

**The predictive validity of the Short-Term Assessment of Risk and Treatability  
(START) for multiple adverse outcomes in a secure psychiatric inpatient  
setting**

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### **Abstract**

The START aims to assist mental health practitioners to estimate an individual's short-term risk for a range of adverse outcomes via structured consideration of their risk ('Vulnerabilities') and protective factors ('Strengths') in 20 areas. It has demonstrated predictive validity for aggression but this is less established for other outcomes. We collated START assessments for  $N=200$  adults in a secure mental health hospital and ascertained 3-month risk event incidence using the START Outcomes Scale. The specific risk estimates, which are the tool developers' suggested method of overall assessment, predicted aggression, self-harm/suicidality and victimisation, and had incremental validity over the Strength and Vulnerability scales for these outcomes. The Strength scale had incremental validity over the Vulnerability scale for aggressive outcomes; therefore consideration of protective factors had demonstrable value in their prediction. Further evidence is required to support use of the START for the full range of outcomes it aims to predict.

Keywords: START, risk assessment, protective factors, aggression/violence, self-harm, vulnerability, self-neglect

## **Introduction**

Individualised risk assessment and risk management are central to the role of all mental health professionals. Structured professional judgment schemes, which comprise empirically derived risk factors and guidelines to facilitate interpretation and scoring, have become the gold standard assessment technique (National Institute for Mental Health in England, 2004) and are commonly used in secure/forensic mental health services (Khiroya, Weaver, & Maden, 2009). However, such schemes have been criticised for their almost exclusive focus on the deficits that are associated with increased risk (Hart, 2001), rather than balancing these against a systematic consideration of an individual's personal strengths or positive attributes that hypothetically constitute protective factors. The consideration of protective factors may reduce the likelihood of negative bias which can contribute to an over-estimation of risk and hence unnecessary restriction and detention; also, there may be clinical advantages such as improving therapeutic relationships and identifying areas for personal growth (de Ruiter & Nicholls, 2011). Further, structured professional judgment has centred on the prediction of risk of aggression and violence (Webster, Martin, Brink, Nicholls, & Desmarais, 2009). However, whilst inpatient aggression and violence can have serious consequences (Bowers et al., 2011), adequate care of mental health inpatients requires consideration of a range of risk outcomes including not only aggression but also self-harm and victimisation (Webster et al., 2009).

### *The Short-Term Assessment of Risk and Treatability*

The Short-Term Assessment of Risk and Treatability (START; Webster et al., 2009) addresses the criticisms of previous structured professional judgement schemes by requiring raters to consider both risk and protective factors, termed Vulnerabilities and Strengths, to assess the likelihood of a range of adverse outcomes: violence, self-harm, suicide, self-neglect,

victimisation, substance abuse and unauthorised leave. The START also requires raters to conclude with an overall risk rating of low, moderate or high, for each undesirable outcome, termed a specific risk estimate (SRE). The START can be scored reliably (e.g. Desmarais, Nicholls, Wilson, & Brink, 2012; Wilson, Desmarais, Nicholls, & Brink, 2010; Wilson, Desmarais, Nicholls, Hart, & Brink, 2013), and it has convergent validity with other risk assessment guides (Abidin et al., 2013; Desmarais et al., 2012; Quinn, Miles, & Kinane, 2013) including the Historical, Clinical and Risk-Management-20 (HCR-20; Webster, Douglas, Eaves, & Hart, 1997), Suicide Risk Assessment and Management Manual (SRAMM; Bouch & Marshall, 2003), and the Structured Assessment of Protective Factors for violence risk (SAPROF; de Vogel, de Ruiters, Bouman, & de Vries Robbé, 2012). However, whilst there is robust evidence that the START can predict violent and aggressive outcomes (e.g. Abidin et al., 2013; Desmarais et al., 2012; Gray et al., 2011; Wilson et al., 2013), very few data are available for the remaining outcomes and results have been inconsistent (O'Shea & Dickens, 2014).

Braithwaite, Charette, Crocker and Reyes (2010) found that the START significantly predicted unauthorised leave and substance abuse, but did not predict self-harm, suicidality, self-neglect or victimisation; whereas Gray et al. (2011) found that it did predict self-harm, self-neglect and victimisation. Further, research has suggested that the START Strength and Vulnerability scores have incremental validity over the HCR-20 and the Psychopathy Checklist: Screening Version (PCL:SV; Hart, Cox, & Hare, 1995) scores for aggressive outcomes over follow-up periods of up to 12 months (Desmarais et al., 2012; Wilson et al., 2013). Further, the specific risk estimates have incremental validity over these scores combined; however, there is currently no evidence that the protective factors make a unique contribution to prediction over and above consideration of risk factors (Wilson et al., 2010).

*Aim of current study*

Given that the START's focus on a range of risk outcomes appears to be a unique feature of the tool it is surprising that so little research has investigated its predictive ability for outcomes other than violence. Further, although the predictive ability of its protective factors (or Strengths scale) has been tested, few studies have examined whether their inclusion, or that of the SREs, improves upon prediction based solely on risk factors. This study, therefore, aimed to extend current knowledge regarding the START by: i) examining the predictive ability of the START for the full range of adverse outcomes, and ii) examining whether either SREs, protective, or risk factors have incremental validity over one another. To do this we have sampled from a larger, more diverse population than has been used in previous research; this is important as the START is intended to be used broadly across mental health services.

From both theoretical and empirical perspectives there are good reasons to believe that the START will predict violent and aggressive outcomes. The tool's manual (Webster et al., 2009) details research literature in support of links between each of the 20 items and violence, while meta-analysis has demonstrated that the START significantly predicts the same outcome (O'Shea & Dickens, 2014). Given the association between inpatient self-harm and aggression directed towards others in inpatient settings (James, Stewart, & Bowers, 2012; Nijman & Campo, 2002), evidence that violence assessment instruments like the HCR-20 predict self-harm (O'Shea, Picchioni, Mason, Sugarman, & Dickens, 2014b), and the fact that there is robust evidence for the START as a predictor of aggressive outcomes (O'Shea & Dickens, 2014), it is reasonable to expect that the START may also be able to predict self-harm. There is less reason to support the tool's ability as a predictor of other outcomes: the START manual details scant evidence of research on the links between its items and other outcomes, and the empirical

evidence is mixed (O'Shea & Dickens, 2014). For the purposes of the current study we therefore hypothesised that START items would significantly predict aggressive and self-harm behaviours but not the remaining outcomes. The SREs should have incremental validity over predictions based on either the Strength or Vulnerability scale, as they are formulated based on consideration of case-specific factors, historical behavior and risk signs, in addition to scale scores.

## **Method**

### *Participants*

St Andrew's is a charitable provider of secure mental health inpatient care located at four sites in England. Eligible participants were consecutive admissions between May 2011 and July 2012, who had at least one START risk assessment completed and remained in the service for at least the next three months. Patients were excluded if their START assessment had in excess of five missing Strength or five missing Vulnerability ratings as per the prorating guidelines in the START manual (Webster et al., 2009).

### *Procedure*

This study employed a pseudo-prospective cohort design. Throughout admission, START assessments were completed by the patients' multidisciplinary team using standard techniques. In addition, risk incidents were recorded by clinical staff in electronic progress notes on each shift. The first START assessment completed for each patient, their demographic and clinical data, and risk incidents for the three months following START assessment were extracted from patients' records, anonymised and linked by a unique code number.

### *Measures*

*START Assessment.* The START comprises 20 dynamic items each scored by a multidisciplinary team on two 3-point scales in terms of both risk factors (Vulnerabilities) and

protective factors (Strengths): 0 indicates no/minimal vulnerability or strength evident, 1 indicates moderate vulnerability/ strength, and 2 indicates high vulnerability/strength. The teams of raters then make a SRE (low, moderate or high) about the likelihood of each of seven risk outcomes occurring over the next three months: violence to others, self-harm, suicide, substance abuse, victimisation, self-neglect, and unauthorised absence. The guidance about how the SREs should be formulated is brief; raters are advised to form an overall impression once all factors, including START Strength and Vulnerability scores, additional case specific factors, key and critical items, and recent risk behaviour, have been considered (Webster et al., 2009). In emergency situations where there is insufficient time to complete a full review of the evidence, raters are instructed to make a dichotomous decision about whether there are any Threats of Harm that are Real, Enactable, Acute and Targeted (T.H.R.E.A.T).

Total scores on the Strength and Vulnerability scales were prorated to account for missing items in accordance with guidelines in the START manual (Webster et al., 2009). The START is specifically intended to be completed by a “number of mental health specialists who work together as a team” (ibid: p.24) through a process of team discussion and consensus in order to incorporate a range of professional opinions for each case. The START manual does not make specific recommendations about the number or precise qualifications of multidisciplinary raters, or their level of training in the START assessment. In the current study setting we exceed the recommendations in the manual about user qualifications in two ways. First, a 1-day training in START assessment is provided in a structured format based on the START manual to all clinicians covering theoretical and practical aspects of the tool. Training includes team discussion and rating of pseudonymised clinical cases followed by feedback and further discussion in the context of ratings given by START experts and other teams at previous training

sessions in order to support reliability. Second, in the study setting it is required that the completed START for each patient is signed off by three members of the multidisciplinary clinical team from different professions (psychiatrist, psychologist, nurse, occupational therapist, social work). Rating is completed every 3 months for each patient and this is supported by regular audit of a sample of cases to ensure compliance. Since each START assessment included in the current study was rated for clinical purposes by each patients' multidisciplinary clinical team, we were not able to calculate inter-rater reliability statistics; a strategy which has been applied in previous research (e.g., Inett, Wright, Roberts, & Sheeran, 2014; Nonstad et al., 2010; Quinn et al., 2013).

*Demographic and Clinical Data.* Information was extracted regarding age, gender, date of admission (and discharge if applicable), security level, legal status, self-reported ethnicity and ICD-10 (World Health Organisation, 1992) psychiatric diagnoses, as recorded by the patients' consultant psychiatrist.

*Risk Outcomes.* It is hospital policy for an electronic progress note to be entered by a qualified member of the clinical team for each patient on a per shift basis. At the time of progress note entry, staff electronically flag the note if any of a range of risk outcomes has occurred; incidents can be flagged for multiple outcomes. We collated all incidents flagged as "Aggression – Physical", "Aggression – Verbal", "Absconding", "Self-harm/Suicide", "Self-neglect" "Substance Misuse", and "Vulnerability". Progress notes for flagged entries were coded using the START Outcome Scale (SOS; Nicholls et al., 2007). The SOS comprises 12 outcome categories, rated on a criterion-referenced severity scale of 0 (outcome absent) to 4 (most severe): verbal aggression, aggression against property, physical aggression against others, sexual aggression, self-harm, suicide ideation and planning, suicide behaviours, self-neglect,

unauthorised leave, substance abuse, being victimised, and stalking. We did not code entries separately for sexual aggression and stalking since the START is not intended to predict these outcomes. Rating was conducted by two of the authors (LO, GD), who were blind to the results of the START assessments at the time of coding, and inter-rater reliability was tested on a sample of flagged entries for 20 patients for each outcome. Raters were required to judge whether each flagged note met the requirement for a level 1 incident or above for any of the outcome categories examined. Aggression against property and physical aggression against others were analysed as a single outcome (physical aggression) as were self-harm, suicide ideation and planning, and suicide behaviours (self-harm/suicide). Self-harm and suicide are treated as separate outcomes in the START; however, this was not possible because, in the current study setting, progress notes are flagged as “self-harm/suicide” if they contain any self-harm or suicidal behaviours. As a result it was problematic to disentangle the underlying intentions between non-suicidal self-harm and actual suicide attempts (Gray et al., 2011). Additionally, we combined incidents of physical aggression and verbal aggression to form an “Any Aggression” category.

#### *Data Analysis*

Descriptive statistics were calculated to examine sample characteristics, the distribution of START Strength scores, Vulnerability scores and SREs, and the incidence of risk outcomes within the follow-up period. Power calculations were conducted in MedCalc for Windows, version 14.8.1 (MedCalc software, Ostend, Belgium) based on an expected large effect size, with  $\alpha=.05$  and  $\beta=.20$ , to identify the required sample size to have sufficient power to detect predictive ability of the START for each outcome. Independent *t* tests were used to investigate differences in mean scores between those who had and those who had not engaged in each

outcome. In order to examine associations between the Strength scores, Vulnerability scores and SREs, Spearman's  $\rho$  correlations were conducted. Coefficients of .10, .30, and .50 are considered small, moderate, and large, respectively (Cohen, 1992). The predictive validity of the START Strength scores, Vulnerability scores and SREs was investigated by calculating area under the curve (AUC) values derived from Receiver Operating Characteristic (ROC) analysis; the violence SRE was used to predict all three aggressive outcomes, whereas both the self-harm SRE and the suicide SRE were used as a predictor for the composite self-harm/suicide outcome. The total Strength score was inverted prior to ROC analysis such that a higher score represented less strength to facilitate comparisons with the predictive efficacy of the Vulnerability scores and SREs. This parameter ranges from 0 to 1; .5 represents a level of chance prediction and .75 is often considered a large effect size (Dolan & Doyle, 2000); Rice and Harris (2005) report that AUC values of .556, .638 and .714 respectively are equivalent to small (.2), moderate (.5) and large (.8) Cohen's  $d$  values (Cohen, 1992), which are one of the most commonly reported measures of effect size (Kraemer & Kupfer, 2006; Rice & Harris, 2005). ROC analysis was selected as it is reasonably unaffected by base rates, compared to other approaches (Mossman, 1994), and it is not affected by how the risk assessment is coded (Pepe, Janes, Longton, Leisenring, & Newcomb, 2004), facilitating comparisons between AUC values derived from different tools. Further, the AUC value can be easily interpreted as the probability that a randomly chosen individual who has engaged in the adverse behaviour will have a higher risk assessment score than someone that has not engaged in the behaviour (Rice & Harris, 1995). Finally, the vast majority of research studies into the predictive validity of the START have reported AUC values, so their use will aid comparisons with previous studies.

Odds ratios were also calculated to present the increase in odds for each one point increase on the Strength and Vulnerability scales, and between those categorised as moderate or high risk, compared to low risk, by the SREs, for each adverse outcome occurring. AUC values have been shown to vary based on the range of scores examined, such that small AUC values would be expected if a risk assessment tool is used on a sample pre-selected to be high risk (Hanson, 2008), as would be the case in the current study setting where participants would not be detained if they were not deemed a risk to themselves or others. Odds ratios are unaffected by a restricted range of scores (Hanson, 2008), so may provide more accurate information in the current setting. Odds ratios of 1.5, 2.5, 4 and 10 can be considered small, moderate, large, and very large, respectively (Rosenthal, 1996).

Finally, block-entry logistic regression analyses were conducted to examine whether either the START Strength or Vulnerability scores have incremental validity over one another when used to predict risk outcomes. The total Vulnerability scores were entered into Step 1 of the model and the total Strength scores were entered in Step 2. This order was then reversed to investigate if Vulnerability scores had incremental validity over Strength scores. Further, the SREs were entered in Step 3 to examine whether they made any contribution to predictive utility beyond the Strength and Vulnerability scores. Significant improvements in chi-square values indicate that there is a statistically significant improvement in the amount of information explained by the model (Field, 2009); increases in the percentage of cases correctly classified by the model are also presented, as this information facilitates a clinical interpretation of whether the statistically significant improvement justifies the additional resources needed to score additional scales. All analyses were conducted using PASW Statistics version 18 for Windows (SPSS Inc, 2009).

## Results

### *Inter-rater Reliability*

Inter-rater reliability for coding the SOS from progress notes was in the excellent range: Cohen's Kappa ranged from .83 to 1.00, the lowest being for self-neglect and the highest for self-harm and physical aggression.

### *Participants*

Of the 214 patients that met the inclusion criteria, 14 were excluded due to excessive missing data from the START assessment leaving a final sample of  $N=200$  (response rate 93.5%) with a mean age of 34.3 ( $SD = 15.2$ ). There were 149 (74.5%) males and 51 females (25.5%). Just over half of the sample had no recorded ethnicity ( $n=105$ , 52.5%), 82 (41%) were Caucasian, 6 (3%) were of Asian or Asian British ethnicity, 4 (2%) were Black or Black British, and the remainder ( $n=3$ , 1.5%) were of mixed ethnic background. Most common psychiatric diagnoses were (F20–F29) schizophrenia, schizotypal and delusional disorders ( $n=76$ , 38%), (F80–F89) disorders of psychological development, ( $n=49$ , 24.5%), (F60–F69) disorders of adult personality and behaviour ( $n=47$ , 23.5%), (F00–F09) organic, including symptomatic, mental disorders ( $n=45$ , 22.5%), and (F70–F79) mental retardation ( $n=35$ , 17.5%). The majority of patients ( $n=120$ , 60%) were resident in low secure wards and 80 (40%) were in medium secure wards. Ninety one patients (45.5%) were detained under forensic sections of the Mental Health Act (1983, 2007) (i.e. following a criminal conviction the offender was sufficiently mentally unwell at the time of sentencing to require hospitalisation, or following conviction was deemed to require transfer from prison to hospital for treatment for mental disorder), 97 (48.5%) were held under civil sections (i.e. those individuals not subject to the criminal justice system, who require detaining for assessment or treatment as they are a risk to themselves or others) and 12

(6%) were admitted informally (i.e. voluntarily). The mean time between admission and START assessment was 187 days ( $SD = 149.35$ ; Range 1-837).

#### *Base rates of risk outcomes*

The base rates of risk outcomes during the three month follow-up period are presented in Table 1. The most common outcome, with the exception of the composite any aggression variable, was verbal aggression which 123 people (61.5%) engaged in. The least common outcome was substance use, which only involved 1.5% ( $n=3$ ) of the sample. Power calculations revealed that 824 and 501 cases would be required to detect a significant effect for substance use and unauthorised leave, respectively, due to low base rates. Therefore, the present study was underpowered to detect predictive efficacy for these outcomes and they were removed from further analyses. There was sufficient power to detect predictive ability for the remaining outcomes; which required sample sizes ranging from 54 for physical aggression to 153 for self-neglect.

There was wide variation in the severity of incidents; self-neglect involved refusing meals, poor personal hygiene, and untidy or unsanitary living space. Victimization ranged from relatively minor name-calling, to being pressurised/coerced into sharing belongings, receiving threats of harm/death, and physical assault requiring hospital visit. There were no incidents of completed suicide during the study period; self-harm/suicide involved both low level incidents, such as scratching and making superficial lacerations, and more serious incidents such as tying ligatures, burning, and ingesting objects requiring hospital intervention. Incidents of verbal aggression spanned the full range of severity, as captured by the SOS, from shouting and name calling to making explicit threats of harm, death, sexual assault, or damage to property. Incidents of physical aggression against property ranged from punching/kicking objects to throwing

objects dangerously at staff and breaking objects; physical aggression directed towards others included threatening gestures, spitting, physical contact without injury, assaults resulting in mild injury, such as swelling, bruising, and small lacerations, and assaults resulting in moderate-severe injury requiring hospital attendance.

#### *START scores and SREs*

Scores on the Strength scale ranged from 1 to 32.80 ( $M=15.84$ ,  $SD=6.60$ ) and the Vulnerability scale ranged from 8 to 40 ( $M=25.50$ ,  $SD=6.55$ ). The mean Strength scores were significantly lower and mean Vulnerability score were significantly higher for patients who had engaged in any aggression, physical aggression, and verbal aggression compared with those who had not. The mean Strength score was also significantly smaller for those who had engaged in self-neglect. There were no significant differences between those who had and had not engaged in the remaining outcomes, but in all cases Strength scores were lower and Vulnerability scores were higher amongst those who engaged in each of the adverse outcomes (See Table 1).

[INSERT TABLE 1 ABOUT HERE]

[INSERT TABLE 2 ABOUT HERE]

The distributions of the SREs are presented in Table 2. The most common classification was low risk for all of the outcomes: risk of violence had the largest proportion of high risk classifications (18%). There were a large number of significant correlations between the total Strength score, total Vulnerability score and each of the SREs (see Table 3). Most associations were small to moderate in magnitude; however, correlations between the total Vulnerability score and total Strength score, and between the SREs for self-harm and suicide would be considered large (Cohen, 1992). Additionally, Strength and Vulnerability scores on each of the

twenty items were significantly negatively correlated. Correlation coefficients ranged from  $-.36$  to  $-.77$  ( $M=-.54$ ) with most exceeding the  $.5$  threshold of a large effect size.

[INSERT TABLE 3 ABOUT HERE]

#### *Predictive validity of the START*

The AUC values derived from ROC analysis are presented in Table 4. The total Vulnerability score significantly predicted aggressive outcomes but did not predict self-harm/suicide, self-neglect, or victimisation. The total Strength score significantly predicted aggressive outcomes and self-neglect. Of the SREs, only those for violence, self-harm/suicide, and victimisation were significant predictors of their respective outcomes. However, only one of the AUC values could be considered to indicate a large effect size (Dolan & Doyle, 2000); self-harm/suicide as predicted by the SRE for self-harm. The remaining significant AUC values would all be classified as moderate effect sizes according to Cohen's (1992) criteria. The AUC values for the SREs were larger than those for the total Strength score and total Vulnerability score for the prediction of physical aggression, self-harm/suicide, and victimisation.

Odds ratios were largely consistent with the results of the ROC analysis (see Table 5). Increases in total Vulnerability and Strength scores were associated with small, but significant increases in the odds of all three aggressive outcomes occurring; additionally, the Strength score produced a significant odds ratio for self-neglect. Increases in START scores were not related to an increase in the odds of any of the remaining adverse outcomes occurring. Individuals classified as moderate or high risk by the specific risk estimates for violence and self-harm/suicide were at increased odds of engaging in the corresponding behaviour, with odds ratios being in the moderate to large range for aggression, and the large to very large range for self-harm. Those deemed at high risk for victimisation were significantly more likely to be

subject to victimisation than those classified as low risk and the odds ratio approached the threshold for a very large effect size; the odds ratio for those rated at moderate risk was not significant. The largest odds ratios were obtained for those rated at high risk of suicide (OR=25.90) and self-harm (OR=13.67) compared to those rated as low risk.

#### *Incremental validity analyses*

Victimisation, self-neglect, and self-harm/suicide were excluded from the logistic regression analyses as they were only significantly predicted by one of the START components. For the prediction of any aggression, physical aggression, and verbal aggression, the total Strength score had incremental validity over the total Vulnerability score and significantly improved the model fit. The increase in the percentage of cases correctly classified by the model ranged from -0.6% to 2.8%. Vulnerability scores did not have incremental validity over the Strength scores for any outcome. The SREs added incremental predictive utility to the total Strength scores and total Vulnerability scores combined for all aggressive outcomes and their inclusion significantly improved model fit (see Table 6). The increase in the percentage of cases correctly classified under each model ranged from 0.6% to 4.4%.

### **Discussion**

The range of scores and risk levels assigned by raters suggests that the START has the potential to distinguish between those who are more or less likely to engage in risk behaviours, even amongst a relatively high risk UK forensic inpatient sample. START Strength and Vulnerability scores both predicted aggressive outcomes and those with higher Vulnerability and inverted Strength scores (i.e. representing fewer strengths) were at increased odds of engaging in aggressive outcomes. Logistic regression analyses revealed that the inclusion of Strengths improved the predictive ability of the START beyond that achieved by Vulnerabilities for these

outcomes. This is a promising finding because previous risk assessment schemes had been criticised for neglecting protective factors (e.g., Hart, 2001; Rogers, 2000), but prior to the current study there was little evidence that their inclusion improved accuracy. In addition, the SRE for violence was a significant predictor of all aggressive outcomes, and those classified as elevated (moderate or high) risk for violence had significantly higher odds of engaging in all aggressive outcomes compared with those rated as low risk. The SRE for violence also had incremental validity over the Strength and Vulnerability scores; this suggests that clinicians are considering extra information that is not captured by either of the scores. However, although this yielded statistically significant improvements in model fit, increases in the percentage of cases correctly classified by the model were small. Furthermore while this study did not include a comparison guide, the predictive validity of the START for aggressive outcomes in our inpatient sample was broadly in keeping with published accounts of other structured professional judgement tools such as HCR-20 (O'Shea, Mitchell, Picchioni, & Dickens, 2013).

The significant associations between each of the SREs suggest that people are likely to be at risk of exhibiting challenging behaviours in multiple domains (Nicholls, Brink, Desmarais, Webster, & Martin, 2006), or perceived as such by clinicians. However, there is very little empirical data that establishes risk factors for the diverse outcomes targeted by the START and previous research suggests that consideration of combinations of subsets of START items in 'optimized scales' provided greater predictive validity for non-aggressive outcomes (Braithwaite et al., 2010). It is unlikely that the same twenty items would be considered of equal importance in the prediction of seven different adverse outcomes. It was hypothesised that the START items may be able to predict self-harm, due to the overlap between individuals who self-harm and engage in other-directed aggression (James et al., 2012; Nijman & Campo, 2002); however, the

current study found that the START scores were not predictive of self-harm/suicide or victimisation within the follow-up period. The inverted START Strength scores were a significant predictor of self-neglect, and holding fewer strengths produced a significant increase in the odds of engaging in self-neglect; this is consistent with the results of Gray et al. (2011). This suggests a promising route for therapeutic interventions to reduce self-neglect in secure services. Since it is the Strength rather than the Vulnerability scores that predict self-neglect, interventions should target improving skills rather than reducing deficits. Given that AUC values for the Strength and Vulnerability score were moderate at best, it suggests that there may be additional relevant factors for these outcomes that are not covered by the START. Further, they were somewhat smaller than those that have been typically obtained. A number of the previous studies on the predictive validity of the START have involved one or more of the tool's authors; an allegiance effect has been observed for other risk assessment tools, such that effect sizes are larger in studies conducted by the tool's authors (Blair, Marcus, & Boccaccini, 2008; Singh, Grann, & Fazel, 2013). Therefore, our independence in comparison with previous studies may contribute to the discrepancies in AUC values. Results suggested that the START SREs for self-harm and suicide can predict the related composite outcome; the self-harm SRE in particular achieved a large effect size, and the odds ratio for those rated as elevated risk of self-harm and suicide, compared with low risk, were the largest in the current study. The SRE for victimisation was also predictive of its associated outcome, and those rated at high, but not moderate, risk had increased odds of being victimised compared with those rated as low risk. The finding of significant prediction by the SREs, in the absence of significant prediction based on scores, combined with the moderate correlations observed between the total Vulnerability score/ total Strength score and the SREs, suggests that clinicians do not simply translate raw scores into risk

levels. It may be that they are using the START as intended; as a framework to guide risk decisions, supplementing their clinical knowledge and expertise prior to making SREs, and focusing on those items most pertinent to the outcome in question. However, it could equally be that they are making SREs based on their own judgment, without any real consideration of the scores at all; or that their formulation hinges upon the critical Vulnerabilities or key Strengths, or recent behaviour. The current study design precludes conclusions about the qualitative contribution of the START assessment process to the risk estimate formulation.

For a risk assessment to be useful in clinical practice, it must be able to inform treatment and management and hence reduce the number of adverse incidents, not just predict their occurrence. As a result it has been suggested that the future of risk assessment research may not lie in further calculation of their predictive value but rather in terms of evaluating whether risk assessment informs management and therefore reduces risk incidence. While this may be the case for outcomes where the risk factors are well-established (e.g. violence in the case of the START), this may not be the case for other outcomes where a need remains to establish whether putative risk factors in fact are associated with each outcome. The current study suggests that START strength or Vulnerability scores generally do not predict the full, intended range of outcomes. As a result we may reasonably question whether, in a clinical context, examination of the present START items is likely to have relevance to planning management or intervention strategies to minimise incidence of every outcome. Further development is required to better establish risk factors for diverse outcomes.

#### *Outcome base rates*

Base rates of aggression were higher in the current study than has been previously observed; 69% had been aggressive during the three month follow-up period compared with 20-

54% in other studies (Chu, Thomas, Ogloff, & Daffern, 2011; Desmarais et al., 2012; Nonstad et al., 2010). However, Braithwaite et al. (2010) found comparable levels of aggression (70.6%). Rates of self-harm/suicidal behaviour were similar to those observed by Braithwaite et al. (2010) and Gray et al. (2011), but rates of unauthorised leave, self-neglect and substance abuse were substantially lower in the current sample. This may in part be due to differences in study settings. All of the patients in the study by Braithwaite et al. (2010) and the vast majority of those in the Gray et al. (2011) study came from civil psychiatric hospitals and hence may have had more opportunity to engage in risk behaviours compared with the current study sample of which nearly half were detained under forensic Mental Health Act sections and 40% were residing in conditions of medium security. Similar rates of unauthorised leave to the current study have been found in medium secure psychiatric units (e.g. Dolan & Snowden, 1994) while rates of unauthorised leave are lower from locked compared to open wards (Stewart & Bowers, 2011). In a secure setting, the perceived risk of unauthorised leave and substance abuse lead to the implementation of risk management procedures, such as greater restrictions and higher levels of physical and procedural security, which largely preclude the risk outcome. Additionally, substance abuse may go undetected. It is also possible that differences in outcome base rates stem from differences in demographic or clinical characteristics; in the current study, fewer people had a diagnosis of schizophrenia and a higher proportion of patients had an intellectual disability or organic diagnosis compared with previous studies on the predictive validity of the START (e.g., Abidin et al., 2013; Braithwaite et al., 2010; Gray et al., 2011; Nonstad et al., 2010). Previous research has demonstrated higher rates of aggression in those with an intellectual disability (O'Shea, Picchioni, McCarthy, Mason, & Dickens, 2014) or organic diagnosis (O'Shea, Picchioni, Mason, Sugarman, & Dickens, 2014a) which may contribute to the

higher rates of aggression observed. Individuals with schizophrenia are over-represented among groups of absconders (Stewart & Bowers, 2011) and have high rates of substance abuse (Gournay, Sandford, Johnson, & Thornicroft, 1997); therefore the comparably low rates of schizophrenia in the current study may contribute to the low rates of these outcomes.

#### *Risk and protective factors*

The START's authors believe that Strengths and Vulnerabilities can be held simultaneously for the same item (Webster et al., 2009). The finding of strong negative correlations between the Strength and Vulnerability scores on all individual items challenges this view and is more consistent with the idea that protective factors are the absence of risk (Costa, Jessor, & Turbin, 1999) or are factors that lie at the opposing end of a continuum to a risk factor (Hawkins, Catalano, & Miller, 1992). However, variation in the correlations between Strength and Vulnerability scores suggests that some items are more easily conceptualised in terms of both Strengths and Vulnerabilities than other items. The high degree of correlation between the two scales also questions the utility of rating items in terms of both Strength and Vulnerability. Inverted Strength scores were a significant predictor of aggressive outcomes and self-neglect, with AUC values exceeding those obtained from the Vulnerability scale, and their inclusion makes a unique contribution to the START's predictive ability. However, this contribution resulted in a maximum increase in the percentage of cases correctly classified of 2.8%, which may not on its own be considered sufficiently large to warrant the extra time and resources needed to score what is in effect an additional scale. It has been claimed that considering strengths is clinically advantageous in terms of reducing negative bias and promoting therapeutic relationships (de Ruiter & Nicholls, 2011) and staff completing START assessments believe that it is beneficial to include strengths (e.g. Desmarais, Collins, Nicholls, & Brink, 2011). However,

there is little evidence that it actually impacts relationships between staff and patients; nor that START assessment reduces recidivism by patients relative to those receiving standard care with no structured risk assessment (Troquete et al., 2013).

### *Limitations*

The reliance on pre-existing, routinely collected information limited the current study; however, it allowed us to collect data for the largest sample to date. We were unable to examine the predictive ability of the START for unauthorised leave or substance abuse due to the low base rates and insufficient power. Self-harm and suicide were treated as one outcome as this is how they are flagged during the routine recording of outcomes in the study setting. Further, we could not verify diagnoses ourselves through structured methods and we were missing a large amount of data pertaining to ethnicity, due to this being a self-reported variable. A further limitation is that the START assessments were completed by the patients' multidisciplinary team; therefore the people responsible for completing the risk assessment are also tasked with managing and preventing risk behaviours. ROC analysis is unable to account for the successful prevention of risk outcomes; therefore this may have contributed to the smaller AUC values obtained in the current study. Further, the SOS lacks a strong evidence base. Few studies have reported on its use and those that have reported lower levels of inter-rater reliability than the current study (e.g. Wilson et al., 2010). It is likely that the SOS can be scored reliably and is a valid measure for aggressive outcomes as it is adapted from the Overt Aggression Scale (OAS; Yudofsky, Silver, Jackson, Endicott, & Williams, 1986), which is one of the most commonly used instruments for measuring aggressive outcomes among psychiatric inpatients (Wilson et al., 2010). It is unclear whether it is a valid measure of the remaining outcomes, which may contribute to the START's poor predictive ability for these outcomes. However, the definitions

used in the SOS are largely consistent with those described in the START manual (Webster et al., 2009). Therefore, coding the outcome data using the SOS likely produced a more valid outcome measure than reliance on the flagged items.

#### *Implications and future considerations*

The START predicted aggression but did not appear to outperform other commonly used guides; SREs were significant predictors of aggressive outcomes, self-harm/suicide, and victimisation, but not self-neglect. This suggests that clinicians are managing to identify those people at risk of engaging in aggression, self-harm and victimisation, but it is unclear to what extent the START assessment contributes to these judgments. They were not able to identify those people at risk of self-neglect, despite the START scores showing predictive ability for this outcome suggesting that clinicians should pay more attention to START scores when forming this SRE. In contrast, clinicians should be encouraged to consider a wide range of other issues when making SREs for self-harm/suicide and victimisation due to the lack of predictive ability of the START scores for these outcomes. This study also provides some of the first evidence that, for violence prediction, the START Strength scores have incremental validity over Vulnerability scores, and hence, that their inclusion makes a unique contribution to risk prediction. Although statistically significant, improvements in the percentage of cases correctly classified were actually very small which leads to questions around resource allocation; however, given the serious consequences of violence for the victim, such as physical injury (Bowers et al., 2011) and mental health problems (Lanctôt & Guay, 2014), as well as damage to therapeutic relationships (Lanctôt & Guay, 2014) and therapeutic nihilism (James et al., 2012), even small improvements in the percentage of correctly classified cases may be deemed worthwhile as more of these serious consequences may be prevented.

Future research should aim to verify whether the SOS can be scored reliably and is a valid measure for outcomes other than aggression, use standardised outcome measures to further investigate the predictive ability of the START for outcomes other than aggression and violence, examine the predictive ability of individual START items, identify additional risk factors relevant to those outcomes not predicted by START scores, and examine if their inclusion improves upon predictive ability. Large sample sizes will be required where base rates are low, as was the case for unauthorised leave and substance abuse in the current setting. Other directions for research could include investigating whether the consideration of strengths has demonstrable clinical benefits, and examining how clinicians form SREs and whether performance can be enhanced through the application of further training and guidelines. Ultimately, research should aim to establish if use of the START leads to a reduction in the number of adverse outcomes occurring, if it can inform treatment, and if it can predict the use of interventions, such as seclusion, restraint and PRN medication.

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**Table 1:** Base rates of risk outcomes and differences between mean Strength and Vulnerability scores as a function of engagement

| <b>Outcome</b>      | <b>Base rate</b> | <b>Mean Strength Score (SD)</b> | <b>Mean Vulnerability Score (SD)</b> |
|---------------------|------------------|---------------------------------|--------------------------------------|
| Any Aggression      | 138 (69%)        |                                 |                                      |
| Yes                 |                  | 14.5 (5.9)                      | 26.6 (5.9)                           |
| No                  |                  | 18.9 (7.2)                      | 23.1 (7.3)                           |
| <i>t</i>            |                  | 4.55***                         | 3.54***                              |
| <i>d</i>            |                  | 0.67                            | 0.52                                 |
| Physical Aggression | 108 (54%)        |                                 |                                      |
| Yes                 |                  | 14.2 (5.6)                      | 27.0 (5.4)                           |
| No                  |                  | 17.8 (7.2)                      | 23.7 (7.3)                           |
| <i>t</i>            |                  | 3.92***                         | 3.64***                              |
| <i>d</i>            |                  | 0.56                            | 0.52                                 |
| Verbal Aggression   | 123 (61.5%)      |                                 |                                      |
| Yes                 |                  | 14.4 (5.9)                      | 26.6 (5.9)                           |
| No                  |                  | 18.2 (7.0)                      | 23.8 (7.2)                           |
| <i>t</i>            |                  | 4.16***                         | 3.03**                               |
| <i>d</i>            |                  | 0.59                            | 0.43                                 |
| Self-harm/Suicide   | 48 (24%)         |                                 |                                      |
| Yes                 |                  | 14.3 (6.7)                      | 26.8 (6.4)                           |
| No                  |                  | 16.3 (6.5)                      | 25.1 (6.6)                           |
| <i>t</i>            |                  | 1.88                            | 1.57                                 |
| <i>d</i>            |                  | 0.31                            | 0.26                                 |
| Self-neglect        | 21 (10.5%)       |                                 |                                      |
| Yes                 |                  | 13.0 (4.1)                      | 27.5 (4.4)                           |
| No                  |                  | 16.2 (6.8)                      | 25.3 (6.7)                           |
| <i>t</i>            |                  | 3.15**                          | 1.47                                 |

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|                    |            |            |            |
|--------------------|------------|------------|------------|
| <i>d</i>           |            | 0.58       | 0.39       |
| Victimisation      | 37 (18.5%) |            |            |
| Yes                |            | 14.0 (5.6) | 27.2 (5.9) |
| No                 |            | 16.3 (6.7) | 25.1 (6.6) |
| <i>t</i>           |            | 1.86       | 1.71       |
| <i>d</i>           |            | 0.36       | 0.32       |
| Unauthorised Leave | 6 (3%)     |            |            |
| Substance Abuse    | 3 (1.5%)   |            |            |

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\*\* $p < .01$ , \*\*\* $p < .001$

**Table 2:** Risk levels assigned by the START specific risk estimates

|               | <b>Low</b>  | <b>Moderate</b> | <b>High</b> | <b>Missing</b> |
|---------------|-------------|-----------------|-------------|----------------|
| Violence      | 81 (40.5%)  | 65 (32.5%)      | 36 (18%)    | 18 (9%)        |
| Self-harm     | 94 (47%)    | 37 (18.5%)      | 21 (10.5%)  | 48 (24%)       |
| Self-neglect  | 100 (50%)   | 52 (26%)        | 21 (10.5%)  | 27 (13.5%)     |
| Victimisation | 103 (51.5%) | 47 (23.5%)      | 25 (12.5%)  | 25 (12.5%)     |
| Suicide       | 101 (50.5%) | 25 (12.5%)      | 7 (3.5%)    | 67 (33.5%)     |

**Table 3:** Correlations between START scores and specific risk estimates

|                            | <b>Vulnerability<br/>Score</b> | <b>Violence<br/>SRE</b> | <b>Self-harm<br/>SRE</b> | <b>Self-neglect<br/>SRE</b> | <b>Victimisation<br/>SRE</b> | <b>Suicide<br/>SRE</b> |
|----------------------------|--------------------------------|-------------------------|--------------------------|-----------------------------|------------------------------|------------------------|
| <b>Strength Score</b>      | -.69***                        | -.37***                 | -.23**                   | -.33***                     | -.26***                      | -.05                   |
| <b>Vulnerability Score</b> | -                              | .39***                  | .26**                    | .23**                       | .25***                       | .09                    |
| <b>Violence SRE</b>        |                                | -                       | .30***                   | .30***                      | .36***                       | .25**                  |
| <b>Self-harm SRE</b>       |                                |                         | -                        | .15                         | .32***                       | .74***                 |
| <b>Self-neglect SRE</b>    |                                |                         |                          | -                           | .34***                       | .04                    |
| <b>Victimisation SRE</b>   |                                |                         |                          |                             | -                            | .30***                 |

*Note.* SRE, specific risk estimate

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

**Table 4:** Predictive validity of the START scores and specific risk estimates

| Outcome             | Strength Score |          |              | Vulnerability Score |          |              | SRE               |          |              |
|---------------------|----------------|----------|--------------|---------------------|----------|--------------|-------------------|----------|--------------|
|                     | AUC            | <i>p</i> | 95%CI        | AUC                 | <i>p</i> | 95%CI        | AUC               | <i>p</i> | 95%CI        |
| Any Aggression      | .689           | <.001    | [.606, .772] | .637                | <.001    | [.551, .723] | <sup>a</sup> .686 | <.001    | [.603, .768] |
| Physical Aggression | .657           | <.001    | [.580, .734] | .639                | <.001    | [.561, .717] | <sup>a</sup> .695 | <.001    | [.618, .771] |
| Verbal Aggression   | .665           | <.001    | [.586, .745] | .612                | .008     | [.530, .694] | <sup>a</sup> .640 | .002     | [.557, .723] |
| Self-harm/Suicide   | .570           | .146     | [.476, .664] | .561                | .203     | [.468, .654] | <sup>b</sup> .783 | <.001    | [.692, .875] |
|                     |                |          |              |                     |          |              | <sup>c</sup> .696 | <.001    | [.587, .805] |
| Self-neglect        | .661           | .016     | [.567, .755] | .599                | .136     | [.489, .710] | .546              | .508     | [.410, .681] |
| Victimisation       | .596           | .069     | [.501, .691] | .580                | .129     | [.483, .677] | .652              | .006     | [.538, .765] |

*Note.* START Strength scores have been inverted for the purpose of this analysis such that higher scores represented less strength; SRE, specific risk estimate; AUC, area under the curve; CI, confidence interval

<sup>a</sup>SRE for violence, <sup>b</sup>SRE for self-harm, <sup>c</sup>SRE for suicide

**Table 5:** Odds ratios for START scores and specific risk estimates

| Outcome             | Vulnerability Score |              | Strength Score |              | SRE – Moderate-Low   |               | SRE - High-Low        |                |
|---------------------|---------------------|--------------|----------------|--------------|----------------------|---------------|-----------------------|----------------|
|                     | OR                  | 95%CI        | OR             | 95%CI        | OR                   | 95%CI         | OR                    | 95%CI          |
| Any Aggression      | 1.09***             | [1.04, 1.14] | 1.12***        | [1.06, 1.17] | <sup>a</sup> 3.36*** | [1.59, 7.11]  | <sup>a</sup> 6.73***  | [2.18, 20.78]  |
| Physical Aggression | 1.09***             | [1.04, 1.14] | 1.09***        | [1.04, 1.15] | <sup>a</sup> 3.27*** | [1.66, 6.48]  | <sup>a</sup> 7.43***  | [2.90, 19.06]  |
| Verbal Aggression   | 1.07**              | [1.02, 1.12] | 1.10***        | [1.05, 1.15] | <sup>a</sup> 2.68**  | [1.33, 5.37]  | <sup>a</sup> 3.59**   | [1.46, 8.81]   |
| Self-harm/Suicide   | 1.04                | [0.99, 1.10] | 1.05           | [1.00, 1.11] | <sup>b</sup> 6.47*** | [2.67, 15.68] | <sup>b</sup> 13.67*** | [4.59, 40.69]  |
|                     |                     |              |                |              | <sup>c</sup> 4.68**  | [1.85, 11.85] | <sup>c</sup> 25.90**  | [2.94, 227.94] |
| Self-neglect        | 1.06                | [0.98, 1.14] | 1.08*          | [1.01, 1.17] | 1.40                 | [0.50, 3.92]  | 1.50                  | [0.38, 6.00]   |
| Victimisation       | 1.05                | [0.99, 1.11] | 1.06           | [1.00, 1.12] | 0.86                 | [0.31, 2.37]  | 7.47***               | [2.86, 19.52]  |

*Note.* START Strength scores have been inverted for the purpose of this analysis such that higher scores represented less strength; SRE, specific risk estimate; CI, confidence interval; OR, odds ratio

<sup>a</sup>SRE for violence, <sup>b</sup>SRE for self-harm, <sup>c</sup>SRE for suicide

\*\* $p < .01$ , \*\*\* $p < .001$

**Table 6:** logistic regression analyses of incremental validity

|                                  |                  | $\beta$ (SE) | Wald  | $\Delta$ cases correctly classified | Model Fit                      |
|----------------------------------|------------------|--------------|-------|-------------------------------------|--------------------------------|
| <b>Any aggression</b>            |                  |              |       |                                     |                                |
| Step 1                           |                  |              |       |                                     |                                |
|                                  | Vulnerability    | .08** (.03)  | 8.83  |                                     | $\chi^2(1) = 9.37^{**}$        |
|                                  | Strength         | .10*** (.03) | 13.76 |                                     | $\chi^2(1) = 15.42^{***}$      |
| Step 2                           |                  |              |       |                                     |                                |
| Vulnerability -                  | Vulnerability    | .02 (.04)    | 0.31  | 1.6%                                | $\chi^2(2) = 15.73^{***}$      |
| Strength                         | Strength         | .09* (.04)   | 5.99  |                                     | $\Delta \chi^2(1) = 6.36^*$    |
| Strength -                       | Strength         | .09* (.04)   | 5.99  | 0%                                  | $\chi^2(2) = 15.73^{***}$      |
| Vulnerability                    | Vulnerability    | .02 (.04)    | 0.31  |                                     | $\Delta \chi^2(1) = 0.31$      |
| Step 3                           |                  |              |       |                                     |                                |
| Vulnerability -                  | Vulnerability    | .00 (.04)    | 0.01  | 0.6%                                | $\chi^2(3) = 25.58^{***}$      |
| Strength - SRE <sup>a</sup>      | Strength         | .07* (.04)   | 3.93  |                                     | $\Delta \chi^2(1) = 9.85^{**}$ |
|                                  | SRE <sup>a</sup> | .84** (.28)  | 8.89  |                                     |                                |
| Strength -                       | Strength         | .07* (.04)   | 3.93  | 0.6%                                | $\chi^2(3) = 25.58^{***}$      |
| Vulnerability - SRE <sup>a</sup> | Vulnerability    | .00 (.04)    | 0.01  |                                     | $\Delta \chi^2(1) = 9.85^{**}$ |
|                                  | SRE <sup>a</sup> | .84** (.28)  | 8.89  |                                     |                                |
| <b>Physical aggression</b>       |                  |              |       |                                     |                                |
| Step 1                           |                  |              |       |                                     |                                |
|                                  | Vulnerability    | .07** (.02)  | 9.15  |                                     | $\chi^2(1) = 9.82^{**}$        |
|                                  | Strength         | .09*** (.03) | 12.00 |                                     | $\chi^2(1) = 13.21^{***}$      |
| Step 2                           |                  |              |       |                                     |                                |
| Vulnerability -                  | Vulnerability    | .03 (.03)    | 0.86  | 2.8%                                | $\chi^2(2) = 14.07^{***}$      |
| Strength                         | Strength         | .07* (.03)   | 4.08  |                                     | $\Delta \chi^2(1) = 4.25^*$    |
| Strength -                       | Strength         | .07* (.03)   | 4.08  | -1.1%                               | $\chi^2(2) = 14.07^{***}$      |

|                                  |                  |                          |       |       |                                  |
|----------------------------------|------------------|--------------------------|-------|-------|----------------------------------|
| Vulnerability                    | Vulnerability    | .03 (.03)                | 0.86  |       | $\Delta \chi^2(1) = 0.85$        |
| <b>Step 3</b>                    |                  |                          |       |       |                                  |
| Vulnerability –                  | Vulnerability    | .00 (.04)                | 0.01  | 4.4%  | $\chi^2(3) = 28.77^{***}$        |
| Strength – SRE <sup>a</sup>      | Strength         | .05 (.04)                | 2.20  |       | $\Delta \chi^2(1) = 14.70^{***}$ |
|                                  | SRE <sup>a</sup> | .89 <sup>***</sup> (.24) | 13.42 |       |                                  |
| Strength –                       | Strength         | .05 (.04)                | 2.20  | 4.4%  | $\chi^2(3) = 28.77^{***}$        |
| Vulnerability – SRE <sup>a</sup> | Vulnerability    | .00 (.04)                | 0.01  |       | $\Delta \chi^2(1) = 14.70^{***}$ |
|                                  | SRE <sup>a</sup> | .89 <sup>***</sup> (.24) | 13.42 |       |                                  |
| <b>Verbal aggression</b>         |                  |                          |       |       |                                  |
| <b>Step 1</b>                    |                  |                          |       |       |                                  |
| Vulnerability                    |                  | .07 <sup>**</sup> (.03)  | 6.92  |       | $\chi^2(1) = 7.26^*$             |
| Strength                         |                  | .09 <sup>***</sup> (.03) | 11.34 |       | $\chi^2(1) = 12.40^{***}$        |
| <b>Step 2</b>                    |                  |                          |       |       |                                  |
| Vulnerability -                  | Vulnerability    | .01(.03)                 | 0.18  | -0.6% | $\chi^2(2) = 12.57^{**}$         |
| Strength                         | Strength         | .08* (.03)               | 5.03  |       | $\Delta \chi^2(1) = 5.32^*$      |
| Strength -                       | Strength         | .08* (.03)               | 5.03  | 0.5%  | $\chi^2(2) = 12.57^{**}$         |
| Vulnerability                    | Vulnerability    | 01(.03)                  | 0.18  |       | $\Delta \chi^2(1) = 0.17$        |
| <b>Step 3</b>                    |                  |                          |       |       |                                  |
| Vulnerability –                  | Vulnerability    | .00 (.03)                | 0.00  | 1.1%  | $\chi^2(3) = 17.54^{***}$        |
| Strength – SRE <sup>a</sup>      | Strength         | .07 (.04)                | 3.63  |       | $\Delta \chi^2(1) = 4.97^*$      |
|                                  | SRE <sup>a</sup> | .53* (.24)               | 4.77  |       |                                  |
| Strength –                       | Strength         | .07 (.04)                | 3.63  | 1.1%  | $\chi^2(3) = 17.54^{***}$        |
| Vulnerability - SRE <sup>a</sup> | Vulnerability    | .00 (.03)                | 0.00  |       | $\Delta \chi^2(1) = 4.97^*$      |
|                                  | SRE <sup>a</sup> | .53* (.24)               | 4.77  |       |                                  |

*Note.* START Strength scores have been inverted for the purpose of this analysis such that higher scores represented less strength; SRE, specific risk estimate

<sup>a</sup>SRE for violence

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$