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Abstract

Objective: This study examined whether executive functioning (EF) mediated the relationship between childhood traumatic brain injury (TBI) and engaging in bullying in prison (BP).

Participants: A sample of male adults in custody in Uruguay (N = 236), drawn from five prisons.

Methods: Inmates filled out self-report questionnaires examining TBI (*Head Injury Questionnaire*), EF (*Behavior Rating Inventory of Executive Function Adult, BRIEF-A*) and bullying in prison (*Direct and Indirect Prisoner Behavior Checklist –revised, SCALED, DIPC-SCALED-r*).

Results: Findings showed that TBI was associated with prison bullying after controlling for age, level of education, socioeconomic status, and civil status. The mediation analysis indicated that the relationship between TBI and bullying was fully mediated via executive impairment, especially through the behavioral regulation component (mainly inhibition and emotional control).

Conclusion: These findings suggested that compensating for EF difficulties in adult inmates with brain injuries might help to decrease the bullying in prison.

Keywords: traumatic brain injury; executive functioning; prison bullying; DIPC

Executive Functioning as Mediator e of the Association Between Traumatic Brain Injury and Prison Bullying

Traumatic brain injury (TBI) is defined as brain damage caused by an external mechanical force (1). TBI among offenders has recently received increased attention in the literature for two reasons. First, the rates of TBI among adults in prison are higher than among the general population (1, 2-7). Second, experiencing TBI during childhood has been correlated with aggression, substance use, neurocognitive deficits, antisocial behavior, recidivism, higher rates of in-prison rule infractions, and lower rates of drugs dependency treatment completion (1, 2, 8-11)..Some evidence has shown an association between TBI and violence and criminality in the community (see below). To date, there has been no research considering the relationship between TBI and other forms of violence such as bullying in prison.

Bullying in Prison

While violence involves the intentional use or threat to use physical force to produce pain (Eisner & Malti, 2015) bullying is a specific form of intra-group aggression that can involve both more direct and observable behaviors (e.g. physical or verbal aggressions) and more indirect and subtler ones (e.g. gossiping) (Ireland, 2005). Bullying between inmates remains an important issue due to its high prevalence and negative effects on victims (13). Bullying and violent behaviors in prison also negatively impacts on prison safety and the effective running of prison regimes (14,15) (Ministry of Justice, 2016). However, research has yet to consider the nature and extent of bullying in Uruguay prisons. If estimates are considered from the UK, where most research has occurred, these are placed between 20% (16) and 80% (17), There is noted variance across studies, populations (e.g. adults, young offenders), and

measures employed (12,18-20). Regardless of these measurement issues, there is a consensus that bullying in prisons is concerning.

Developing a theoretical understanding of why bullying occurs in prison is important, with the most integrated model representing the *Multifactor Model of Bullying in Secure Settings* (MMBSS, 21). This model emphasizes the role of individual factors and how these interact with the physical and social aspects of a prison to promote bullying. It draws on *Importation Theory* (22) and *Deprivation Theory* (23,24), with the former accounting for pre-existing characteristics and the latter the restrictions of the prison environment that serve to promote aggression. There is an emphasis placed by the MMBSS on the environment reinforcing aggression, with two primary pathways to bullying offered. First, the *desensitization pathway*, which captures increased exposure to bullying and related factors, including the enhancement of existing individual characteristics likely to promote bullying and a role for emotions (e.g. fear, hostility) in increasing the potential to be aggressive. Second, the *environment and prior characteristic pathway*, where involvement in bullying is considered a product of the interaction between the environment and stable individual characteristics. This pathway has accounted for a more trait-driven understanding of bullying.

In terms of individual-level characteristics, research has demonstrated that prison bullying is associated with criminal history characteristics and time spent in prison (12,25), traits/predisposition for hostile attribution and aggressive normative beliefs (26), moral disengagement (20), limitations in social problem solving (27)and, to a degree, empathy (19, but see 28). These factors have all been integrated into the MMBSS. However, the role for TBI and executive functioning has not yet been considered. These factors represent *imported* factors (22), which are stable and present prior to entry to a prison, and they may be important individual characteristics that need to be taken into account. Demonstrating their relevance could widen the application of relevant individual characteristics for the *environment and*

prior characteristic pathway of the MMBSS and could further contribute to an understanding of what other factors could impact on emotional control, which forms part of the *desensitization* pathway.

Traumatic Brain Injury, Executive Functioning, and Violence

Research has demonstrated an association between TBI and the executive functions (EF), and violent and aggressive behaviors. First, TBI is frequently associated with impaired executive functioning in the general population (29, 30). EF describe several interrelated high order cognitive abilities and behaviors such as inhibition, working memory, flexibility/shifting and decision-making (31). These functions play a key role in self-regulation, social, behavioral adaptation and success (30, 32), and are mainly (but not exclusively) mediated by the prefrontal cortex (33,34).

Second, empirical research has shown links between EF and violence. Life course persistent offenders are characterized by neuropsychological deficits, lack of inhibition control and negative emotionality (35, 36). In addition, neuroimaging studies with antisocial, psychopathic and violent offenders have found significantly reduced prefrontal structure and function (37). Finally, specific executive functions were found to be impaired in the general prison population (i.e., attention and set-shifting), among both violent (i.e., set-shifting and working memory) and non-violent offenders (i.e., inhibition, working memory and problem solving) (38).

Finally, the link between TBI and aggressive behavior has been supported by research. This association illustrates that individuals with a TBI exhibit more impulsivity, lack of perseverance and weak response inhibition (41), and exhibit different forms of impulsive and episodic aggression (42). Studies found that offenders with a history of TBI were more likely to commit crimes and serious violent crimes (43-45), and violent offenders differed from non-violent offenders in terms of their head injury histories (46). However, despite these well-

established associations, very little research has assessed factors that mediate the association between TBI and aggressive delinquency and violent behavior. One study reported that offenders with history of TBI performed worse on executive functioning than those without a history of TBI (47), but factors that mediate this association are understudied. Only two recent studies assessed two factors, showing that self-control and temperament mediated the association (48,49).

Therefore, we need a better understanding of whether TBI has a direct or indirect effect on prison bullying as demonstrated in other types of violent behaviors. Particularly, given that TBI is highly prevalent among offenders and is associated to aggression, the knowledge of the links between TBI and prison bullying is key to respond accordingly to bullies needs and risk factors in order to improve the best practices in prison (50). Evidence for such a link, for example, would suggest a more cognitive rehabilitation approach to managing the challenging behavior as opposed to a restrictive approach. No study has yet examined the role of EFs in the relationship between TBI and bullying in prison.

The Current Study

To address this gap in the literature, this study investigated whether the association between TBI and prison bullying among Uruguayan offenders in custody was mediated by EF. Based on previous literature on aggression and criminality, we predicted that a higher degree of executive dysfunction would be associated with prison bullying. Additionally, we predicted that TBI would be indirectly associated with prison bullying through executive dysfunction, indicating the presence of a mediation effect. Finally, we hypothesized that some executive domains would mediate more strongly than others the relationship between TBI and prison bullying.

Methods

Participants and Procedure

Participants were drawn from a non-probabilistic sample of 340 male inmates from five different prisons, with different security levels, across the Uruguayan Prison Service of adult inmates, as part of a larger research project commissioned by the Uruguayan Prison Service. Inmates were approached and invited to participate in the study (both verbally and in writing) in accordance with the Ethics guidelines of the Helsinki and American Psychological Association protocols. Participants were excluded only if they were illiterate and did not speak/read in Spanish. All participants that agreed to participate in the study (11% of those that meet inclusion criteria declined to participate) signed an informed consent. Questionnaire completion was supervised by two researchers. The final sample comprised 236 inmates, with the rest removed due to incompletion of measures and/or a lack of control variables being completed, mainly those relating to socio demographic variables.

Measures

Traumatic brain injury

An adapted version of *The Ohio State University Traumatic Brain Injury (TBI) Identification Method (OSU TBI-ID)* (51) was employed. Inmates were asked four questions to assess whether they suffered serious accidents during their childhood associated with injuries involving an impact in the head, vehicle accidents, domestic accidents, or involvement in fight. The question regarding head injury while serving in the military was excluded because there is no military service in Uruguay (see Appendix). Responses for each question were coded with three options ("*No"* = 0; "*Yes, once"* = 1; "*Yes, more than once"* = 2) (Cronbach's α = .60). For each accident, and additional question was asked if respondent lose consciousness including three options ("*No*" = 0, "*Yes, but without causing unconsciousnes*s" = 1, "*Yes, but causing unconsciousness*" = 2). These two questions were used to create a sum index that consider frequency and seriousness of each of the four types

of accidents ("Never happened" = 0, "Happened at least once but without causing unconsciousness" = 1, "Happened causing unconsciousness" = 2) (α = .65).

Executive functioning

The Spanish version of the *Behavior Rating Inventory of Executive Function Adult* version (BRIEF-A; 52) comprises 75 items scored on a 3-point Likert-scale ("*Never"* = 0, "*Sometimes"* = 1, and "*Often"* = 2), which provided a General Executive Composite score (GEC) (α = .95) and two index scores: 1) The Behavioral Regulation Index (BRI) (α = .92), which includes four domains: inhibition (e.g., "*I have trouble sitting still*"), shift (e.g., "*I am bothered by having to deal with changes"*), emotional control (e.g. *"I overreact to small problems*"), and self-monitoring (e.g., *"I talk at the wrong time"*). 2) The Metacognition Index (MCI), which yields five domains (α = .91): initiate (e.g., *"I have trouble getting started on tasks*"), working memory (e.g., *"I have a short attention span"*), plan/organize (e.g., "*I don't plan ahead for tasks*"), task monitoring (e.g., *I have problems completing my work"*), organization of materials (e.g., *"I don't pick up after myself"*)[1].

Prison bullying

The *Direct and Indirect Prisoner Behavior Checklist- revised SCALED version* (DIPC-SCALED-r, 53) includes 33 items on direct aggression such as: physical violence ("*I have hit or kicked another prisoner*"), verbal violence ("*I have called someone names about their color or race*"), psychological violence ("*I have intimidated someone*"), sexual violence ("*I have sexually harassed someone*"), and theft ("*I have taxed another prisoner*").[2] Inmates were asked how frequently they engaged in these behaviors in the past month ("*Never"* = 0, "*Rarely"* = 1, "*Sometimes"* = 2, "*Often"* = 3, "*Always"* = 4). This measure has been extensively applied and validated on different type of prison populations (males, females, adults, young offenders (e.g., 19, , 54-56) and is used in this study as composite measure of

explicit aggressive behaviors (α = .91). A summative index score was created based on the incidence of the 33 different types of direct aggressions in prison during the last month.

Control variables

Several control variables were also included in this study, including age, civil status (married/in a relationship, single, widow, divorced/separated), education level (ranged from not having any study to finishing university studies), and a proxy of socioeconomic status (SES) of the inmates' household in their childhood (i.e., level of education attained by parents or guardians of the inmate during their childhood) as controls in the mediation model.

Statistical Analyses

The analysis began with the descriptive statistics of the sociodemographic characteristics of the sample. Then, we examined the association between the independent, dependent and mediator variables, and tested key parametric assumptions regarding multicollinearity, normality, linearity and homoscedasticity. Next, we estimated mediation effects using three multivariate Ordinary Least Squares regression models (57) including control variables: the direct effect between the independent variable (TBI) and the dependent variable (prison bullying); the direct relationship between TBI and the mediation variable (EF); and the regression of TBI and EF on prison bullying. We conducted separated analyses including different mediators (i.e., Global, Behavioral Regulation and Metacognition). As a sensitivity analysis, the mediation models were also estimated with each of the nine domains in the Behavioral Regulation and Metacognition to isolate the factors responsible for the mediation. We estimated the indirect effect by evaluating how significant is the change in the independent variable's coefficient after including the mediation variable in the analysis (58).

In order to address potential biases of the Sobel test due to non-normality distribution of variables (59, 60), we applied non-parametric tests based on bootstrap methods, which consisted of resampling the data with replacement (61). Accordingly, we used non-parametric mediation methods as robustness checks that involved 10,000 bootstrapped resamples with replacement to estimate the indirect or average causal mediation effects (ACME), the average direct effect (ADE), the total effect, and the proportion of the effect of the independent variable on the dependent variable that is channeled through the mediator. All mediation models adjusted for potential confounding including sociodemographic characteristics of inmates, and multiple test corrections (Bonferroni (62) and Benjamini Hochberg (63) tests). All analyses were performed using the mediation package in R (64).

Results

More than half (61%) of the sample committed bullying in prison. Sociodemographic, executive functioning, TBI, and offense characteristics, are presented in Table 1 for all inmates, and separately by bullying status (i.e., bullies and non-bullies). [3] Both bullies and non-bullies were similar and revealed no significant differences in terms of sociodemographic variables, such as age, education, civil status, SES, and involvement in crimes (except for burglaries and other crimes). Additionally, inmates who committed bullying reported significant differences in terms of EF [M =114 (SD = 19.63)]and TBI [M = 3.67 (SD = 2.15)] than those who did not commit bullying [EF: M= 100.87 (SD = 18.96), TBI: M = 2.4 (SD = 2.01)].

[INSERT TABLE 1 HERE]

Correlations between sociodemographic variables, predictors and mediators showed no evidence of multicollinearity; correlations were no higher than .4 and no VIF values were higher than 2.5 (see Table 2). Initial descriptive analysis and analysis of residuals showed that data was not normally distributed with mediator variables skewed and, in most cases,

leptokurtic. The dependent variable (prison bullying) was highly leptokurtic (12.25) and skewed (2.48). While the Behavioral Regulation Index was mesokurtic (2.81) and not skewed (.55), the Metacognition Index was also slightly leptokurtic (3.67) and moderately skewed (.78), and the Global Index of EF was slightly leptokurtic (3.18) and moderately skewed (.6). Thus, mediation analysis implemented non-parametric tests to deal with these violated assumptions.

[INSERT TABLE 2 HERE]

Mediation Analysis

Mediation analysis was conducted in two steps. First, we conducted a mediation analysis with TBI as independent variable on prison bullying and evaluated the mediating role of the three main indices of EF, that is, the Global, Behavioral and Metacognition . Second, we analyzed the role of each item in both Behavioral Regulation and Metacognitive domains to evaluate which were the significant and stronger domains.

With regards to the EF Global Index, a first regression model on prison bullying including TBI and covariates explained a very small proportion of variance (adj. R-squared = .02, F [5, 230] = 2.02, p =0.076), showing that only TBI was significantly associated with higher involvement in prison bullying (b = .54*). A second regression model on the Global Index that included TBI and covariates explained a significant but modest proportion of variance (adj. R-squared = .17, F [5, 230] = 10.74, p < .001) and with TBI again as the only significant covariate of the model (b = 3.43***). These results are indicated in Table 3.

The third model regressed prison bullying on TBI and EF and covariates explained a small proportion of variance (adj. R-squared = .12, F [6, 229] = 6.58, p < .001) and showed that TBI ceased to be significantly associated with prison bullying (b = .09), while EF was significantly associated (b = .13***). We estimated the same three models using Poisson regression and although most of the covariates were significant, we obtained similar

mediation results: while EF was significantly associated with prison bullying in the final model ($b = .02^{***}$), TBI was statistically non significant ($b = .02$, $p = .08$). Then, we used bootstrapping procedures to test in a more robust way the significance of the indirect effect of EF. The ACME found was large ($.447^{***}$) and so was the proportion of the effect of on the criminal trajectory directed via EF (83%), and significant ($p < .05$). These results are indicated in Table 4. Overall, there was evidence in support for full mediation of EF (Figure 1A).

Regarding the Metacognition Index, the regression model on the Metacognition Index that included TBI and covariates also explained a small proportion of variance (adj. R-squared = .13, F [5, 230] = 7.808, $p =$) with TBI ($b = 1.64^{***}$) significantly associated with prison bullying (see Table 3). The regression model on prison bullying including TBI, Metacognition and covariates that explained a small proportion of variance (adj. R-squared = .10, F [5, 248] = 5.248, $p =$) showed again that while TBI was not a significant covariate ($b = .21$), the Metacognition index was a significant covariate ($b = .20^{***}$) (see Table 4). Once again, Poisson regression models showed similar results confirming the indirect effect with Metacognition significantly associated with prison bulling in the final model ($b = .03^{***}$). TBI, although still a significant factor, diminished considerably from .11 to .02. Bootstrap procedures confirmed the indirect effect of the Metacognition. The ACME was smaller in relation to the overall EF , but still significant and large ($.328^{***}$), and the fraction of the effect of TBI on prison bullying that is mediated by the Metacognition was 61% and significant ($p < .05$) (see Table 4 and Figure 1B).

We followed the same procedure to evaluate the mediation role of the Behavioral Regulation Index. We regressed TBI and covariates on the Behavioral Regulation and the model explained a modest proportion of variance (adj. R-squared = .18, F [5, 230] = 11.04, $p < .001$) with TBI ($b = 1.79^{***}$) significantly associated with prison bullying (Table 3). The

regression model on prison bullying that included covariates, TBI and Behavioral Regulation showed a small but significant percentage of explained variance (adj. R-squared = .12, F [6, 229] = 6.47, $p < .001$) with Behavioral Regulation presenting as a significant covariate (b = .25***) and TBI no longer presenting as a significant covariate (b = .09) (see Table 4).

When Poisson regression models were conducted, we also observed mediation effects in the final model, with Behavioral Regulation significantly associated with prison bulling (b = .05***) and TBI not significantly associated (b = .02, p = .08). Non parametric mediation analysis based on bootstrap resampling also demonstrated evidence of an indirect effect with a significant and large ACME (.447***), with a large percentage of the effect of TBI on prison bullying channeled through the Behavioral Regulation (83%) (see Table 4 and Figure 1C).

[INSERT TABLE 3 HERE]

[INSERT TABLE 4 HERE]

As a sensitivity analysis, we examined indirect effect of the Behavioral Regulation and Metacognition domains. We found evidence of indirect effects in most domains of both two factors. However, evidence was stronger among Behavioral Regulation than in Metacognition. Inhibition and Emotional Control showed stronger indirect effects (.395 and .365 respectively) and all the Behavioral Regulation domains showed statistically significant indirect effects and proportion of indirect effect (Table 4). However, in relation to Metacognition domains, Organization of Materials and Working Memory demonstrated non-significant indirect effects for the proportion of mediation. In addition, the executive domains that exhibited significant mediation effects, yielded smaller effect sizes (below .3), and their proportion of the indirect effect was below 55% (see Table 4). These findings were statistically significant using Benjamini – Hochberg corrections, and with a more stringent

test (i.e., Bonferroni) all test remain significant except for Shift, Working Memory and Task Monitoring.

[INSERT FIGURE 1 HERE]

Discussion

This study investigated the existence of mechanisms in the association between TBI and prison bullying. Our findings showed the relevance of EF as well as the Behavioral Regulation and Metacognition indexes as mediators of the TBI – prison bullying link. These findings are relevant for a number of reasons.

First, these findings provide preliminary support that TBI correlates with executive dysfunction among a sample of Uruguayan inmates. Furthermore, bullies reported poorer scores on EF and more significant histories of TBI compared to non-bullies. Although these findings shed light on a topic barely studied, we should be cautious since this is a non-probability sample of five Uruguayan correctional facilities. However, the findings align with the existing research in demonstrating that TBI is associated with increased levels of aggression (41, 42) and with executive dysfunctions in offender populations (38, 39) and in custody aggression (40). Finally, these findings also corroborate the importance of including the individual characteristics of inmates to explain, together with physical and social environmental characteristics, the pathways towards prison bullying. The noted association with TBI and EF adds, for example, to the *environment and prior characteristic* pathway of the MMBSS (21). Until now that pathway has emphasized a role for traits and beliefs but can now be extended to capture more developmental and enduring characteristics such as TBI and EF (21).

Second, the mediation analysis supported our hypotheses, namely that EF will fully mediate the effect between TBI and prison bullying. When examining the mediation effect of

the two different executive indexes, the Behavioral Regulation Index yielded a strongest mediation effect than the Metacognition Index. Finally, when considering each executive domain, we found that inhibition, emotional control, and planning/organizing showed the strongest indirect effects. To a degree, these findings are aligned with two preliminary studies in which temperament mediated TBI and violence in incarcerated youths (49) and where self-control mediated TBI and aggressive delinquency (84). However, the former used youth offenders and did not measure executive functioning as mediator (49), with the latter employing a longitudinal design (58). Regardless, it continues to add to the individual characteristics considered important by the MMBSS *environment and prior characteristic pathway* and to the *desensitization pathway*, where the management of emotions becomes challenging, leading to aggressive behavior. Difficulties in behavioral regulation and metacognition are expected to reduce the capacity an individual has to manage challenging emotions.

Since there are no studies linking TBI with prison bullying, the results can also be interpreted in relation to previous studies on TBI and violent and criminal behaviors. There are two possible pathways that could explain this association (65, 66). The first pathway involves damage in the frontal cortex. The neuropsychological consequences of brain injury are poor memory, attention, concentration, planning, emotional regulation, impulsiveness, attentional control and damaged inhibitory functions (1). Our findings support this pathway since bullies reported higher executive deficits than non-bullies, especially in planning, emotional regulation, and inhibition. Offenders with a maladaptive emotion regulation style have reported a more extensive history of aggression (67). A review on studies using traditional task to measure executive domains showed that prison populations were impaired in attention and set-shifting. However, while violent offenders were impaired in set-shifting and working memory, non-violent offenders were impaired in inhibition, working memory

and problem solving (38). Our study corroborates previous evidence showing that different offenders groups display different EF profiles (38, 40, 68-71). This heterogeneity might be an artifact of methodological differences across the studies and a constellation of factors in offenders (not only TBI) such as drug and alcohol abuse, mental health issues, childhood maltreatment, personality disorders, developmental and learning disorders, low IQ, and low levels of education.

The second pathway is that the relation between brain injury and criminal behavior is spurious and both are affected demographic variables and preexistent antisocial behaviors. For example, a study that controlled for SES and childhood disrupted behaviors showed that TBI was no longer associated with criminal behavior in the adulthood (72). However, our findings did not support this pathway since TBI remained associated with bullying even after controlling for SES and education but via EF as an indirect effect. These divergences might be due to the different dependent variables used by studies (prison bullying vs. criminal behavior) and/or biases in estimation due to problematic control of colliders or mediators in the explanation of aggressive behaviors (73). Future studies should explore more comprehensively what the role is of these different sets of socio demographic and psychological variables in the explanation of prison bullying. However, previous research has placed less emphasis on social-demographic factors in prison bullying in comparison to more *developed* characteristics such as personality, beliefs and attribution biases (e.g. 21). Accounting for this, we cannot rule out that the EF – prison bullying link may be significantly affected by other variables, particularly those which have shown empirical association with aggression and impairment in executive functions (e.g. use of drugs, mental health, etc.) (Fernandez Serrano et al., 2010; Hoaken et al., 2012; Reynolds et al, 2010).

Finally, these findings have important implications for offender rehabilitation assessment and programming. Prison bullying might be reduced by including specific measures, such as

delivering routine screening for TBI and EF when entering in prison, and by adapting the current rehabilitation programs and anti-bulling strategies to offenders with executive deficits and TBI. It is already accepted that adapting programmes for the therapeutic needs of those with a TBI can bring benefit (e.g. 74). What is being suggested here is potential value in considering a cognitive rehabilitation approach to managing bullying in a prison. This would certainly assist with the size of the difficulties since individual interventions could quickly out pace resources. Some examples of anti-bullying strategies in prison are the 'Supported Living Unit' to protect victims of bullying, and a good quality staff-prisoner relationships (75, see also Prison and Probation Prison and Probation Ombudsman, 2011). Additionally, previous research has highlighted the need of conducting routine screening of TBI within prisons, along with the training of prison staff to manage correctly these prisoners and improve the relationship between staff and prisoners, because some behaviors may be mistakenly considered defiant without considering that they could be consequence of TBI (see Pitman et al., 2015). Very few interventions in prison take into account TBI. A recent review found positive results of interventions in prison taking into account brain injuries in four studies but authors warn about their methodological limitations (de Geus et al., 2021). Additionally, neuropsychological impairment reported in our study may interfere with their ability to attend to, understand, or process information, and may make it difficult for prisoners with TBI to participate actively and consistently in interventions (Manly & Murphy, 2012; Zoccolotti et al., 2011).

In addition, the MMBSS clearly demonstrates the role of the environment (social and physical) in understanding and managing prison bullying and does not necessarily advocate for individual treatment for those involved as bullies and/or victims (21). Thus, what is being suggested here is not an adapted individual therapy/intervention approach for bullies and/or victims per se but a *whole-prison* approach that adopts some principles of cognitive

rehabilitation in the communication and delivery of whole-regime approaches to managing bullying. A cognitive rehabilitation service, for example, would focus on psychoeducation, not over-whelm with information, manage over-stimulus and emotional regulation as standard, have distractions in place and compensate for impairments in learning, including in the retention of information. The innovation adoption of such principles may have application to prisons and could be seen as a means of managing bullying and other acts of indiscipline, if linked to TBI and/or EF

Strengths and Limitations

The current study has several strengths. It is the first to examine prison bullying using a large Latin American incarcerated sample. Moreover, it has included a wide range of executive domains and the role of these domains. However, the study is not without limitations. First, it is cross-sectional, preventing any determination of a direct causal relationship between TBI and involvement in bullying. Longitudinal data would be required to assess the long-term effects of TBI and the mediation impact of EF over time. Second, the inclusion of ability-based tests to measure EF to complement self-report measures would have increased the robustness of our results. Likewise, the inclusion of medical records, clinicians or family informants to complement the self-report measures of TBI would have increased the external validation. Additionally, to increase the generalizability of our results, future research should explore the role of other relevant variables as cofounders and/or potential mediators of the link between TBI, EF and bullying in prison, notably the problematic use of drugs, personality traits, experiencing strains, and having mental health problems, etc. . Finally, these results cannot be generalised to all Uruguayan prisoners because this is not a representative sample. What is more, given the self-reported methodology used in the study illiterate individuals were excluded. Although illiteracy is not associated with bullying or violent behaviours in the literature, future research should evaluate if the associations between

traumatic brain injuries, executive functions and prison bullying remain or change significantly in illiterate samples.

Conclusions

TBI and executive dysfunctions are prevalent in prison populations, especially among violent offenders. Bullying in prison is also identified as an aggressive behavior that requires further study, particularly to understand the more enduring individual characteristics that could be involved. The findings of this novel study contribute to the gap in the literature, suggesting that EF mediates the association between TBI and prison bullying. Thus, EF might be an important variable to consider in programmes for adult offenders with TBI, including via a cognitive rehabilitation approach. Current anti-bullying strategies might therefore benefit from including programmes that compensate for the executive functioning challenges of bullies with TBI.

Notes

[1] The reliability of the aforementioned nine domains was: inhibition (α = .74), shift (α = .56), emotional control (α = .85), self-monitor (α = .77), initiate (α = .73), working memory (α = .78), plan/organize (α = .69), task monitor (α = .58), organization of materials (α = .77).
[2] The original tool included also included positive/proactive behaviors, negative behaviors towards prison staff, drug related behaviors, reactions to victimization and indirect aggression. Only direct aggression items were applied in the current study.
[3] A cut off criteria was used for classification: Respondents were considered bullies if during the last month they had committed any kind of direct aggression at least on rare occasions.

Disclosure statement

The authors report no conflict of interest.

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Table 1

Sociodemographic Characteristics and Prison Bullying of the Total Sample

Variables	Total sample (n=332)	Non-bullies (n=131, 39%)	Bullies (n=201, 61%)
Age [mean years (SD)]	31.04 (8.97)	31.22 (9.43)	1.01 (8.68)
Level of education [N (%)]			
Incomplete primary school	55 (16.5%)	22 (17.3%)	33 (16.8%)
Primary school	62 (18.6%)	33 (26%)	28 (14.2%)
Incomplete secondary school	190 (55.4%)	63(49.6%)	122 (61.9%)
Secondary school	10 (3%)	3 (2.4%)	6 (3%)
University & tertiary studies	14 (4.2%)	6 (4.7%)	8 (4.1%)
Civil status [N (%)]			
Married or in relationship	107 (35.9%)	50 (42%)	57 (32.2%)
Divorced, separated or widow	59 (19.8%)	24 (20.2%)	35 (19.8%)
Single	132 (44.3%)	45 (37.8%)	85 (48%)
Parents´ education level [*M* (SD)]	5.87 (3.57)	5.60 (3.20)	6.09 (3.81)
Index of offense [N (%)]			
Robbery	146 (43.8%)	48 (36.6%)	98 (48.8%)*
Burglary	76 (22.8%)	29 (22.1%)	45 (22.4%)
Murder	47 (14.1%)	16 (12.2%)	31 (15.4%)
Drug trafficking	32 (9.6%)	12 (9.2%)	20 (10%)
Other	33 (9.9%)	26 19.8%)	7 (3.5%)***
Executive functions (GEC)	108.84(20.33)	100.87(18.96)	114.04(19.63)***
Type of TBI [N (%)]			
Injury involving impact in the head	191 (57%)	52 (40%)	137 (68%)
Vehicle accident	256 (77%)	88 (68%)	166 (83%)
Domestic accident	120 (36%)	41 (31%)	78 (39%)
Fight / faint due to drugs	168 (50%)	41 (31%)	126 (63%)
TBI [*M* (SD)]	3.18 (2.18)	2.4 (2.01)	3.67 (2.15) *

GEC = global executive composite, M = mean, SD = standard deviation, TBI = traumatic brain injury
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; $p < 0.1$ (two-tailed test)

Table 2

Correlations among TBI, EF Domains, Prison Bullying and Control Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) Age	1.00															
(2) Civil status	-.27**	1.00														
(3) Education	-.11**	-.11	1.00													
(4) Parents' education	.00	-.04	.38***	1.00												
(5) Prison bullying	-.02	.05	-.06	-.04	1.00											
(6) Traumatic Brain Injury	.04	-.01	-.07	-.04	.38***	1.00										
(7) Inhibition	-.11*	-.04	-.14*	-.08	.35***	.37***	1.00									
(8) Shift	-.05	-.05	-.17**	-.11	.20***	.30***	.48***	1.00								
(9) Emotion	-.05	-.02	-.12*	-.07	.34***	.37***	.75***	.54***	1.00							
(10) Self-monitoring	-.015*	-.07	.18**	-.10	.34***	.25***	.66***	.45***	.70***	1.00						

(Table 2 cont.)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(11) Initiate	-.11	-.01	-.09	-.07	.22***	.30***	.58***	.58***	.51***	.55***	1.00					
(12) Working memory	-.10	-.02	-.25***	-.16**	.18***	.31***	.59***	.51***	.57***	.50***	.65***	1.00				
(13) Plan organizing	-.03	.01	-.13*	-.09	.27***	.32***	.60***	.49***	.61***	.60***	.59***	.62***	1.00			
(14) Task monitoring	-.16**	.02	-.18**	-.04	.22***	.20***	.49***	.40***	.48***	.51***	.55***	.52***	.53***	1.00		
(15) Organization of materials	-.02	.06	-.02	-.01	.21***	.15**	.49***	.34***	.34***	.39***	.47***	.47***	.46***	.46***	1.00	
(16) Executive functions	-.11	-.02	-.18***	-.11	.35***	.38***	.84***	.67***	.83***	.79***	.79***	.79***	.81***	.69***	.63***	1.00

NOTE: Unstandardized coefficients from linear regression are presented with 95% confidence intervals
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; $p < 0.1$ (two-tailed test)

Table 3

Linear Regression Models for Traumatic Brain Injury, Executive Functions and Prison Bullying

Variables	Prison bullying [95%CI][a]	Executive Functions											
		GEC[b] [95%CI]	MI[c] [95%CI]	BRI[d] [95%CI]	Inhibition [95%CI]	Shift [95%CI]	Emotional control [95%CI]	Self-monitoring [95%CI]	Initiate [95%CI]	Working memory [95%CI]	Plan / organize [95%CI]	Task monitor [95%CI]	Organization materials [95%CI]
Traumatic Brain Injury	.54* [.11, .97]	3.43*** [2.34, 4.52]	1.64*** [1.03, 2.26]	1.79*** [1.23, 2.35]	.51*** [.33, .69]	.26*** [.15, .36]	.73*** [.48, .97]	.30*** [.15, .44]	.37*** [.22, .52]	.43*** [.26, .60]	.49*** [.31, .66]	.18** [.06, 2.9]	.18* [0.01, .35]
Age	-.07 [-.17, .04]	-.22 [-.48, .05]	-.12 [-.27, .03]	-.10 [-.23, .04]	-.04* [-.09, -.00]	-.01 [-.04, .02]	-.02 [-.08, .04]	-.02 [-.06, .01]	-.03(.) [-.07, .00]	-.04(.) [-.08, .01]	-.01 [-.05, .04]	-.03(.) [-.06, 1.73]	-.01 [-.06, .03]
Civil status	1.14 [-1.3, 3.6]	-3.51 [-9.74, 2.73]	-.83 [-4.36, 2.70]	-2.68 [-5.89, .53]	-.32 [-1.34, .71]	-.61* [-1.22, -0.01]	-.79 [-2.17, .59]	-.96* [-1.79, -.13]	-.42 [-1.29, .46]	-.30 [-1.29, .68]	-.20 [-1.22, .83]	.03 [-.62, 6.76]	-.06 [-.94, 1.05]
Education	-.21 [-.57, .15]	-.65 [-1.57, .27]	-.25 [-.77, .27]	-.40(.) [-.88, .07]	-.08 [-.23, .07]	- 0.12** [-.21, -.03]	-.10 [-.30, .11]	-.10 [-.22, .02]	.02 [-.11, .15]	-.14(.) [-.29, .00]	-.07 [-.22, .08]	-.09(.) [-.18, 1.00]	.02 [-.12, .17]
Parents' education	.07 [-.21, .35]	.51 [-1.23, .20]	-.32 [-.73, .08]	-.19 [-.56, .18]	-.05 [-.16, .07]	-.04 [-.11, .03]	-.06 [-.22, .10]	-.05 [-.14, .05]	-.09(.) [-.19, .01]	-.13* [-.25, -.02]	-.08 [-.20, .04]	-.01 [-.08, 6.56]	-.01 [-.12, .10]

[a]Unstandardized coefficients from linear regression are presented with 95% confidence intervals.
[b]GEC = Global executive composite
[c]MI = Metacognition index
[d]BRI = Behavioral regulation index
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$ (.) $p < 0.1$ (two-tailed tests)

Table 4

Mediation Analysis for Traumatic Brain Injury , Executive Functions and Prison Bullying

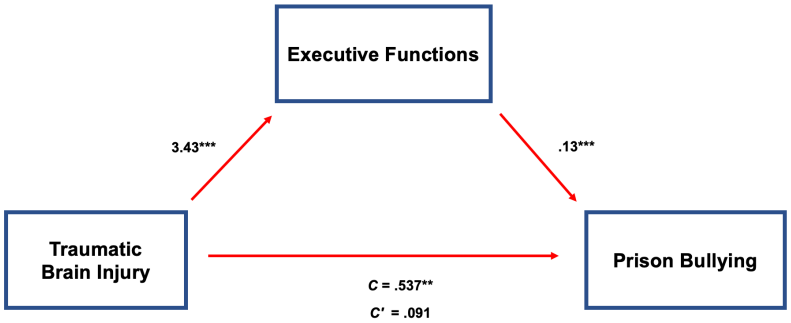
Variables	Executive Functions											
	GEC[b] [95%CI]	MI[c] [95%CI]	BRI[d] [95%CI]	Inhibition [95%CI]	Shift [95%CI]	Emotional control [95%CI]	Self-monitoring [95%CI]	Initiate [95%CI]	Work memory [95%CI]	Plan / organize [95%CI]	Task monitor [95%CI]	Organization materials [95%CI]
Traumatic Brain Injury	.09 [-.35, .53]	.21 [-.23, .65]	.09 [-.35, .53]	.142 [-.29, .58]	.375 [-.07, .82]	.172 [-.27, .62]	.29 [-.14, .71]	.33 [-.11, .77]	.321 [-0.12, .76]	.265 [-.18, .71]	.380(.) [-.05, .81]	.426 [.01, .85]
Mediator	.13*** [.08, .18]	.20*** [.11, .29]	.25*** [.16, .34]	.77*** [.48, 1.07]	.64* [.11, 1.16]	.503*** [.28, .73]	.84*** [.47, 1.21]	.563** [.21, .92]	.501** [0.18, .81]	.561*** [.26, .87]	.885*** [.41, 1.36]	.615 [.30, .93]
ACME[e]	.447*** [.22, .72]	.328*** [.12, .61]	.447*** [.25, .68]	.395*** [.22, .61]	.163** [.04, .33]	.365*** [.19, .58]	.249*** [.11, .43]	.208** [.06, .41]	.216** [.05, .45]	.272*** [.09, .51]	.157** [.03, .35]	0.111(.) [-.01, .27]
ADE[f]	.091 [-.49, .64]	.210 [-.38, .77]	.0901 [-.47, .61]	.142 [-.39, .66]	.3745 [-.16, .88]	.172 [-.37, .68]	.289 [-.26, .80]	.329 [-.24, .86]	.321 [-.26, .85]	.265 [-.32, .82]	.380 [-.17, .90]	.426 [-.10, .93]
Total effect	.537* [.03, 1.02]											
Prop. of indirect effect	.831* [.22, 4.86]	.610* [.09, 3.74]	.832* [.25, 4.52]	.735* [.23, 3.73]	.303* [.01, 1.86]	.679* [.22, 3.63]	.463* [.10, 2.35]	.387* [.03, 2.34]	.402(.) [-.02, 2.40]	.507* [.04, 3.06]	.292* [.00, 1.75]	.207(.) [-.10, 1.25]

[a]Unstandardized coefficients from linear regression are presented with 95% confidence intervals.
[b]GEC = Global executive composite
[c]MI = Metacognition index
[d]BRI = Behavioral regulation index
[e]ACME = Indirect effect
[f]ADE = Average direct effect
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$ (.) $p < 0.1$ (two-tailed tests)

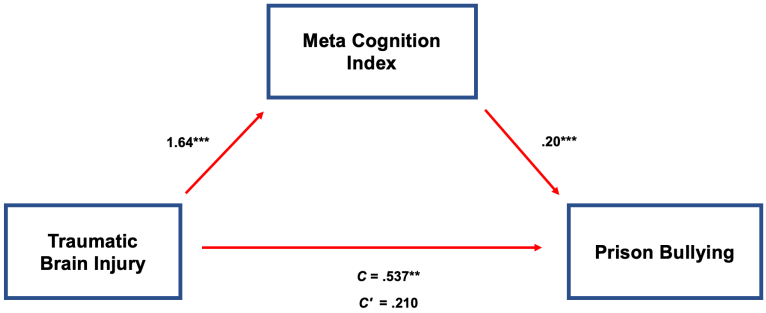
Figure 1

Mediation Analyses of the Association between Traumatic Brain Injury and Prison Bullying by Executive Functions (A), Metacognition Index (B) and Behavioral Regulation Index (C).

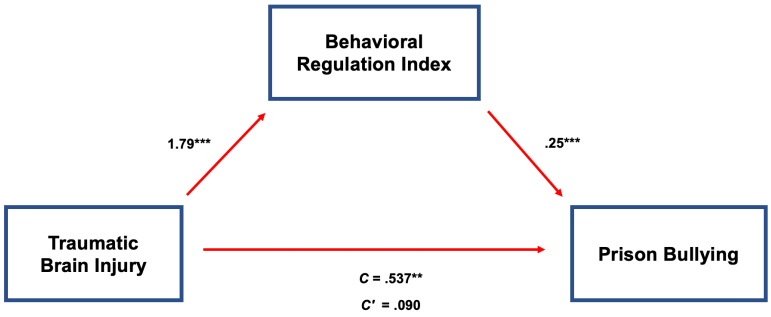
1A)



1B)



1C)



Note: n = 238. Analysis controlled by age, civil status, education and parents' education
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$ (.) $p < 0.1$ (two-tailed tests)

Appendix

HEAD INJURY QUESTIONNAIRE

This questionnaire is designed to determine whether you have ever had a significant injury to your brain. Before answering the questions, please read the questions carefully and think carefully about your history. It is common for people to forget head injuries, car accidents, minor falls, etc. when they are not followed by a loss of consciousness or significant impairment.

	a. Have you ever had this event?	**b. Did you lose consciousness from this/these event(s)?**	**c. After this/these event(s), did you suffer from dizziness, headache, vomit, vertigo, neck pain, etc?**	**d. After this/these event(s), were you hospitalized?**
1. Have you ever had an injury involving an impact to your head?	❍ Yes, only once ⇨ ❍ Yes, more than one time ⇨ ❍ No *(Go to question 2)*	❍ Yes ❍ No	❍ Yes ❍ No	❍ Yes ❍ No

	a. Have you ever had any of these events?	**b. Did you lose consciousness from this/these event(s)?**	**c. After this/these event(s), did you suffer from dizziness, headache, vomit, vertigo, neck pain, etc?**	**d. After this/these event(s), were you hospitalized?**
2. Have you ever had a car, motorbike, bike or horse accident?	❍ Yes, only once ⇨ ❍ Yes, more than one time ⇨ ❍ No *(Go to question 3)*	❍ Yes ❍ No	❍ Yes ❍ No	❍ Yes ❍ No

	a. Have you ever had any of these events?	**b. Did you lose consciousness from this/these event(s)?**	**c. After this/these event(s), did you suffer from dizziness, headache, vomit, vertigo, neck pain, etc?**	**d. After this/these event(s), were you hospitalized?**
3. Were you told that you fell as a child (down stairs, off a table or chair, at a park?)	❍ Yes, only once ⇨ ❍ Yes, more than one time ⇨ ❍ No *(Go to question 4)*	❍ Yes ❍ No	❍ Yes ❍ No	❍ Yes ❍ No

	a. Have you ever had any of these events?	b. Did you lose consciousness from this/these event(s)?	c. After this/these event(s), did you suffer from dizziness, headache, nausea, vertigo, neck pain, etc?	d. After this/these event(s), were you hospitalized?
4. Ever been in a fight, been beaten or attacked, passed out from alcohol?	❍ Yes, only once ⇨ ❍ Yes, more than one time ⇨ ❍ No	❍ Yes ❍ No	❍ Yes ❍ No	❍ Yes ❍ No