivism across all regression models.  
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10 Finally, we argue that it is important to acknowledge the potential impact of aging on dynamic  
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12 risk factors and how this may be expressed in observed changes on these domains. Changes on the VRS-  
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14 SO dynamic items can occur in response to different risk mitigating agents, of which  
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16 correctional/forensic treatment is only one. It is anticipated that age-related changes will occur across  
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18 many risk relevant domains (e.g., decreased sex drive, decreased victim access, improved emotional and  
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20 behavioral controls; see Hanson, 2002), and that these may be captured in dynamic item risk and  
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22 change ratings. That age may influence dynamic risk in such a manner further underscores the  
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24 importance of using dynamic instruments that can reflect such changes in sexual violence risk  
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26 assessments with older offenders.  
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### 30 Limitations and Conclusions

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32 There are noteworthy limitations to the present research with implications for further work. The  
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34 most significant limitation in our view was the relatively limited subsample of men who were released  
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36 after age 60. While the existing subsample of older men enabled testing several key hypotheses about  
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38 the discrimination and calibration properties of VRS-SO scores, the low recidivism base rates coupled  
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40 with the smaller  $n$  precluded more extensive analyses employing fixed follow-ups and may also have  
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42 implications for the stability of some findings with this age group (e.g., with there being only two  
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44 observed sexual recidivists for the  $\geq 60$ s group in E/O analyses). Use of the VRS-SO normative sample to  
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46 examine age-related discrimination and calibration also increases the potential for model overfitting,  
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48 and the present study findings and conclusions would be strengthened through replication and  
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50 extension to other samples. A further consideration is that, time free in the community post release has  
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52 important implications for continued risk reduction and cessation of offending; that is, the longer an  
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3 individual stays out of custody and remains crime free, the less likely is that individual to return to  
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5 custody for a new sexual or violent crime (Hanson, Harris, Letourneau, Helmus, & Thornton, 2018). It  
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7 was beyond the scope of the present study to examine the interaction of risk, time free, and/or support  
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9 services in the community or even prerelease to estimated rates of future sexual offending, when the  
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11 focus instead was on the psychometric properties of a sexual violence risk tool among age stratified  
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13 groups. This is a worthy line of future research with implications for use of the VRS-SO with older  
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15 offenders and how recidivism projections factor in time free in the community.  
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19 These limitations notwithstanding, the substantive findings broadly support the VRS-SO's  
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21 discrimination and calibration properties for sexual recidivism with different age groups, including for  
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23 older individuals; age-related calibration for the oldest cohort was strongest when the VRS-SO dynamic  
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25 risk and change scores were used in tandem with Static-99R. Calibration findings, however, indicated  
26  
27 fairly substantial overprediction of general violence among older offenders by the VRS-SO only model,  
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29 and as such, users would be advised to use the integrated VRS-SO-Static-99R model if appraising risk for  
30  
31 general violence with older offenders (and in such instances such a purpose may be better served by a  
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33 general violence risk tool). The optimal way to incorporate age into the VRS-SO and its applications has  
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35 yet to be determined. Further research will inform various possibilities (e.g., reweighting the age item,  
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37 revising or adding predictors in online calculator), and whether they sufficiently strengthen the age  
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39 correction with older offenders to merit additional revisions to the tool.  
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Table 1

*Static-99R and VRS-SO Score Age Group Comparisons*

Risk measure	< 30 (n = 312) M (SD)	30s (n = 384) M (SD)	40s (n = 356) M (SD)	50s (n = 158) M (SD)	≥ 60 (n = 77) M (SD)	F-test
Static-99R	5.1 (2.1)	4.6 (2.3)	2.5 (2.4) <sup>a,b</sup>	2.3 (2.6) <sup>a,b</sup>	-0.3 (2.5) <sup>a,b,c,d</sup>	130.03***
VRS-SO						
Static	10.8 (3.7)	9.5 (4.2) <sup>a</sup>	7.8 (4.7) <sup>a,b</sup>	7.3 (4.5) <sup>a,b</sup>	6.2 (4.6) <sup>a,b,c</sup>	35.65***
Dynamic pre	26.0 (8.0)	25.6 (7.8)	24.9 (8.1)	25.4 (8.3)	24.2 (7.8)	1.31
Dynamic post	22.8 (8.2)	21.8 (7.8)	20.8 (7.7)	21.7 (8.7)	20.3 (7.5)	3.25*
Change	3.2 (2.4) <sup>c</sup>	3.8 (2.4)	4.1 (2.7)	3.7 (2.8)	3.9 (3.2)	5.51***
Total pre	36.8 (10.5)	35.1 (10.7)	32.7 (11.4) <sup>a</sup>	32.8 (11.5) <sup>a</sup>	30.3 (11.1) <sup>a,b</sup>	9.74***
Total post	33.6 (10.7)	31.3 (10.7)	28.6 (10.9) <sup>a</sup>	29.0 (11.7) <sup>a</sup>	26.4 (10.8) <sup>a,b</sup>	12.99***
Sexual deviance pre	6.4 (4.1) <sup>c,d,e</sup>	7.0 (3.9) <sup>c,d,e</sup>	8.0 (4.1) <sup>e</sup>	8.7 (3.9)	9.5 (3.6)	16.86***
Sexual deviance post	5.6 (3.7) <sup>c,d,e</sup>	5.9 (3.4) <sup>d,e</sup>	6.7 (3.5) <sup>e</sup>	7.3 (3.6)	7.9 (3.4)	11.95***
Criminality pre	9.6 (3.6)	9.1 (4.0)	7.7 (4.1) <sup>a,b</sup>	7.3 (4.1) <sup>a,b</sup>	5.2 (3.5) <sup>a,b,c,d</sup>	29.61***
Criminality post	8.7 (3.5)	7.9 (3.6)	6.6 (3.5) <sup>a,b</sup>	6.5 (3.9) <sup>a,b</sup>	4.7 (3.5) <sup>a,b,c,d</sup>	29.86***
Treatment responsivity pre	6.5 (2.5)	6.2 (2.4)	6.2 (2.6)	6.3 (2.6)	6.5 (2.6)	0.81
Treatment responsivity post	5.5 (2.6)	5.1 (2.5)	5.0 (2.5)	5.3 (2.7)	5.4 (2.5)	1.82

Note: Results of one-way omnibus MANOVA: Pillai's Trace = .45,  $F(44, 5096) = 14.51, p < .001$ . F-test results for main effect of age on a given measure: \*\*\*  $p < .001$ , \*  $p < .05$ . Results of Tukey beta post hoc multiple comparisons: <sup>a</sup> = lower than < 30 group, <sup>b</sup> = lower than 30s group, <sup>c</sup> = lower than 40s group, <sup>d</sup> = lower than 50s group, <sup>e</sup> = lower than ≥ 60 group.

Table 2

*Age Group Base Rates of Sexual and Violent Recidivism*

Recidivism criterion	< 30 % (n)	30-39 % (n)	40-49 % (n)	50-59 % (n)	60+ % (n)
Sexual					
5-year	14.8 (46/311)	15.3 (58/378)	6.3 (22/348) <sup>a,b</sup>	8.4 (13/155) <sup>a,b</sup>	2.6 (2/76) <sup>a,b</sup>
10-year	22.4 (57/255)	23.5 (68/289)	12.5 (29/232) <sup>a,b</sup>	10.2 (9/88) <sup>a,b</sup>	4.3 (2/47) <sup>a,b</sup>
Overall	24.0 (75/312)	20.8 (80/384)	10.7 (38/356) <sup>a,b</sup>	12.7 (20/158) <sup>a,b</sup>	6.5 (5/77) <sup>a,b</sup>
Violent					
5-year	33.4 (104/311)	29.9 (113/378)	13.5 (47/348) <sup>a,b</sup>	11.0 (17/155) <sup>a,b</sup>	4.0 (3/76) <sup>a,b,c</sup>
10-year	49.4 (126/255)	43.9 (127/289)	26.3 (61/232) <sup>a,b</sup>	12.5 (11/88) <sup>a,b,c</sup>	4.3 (2/47) <sup>a,b,c</sup>
Overall	52.6 (164/312)	41.7 (160/384)	23.9 (85/356) <sup>a,b</sup>	17.1 (27/158) <sup>a,b</sup>	7.8 (6/77) <sup>a,b,c</sup>

Note: chi square analysis between age groups: <sup>a</sup> = lower than < 30 group, <sup>b</sup> = lower than 30-39 group, <sup>c</sup> = lower than 40-49 group, <sup>d</sup> = lower than 50-59 group, <sup>e</sup> = lower than 60+ group

Running head: VRS-SO and Age

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Table 3

*Predictive Accuracy of Static-99R and VRS-SO Scores (AUC, 95%CI) for Sexual Recidivism and Fixed Effects Meta-Analysis by Age Group*

Risk Measure	Age Group						Fixed effects meta-analysis 5-year			Fixed effects meta-analysis 10-year			
	< 30	30s	40s	50s	≥ 60	AUC	Q	I <sup>2</sup>	AUC	Q	I <sup>2</sup>		
Static-99R	.60* [.51, .69]	.62** [.53, .70]	.66*** [.59, .74]	.70*** [.63, .77]	.73*** [.63, .83]	.77*** [.70, .85]	.67* [.51, .82]	.73* [.54, .91]	.70 [.43, .98]	.66*** [.61, .71]	3.46 0.00	.70*** [.66, .74]	7.69 47.96
VRS-SO	.65*** [.57, .74]	.66*** [.59, .74]	.69*** [.62, .76]	.72*** [.65, .78]	.74*** [.63, .85]	.80*** [.72, .87]	.67* [.50, .84]	.67 [.49, .86]	.77* [.59, .95]	.71*** [.66, .76]	1.63 0.00	.73*** [.69, .77]	6.93 42.29
Static	.71*** [.64, .78]	.70*** [.62, .77]	.66*** [.59, .74]	.68*** [.61, .75]	.75*** [.64, .86]	.71*** [.61, .80]	.63 [.46, .80]	.61 [.41, .81]	.80* [.66, .94]	.71*** [.66, .76]	6.33 36.80	.70*** [.66, .74]	3.27 0.00
Dynamic pre	.72*** [.65, .80]	.71*** [.63, .78]	.69*** [.62, .76]	.71*** [.64, .77]	.77*** [.67, .88]	.72*** [.63, .81]	.67* [.51, .83]	.66 [.48, .83]	.81* [.68, .93]	.74*** [.69, .78]	5.67 29.46	.72*** [.68, .76]	2.67 0.00
Dynamic post	.71*** [.63, .79]	.71*** [.63, .78]	.69*** [.63, .76]	.72*** [.65, .78]	.77*** [.67, .87]	.76*** [.68, .84]	.66 [.49, .82]	.64 [.43, .85]	.81* [.66, .96]	.73*** [.68, .78]	4.69 14.77	.73*** [.69, .77]	2.83 0.00
Total pre	.72*** [.65, .80]	.72*** [.64, .79]	.71*** [.64, .77]	.74*** [.67, .80]	.79*** [.69, .89]	.77*** [.69, .85]	.70* [.53, .86]	.68 [.49, .87]	.82* [.68, .95]	.75*** [.70, .79]	4.31 7.05	.74*** [.71, .78]	2.52 0.00
Total post	[.65, .80]	[.64, .79]	[.64, .77]	[.67, .80]	[.69, .89]	[.69, .85]	[.53, .86]	[.49, .87]	[.68, .95]	[.70, .79]		[.71, .78]	

Note: \*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ . Follow-up not fixed for age 60+ group owing to low base rates and unstable AUC values.

Running head: VRS-SO and Age

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Table 4

*Predictive Accuracy of Static-99R and VRS-SO Scores (AUC, 95%CI) for Violent Recidivism and Fixed Effects Meta-Analysis by Age Group*

Risk Measure	Age Group						Fixed effects meta-analysis								
	< 30	30s	40s	50s	≥ 60	5-year	10-year								
Static-99R	.59* [.52, .65]	.57* [.50, .64]	.69*** [.63, .75]	.73*** [.67, .79]	.66*** [.58, .74]	.70*** [.63, .78]	.73** [.60, .85]	.66 [.47, .84]	.75* [.56, .92]	.66*** [.62, .69]	7.31 [6.23, 8.39]	45.28 [35.82, 54.76]	.68*** [.64, .72]	12.89* [10.95, 14.83]	68.98 [63.46, 74.50]
VRS-SO	.61** [.54, .67]	.59* [.52, .66]	.69*** [.63, .75]	.72*** [.66, .78]	.66*** [.58, .74]	.72*** [.64, .79]	.69* [.54, .83]	.59 [.40, .78]	.78* [.63, .94]	.66*** [.63, .70]	6.23 [5.38, 7.08]	35.82 [26.38, 45.26]	.68*** [.64, .71]	10.95* [9.62, 12.28]	63.46 [58.98, 68.94]
Dynamic pre	.71*** [.66, .77]	.69*** [.63, .75]	.66*** [.60, .72]	.67*** [.61, .73]	.65*** [.57, .74]	.65*** [.58, .73]	.71** [.57, .85]	.64 [.47, .82]	.67 [.42, .92]	.68*** [.65, .72]	2.38 [1.96, 2.80]	0.00 [0.00, 0.00]	.67*** [.63, .71]	0.62 [0.39, 0.85]	0.00 [0.00, 0.00]
Dynamic post	.73*** [.67, .79]	.72*** [.66, .79]	.68*** [.63, .74]	.70*** [.64, .76]	.67*** [.59, .76]	.65*** [.67, .73]	.71** [.56, .85]	.71* [.55, .86]	.68 [.44, .93]	.70*** [.67, .74]	1.96 [1.66, 2.26]	0.00 [0.00, 0.00]	.70*** [.66, .73]	2.39 [1.30, 3.48]	0.00 [0.00, 0.00]
Total pre	.70*** [.64, .76]	.67*** [.61, .74]	.69*** [.63, .74]	.71*** [.65, .77]	.67*** [.59, .75]	.69*** [.61, .77]	.73** [.59, .86]	.65 [.47, .83]	.74 [.55, .92]	.69*** [.66, .73]	0.71 [0.66, 0.76]	0.00 [0.00, 0.00]	.69*** [.66, .73]	1.30 [0.95, 1.65]	0.00 [0.00, 0.00]
Total post	.71*** [.65, .77]	.70*** [.63, .76]	.71*** [.65, .76]	.73*** [.67, .78]	.69*** [.61, .77]	.69*** [.61, .76]	.73** [.59, .87]	.69* [.53, .86]	.74 [.56, .92]	.71*** [.67, .74]	0.43 [0.38, 0.48]	0.00 [0.00, 0.00]	.71*** [.67, .74]	0.95 [0.80, 1.10]	0.00 [0.00, 0.00]

Note: \*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ . Follow-up not fixed for age 60+ group owing to low base rates and unstable AUC values



Running head: VRS-SO and Age

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Table 5

Cox Regression Survival Analysis: Prediction of Sexual Recidivism (Hazard Ratios with 95% CIs) by VRS-SO Dynamic Factor Scores and Fixed Effects

Meta-Analysis by Age Group

	Age group					Fixed effects meta-analysis	
	< 30	30s	40s	50s	≥ 60	$e^{\beta}$	$Q$ $I^2$
<b>VRS-SO factor score</b>							
Sexual deviance pre	1.065* [1.009, 1.125]	1.082** [1.023, 1.144]	1.100* [1.012, 1.196]	1.056 [0.936, 1.192]	1.231 [0.905, 1.675]	1.079*** [1.043, 1.117]	1.07 0.00
Sexual deviance post	1.107*** [1.043, 1.175]	1.122*** [1.055, 1.192]	1.152** [1.051, 1.263]	1.102 [0.970, 1.250]	1.317 [0.953, 1.821]	1.118*** [1.080, 1.157]	1.64 0.00
Sexual deviance change	0.510*** [0.382, 0.676]	0.659*** [0.536, 0.812]	0.607** [0.435, 0.847]	0.676* [0.457, 0.999]	0.600 [0.279, 1.294]	0.613*** [0.536, 0.702]	2.47 0.00
Criminality pre	1.140*** [1.068, 1.217]	1.121*** [1.056, 1.191]	1.133** [1.044, 1.230]	1.104 [0.998, 1.223]	1.231 [0.991, 1.530]	1.127*** [1.089, 1.167]	1.02 0.00
Criminality post	1.158*** [1.058, 1.236]	1.168*** [1.094, 1.248]	1.174*** [1.071, 1.287]	1.128* [1.020, 1.247]	1.302* [1.050, 1.615]	1.164*** [1.122, 1.209]	1.37 0.00
Criminality change	0.606*** [0.473, 0.776]	0.577*** [0.445, 0.747]	0.759 [0.518, 1.112]	0.571* [0.347, 0.939]	0.098*** [0.017, 0.568]	0.608*** [0.521, 0.709]	5.99 33.21
Treatment responsiveness pre	1.176*** [1.074, 1.288]	1.100* [1.006, 1.204]	1.332*** [1.163, 1.525]	1.037 [0.875, 1.229]	1.734* [1.074, 2.798]	1.159*** [1.098, 1.224]	9.62* 58.43
Treatment responsiveness post	1.171*** [1.072, 1.280]	1.156*** [1.062, 1.259]	1.327*** [1.172, 1.502]	1.084 [0.924, 1.273]	1.682* [1.074, 2.634]	1.189*** [1.128, 1.253]	7.20 44.45
Treatment responsiveness change	0.758 [0.561, 1.024]	0.640** [0.481, 0.852]	0.772 [0.515, 1.155]	0.707 [0.451, 1.110]	1.286 [0.539, 3.067]	0.726*** [0.614, 0.858]	2.61 0.00

Note: \*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ . Change score associations employ residualized change scores (i.e., controlling for pretreatment score). Hazard ratios > 1.0 indicate positive association with recidivism, values < 1.0 indicate association with decreased recidivism.

Running head: VRS-SO and Age

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Table 6

Cox Regression Survival Analysis: Prediction of Violent Recidivism (Hazard Ratios with 95% CIs) by VRS-SO Dynamic Factor Scores and Fixed Effects

Meta-Analysis by Age Group

	Age group					Fixed effects meta-analysis		
	< 30	30s	40s	50s	≥ 60	e <sup>b</sup>	Q	I <sup>2</sup>
<b>VRS-SO factor score</b>								
Sexual deviance pre	1.026 [0.989, 1.065]	0.999 [0.961, 1.039]	1.026 [0.973, 1.081]	1.027 [0.927, 1.138]	1.116 [0.865, 1.441]	1.020	1.90	0.00
Sexual deviance post	1.060*** [1.017, 1.104]	1.029 [0.984, 1.075]	1.054 [0.992, 1.120]	1.072 [0.962, 1.195]	1.154 [0.886, 1.503]	1.051***	1.42	0.00
Sexual deviance change	0.570*** [0.471, 0.690]	0.705*** [0.609, 0.817]	0.743** [0.601, 0.918]	0.684 [0.490, 0.953]	0.772 [0.403, 1.482]	0.676***	4.30	6.89
Criminality pre	1.213*** [1.156, 1.274]	1.203*** [1.149, 1.259]	1.173*** [1.110, 1.240]	1.179*** [1.077, 1.290]	1.127 [0.916, 1.386]	1.192***	1.26	0.00
Criminality post	1.224*** [1.167, 1.283]	1.249*** [1.190, 1.312]	1.196*** [1.125, 1.272]	1.198*** [1.098, 1.307]	1.183 [0.965, 1.452]	1.222***	1.52	0.00
Criminality change	0.641*** [0.541, 0.760]	0.648*** [0.534, 0.785]	1.033 [0.806, 1.324]	0.537* [0.333, 0.865]	0.161* [0.037, 0.713]	0.698***	16.34**	75.52
Treatment responsivity pre	1.195*** [1.125, 1.270]	1.171*** [1.098, 1.249]	1.220*** [1.117, 1.331]	1.157 [0.996, 1.345]	1.338 [0.943, 1.899]	1.193***	1.21	0.00
Treatment responsivity post	1.196*** [1.127, 1.269]	1.213*** [1.144, 1.289]	1.196*** [1.102, 1.299]	1.128 [0.981, 1.297]	1.366 [0.949, 1.966]	1.200***	1.27	0.00
Treatment responsivity change	0.782* [0.636, 0.961]	0.666*** [0.541, 0.820]	0.981 [0.759, 1.269]	0.696 [0.472, 1.027]	1.039 [0.451, 2.393]	0.777***	5.82	31.21

Note: \*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ . Change score associations employ residualized change scores (i.e., controlling for pretreatment score). Hazard ratios > 1.0 indicate positive association with recidivism, values < 1.0 indicate association with decreased recidivism.

Table 7  
*Cox Regression Survival Analysis: Incremental Prediction of Static and Dynamic Risk and Change Scores for Sexual Recidivism as a Function of Age with Fixed Effects Meta-Analysis of Hazard Ratios*

Age group	Regression Model (1-10)	Sexual recidivism					
		B	SE	Wald	p	e <sup>B</sup>	LL, UL
VRS-SO models							
< 30	1 VRS-SO total pre	.055	.011	25.67	<.001	1.057	1.034, 1.080
	VRS-SO change	-.120	.048	6.25	.012	0.887	0.807, 0.974
30s	2 VRS-SO total pre	.059	.011	30.06	<.001	1.061	1.038, 1.083
	VRS-SO change	-.150	.045	10.96	.001	0.861	0.788, 0.941
40s	3 VRS-SO total pre	.089	.017	27.22	<.001	1.093	1.057, 1.129
	VRS-SO change	-.144	.059	6.01	.014	0.866	0.772, 0.972
50s	4 VRS-SO total pre	.033	.019	3.22	.073	1.034	0.997, 1.073
	VRS-SO change	-.143	.083	3.00	.083	0.867	0.737, 1.019
≥ 60	5 VRS-SO total pre	.121	.048	6.29	.012	1.129	1.027, 1.241
	VRS-SO change	-.164	.135	1.48	.224	0.849	0.652, 1.105
<i>Fixed effects meta-analysis:</i>		VRS-SO total pre: e <sup>B</sup> = 1.062 [1.049, 1.075], p < .001; Q = 9.44, p = .051; I <sup>2</sup> = 57.63 VRS-SO change: e <sup>B</sup> = 0.872 [0.828, 0.918], p < .001; Q = 0.33, p = .988; I <sup>2</sup> = 0.00					
Static-99R and VRS-SO models							
< 30	6 Static-99R	-.016	.062	0.07	.793	0.984	0.871, 1.111
	VRS-SO dynamic pre	.070	.015	20.89	<.001	1.072	1.041, 1.105
	VRS-SO change	-.124	.048	6.55	.010	0.884	0.804, 0.971
30s	7 Static-99R	.180	.061	8.64	.003	1.197	1.062, 1.349
	VRS-SO dynamic pre	.040	.016	6.09	.014	1.041	1.008, 1.075
	VRS-SO change	-.135	.045	9.02	.003	0.873	0.800, 0.954
40s	8 Static-99R	.230	.083	7.60	.006	1.259	1.069, 1.482
	VRS-SO dynamic pre	.066	.024	7.62	.006	1.068	1.019, 1.120
	VRS-SO change	-.148	.060	6.05	.014	0.862	0.766, 0.970
50s	9 Static-99R	.215	.107	4.00	.045	1.240	1.004, 1.530
	VRS-SO dynamic pre	-.007	.033	0.05	.826	0.993	0.931, 1.059
	VRS-SO change	-.142	.081	3.08	.079	0.868	0.740, 1.017
≥ 60	10 Static-99R	-.052	.214	0.06	.806	0.949	0.624, 1.443
	VRS-SO dynamic pre	.200	.093	4.66	.031	1.222	1.019, 1.465
	VRS-SO change	-.214	.132	2.61	.106	0.808	0.623, 1.047
<i>Fixed effects meta-analysis:</i>		Static-99R: e <sup>B</sup> = 1.129 [1.052, 1.211], p = .001; Q = 9.33, p = .053; I <sup>2</sup> = 57.13 VRS-SO dynamic pre: e <sup>B</sup> = 1.054 [1.035, 1.073], p < .001; Q = 8.32, p = .081; I <sup>2</sup> = 51.90 VRS-SO change: e <sup>B</sup> = 0.868 [0.825, 0.915], p < .001; Q = 0.37, p = .985; I <sup>2</sup> = 0.00					

Note: Significant p-values in bold font. VRS-SO total is the sum of static and dynamic items.

## VRS-SO and Age

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Table 8

*Cox Regression Survival Analysis: Incremental Prediction of Static and Dynamic Risk and Change Scores for Violent Recidivism as a Function of Age with Fixed Effects Meta-Analysis of Hazard Ratios*

Age group	Regression Model (1-10)	Violent recidivism					
		<i>B</i>	<i>SE</i>	<i>Wald</i>	<i>p</i>	<i>e<sup>B</sup></i>	<i>LL, UL</i>
<i>VRS-SO models</i>							
< 30	1 VRS-SO total pre	.051	.008	42.99	<b>&lt;.001</b>	1.052	1.036, 1.068
	VRS-SO change	-.111	.032	11.93	<b>.001</b>	0.895	0.840, 0.953
30s	2 VRS-SO total pre	.056	.008	55.85	<b>&lt;.001</b>	1.058	1.043, 1.074
	VRS-SO change	-.141	.032	18.98	<b>&lt;.001</b>	0.868	0.815, 0.925
40s	3 VRS-SO total pre	.066	.011	38.13	<b>&lt;.001</b>	1.068	1.046, 1.091
	VRS-SO change	-.070	.039	3.20	.074	0.933	0.864, 1.007
50s	4 VRS-SO total pre	.047	.017	8.12	<b>.004</b>	1.048	1.015, 1.083
	VRS-SO change	-.125	.070	3.18	<b>.075</b>	0.882	0.769, 1.012
≥ 60	5 VRS-SO total pre	.087	.039	4.84	<b>.028</b>	1.091	1.009, 1.178
	VRS-SO change	-.131	.124	1.13	.288	0.877	0.688, 1.117
<i>Fixed effects meta-analysis:</i>		VRS-SO total pre: $e^B = 1.059$ [1.049, 1.070], $p < .001$ ; $Q = 2.82$ , $p = .588$ ; $I^2 = 0.00$ VRS-SO change: $e^B = 0.896$ [0.864, 0.929], $p < .001$ ; $Q = 1.64$ , $p = .802$ ; $I^2 = 0.00$					
<i>Static-99R and VRS-SO models</i>							
< 30	6 Static-99R	.001	.041	0.00	.979	0.999	0.921, 1.083
	VRS-SO dynamic pre	.069	.011	39.34	<b>&lt;.001</b>	1.071	1.048, 1.094
	VRS-SO change	-.115	.032	12.71	<b>&lt;.001</b>	0.891	0.836, 0.949
30s	7 Static-99R	.217	.044	24.79	<b>&lt;.001</b>	1.243	1.141, 1.354
	VRS-SO dynamic pre	.035	.011	9.36	<b>.002</b>	1.035	1.012, 1.058
	VRS-SO change	-.123	.032	14.73	<b>&lt;.001</b>	0.885	0.831, 0.942
40s	8 Static-99R	.208	.055	14.29	<b>&lt;.001</b>	1.232	1.105, 1.372
	VRS-SO dynamic pre	.047	.016	8.36	<b>.004</b>	1.048	1.015, 1.082
	VRS-SO change	-.073	.040	3.42	.064	0.929	0.860, 1.004
50s	9 Static-99R	.213	.091	5.53	<b>.019</b>	1.238	1.036, 1.478
	VRS-SO dynamic pre	.022	.028	0.64	.424	1.023	0.968, 1.080
	VRS-SO change	-.136	.069	3.87	<b>.049</b>	0.873	0.763, 0.999
≥ 60	10 Static-99R	.290	.188	2.39	.122	1.337	0.925, 1.932
	VRS-SO dynamic pre	.030	.076	0.16	.692	1.031	0.888, 1.196
	VRS-SO change	-.125	.134	0.87	.351	0.883	0.679, 1.147
<i>Fixed effects meta-analysis:</i>		Static-99R: $e^B = 1.146$ [1.092, 1.203], $p < .001$ ; $Q = 17.65$ , $p = .001$ ; $I^2 = 77.34$ VRS-SO dynamic pre: $e^B = 1.055$ [1.042, 1.069], $p < .001$ ; $Q = 5.16$ , $p = .272$ ; $I^2 = 22.41$ VRS-SO change: $e^B = 0.898$ [0.865, 0.933], $p < .001$ ; $Q = 1.19$ , $p = .879$ ; $I^2 = 0.00$					

*Note:* Significant p-values in bold font. VRS-SO total is the sum of static and dynamic items.

Running head: VRS-SO and Age

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Table 9. Calibration: Static-99R, VRS-SO, and Age at Release Logistic Regression Models for 5 and 10-Year Sexual Recidivism

Regression model	Sexual recidivism 5-year						Sexual recidivism 10-year							
	$\Delta\chi^2$	B	SE	Wald	p	$e^B$	LL, UL	$\Delta\chi^2$	B	SE	Wald	p	$e^B$	LL, UL
VRS-SO model														
Block 1														
VRS-SO total pre	<b>78.63***</b>	.082	.011	58.45	<.001	1.086	1.063, 1.109	<b>110.64***</b>	.086	.009	82.45	<.001	1.089	1.069, 1.110
VRS-SO change		-1.48	.041	12.44	<.001	0.862	0.794, 0.936		-1.48	.036	16.61	<.001	0.862	0.803, 0.926
Block 2														
VRS-SO total pre	<b>6.65**</b>	.079	.011	51.68	<.001	1.082	1.059, 1.106		.082	.010	73.99	<.001	1.086	1.066, 1.106
VRS-SO change		-1.34	.043	9.60	.002	0.874	0.803, 0.952	<b>7.03**</b>	-1.35	.037	13.18	<.001	0.873	0.812, 0.940
Age at release		-0.28	.011	6.27	.012	0.972	0.951, 0.994		-0.24	.009	6.72	.010	0.976	0.958, 0.994
Block 3														
VRS-SO total pre	<b>4.81*</b>	.078	.011	51.05	<.001	1.082	1.059, 1.105		.082	.010	73.39	<.001	1.085	1.065, 1.106
VRS-SO change		-1.40	.044	10.21	.002	0.869	0.798, 0.947		-1.38	.038	13.58	<.001	0.871	0.809, 0.937
Age at release		.152	.090	2.84	.092	1.164	0.975, 1.389	<b>2.09</b>	.064	.065	0.99	.319	1.067	0.939, 1.211
Age at release <sup>2</sup>		-0.02	.001	3.91	.048	0.998	0.995, 1.000		-0.01	.001	1.88	.170	0.999	0.997, 1.000
VRS-SO and Static-99R model														
Block 1														
Static-99R	<b>84.93***</b>	.247	.050	24.77	<.001	1.280	1.161, 1.410	<b>117.39***</b>	.254	.042	35.85	<.001	1.289	1.186, 1.401
VRS-SO dynamic pre		.060	.015	15.33	<.001	1.062	1.030, 1.094		.060	.013	20.22	<.001	1.062	1.034, 1.090
VRS-SO change		-1.34	.043	9.64	.002	0.875	0.804, 0.952		-1.31	.037	12.32	<.001	0.878	0.816, 0.944
Block 2														
Static-99R	<b>1.54</b>	.218	.055	15.79	<.001	1.244	1.117, 1.385	<b>0.84</b>	.235	.047	24.90	<.001	1.265	1.154, 1.388
VRS-SO dynamic pre		.063	.016	16.48	<.001	1.065	1.033, 1.098		.062	.014	20.99	<.001	1.064	1.036, 1.092
VRS-SO change		-1.28	.044	8.54	.003	0.880	0.808, 0.959		-1.27	.038	11.41	.003	0.881	0.818, 0.948
Age at release		-0.16	.013	1.51	.219	0.984	0.960, 1.009		-0.10	.011	0.83	.362	0.990	0.970, 1.011
Block 3														
Static-99R	<b>2.42</b>	.206	.056	13.78	<.001	1.229	1.102, 1.370	<b>0.47</b>	.231	.048	23.54	<.001	1.260	1.148, 1.383
VRS-SO dynamic pre		.064	.016	16.90	<.001	1.066	1.034, 1.099		.062	.014	21.16	<.001	1.064	1.036, 1.093
VRS-SO change		-1.32	.044	8.97	.003	0.876	0.804, 0.955		-1.28	.038	11.60	.001	0.880	0.817, 0.947
Age at release		.113	.089	1.62	.203	1.119	0.941, 1.332		.033	.064	0.26	.607	1.034	0.911, 1.172
Age at release <sup>2</sup>		-0.02	.001	2.10	.147	0.998	0.996, 1.001		-0.01	.001	0.45	.502	0.999	0.998, 1.001

Note: \*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ . Significant p-values in bold font. Cases (N = 911) are from VRS-SO normative sample with minimum 10-year follow-up.

VRS-SO and Age

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Table 10. Calibration: Static-99R, VRS-SO, and Age at Release Logistic Regression Models for 5 and 10-Year Violent Recidivism

Regression model	Violent recidivism 5-year						Violent recidivism 10-year							
	$\Delta\chi^2$	B	SE	Wald	p	$e^B$	LL, UL	$\Delta\chi^2$	B	SE	Wald	p	$e^B$	LL, UL
VRS-SO model														
Block 1														
VRS-SO total pre	<b>106.49***</b>	.075	.008	84.28	<.001	1.078	1.061, 1.095	<b>138.38***</b>	.079	.008	105.99	<.001	1.082	1.066, 1.099
VRS-SO change		-.124	.032	14.77	<.001	0.883	0.829, 0.941		-.148	.031	23.31	<.001	0.863	0.812, 0.916
Block 2														
VRS-SO total pre	<b>33.65***</b>	.070	.008	68.50	<.001	1.072	1.055, 1.090	<b>53.87**</b>	.073	.008	84.93	<.001	1.076	1.059, 1.093
VRS-SO change		-.099	.034	8.57	.003	0.906	0.847, 0.968		-.120	.032	14.09	<.001	0.887	0.833, 0.944
Age at release		-.048	.009	30.24	<.001	0.953	0.937, 0.969		-.055	.008	47.81	<.001	0.946	0.931, 0.961
Block 3														
VRS-SO total pre	<b>11.13***</b>	.070	.008	67.93	<.001	1.072	1.054, 1.090	<b>6.27*</b>	.073	.008	84.39	<.001	1.076	1.059, 1.092
VRS-SO change		-.106	.034	9.41	.002	0.900	0.841, 0.963		-.125	.032	14.86	<.001	0.882	0.828, 0.940
Age at release		.172	.073	5.60	.018	1.187	1.030, 1.369		.084	.059	2.01	.156	1.088	0.968, 1.222
Age at release <sup>2</sup>		-.003	.001	8.94	.003	0.997	0.995, 0.999		-.002	.001	5.46	.020	0.998	0.997, 1.000
VRS-SO and Static-99R model														
Block 1														
Static-99R	<b>130.53***</b>	.255	.038	46.19	<.001	1.291	1.199, 1.389	<b>175.20***</b>	.282	.035	65.95	<.001	1.326	1.239, 1.420
VRS-SO dynamic pre		.051	.012	18.34	<.001	1.053	1.028, 1.077		.050	.011	19.78	<.001	1.051	1.028, 1.075
VRS-SO change		-.105	.033	10.02	.002	0.900	0.843, 0.961		-.124	.032	15.60	<.001	0.883	0.830, 0.939
Block 2														
Static-99R	<b>15.80***</b>	.184	.042	19.00	<.001	1.202	1.107, 1.306	<b>25.11***</b>	.196	.039	24.95	<.001	1.217	1.127, 1.315
VRS-SO dynamic pre		.061	.012	24.05	<.001	1.063	1.037, 1.089		.062	.012	28.06	<.001	1.064	1.040, 1.089
VRS-SO change		-.092	.034	7.34	.007	0.912	0.853, 0.975		-.112	.032	12.11	.001	0.894	0.839, 0.952
Age at release		-.038	.010	15.09	<.001	0.963	0.945, 0.981		-.044	.009	23.82	<.001	0.957	0.941, 0.974
Block 3														
Static-99R	<b>7.05**</b>	.169	.043	15.65	<.001	1.184	1.089, 1.287	<b>3.19</b>	.188	.040	22.60	<.001	1.207	1.117, 1.304
VRS-SO dynamic pre		.062	.012	25.18	<.001	1.064	1.039, 1.091		.063	.012	28.72	<.001	1.065	1.041, 1.090
VRS-SO change		-.098	.035	8.03	.005	0.907	0.847, 0.970		-.116	.033	12.66	<.001	0.891	0.835, 0.949
Age at release		.137	.071	3.69	.055	1.146	0.997, 1.318		.056	.058	0.91	.340	1.057	0.943, 1.185
Age at release <sup>2</sup>		-.002	.001	5.94	.015	0.998	0.996, 1.000		-.001	.001	2.90	.088	0.999	0.997, 1.000

Note: \*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ . Significant p-values in bold font. Cases ( $N = 911$ ) are from VRS-SO normative sample with minimum 10-year follow-up.

Table 11

*Calibration: E/O Index Analyses Comparing Observed Rates of 5 and 10-Year Sexual Recidivism Among Age Cohorts to Logistic Regression Estimates Generated by VRS-SO Risk and Change Score Combinations (with and without Static-99R).*

Age	Observed		Static-99R and VRS-SO predicted			VRS-SO predicted		
	N	n recid	n recid	E/O	95% CI	n recid	E/O	95% CI
Sexual recidivism (5-year)								
< 30	311	46	46.7	1.01	0.76, 1.35	43.3	0.94	0.70, 1.25
30s	378	58	47.4	0.82	0.63, 1.06	42.9	0.74*	0.57, 0.96
40s	348	22	29.3	1.33	0.88, 2.02	33.1	1.50	0.99, 2.26
50s	155	13	14.7	1.13	0.66, 1.95	16.2	1.25	0.72, 2.15
≥ 60	76	2	4.2	2.10	0.53, 8.40	6.5	3.25	0.81, 13.00
Sexual recidivism (10-year)								
< 30	255	57	58.0	1.02	0.79, 1.32	52.5	0.92	0.60, 1.19
30s	289	68	59.7	0.88	0.69, 1.12	53.1	0.78*	0.61, 0.99
40s	232	29	31.9	1.10	0.76, 1.31	37.4	1.29	0.90, 1.86
50s	88	9	10.8	1.20	0.62, 2.31	12.7	1.41	0.73, 2.71
≥ 60	47	2	2.8	1.40	0.35, 5.60	5.0	2.51	0.63, 10.03

*Note:* \* significant E/O Index. 5-year (n = 1,268) and 10-year (n = 911) outcome analyses are reported using all available cases. 5-year logistic regression models: Static-99R and VRS-SO predicted = Static-99R ( $B_1 = .194$ ), VRSSO dynamic pre ( $B_1 = .061$ ), change ( $B_1 = -.143$ ), constant ( $B_0 = -4.087$ ); VRS-SO predicted = VRS-SO total pre ( $B_1 = .078$ ), change ( $B_1 = -.150$ ), constant ( $B_0 = -4.483$ ). 10-year logistic regression models (see also Olver et al., 2018, Table 3, p. 949): Static-99R and VRS-SO predicted = Static-99R ( $B_1 = .254$ ), VRSSO dynamic pre ( $B_1 = .059$ ), change ( $B_1 = -.130$ ), constant ( $B_0 = -3.736$ ); VRS-SO predicted = VRS-SO total pre ( $B_1 = .085$ ), change ( $B_1 = -.148$ ), constant ( $B_0 = -4.124$ ).

Table 12

*Calibration: E/O Index Analyses Comparing Observed Rates of 5 and 10-Year Violent Recidivism Among Age Cohorts to Logistic Regression Estimates Generated by VRS-SO Risk and Change Score Combinations (with and without Static-99R).*

Age	Observed		Static-99R and VRS-SO predicted			VRS-SO predicted		
	N	n recid	n recid	E/O	95% CI	n recid	E/O	95% CI
Violent recidivism (5-year)								
< 30	311	104	91.6	0.88	0.73, 1.07	82.4	0.79*	0.65, 0.96
30s	378	113	95.7	0.85	0.71, 1.02	85.4	0.76*	0.63, 0.92
40s	348	47	59.6	1.27	0.95, 1.69	68.2	1.45*	1.09, 1.93
50s	155	17	28.0	1.65*	1.03, 2.65	32.1	1.89*	1.17, 3.04
≥ 60	76	3	7.9	2.63	0.85, 8.15	13.5	4.50*	1.45, 13.95
Violent recidivism (10-year)								
< 30	255	126	112.3	0.89	0.75, 1.06	102.1	0.81*	0.68, 0.96
30s	289	127	116.5	0.92	0.77, 1.10	105.3	0.83*	0.70, 0.99
40s	232	61	67.7	1.11	0.86, 1.43	77.3	1.27	0.99, 1.63
50s	88	11	22.8	2.07*	1.15, 3.74	27.0	2.46*	1.36, 4.44
≥ 60	47	2	6.4	3.20	0.80, 12.80	11.7	5.85*	1.46, 23.39

*Note:* \* significant E/O Index. 5-year (n = 1,268) and 10-year (n = 911) outcome analyses are reported using all available cases. 5-year logistic regression models: Static-99R and VRS-SO predicted = Static-99R ( $B_1 = .243$ ), VRSSO dynamic pre ( $B_1 = .052$ ), change ( $B_1 = -.138$ ), constant ( $B_0 = -3.157$ ); VRS-SO predicted = VRS-SO total pre ( $B_1 = .074$ ), change ( $B_1 = -.147$ ), constant ( $B_0 = -3.424$ ). 10-year logistic regression models (see also Olver et al., 2018, Table 4, p. 950): Static-99R and VRS-SO predicted = Static-99R ( $B_1 = .282$ ), VRSSO dynamic pre ( $B_1 = .049$ ), change ( $B_1 = -.123$ ), constant ( $B_0 = -2.509$ ); VRS-SO predicted = VRS-SO total pre ( $B_1 = .078$ ), change ( $B_1 = -.147$ ), constant ( $B_0 = -2.788$ ).



Supplemental Table S1. Static-99R, VRS-SO, and Age at Release Alternative Logistic Regression Models for 5 and 10-Year Sexual Recidivism

	Sexual recidivism 5-year						Sexual recidivism 10-year								
	$\Delta\chi^2$	B	SE	Wald	p	e <sup>B</sup>	LL, UL	$\Delta\chi^2$	B	SE	Wald	p	e <sup>B</sup>	LL, UL	
VRS-SO and Static-99R model															
Block 1															
9	VRS-SO dynamic pre + Static-99R	<b>73.62***</b>	.091	.012	55.23	<.001	1.095	1.069, 1.122	<b>100.69***</b>	.093	.011	75.79	<.001	1.097	1.075, 1.120
10	VRS-SO change		-1.45	.042	11.91	.001	0.865	0.797, 0.939		-1.44	.036	15.82	<.001	0.866	0.807, 0.930
Block 2															
12	VRS-SO dynamic pre + Static-99R	<b>6.60**</b>	.086	.012	48.13	<.001	1.090	1.064, 1.117	<b>6.94**</b>	.089	.011	66.91	<.001	1.093	1.070, 1.116
13	VRS-SO change		-1.31	.043	9.20	.002	0.877	0.806, 0.955		-1.31	.037	12.56	.001	0.877	0.815, 0.943
14	Age at release		-.029	.011	6.23	.013	0.972	0.950, 0.994		-.024	.009	6.64	.010	0.976	0.958, 0.994
Block 3															
17	VRS-SO dynamic pre + Static-99R	<b>3.54</b>	.085	.012	46.47	<.001	1.089	1.062, 1.116	<b>1.20</b>	.088	.011	65.59	.001	1.092	1.069, 1.115
18	VRS-SO change		-1.36	.044	9.68	.002	0.873	0.801, 0.951		-1.34	.037	12.83	<.001	0.875	0.813, 0.941
19	Age at release		.126	.089	2.00	.158	1.134	0.952, 1.351		.043	.064	0.44	.505	1.044	0.921, 1.183
20	Age at release <sup>2</sup>		-.002	.001	2.96	.085	0.998	0.996, 1.000		-.001	.001	1.11	.293	0.999	0.998, 1.001
VRS-SO model															
Block 1															
24	VRS-SO static	<b>85.18***</b>	.154	.031	25.28	<.001	1.166	1.098, 1.238	<b>122.80***</b>	.169	.026	40.90	<.001	1.184	1.124, 1.246
25	VRS-SO dynamic pre		.052	.016	10.82	.001	1.054	1.021, 1.087		.050	.014	12.90	<.001	1.051	1.023, 1.080
26	VRS-SO change		-1.45	.043	11.37	.001	0.865	0.796, 0.941		-1.42	.037	14.61	<.001	0.868	0.807, 0.933
Block 2															
28	VRS-SO static	<b>3.87*</b>	.137	.032	18.11	<.001	1.146	1.076, 1.221	<b>3.19</b>	.155	.028	31.79	<.001	1.168	1.107, 1.233
29	VRS-SO dynamic pre		.056	.016	12.15	<.001	1.058	1.025, 1.091		.053	.014	14.18	<.001	1.054	1.026, 1.083
30	VRS-SO change		-1.34	.044	9.35	.002	0.875	0.803, 0.953		-1.34	.038	12.50	<.001	0.875	0.813, 0.942
31	Age at release		-.022	.012	3.70	.054	0.978	0.956, 1.000		-.017	.010	3.10	.078	0.983	0.965, 1.002
Block 3															
34	VRS-SO static	<b>5.15*</b>	.139	.032	16.63	<.001	1.149	1.079, 1.223	<b>2.49</b>	.157	.028	32.25	<.001	1.170	1.108, 1.235
35	VRS-SO dynamic pre		.054	.016	11.44	.001	1.056	1.023, 1.090		.051	.014	13.50	<.001	1.053	1.024, 1.082
36	VRS-SO change		-1.40	.044	10.02	.002	0.869	0.797, 0.948		-1.37	.038	12.99	<.001	0.872	0.809, 0.939
37	Age at release		.164	.090	3.30	.069	1.178	0.987, 1.405		.081	.065	1.53	.217	1.084	0.954, 1.232
38	Age at release <sup>2</sup>		-.002	.001	4.17	.041	0.998	0.995, 1.00		-.001	.001	2.24	.135	0.999	0.997, 1.000

Note: \*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ . Significant p-values in bold font. Cases (N = 911) are from VRS-SO normative sample with minimum 10-year follow-up.