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The relationship between emotional regulation difficulties and aggression in forensic populations: a systematic review; and an empirical study examining the mediating roles of emotional regulation and hostile attribution bias in the relationship between traumatic brain injury and violent offending.

Geraldine O’Neill

Submitted in part fulfilment of the degree of

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Overview to Thesis Portfolio

This thesis was completed in part fulfillment of the Doctorate in Clinical Psychology. It is divided into two chapters. Chapter one is a systematic review examining the relationship between emotional regulation difficulties and aggression in forensic populations. Chapter two is an empirical study investigating the relationship between traumatic brain injury and violent offending, with a specific focus on the mediating roles of emotional regulation and hostile attribution bias.

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Thesis Portfolio Abstract

Chapter One: Systematic Review

High levels of violence and aggression are observed in forensic populations. Difficulties with emotional regulation (ER) may be a risk factor for aggression. This systematic review summarized research examining the relationship between ER difficulties and aggression in individuals who offend. A systematic search of three electronic databases revealed twelve studies which were for eligible for inclusion. Seven of the studies found moderate associations between global ER and/or ER subscales and aggression. A group with adaptive ER had lower levels of aggression compared to those with maladaptive ER, and ER was found to be a potential mediator in the relationship between factors such as low self-esteem, post-traumatic stress syndrome, psychopathy, traumatic brain injury, alexithymia and aggression. Studies were consistent in identifying an association between ER and aggression in forensic populations. Future research should include longitudinal studies of ER and aggression, and further investigations should be conducted into the effectiveness of ER skills
training in addressing aggression in forensic populations.

Chapter Two: Empirical Study

This empirical study aimed to ascertain if emotional regulation (ER) difficulties and/or hostile attribution bias (HAB) played a role in explaining the relationship between having a history of traumatic brain injury (TBI) and engaging in violent offending. Eighty-two male offenders completed three questionnaires relating to TBI, ER and HAB, and consented to their offence history being accessed for research purposes. Results indicated that prevalence of TBI was extremely high in this prison setting at a rate of 96.3%. Mild TBI was most prevalent at 61% and, moderate and severe TBI accounted for 9.7% of the sample. The main source of TBI was assaults accounting for 48%. No significant differences were found between ‘no TBI’ and ‘TBI’ groups in relation to ER difficulties, HAB and offending behaviour. No significant relationships were found between TBI severity, ER, HAB and violent offending. Neither ER difficulties nor HAB mediated the relationship between TBI and violent offending in this offender population. Further research of this nature is needed to explore the relationship between TBI and criminality, specifically, looking at potential causal mechanisms as this remains unclear.
Lay Summary

Chapter One: Systematic Review

Levels of violence and aggression are high amongst individuals who engage in crime. Difficulties with emotion regulation (ER) (which involves being able to manage our emotions, tolerate distress and control impulsive behaviours), may increase the risk of an individual behaving aggressively. This review examined research studies in the area of ER and aggression in offending populations. By exploring and summarizing the findings, the authors hoped to help identity if addressing ER difficulties is a potential treatment target which could inform interventions aimed at reducing levels of aggression and violent reoffending. Following a systematic search of the research in this area, twelve studies were included. The studies reviewed were consistent in identifying an association between ER and aggression in offending populations. For example, in one study, offenders who were considered to have difficulties with ER, had higher levels of aggression when compared to those who did not have difficulties with ER. Difficulties with ER were also found to partly explain the relationship between factors such as low self-esteem, psychopathy, traumatic brain injury and aggression. Future research should include the study of ER and aggression with offenders over substantial periods of time (months/years), to establish whether difficulties with ER, is predictive of future violence. Further investigation should also be conducted into the effectiveness of interventions aimed at improving ER skills, in relation to reducing aggression in offending populations.

Chapter Two: Empirical Study

Rates of traumatic brain injury (TBI) among individuals who offend, are much higher than in the general public. This suggests that there may be a relationship between TBI and criminality. In particular, TBI has been found to be associated with violence; however, it is
unclear what underlying processes are involved in this relationship. Hostile attribution bias (HAB) is the tendency to interpret the behaviour of others as being antagonistic. Research suggests that individuals who have a history of a TBI, display greater levels of HAB. Emotional regulation (ER) involves being able to manage our emotions, tolerate distress and control impulsive behaviours. Difficulties with ER are common following TBI and can be debilitating. This research study aimed to examine prevalence rates of TBI in offenders and investigate whether difficulties with ER and HAB play a role in explaining the relationship between TBI and violent offending. Eighty-two male offenders completed three questionnaires relating to TBI, ER and HAB, and consented to their offence history being accessed. Results indicated that the prevalence of TBI was extremely high at a rate of 96.3%. The main source of sustaining a TBI was via an assault which accounted for 48% of TBIs. There were no differences found between offenders who had never experienced a TBI and offenders who had a history of TBI in relation to ER difficulties, HAB and offending behaviour. Furthermore, neither ER difficulties nor HAB explained the relationship between TBI and violent offending. Further research is needed to explore other factors which may help explain the relationship between TBI and offending. This study did however identify TBI as a potential area of need in offending populations by highlighting its extremely high prevalence. Furthermore, a high rate of exposure to/involvement in violence was also observed in this prison population via information regarding how TBIs were sustained. This suggests that there is potentially a need for violence awareness programmes that are made available to all offenders (not just those convicted of violent offences), this may not only reduce violent reoffending but indirectly reduce TBI incidences as it violence appears to be a primary cause of TBI in this population.
Examining the relationship between emotional regulation difficulties and aggression in forensic populations: A systematic review.

Geraldine O’Neill\textsuperscript{1}corresponding author and Dr. Suzanne O’Rourke\textsuperscript{2}.

\textsuperscript{1}Correspondence email: \textsuperscript{2}School of Health in Social Sciences, the University of Edinburgh, Scotland.

Produced according to submission guidelines for the Aggression and Violent Behavior Journal. (Appendix A).

Abstract

Aggression is particularly high amongst forensic populations. Difficulties with emotional regulation (ER) may be a risk factor for aggression; however, no systematic review has examined ER and aggression specifically focusing on individuals who offend. Following Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, three databases were searched in September 2021. Twelve studies were identified. Seven of the included studies, found moderate associations between global ER and/or ER subscales and aggression. A group with adaptive ER displayed lower levels of aggression compared to a group with maladaptive ER, and ER was found to be a potential mediator in the relationship between factors such as low self-esteem, PTSD, psychopathy, TBI, alexithymia and aggression. Studies are consistent in identifying an association between ER and aggression in forensic populations. Future research should include longitudinal studies of ER and aggression in individuals who offend, and further investigation into the effectiveness of ER skills training in addressing aggression in this population is required.

Keywords: Emotional regulation; aggression; forensic populations.
1. Introduction

Aggressive behaviour is a multifaceted public health issue which has profound health and psychosocial effects on all involved, and poses a considerable economic toll [1-2]. A report by the UK Home Office indicated that offences against the person are estimated to have cost £50.1 billion in 2015/2016; latest figures indicate this rose to £72.5 billion in 2020, driven by a sharp rise in homicide, serious assaults, rape and robbery [3 – 4]. Violent offences are reported to have accounted for approximately 75% of the total economic impact, despite only accounting for 1/3 of the number of crimes; due to their greater physical and emotional cost [3]. The World Health Organization (2002) highlighted the identification of factors that predict violence and aggression as an international research priority [5], as understanding the risk factors for aggression is pivotal to enabling effective prevention and intervention [2].

Research has shown that difficulties with emotional regulation (ER) could be a risk factor for aggression; it has been linked with aggressive tendencies (violence, anger and hostility), across various populations (undergraduates, adolescents, substance users, psychiatric samples and combat veterans) [6 - 10]. The prevalence of aggression is particularly high among offenders [11 - 13] and offenders who have difficulties with ER, have more prolific histories of aggression [11]. For the purpose of this systematic review, the focus will be on exploring the relationship between ER and aggression in offending populations.

1.1. Aggression

In order for an individual’s behaviour to be defined as aggressive, it should include 4 elements: 1) Intention: the perpetrator intends to cause harm; 2) Purpose: the perpetrator expects to achieve a proximal or distal outcome; 3) Motivation to avoid: the target is motivated to avoid the aggressive behaviour to protect their physical and/or emotional integrity; 4) Violation of norms – the target or community consider the aggressive behaviour
to be unwarranted, inappropriate or illegitimate [14].

Aggression is an umbrella term which encompasses physical, verbal, psychological and other means of causing harm [2]. Aggressive behaviour does not necessarily include a physical aspect; non-violent aggressive behaviour also leads to negative outcomes and is also highlighted as being worthy of research attention [2]. Violence is defined as an aggressive act executed with the aim of causing extreme physical harm, such as injury or death [15]. An individual can be aggressive without using violence; however, the use of violence is aggression in its most extreme form [14].

Aggressive behaviour can be classified as impulsive or premeditated. Impulsive aggression (otherwise known as reactive aggression) occurs as an immediate response to a perceived threat; contrarily, premeditated aggression (otherwise known as proactive aggression) is pre-planned behaviour undertaken in pursuit of an external goal [1]. It is worth highlighting that although there is significant evidence for the reliability and validity of the distinction between impulsive and premeditated aggression, most violent offenders exhibit both forms of aggression, therefore classifying offenders in this categorical way is unhelpful for research purposes; ideally, studies in the area of aggression should examine both impulsive and premeditated aggression concurrently [1].

1.2. Models/ Theoretical perspectives on aggression

There are several theoretical perspectives on human aggression. One of the first theories of aggression was the frustration-aggression hypothesis which argued that (1) aggression is always preceded by frustration; and (2) frustration always leads to aggression [16]. This model was based on Freud’s psychoanalytic idea of catharsis; in order to reduce aggression (which Freud argued was an innate instinctual drive), individuals had to engage in an activity which released it [16]. However, this theory came under much scrutiny, with particular
reference to its sweeping generalization that frustration *always* leads to aggression [17]. Miller (1941) revised the theory highlighting that frustration can trigger various responses including aggression, escape or finding a new way to address the frustration in order to achieve a desired outcome [17 - 18]. Although Miller’s (1941) revision wasn’t hugely popular, it did introduce the idea that frustration can be dealt with in both aggressive and non-aggressive ways, which influenced early learning theories of aggression [17 - 18].

Social learning theory [19 - 20] suggests that individuals acquire aggressive behaviour via observational learning processes; they either directly experience aggression or observe others displaying aggression [21]. Social learning theory is particularly relevant to understanding the acquisition of premeditated/instrumental/proactive aggression; individuals may observe that the use of aggressive behaviour can achieve a desired outcome (e.g., resolve a conflict, allows someone to get something they want), therefore, they may model this behaviour when faced with a similar situation [2]. However, social learning theory has been criticized for its lack of empirical testing in natural settings [22]. It is argued that despite its name, social learning theory ignores the impact of the social context in which behaviour is learned e.g., by underestimating the reciprocal behaviour of individuals who may be engaged in social interactions [23]. This is due to the limitations imposed by laboratory style settings [23].

The General Aggression Model (GAM) is described as a comprehensive, integrative, framework for understanding aggression, which considers the influence of social, cognitive, personality, developmental and biological factors on aggression [24]. The GAM describes three pivotal stages in understanding an episode of aggression: (1) person and situation inputs, (2) current internal states such as cognition, arousal, affect and brain activity; and (3) outcomes of appraisal and decision-making processes [15]. It argues that a feedback loop can be created which can influence future cycles of aggression [15]. Although the GAM positions
itself as being an overarching, integrative framework, it can be described as predominantly a social cognitive script theory [25]. Anderson and Bushman (2002) highlighted that according to GAM ‘aggression is largely based on the activation and application of aggression related knowledge structures stored in memory e.g., scripts and schemas’ [as cited in 25].

Critics of the GAM and social cognitive theories of aggression contend that they do not go far enough to explain aggressive phenomena and are simplistic e.g., viewing aggressive behaviour as an automatic and mechanistic learning process which individuals have little control over [25]. Critics argue that diathesis stress approaches (which combine biological/genetic, personality and environmental influences) such as the catalyst model, are more successful in predicting aggressive behaviour in laboratory and real world settings, when directly compared with the GAM [25, 26].

1.3. Emotional regulation

Emotion regulation (ER) is a series of mechanisms through which individuals influence the onset, course, and experience of their emotions [27]. ER is considered fundamental to psychological functioning and mental well-being [28]. Adaptive ER is behaviour which allows a person to function successfully in their environment [29]. This involves decision making (either at a conscious or unconscious level) which is aimed at achieving a desired emotional state [28]. Emotional dysregulation is a multi-dimensional construct which encompasses difficulties with emotional awareness, understanding and emotional acceptance; difficulties engaging in goal-directed behaviour, impulse control difficulties and limited access to context appropriate coping strategies to manage distress [30]. However, there is much debate in relation to defining ER, with claims that a lack of ‘definitional clarity’ has hindered research in this area [30 - 31]. Gratz and Roemer (2004) argue that ER strategies cannot be categorized as inherently adaptive or maladaptive as the context of the situation
and goals of the individual need to be considered [11, 54]. For example, suppressing anger may be adaptive strategy which allows an individual to function in a demanding workplace, however, it could be considered maladaptive if trying to resolve interpersonal issues [11].

1.3. Models/Theoretical perspectives on emotional regulation

There are several models of ER; one of the most simplistic is a hedonic perspective which conceptualizes ER as a process aimed at maximizing positive emotions and minimizing negative emotions [32]. However, critics of this perspective argue that it does not take into consideration instrumental motives to regulate ones’ emotions [32]. For example, an individual may want to decrease actively experiencing positive emotions in order to stay focused on a task [32]. Gross (2014) goes further with his process model of ER, by suggesting that ER involves reducing, strengthening or maintaining the experience of positive or negative affect, based on an individual’s current needs or goals [32]. Gross (2014, 2015) also refers to this as up-regulation (increasing an emotional state) or down regulation/suppression (reducing an emotional state) [33 - 34]. Strategies for increasing or suppressing an emotional state include cognitive reappraisal, which involves intentionally re-interpreting a situation with the goal of amplifying or reducing its emotional impact [28].

Response modulation is another strategy which is used to directly influence ones’ experience of an emotional response e.g., using drugs, alcohol or food to alter one’s affective state, or exercise or deep breathing to address the physiological element of the emotional response [34].

Gross (2015) elaborated on the original process model with an extended version, in which he describes ER as a valuation process (i.e., is this emotion good or bad for me?) [34]. Gross (2015) highlights three stages of ER in his extended process model: 1) identification, which involves deciding whether to regulate; 2) selection, which involves deciding which strategy
to use and 3) implementation of the selected tactic [34]. Although the process model is considered one of the most popular theories of ER [35], some ER theorists argue that it may not give enough consideration to factors such as personality characteristics, emotional intelligence and flexibility [32, 36 - 37]. Flexibility models of ER incorporate the aforementioned factors. They suggest that individuals need to be flexible in their use of ER strategies across situations, and with the knowledge of their own personality characteristics, which may highlight that some ER strategies may be more suitable to them than others [32, 36 - 37]. Bonanno and Burton (2014) argue that a new construct of regulatory flexibility is required; they argue that inflexibility in relation to ER is maladaptive and associated with poorer psychological functioning [32, 36, 38].

1.4. Emotional regulation and aggression

Research suggests that emotional dysregulation may precipitate acts of aggression [39]. In a study of undergraduate students, the use of negative urgency (impulsivity) and emotional suppression (considered maladaptive ER strategies), predicted greater levels of displaced aggression (aggression aimed at someone or something that is not the source of the aggression arousing feelings) [40]. However, the provision of course credits to participants and the study’s laboratory setting, calls into question, its reliability and generalizability to real world aggression (e.g., the aggression measure involved the allocation of a hot sauce) [40]. A study by Sullivan and colleagues (2010) examined the association between ER coping and physical and relational aggression in a group of adolescents [7]. Findings indicated that youth who were reluctant to express emotion, engaged in higher levels of relational aggression (where harm is caused by damaging an individual’s relationship or social status) [7]. Difficulties coping with anger regulation were found to be significantly associated with higher levels of physical aggression but not relational aggression [7]. The authors concluded that adolescence is a period when ER skills are being developed and youth
who have difficulty learning adaptive ways to manage anger in particular, could be at risk for engaging in physical aggression [7]. Results however should be interpreted with caution as significant relationships between ER and aggression variables were modest in size [7].

An association between ER and aggression has also been established in other populations to include individuals diagnosed with mental illness. For example, a study which examined the role of emotional dysregulation in increasing the risk for violence and aggression in individuals with and without borderline personality disorder (BPD), found that having elevated baseline levels of, and less improvement in emotional dysregulation over time was predictive of violence [41]. Individuals with a BPD diagnosis displayed maladaptive ER, both cross-sectionally and longitudinally, and increased levels of emotional dysregulation in this group fully mediated their increased propensity for engaging in violence [41]. Newhill, Eack and Mulvey (2012) concluded that difficulties with ER could be a key factor in explaining why individuals with BPD engage in aggression directed towards themselves (self-harm) and others [41]. This study had particular strengths as it was longitudinal and had a relatively large sample size, however, it did not use a dedicated ER measure; rather, it adapted the Novaco Anger Scale (NAS) [42] to capture emotional dysregulation, a potential limitation [41].

The prevalence of aggression is particularly high among individuals with a criminal history, and offenders who have a maladaptive ER style, have been found to have more prolific histories of aggression compared to those with an adaptive ER style [11, 12, 39, 43]. Yet, to the author’s knowledge, no systematic review exists which specifically examines ER and aggression in forensic populations. Exploring and synthesizing ER and aggression research could help identity if addressing ER difficulties is a potential treatment target for forensic populations, which could reduce aggressive behaviour and violent recidivism. The reduction
of violent offending is a priority given the potential harm to the victim, perpetrator and the community [1]. The aim of this systematic review is therefore to explore the relationship between ER and aggression, focusing specifically on forensic populations.

2. Method

This review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines [44].

2.1. Eligibility criteria

Studies were selected based on the following inclusion criteria:

1). Studies examined a relationship between emotional regulation and aggression in male and/or female forensic populations. This included juvenile and adult offending populations who were incarcerated in a prison or in a detention centre; or who were on probation or parole, or a forensic inpatient or a forensic outpatient.

2). Employed a global measure of ER. This included either a measure specifically designed to examine ER only or ER was measured as a global construct as part of another measure. Studies were also included if they examined ALL subscales of an ER measure rather than a total ER score.

3). Utilized a quantitative measure of aggression.

4). Studies were original research, published in peer reviewed journals.

5). Written in English.

Exclusion criteria included:

1). Studies which were qualitative in design.

2). Studies which only examined a single component of ER e.g., ability to use ER strategies or impulsivity.

3). Studies which involved a population described as aggressive but the study did not
use a validated, quantifiable measure of aggression. E.g., A study involving violent offenders, but no aggression measure was used, or the study solely measured number of violent offences based on self-report.

4) Dissertations, theses, poster presentations and conference abstracts.

2.2. Search strategy
The search was carried out in September 2021 using the OVID interface. MEDLINE, PsychINFO and EMBASE electronic databases were searched using the following terms:

1). "EMOTION$ REGULAT$" or "EMOTION$ DYSREGULAT$" or "AFFECT$ REGULAT$" or "AFFECT DYSREGULAT$"
2). OFFEND$ or PRISON$ or FORENSIC$ or DELIQUEN$ or CRIM$
3). AGGRESS$ or VIOLEN$

The search was limited to peer reviewed journals published in English. The reference lists of journal articles identified as eligible were then hand searched for any relevant articles. A protocol for the current review was written in line with guidelines provided by the International Prospective Register of Systematic Reviews (PROSPERO).

2.3. Data synthesis
Several of the eligible studies had a wider aim than the focus of this review. Only findings concerning potential associations between ER and aggression were eligible for inclusion. A meta-analysis was not performed for several reasons: heterogeneity in the samples (e.g., adult versus juvenile samples, imprisoned participants versus those supervised in the community); heterogeneity in the measures used (e.g., Buss Perry Aggression questionnaire versus Life History of Aggression assessment) and heterogeneity in the analyses that were conducted to meet the wider aims of each individual study. Descriptive statistics, effect sizes and strength of association between the variables of ER and aggression were reported when provided.
Cohen’s interpretation of effect sizes was employed in this review (r = .10 to .29 = small, r = .30 to .49 = medium and r = .50 to 1.0 = large) [45].

2.4. Study quality

The quality of studies was assessed using a tailored version of the Appraisal tool for Cross-Sectional Studies (AXIS Tool) [46]. See Appendix 1. A recent review of methodological quality assessment tools highlighted the AXIS tool as a recommended instrument for critical appraisal of cross-sectional analytical studies [47]. The scoring criteria was adapted for the purpose of this review, the responses in the AXIS tool are “Yes”, “No”, “Don’t Know”, however, to better reflect appraisal findings in the current study, the option of “Partially Addressed” was added. The authors of the AXIS tool argue that numerical scales for scoring checklist criteria can be problematic as checklist criteria are not linear, some criteria may hold a greater bearing on the quality of the study than others [46], therefore, it is controversial to rate them numerically. However, whilst they also acknowledge that qualitative ratings are influenced by individual reviewer’s judgements, they argue that this subjectivity allows for greater flexibility [46]. As the AXIS tool does not provide an overall quality rating, Scottish Intercollegiate Guidance Network (SIGN) methodological quality categories were used which include “High quality”, “Acceptable quality” and “Low quality” [48]. (See appendix 1 for further description). Quality appraisals on all of the identified studies were performed by the primary author GON. One third of the papers (n=4) were selected randomly, using a number generator, for appraisal by a second reviewer. No ratings differed by more than one category. Discrepancies were discussed until consensus was reached and any clarifications in criteria interpretation applied across the remaining studies.
3. Results

3.1. Study selection

The initial search returned 494 journal articles; duplicates were removed which left 292 articles to be screened. Twelve studies met the final inclusion criteria. During the process of study selection, it became evident that the same sample had been used in some of the journal articles under review (which was confirmed by contacting the corresponding authors). The studies which were included in the final selection were those in which the main aim most aligned with the focus of the review (exploring the relationship between ER and aggression in forensic populations) and which had the larger sample size. See Figure 1 for a breakdown of the screening process.
Figure 1. PRISMA Flow Diagram of Study Selection.

Records identified through searching EMBASE, PsychInfo & MEDLINE (n = 494)

Records after duplicates removed (n = 279)

Title & abstract screened (n = 292)

Full-text articles assessed for eligibility (n = 54)

Studies included in narrative synthesis (n = 12)

Records excluded (n = 238)

Full-text articles excluded (n = 42)
- Systematic review: n = 3
- Qualitative design: n = 4
- Not a forensic population: n = 6
- No global measure of ER: n = 10
- No validated or quantifiable measure of aggression: n = 8
- No global measure of ER nor quantifiable measure of aggression: n = 4
- No statistical investigation into relationship between ER & aggression: n = 2
- Same sample used: n = 5
3.2. Study characteristics

The key characteristics and findings of eligible studies are presented in Table 1.1 and 1.2 respectively. Each study was allocated a study number which will be used as a reference throughout. One study was conducted in Italy and the Netherlands (S1), three in Italy (S2, 3 & 12), one in Australia (S4), six in the USA (S5, 6, 8, 9, 10, 11) and one in the Netherlands (S7). All of the studies were quantitative and cross-sectional in design (S1, 2, 3 & 7). Four studies had a comparator control group (S2, 3, 7 & 12). Study one was a multi-sample, multi-measure design as opposed to a comparative design. The authors indicated that they did not plan on conducting comparative analyses between the two samples (community and forensic), instead they aimed to examine the replicability of their findings in two independent samples and extend their knowledge in relation to different models of aggression [49].

Studies two and three were partly overlapping; it was an on-going research project with study three having a larger sample size.

Overall, the studies had a total of 2065 participants from forensic populations and 1180 non-forensic community based participants (S2 was not included in this count as participants overlapped with S3). Forensic sample sizes ranged from 58 - 636 participants (S11 & 6 respectively) and non-forensic community samples ranged from 51 – 521 participants (S7 & 1 respectively). Ten of the studies had adult samples (S1 – 9 & 12), with the mean ages of 30.43 years to 43.4 years in forensic samples and 32.7 years to 42.94 years in non-forensic samples. Two studies involved juvenile samples (S10 & 11), with mean ages of 14.98 years to 15.37 years. Eight studies (S1, 2, 3, 5, 7, 8, 10 & 12) had exclusively male forensic participants, studies nine and 11 had exclusively female forensic participants, and studies four and six had both male and female forensic participants. Forensic settings included prisons (S1, 2, 3, 5, 6, 7, 12), community correction offices (S4), batterer intervention programmes (S8 & 9) and juvenile detention centres (S10 & 11). Two studies (S5 & 6) identified that
participants used illicit drugs and/or had a history of traumatic brain injury (S6).

3.3. Quality assessment

The outcome of the quality assessment indicated that five studies were considered to be of high quality (S1, 6, 7, 9 & 10) and the remaining seven studies were considered to be of acceptable quality (S2, 3, 4, 5, 8, 11 & 12). The most common quality issues were in relation to justification of sample sizes (e.g., only one study reported having conducted power calculations (S7) and the area of non-responders was poorly addressed across all studies. Five studies (S3, 4, 8, 9 & 11) didn’t address the question of funding sources or potential conflicts of interest which could potentially have affected the author’s interpretation of the results.

The majority of studies included in this review identified and controlled for at least one confounding factor with the exception of one study (S5). Confounding variables addressed included age, education level and ethnicity (S7 & 10), verbal intelligence (S4), current psychopathological distress (S3), alcohol consumption (S6), anti-social traits and substance use (S9), and attendance at domestic violence intervention programmes (S8 & 9). The remaining studies (S1, 2, 11 & 12), only controlled for variables which were central to the primary objective of their study, when conducting mediation analyses. For example, psychopathy (S1), self-esteem (S2 & 12), attitudes towards violence (S12) and potential overlap between reactive and proactive aggression was controlled for in study 11.

3.4. Emotional regulation measures

There were four different ER instruments employed across the 12 studies included in this review. The most utilized measure for ER was the Difficulties in Emotional Regulation Scale (DERS) [50] with eight measures employing this (S1 -5, 8, 9 & 12). This included different translations (Dutch, Italian) and abbreviated versions (e.g., S1 used a short 16 item version with their community sample). The DERS is reported to have excellent internal consistency,
good test–re-test reliability, good convergent and discriminant validity [13]. It has been used in several forensic studies including studies outside of this review (e.g. [12, 43]). Three studies (S6, 10 & 11) used the Abbreviated Dysregulation Inventory (ADI) [52], with two using the affective/emotional regulation subscale only (S10 & 11). A Dutch version of the Emotion Regulation Questionnaire (ERQ) [53] was used in one study (S7).

In relation to psychometric properties of ER measures in the current review, information on reliability (calculated for each sample using Cronbach’s alpha) was provided for nine of the studies. DERS Cronbach’s alpha values ranged from .88 - .94 (S1 and 8 respectively), indicating excellent levels of internal consistency. With regards to the ADI, internal consistency coefficients in the studies under review, ranged from adequate $\alpha = .75$ (S11) to good $\alpha = .89$ (S6). No information regarding internal consistency was provided for use of the ERQ with the sample in study seven. None of the studies reported further psychometric properties such as test re-test reliability in relation to their own samples.

3.5. Aggression measures

With regards to measuring aggression, there was substantial variability in the instruments employed, with seven different measures used across the 12 studies. The most utilized measure was the Buss Perry Aggression Questionnaire [54] which was used in five studies (S1-3, 6 & 7). The BPAQ has previously shown good psychometric properties in forensic samples in terms of internal consistency, test–re-test reliability and convergent and discriminant validity e.g., in a sample of partner assaultive men in Spain [55] and in a sample of Belgian prison inmates [56]. Other measures used in the current review, included, the Life History of Aggression assessment (LHA) [57], the Abuse Behaviour Inventory (ABI), [58], subscales of the Revised Conflict Tactics Scales [59, 60], the Reactive Proactive Aggression questionnaire (RPQ) [61], the Peer Conflict Scale (PCS) [62] and an adapted version of the
Assessing Acceptance of Violence scale [63] (See Table 1.1).

Internal consistency coefficients for the various aggression measures were provided for 10 of the studies in the current review. The BPAQ produces scores on four aggression dimensions (physical aggression, verbal aggression, anger and hostility). Cronbach alphas values for the different dimensions ranged from relatively low .52 (verbal aggression, S1) to good at .82 (physical aggression, S1); and for BPAQ total scores, Cronbach alpha values were .89 for two of the studies (S3 & S6) reflecting very good internal consistency. The ABI was reported to have excellent reliability with a coefficient alpha of .91 (S8). Internal consistency of the PCS scales ranged from adequate (proactive relational, $\alpha = 0.76$) to excellent (total overt $\alpha = 0.90$) in the two samples it was utilized in (S10 & 11). Cronbach alpha values for the physical assault scale of the CTS2 measure was .88 for both samples it was employed in, in the current review (S5 & S9), reflecting good levels of internal consistency. Two of the studies did not report any internal consistency outcomes for the measures they employed in their own samples (LHA aggression subscale (S4) and the BPAQ (S7)). Good levels of internal consistency were reported for the Assessing Acceptance of Violence scale with values ranging from $\alpha = 0.80 – 0.82$ for community males, females and inmates [64]. No further psychometric properties were reported for any of the studies in relation to their own samples with the exception of internal consistency.
<table>
<thead>
<tr>
<th>Study Number</th>
<th>Author Country Year</th>
<th>Sample Size Gender Population Mean Age &amp; SD</th>
<th>Study Design</th>
<th>Emotional Regulation (ER) Measure</th>
<th>Aggression (AGG) Measure</th>
<th>ER Score</th>
<th>AGG Score</th>
<th>Quality Assessment Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study</td>
<td>Sample</td>
<td>Mean age (SD)</td>
<td>DERS mean total score (SD)</td>
<td>BPAQ mean total score (SD)</td>
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<td></td>
<td></td>
<td>CC</td>
<td>Offender sample: DERS mean total score: 72.0 (SD: 19.3). Community sample: DERS mean total score: 72.6 (SD: 19.0).</td>
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<tr>
<td>4. Roberton et al. [11] Australia 2014</td>
<td>64 individuals recruited from community corrections offices, 52 (81%) were male. Mean age of 37.2 years (SD = 11.9).</td>
<td>CS</td>
<td>DERS.</td>
<td>LHA: Aggression subscale only.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>DERS mean total score: 90.64 (SD: 25.78).</td>
<td>LHA Aggression score: 15.34 (SD: 6.83).</td>
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<tr>
<td>5. Wahlstrom et al. [66] USA 2015</td>
<td>60 males who were incarcerated in prison and identified as substance users. Mean age: 34.4 years</td>
<td>CS</td>
<td>DERS.</td>
<td>CTS2 – Physical assault subscale only.</td>
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<td></td>
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<td></td>
<td>DERS mean total score: 86.67 (SD: 13.48).</td>
<td>CTS2: Physical assault subscale: Mean score: 1.54 (SD: 6.74).</td>
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</tbody>
</table>
**6. Fishbein et al. [67]**  
**USA**  
**2016**  
320 male prisoners and 316 female prisoners (636 inmates in total).  
431 (67.8%) had experienced a TBI and 586 (92.1%) had a history of illicit drug use.  

Mean age: 35.5 years old (SD = 9.9) with females reporting a slightly older average age than males (36.1 vs. 34.8, respectively, non-significant).

**CS**  
**ADI.**  
**BPAQ.**  
No mean ADI scores reported for emotional dysregulation.  
For the total sample, the mean total aggression score is 80.5 (SD = 22.4) with males reporting marginally higher aggression relative to females (82.0 vs. 79.0; t = 1.66; p < .10).

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**7. Jansen [68]**  
**The Netherlands**  
**2020**  
281 males incarcerated in prison. Mean age: 38.29 (SD: 12.39).  
51 male non-incarcerated controls. Mean age: 42.94 (SD: 17.43).

**CS**  
**CC**  
**ERQ (Dutch version).**  
Short version of the BPAQ (Dutch translation).  
ERQ mean scores offender sample: 35.60 (SD:9.51).  
Non-incarcerated controls: 37.84 (SD: 7.21).  
BPAQ mean scores offender sample: 27.44 (SD: 10.67).  
Non-incarcerated control group: 22.29 (SD: 8.04).  
High
<table>
<thead>
<tr>
<th>Study</th>
<th>Sample Details</th>
<th>Measure</th>
<th>Subscales/Assessment</th>
<th>Total Score</th>
<th>Standard Deviation</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Tager et al. [69]</td>
<td>USA 2010: 108 males referred to Batterer Intervention Programmes. Mean age: 35.2 years (SD: 11.1).</td>
<td>DERS.</td>
<td>ABI.</td>
<td>DERS mean total score: 84.00 (SD: 22.7).</td>
<td>ABI mean total score: Acceptable 49.5 (SD: 13.3).</td>
<td></td>
</tr>
<tr>
<td>9. Grigorian et al. [70]</td>
<td>USA 2019: 71 females arrested for domestic violence and court-ordered to attend Batterer Intervention Programmes. Mean age: 30.43 years (SD: 10.73).</td>
<td>DERS.</td>
<td>CTS2: Psychological aggression and physical assault subscales.</td>
<td>Total DERS score not reported but could be calculated: 86.82 (SD: 32.24).</td>
<td>Psychological aggression perpetration: 3.36 (SD: 1.17). Physical assault perpetration: 2.22 (SD: 1.44).</td>
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<tr>
<td>12. Stefinile et al. [64]</td>
<td>CC</td>
<td>CS</td>
<td>AAV.</td>
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</table>

**Italy**

**2021**

3.6. The relationship between ER & aggression in forensic populations

The effect sizes were on average, medium (with r ranging from .15 - .49) in the studies which employed correlation coefficients (S1 - 3, 5, 9 -11). See Table 1.2. This indicated a moderate association between ER difficulties and aggression in forensic populations. The presence of significant correlations between the DERS total score and the following BPAQ subscales: physical aggression $r = .33$ to .34; anger $r = .41$ - .48 and hostility $r = .32$ - .38 were observed in two studies (S1 & 2). Neither study observed a significant correlation between the DERS total score and the verbal aggression subscale of the BPAQ in their forensic samples (S1& 2). One study (S5) did not find a significant association between the total score on an ER measure (DERS) and an aggression measure (CTS2 physical assault subscale); however, they did find significant associations between aggression and the DERS impulsivity subscale ($r = .46$) and the limited access to ER strategies subscale ($r = .32$). Similar findings regarding the relationship between aggression and the DERS subscales were replicated in S9, however, in addition to the impulsivity and limited access to ER strategies subscales, significant associations were also found between the CTS2 physical assault and the DERS goal directed behaviour subscale ($r = .32$) and emotional clarity subscale ($r = .37$). Study nine also revealed significant correlations between psychological aggression (CTS2 subscale) and the DERS impulsivity subscale ($r = .36$), and DERS lack of emotional clarity subscale ($r = .34$). See Table 1.2.

Study three also examined all the DERS subscales and their association with the BPAQ subscales (physical aggression, verbal aggression, anger and hostility). Significant correlations were observed between physical aggression and all 6 DERS subscales; verbal aggression correlated with DERS goals and impulsivity only; anger and hostility correlated with all DERS subscales except emotional awareness (S3). See Table 1.2 for correlation coefficients.
Further examination of the results revealed that in study 11, a significant correlation was found between emotional dysregulation and overt aggression (r = 0.32, p < 0.05) but not relational aggression in female adolescent detainees. In a separate study involving male juvenile detainees, significant correlations were found between ER and reactive aggression (r = 0.46, p < 0.01) and proactive aggression (r = 0.31, p < 0.01).

Some of the studies under review adopted a between groups design when looking at the relationship between ER and aggression. For example, study four split its sample into adaptive and maladaptive ER groups. Results indicated that participants in the adaptive ER group had lower aggression levels than those in the maladaptive ER group with a partial eta squared value of .15 indicating a large effect size. See Table 1.2 for further details. Study seven found that detainees with a history of TBI reported significantly (f(1,766858.6) = 30.90; p < .001) more aggression evidenced by higher general aggression scores on the AQ (m = 31.75 sd = 10.52), when compared to detainees with no history of TBI (m = 23.86 sd = 9.45); however, there was no significant difference between the groups in terms of ER (F = 0.19, p = .67, n² .00).

3.7. Emotional regulation as a mediator

Further associations between ER and aggression were suggested in studies included in this review which employed mediation statistical methods (S1, 2, 5, 6 & 12). Stefinile and colleagues (2021) in study 12, indicated that ER difficulties mediated the relationship between self-esteem and aggression in community men (z = -2.03, p = <.05), women (z = -2.40, p = <.05) and inmates (z = -3.78, p = <.001) [64]. These results replicated those of study two which found that ER mediated the relationship between low self-esteem and physical aggression, anger and hostility. Results of meditational analysis in study six indicated that ER difficulties mediated the relationship between traumatic brain injury (TBI) and aggression in
a forensic sample, with results suggesting a significant association between emotional dysregulation and total aggression (21.46, \( p < .001 \)) [67]. Emotional dysregulation was found to explain a portion of the shared variance between psychopathy and physical aggression, anger and hostility in study one [49]. Furthermore, difficulties in relation to non-acceptance of emotional responses (a specific ER strategy), were found to moderate the relationship between PTSD symptoms and aggression perpetration in offenders who were methamphetamine users, as illustrated in study five [66]. Study three also revealed that emotion dysregulation and impulsivity mediated the relationship between alexithymia and aggression in forensic and community samples, with emotion dysregulation demonstrating a relatively stronger effect.
1.2. Statistical analysis & key findings regarding the relationship between ER and aggression in forensic populations.

<table>
<thead>
<tr>
<th>Study Number</th>
<th>Author</th>
<th>Country</th>
<th>Year</th>
<th>Statistical Analyses Employed</th>
<th>Statistical outcomes regarding the relationship between ER &amp; Aggression</th>
<th>Effect Size</th>
<th>Other Key Findings</th>
</tr>
</thead>
</table>
3. Garofalo, Velotti et al. [65]


Offender sample:
Correlations:
- BPAQ Physical aggression & all DERS subscales with \(r\) ranging from .15** to .49**.
- BPAQ verbal aggression & DERS goals (\(r = .15**\)) & negative urgency (\(r = .19***\)) only.
- BPAQ anger & ALL DERS subscales except emotional awareness, with \(r\) ranging from .33*** to .53***.
- BPAQ hostility & all DERS subscales except emotional awareness, with \(r\) ranging from .24*** to .47***.

Community sample:
Correlations:
- BPAQ Physical aggression & all DERS subscales except emotional awareness with \(r\) ranging from .20** to .50***.
- BPAQ verbal aggression subscale & all DERS subscales except emotional awareness and clarity, with \(r\) ranging from .16* to .28***.
- BPAQ anger & all DERS subscales except emotional awareness, \(r\) ranged from .22*** to .62***.
- BPAQ hostility & all DERS subscales except emotional awareness, with \(r\) ranging from .27*** to .60***.

- Offender sample reported significantly greater scores than the community sample on the BPAQ subscales of physical aggression, hostility and BPAQ total scores.
- No significant differences between the two samples occurred in relation to DERS total scores.
- Emotion dysregulation and impulsivity mediated the relationship between alexithymia and aggression in both samples, with emotion dysregulation demonstrating a relatively stronger effect.
<table>
<thead>
<tr>
<th></th>
<th>Roberton et al. [11]</th>
<th>ANOVAs. Chi-square tests. Regression.</th>
<th>The adaptive ER group had lower levels of aggression (M = 11.52, SD = 6.15) when compared to the maladaptive ER group (M = 17.79, SD = 6.14), F(4, 59) = 10.46, p = .002, n² .15, when controlling for age, education and verbal intelligence. N/A</th>
<th>• In the ER group, normative beliefs about aggression and education were significant predictors of aggression, with a final regression model indicating that these variables accounted for approximately 36% of the variance in participants' history of aggression. • Offenders who can regulate their emotions adaptively will be less likely to engage in aggressive behaviours compared to those with maladaptive ER.</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Australia</td>
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<td></td>
<td>2014</td>
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<tr>
<td></td>
<td>Wahlstrom et al. [66]</td>
<td>Correlations. Regression.</td>
<td>Correlations: Total DERS &amp; CTS2 physical assault, $r = .22$. CTS2 physical assault &amp; DERS impulsivity subscale, $r = .46^{**<em>}$. CTS2 physical assault &amp; DERS limited access to ER strategies subscale, $r = .32^</em>$.</td>
<td>• PTSD symptoms bolster the risk of aggression via various forms of emotion dysregulation among imprisoned methamphetamine users. Multivariate analyses indicated that only PTSD symptoms and DERS non-acceptance of emotional responses subscale, predicted aggressive behaviour. • Interaction effects indicated that PTSD symptoms interacted with DERS impulse control difficulties, limited access to ER strategies and non-acceptance of emotional responses to predict aggressive behaviour.</td>
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<tr>
<td></td>
<td>USA</td>
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<td></td>
<td>2015</td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>Year</td>
<td>Methodology</td>
<td>Findings</td>
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<tr>
<td>6. Fishbein et al. [67]</td>
<td>USA</td>
<td>2016</td>
<td>General linear Modelling, Mediation.</td>
<td>TBI may be a “proxy” for ER difficulties as it is significantly related to total aggression (21.46, ( p &lt; .001 )) after accounting for all other variables (current age, age at first drug use, TBI before the age of 13, TBI after the age of 13 and female gender).</td>
</tr>
<tr>
<td>7. Jansen [68]</td>
<td>The Netherlands</td>
<td>2020</td>
<td>Chi-square tests. Independent t-tests. ANOCOVAS</td>
<td>No sig. differences between detainees and NICs in terms of ERQ scores: ( t(226.90) = -1.55 \ p = .12 ). Sig. differences found in relation to aggression with detainees scoring higher on the BPAQ: ( t(229.87) = 3.19 \ p = .002 ).</td>
</tr>
<tr>
<td>8. Tager et al. [69]</td>
<td>USA</td>
<td>2010</td>
<td>Correlations. Regression.</td>
<td>Correlation between DERS mean total score and ABI mean total score: ( .46^{**} ).</td>
</tr>
<tr>
<td>9. Grigorian et al. [70]</td>
<td>USA</td>
<td>2019</td>
<td>Correlations &amp; hierarchical multiple regressions.</td>
<td>Correlations between DERS subscales &amp; physical assault perpetration: Non-acceptance: .21 Goal directed behaviour:.32* Impulse control:.46** Emotional awareness:.18 ER strategies:.35* Emotional clarity:.37* Correlations between individual DERS subscales and psychological aggression:</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Methodology</td>
<td>Key Findings</td>
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<tr>
<td>10. Miller et al. [71]</td>
<td>USA 2019</td>
<td>Correlations, Latent Profile Analysis.</td>
<td>Correlations: ADI ER subscale &amp; PCS subscales: Reactive aggression: 0.46**, Proactive aggression: 0.31** Medium</td>
<td></td>
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<tr>
<td>11. Marsee et al. [72]</td>
<td>USA 2007</td>
<td>Correlations &amp; hierachical multiple regressions.</td>
<td>Correlation: ADI ER subscale &amp; PCS subscales: Total relational: 0.20, Reactive relational: 0.24, Proactive relational: 0.12, Total Overt: 0.32*, Reactive Overt: 0.42**, Proactive Overt: 0.09 Medium</td>
<td></td>
</tr>
<tr>
<td>12. Stefinile et al. [64]</td>
<td>Italy 2021</td>
<td>Hierarchal multiple regression &amp; sobel tests.</td>
<td>Emotional dysregulation mediated the effect of self-esteem on aggressive behaviour in both community men (z = -2.03, p = &lt;.05), women (z = -2.40, p = &lt;.05) &amp; inmates (z = -3.78, p = &lt;.001). NR</td>
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</table>

- Risk of serious aggressive behaviour and violent offending may be highest among youth who are easily provoked to respond aggressively (i.e., elevated hyper-arousal symptoms) while simultaneously able to maintain emotional detachment (i.e., elevated emotional numbing symptoms and CU traits).
- Reactive aggression was uniquely associated with emotion dysregulation & anger to perceived provocation.
- Proactive aggression was uniquely associated with callous–unemotional traits and biased outcome expectations for aggression.
- Controlling impulsive behaviours specifically mediated the relationship between self-esteem and aggressive behaviour in community participants and inmates.
4. Discussion

The results of the present systematic review (SR) suggest that there is an association between ER difficulties and aggression in forensic populations. The majority of studies reviewed found significant correlations between global ER scores and/or ER subscale scores and aggression; medium effect sizes were reported, which suggests a moderate association. The relationship between physical aggression and DERS subscales, specifically the impulsivity subscale and limited access to ER strategies was highlighted. With regards to the impulsivity finding, this was relatively unsurprising given the well documented association between impulsiveness (rapid, poorly planned responses which are difficult to inhibit) and violence in the research literature [73 - 75]. The relationship found between limited access to ER strategies and physical aggression, in addition to the finding that those in a maladaptive ER group had higher levels of aggression, further builds on research suggesting that maladaptive coping (evidenced by poor problem-solving skills, difficulty seeking social support, and using avoidance as a coping strategy) is associated with violence [76]. Furthermore, this review highlights how the construct of ER has a wide ranging influence with regards to aggression, with evidence to suggest that it partly explains the relationship between factors such as self-esteem, alexithymia, TBI, psychopathy, PTSD symptoms and aggression; with the research suggesting that ER partly mediates these associations.

The findings of this review, supports those observed in a narrative review of ER and the general aggression model [29], and a systematic review looking at the association between emotion, social information processing (SIP) and aggression [77], in that it highlights evidence of an association between maladaptive ER and aggression. However, Roberton and colleagues (2012) primarily focus on 3 ER strategies (emotional awareness, emotional acceptance and access to ER strategies) [29] as opposed to global ER as in the current review; and Smeijers and colleagues (2020) focus more on the influence of ER on SIP in explaining
aggression [77]. Furthermore, both Smeijers and colleagues (2020) and Roberton and colleagues (2012) include a variety of populations (children, adolescents, adults, undergraduates and offenders) [29, 64] in contrast to the current review, which hones in specifically on forensic populations, who may be considered the key target population in terms of addressing aggression and violence.

4.1. Study quality & methodology
All of the studies included in the review were considered to be of acceptable to high quality. A methodological strength of the majority of studies was the consideration given to potential confounding variables such as substance use and attendance at intervention sessions; these factors could have impacted on a participant’s scores on ER and aggression measures. For example, a recent meta-analysis highlighted a significant association between ER and substance use [78]. The issue of non-responders was poorly addressed across all studies. Consideration of non-responders may be viewed as more pertinent in longitudinal studies (due to attrition rates), as opposed to cross-sectional studies, however, it is still relevant as participation bias (or non-response bias) can inadvertently influence results by making them non-representative of the target population, as those who have participated may disproportionately possess certain traits which may affect outcomes. Possible ways in which the issue of non-response bias could have been addressed in the studies under review include, involving potential participants in the design and structuring of questions, monitoring throughout the study to identify under-representation and post-survey adjustment techniques such as weighting [79].

4.2. Limitations of the review
The majority of the studies had a much wider scope than the primary objective of this review which was examining the relationship specifically between ER and aggression in forensic populations. There was considerable variability in the ER and aggression measures used (four
different ER measures and seven different aggression measures) which made comparisons across studies difficult. Causal inferences could not be made about the association between ER and aggression because of the cross sectional design of the studies included. For example, whether ER precedes aggression or aggression precedes ER could not be determined. Whilst a narrative approach provides an exploratory investigation into ER and aggression in individuals who offend, a meta-analysis would allow for data synthesis of the effect sizes for comparison across studies which may be more robust. The aforementioned heterogeneity in the review studies included would not allow for a meta-analysis.

4.3. Strengths of the review
A primary strength of this review is its focus on the relationship between ER and aggression, specifically in forensic populations. Offenders are a key target group in terms of rehabilitation and reducing violent recidivism, as levels of aggression are particularly high in forensic populations [11 - 13]. Inadvertently, this review also highlighted the paucity of research looking specifically at ER and aggression in women who offend, with only four of the 12 studies including female forensic participants. Research indicates that men and women may differ in their displays of aggression and the female hormone progesterone may assist with ER [80]. It may therefore be useful to examine how ER and aggression differs in male and female forensic samples as it may inform the development of more tailored interventions for these groups.

4.4. Clinical implications
This review highlighted a moderate association between emotional dysregulation and aggression in forensic populations; this suggests that there may be merit in incorporating ER skills training when addressing violent and aggressive behaviour in offenders. A recent intervention study found that focusing on enhancing ER ability and conflict resolution skills, has the potential to decrease levels of intimate partner violence, however, this study involved
individuals who had voluntarily sought help, it was delivered on-line, and it covered mild forms of abusive behaviour only, therefore, findings may not be generalizable to addressing more severe violence which may be seen in forensic populations [81]. Garofalo and colleagues (2020) found that higher levels of mindfulness and lower levels of emotional dysregulation were associated with lower levels of aggression in offenders; they hypothesized that practicing mindfulness based skills (e.g., a non-judgmental stance), may strengthen emotion regulatory abilities and in turn reduce aggressive and violent behaviour [13]. It would seem that ER ability is potentially a key target for prevention and treatment programs aimed at reducing aggression; more research is required to evaluate the effectiveness of such interventions in forensic populations.

4.5. Future directions
This review identified that more research is needed in relation to ER and aggression in female offenders, as research in this area appears to focus predominantly on males. The need for more homogeneity in relation to ER and aggression measures used was also highlighted to enable comparison across studies and the ability to make more conclusive findings. More longitudinal research is needed in relation to ER and aggression in forensic populations. Longitudinal studies would enable researchers to establish if emotional dysregulation is predictive of future violence in forensic populations, like we have seen in studies looking at ER and aggression in individuals with mental illness. For example, research by Newhill, Eack and Mulvey (2012) identified emotional dysregulation as a significant longitudinal predictor of violence in individuals with a borderline personality diagnosis [41]. Additionally, there is a limited research examining interventions which target ER and aggression in offenders, research of this nature could help identify if ER is a legitimate treatment target for reducing aggression and violent recidivism.
4.6. Conclusion

Findings from the current review suggest that difficulty regulating ones’ emotions is associated with aggression in forensic populations. Interventions which incorporate ER skills training may help address aggressive behaviour in individuals who offend, however, more consistency is needed in relation to ER and aggression measures used; more longitudinal studies are required, and further investigation into the effectiveness of ER skills training with this population is needed.
References


4. Dathan M. Cost of rising crime is nearly £100bn a year, ministers told. Times (London, England: 1788) [Internet]. 2021 Apr 8 [cited 2022 Jan 27]; Available from: https://www.thetimes.co.uk/article/cost-of-rising-crime-is-nearly-100bn-a-year-ministers-told-hsd7n63nd


Geraldine O’Neill1 corresponding author, Dr. Suzanne O’Rourke2, Prof. Kevin Power3, Dr. Kimberly Sham Ku4, and Jillian Galloway5.

1 Correspondence email: 2 Department of Clinical Psychology, the University of Edinburgh, Scotland; 3 Tayside Area Psychological Therapies Service, NHS Tayside, Scotland & School of Natural Sciences, University of Stirling, Scotland. 4 Birmingham and Solihull Mental Health NHS Foundation Trust; 5 Angus Health and Social Care Partnership, Scotland.

Produced according to submission guidelines for the Brain Injury Journal. (Appendix C).

Abstract

Purpose: To ascertain if emotional regulation (ER) difficulties and/or hostile attribution bias (HAB) play a role in explaining the relationship between having a history of traumatic brain injury (TBI) and engaging in violent offending.

Method: Eighty-two male offenders completed three questionnaires relating to TBI, ER and HAB, and consented to their offence history being accessed for research purposes.

Results: Prevalence of TBI was extremely high (96.3%). Mild TBI was most prevalent at 61% and, moderate and severe TBI accounted for 9.7% of the sample. The main source of TBI was assaults (48%). No significant differences were found between ‘no TBI’ and ‘TBI’ groups in relation to ER difficulties, HAB and offending behaviour. No significant relationships were found between TBI severity, ER, HAB and violent offending. No significant results were found regarding the mediating effects of ER difficulties or HAB between TBI severity and violent offending.

Conclusion: Neither ER difficulties nor HAB mediated the relationship between TBI and violent offending in this forensic population. Further research of this nature is needed to explore the relationship between TBI and criminality, specifically, looking at potential causal mechanisms as this remains unclear.

Keywords: Traumatic brain injury, emotional regulation, hostile attribution bias, offending.
Introduction

Traumatic brain injury in forensic populations

Traumatic brain injury (TBI) prevalence rates in the general population are estimated to be between 12% to 16.7% in males, and 8.5% in females [1]. In contrast, the prevalence of TBI among offending populations is much higher, suggesting a possible association between TBI and criminality [2 -3]. A UK study identified a TBI prevalence rate of 65% in a prison sample; a rate of 67.8% was found in USA prison study; 63.8% of male offenders in New Zealand had a history of TBI; a French prison study found a TBI rate of 30.6% and systematic reviews have reported prevalence rates in forensic samples which range from 9.7% to 100%, with an average rate of 46% [4 - 8]. It is highly probable that these figures are an under-estimation of TBI prevalence in forensic populations, as head injuries (HI) may go unreported as individuals may not seek medical help, e.g., if they perceive the HI to be minor, if the effects of HI are confused with the effects of intoxication, or if the injury was sustained during a criminal act [2].

A history of TBI can have a range of detrimental effects including behavioural consequences (lack of inhibition and violence), social effects (lack of emotional awareness and empathy), and cognitive impairment (slowness in information processing and impulsivity) [8]. Due to the fact that there may be no outward signs of TBI, there is a potential for it to go unidentified. Unidentified TBI could have a considerable impact on an offender’s behaviour, e.g., they may have difficulty adhering to prison rules and it could potentially contribute to recidivism [9]. Those with a history of TBI, enter the custodial system at a younger age, have higher rates of repeat offending and three or more TBIs are associated with more violent offences [4, 10]. Furthermore, TBI is associated with mental health problems, increased alcohol and cannabis use, a significantly higher number of incarcerations and total time spent in prison [7]. Whilst the literature provides evidence of a strong association between TBI and
delinquency, no causal link has yet been established; it has therefore been recommended that future research further examines this relationship [8].

**TBI & violence**

The impact of violence is profound in terms of social, legal, political, financial and human costs; therefore, there is a need to understand factors predisposing individuals to engage in violence and to develop preventative strategies [11]. A Swedish, population-based, longitudinal study examined TBI history with subsequent violent crime [12]. It found that 8.8% of individuals with a history of TBI, committed a violent crime after diagnosis which, when compared to matched controls, presented a markedly increased risk [12]. Pitman and colleagues (2015) identified that prisoners who had a history of TBI were more likely to have committed a violent offence, with a prevalence rate of violent offending of 60.4% in the TBI group compared to 38% of controls [13]. However, controls and the TBI group were matched only on limited demographic criteria which did not include possible confounding variables such as severity of drug use [13]. Evidently, TBI is associated with violence; however, most individuals who sustain a TBI do not become violent. Ambiguity remains in relation to the mechanisms that mediate or moderate this association [14].

**Hostile attribution bias & TBI**

Hostile attribution bias (HAB) can be defined as the tendency to interpret the intent of others as being antagonistic, despite social and environmental cues being ambiguous [15]. There is a paucity of research in the area of TBI and HAB with a single study examining negative attributions and anger following TBI. The study compared negative attributions made by individuals with and without a history of TBI and examined the extent to which negative attributions predicted angry ratings in response to 3 different hypothetical scenarios [16]. Results indicated that individuals who had sustained a TBI, had significantly higher ratings of
Irritation and anger, and attributions of intent, hostility and blame compared with healthy controls. However, the need for replication of the study with a larger sample and for further examination of characteristics associated with negative attribution bias was identified [16].

**Hostile attribution bias & violence**

Research suggests that aggressive individuals exhibit a strong tendency to attribute hostile intent in the behaviour of others, which may partly explain socially inappropriate and aggressive reactions in this group [17 - 20]. A recent systematic review found a small to medium positive association between HAB and aggression in adults [21]. However, there was large heterogeneity in the samples used (various populations included) and a range of different measures for HAB and aggression were employed, which made cross study comparison difficult [21]. Additionally, the majority of studies were correlational, therefore, a cause and effect relationship could not be inferred; consequently, findings are considered preliminary [21]. Further research examining responses to morphed fear-anger faces across 3 groups (which included prisoners with a history of violent crimes, prisoners convicted of child sexual abuse (CSA) and matched controls from the general population), found that violent offenders presented with a reliable HAB as they rated ambiguous fear-anger expressions as angrier, compared to both perpetrators of CSA and matched controls [22]. The authors suggested that HAB may be one mechanism which drives violent behaviour in aggressive individuals [22]. Research also suggests that HAB may serve as a precipitating factor for aggressive behaviour as it potentially increases the likelihood of an aggressive response; if an aggressive individual infers hostile intent in the behaviour of others, they may believe that violent behaviour is justifiable, as they may consider it to be retaliation as opposed to instigation [23]. A better understanding of HAB could inform prognosis in relation to recidivism and potentially help develop more tailored therapeutic interventions [22].
Emotional regulation, TBI & violence

Emotional regulation (ER) is a multidimensional construct which encompasses awareness, clarity and acceptance of one’s emotions, the ability to tolerate distress, engage in goal-directed behaviour when upset, control impulsive behaviours and to use effective and adaptive emotional regulation strategies [24 - 25]. If an individual lacks or displays undeveloped skills in at least one of the aforementioned areas, it is defined as emotion dysregulation [24, 26]. Difficulties with ER are among the most common and debilitating sequelae of TBI [27 - 30], with perhaps 50% of individuals who have had a TBI presenting with clinically significant levels of anxiety and depression [31]. Furthermore, research indicates that TBI commonly impairs both the expression and experience of negative affect; individuals may decrease their levels of self-monitoring and self-control, which may manifest in displays of irritability, aggression, impulsivity, and quick-temper [30]. Research also indicates that alexithymia (difficulty identifying, differentiating and communicating feelings) is prevalent in individuals who have sustained a TBI and may play a contributory role in emotional dysregulation [32 – 33]. Some evidence suggests that interventions aimed at reducing alexithymia and emotion dysregulation in individuals with TBI, may result in positive changes, suggesting that emotional dysregulation is “treatable” following TBI [34]. However, it is acknowledged that this was a phase 1 trial with a small sample size [34].

Emotional dysregulation that manifests as anger/aggression can have a powerful impact on the individual and their relationships with others [35]. Research suggests that impairments in ER domains have been consistently linked with aggressive tendencies (physical aggression in particular), across a range of populations, including undergraduates, psychiatric patients, juvenile and adult offending populations [25]. It has been hypothesized that emotional dysregulation may make it difficult to inhibit aggressive impulses and displays of violence can serve to regulate the negative affect [36].
Research which examined emotion dysregulation, masculine norms, and abuse perpetration among a clinical sample of men referred for domestic assault, revealed that emotion dysregulation was the strongest predictor of reported abuse, uniquely accounting for approximately 18% of the variance [37]. These findings suggest that males who perpetrate domestic violence, may utilize maladaptive ER strategies, whereby they externalize and attempt to change their partner’s behaviour, as opposed to directly addressing their internal emotional state [37]. Dialectical behaviour strategies including ER skills training and strategies to increase distress tolerance have been suggested to reduce intimate partner violence and abuse [37].

**Study rationale**

Despite the fact that a high prevalence of TBI has been observed internationally in prison populations, no causal link has been established between TBI and criminality due to a multitude of confounding factors (e.g., drug and alcohol use), a lack of control groups in studies and a lack of TBI normative data in the general population for comparison [2-3,8]. Consequently, it has been recommended that public health professionals go further to examine the link between TBI and crime, suggesting that a clinical study be conducted to compare prisoners with and without TBI in relation to associated factors [8].

Research suggests that links exist between TBI, ER difficulties, HAB and violence; however, no study has examined ER, HAB, TBI and violent offending in the one model. This study endeavors to address this gap in the literature by examining the relationship between TBI and violent offending in a Scottish prison population, by investigating the mediating roles of ER and HAB. It also aligns with recommendations made by the National Prisoner Health Care Network’s Report (2016) on Brain Injury and Offending [9] which include: determining the prevalence of disability in offenders arising from TBI and examining the viability of TBI
screening tools in prison populations. Research in this area has strong clinical utility as if the findings indicate that ER and/or HAB act as mediators, it identifies these domains as potential treatment targets. Interventions tailored to address ER difficulties and HAB could potentially lead to more effective rehabilitation and reduce recidivism rates in relation to violent offending. This will have benefits not only for the individual affected by a TBI, but also society as a whole, in terms of both the human and financial costs of violent offending.

Hypotheses

1). Offenders with a history of TBI will have a more severe history of violent offending as evidenced by higher scores on Violence Rating Scales (VRS) [38 – 39] and a higher number of violent convictions.

2). Offenders with a history of TBI will display greater emotional dysregulation evidenced by higher scores on the difficulties in emotional regulation scale (DERS) compared to offenders without a history of TBI.

3). Offenders with a history of TBI will display greater HAB evidenced by higher scores on the hostile interpretations questionnaire (HIQ) compared to offenders without a history of TBI.

4). Emotional regulation (ER) and hostile attribution bias (HAB) will mediate the relationship between history of TBI and violent offending. Participant age will be controlled for. As levels of HAB and/or ER increase, the strength of the relationship between history of TBI and violent offending will increase.

Method

Study population & sample size

Participants were recruited from a low secure open prison and a maximum security prison located in a single Scottish health board. To participate, individuals had to meet the following inclusion criteria: be male offenders between the ages of 21 - 65 years’ old, be proficient in
the English language and able to provide informed consent. Exclusion criteria were a formal
diagnosis of an intellectual disability and being outside the study age bracket (21 – 65 years
old). A higher age limit of 21 – 65 years old, as opposed to 18 – 65 years old was set for
practical reasons, as in the Scottish justice system, offenders aged 18 – 21 years old are
detained in young offender’s institutions which the researcher did not have access too. A
power analysis was calculated using G*Power 3.1.9.2 [40]. Due to the dearth of research
examining ER and HAB as possible mediators in the relationship between TBI and violent
offending, the effect size was estimated to be medium (f2 .15). Power (1-β err prob) was set
at .80 and alpha (α err prob) was set at .05 for a linear multiple regression with 3 predictors
[40]. An a priori power analysis indicated that the study required a sample size of 77
participants.

Measures

The Ohio State University TBI Identification Method

The Ohio State University Traumatic Brain Injury Identification (OSU-TBI-ID) instrument
was designed to identify the prevalence and severity of TBI. Research indicates that it has
both high levels of validity and reliability, particularly in relation to test retest reliability and
inter-rater reliability [41]. It has been used in several studies, across a range of populations,
including military personnel, veterans, and offenders [41 – 43]. It is also freely available
(www.ohiovalley.org/tbi-id-method). The short form, which takes 3 – 5 minutes to
administer, was utilized as recommended by the NPHG BIO report [9]. Information provided
by participants regarding the nature of their head and neck injuries was used to determine the
likelihood and severity of TBI. OSU TBI-ID categories include improbable, possible, mild,
moderate and severe (Table 1). The same classification system has been used in previous
studies [40, 43]. For correlational and mediational analyses, TBI was treated as a continuous
variable on a severity scale as per OSU-TBI-ID classifications.
The presence of possible TBI has been used in previous studies utilizing the OSU-TBI-ID to create a dichotomy of ‘TBI’ versus ‘No TBI’ [45]. However, in a recent review of how TBI relates to crime, Williams and colleagues (2018) highlighted that a very mild head injury (typically referred to as a ‘concussion’ with some disorientation but no, or very brief loss of consciousness), rarely leads to permanent brain damage [46]. They highlighted that a mild TBI is considered to involve 0–30 min of LOC and over 30 minutes is a moderate to severe TBI, with increased severity, leading to a higher risk of impairment [46]. Therefore, for the purpose of the current study, a higher bar was applied to create a dichotomy in the sample when doing between group analyses. Those with a very mild head injury or concussion but no LOC, were placed in the ‘no/improbable TBI group’ and participants with mild, moderate and severe TBI where a LOC was sustained, were placed in the ‘TBI group’. This method has also been employed in similar research in this area [45].

Table 1. TBI classification

<table>
<thead>
<tr>
<th>TBI Classification</th>
<th>Head and/or neck injury with:</th>
<th>TBI Grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improbable</td>
<td>No altered consciousness* or LOC.*</td>
<td>No/Improbable TBI</td>
</tr>
<tr>
<td>Possible</td>
<td>Altered consciousness but no LOC.</td>
<td>No/Improbable TBI</td>
</tr>
<tr>
<td>Mild</td>
<td>LOC &lt; 30 minutes.</td>
<td>TBI</td>
</tr>
<tr>
<td>Moderate</td>
<td>LOC &gt; 30 but &lt; 24 hours.</td>
<td>TBI</td>
</tr>
<tr>
<td>Severe</td>
<td>LOC &gt; 24 hours.</td>
<td>TBI</td>
</tr>
</tbody>
</table>

*Altered consciousness: Dazed and/or memory gap. LOC: Loss of consciousness.

Difficulties in Emotional Regulation Scale

The difficulties in emotional regulation scale (DERS), is a self-report measure which comprises of 36 items that assess emotion dysregulation. Participants are asked to rate how often each item applies to them, and responses are scored on a 5-point Likert scale ranging from 1 (almost never) to 5 (almost always), with higher scores indicating a greater severity of
emotion dysregulation. The measure has 6 subscales which relate to specific domains of ER, however, for the purpose of this study only the total DERS score was used. The measure has construct validity, an internal consistency estimate of .93, and a two week test–retest reliability estimate of .88 [24, 37]. It has been used in a range of populations which include individuals who have sustained a TBI [34] and violent offenders [25, 47].

The Hostile Interpretations Questionnaire

The hostile interpretations questionnaire (HIQ) is a 28 item assessment instrument designed to measure a participant’s overall level of hostility, its characteristics, and the social situations in which hostility occurs [48 – 49]. The HIQ includes 7 vignettes with 4 questions per vignette. Questions are answered using a 5-point Likert scale (e.g., strongly agree to strongly disagree). The HIQ provides a total score and nine subscale scores. Five subscales assess the social context that elicits a hostile response which include interpersonal scenarios with authority figures, intimate/family figures, acquaintances, work figures and individuals who are anonymous. Four subscales examine different domains of hostility including overgeneralization, attribution, hostile reaction and external blame. Higher scores on the HIQ indicate greater hostility [50].

The HIQ has normative data among adult prisoners [50], individuals on probation, and college students [49]. Internal consistency estimates for the HIQ total score range between .88 and .90, and between .50 and .84 for the nine subscales [49]. The HIQ has been validated against other anger assessment instruments and a measure of response bias (i.e., falsifying) [48, 50].

Violent Offending

Information regarding participant’s offence history was garnered from each participant’s offender management records. This included number of convictions to date, the number of
violent convictions, nature of current conviction, age at first conviction and age at first violent conviction. This data was operationalized using the Violence Rating Scales (VRS) [38 – 39]. There are two scales, the first scale rates an individual’s index offence (current conviction), and the second scale rates an individual’s overall record in terms of violent offending. The first scale rates the index offence in terms of severity of violence and ranges from 0 – 4 (0 = completely non-violent, 1 = minimal violence, 2 = moderate violence, 3 = moderately severe violence and 4 = severe violence). The second scale rates the individual’s overall record in terms of violent offending and similarly, scores range from 0 - 4; ‘never been convicted for violence’ is at the bottom end of the scale (0 rating) and ‘one or more severely violent episode in which someone’s life or health has been seriously endangered’ is at the top end of the scale with a rating of 4. The two scale scores can then be added (VRS index score + VRS overall record score), to produce a VRS total score which is rated out of 8; with higher scores reflecting a greater severity of violence [38 – 39]. These violence rating scales have been used in previous research with prison populations [39] and forensic inpatients, both male [51] and female [52].

Previous research has typically used the VRS total scores to split their samples into violent/non-violent groups. Robertson and Gunn (1987) placed participants with a total score of 0-3 in a non-violent group and those with scores of 4–8 in the violent category [39]. An even higher threshold was adopted by Kumari and colleagues (2009) who used a cut-off of 5 for inclusion in the violent group, which is indicative of a fatal, or near fatal, act of violence against another and at least one other episode of at least moderately serious violence [51]. For the purpose of the current study, VRS index scores and VRS total scores will be reported, but the ‘VRS overall record score’ (rated out of 4) is used for correlation and mediation analyses as it better reflects an individual’s capacity for violence.
Procedure

Ethical approval was sought and granted by the Scottish Prison Service (SPS) Research Access Ethics Committee (RAEC), an NHS Research Ethics Committee and the University of Edinburgh Research Ethics Committee. Research study information sessions were held in each research site and participant information sheets were left at various locations across each prison (for example, in the health care centres and on the prison landings). Subsequently, individuals had the opportunity to express their interest in taking part in the study by signing an individual sign-up sheet which was attached to the participant information sheet. The sign-up process incorporated an opt-in clause that if individuals signed-up they were providing their consent to allow the study researcher to liaise with prison staff, to ascertain if they met eligibility criteria. If individuals were eligible, a research appointment was scheduled. During this appointment, informed consent was taken, including asking individuals to provide their consent for the researcher to access their offender management and healthcare records. Study measures were then completed. Participants were asked to attend one research appointment only. Participant’s General Practitioner’s (GP’s) were informed about an individual’s participation in the study and the outcome of the TBI assessment. Data were collected between September 2018 and May 2019.

Statistical analysis

There were no data items missing. Analyses were conducted using Statistical Package for Social Sciences (SPSS, version 25). Data were reviewed regarding assumptions and where these were violated, non-parametric approaches were used. Between group differences (TBI versus No/Improbable TBI) were investigated using Mann Whitney–U tests and then a series of bivariate correlations were conducted. Mediation analyses were performed using the macro 'PROCESS' version 3.5 (downloadable from: http://www.processmacro.org/download.html).
PROCESS runs simultaneous regressions to test the direct and indirect effects of an independent variable on the dependent variable with one or more mediators. In mediation analysis if the independent variable (in this study, TBI severity) and dependent variable (VRS overall record score), are indicated to be significantly related, mediation effects are being assessed [53]. If there is no significant relationship between the independent and dependent variables, then indirect effects are assessed. Effects were investigated using percentile bootstrap confidence intervals with bootstrap samples. A mediation or indirect effect is considered to be significant if the upper and lower bounds of the confidence intervals do not contain zero. In this study, percentile bootstrap confidence intervals set at 95% based on 5000 bootstrap samples were used to assess indirect effects of TBI severity on violent offending, through the mediating effects of ER and HAB. Previous research has shown that age has a potential impact on some of the variables under investigation. For example, increasing age is associated with greater access to ER strategies [54]; in relation to violence, research indicates that adults over the age of 25 have a different aggressive response profile compared to their younger counterparts [55] and in other research studies examining HAB and aggression, age has been controlled for as a potential confounding variable [56]. In order to reduce the potential influence of age on the relationship between the study variables, age was therefore included as a covariate. The proposed multiple mediation models are presented in Figure 1 and Figure 2.
Figure 1. Proposed Model 1: Violence Rating Scale (VRS) score for participant’s overall record as dependent variable.

X: Independent Variable
TBI Severity

Y: Dependent Variable
Violence Rating Score

Mediator 1 Emotional Regulation
DERS Total Score

Mediator 2 Hostile Attribution Bias
HIQ Total Score

Covariate: Age

Figure 2: Proposed Model 2: Number of violent convictions as the dependent variable.

X: Independent Variable
TBI Severity

Y: Dependent Variable
Number of violent convictions

Mediator 1 Emotional Regulation
DERS Total Score

Mediator 2 Hostile Attribution Bias
HIQ Total Score

Covariate: Age
Results

Sample, prevalence & severity of TBI

One hundred and four individuals expressed an interest in taking part in the study. Eighteen individuals withdrew, 3 individuals were transferred to a different establishment or liberated prior to their research appointment and one individual was only later identified as ineligible for participation. Subsequently, 82 individuals (n = 82) met the inclusion criteria for participation which met statistical power. The age range of participants was 22 – 63 years (M = 37.18, SD = 10.192).

Seventy-nine participants (96.3%) screened positive for ‘any’ form of TBI ranging from possible to severe; mild TBI was most prevalent within the sample at 61% (n=50), and moderate and severe TBI accounted for almost 10% of the sample (n= 8). (Table 2).

<table>
<thead>
<tr>
<th>Number of offenders screened for TBI</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any TBI</td>
<td>79</td>
<td>96.3</td>
</tr>
<tr>
<td>No/Improbable TBI</td>
<td>3</td>
<td>3.3</td>
</tr>
<tr>
<td>Possible TBI</td>
<td>21</td>
<td>25.6</td>
</tr>
<tr>
<td>Mild TBI</td>
<td>50</td>
<td>61</td>
</tr>
<tr>
<td>Moderately Severe TBI</td>
<td>6</td>
<td>7.3</td>
</tr>
<tr>
<td>Severe TBI</td>
<td>2</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Of those participants who had sustained some form of TBI (n =79), 58 (73.4%) experienced a TBI with LOC. See Table 3 for number and length of LOC episodes.

<table>
<thead>
<tr>
<th>Number of participants who sustained a LOC</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 TBI with LOC</td>
<td>24</td>
<td>41.4</td>
</tr>
<tr>
<td>2 TBI’S with LOC</td>
<td>15</td>
<td>25.9</td>
</tr>
<tr>
<td>3 TBI’S with LOC</td>
<td>19</td>
<td>32.7</td>
</tr>
<tr>
<td>TBI with LOC&lt; 30 minutes</td>
<td>50</td>
<td>86.2</td>
</tr>
<tr>
<td>1 TBI with LOC &gt; 30 minutes</td>
<td>6</td>
<td>10.3</td>
</tr>
<tr>
<td>2 TBI’S with LOC &gt; 30 minutes</td>
<td>2</td>
<td>3.4</td>
</tr>
</tbody>
</table>
Causes of TBI

There were 133 TBIs with LOC sustained in total. The OSU-TBI-ID delineates 4 categories of causes of TBI (Table 4). A fall/being hit by something or being injured while playing sports was the most common cause of TBI with LOC, accounting for 54.89% (73 LOCs).

Table 4. Causes of TBI with LOC as per OSU-TBI ID categories

<table>
<thead>
<tr>
<th>Cause of TBI with LOC</th>
<th>Number of LOCs</th>
<th>% of LOCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A fall/Being hit by something/Injured playing sports</td>
<td>73</td>
<td>54.89</td>
</tr>
<tr>
<td>Car accident/Crashing some other moving vehicle</td>
<td>29</td>
<td>21.8</td>
</tr>
<tr>
<td>Fight/Being hit by someone/Being shaken violently/Being shot in the head</td>
<td>31</td>
<td>23.31</td>
</tr>
<tr>
<td>Explosion</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Further breakdown revealed that 48% (66 TBIs with LOC) were caused by assaults which encompassed both assaults using a weapon e.g., bottle (25%) and assaults by a person e.g., punch (23%). (Figure 3).

Figure 3. Breakdown of causes of TBI with LOC
Prevalence & causes of head/neck injuries without LOC (Possible TBIs)

Further investigation revealed that there were 182 head/neck injuries (without LOC) sustained in those who responded positively for some form of TBI. Assault was the most common cause of head/neck injury without LOC accounting for 52% (95) of all head or neck injuries sustained, with 41% (74) of those injuries being categorized as a result of assault involving a weapon e.g., bottle. (Figure 4).

Figure 4. Breakdown of causes of head/neck injuries without LOC

Periods of multiple repeated impacts to the head
As part of the OSU-TBI-ID, participants were asked about times in their life when they experienced multiple repeated impacts to their heads e.g., a history of abuse, contact sports or military duty. Forty-one (51.9%) of the 79 participants who screened positive for some level of TBI (possible – severe), reported having experienced episodes of multiple repeated
impacts to the head (54 multiple repeated head impact episodes were recorded in total). (Figure 5).

**Figure 5. Breakdown of causes of episodes of multiple repeated impacts to the head**

<table>
<thead>
<tr>
<th>Cause of multiple repeated impacts to the head</th>
<th>Percentage of multiple repeated impacts to the head</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple assaults due to frequent involvement in fights</td>
<td>46%</td>
</tr>
<tr>
<td>Contact sports E.g. boxing</td>
<td>33%</td>
</tr>
<tr>
<td>Historical abuse</td>
<td>15%</td>
</tr>
<tr>
<td>Other E.g. frequent falls due to intoxication</td>
<td>6%</td>
</tr>
</tbody>
</table>

**Current criminal profile of the sample**

Examination of participant’s current convictions revealed that 53.7% (n = 44) were serving a custodial sentence for violence (e.g., homicide, assault, robbery). (Table 5).

**Table 5. Criminal profile of sample**

<table>
<thead>
<tr>
<th>Crime category</th>
<th>Number of offenders</th>
<th>Percentage of offenders %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Violence*. E.g., Homicide, assault &amp; robbery.</td>
<td>44</td>
<td>53.7</td>
</tr>
<tr>
<td>Non-violent offences. E.g., Theft, drugs &amp; fraud.</td>
<td>29</td>
<td>35.4</td>
</tr>
<tr>
<td>Contact sex offences. E.g., Rape &amp; sexual assault.</td>
<td>5</td>
<td>6.1</td>
</tr>
<tr>
<td>Non-contact sex offences. E.g., Possession of indecent images.</td>
<td>4</td>
<td>4.9</td>
</tr>
</tbody>
</table>

*Non-sexual acts of violence
Number of convictions

The average number of total convictions (violent and non-violent) was 14.5 (range 1 – 68, SD: 16.6). The average number of violent convictions in the sample was 4.21 (range 0 – 28, SD: 5.9). Convictions for contact sex offences were categorized as violent when calculating the number of convictions, a method employed in previous studies [57 – 58].

Age at 1st TBI & 1st conviction

The following section refers only to participants who sustained TBI with a LOC (n = 58). Only those with this level of severity were included as theoretically, mild head injuries would be less relevant in terms of their impact on future offending. The average age of first sustaining a TBI with a LOC was 16.5 years and age of first conviction (either violent or non-violent) was 25.8 years (Table 6); 81% (n = 47) of participants sustained their TBI before their first conviction.

For those who had sustained a TBI with a LOC and were categorized as violent offenders (n = 39), the average age of first TBI with LOC was 16.4 years and the age of first violent conviction was 26.1 years (Table 6); 82% (n = 32) of violent offenders sustained their TBI prior to their first violent conviction. The average length of time between an offender’s first TBI with LOC and first conviction was 12.8 years.

Furthermore, 51.7% (n= 30) experienced a TBI with LOC at or prior to the age of 15 and 34.5% (n = 20) experienced this at or before the age of 12, which is associated with more detrimental effects due to the impact on the developing brain.
Table 6. Age at 1st TBI with LOC & age at 1st conviction

<table>
<thead>
<tr>
<th></th>
<th>Age (Mean no. of years)</th>
<th>Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at 1st TBI with LOC</td>
<td>16.5</td>
<td>4 – 39</td>
<td>8</td>
</tr>
<tr>
<td>Age at 1st conviction</td>
<td>25.8</td>
<td>16 – 55</td>
<td>8.8</td>
</tr>
<tr>
<td>Timeframe between 1st TBI &amp; 1st conviction</td>
<td>12.8.</td>
<td>1 – 45</td>
<td>9.9</td>
</tr>
<tr>
<td>Violent offenders age at 1st TBI with LOC</td>
<td>16.4</td>
<td>4 – 38</td>
<td>7.6</td>
</tr>
<tr>
<td>Violent offenders age at 1st violent conviction</td>
<td>26.1</td>
<td>16 – 55</td>
<td>9.2</td>
</tr>
<tr>
<td>Timeframe between 1st TBI &amp; 1st violent conviction</td>
<td>12.8.</td>
<td>1 – 45</td>
<td>11</td>
</tr>
</tbody>
</table>

*Table refers exclusively to participants who experienced a TBI with LOC (mild, moderate and/or severe, n = 58).

Scores on the Violence Rating Scales (VRS)

With regards to their current index offence, 35.4% scored 4 for severe violence (where the victim died, or their life or health was seriously endangered). In relation to history of violence when considering a participant’s overall record, 52.4% scored 4 which indicated the presence of one or more severely violent episode/conviction where someone’s life or health had been seriously endangered. Combining the scores related to participant’s index offence and their overall record gave a total score for violence. Using Robertson and Gunn’s (1987) violence split, participants with a total score of 0-3 were categorized as the non-violent group and those with scores of 4–8 were placed in the violent group. Table 7 provides a breakdown of scores on the VRS.
### Table 7. VRS scores

<table>
<thead>
<tr>
<th>VRS Rating scale &amp; score</th>
<th>Number of participants (n)</th>
<th>Percentage of participants (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRS Index Offence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-violent (0)</td>
<td>32</td>
<td>39</td>
</tr>
<tr>
<td>Minimal violence (1)</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>Moderate violence (2)</td>
<td>8</td>
<td>9.8</td>
</tr>
<tr>
<td>Moderately severe violence (3)</td>
<td>12</td>
<td>14.6</td>
</tr>
<tr>
<td>Severe violence (4)</td>
<td>29</td>
<td>35.4</td>
</tr>
<tr>
<td>VRS Overall Record</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No convictions for violence (0)</td>
<td>20</td>
<td>24.4</td>
</tr>
<tr>
<td>Some evidence of violence (1)</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>1 or 2 convictions for minor assaults or damage to property (2)</td>
<td>6</td>
<td>7.3</td>
</tr>
<tr>
<td>3 or more incidents of violence (3)</td>
<td>12</td>
<td>14.6</td>
</tr>
<tr>
<td>1 or more severely violent episode (4)</td>
<td>43</td>
<td>52.4</td>
</tr>
<tr>
<td>Total VRS Rating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-violent (0 – 3)</td>
<td>28</td>
<td>34.4</td>
</tr>
<tr>
<td>Violent (4 – 8)</td>
<td>54</td>
<td>65.9</td>
</tr>
</tbody>
</table>

### DERS & HIQ Scores

A breakdown of DERS and HIQ scores is provided in Table 8.

### Table 8. DERS & HIQ scores

<table>
<thead>
<tr>
<th>Measure &amp; Sample</th>
<th>Number of participants</th>
<th>Mean total score</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>DERS (Total sample)</td>
<td>82</td>
<td>84.94</td>
<td>30.33</td>
<td>36</td>
<td>159</td>
</tr>
<tr>
<td>DERS (Violent offenders)</td>
<td>54</td>
<td>82.94</td>
<td>31.09</td>
<td>36</td>
<td>159</td>
</tr>
<tr>
<td>DERS (Non-violent offenders)</td>
<td>28</td>
<td>88.79</td>
<td>28.97</td>
<td>52</td>
<td>143</td>
</tr>
<tr>
<td>HIQ (Total sample)</td>
<td>82</td>
<td>72.79</td>
<td>16.9</td>
<td>34</td>
<td>112</td>
</tr>
<tr>
<td>HIQ (Violent offenders)</td>
<td>54</td>
<td>73.15</td>
<td>16.11</td>
<td>34</td>
<td>109</td>
</tr>
<tr>
<td>HIQ (Non-violent offenders)</td>
<td>28</td>
<td>72.11</td>
<td>18.56</td>
<td>39</td>
<td>112</td>
</tr>
</tbody>
</table>

### Comparing participants with and without a history of TBI

Review of data assumptions revealed the presence of outliers (which were retained as they captured natural variation in the sample); assumptions of normality and homogeneity of variances were also violated. Mann-Whitney U tests, (the non-parametric alternative to the independent t-test) were therefore employed. Given the low risk of long term effects of TBI
without LOC, those with a very mild head injury or concussion but no LOC, were placed in the no/improbable TBI group (29.3%, n = 24) and participants with mild, moderate and severe TBI were placed in the TBI group (70.7%, n = 58). Although the TBI group scored higher on many of the variables, Mann-Whitney U tests revealed no significant differences in the TBI and no TBI groups in relation to: age, DERS total score, HIQ total score, VRS overall record scores, number of violent convictions and number of total convictions (violent and non-violent convictions) (Table 9.).

Table 9: Between Group Differences: TBI versus No/Improbable TBI

<table>
<thead>
<tr>
<th>Measure</th>
<th>Group</th>
<th>N</th>
<th>Median</th>
<th>U</th>
<th>Z</th>
<th>P</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td>TBI</td>
<td>58</td>
<td>36.5</td>
<td>626.5</td>
<td>-.709</td>
<td>.478</td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>No TBI</td>
<td>24</td>
<td>36.5</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DERS</td>
<td>TBI</td>
<td>58</td>
<td>89.5</td>
<td>519.5</td>
<td>-1.800</td>
<td>.072</td>
<td>-0.02</td>
</tr>
<tr>
<td></td>
<td>No TBI</td>
<td>24</td>
<td>63.5</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIQ</td>
<td>TBI</td>
<td>58</td>
<td>73.5</td>
<td>568.5</td>
<td>-1.300</td>
<td>.194</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>No TBI</td>
<td>24</td>
<td>71</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VRS Overall Record Score</td>
<td>TBI</td>
<td>58</td>
<td>4</td>
<td>684.0</td>
<td>-.134</td>
<td>.894</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>No TBI</td>
<td>24</td>
<td>4</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Violent Convictions</td>
<td>TBI</td>
<td>58</td>
<td>2</td>
<td>580.5</td>
<td>-1.194</td>
<td>.232</td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>No TBI</td>
<td>24</td>
<td>1</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Number of Convictions</td>
<td>TBI</td>
<td>58</td>
<td>8.5</td>
<td>528.5</td>
<td>-1.711</td>
<td>.087</td>
<td>-0.02</td>
</tr>
<tr>
<td></td>
<td>No TBI</td>
<td>24</td>
<td>5</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bivariate correlations

The assumption of linearity for performing parametric correlation analyses was violated, therefore, a series of Kendall’s tau-b tests (a non-parametric alternative), were performed to determine the presence of relationships between the main variables of interest. There were no significant relationships found between TBI severity (IV) and DERS score ($\tau_b = .122, p = .163$) or HIQ score ($\tau_b = .076, p = .383$), nor were there significant relationships found between TBI severity and: VRS overall record score ($\tau_b = .032, p = .743$) or number of violent convictions ($\tau_b = .139, p = .131$). There were no significant correlations between the
potential mediator DERS and VRS overall record score ($r_b = -0.163, p = 0.058$) and number of violent convictions ($r_b = 0.043, p = 0.591$). Finally, there were no significant correlations found between the other potential mediator HIQ score and VRS overall record score ($r_b = -0.056, p = 0.516$) or number of violent convictions ($r_b = 0.077, p = 0.337$). Further exploratory analysis revealed a weak negative correlation between participant age and DERS score and HIQ score (DERS $r_b = -0.253, p = 0.001$, HIQ $r_b = -0.233, p = 0.004$); a weak positive correlation between TBI severity and number of total convictions ($r_b = -0.222, p = 0.012$) and a moderate positive correlation between DERS total score and HIQ total score ($r_b = 0.362, p = 0.000$).

Mediation Analysis: Model 1: VRS overall record score as the dependent variable

Assumptions testing for performing multiple regression was performed before conducting the mediation analysis. Assumptions of linearity, normality and homoscedasticity were violated and one extreme outlier was found and subsequently removed when VRS overall record score was the dependent variable (mediation Model 1). Bootstrapping was used as it allows the analyses to be carried out on data which does not meet parametric assumptions. Additionally, the PROCESS approach does not require the independent variable and dependent variable to be significantly associated, as it is possible that all or the majority of the influence of the independent variable on the dependent variable occurs through indirect effects [59].

The mediate macro was used to examine whether scores on the HIQ and DERS mediated the relationship between TBI severity and violent offending, with VRS overall record score as the dependent variable. Age was also included as a covariate. Covariates are variables which are not part of the main statistical model but may exert an effect on the dependent variable, either directly or through confounding effects when combined with other variables. Including age as a covariate allows for its effects to be controlled for and assessed.

The outcome from the mediation analysis for Model 1 is presented in the following order in
Table 10: DERS and HIQ scores were separately regressed onto TBI severity and age to assess pathways from the independent variables and covariates to mediators. Following this, VRS overall record scores were regressed onto TBI severity, DERS, HIQ and age to test the pathway from independent variables/covariates and mediators to the dependent variable. The first section of Table 10 shows that the TBI severity and age did predict DERS scores when in combination (F (2, 78) = 6.556, p = .0023), however, only age emerged as a significant independent predictor (t = -3.3883, p = .0011). A similar pattern can be observed in section 2 of the table, TBI severity and age did predict HIQ scores in combination (F (2, 78) = 3.6218, p = .0313), however, only age emerged as a significant independent predictor (t = -2.5532, p = .0126). The 3rd section of the table displays the coefficients for VRS overall record scores regressed onto TBI severity, DERS, HIQ and age. This model was not significant (F (4, 76) = .4624, p = .7631), nor were there any significant independent predictors observed. Section 4 depicts the total effects of TBI severity and age on VRS overall record scores, and was not significant (F (2, 78) = .4355, p = .6485).

Table 10: Model 1: Mediation Regression Analysis with VRS Overall Record Score as Dependent Variable

<table>
<thead>
<tr>
<th>Outcome &amp; Predictors</th>
<th>R-Sq</th>
<th>B Coefficient</th>
<th>SE</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome = DERS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TBI</td>
<td></td>
<td>6.2441</td>
<td>4.3729</td>
<td>.3253</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>-1.1023</td>
<td>-3.3883</td>
<td>1.4279</td>
<td></td>
</tr>
<tr>
<td><strong>Outcome = HIQ</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>.0850</td>
<td>83.7520</td>
<td>9.5667</td>
<td>2.3668</td>
<td>-.4659</td>
</tr>
<tr>
<td>TBI</td>
<td></td>
<td>2.3668</td>
<td>2.4527</td>
<td>.1825</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>-.4659</td>
<td>-.25532</td>
<td>.9650</td>
<td></td>
</tr>
<tr>
<td><strong>Outcome = VRS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>.0238</td>
<td>2.5221</td>
<td>1.4348</td>
<td>.1394</td>
<td>-.0069</td>
</tr>
<tr>
<td>TBI</td>
<td></td>
<td>.1394</td>
<td>.2595</td>
<td>.0075</td>
<td></td>
</tr>
<tr>
<td>DERS</td>
<td></td>
<td>-.0069</td>
<td>-.9150</td>
<td>.0805</td>
<td></td>
</tr>
<tr>
<td>HIQ</td>
<td></td>
<td>.0011</td>
<td>.0134</td>
<td>.0205</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>.0086</td>
<td>.4208</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total effect model with VRS as outcome</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>.0110</td>
<td>1.8719</td>
<td>1.8874</td>
<td>.0992</td>
<td>.0157</td>
</tr>
<tr>
<td>TBI</td>
<td></td>
<td>.0992</td>
<td>.9918</td>
<td>.2543</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>.0157</td>
<td>.8295</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

75
Percentile bootstrap confidence intervals indicated that there were no significant indirect effects of TBI severity on VRS overall record scores, through the variables of emotional regulation difficulties (DERS) and hostile attribution bias (HIQ) (see Table 11).

**Table 11: Bootstrapped confidence intervals for the indirect effect of TBI severity on VRS overall record scores through ER and HAB.**

<table>
<thead>
<tr>
<th>Mediator</th>
<th>Effect</th>
<th>SE</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>DERS</td>
<td>-.0428</td>
<td>.0700</td>
<td>-.2164</td>
<td>.0622</td>
</tr>
<tr>
<td>HIQ</td>
<td>.0025</td>
<td>.0520</td>
<td>-.1078</td>
<td>.1186</td>
</tr>
</tbody>
</table>

Mediation Analysis: Model 2: Number of violent convictions as the dependent variable.

Model 2 involved examining whether HIQ scores and DERS scores mediated the relationship between TBI severity and violent offending, with number of violent offences as the dependent variable. The outcome from the mediation analysis for Model 2 is presented in the following order in Table 12: DERS and HIQ scores were separately regressed onto TBI severity and age to assess pathways from the independent variables and covariates to mediators. Following this, number of violent offences was regressed onto TBI severity, DERS, HIQ and age to test the pathway from independent variables/covariates and mediators to the dependent variable. The first section of Table 12 shows that the TBI severity and age did predict DERS scores when in combination (F (2, 79) = 5.6954, p = .0049), however, only age emerged as a significant independent predictor (t = -3.1385, p = .0024). A similar pattern can be observed in section 2 of the table, TBI severity and age did predict HIQ scores in combination (F (2, 79) = 5.1385, p = .0080), however, only age emerged as a significant independent predictor (t = -3.0116, p = .0035). The 3rd section of the table displays the coefficients for number of violent convictions regressed onto TBI severity, DERS, HIQ and age. This model was not significant (F (4, 77) = .6367, p = .6378), nor were there any
significant independent predictors observed. Section 4 depicts the total effects of TBI severity and age on number of violent convictions and was not significant (F (2, 79) = 1.1651, p = .3172).

Table 12: Model 2: Mediation regression analysis with number of violent convictions as dependent variable

<table>
<thead>
<tr>
<th>Outcome &amp; Predictors</th>
<th>R-Sq</th>
<th>B Coefficient</th>
<th>SE</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome = DERS</strong></td>
<td>.1260</td>
<td>106.0526</td>
<td>17.0592</td>
<td>6.2167</td>
<td>.0000</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td>5.5200</td>
<td>4.3546</td>
<td>1.2676</td>
<td>.2087</td>
</tr>
<tr>
<td>TBI</td>
<td></td>
<td>-.9824</td>
<td>.3130</td>
<td>-3.1385</td>
<td>.0024</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Outcome = HIQ</strong></td>
<td>.1151</td>
<td>84.7664</td>
<td>9.5531</td>
<td>8.8732</td>
<td>.0000</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td>2.7411</td>
<td>2.4386</td>
<td>1.1241</td>
<td>.2644</td>
</tr>
<tr>
<td>TBI</td>
<td></td>
<td>-.5279</td>
<td>.1753</td>
<td>-3.0116</td>
<td>.0035</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Outcome = Violent convictions</strong></td>
<td>.0320</td>
<td>-1.7193</td>
<td>5.0984</td>
<td>-.3372</td>
<td>.7369</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td>1.2712</td>
<td>.9134</td>
<td>1.3917</td>
<td>.1680</td>
</tr>
<tr>
<td>TBI</td>
<td></td>
<td>.0099</td>
<td>.0259</td>
<td>.3826</td>
<td>.0311</td>
</tr>
<tr>
<td>DERS</td>
<td></td>
<td>.0068</td>
<td>.0463</td>
<td>.1459</td>
<td>.8844</td>
</tr>
<tr>
<td>HIQ</td>
<td></td>
<td>.0280</td>
<td>.0700</td>
<td>.4005</td>
<td>.6899</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total effect model with violent convictions as outcome</strong></td>
<td>.0287</td>
<td>-.0952</td>
<td>3.4946</td>
<td>-.0273</td>
<td>.9783</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td>1.3444</td>
<td>.8920</td>
<td>1.5071</td>
<td>.1358</td>
</tr>
<tr>
<td>TBI</td>
<td></td>
<td>.0147</td>
<td>.0641</td>
<td>.2299</td>
<td>.8188</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Percentile bootstrap confidence intervals indicated that there were no significant indirect effects of TBI severity on number of violent offences, through the variables of emotional regulation difficulties (DERS scores) and hostile attribution bias (HIQ scores) (Table 13).

Table 13: Bootstrapped confidence intervals for the indirect effect of TBI severity on number of violent convictions through DERS and HIQ.

<table>
<thead>
<tr>
<th>Mediator</th>
<th>Effect</th>
<th>SE</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>DERS</td>
<td>.0547</td>
<td>.1607</td>
<td>-.1886</td>
<td>.4813</td>
</tr>
<tr>
<td>HIQ</td>
<td>.0185</td>
<td>.1367</td>
<td>-.2621</td>
<td>.3220</td>
</tr>
</tbody>
</table>
Post-Hoc exploratory mediation analysis: Model 3: Total number of convictions (violent & non-violent convictions) as the dependent variable.

Post-hoc analyses were conducted to further examine any potential link between TBI and offending by examining total number of convictions (violent and non-violent convictions) in a mediation analysis. This mediation model (Model 3) involved examining whether HIQ scores and DERS scores mediated the relationship between TBI severity and offending with total number of offences as the dependent variable. The outcome from the mediation analysis for Model 3 is presented in Figure 6 and in the following order in Table 14: HIQ and DERS scores were separately regressed onto TBI severity and age to assess pathways from the independent variables and covariates to mediators. Following this, number of total offences were regressed onto TBI severity, HIQ, DERS and age to test the pathway from independent variables/covariates and mediators to the dependent variable. The first section of Table 14 shows that the TBI severity and age did predict HIQ scores when in combination (F (2, 79) = 5.1385, p = .0080), however, only age emerged as a significant independent predictor (t = -3.0163, p = .0035). A similar pattern can be observed in section 2 of the table, TBI severity and age did predict DERS scores in combination (F (2, 79) = 5.6954, p = .0049), however, only age emerged as a significant independent predictor (t = -3.1385, p = .0024). The 3rd section of the table displays the coefficients for number of total convictions regressed onto TBI severity, DERS, HIQ and age. This model was significant (F (4, 77) = 3.8530, p = .0066). An adjusted R² of .1668 indicated that TBI severity, DERS and age accounted for 16.7% of the variance in number of total convictions, however, only TBI severity was a significant predictor (t = 2.6994, p = .0085), with a higher total number of convictions being associated with greater TBI severity. Section 4 shows that the total effects of TBI severity and age on number of total convictions was significant (F (2, 79) = 5.3226, p = .0068), with TBI severity only highlighted as a significant predictor (t = 3.0020, p = .0036).
Figure 6: Proposed Model 3: Total number of convictions (violent & non-violent) as the dependent variable.

**Significant at the 0.01 level

Table 14: Model 3: Mediation regression analysis with total number of convictions (violent and non-violent) as the dependent variable

<table>
<thead>
<tr>
<th>Outcome &amp; Predictors</th>
<th>R-Sq</th>
<th>B Coefficient</th>
<th>SE</th>
<th>t</th>
<th>p</th>
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<td><strong>Outcome = HIQ</strong></td>
<td></td>
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</tr>
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<td>.2644</td>
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<tr>
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<td>17.0592</td>
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<td>.1826</td>
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<tr>
<td><strong>Total effect model with total convictions as outcome</strong></td>
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<td>.1716</td>
<td>.1716</td>
<td>.1716</td>
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</tbody>
</table>
Percentile bootstrap confidence intervals indicated that there were no significant indirect effects of TBI severity on total number of offences, (violent and non-violent) through the variables of ER difficulties and HAB as both sets of confidence intervals contained a zero (see Table 15). In conclusion, emotional regulation (DERS scores) and hostile attribution bias (HIQ scores) did not mediate, nor were significant indirect effects found in the relationship between TBI severity and total number of offences.

Table 15: Bootstrapped confidence intervals for the indirect effect of TBI severity on total number of convictions (violent and non-violent) through ER and HAB.

<table>
<thead>
<tr>
<th>Mediator</th>
<th>Effect</th>
<th>SE</th>
<th>Lower</th>
<th>Upper</th>
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<td>DERS</td>
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</table>
Discussion

In this study, we set out to contribute to the knowledge base in the area of TBI and violent offending, by examining the potential mediating roles of ER difficulties and HAB. Firstly, the study highlighted the extremely high prevalence of TBI in a Scottish prison population, with 96.3% of participants reporting some form of TBI, ranging from possible TBI to severe TBI. This rate is particularly high when compared to a UK based prison study, in which TBI rates of 65% were observed [4]. Sixty-five participants in the current study (79.3%), reported that they had attended A&E for an injury to their head or neck. This is a much higher rate than a recent study, which specifically examined hospitalized head injury (HHI) in a national population of Scottish prisoners and found rates of HHI of 24.7% [2]. However, comparison across these studies should be made with caution as they employ different recording methods for TBI. For example, Williams and colleagues (2010) posed a series of self-report questions on previous head injuries (not a specific TBI questionnaire) [4] and McMillan and colleagues (2019) examined Scottish morbidity records, which are generated for admissions to hospital and use the International Classification of Disease’s (ICD-9) codes to record diagnoses [2]. Hospital records are arguably a gold standard for more severe injuries in relation to head injury as opposed to self-report, however, injuries may also go under-reported and un-captured if an individual does not attend hospital e.g., if the injury was sustained during a criminal act [2]. It is also worth highlighting that in a study by Schofield and colleagues (2011), a 70% concurrence rate was found between self-reported and medically recorded TBI in adult offenders [60].

When comparing TBI prevalence rates with other studies which use the OSU-TBI-ID measure, the current study continued to reveal higher rates of any TBI (this included possible, mild, moderate and severe TBI). For example, a USA study involving Indiana State male prisoners, found a prevalence rate of 37.5% of any TBI [45]; and another USA study based in
South Carolina, found that approximately 65% of male inmates reported having experienced a history of TBI [43]. These TBI prevalence rates are in stark contrast to the rate of 96.3% observed in the current Scottish study. The most common TBI severity rating in this study was mild TBI with 61% of participants screening in for this category. Mild TBI was also the most prevalent TBI category among Indiana State prisoners at a lower rate of 19.7% [45]. In the current study, 70.7% (n = 58) of participants had sustained a TBI with a LOC; again, this is much higher than LOC observed in other studies, with less than a quarter of the sample of Indiana State prisoners (23.8%) identifying that they were knocked out or lost consciousness following a TBI [45].

In the current study, TBIs with LOC were most commonly sustained as a result of a fall or being hit by something or injured playing sports and accounted for 54.9% of TBIs. This finding replicated that of Ray and colleagues (2014) with this category being the most common cause of TBI at 20.9%. [45]. Participants in the USA studies and the current Scottish study were comparable in age and status in that they were prison inmates, however, the two USA studies had much larger sample sizes (n =320 [43] and n = 831 [45]); arguably these larger samples may better represent the diversity of forensic populations and findings may be more generalizable.

In the current study, when the source of TBI was further broken down, it revealed that 48% of TBIs with LOC were caused by assaults. Evidence from the USA suggests that in the general population, assaults account for approximately 10% of TBIs [61]; in the current study, assaults accounted for nearly 5 times that number. This is potentially indicative of this population’s greater propensity to be exposed to and/or involved in violence. This assertion is further supported by the fact that assaults accounted for 52% of head injuries without LOC sustained in the current sample. Furthermore, periods of engaging in frequent fighting, was
the most common cause of multiple repeated impacts to the head in this sample. Compared to the causes of TBI in other offending populations, assaults as a cause of TBI continued to be higher in this population. For example, a recent Dutch study, examining TBI, convictions, aggression and psychological functioning in offenders, found that ‘traffic accidents’ were the most common cause of head injury in the detainee sample, accounting for 50.64% of head injuries, and ‘violence’ was the second most common source of TBI accounting for 33.3% of head injuries [62]. Evidently, TBI sustained as a result of violence was particularly high in this Scottish prison population. This finding may not be hugely surprising as evidence suggests that levels of violence are high in Scotland. For example, a report by the United Nations in 2005 described Scotland as "the most violent country in the developed world", citing 2,000 serious assaults every week [63]. This was a time when at least half of the participants in the current study would have been aged 20 and above. However, the Scottish government disputed the findings of this report arguing that cross-country comparisons were inaccurate due to the different ways offences are defined, counted and recorded across the world. Levels of violence did drop significantly in Scotland between 2008-09 and 2017-18 with serious assault and attempted murder cases falling by 35%, however, convictions for non-sexual crimes of violence increased by 21% in 2019-20, with the number of people convicted for attempted murder and serious assault rising by 11% [64]. The high incidence of violence in Scotland could help explain the high prevalence of TBI caused by assault in this population.

The average age of first sustaining a TBI with LOC in the current study was 16.5 years old, which is younger when compared to other offending populations. For example, in a USA study looking at the relationship between TBI, illicit drug use and aggression, the average age of LOC as a result of TBI was 19.5 years old in male inmates [5], and in Indiana State male prisoners, the average age of first TBI with LOC was 18.9 years old [45]. Additionally, in the
current study, for those who sustained a TBI with LOC, 51.7% (n= 30) experienced this at or prior to the age of 15, this figure is higher when compared to other studies. For example, Ray & Richardson (2017) found that 35.2% of their offending sample had experienced their first TBI incident at age 14 and below [41]. Further analysis of the data in the current study indicated that 34.5% of participants (n = 20), experienced a TBI with LOC at or before the age of 12. Research indicates TBI sustained at a younger age can have greater neuro-developmental implications. For example, head injury in the developing brain particularly in area of the prefrontal cortex, can result in impaired functioning in relation to decision making, problem solving, ER, social behaviour and self-awareness, which are all linked to aggression and violent behaviour [65]. Research also indicates that a TBI does not have to be severe to impact on normal childhood development and result in life-long impairment in areas of cognitive and emotional maturity, both of which are linked to criminal behaviour [66].

Results in the current study indicated that 81% of all participants who have a history of TBI with LOC, sustained their TBI prior to their first conviction (both violent and non-violent convictions). This finding was also replicated when looking at violent offenders only, with 82% having experienced a TBI with LOC prior to their first violent conviction. This finding may suggest that TBI may be a pre-cursor to engaging in offending, a causal factor. However, causality cannot be inferred for several reasons, e.g., offending behaviour may have occurred at an earlier age, pre-TBI, and it is not recorded on participant’s criminal record as they were a juvenile at the time of the offence. This finding requires further replication in longitudinal studies to allow any conclusions to be made.

Emotional regulation difficulties appeared to be greater in this sample as evidenced by a higher mean DERS score (84.94, SD: 30.33) when compared to other offending and
community samples. For example, a recent study reported a mean DERS score of 72.0 (SD: 19.3) in an offender sample, and 72.6 (SD: 19.0) in a community sample [67]. In contrast, HAB was found to be lower in this Scottish prison population when compared to other forensic populations (as evidenced by lower scores in the HIQ) in both violent (73.15, SD: 16.11) and non-violent offenders (72.11, SD: 18.56). For example, a Canadian study found a HIQ mean total score of 79.7 (SD: 17) in a violent offender sample [50], and a study conducted in Singapore, found mean HIQ scores of 87.05 (SD: 16.16) in violent offenders, and 78.53 (SD: 12.04) in non-violent offenders [68]. Whilst all self-report measures may be at risk of inaccurate reporting, the HIQ is a questionnaire which could potentially be at a greater risk of this, due to the nature of the questions (e.g., questions in relation to being on probation, treatment by police officers etc.), in addition to the presence of already heightened levels of suspicion in criminal populations [69]. We also have to consider the impact of country culture in relation to these findings. Evidence indicates that there can be significant differences in response bias on self-report measures in participants from different countries [70], therefore comparing scores across countries on measures such as the HIQ, should be done with caution. It is possible that participants in this study may have provided more socially desirable responses (influenced by country culture, societal beliefs etc.) which could potentially explain the lower levels of HAB detected in this specific population.

A significant positive correlation was found between ER difficulties and HAB in the sample, the greater the level of emotional dysregulation, the greater the degree of hostile attributions and vice versa. This finding has replicated that of other research in this area. For example, in a study examining emotions, social information processing and aggression in boys; adaptive ER was found to be negatively related to HAB; that is, the more emotionally regulated the individuals were, the less HAB was observed [71].
The finding that TBI severity and violent offending were not significantly associated in the current study contrasts with that of previous research [4, 10, 12, 13, 46]. However, it could be argued that violence is so endemic in this population (evidenced by assaults and fighting being the primary source of LOC and head injuries), that it is obscuring any potential relationship between TBI and violence. The level of violence reported during TBI screening potentially suggests that exposure to and/or engaging in violent behaviour is the norm for many of these individuals, therefore, the impact of TBI on this level of violence is difficult to discern. Furthermore, the outcome measures for violence employed, focus on convictions for violence, which may not fully capture an individual’s true capacity for violence, as not all violent episodes may have resulted in a conviction. A similar explanation could be made as to why there were no differences detected across any of the measures between ‘no/improbable TBI’ and ‘TBI’ groups. A history of TBI was also endemic in this population and was detected in 96.3% (n = 79) of the sample. Whilst individuals with ‘possible TBI’ were placed in the ‘no/improbable TBI’ category (replicating methods used in other studies [45], it is possible that there were neuro-developmental impacts as a result of these head/neck injuries, which may account for the absence of significant differences in the outcome measures across the no TBI and TBI groups.

Post hoc exploratory analysis did however reveal a significant association between TBI severity and total number of convictions (violent and non-violent convictions), and indicated that TBI severity is a significant predictor of number of total convictions. This finding replicates that of the research literature into TBI and criminality. For example, Durand and colleagues (2016) report that TBI is associated with a significantly higher number of incarcerations and total time spent in prison [7]. Numerous studies highlight the high prevalence of TBI in offending populations, with a recent international systematic review reporting that TBI prevalence rates in prison ranged from 9.7% to 100%, with an average rate
No significant differences in ER difficulties nor HAB levels were detected across the ‘no/improbable TBI’ and ‘TBI’ groups; there were no significant associations found between ER and HAB levels with any of the offending behaviour variables (VRS overall record score, number of violent convictions and number of total convictions), nor were ER or HAB found to mediate any relationships between TBI and offending. These findings were surprising, given the results of recent research findings by Fishbein and colleagues (2016), which reported that emotional dysregulation (but not cognitive dysregulation), mediated the effects of TBI on aggression in an offending population, with a history of illicit substance misuse [5]. Research also suggests that individuals who have sustained a TBI have greater attributions of intent, hostility and blame compared with healthy controls [16]; and that violent offenders present with greater HAB as compared to both perpetrators of childhood sexual abuse and matched controls [22]. However, a very recent study involving Dutch detainees reported similar results to the current study, in that they found that neither ER difficulties nor hostility differed across ‘no TBI’ and ‘TBI’ groups [62]. It is possible however, that the homogeneity of population characteristics in the current study (e.g., endemic TBI and widespread exposure to violence etc.), obscured any such relationships being detected.

The experience of TBI may contribute to offending behaviour through various mechanisms such as substance misuse and psychiatric disorder. For example, Fishbein and colleagues (2016) found that TBI sustained at an early age, predicted greater severity and earlier onset of drug-use; and earlier onset of drug use, predicted greater aggression, irrespective of the age of TBI [5]. Ray and colleagues (2014) observed that inmates with a TBI are twice as likely to have a psychiatric disorder compared to those without a TBI history [45]. Factors such as
substance misuse and psychiatric disorder were not considered as confounding variables in the current study, which is a potential limitation. Further limitations include the absence of a non-offending control group for comparison and focusing only on convictions when measuring violent offending behaviour. The inclusion of a measure of aggression may have provided a more global picture of a participant’s capacity for violence in addition to conviction history, although it would have been dependent on self-report. The use of a cross-sectional as opposed to a longitudinal design is an additional limitation. A longitudinal study would have enabled greater insight into TBI history and offending behaviour patterns over time, and could potentially illicit more information about the existence of a cause and effect relationship between TBI and offending. Future studies should therefore consider potential confounding variables such as substance misuse, incorporate a non-incarcerated control group and consider employing a longitudinal design.

In terms of clinical implications, this study demonstrates that it is viable to administer the OSU-TBI-ID short form in a prison setting, to detect the presence of TBI. The study contributes to the evidence base identifying TBI as an area of need in offending populations, by reporting an extremely high prevalence of TBI in Scottish prison populations. It contributes to the knowledge base regarding the underlying mechanisms of the association between TBI and criminality, in that it suggests that ER difficulties and HAB are not mediators in the relationship between TBI and offending. This finding would however, require further replication in more robust studies before any substantial claims could be made. It does, however, highlight the need to examine other potential causal mechanisms in the relationship between TBI and offending, as the link between TBI and criminality continues to remain unclear. If more knowledge can be gained in relation to causal mechanisms, it could lead to more targeted neuro-rehabilitative treatment and provide evidence of the importance of the prevention of violence given that TBI is the result. For
example, the provision of community schemes to divert youth from criminal activity and gang involvement. Furthermore, this study highlighted an extremely high prevalence of exposure to/involvement in violence (as evidenced by TBI causes) in this prison population. Treatment programmes in relation to violence are predominantly provided for offenders with violent offences, however, this study highlights that there is potentially a need for violence awareness/reduction programmes in the prison setting for all prisoners, to highlight the impact of issues such inter-generational violence and role modeling, and risks associated with violence e.g., TBI and its effects. Indirectly, psychoeducation in relation to violence could reduce TBI incidences as it appears to be the primary cause of TBI in this population.

If TBI continues to be poorly addressed in prison, the effects are far-reaching. Research has shown that prisoners with a history of TBI have fewer treatment gains and a higher rate of drop-out in forensic rehabilitation programmes; they have higher rates of institutional infractions and reconviction rates, therefore the economic and social burden to society as a whole is profound, as well as the personal costs to the individual in relation to their quality of life and potential for change [2, 46].
References


43. Ferguson PL, Pickelsimer EE, Corrigan JD, Bogner JA, Wald M. Prevalence of traumatic brain injury among prisoners in South Carolina. J Head Trauma Rehabil


Appendix A

Author Guidelines for Submission to the Aggression and Violent Behavior journal.

AGGRESSION AND VIOLENT BEHAVIOR

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DESCRIPTION

Aggression and Violent Behavior, A Review Journal is a multidisciplinary journal that publishes substantive and integrative reviews, as well as summary reports of innovative ongoing clinical research programs on a wide range of topics germane to the field of aggression and violent behavior. Papers encompass a large variety of issues, populations, and domains, including homicide (serial, spree, and mass murder: sexual homicide), sexual deviance and assault (rape, serial rape, child molestation, paraphilias), child and youth violence (firesetting, gang violence, juvenile sexual offending), family violence (child physical and sexual abuse, child neglect, incest, spouse and elder abuse), genetic predispositions, and the physiological basis of aggression.

Manuscripts that articulate disparate orientations will be welcomed, given that this journal will be cross-disciplinary and cross-theoretical. Indeed, papers will emanate from numerous disciplines, psychology, psychiatry, criminology, criminal justice, law, sociology, anthropology, genetics, social work, ethology, and physiology.

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Divide the article into clearly defined sections.

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Provide sufficient details to allow the work to be reproduced by an independent researcher. Methods that are already published should be summarized, and indicated by a reference. If quoting directly from a previously published method, use quotation marks and also cite the source. Any modifications to existing methods should also be described.

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Results should be clear and concise.

Discussion
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The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.
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If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

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Reference to a chapter in an edited book:
Reference to a website:
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Appendix B

The Appraisal tool for Cross-Sectional Studies
The Appraisal tool for Cross-Sectional Studies (AXIS Tool) (Downes, Brennan, Williams & Dean, 2016) [46]

<table>
<thead>
<tr>
<th>Tailored Scoring Criteria</th>
<th>Yes = Y</th>
<th>Partially Addressed = PA</th>
<th>No = N</th>
<th>Don’t Know = DK</th>
</tr>
</thead>
</table>

**Introduction**
1. Were the aims/objectives of the study clear?  
   - 1. Garofalo, Neumann et al. (2020).  
   - 4. Roberton et al. (2014).  
   - 6. Fishbein et al. (2016).  
   - 8. Tager et al. (2010).  
   - 10. Miller et al. (2019).  
   - 13. Y  
   - 14. Y  
   - 15. PA  
   - 16. Y  
   - 17. PA  
   - 18. PA  
   - 19. Y  
   - 20. PA  
   - 21. PA  
   - 22. Y  
   - 23. Y  
   - 24. Y  
   - 25. Y  
   - 26. Y  
   - 27. Y  
   - 28. Y  

**Methods**
2. Was the study design appropriate for the stated aim(s)?  
   - 1. Y  
   - 2. Y  
   - 3. Y  
   - 4. PA  
   - 5. Y  
   - 6. Y  
   - 7. Y  
   - 8. Y  
   - 9. Y  
   - 10. Y  
   - 11. Y  
   - 12. Y  
   - 13. Y  
   - 14. Y  
   - 15. Y  
   - 16. Y  
   - 17. Y  
   - 18. Y  
   - 19. Y  
   - 20. Y  
   - 21. Y  
   - 22. Y  
   - 23. Y  

3. Was the sample size justified?  
   - 1. N  
   - 2. N  
   - 3. N  
   - 4. PA  
   - 5. N  
   - 6. N  
   - 7. Y  
   - 8. N  
   - 9. N  
   - 10. N  
   - 11. N  
   - 12. N  
   - 13. N  
   - 14. N  
   - 15. Y  
   - 16. N  
   - 17. N  

4. Was the target/reference population clearly defined? (Is it clear who the research was about?)  
   - 1. Y  
   - 2. Y  
   - 3. Y  
   - 4. PA  
   - 5. Y  
   - 6. Y  
   - 7. Y  
   - 8. Y  
   - 9. Y  
   - 10. Y  
   - 11. Y  
   - 12. Y  
   - 13. Y  
   - 14. Y  
   - 15. Y  
   - 16. Y  

5. Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?  
   - 1. PA  
   - 2. PA  
   - 3. PA  
   - 4. PA  
   - 5. PA  
   - 6. PA  
   - 7. Y  
   - 8. Y  
   - 9. Y  
   - 10. Y  
   - 11. Y  
   - 12. Y  
   - 13. Y  
   - 14. Y  
   - 15. Y  

6. Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?  
   - 1. PA  
   - 2. PA  
   - 3. PA  
   - 4. PA  
   - 5. PA  
   - 6. PA  
   - 7. Y  
   - 8. Y  
   - 9. Y  
   - 10. Y  
   - 11. Y  
   - 12. Y  

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<tbody>
<tr>
<td>7. Were measures taken to address and categorise non-responders?</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>PA</td>
<td>N</td>
<td>PA</td>
<td>N</td>
<td>N</td>
<td>PA</td>
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<td>8. Were the risk factor and outcome variables measured appropriate to the aims of the study?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>PA</td>
<td>PA</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>9. Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialled, piloted or published previously?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>PA</td>
<td>Y</td>
<td>PA</td>
<td>PA</td>
<td>Y</td>
<td>Y</td>
<td>PA</td>
</tr>
<tr>
<td>10. Is it clear what was used to determine statistical significance and/or precision estimates? (E.g. p values, CIs)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>11. Were the methods (including statistical methods) sufficiently described to enable them to be repeated?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>PA</td>
<td>Y</td>
<td>PA</td>
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<tr>
<td><strong>Results</strong></td>
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<td>12. Were the basic data adequately described?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>Y</td>
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</tr>
<tr>
<td>14. If appropriate, was information about non-responders described?</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>PA</td>
<td>N</td>
<td>PA</td>
<td>N</td>
<td>N</td>
<td>PA</td>
</tr>
<tr>
<td>15. Were the results internally consistent?</td>
<td>Y</td>
<td>Y</td>
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<td>16. Were the results for the analyses described in the methods, presented?</td>
<td>Y</td>
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<td><strong>Discussion</strong></td>
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<td>17. Were the author’s discussions and conclusions justified by the results?</td>
<td>Y</td>
<td>Y</td>
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<td>18. Were the limitations of the study discussed?</td>
<td>Y</td>
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<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Other</td>
<td>19. There were no funding sources for the research or conflicts of interest which may affect the author’s interpretation of the results.</td>
<td>Y</td>
<td>Y</td>
<td>DK</td>
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<td>20. Was ethical approval or consent of participants obtained?</td>
<td>Y</td>
<td>PA</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>Y</td>
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</table>

**Overall Quality Assessment Rating:**

- **High quality:** ++
- **Acceptable:** +
- **Low:** -

**High quality:** Majority of criteria met. Little or no risk of bias. Results unlikely to be changed by further research.

**Acceptable:** Most criteria met. Some flaws in the study with an associated risk of bias. Conclusions may change in the light of further studies.

**Low quality:** Either most criteria not met, or significant flaws relating to key aspects of study design. Conclusions likely to change in the light of further studies (SIGN, 2014).
Appendix C

Author Guidelines for Submission to Brain Injury Journal

Instructions for authors

Thank you for choosing to submit your paper to us. These instructions will ensure we have everything required so your paper can move through peer review, production and publication smoothly. Please take the time to read and follow them as closely as possible, as doing so will ensure your paper matches the journal's requirements. For general guidance on the publication process at Taylor & Francis please visit our Author Services website.

This journal uses ScholarOne Manuscripts (previously Manuscript Central) to peer review manuscript submissions. Please read the guide for ScholarOne authors before making a submission. Complete guidelines for preparing and submitting your manuscript to this journal are provided below.

About the journal

Brain Injury is an international, peer-reviewed journal publishing high-quality, original research. Please see the journal’s Aims & Scope for information about its focus and peer-review policy.

Peer review

Taylor & Francis is committed to peer-review integrity and upholding the highest standards of review. Once your paper has been assessed for suitability by the editor, it will then be double blind peer-reviewed by expert referees. Find out more about what to expect during peer review and read our guidance on publishing ethics.

Preparing your paper

Brain Injury is committed to improving and maintaining the consistency and quality of manuscripts submitted and published. Authors are strongly encouraged to review and comply with the reporting guidelines relevant to their submission. Reviewers have been instructed to evaluate submissions on the basis of their conformity to the guidelines. The table below provides information about guidelines for different study types.

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Name</th>
<th>Source</th>
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<tbody>
<tr>
<td>Case reports</td>
<td>CARE</td>
<td><a href="http://www.care-statement.org/">www.care-statement.org/</a></td>
</tr>
<tr>
<td>Diagnostic accuracy</td>
<td>STARD</td>
<td><a href="http://www.stard-statement.org/">www.stard-statement.org/</a></td>
</tr>
<tr>
<td>Observational studies</td>
<td>STROBE</td>
<td><a href="http://strobe-statement.org/">http://strobe-statement.org/</a></td>
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</table>
All authors submitting to medicine, biomedicine, health sciences, allied and public health journals should conform to the Uniform Requirements for Manuscripts Submitted to Biomedical Journals, prepared by the International Committee of Medical Journal Editors (ICMJE).

**Submission types**

*Brain Injury* accepts the following types of submissions: original research and Letters to the Editor. Letters to the Editor will be considered for publication subject to editor approval and provided that they either relate to content previously published in the Journal or address any item that is felt to be of interest to the readership. Letters relating to articles previously published in the Journal should be received no more than three months after publication of the original work. Pending editor approval, letters may be submitted to the author of the original paper in order that a reply be published simultaneously.

Letters to the Editor can be signed by a maximum of three authors, should be between 750 and 1,250 words, may contain one table/figure and may cite a maximum of five references. All Letters should be submitted via ScholarOne Manuscripts and should contain a Declaration of Interest statement.

Some journals set a maximum length for submissions. Though *Brain Injury* does not have a specific limit, we prefer that manuscripts not exceed 5,000 words excluding abstract, references, tables, and figure legends. If articles are greater than 5,000 words, authors may be asked to shorten their manuscript.

**Structure**

Your paper should be compiled in the following order: title page; abstract; keywords; main text; acknowledgments; declaration of interest statement; references; appendices (as appropriate); table(s) with caption(s) (on individual pages); figures; figure captions (as a list).

**Formatting and templates**

Papers may be submitted in any standard file format, including Word and LaTeX. Figures should be saved separately from the text. The main document should be double-spaced, with one-inch margins on all sides, and all pages should be numbered consecutively. Text should appear in 12-point Times New Roman or other common 12-point font. For all manuscripts, gender-, race-, and creed-inclusive language is mandatory. Use person-first language throughout the manuscript (i.e., persons with brain injury rather than brain injured persons).

**Notes on style.** All authors are asked to take account of the diverse audience of *Brain Injury*. Clearly explain or avoid the use of terms that might be meaningful only to a local or national audience.

Some specific points of style for the text of original papers, reviews, and case studies follow:
Brain Injury prefers US to 'American', USA to 'United States', and UK to 'United Kingdom'.

Brain Injury uses conservative British, not US, spelling, i.e. colour not color; behaviour (behavioural) not behavior; [school] programme not program; [he] practises not practices; centre not center; organization not organisation; analyse not analyze, etc.

Single 'quotes' are used for quotations rather than double "quotes", unless the 'quote is "within" another quote'.

- Punctuation should follow the British style, e.g. 'quotes precede punctuation'.
- Punctuation of common abbreviations should follow the following conventions: e.g. i.e. cf. Note that such abbreviations are not followed by a comma or a (double) point/period.

- Dashes (M-dash) should be clearly indicated in manuscripts by way of either a clear dash (-) or a double hyphen (--).

- Brain Injury is sparing in its use of the upper case in headings and references, e.g. only the first word in paper titles and all subheads is in upper case; titles of papers from journals in the references and other places are not in upper case.

- Apostrophes should be used sparingly. Thus, decades should be referred to as follows: 'The 1980s [not the 1980's] saw ...'. Possessives associated with acronyms (e.g. APU), should be written as follows: 'The APU's findings that ...', but, NB, the plural is APUs.

- All acronyms for national agencies, examinations, etc., should be spelled out the first time they are introduced in text or references. Thereafter the acronym can be used if appropriate, e.g. 'The work of the Assessment of Performance Unit (APU) in the early 1980s ...'. Subsequently, 'The APU studies of achievement ...', in a reference ...

- Material to be emphasized (italicized in the printed version) should be underlined in the typescript rather than italicized. Please use such emphasis sparingly.

- n (not N), % (not per cent) should be used in typescripts.

- Numbers in text should take the following forms: 300, 3000, 30 000. Spell out numbers under 10 unless used with a unit of measure, e.g. nine pupils but 9 mm (do not introduce periods with measure). For decimals, use the form 0.05 (not .05).

**Style guidelines**

Submissions to Brain Injury should follow the style guidelines described in Scientific Style and Format: The CSE Manual for Authors, Editors, and Publishers (8th ed.). Merriam-Webster's Collegiate Dictionary (11th ed.) should be consulted for spelling.

**References**
References should be presented in a separate section at the end of the document, in accordance with Vancouver system guidelines (see *Citing Medicine*, 2nd ed.). The references should be listed and numbered based on the order of their first citation. Every reference should be assigned its own unique number. References should not be repeated in the list, with each mention given a different reference number, nor should multiple references be combined under a single reference number. Digits in parentheses (e.g., (1, 2)) should be used for in-text citations. Citations should precede terminal (e.g., periods, commas, closed quotation marks, question marks, exclamation point) and nonterminal punctuation (e.g., semicolons, colons). Reference numbers should not be placed in parentheses.

Author listings in references should be formatted as indicated below.

| 1 author | Smith A |

Models from US National Library of Medicine (NLM) resources (e.g., *MEDLINE, Index Medicus*), should be employed for abbreviating journal titles in the reference section. Examples of common reference types appear below.


Checklist: what to include

1. **Author details.** Please ensure everyone meeting the International Committee of Medical Journal Editors (ICJME) requirements for authorship is included as an author of your paper. All authors of a manuscript should include their full name and affiliation on the cover page of the manuscript. Where appropriate, please also include ORCiDs and social media handles (Facebook, Twitter or LinkedIn). One author will need to be identified as the corresponding author, with their email address normally displayed in the published article. Authors’ affiliations are the affiliations where the research was conducted. If any of the named co-authors moves affiliation during the peer-review process, the new affiliation can be given as a footnote. Please note that authorship may not be changed after acceptance. Also, no changes to affiliation can be made after your paper is accepted. Read more on authorship here.

2. **Structured abstract.** This summary of your article is normally no longer than 200 words.
For papers reporting original research, state the primary objective and any hypothesis tested; describe the research design and your reasons for adopting that methodology; state the methods and procedures employed, including where appropriate tools, hardware, software, the selection and number of study areas/subjects, and the central experimental interventions; state the main outcomes and results, including relevant data; and state the conclusions that might be drawn from these data and results, including their implications for further research or application/practice.

For review essays, state the primary objective of the review; the reasoning behind your literature selection; and the way you critically analyse the literature; state the main outcomes and results of your review; and state the conclusions that might be drawn, including their implications for further research or application/practice. Read tips on writing your abstract.

3. Keywords. Keywords are the terms that are most important to the article and should be terms readers may use to search. Authors should provide 3 to 5 keywords. Please read our page about making your article more discoverable for recommendations on title choice and search engine optimization.

4. Funding details. Please supply all details required by your funding and grant-awarding bodies as follows:

For single agency grants

This work was supported by the <Funding Agency> under Grant< number xxxx>.

For multiple agency grants

This work was supported by the <Funding Agency #1> under Grant< number xxxx>; <Funding Agency #2> under Grant <number xxxx>; and <Funding Agency #3> under Grant <number xxxx>.

5. Disclosure statement. With a disclosure statement you acknowledge any financial interest or benefit that has arisen from the direct applications of your research. Further guidance, please see our page on what is a conflict of interest and how to disclose it.

6. Supplemental online material. Supplemental material can be a video, dataset, fileset, sound file, or anything else which supports (and is pertinent to) your paper. Supplemental material must be submitted for review upon paper submission. Additional text sections are normally not considered supplemental material. We publish supplemental material online via Figshare.

7. Figures. Figures should be high quality (600 dpi for black & white art and 300 dpi for color). Figures should be saved as TIFF, PostScript or EPS files. Figures embedded in your text may not be able to be used in final production.

8. Tables. Please supply editable table files. We recommend including simple tables at the end of your manuscript, or submitting a separate file with tables.

9. Equations. If you are submitting your manuscript as a Word document, please ensure that equations are editable. Please see our page on mathematical symbols and equations for more
information.

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Guidelines for medicine and health publications

Disclosure of interest

Please include your disclosure statement under the subheading “Disclosure of interest.” If you have no interests to declare, please state this (suggested wording: The authors report no conflict of interest). For all NIH/Wellcome-funded papers, the grant number(s) must be included in the declaration of interest statement. Read more on declaring conflicts of interest here.

Clinical Trials Registry

In order to be published in a Taylor & Francis journal, all clinical trials must have been registered in a public repository at the beginning of the research process (prior to patient enrollment). Trial registration numbers should be included in the abstract, with full details in the methods section. The registry should be publicly accessible (at no charge), open to all prospective registrants, and managed by a not-for-profit organization. For a list of registries that meet these requirements, please visit the WHO International Clinical Trials Registry Platform (ICTRP). The registration of all clinical trials facilitates the sharing of information among clinicians, researchers, and patients, enhances public confidence in research, and is in accordance with the ICMJE guidelines.

Complying with ethics of experimentation

Please ensure that all research reported in submitted papers has been conducted in an ethical and responsible manner, and is in full compliance with all relevant codes of experimentation and legislation. All papers which report in vivo experiments or clinical trials on humans or animals must include a written statement in the Methods section. This should explain that all work was conducted with the formal approval of the local human subject or animal care committees (institutional and national), and that clinical trials have been registered as legislation requires. Authors who do not have formal ethics review committees should include a statement that their study follows the principles of the Declaration of Helsinki.

Consent. All authors are required to follow the ICMJE requirements on privacy and informed consent from patients and study participants. Please confirm that any patient, service user, or participant (or that person’s parent or legal guardian) in any research, experiment, or clinical
trial described in your paper has given written consent to the inclusion of material pertaining to themselves, that they acknowledge that they cannot be identified via the paper; and that you have fully anonymized them. Where someone is deceased, please ensure you have written consent from the family or estate. Authors may use this Patient Consent Form, which should be completed, saved, and sent to the journal if requested.

Health and safety. Please confirm that all mandatory laboratory health and safety procedures have been complied with in the course of conducting any experimental work reported in your paper. Please ensure your paper contains all appropriate warnings on any hazards that may be involved in carrying out the experiments or procedures you have described, or that may be involved in instructions, materials, or formulae.

Please include all relevant safety precautions; and cite any accepted standard or code of practice. Authors working in animal science may find it useful to consult the International Association of Veterinary Editors’ Consensus Author Guidelines on Animal Ethics and Welfare and Guidelines for the Treatment of Animals in Behavioral Research and Teaching. When a product has not yet been approved by an appropriate regulatory body for the use described in your paper, please specify this, or that the product is still investigational.

Submitting your paper

Brain Injury uses ScholarOne Manuscripts to manage the peer-review process. If you have not submitted a paper to this journal before, you will need to create an account in ScholarOne Manuscripts. Please read the guidelines above and then submit your paper in the relevant Author Center, where you will find user guides and a helpdesk.

If you are submitting in LaTeX, please convert the files to PDF beforehand (you will also need to upload your LaTeX source files with the PDF). Your manuscript must be accompanied by a statement that it has not been published elsewhere and that it has not been submitted simultaneously for publication elsewhere.

Authors should prepare and upload two versions of their manuscript. One should be a complete text, while in the second all document information identifying the author(s) should be removed from files to allow them to be sent anonymously to referees. When uploading files authors will then be able to define the non-anonymous version as "File not for review".

We recommend that if your manuscript is accepted for publication, you keep a copy of your accepted manuscript. For possible uses of your accepted manuscript, please see our page on sharing your work.

Data sharing policy

This journal applies the Taylor & Francis Basic Data Sharing Policy. Authors are encouraged to share or make open the data supporting the results or analyses presented in their paper where this does not violate the protection of human subjects or other valid privacy or security concerns.

Authors are encouraged to deposit the dataset(s) in a recognized data repository that can mint a persistent digital identifier, preferably a digital object identifier (DOI) and recognizes a long-term preservation plan. If you are uncertain about where to deposit your data, please see
Authors are further encouraged to cite any data sets referenced in the article and provide a Data Availability Statement.

At the point of submission, you will be asked if there is a data set associated with the paper. If you reply yes, you will be asked to provide the DOI, pre-registered DOI, hyperlink, or other persistent identifier associated with the data set(s). If you have selected to provide a pre-registered DOI, please be prepared to share the reviewer URL associated with your data deposit, upon request by reviewers.

Where one or multiple data sets are associated with a manuscript, these are not formally peer reviewed as a part of the journal submission process. It is the author's responsibility to ensure the soundness of data. Any errors in the data rest solely with the producers of the data set(s).

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Please note that Brain Injury uses CrossRef Similarity Check™ (Powered by iThenticate) to screen papers for unoriginal material. By submitting your paper to the journal you are agreeing to originality checks during the peer-review and production processes.

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We will deposit all National Institutes of Health or Wellcome Trust-funded papers into PubMedCentral on behalf of authors, meeting the requirements of their respective open access (OA) policies. If this applies to you, please ensure that you have included the appropriate funding bodies in your submission’s funding details section. You can check various funders’ OA policy mandates here and find out more about sharing your work here.

Open access

This journal gives authors the option to publish open access via our Open Select publishing program, making it free to access online immediately on publication. Many funders mandate publishing your research open access; you can check open access funder policies and mandates here.

Taylor & Francis Open Select gives you, your institution or funder the option of paying an article publishing charge (APC) to make an article open access. Please contact openaccess@tandf.co.uk if you would like to find out more, or go to our Author Services website.

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Appendix D

Participant Information Sheet

TBI, HAB, ER & Violence
Version 3 12/12/2018
IRAS ID: 240644

Participant Information Sheet

Study Title: The relationship between brain injury, hostile interpretations, emotions and violent offending.

You are being invited to take part in a research study. Before you decide if you would like to take part, please take time to read the following information carefully.

What is the purpose of this study?
To find out if having experienced a brain injury makes people more likely to be violent because of the way they interpret the behaviour of others, and manage their emotions. This research is being completed as part of an educational qualification.

Why am I being invited to take part?
You are being invited to take part as the research is with prisoners.

Do I have to take part?
No, it is entirely up to you. If you do decide to take part, the answers that you give will not affect your prison sentence, the treatment you receive from the prison service or any of your legal rights. Also, if you decide to take part, then change your mind and no longer want to participate, that is fine. You can be taken out of the study at any time, without any consequences.

What will I have to do if I take part?
1). You will be asked to put your name on an individual “sign-up sheet” which can be found at study information sessions, at the health care centre and on prison landings.
2). When you have completed the sign-up sheet, it can be placed in the mental health referrals box (located on the prison landings) or it can be given directly to the researcher (Geraldine O'Hagan) or prison staff.
3). If you sign up, you are giving Geraldine permission to find out if you are eligible to take part in the study, by speaking to prison officers or health care staff.
4). To be eligible to take part, you must:
   - Be between the ages of 21 – 65 year’s old
   - Be able to speak and understand the English language
   - Not have an intellectual disability
5). If you are eligible, you will be invited to a research appointment with Geraldine.

6). Research appointments will take place in the health care centre and should take approximately 30-40 minutes. **You will be asked to attend 1 research appointment only.**

7). At this appointment, you will go over the participant information sheet again with Geraldine. You will be given an opportunity to ask any questions you have about the study. You will then be asked to read and sign a consent form.

8). You will be asked to complete 3 questionnaires. The questionnaires aim to find out:
   - if you have ever had a brain injury
   - how you interpret other people’s behaviour
   - how you think about and deal with your emotions

9). If you have any difficulties with reading or writing you can still take part as Geraldine will help you.

10). Geraldine will also need to look at information about your offending history which is held in your offender management records. This will include looking at the number of convictions you have, the types of offences you have committed and the number and length of prison sentences. The researcher will also collect information about your age, gender and participation in treatment programmes.

11). Geraldine will also need to access your health care records. This will be to let health care staff and your General Practitioner (GP) know that you have taken part in the study. If your answers to the brain injury questionnaire suggests that you may have had a brain injury, Geraldine will also let the prison health care team and your GP know. A letter will be sent to your GP and the prison health care team highlighting the above.

12). Geraldine will let you know during the research appointment if the answers you provided suggest that you may have had a brain injury. Geraldine will advise you to seek further advice from the prison health care team or your GP if you wish to do so.

13). Not everyone will be eligible to take part; if this is the case for you, you will receive a sheet to let you know.

**You will not be asked to discuss your offences with the researcher at any time.**

**What are the risks of taking part?**
The risks of taking part are small. However, it is possible that some of the questions you are asked may bring up some difficult thoughts and feelings. Geraldine will be available to discuss this with you during the appointment. You could also use the support of the chaplaincy or the support services offered via the mental health team.

**What are the possible benefits of taking part?**
Taking part is unlikely to benefit you directly. However, it is hoped that findings will help to improve our understanding of some of the difficulties people may experience after they have a brain injury and how this may affect their offending behaviour.

**What will happen to the information I give?**
All information will be anonymised and held in locked drawers in a secure office on NHS premises, and in password protected electronic folders on NHS computers. Your name will not be used on any of the information and instead you will be given a research code to protect confidentiality. Only the research team will have access to the data.

If you disclose information during participation that causes concern about your safety, or
the safety of others, this will be shared with prison staff and health care staff. If you disclose information regarding illegal activity, then this information may also be shared with relevant professionals. Where possible, you would be fully informed of this decision. When the study is written up, your name and any information which may identify you will be removed so there is no possibility of you being identified. After the study is completed, the data collected as part of the study will be kept in a secure location within the Scottish Prison Service (SPS) for a period of 5 years. Additionally, a copy of the anonymised data will be provided to the University of Edinburgh to be kept on the university's long-term electronic storage system as an anonymised database for a minimum of 3 years.

**What are my data protection rights?**
The University of Edinburgh is a Data Controller for the information you provide. You have the right to access information held about you. Your right of access can be exercised in accordance with Data Protection Law. You also have other rights including rights of correction, erasure and objection. For more details, including the right to lodge a complaint with the Information Commissioner’s Office, please visit [www.ico.org.uk](http://www.ico.org.uk). Questions, comments and requests about your personal data can also be sent to the University Data Protection Officer – [dpo@ed.ac.uk](mailto:dpo@ed.ac.uk)

**What will happen to the results of the research study?**
The research is being completed as part of a doctorate in clinical psychology and will be written up in the form of a thesis, a copy of which will be stored at the University of Edinburgh's library. The study may also be presented for publication at a later date. You can request a summary of the results from the mental health team when the study is completed. The researcher also hopes to deliver a presentation of the findings of the study to SPS staff and participants.

**Who is organising & funding the research?**
The study is being organised by Geraldine O'Hagan (trainee clinical psychologist). The study is being sponsored and funded by the University of Edinburgh.

**Who has reviewed the study?**
The study has been reviewed and approved by the SPS Research Access Ethics Committee. Additionally, all research in the NHS is looked at by an independent group of people called a Research Ethics Committee. The East of Scotland Research Ethics Service REC 2, which has responsibility for scrutinising all proposals for medical research on humans, has examined the proposal and has raised no objections from the point of view of research ethics. It is a requirement that your records in this research, together with any relevant medical records, be made available for scrutiny by monitors from the University of Edinburgh and NHS Tayside, whose role is to check that research is properly conducted and the interests of those taking part are adequately protected.

**Researcher Contact Details**
If you would like any further information please do not hesitate to contact Geraldine O'Hagan via the mental health team in the prison, where she will be based 1-2 days a week until April 2019. Geraldine can also be contacted via email [geraldine.ohagan@nhs.net](mailto:geraldine.ohagan@nhs.net) or you can telephone 01382 346160 and leave a message for Geraldine with Linda Scott (Office Manager & Personal Assistant to Prof. Power, Director of Psychology).

**Independent Contact Details**
If you would like to discuss this study with someone independent of the study team, please contact Lucie Michalova (trainee clinical psychologist) via email [l.michalova@nhs.net](mailto:l.michalova@nhs.net) or telephone 01382 346160 and leave a message for Lucie with Linda Scott (Office Manager &
What can I do if I would like to make a complaint?
If you wish to make a complaint about the study please contact the University of Edinburgh’s Research Governance team via email at resgov@accord.scot Complaint forms are also freely available on the prison halls.

What do I do next if I want to take part?
If you do decide to take part, please complete an individual sign-up sheet which can be found at study information sessions, at the health care centre and on prison landings.
Appendix E

Individual Sign-Up Sheet

Study Title: The relationship between head injury, hostile attributions, emotions and violent offending.

• I have received a participant information sheet for the above study and I am interested in taking part.

• I am aware that by signing up, I am giving my consent to allow the study researcher, Geraldine O’Hagan (Trainee Clinical Psychologist), to liaise with prison and/or healthcare staff to find out if I am eligible to take part in the study.

• I am also aware that signing up DOES NOT mean that I have to take part in the study.

Print Name: __________________________________________

Signature: ____________________________________________

Prison Number: _______________________________________

Date: _______________________________________________
Appendix F
Participant Consent Form

PARTICIPANT CONSENT FORM
Study Title: The relationship between brain injury, hostile attributions, emotions and violent offending.

1. I confirm that I have read and understand the information sheet (12/12/2018, Version 4) for the above study. I have had the opportunity to consider the information, ask questions and have had these questions answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without my medical care, legal rights and/or treatment provided to me by the prison service being affected.

3. I give permission for Geraldine O’Hagan (chief investigator) to access my offender management records and healthcare records for the purposes of this research study.

4. I understand that relevant sections of my medical records and data collected during the study may be looked at by individuals from the regulatory authorities and from the Sponsor (the University of Edinburgh) or from the NHS Board where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.

5. I agree to my General Practitioner (GP) and the prison health care team being informed about my participation in this study.

6. I agree to my GP and the prison health care team being informed if the responses I give to the brain injury questionnaire suggest that I may have had a brain injury.

7. I agree to take part in the above study.
Name of Person Giving Consent  Date  Signature  Prison Number
____________________________________________________________________  __________   __________________________  _______________
Name of Person taking Consent  Date  Signature
____________________________________________________________________  __________  __________________________
Appendix G

Flow Diagram of Participation

TBI, HAB, ER & Violence, Version 2 12/12/18

Taking part in the research study

1) Sign the sign-up sheet

2) Place the sign-up sheet in the mental health referrals box or give it to a member of staff.

3) The researcher will check to see if you are eligible to take part. You must be between the ages of 21 – 65 years old, be able to speak and understand the English language, and not have an intellectual disability.

4) If you are eligible, a research appointment will be arranged.

5) You will be asked to attend 1 research appointment. It will last 30 – 40 minutes.

6) During this appointment, you will go through the participant information sheet, read and sign a consent form, and you will be asked to complete 3 questionnaires. Geraldine will be there to help you with this.
7) You will be asked for your permission to allow the researcher to get information from your offender management records and to access your health care records.

8) Confidentiality: Your name will not be used on any of the information collected and instead you will be given a research code to help ensure you cannot be identified.

9) Results: The findings of the study will be written up as a piece of work for the University of Edinburgh and they may also be put forward to be published in a journal. You can also request a copy of the results from the mental health team.
1. INTRODUCTION

1.1 BACKGROUND & SCIENTIFIC JUSTIFICATION

Traumatic Brain Injury (TBI) in Offending Populations

A history of TBI can have a range of detrimental effects including behavioural consequences (lack of inhibition and violence), social effects (lack of emotional awareness and empathy), and cognitive impairment (slowness in information processing and impulsivity) (Durand et al., 2017). Due to the fact that there may be no outward signs of TBI, there is a potential for it to go unidentified. Unidentified TBI could have a considerable impact on an offender’s behaviour, for example, they may have difficulty adhering to prison rules and it could potentially contribute to recidivism (NPHI, 2016). Lord Bradley’s (2009) report indicated that efforts are being made to attend to the needs of vulnerable offenders with intellectual disabilities and mental health problems, however, the needs of offenders who have a history of TBI continues to be poorly addressed (Pitman et al., 2015).

Several studies indicate that the prevalence of TBI among incarcerated populations is much higher than in the general population, suggesting an association between TBI and criminality (Farrer & Hedges, 2011). In a French prison study, Durand and colleagues (2016) found a TBI prevalence rate of 30.6%. A UK study identified TBI prevalence rates of 60.7% in prison sample, they also found that those who had a history of TBI entered the custodial system at a younger age, had higher rates of repeat offending and three or more TBIs were associated with more violent offences (Williams et al.,
Research also indicates that TBI is associated with mental health problems, increased alcohol and cannabis use, a significantly higher number of incarcerations and total time spent in prison (Durand et al., 2016). A recent systematic review reported that TBI prevalence rates in prison ranged from 9.7% to 100% with an average rate of 46% (Durand et al., 2017). Whilst the literature provides evidence of a strong association between TBI and delinquency, no causal link has yet been established; it has therefore been recommended that future research further examines this relationship (Durand et al., 2017).

**TBI & Violence**

The impact of violence is profound in terms of social, legal, political, financial and human costs, therefore, there is a need to understand factors predisposing individuals to engage in violence, develop preventative strategies for those at risk of being violent and for those who are violent (Hancock et al., 2010).

A Swedish, population-based, longitudinal study examined TBI history with subsequent violent crime (Fazel et al., 2011). It found that 8.8% of TBI cases committed violent crime after diagnosis, which when compared to matched controls, presented a markedly increased risk (Fazel et al., 2011). Pitman and colleagues (2015) identified that prisoners who had a history of TBI were more likely to have committed a violent offence, with a prevalence rate of violent offending of 60.4% in the TBI group compared to 38% of controls. However, a criticism of this study is that controls were only broadly matched in terms of demographics, with the researchers themselves identifying the need for more “sophisticated” matching methods to enable more powerful control of potential confounding variables, such as, severity of drug use (Pitman et al., 2015).

Head injury is associated with violence and violent offending, however, most individuals who sustain a TBI do not become violent. Ambiguity remains in relation to the mechanisms that mediate or moderate this association (Kenny & Lennings, 2007).

**Hostile Attribution Bias & TBI**

Hostile attribution bias (HAB) can be defined as the tendency to interpret the intent of others as being hostile, despite social and environmental cues being ambiguous (Milich & Dodge, 1984). A recent study examining negative attributions and anger following TBI defined negative attributions as judgments of intent, hostility and blame in relation to the behaviour of others (Neumann, Malec & Hammond, 2017a). The study compared negative attributions made by individuals with and
without a history of TBI and examined the extent to which negative attributions predicted angry ratings in response to 3 different hypothetical scenarios (Neumann et al., 2017a). Hypothetical scenarios encompassed a benign, an ambiguous and a hostile character portrayal (Neumann et al., 2017a). Participants were required to rate their levels of irritation and anger in response to the situation, and rate how intentional, hostile, and blameworthy they perceived the characters' behaviours (Neumann et al., 2017a). Results indicated that individuals who had sustained a TBI had significantly higher ratings of irritation and anger, and attributions of intent, hostility and blame compared with healthy controls, across all scenarios. The authors concluded that individuals with TBI may have greater negative attribution bias, in which they disproportionately judge the intent, hostility, and blameworthiness of others' behaviours, which contributes to feelings of anger (Neumann et al., 2017a). They identified the need for replication of the study with larger samples and the need for further examination of characteristics associated with negative attribution bias (Neumann et al., 2017a).

**Hostile Attribution Bias & Violence**

Research suggests that aggressive individuals exhibit a strong tendency to attribute hostile intent in the behaviour of others, which may partly explain socially inappropriate and aggressive reactions in this group (Dodge, 1980; Dodge, 2006, De Castro et al., 2002 and Schonenberg & Jusyte, 2014). A study by Schonenberg and Jusyte (2014) investigated hostile response bias to emotionally ambiguous faces in sample of antisocial violent offenders compared to matched controls. Results suggested that aggression was associated with a tendency to interpret ambiguous facial expressions (specifically those with subtle angry features) as hostile; furthermore, violent offenders also displayed a tendency to overrate the perceived intensity of anger compared to controls (Schonenberg & Jusyte, 2014). However, this study had several limitations such as the use of a control group who were matched only in age and education level. This may have resulted in confounding variables, such as the effects of incarceration, impacting on the results (Schonenberg & Jusyte, 2014).

A more recent study examined responses to morphed fear-anger faces across 3 groups which included prisoners with a history of violent crimes, prisoners convicted of child sexual abuse (CSA) and matched controls from the general population (Wegrznl, Westphal & Kissler, 2017). Results demonstrated that violent offenders presented with a reliable HAB as they rated ambiguous fear-anger expressions as more angry, compared to both perpetrators of CSA and matched controls (Wegrznl et al., 2017). The authors suggested that HAB may be one mechanism which drives violent
behaviour in aggressive individuals (Wegrznl et al., 2017). Research also suggests that HAB may serve as a maintaining factor for aggressive behaviour as it potentially increases the likelihood of an aggressive response; if an aggressive individual infers hostile intent in the behaviour of others, they may believe that violent behaviour is justifiable as they may consider it to be retaliation as opposed to instigation ((Holtzworth-Munroe, 1991, as cited in Helfritz-Sinville & Stanford, 2014). A better understanding of HAB could inform prognosis in relation to recidivism and potentially help develop more tailored therapeutic interventions (Wegrznl et al., 2017)

**Emotional Regulation, TBI & Violence**

Emotional regulation is a multidimensional construct which encompasses awareness, clarity and acceptance of one’s emotions, the ability to tolerate distress, engage in goal-directed behavior when upset, control impulsive behaviours and to use effective and adaptive emotional regulation strategies (Gratz & Roemer, 2004, Garofaloa & Velotti, 2017). If an individual lacks or displays undeveloped skills in at least one of the aforementioned areas, it is defined as emotion dysregulation (Gratz & Roemer, 2004, Miles et al., 2017).

Difficulties with emotion regulation are among the most common and debilitating sequelae of TBI (Enberg & Teasdale, 2004, Draper et al., 2007, Wood et al., 2005 and Dethier et al., 2013). A study by Anson and Ponsford (2006) examined coping and emotional adjustment following TBI; results indicated that approximately 50% of the TBI sample had clinically significant levels of anxiety and depression. Higher levels of anxiety, depression, psychosocial dysfunction and lower levels of self-esteem were also more pronounced in individuals who had a tendency to employ non-productive coping strategies such as avoidance, self-blame, and the use of drugs and alcohol (Anson & Ponsford, 2006).

Furthermore, research indicates that TBI commonly impairs both the expression and experience of negative affect; individuals may decrease their levels of self-monitoring and self-control, which may manifest in displays of irritability, aggression, impulsivity, and quick-temper (Elsass & Kinsella, 1987; Grattan & Eslinger, 1989; Newton & Johnson, 1985 as cited in Dethier et al., 2013). Research also indicates that alexithymia is prevalent in individuals who have sustained a TBI and may play a contributory role in emotional dysregulation (Williams & Wood, 2010; Wood & Williams, 2007). Alexithymia is defined by Sifneos (1973) as difficulty identifying and communicating feelings, differentiating feelings and body sensations, reduced fantasy, and an externally oriented cognitive style (as cited in Dethier et al., 2013). A recent study examined the acceptability and initial efficacy
of an emotional self-awareness treatment aimed at reducing alexithymia and emotion dysregulation in individuals with TBI (Neumann, Malec & Hammond, 2017b). Results depicted positive changes which suggests that emotional dysregulation is “treatable” following TBI, however, it is acknowledged that this was a phase 1 trial with a small sample size (Neumann et al., 2017b).

Emotional dysregulation that manifests as anger/aggression can have a powerful impact on the individual and their relationships with others (Winegardner et al., 2016). Research suggests that impairments in emotional regulation domains have been consistently linked with aggressive tendencies (physical aggression in particular), across a range of populations, including undergraduates, psychiatric patients, juvenile and adult offending populations (Garofaloa & Velotti, 2017). It has been hypothesized that emotional dysregulation may make it difficult to inhibit aggressive impulses and displays of violence can serve to regulate the negative affect (Tharp et al., 2013).

A study by Tager, Good, and Brammer (2010) examined emotion dysregulation, masculine norms, and abuse perpetration among a clinical sample of men referred for domestic assault. Results indicated that emotion dysregulation and the masculine norm of dominance accounted for approximately 25% of the variance in self-reported intimate partner abuse. Emotion dysregulation was the strongest predictor of reported abuse, uniquely accounting for approximately 18% of the variance. The researchers highlighted that the findings suggest that males who perpetrate domestic violence may be utilizing maladaptive emotional regulation strategies whereby they externalize and attempt to change their partner’s behavior as opposed to directly addressing their internal emotional state (Tager et al., 2010). Tager and colleagues (2010) suggest that dialectical behavior strategies which include emotional regulation skills and strategies to increase distress tolerance, may be helpful in reducing intimate partner violence and abuse.

**Conclusion**

Despite the fact that a high prevalence of TBI in prison populations has been confirmed, no causal link has been established between TBI and criminality due to a multitude of potential confounding factors, a lack of control groups in studies and a lack of TBI normative data in the general population (Durand et al., 2017). A recent systematic review recommended that public health professionals go further to examine the link between TBI and criminality, suggesting that a clinical study be conducted to compare prisoners with and without TBI in relation to associated factors (Durand et al., 2017).
Evidently, as this literature review suggests, there are links between TBI, emotional dysregulation, HAB and violence. However, to the author’s knowledge, no study has examined emotional dysregulation, HAB, TBI and violent offending in the one model. This author proposes to examine the relationship between TBI and violent offending in a Scottish prison population by investigating the mediating roles of emotional regulation and HAB. This study has strong clinical utility as if the findings indicate that emotional dysregulation and/or HAB act as mediators, it identifies these domains as potential treatment targets. Interventions tailored to address emotional dysregulation and HAB could potentially lead to more effective rehabilitation and reduce recidivism rates in relation to violent offending. This will have benefits not only for the individual affected by a TBI, but also society as a whole, in terms of both the human and financial costs of violent offending.

Additionally, the proposed study aligns with recommendations made by the National Prisoner HealthCare Network’s Report on Brain Injury and Offending (NPHN BIO, 2016) which include: determining the prevalence of disability in offenders arising from TBI and examining the viability of TBI screening tools in prison populations. The literature suggests that there is a need for a study of this nature as currently it appears that “TBI is being largely unrecognised, undiagnosed and essentially unmanaged within the criminal justice system (CJS)” (Pitman et al., 2015).

**Risks**

**Participant Distress**

Recalling history of Traumatic Brain Injury (TBI) may potentially bring up some difficult memories for participants. The CI is a trainee clinical psychologist and will be able to respond appropriately and empathically to any emotional/psychological distress displayed in relation to this or any of the measures completed. Additionally, the CI will be closely supervised by qualified psychologists and will be able to discuss any risk related concerns with her supervisors. If any immediate risks are identified, the CI will follow the risk management procedures of HMP Perth and HMP Castle Huntly. If appropriate, the CI will also encourage the participant to access support through the chaplaincy or support services offered via the mental health team. Additionally, participants will be made aware that they can withdraw from the study at any stage up to the point of data analysis.

**Confidentiality Breach**

It is a potential risk that participant confidentiality will be breached. To minimize this risk, all participants will be assigned an anonymous participant ID. Participant’s name and corresponding ID will be entered onto an Excel document which will be stored and accessible on NHS computers only.
The document will be password protected and will only be accessible by the study researchers. All study measures completed will use participant IDs. Hard copies of measures will be transferred from the prison setting to a psychology department in NHS Tayside. Transportation of hard copies of measures will be via a locked case which will be in the CI’s possession, providing a second level of security. Hard copies of all measures will be stored within locked cabinets which are only accessible by the CI. All anonymised data will be entered into an excel database which will be password protected and stored in a different folder from the excel document containing identifiable participant IDs. Password protected, excel folders will be stored in a limited access area of the NHS Tayside server which is backed up daily. The information will only be stored and accessible on NHS computers by the study researchers. If any data is required to be transferred to a USB, the USB will be encrypted for security and confidentiality purposes. There will be no identifiable participant information stored on university computers.

The only circumstances in which confidentiality will be breached is if a participant is identified as being a risk of harm (to self or others) and the benefits such as ensuring participant safety justifies a confidentiality breach. Additionally, should participants make a criminal disclosure while participating in the study, confidentiality will be breached and relevant professionals informed (in line with local procedures at HMP Perth and HMP Castle Huntly).

All confidential research data obtained from SPS will be property of the crown and will be kept securely for up to a maximum of 60 months on completion of the research and destroyed thereafter, as per guidelines set out by SPS. A copy of the anonymised electronic data will be provided to the University of Edinburgh. This will be kept on the university’s long term electronic storage system as an anonymised database for a minimum of 3 years. The data will not be used for studies in the future.

The study researchers will also adhere to NHS Tayside Code of Confidentiality and Data Protection as part of routine practice.

**Researcher Safety**

The CI will be running information sessions with groups of offenders. Kimberly Sham Ku (Forensic Psychologist & study researcher) will be present at these information sessions and a SPS Prison Officer will also be present to provide an extra level of security. The CI will also be running individual research appointments and therefore, will be meeting directly with offenders, some of whom will have a history of violent offences. Ensuring CI safety is therefore important. All appointments will be
conducted in the prison healthcare centre or in prison interview suites which have appropriate security arrangements. At no time will the CI conduct research meetings in environments that may compromise her safety. Additionally, the CI will have a personal alarm and will adhere to local SPS policies and procedures designed to ensure worker safety and manage risk. Furthermore, the CI will be completing Personal Protection Training prior to starting recruitment. The CI has also worked as psychology assistant in a prison service and is therefore familiar with the prison environment and working with this client group.

**Benefits**

There are no direct benefits to research participants. Participation in the study will not affect participant's care, life in prison or parole in any way which will be highlighted to participants in the information session and the participant information sheet.

However, when the CI disseminates the findings of the study upon completion, it is hoped it may increase participant's knowledge and understanding about relevant factors that may be contributing to their own forensic psychopathology. It is also hoped that the study will lead to further avenues of research in relation to TBI and offending, and potentially provide evidence for the need to develop more tailored treatment programmes.

**2. STUDY OBJECTIVES**

**2.1 Primary Objective**

1). Do emotional dysregulation and/or hostile attribution bias play a role in explaining the relationship between history of traumatic brain injury (TBI) and violent offending? Essentially, does the relationship between TBI and violent offending change with higher or lower levels of emotional regulation and hostile attribution bias?

**2.2 Secondary Objectives**

2). Do offenders with a history of TBI have a more severe history of violent offending?

3). Do offenders with a history of TBI display greater emotional dysregulation compared to offenders without a history of TBI?

4). Do offenders with a history of TBI display greater hostile attribution bias compared to offenders without a history of TBI?

**3. HYPOTHESES**
3.1 Primary Hypothesis

1). Emotional regulation and hostile attribution bias will contribute to the explanation of the relationship between history of TBI and violence offending. As levels of hostile attribution bias and/or emotional regulation difficulties increase, the strength of the relationship between history of TBI and violent offending will increase.

3.2 Secondary Hypotheses

2). Offenders with a history of TBI will have a more severe history of violent offending as evidenced by higher scores on the Violence Rating Scales (VRS) (Gunn & Robertson, (1976); Robertson et al., (1987)).
3). Offenders with a history of TBI will display greater emotional dysregulation compared to offenders without a history of TBI.
4). Offenders with a history of TBI will display greater hostile attribution bias compared to offenders without a history of TBI.

4. STUDY DESIGN

The study will use a cross sectional design. The independent variable is history of TBI as measured by the Ohio State University TBI identification method (OSU TBI-ID). The dependent variable is history of violence which will be measured by examining a participant’s offending history and this data will be operationalised using the Violence Rating Scales (Gunn & Robertson, (1976); Robertson et al., (1987)). The study will employ a mediation model to examine ER and hostile attributions as potential mediators in the relationship between TBI and violence. Emotional regulation will be examined using the Difficulties in Emotional Regulation Scale (DERS, Gratz & Roemer, 2004). Hostile attribution bias will be examined using the Hostile Interpretations Questionnaire (HIQ) (Mamuza & Simourd, 1997).

5. STUDY POPULATION

5.1. Study Participants

The study is with a forensic population and the setting will be HMP Perth and HMP Castle Huntly. Participants will be adult male offenders between 21 – 65 years old who are currently incarcerated at HMP Perth and HMP Castle Huntly. HMP Perth is a maximum security prison which receives adult male offenders predominantly from the court services in Perth and Kinross, Dundee, Angus and Fife. Its capacity is approximately 630 offenders and population includes offenders on remand, short term offenders (serving less than 4 years), long term offenders (serving 4 years or more) and sex offenders. Castle Huntly is an open prison with the capacity to accommodate 285 low supervision
adult male offenders. Offenders can progress to Castle Huntly after a period in a closed prison and a robust risk management process. The focus in HMP Castle Huntly is on preparing offenders for release by enhancing personal responsibility, increasing job readiness and positive citizenship, with the aim of reducing recidivism.

A power calculation indicated that approximately 77 participants will be required for the study (see sample size calculation section). Potential participants will be invited to attend an information session regarding the study (the study will be advertised in the prisons using posters). If individuals decide to participate and are eligible, they will be asked to meet with the CI on one occasion only. This will be to complete the measures and provide their consent for the CI to access their offender management and healthcare records. The CI aims to present the findings of the study to interested participants and staff once it has been completed and assessed. It is estimated that this could take up to 18 months from the participant’s initial research appointment.

5.2. Inclusion Criteria
- Male offenders between the ages of 21 - 65 years’ old
- Proficient in the English language
- Able to provide informed consent.

5.3. Exclusion Criteria
- Known diagnosis of an intellectual disability

6. PARTICIPATION SELECTION & ENROLMENT

6.1. Identifying Participants
- Posters raising awareness of the research study and advertising study information sessions will be put up in the prison healthcare centre and the prison landings. If prisoners are interested in taking part, they can choose to attend an information session.
- Study information sessions will take place with staff and groups of offenders to inform them about the study and allow them the opportunity to ask any questions. Offenders may also be informed about the study by members of the healthcare team. Offenders will also be provided with a participant information sheet. These will be available at the information sessions/in the healthcare suite and on prison landings.
- If individuals are interested, there will be individual sign-up sheets available at the information sessions/in the healthcare suite/ and on the landings. Individual sign-up sheets will be placed in a mental health referrals box once completed. This box is confidential and is organised each day by
ment health care staff. Mental health care staff will pass on the individual sign-up sheets to the study researchers (Geraldine O'Hagan (CI) and Kimberly Sham Ku (Forensic Psychologist & study researcher). Alternatively, individual sign-up sheets can be given directly to Geraldine O'Hagan (CI) or the member of staff who has spoken to the individual about the study, to be passed on to the CI.

- There will be an opt-in clause (highlighted during the information session; in the individual sign-up sheet and in the participant information sheet), that if interested participants’ sign-up, they are providing their consent to allow the study researchers to liaise with prison staff, to ascertain if they meet eligibility criteria before a research appointment is scheduled.

- If a potential participant meets eligibility criteria, a research appointment will be scheduled. There will be at least 24 hours between the individual being provided with the participant information sheet and the research appointment to allow individuals sufficient time to contemplate their participation. Individuals who are eligible to take part will receive a research appointment letter.

- If an interested participant does not meet eligibility criteria, they will receive a sheet highlighting, in a sensitive manner, that not everyone will be eligible to take part in the study.

- If information sessions are over-subscribed and individuals who expressed interest in attending cannot be accommodated, they will be sent a participant information sheet by mail and a research appointment will be offered. At this research appointment they will be provided with the opportunity to ask any questions they might have about the study and they will be given the opportunity to participate in the study. They will have received the participant information sheet via mail at least 24h hours before this appointment which will allow them sufficient time to contemplate their participation.

6.2. Consenting Participants

During the research appointment, individuals can ask any further questions they have about the study. If they are happy to proceed, informed consent will be taken and the research measures administered. Participants will be reminded that participation is voluntary and they can withdraw their consent at any time up to the point of data analysis.

7. STUDY PROCEDURE & MEASURES

7.1. Study Procedure

Procedure

Due to the nature of the secure prison environment, participants must be escorted to appointments by a prison officer. Participants who are incarcerated in the same landing/house will be scheduled consecutively if possible to ease prison officer time burden. The study will involve 1 research
appointment only and will take approximately 30 - 40 minutes. Initially, the participant information sheet will be revised with the individual to ensure they have a full understanding of what participation in the study involves. Consent forms will then be completed. Consent forms will include access to participant’s demographic information on the offender management system to include gender and age. This will be used in a description of the population. The researcher will also want to ascertain from offender management records if a participant has participated in any treatment programmes as this may be an important factor to consider, for example, participation in an anger management programme.

Consent forms will also request access to an offender’s health care records. This will be to ascertain if they are registered with the prison General Practitioner (GP) or a community GP as a participant’s GP must be informed of their participation in the study. Additionally, access to health care records is required to allow the CI to document an individual’s participation in the study. Furthermore, if a participant’s responses on the TBI screen suggest that they have had a TBI, the participant’s GP and the prison health care team will be informed about this. The aforementioned information will be included in a letter to the GP, a copy of which will also be sent to the prison health care team. The researcher will be able to ascertain during the research appointment if a participant has screened in for a TBI. The researcher will let the participants know, that the responses they have provided, suggest that they may have had a TBI. Participants will be told that their GP and the prison health care team will be informed (this is included in the participant information sheet and the consent form). Participants will be advised to speak to their GP or prison health care should they wish to seek further advice.

The research appointment will involve completion of a TBI screen and 2 questionnaires (1 examining emotional dysregulation and 1 assessing hostile attribution bias). Measures will be discussed in greater detail below.

7.2. Study Measures

The Ohio State University TBI Identification Method (OSU-TBI-ID)

The Ohio State University Traumatic Brain Injury Identification (OSU-TBI-ID) instrument was designed to identify the prevalence and severity of TBI. Research indicates that it has both high levels of validity and reliability, particularly in relation to test retest reliability and inter-rater reliability (Ray & Richardson, 2017). It has been used in several studies, across a range of populations, including military personnel, veterans, and offenders (Bogner & Corrigan, 2009;
Additional, in a systematic review of TBI in prison populations, O’Rourke and colleagues (2016) connote that the high degree of variation in TBI prevalence rates may be attributable to inconsistencies in the way TBI is measured, as only 7 studies used valid and reliable screening tools. The researcher proposes to use the OSU-TBI ID as it is deemed both reliable and valid. It is also freely available (www.ohiovalley.org/tbi-id-method). The short form which takes 3 – 5 minutes to administer will be utilised, as recommended by the NPHG BIO report.

**Difficulties in Emotional Regulation Scale (DERS, Gratz & Roemer, 2004)**

The DERS is a self-report measure which comprises of 36 items that assess emotion dysregulation. Participants are asked to rate how often each item applies to them, and responses are scored on a 5-point Likert scale ranging from 1 (almost never) to 5 (almost always), with higher scores indicating a greater severity of emotion dysregulation. The measure has 6 subscales which relate to specific domains of emotional regulation which include: non-acceptance of emotional responses, difficulties engaging in goal-directed behavior when upset, difficulties controlling impulsive behavior under negative emotional arousal, poor emotional awareness, limited access to effective emotion regulation strategies and poor emotional clarity. Gratz and Roemer (2004) provided evidence of construct validity, they report an internal consistency estimate of .93, and 2-week test–retest reliability estimate of .88 (Gratz & Roemer, 2004, Tager et al., 2010). The measure has been used in a range of populations which include individuals who have sustained a TBI (Neumann et al., 2017b) and violent offenders (Garofaloa & Velotti, 2017).

**The Hostile Interpretations Questionnaire (HIQ) (Mamuza & Simourd, 1997)**

The HIQ is a 28 item assessment instrument designed to measure a participant’s overall level of hostility, the social situations under which hostility occurs, and the characteristics of their hostility (Simourd & Mamuza, 2016). The HIQ includes 7 vignettes with 4 questions per vignette. Questions are answered using a 5-point Likert scale (e.g., strongly agree to strongly disagree). The HIQ provides a total score and 9 subscale scores. Five subscales assess the social context that elicits a hostile response which include interpersonal scenarios with authority figures, intimate/family figures, acquaintances, work figures and individuals who are anonymous. Four subscales examine different domains of hostility including overgeneralization, attribution, hostile reaction and external blame. Higher scores on the HIQ indicate greater hostility (Simourd & Mamuza, 2000).

The HIQ has normative data among adult prisoners (Simourd & Mamuza, 2000), individuals on probation, and college students (Simourd & Mamuza, 2016). Internal consistency estimates for the
HIQ total score range between .88 and .90, and between .50 and .84 for the 9 subscales (Simourd & Mamuza, 2016). The HIQ has been validated against other anger assessment instruments and a measure of response bias (i.e., falsifying) (Mamuza & Simourd, 1997; Simourd & Mamuza, 2000). It is noteworthy that the authors highlight that the HIQ is less susceptible to response bias than other traditional measures of anger/hostility (Simourd & Mamuza, 2000).

**Violent Offending**

Information regarding participant’s offence history will be garnered from each participant’s offender management records. This will include number and type of offence/s to date, current offence type, length of custodial sentence/s, total length of custodial sentence/s for violent offences, date of first violent offence and history of violence/institutional infractions during the current incarceration period. It is estimated that it will take approximately 20 minutes to obtain this information from each participant’s records.

The researcher will operationalize this data using Violence Rating Scales (VRS) (Gunn & Robertson, (1976); Robertson et al., (1987)). One scale rates the current offence in terms of violence and the second scale rates the individual’s overall record in terms of violent offending. Each scale has 5 points, 0 indicates an absence of violence, 4 indicates severe violence which encompasses the death of a victim or serious endangerment of health. These violence rating scales have been used in previous research with a prison population which examined cognitive correlates of violence (Robertson et al., 1987).

It is estimated that research appointments will take a maximum of 30 – 40 minutes per participant. Data collection will take place over a 7- 8 month period.

8. **SAMPLE SIZE & STATISTICAL ANALYSIS**

8.1. **Sample Size**

A power analysis was calculated using G*Power 3.1.9.2. Due to the fact that there is a dearth of research examining emotional dysregulation and HAB as possible mediators in the relationship between TBI and violent offending, the effect size was estimated to be medium (f2 .15). Power (1-β err prob) was set at .80 and alpha (α err prob) was set at .05 for a linear multiple regression with 3 predictors. An a priori power analysis indicated that the study requires a sample size of 77 participants in order to detect significant effects if they exist. The CI would like to set the sample size between 77 - 100 participants. This will give the CI scope to see more participants if there is sufficient interest in the study and will also increase the statistical power of the study.
8.2. Statistical Analysis

Primary Analysis
All data will be analysed using SPSS version 22. Initially, descriptive statistics will be calculated on the data. T-tests will be utilised to investigate between group differences in relation to the TBI/No TBI groups. Associations between the variables will then be examined using Pearson’s correlation and logistic regression analyses. If variables are found to be significantly associated, they will be entered into mediation analyses, using the PROCESS Macro for SPSS (Hayes, 2013).

9. APPLICATION
- The study will primarily help ascertain whether emotional dysregulation and/or hostile attribution bias mediate the relationship between TBI and violence, therefore, identifying these domains as potential targets for more tailored interventions. More tailored interventions which address areas of need following TBI, may lead to more effective rehabilitation and reduced recidivism in the long term. This potentially has beneficial effects for offenders and society as a whole, when the human and financial cost of violent offending and incarceration is considered.
- The project will identify the prevalence of self-reported head injury in a Scottish prison population.
- The study may also provide evidence to help establish whether the OSU-TBI ID is a feasible screening tool to use in prison settings to detect the presence of TBI.
- The study could provide further evidence highlighting the need for the CJS to better identify and treat head-injured offenders.

10. REFERENCES


Appendix I

Scottish Prison Service Research Access Ethical Approval

HEADQUARTERS
Research
Strategy and Innovation

Calton House
5 Redheughs Rigg
EDINBURGH
EH12 9HW

Direct dialing: 0131 330 3766
Switchboard: 0131 330 3500

Geraldine O'Hagan
Trainee Clinical Psychologist NHS Tayside
University of Edinburgh
Edinburgh

10 January 2019

Dear Geraldine

History of Traumatic Brain Injury and Violent Offending: The Mediating Roles of Emotional Dysregulation and Hostile Attribution Bias

The above research study was considered in the SPS Research Access and Ethics Committee (RAEC) at its meeting in December 2017. RAEC was content to approve access for the study.

You have previously signed the standard access regulations and these are held on file.

RAEC wished you well in the conduct of the research and looked forward to receiving a copy of the report on completion of the project.

Yours sincerely

Dr James Carnie
Head of SPS Research
Appendix J

East of Scotland Research Ethics Service Confirmation of Approval Letter
Dear Ms O'Hagan

Study Title: History of Traumatic Brain Injury and Violent Offending: The Mediating Roles of Emotional Dysregulation and Hostile Attribution Bias.

REC reference: 18/ES/0078
Protocol number: CAHSS1802/03
IRAS project ID: 240644

Thank you for your letter of 28 July 2018, responding to the Committee’s request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to make a request to postpone publication, please contact hra.studyregistration@nhs.net outlining the reasons for your request.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

The REC favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements. Each NHS organisation must
confirm through the signing of agreements and/or other documents that it has given permission for the research to proceed (except where explicitly specified otherwise). Guidance on applying for HRA and MCRW Approval (England and Wales)/ NHS permission for research is available in the Integrated Research Application System, at [www.hra.nhs.uk](http://www.hra.nhs.uk) or at [http://www.rdforum.nhs.uk](http://www.rdforum.nhs.uk).

Where a NHS organisation’s role in the study is limited to identifying and referring potential participants to research sites (“participant identification centre”), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of management permissions from host organisations

Registration of Clinical Trials

All clinical trials (defined as the first four categories on the IRAS filter page) must be registered on a publically accessible database within 6 weeks of recruitment of the first participant (for medical device studies, within the timeline determined by the current registration and publication trees).

There is no requirement to separately notify the REC but you should do so at the earliest opportunity e.g. when submitting an amendment. We will audit the registration details as part of the annual progress reporting process.

To ensure transparency in research, we strongly recommend that all research is registered but for non-clinical trials this is not currently mandatory.

If a sponsor wishes to request a deferral for study registration within the required timeframe, they should contact [hra.studyregistration@nhs.net](mailto:hra.studyregistration@nhs.net). The expectation is that all clinical trials will be registered, however, in exceptional circumstances non registration may be permissible with prior agreement from the HRA. Guidance on where to register is provided on the HRA website.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Ethical review of research sites

NHS sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see “Conditions of the favourable opinion” below).

Non-NHS sites

The Committee has not yet completed any site-specific assessment (SSA) for the non-NHS research site(s) taking part in this study. The favourable opinion does not therefore apply to any non-NHS site at present. We will write to you again as soon as an SSA application(s) has been reviewed. In the meantime no study procedures should be initiated at non-NHS sites.
Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

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Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements
The attached document "After ethical review – guidance for researchers" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The HRA website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

User Feedback

The Health Research Authority is continually striving to provide a high quality service to all applicants and sponsors. You are invited to give your view of the service you have received and the application procedure. If you wish to make your views known please use the feedback form available on the HRA website: [http://www.hra.nhs.uk/about-the-hra/governance/quality-assurance/](http://www.hra.nhs.uk/about-the-hra/governance/quality-assurance/)

HRA Training

We are pleased to welcome researchers and R&D staff at our training days – see details at [http://www.hra.nhs.uk/hra-training/](http://www.hra.nhs.uk/hra-training/)

| 18/ES/0078 | Please quote this number on all correspondence |

Yours sincerely

Mrs Samantha Downie
Chair

Email: esores.tayside@nhs.net

Enclosures: “After ethical review – guidance for researchers”

Copy to: Charlotte Smith, University of Edinburgh
NHS Tayside R&D office
Appendix K

NHS Tayside R&D Approval
06 August 2018

Ms Geraldine O'Hagan
Trainee Clinical Psychologist
NHS Tayside
15 Dudhope Terrace
Dundee
DD3 6HH

Dear Ms O'Hagan,

R&D MANAGEMENT APPROVAL – TAYSIDE

Title: History of Traumatic Brain Injury and Violent Offending: The Mediating Roles of Emotional Dysregulation and Hostile Attribution Bias

Chief Investigator: Ms Geraldine O'Hagan
Principal Investigator/Local Collaborator: Dr Kimberly Sham Ku

Tayside Ref: 2018PU02 NRS Ref: N/A
R&CI Ref: 18/RS/0078
Sponsor: University of Edinburgh
Funder: No External Funding

Many thanks for your application to carry out the above project here in NHS Tayside. I am pleased to confirm that the project documentation (as outlined below) has been reviewed, registered and Management Approval has been granted for the study to proceed locally in Tayside.

Approval is granted on the following conditions:-

- ALL Research must be carried out in compliance with the Research Governance Framework for Health & Community Care, Health & Safety Regulations, data protection principles, statutory legislation and in accordance with Good Clinical Practice (GCP).

- All amendments to be notified to TASC R&D Office via the correct amendment pathway. Either direct to the R&D Office or via the Lead Co-ordinating Centre depending on how the study is set up (http://www.hrsa.chs.uk/terminology-and-standards/good-clinical-practice-amendments/).


- TASC R&D Office to be informed of change in Principal Investigator, Chief Investigator or any additional research personnel locally.

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• Notification to TASC R&D Office of any change in funding.

• As custodian of the information collated during this research project you are responsible for ensuring the security of all personal information collected in line with NHS Scotland IT Security Policies, until destruction of this data.

• All eligible and adopted studies will be added to the Central Portfolio Management System (CPMS). Recruitment figures for eligible and adopted studies must be recorded onto the Portfolio every month. This is the responsibility of the lead UK site. If you are the lead, or only UK site, we can provide help or advice with this. For information, contact Sarah Kennedy (01382 383882 or sarah.kennedy17@nhs.net) or TASCportfolio.tayside@nhs.net.

• Annual reports are required to be submitted to TASC R&D Office with the first report due 12 months from date of issue of this management approval letter and at yearly intervals until completion of the study.

• Notification of early termination within 15 days or End of Trial within 90 days followed by End of Trial Report within 1 year to TASC R&D Office.

• You may be required to assist with and provide information in regard to audit and monitoring of study.

Please note you are required to adhere to the conditions, if not, NHS management approval may be withdrawn for the study.

Approved Documents

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- 2 -
May I take this opportunity to wish you every success with your project.

Please do not hesitate to contact TASC R&D Office should you require further assistance.

Yours sincerely

Elizabeth Coote
Head of Non-Commercial Research Services

Tayside medical Science Centre (TASC)
Ninewells Hospital & Medical School
TASC Research & Development Office
Residency Block, Level 3
George Fric Way
Dundee DD1 9SY
Email: liz.coote@nhs.net
Tel: 01382 383876 Fax: 01382 740122

C.c.

tascportfolio.tayside@nhs.net
References


http://dx.doi.org/10.1037/a0023842.


https://doi.org/10.1186/s40779-020-00238-8


Sharma, L., Markon, K. E., Clark, L. A. (2014). Toward a theory of distinct types of


Behavior, 41, 346–352.


