

# Prediction of Violence and Self-Harm in Mentally Disordered Offenders: A Prospective Study of the Efficacy of HCR-20, PCL-R, and Psychiatric Symptomatology

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The efficacy of the Historical, Clinical, and Risk Management Scales (HCR-20; C. D. Webster, D. Eaves, K. S. Douglas, & A. Wintrup, 1995), Psychopathy Checklist—Revised (PCL-R; R. D. Hare, 1991), Beck Hopelessness Scale (BHS; A. T. Beck, A. Weissman, D. Lester, & L. Trexler, 1974), and Brief Psychiatric Rating Scale (BPRS) to predict violence and self-harm in 34 institutionalized mentally disordered offenders was assessed. Both the HCR-20 and BPRS were strong predictors of violence whereas the PCL-R had moderate predictive ability. BHS was the only variable predictive of self-harm. Although risk assessment measures were successful at predicting in-patient violence, a clinical measure of mental state was at least as effective in these mentally disordered offenders.

The evaluation of risk of future dangerousness is clearly important not only to clinicians but also to society in general. To this end, psychological tests of psychopathology and structured professional guidelines have been pressed into use as possible predictive tools of future dangerousness. For example, tests such as the Historical, Clinical, and Risk Management Scales (HCR-20; Webster, Eaves, Douglas, & Wintrup, 1995) and the Hare Psychopathy Checklist—Revised (PCL-R; Hare, 1991) have been shown to have good predictive validity in prospective studies of future violent offending (Hare, 2001; Mossman, 2000).

Psychopathy, as measured by the PCL-R, has been shown to be a good predictor of general recidivism and, particularly, violent recidivism. This finding generalizes across a variety of different offender populations (e.g., adult offenders; Hart, Kropp, & Hare, 1988) and adolescent offenders (Gretton, 1998, as cited in Hare, 2001). It has been shown to predict violent crime (Serin & Amos,

1995), and among sex offenders, those with high PCL-R scores commit more violent and sadistic sexual offences than low scorers (Firestone, Bradford, Greenberg, & Larose, 1998; Serin, Malcolm, Khanna, & Barbaree, 1994). Although meta-analyses found the PCL-R to be unparalleled in its ability to predict violent recidivism in a prison population, doubts were raised about the applicability of these findings beyond White Canadian offenders (Salekin, Rogers, & Sewell, 1996). Subsequent research, however, has found that the same pattern of results is found with White and African American offenders in the United States (Hemphill, Newman, & Hare, 2001, as cited in Hare, 2001) and in United Kingdom prison populations (Cooke & Michie, 1999; Hare, Clarke, Grann, & Thornton, 2001).

These studies have investigated the relationship between psychopathy and recidivism in a prison population. Surprisingly little research has been conducted on the predictive validity of the PCL-R in either forensic psychiatric patients (i.e., those people committed to secure facilities for psychiatric treatment under criminal law) or civil psychiatric patients (i.e., those people committed to psychiatric treatment in nonsecure facilities under a civil mental health act). Few prospective studies that use reconviction as the outcome measure have been conducted in forensic psychiatric patients. Rice and Harris (1992) found that scores on the PCL-R were associated with violent recidivism as much for schizophrenic patients found not guilty by reason of insanity as for nonpsychotic offenders (see also Harris, Rice, & Quinsey, 1993). In a civil psychiatric population Steadman et al. (1999) have shown that the Psychopathy Checklist: Screening Version (PCL: SV) was the single best predictor of postdischarge violence compared with 133

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potential other predictors (see also Silver, Mulvey, & Monahan, 1999).

Recently, two retrospective studies have been conducted in forensic psychiatric patients; both used case-file data that did not incorporate interview ratings. Tengström, Grann, Långström, and Kullgren (2000) separated schizophrenic violent offenders into those defined as psychopathic (PCL-R score > 25) and nonpsychopathic (PCL-R score < 26). The psychopathic group had a recidivism rate over three times that of the nonpsychopathic cohort. Reiss, Meux, and Grubin (2000), however, failed to find an association between PCL-R score and a variety of outcome factors, including recidivism on discharge. It is unclear why this study in an English high-security hospital failed to replicate previous findings that the PCL-R is highly predictive of later recidivism.

In the majority of these studies the measure taken to assess the validity of the risk assessment was whether offenders were convicted of reoffending within a certain time period. This suffers several methodological drawbacks. First, not everyone who acts violently is caught or convicted of the act; hence many violent acts may be missed and unaccounted for. It is widely accepted that the relationship between reoffending and reconviction is complex. Second, the binary decision "reconviction or not" does not give us a measure of the severity and/or frequency of violent acts, and in some cases, the reconviction offence may have nothing to do with the risk that was assessed (e.g., acquisitive offences). Hence the perceived accuracy of the risk assessment tool (e.g., PCL-R) to predict violent behavior may be substantially deflated because of inaccuracies in the dependent measure rather than because of the poor predictive validity of the risk assessment tool itself. One way to avoid this source of inaccuracy is to monitor violent and aggressive behavior within the institution.

Only three studies have examined the ability of the PCL-R to predict institutional aggression and violence in forensic psychiatric populations. These studies have shown that forensic patients who fulfill PCL-R criteria for psychopathy are at significantly greater risk of violence than are nonpsychopathic patients (e.g., Belfrage, Fransson, & Strand, 2000; Heilbrun et al., 1998). Hill, Rogers, and Bickford (1996) examined the ability of the PCL: SV to predict episodes of self-harm, aggression, escape attempts, and treatment refusal in forensic patients. They found that the PCL: SV was predictive of both aggression and treatment noncompliance. Belfrage et al. (2000) also used the PCL: SV in a prospective study of institutional violence. Using a simple violence-no violence dichotomy, they found that patients who were violent had significantly increased PCL: SV scores. The PCL: SV was found to identify the violent patients in the institution even though the patient group was homogeneous, with a median PCL: SV score of 20, and 30 of 41 patients were diagnosed with psychopathy. However, this study relied on gross categorizations of behavior. For example, the 8 people who were violent in the Belfrage et al. (2000) study had committed very different types of behavior, ranging from verbal threats, to damaging their cells, to serious physical violence to staff.

The HCR-20 violence risk assessment scheme (Webster, Douglas, Eaves, & Hart, 1997; Webster et al., 1995) was developed to be applicable to a wide variety of offender populations and to assess both clinical state and effectiveness of risk management strategies, as well as historical, or static, variables. The usefulness of the HCR-20 as a predictor of violent behavior has been dem-

onstrated in a number of studies. Both retrospective analyses (Douglas, Ogloff, Nicholls, & Grant, 1999; Douglas & Webster, 1999; Strand, Belfrage, Fransson, & Levander, 1998) and prospective analyses (Belfrage et al., 2000; Grann, Belfrage, & Tengström, 2000) have shown that the HCR-20 is strongly associated with violence in both forensic psychiatric and civil psychiatric and in mentally disordered prison populations. Indeed, when compared with the PCL: SV, the HCR-20 was a more stable predictor of violence in the community (Douglas et al., 1999). Further, in a regression analysis the HCR-20 added significant predictive ability beyond the PCL: SV, although the converse was not true (Douglas et al., 1999). Thus, these preliminary results on the HCR-20 indicate that it may be a better predictor of violent recidivism within mentally disordered populations than even the PCL-R or PCL: SV. However, all studies of the HCR-20 to date have been conducted with psychiatric patients. Even those studies investigating violence in prisoners have studied subsets of prisoners with either mental illness (Douglas et al., 1999) or personality disorder (Belfrage et al., 2000). No study has yet been completed with non-mentally disordered prisoners.

The studies cited have attempted to predict participants' violent behavior toward others. An important part of forensic mental health staff's risk management is to predict not only patients' violence toward others but also toward the self. Self-harm and suicide attempts are common occurrences in forensic institutions (Hill et al., 1996; Vaughan, Pullen, & Kelly, 2000). Scores on the PCL: SV have been found to be associated with self-harm such that for psychopathic individuals aggression was never self-directed, whereas for the nonpsychopathic group over 33% of the aggressive acts were self-directed (Hill et al., 1996). More recent work (Verona, Patrick, & Joiner, 2001) has shown that Factor 2 of the PCL-R (which reflects chronic antisocial deviance) was significantly related to suicide history. The usefulness of the HCR-20 in evaluating risk of violence to self has yet to be assessed, as it was devised to guide assessment of risk of violence toward others.

Previous research (Beck, Brown, & Steer, 1989; Niméus, Trauskman-Bendz, & Alsén, 1997; Sidley, Calam, Wells, Hughes, & Whitaker, 1999) has demonstrated that the best psychometric instrument for predicting both suicidal ideation and suicide is the Beck Hopelessness Scale (BHS; Beck, Weissman, Lester, & Trexler, 1974). However, this association has never been demonstrated in mentally disordered offenders. Therefore, as part of the current study, we assessed the efficacy of the PCL-R, HCR-20, and BHS in predicting institutional self-harm and suicide. Feelings of hopelessness may lead people to act with little regard to the consequences of their actions. We therefore hypothesized that those patients with high hopelessness scores may be not only at risk of harm to self but also at increased risk of causing harm to others.

In evaluating future risk of violence, previous studies have contained one or more potential shortcomings that hamper the interpretation of the results. Most problematic is the choice of dependent variable(s). As previously mentioned, many studies simply take a binary measure (e.g., reconviction or not, incident of violence or not) and therefore lose information on the frequency or severity of the violence (Monahan, 1981). Second, studies have used retrospective case-note analysis rather than the more powerful prospective approach. Those studies that do use a prospective design often confound their data by not attempting to control for the various length of follow-up periods for the individuals in the

sample (Belfrage et al., 2000). Someone who is followed up for 1 month has less opportunity to offend than someone who is followed up for 22 months. Third, there have been few attempts to distinguish different forms of violence, such as violence to others, violence to property, verbal aggression, and violence to self. Such fine-grained analysis of the individual's behavior is desirable to assess just what the various risk-assessment tools are capable of predicting. Likewise, we have taken care to produce the most accurate use of the risk-assessment tools by basing them on interview as well as on clinical notes. However, the gathering of such information (see the Method section) is difficult and time consuming, and thus, the sample size gathered is small. Nevertheless, because we have maximized the power of our analysis by (a) using continuous variables, (b) decreasing the error of undetected violence, (c) controlling for different follow-up periods, (d) maintaining stable context between assessment and follow-up, and (e) using a prospective design, we hoped to detect significant effects. In addition, this is the first study of the predictive validity of the HCR-20 in the U.K. population.

The population in this study was mentally disordered. Clearly, mental disorder alone may lead to violent acts (Menuck, 1983; Werner, Yesavage, Becker, Brunsting, & Isaacs, 1983), and thus, it seemed prudent to take a measure of current symptom severity and assess its predictive properties. The Brief Psychiatric Rating Scale (BPRS; Overall & Gorham, 1962) was chosen, as it is a commonly used measure of symptom severity. As symptoms wax and wane with remission and relapse, it was also thought important to get some measure of future prognosis of mental illness. Age of first psychiatric admission is often used as an indicator of future prognosis of mental illness such that the younger the first psychiatric admission the worse the prognosis (e.g., Moriarty et al., 2001). Previous studies have not included psychiatric symptom severity as one of the predictive measures of future violence, and the efficacy of symptom measures to predict future violence and self-harm have never been compared with formalized risk-assessment tools such as the HCR-20 and PCL-R.

## Method

### Participants

Participants were 34 mentally disordered offenders who were admitted to one of two medium-secure hospital units in the U.K. All participants had committed serious offences within the context of a mental disorder. Twenty-six and a half percent had committed manslaughter, 38.2% violent offences (usually grievous bodily harm or actual bodily harm), 14.7% arson, 5.9% sexual offences (rape or attempted rape), 5.9% sexual offences against children, and 8.8% a variety of other offences (firearm offences, armed robbery, etc.). With regard to diagnosis, 44.1% were suffering from paranoid schizophrenia, 23.5% from depression, 14.7% from personality disorder, and 17.6% from other diagnoses (bipolar affective disorder, neurosis, organic disorder). All patients were assessed for the study within the first 2 weeks of admission to the unit. The mean age of the offenders at the time of assessment was 33.0 years ( $SD = 11.9$ ), with an age range from 17 years to 62 years. The majority, 76.5% ( $n = 26$ ), was male, and 23.5% ( $n = 8$ ) were female. White participants accounted for 85.3%, 8.8% were African Caribbean, and 5.9% were Asian. The mean age at first admission to a psychiatric hospital was 27.3 years ( $SD = 9.9$ ), with a range from 15 years to 59 years.

Twenty-three and a half percent of the patients were on civil sections of the Mental Health Act (United Kingdom Home Office, 1983), 35.3% were

on Court orders (8.8% under restriction), and 38.2% were remanded and sentenced prisoners transferred for treatment. The mean number of total convictions (including current conviction) for the patients was 5.5 ( $SD = 8.2$ ), with a range from 0 to 40. The mean number of violent convictions was 2.9 ( $SD = 4.0$ ), with a range from 0 to 17. The mean number of nonviolent convictions was 4.6 ( $SD = 1.1$ ), with a range from 0 to 18.

### Measures

The four main measures used in the study were the PCL-R, HCR-20, BHS, and BPRS. The PCL-R measures a common kernel of personality traits that can define the disorder of psychopathy. It consists of a 20-item evaluation of psychopathy, which incorporates both interview assessments and file-based information. Each of the 20 items are scored on a 3-point scale from 0 to 2, where a score of 0 indicates that *the item is not present for the individual*; a score of 1 indicates that *it may be present but that the evidence available is not strong enough to warrant a score of 2*; and a score of 2 indicates that *the item is definitely present*. The possible range of scores on the PCL-R is therefore 0–40. The higher the score obtained, the nearer the individual is to the prototypical psychopath. The PCL-R consists of two factors: Factor 1 measures selfish and callous personality and relates mainly to interpersonal and affective traits. Factor 2 measures socially deviant behavior and past criminality. The PCL-R has excellent interrater reliability ( $r = .90$ ; Hare, 1991).

The HCR-20 (Version 1) measures 20 variables that have been shown to relate to future risk of violence (Webster et al., 1995). The current study was started before Version 2 of the HCR-20 was published (Webster et al., 1997), but the content of the items across the two versions are directly comparable (Douglas & Webster, 1999). The HCR-20 is divided into three subscales. The Historical subscale has 10 items that relate to static variables present in the individual's past. The Historical subscale includes items that relate to a past history of mental illness, psychopathy, personality disorder, and substance misuse. The Clinical subscale has 5 items that relate to the current status of dynamic risk markers, namely lack of insight, negative attitudes, active symptoms of major mental illness, impulsivity, and unresponsiveness to treatment. The Risk Management subscale has 5 items that relate to the individual's future social and treatment circumstances and the person's estimated reaction to these. Items include exposure to destabilizers, lack of personal support, and response to stress. The Risk Management subscale could not be completed for the current study because the patients had only just been admitted to medium security (within 2 weeks of assessment), and it was not possible to estimate their projected social situations on discharge. Another reason for deleting the Risk Management subscale was that the current study did not attempt to predict violence after discharge but was instead interested in predictions of violence within the in-patient facility. The omission of the Risk Management subscale is common where discharge or postrelease information is unavailable (Douglas & Webster, 1999). Because we omitted the Risk Management subscale, the HCR-20 now strictly became the HC-15. However, for ease of reference with other studies, we continue to refer to the shortened measure as the HCR-20.

The HCR-20 is scored in the same way as the PCL-R. Each item is awarded a score of 0 if the characteristic is not present for the individual, a score of 1 indicates that it may be present, and a score of 2 indicates that the item is definitely present. The possible range of scores on the HCR-20 is therefore 0–40, but for the current study, scores could only range 0–30 because of the omission of the Risk Management subscale. Higher scores indicate higher future risk of violence. Interrater reliability for the HCR-20 has been found to be high ( $r = .80$ ; Douglas & Webster, 1999).

The BHS is a 20-item self-report questionnaire of pessimism and hopelessness. Each item is rated as true or false and scores can vary from 0 to 20. Previous studies have shown that a score of 9 or above on the BHS is predictive of future suicide attempts (Beck, Brown, Berchick, Stewart, &

Steer, 1990; Beck et al., 1989). The interrater reliability of the BHS has been found to be high ( $r = .93$ ; Beck et al., 1974).

The 16-item BPRS (Overall & Gorham, 1962) was used to evaluate current severity of mental illness. The 16 items include ratings of emotional withdrawal, conceptual disorganization, grandiosity, hostility, suspiciousness, hallucinatory behavior, unusual thought content, and blunted affect. Each of the 16 items is rated on a 1 (*not present*) to 7 (*extremely severe*) scale, and therefore, scores range from 16 to 112, with higher scores indicating more severe mental illness symptoms. The interrater reliability of the BPRS has been found to be high, with the mean reliability of the 16 items being  $r = .83$  (Overall & Gorham, 1962).

### Procedure

Ethical Committee approval was obtained from Iechyd Morgannwg Health Authority. Participants were notified about the nature and aims of the study and gave written informed consent. Any patient who was considered not mentally well enough to be able to give informed consent was excluded from the study. No patient was excluded on this basis. Successive admissions to a medium-secure unit over 24 months were included in the study. All participants were assessed on the measures within 2 weeks of admission to the unit.

All assessments were completed by interviews with the patients and by access to file-based information. All background psychiatric and mental health reports on the patients were obtained, as were full criminal-record history and probation information. All ratings (HCR-20, PCL-R, BPRS) were performed jointly by two raters, who both interviewed the patient and performed a review of the file information. One of these raters was Nicola S. Gray, who is a consultant clinical and forensic psychologist accredited by the British Psychological Society. She is fully trained on the PCL-R and has a wealth of experience of administering both the HCR-20 and BPRS. The other raters were both senior mental health nurse practitioners. We were not able to evaluate interrater reliability as the ratings were made jointly (as recommended in the PCL-R manual). Interviews took between 1.5 hr and 3.5 hr to complete and were always conducted jointly by two interviewers. Unfortunately, because of the severity of illness of the sample, 10 people were unwilling to complete the BHS questionnaire.

Following the day of assessment, all incidents of verbal aggression, aggression to property, physical aggression to staff or other patients, and episodes of self-harm or suicide were documented using a structured report form. The structured behavioral-rating scale was specifically designed for the study and was termed the Aggression Vulnerability Scale (AVS). Prior to the present study, the reliability and validity of this measure was assessed by presenting video role-plays to 40 members of the nursing staff for evaluation using the AVS. Interrater reliability (as assessed by intraclass correlations) was found to be highly significant (all  $ps < .01$ ) for all classes of behavior (physical aggression:  $r = .86$ ; aggression to property:  $r = .86$ ; verbal aggression:  $r = .59$ ; self-harm:  $r = .82$ ).

For the present study, the AVS was completed on a weekly basis by a bachelor's-level psychology graduate who accessed the nursing records and incident report forms and conducted weekly interviews with the primary nurses. These data were collected for 3 months postassessment interview or until when the patient was transferred to a different unit (either high-secure hospital or other medium-secure unit).

### Results

The mean PCL-R score was 10.4 ( $SD = 1.5$ , range: 0–33). Using the recommended U.K. cut-off score of 25 (Cooke & Michie, 1999), we found only 2 people (6%) in our sample could be considered psychopathic, with scores of 29 and 33. The mean Factor 1 score was 3.9 ( $SD = 4.3$ ), and the mean Factor 2 score was 5.5 ( $SD = 4.2$ ). The mean total History and Clinical score (maximum possible score = 30) was 15.6 ( $SD = 5.1$ , range: 5–27).

The means of the History and Clinical subscales, respectively, were 10.2 ( $SD = 3.4$ , range: 3–18) and 5.4 ( $SD = 2.6$ , range: 1–10). The mean BHS score was 8.6 ( $SD = 6.4$ , range: 1–19). Twelve people (50%) fell above the criterion score of 9 recommended by Beck et al. (1990) to indicate serious risk of future suicide. The mean BPRS score was 42.0 ( $SD = 2.7$ , range: 17–74) and mean age at first psychiatric admission was 27.3 years ( $SD = 9.8$ , range: 15–59).

The mean number of incidents of verbal aggression was 7.21 ( $Mdn = 1.0$ ,  $SD = 13.45$ , range: 0–49). Over 50% of patients showed at least one incident of verbal aggression during the 3-month study period. The mean number of incidents of aggression to property was 1.00 ( $Mdn = 0.0$ ,  $SD = 2.58$ , range: 0–14), with 32.4% of the sample showing at least one incident of this behavior. For physical aggression the mean number of incidents was 1.38 ( $Mdn = 0.0$ ,  $SD = 3.19$ , range: 0–16), with 32.4% of patients showing at least one act of physical aggression to either staff or patients. Finally, 52.9% of our sample committed at least one act of self-harm, with a mean number of incidents of 5.59 ( $Mdn = 1.0$ ,  $SD = 10.84$ , range: 0–40). The majority of the sample (67.6%) stayed within the unit for the full extent of the follow-up period (91 days). The remaining patients were transferred to different units within this time period (length of admission; range: 20–87 days). To control for the differing follow-up periods, we calculated an incident rate for each of our dependent measures by dividing the total number of incidents score by the length of the follow-up period. This incident rate is used for all subsequent analyses. We note, however, that incident rate also has some drawbacks. For example, serious incidents may result in seclusion that, in turn, decreases the likelihood of further incidents.

### Relationship Between the Measures

Spearman's correlation indicated a good correspondence between the different measures. There were significant correlations between the PCL-R and both the History subscale ( $r = .68$ ,  $p < .01$ ) and Clinical subscale ( $r = .46$ ,  $p < .01$ ) of the HCR-20. The combined History and Clinical subscales also showed a significant correlation with the PCL-R ( $r = .69$ ,  $p < .01$ ). It is perhaps not surprising that the correlations between PCL-R and both the History subscale and the total HCR-20 were large, because the PCL-R score is itself an item in the History subscale. However, we decided not to exclude this item because we wanted to keep the integrity of the History subscale to investigate the degree of redundancy between the scales. The magnitude of these correlations was very similar to that obtained by Douglas and Webster (1999), who found that the PCL-R was correlated with the History subscale at .50, with the Clinical subscale at .43, and with the combined subscale at .59. The Factor 1 scale (personality and interpersonal traits) of the PCL-R correlated significantly with both the History subscale ( $r = .50$ ,  $p < .01$ ) and the combined History and Clinical subscales total ( $r = .49$ ,  $p < .01$ ). Factor 2 (antisocial behavior) of the PCL-R correlated significantly with both the History subscale ( $r = .66$ ,  $p < .01$ ), the Clinical subscale ( $r = .51$ ,  $p < .01$ ), and the combined History and Clinical subscales total ( $r = .68$ ,  $p < .01$ ). Thus, there is strong evidence that the PCL-R and HCR-20 show a significant amount of shared variance.

Perhaps surprisingly, the BHS was found to significantly correlate with both the HCR-20 and the PCL-R. Significant correlations were obtained with both the History subscale ( $r = .46, p < .03$ ), the combined History and Clinical subscales total of the HCR-20 ( $r = .51, p < .01$ ), and the Factor 2 scale of the PCL-R ( $r = .41, p < .05$ ). There was a trend toward significance for the Clinical subscale ( $r = .39, p < .06$ ) and the total PCL-R score ( $r = .38, p < .07$ ). The correlation between the BHS and the Factor 1 scale of the PCL-R was not found to be significant ( $r = .21, p > .1$ ).

As expected, the BPRS was strongly correlated with the Clinical subscale of the HCR-20 ( $r = .71, p < .01$ ), and also the HCR-20 total ( $r = .63, p < .01$ ). The only other correlation to reach significance was Factor 2 of the PCL-R ( $r = .35, p < .05$ ). Finally, the age of first psychiatric admission showed moderate correlation with HCR-20 ( $r = -.41, p < .03$ ), and each of its subscales (History:  $r = -.36, p < .05$ ; Clinical:  $r = -.38, p < .05$ ) and with Factor 2 of the PCL-R ( $r = -.39, p < .03$ ). These negative correlations mean that those with a first admission at a young age tended to show greater scores on these assessment measures. There was also a trend toward a relationship between age of first admission and current BPRS score ( $r = -.34, p = .05$ ).

### Predicting Violent Behavior

Several complementary analyses of the data were performed. The use of continuous dependent measures allowed us to correlate incident rate of a particular behavior against the various symptom variables and risk assessment indicators. Nonparametric correlations were used (Spearman's rho), as the data from many of the dependent measures were not normally distributed.

We also used signal detection theory in each of our measures. Such techniques are gaining widespread acceptance (Mossman, 1994) as a succinct and informative way of describing the predictive value of a tool. Signal detection theory takes account of differing number of incidents base rates and the fact that many risk-assessment tools, such as the PCL-R, have many possible values that could be used as the cut-off point for making predictions. To apply this analysis to our data set, we had to sacrifice the continuous nature of our dependant measures and to simply assign each person as "violent" or "not violent" for each of our target behaviors. We could then calculate the proportion of people we correctly predicted as showing the target behavior (true positive or hit rate) and the proportion of people whom we incorrectly predicted to show violent behavior (false positive or false alarm rate) for each level of our risk assessment tool (or symptom measure). These two rates can then be plotted against one another, as has been done in Figure 1 for the two factors of the PCL-R and the prediction of violence to property, for purpose of illustration. Note that in such receiver operating characteristic spaces, points falling on the diagonal line tell us that our false alarm rate rises as fast as our hit rate and thus our tool is not a useful predictor. If the hit rate rises much faster than the false alarm rate, the points fall above the diagonal line, and the nearer to the left and upper axes these points fall the better the tool is at predicting the target behavior. To quantify this, we used the area under the curve (AUC). For a diagonal line the AUC would be .5 and for a perfect predictor, the AUC would be 1.0. The probability that the AUC differed from .5 (i.e., that the tool had some significant predictive power) was also

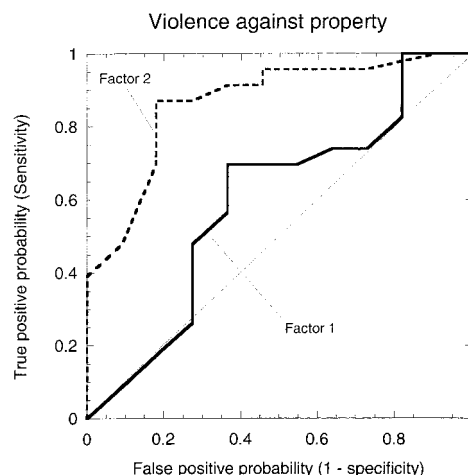


Figure 1. Illustration of typical receiver operating characteristic (ROC) analyses. For each score of our risk assessment tool, we calculate the proportion of people who commit the target behavior who fall above this score (true positive) and the proportion of people who did not commit the target behavior who fall above this score (false positive). These two scores are plotted against one another for all possible scores to produce the ROC functions. The area under the curve (AUC) is then calculated. For Figure 1, the two curves represent Factor 1 (solid line) and Factor 2 (broken line) of the PCL-R, and the target behavior is violence against property. The AUCs are .60 and .87, respectively.

calculated. For the examples given in Figure 1, Factor 1 gave an AUC of .60 ( $p > .1$ ) while Factor 2 gave an AUC of .87 ( $p < .01$ ).

Two other measures have been widely used to demonstrate the predictive validity of a particular measure. These both involve taking some cut-off point of the predictor and comparing those people falling below this point against those above the cut-off point. For convenience, this cut-off point is often taken as the middle of the sample as defined by the median value. If those scoring higher than the median produce significantly more of the target behavior than those scoring less than the median, the predictor is clearly useful.<sup>1</sup> To assess this, we used a nonparametric comparison of means (Mann-Whitney U) for those scoring higher versus those scoring lower than the median value for each of our predictors. Those with the exact median score were excluded. Finally, we also present the odds ratio (OR), as this allows direct comparison with previous studies that used the same predictor. Briefly, this refers to the difference in the probability of committing the target behavior between those scoring higher or lower than the median. Hence, an OR of 3.00 would mean that somebody scoring greater than the median is 3 times more likely to show the target behavior than someone scoring less than the median. It is often accepted that ORs of 2.50 and above are considered substantial and clinically important (Fleiss, Williams, & Dubro, 1986).

<sup>1</sup> Many predictive studies have approached the issue from the opposite direction. They divide the participants into offenders and nonoffenders and then compare these two groups on their scores on the predictor measure (e.g., Belfrage et al., 2000). This, of course, has to be done retrospectively (as one has to wait for the end of the study to decide whether a person offended) rather than in a truly predictive manner.

The results of these analyses can be seen in Tables 1–4, which report the various indices and the significance levels for each of the four dependent measures (verbal aggression, violence to property, physical violence, and self-harm), respectively. We summarize the most important findings for each risk assessment tool and symptom measure in the following text.

### HCR-20

For the measures of verbal aggression, violence to property, and physical violence, the total score for the History and Clinical subscales (termed HCR-20) was found to be a very good predictor of these behaviors with correlations ranging between .53 and .56, AUCs between .79 and .83, and ORs between 2.55 and 8.85. The two subscales used here (History and Clinical) were also each found to have good predictive validity with little difference between the subscales. Overall, the total HCR-20 was consistently better than either of the subscales alone. However, the HCR-20 was not a useful predictor of self-harm.

### PCL-R

The total PCL-R had some predictive validity for the measures of violence to property and physical violence ( $r_s = .35-.38$ ; AUCs = .70–.76; ORs = 1.88–2.84), although these were notably less than for the HCR-20 (see previous). The PCL-R did not significantly predict verbal aggression. In examining the two subscales of the PCL-R, we found that Factor 1 (interpersonal and affective traits) proved to be a poor predictor of any target behavior, while Factor 2 (antisocial behavior) was more effective than the total PCL-R in all its predictions. Most notably, Factor 2 seems to be a powerful predictor of violence toward property rather than of verbal or physical violence. PCL-R scores did not prove successful predictors of self-harm.

### BHS

The BHS did not predict acts of verbal aggression or physical violence. However, it did have some predictive value for violence to property. As predicted, it was a highly effective indicator of acts of self-harm ( $r = .67$ ; AUC = .86; OR = 4.50).

### BPRS

The BPRS was a very good predictor of verbal aggression and physical violence ( $r_s = .58-.61$ ; AUCs = .81–.84; ORs = 2.31–4.00) and was a moderate predictor of violence to property. It did not significantly predict acts of self-harm.

### Age of First Psychiatric Admission

The age of the participant at their time of first psychiatric admission proved to have useful predictive powers for acts of verbal aggression and property violence ( $r_s = -.37$  through  $-.48$ ; AUCs = .72–.76; ORs = 2.00–3.53). It had no significant predictive power for physical violence or acts of self-harm.

## Discussion

The current study used dependent measures that are continuous in nature (but that can also be dichotomized to aid comparison with previous studies), classified behavior into different forms of aggression, accounted for the small variation in follow-up periods across individuals by calculating an incident rate, and conducted a prospective study.

Consistent with previous studies (Belfrage et al., 2000; Douglas et al., 1999; Douglas & Webster, 1999; Grann et al., 2000; Strand et al., 1998), the HCR-20 was strongly predictive of all forms of outward aggression (verbal, property, and physical) but did not predict harm to self. We found that both the Clinical and Historical subscales were also good predictors of all forms of violence and that both subscales were similar in their predictive abilities. This result differs from the results found for retrospective analyses where the predictive validity of the Clinical subscale has been found to be very low and not to add predictive ability to the total HCR-20 score (e.g., Douglas et al., 1999; Douglas & Webster, 1999). Douglas and Webster (1999) interpreted this lack of predictive validity of the Clinical subscale as being due to the fact that it is very difficult to obtain accurate clinical information from retrospective case-note analyses. The prospective nature of the current study therefore contributed to the highly predictive ability of the Clinical subscale. This highlights the importance of obtaining accurate clinical data. On the other hand, Belfrage et al. (2000)

Table 1  
Correlations, AUCs, ORs, and *p* Values of the Mann–Whitney *U* Test for a Median Split for the Target Behavior of Verbal Aggression

Variable	<i>r</i>	<i>p</i>	AUC	<i>p</i>	OR	Mdn split <i>p</i>
HCR-20	.53	<.001	.79	<.001	2.55	<.01
History	.43	<.01	.73	<.05	2.21	<.01
Clinical	.49	<.01	.74	<.01	2.27	<.05
PCL-R	.30	.09	.60	<i>ns</i>	1.37	<i>ns</i>
Factor 1	.20	<i>ns</i>	.52	<i>ns</i>	1.25	<i>ns</i>
Factor 2	.38	<.05	.68	<i>ns</i>	2.07	<.05
BHS	.09	<i>ns</i>	.51	<i>ns</i>	1.50	<i>ns</i>
BPRS	.58	<.001	.81	<.001	2.31	<.05
Age at 1st admission, years	-.48	<.01	.76	<.01	2.00	.07

Note. AUC = area under the receiver operating characteristic curve; OR = odds ratio; HCR-20 = Historical, Clinical, and Risk Management Scales; PCL-R = Hare Psychopathy Checklist—Revised; BHS = Beck Hopelessness Scale; BPRS = Brief Psychiatric Rating Scale.

Table 2  
Correlations, AUC, ORs, and *p* Values of the Mann–Whitney *U* test for a Median Split for the Target Behavior of Violence to Property

Variable	<i>r</i>	<i>p</i>	AUC	<i>p</i>	OR	Mann–Whitney <i>U p</i>
HCR-20	.56	<.001	.83	<.001	8.85	<.01
History	.54	<.001	.82	<.001	8.45	<.01
Clinical	.49	<.001	.77	<.001	3.85	.09
PCL–R	.38	.05	.76	<.01	4.36	<.05
Factor 1	.14	<i>ns</i>	.60	<i>ns</i>	2.84	<i>ns</i>
Factor 2	.58	<.001	.87	<.001	6.75	<.05
BHS	.30	.09	.70	<.05	6.02	<.01
BPRS	.34	.06	.69	<.05	2.36	<i>ns</i>
Age at 1st admission, years	–.37	<.05	.72	<.05	3.53	<.05

Note. AUC = area under the receiver operating characteristic curve; OR = odds ratio; HCR-20 = Historical, Clinical, and Risk Management Scales; PCL–R = Hare Psychopathology Checklist—Revised; BHS = Beck Hopelessness Scale; BPRS = Brief Psychiatric Rating Scale.

demonstrated that both the Clinical and the Risk Management subscales of the HCR-20 had significant predictive validity of recidivism, whereas the History subscale did not. Belfrage et al. (2000) noted that almost all offenders in their sample were high risk, as they were resident within a maximum-security facility. Therefore, almost all offenders had a high score on the History subscale, which led to a lack of variance and discriminatory ability for this subscale in that sample.

The PCL–R was only a moderate predictor of all forms of aggression. When total PCL–R score was separated into Factor 1 (interpersonal and affective traits) and Factor 2 (antisocial behavior) scores, we found that Factor 1 showed no significant predictive validity on any form of aggression. Factor 2, however, was a good predictor. The poorer performance of the total PCL–R compared with the HCR-20 was, therefore, due to the Factor 1 scores contaminating the predictive ability of Factor 2. It should be noted, however, that the Factor 1 scores are very low and hence range restrictions may contribute to the limited validity of these scores. These findings are similar to those of Belfrage et al. (2000); Grann, Långström, Tengström, and Kullgren (1999); and Salekin et al. (1996), who found that the predictive validity of Factor 2 is higher than the predictive validity of Factor 1. Reiss et al. (2000) found

that for male mentally disordered offenders in a U.K. high-security hospital, the PCL–R was unable to predict reoffending. This may, therefore, have been due to Reiss et al. (2000) not separating PCL–R score into Factor 1 and Factor 2 subscales.

Taken in totality, the two studies that have compared the PCL–R and the HCR-20 within a mentally ill population (i.e., the current study in hospitalized mentally ill offenders and Douglas & Webster (1999) in mentally ill offenders in prison) have shown that the HCR-20 is superior at predicting risk of violence. In contrast, Belfrage et al. (2000), who compared the PCL: SV and HCR-20 in a non-mentally ill prison population, found that both measures were roughly equivalent in predicting violent behavior.

The current study included a basic assessment of current clinical state (BPRS) as a risk measure and is the first to use a simple measure related to prognosis of mental illness (age at first psychiatric admission). Surprisingly, for acts of physical and verbal aggression the BPRS predicted aggression as well as any of the other measures. Our indicator of poor clinical prognosis (age at first psychiatric admission) had a modest relationship with all measures of aggression. Although in our highly symptomatic sample the BPRS out-performed age at first admission, this latter variable may well be of increased utility in samples that are

Table 3  
Correlations, AUC, ORs, and *p* Levels of the Mann–Whitney *U* Test for a Median Split for the Target Behavior of Physical Aggression

Variable	<i>r</i>	<i>p</i>	AUC	<i>p</i>	OR	Mann–Whitney <i>U p</i>
HCR-20	.53	<.001	.81	<.001	8.25	<.01
History	.43	<.01	.77	<.001	7.46	<.05
Clinical	.49	<.01	.79	<.001	7.42	<.05
PCL–R	.35	<.05	.70	<.05	1.88	<i>ns</i>
Factor 1	.20	<i>ns</i>	.63	<i>ns</i>	1.71	<i>ns</i>
Factor 2	.36	<.05	.69	<.05	2.26	<i>ns</i>
BHS	.18	<i>ns</i>	.53	<i>ns</i>	1.52	<i>ns</i>
BPRS	.61	<.001	.84	<.001	4.00	<.05
Age at 1st admission, years	–.32	.07	.64	<i>ns</i>	1.67	<i>ns</i>

Note. AUC = area under the receiver operating characteristic curve; OR = odds ratio; HCR-20 = Historical, Clinical, and Risk Management Scales; PCL–R = Hare Psychopathology Checklist—Revised; BHS = Beck Hopelessness Scale; BPRS = Brief Psychiatric Rating Scale.

Table 4  
Correlations, AUCs, ORs, and *p* levels of the Mann–Whitney *U* Test for a Median Split for the Target Behavior of Self-Harm

Variable	<i>r</i>	<i>p</i>	AUC	<i>p</i>	OR	Mann–Whitney <i>U p</i>
HCR-20	.24	<i>ns</i>	.64	<i>ns</i>	1.26	<i>ns</i>
History	.14	<i>ns</i>	.60	<i>ns</i>	1.07	<i>ns</i>
Clinical	.26	<i>ns</i>	.62	<i>ns</i>	1.26	<i>ns</i>
PCL-R	-.01	<i>ns</i>	.48	<i>ns</i>	1.06	<i>ns</i>
Factor 1	-.17	<i>ns</i>	.40	<i>ns</i>	0.77	<i>ns</i>
Factor 2	.18	<i>ns</i>	.60	<i>ns</i>	1.50	<i>ns</i>
BHS	.67	<.001	.86	<.001	4.50	<.01
BPRS	.32	<i>ns</i>	.65	<i>ns</i>	1.76	<i>ns</i>
Age at 1st admission, years	-.21	<i>ns</i>	.62	<i>ns</i>	1.82	<i>ns</i>

Note. AUC = area under the receiver operating characteristic curve; OR = odds ratio; HCR-20 = Historical, Clinical, and Risk Management Scales; PCL-R = Hare Psychopathy Checklist—Revised; BHS = Beck Hopelessness Scale; BPRS = Brief Psychiatric Rating Scale.

currently in remission (who therefore have low BPRS scores with little variance). The current sample was all assessed within 2 weeks of admission to hospital and therefore had mostly high symptom ratings on the BPRS. Our results showing that the BPRS is a powerful prospective risk factor in a mentally disordered offender population stand in contrast to those reported from the MacArthur Violence Risk Assessment Study (Monahan et al., 2001). This study showed no correlation between BPRS score and later physical violence. Obviously, we need to interpret these discrepant findings. The two studies differ in at least two important aspects. First, the MacArthur project evaluated risk in a civil psychiatric population. Hence, these people suffer from mental illness but have not committed offences. On the other hand, our participants all committed crimes within the context of their mental disorder. Hence, it would seem likely that current clinical state would be a better indicator of future violence in a mentally disordered population. Second, in the MacArthur study, the BPRS ratings were made at point of discharge, whereas our assessment was conducted at admission to the hospital. This difference in methodology would have led to a difference in severity of symptoms at assessment and to a possible restriction in range of BPRS scores for the MacArthur study. This restriction in range would then necessarily limit the BPRS's ability to predict future violent behavior. Future research is needed to address these issues and their relative contribution to the differences in predictive power found between these studies.

Against predictions, the BHS was not found to consistently predict any form of violence other than self-harm. Consistent with many previous studies, the BHS was highly predictive of self-harming and suicidal behavior. No other variable was found to have any significant predictive properties for this target behavior. Thus the BHS's ability to predict self-harm supports its validity for this type of risk.

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