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Journal

Aggressive Behavior, 46(1)

ISSN

0096-140X

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Publication Date

2020

DOI

10.1002/ab.21867

Peer reviewed

HHS Public Access

Author manuscript

Aggress Behav. Author manuscript; available in PMC 2020 May 07.

Published in final edited form as:

Aggress Behav. 2020 January ; 46(1): 5–15. doi:10.1002/ab.21867.

Associations between violence, criminality and cognitive control deficits among young men living in low resource communities in South Africa

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Abstract

Despite empirical support for "Self-control theory" in criminology, there is controversy about how self-control should be operationalised. Working within the framework of "self-control theory", we investigated if violence and criminal behaviours are associated with nine distinct dimensions of cognitive control in a community sample of young men (n=654) living in peri-urban townships in South Africa. Cognitive control was assessed using the Behavior Rating Inventory of Executive Function. Multivariate statistical analysis was use, to identify associations between violence and criminality, and de-aggregated measures of nine distinct components of cognitive control. Fifteen percent of the sample reported recent violence, 27% had been in physical fights with family/ friends in the preceding 6 months, 10% reported being arrested, 4% reported forced sexual contact, and 26% reported intimate partner violence (IPV). Controlling for substance use and

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Authors' contributions

JB was responsible for the data analysis plan, interpretation of findings, and preparation of the manuscript. EA and CG were responsible for data analysis, interpretation of findings, and contributing to the manuscript. SR, JS and SG were responsible for project management, data collection, and manuscript preparation.

MT and MR was responsible for conceptualisation of the project, management of the project, interpretation of findings, and contributing to the manuscript.

[a]These authors share senior authorship

Declarations

Ethics approval and consent to participate

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. The institutional review boards of the University of California, Los Angeles (IRB#14–001587) and Stellenbosch University (N14/08/116) approved the study protocol.

Data availability

Data for this project has not been shared in the public domain, in order to protect participants' privacy and safeguard confidentiality. De-identified data are available on request from the authors.

Competing interests

The authors declare that they have no competing interests.

sociodemographic variables, contact with the criminal justice system and violence were associated with deficits in all domains of cognitive control. Forced sexual contact was associated with behavioural dysregulation. IPV was associated with behaviour dysregulation and executive control dysfunction. Future studies might utilise de-aggregated measures of self-control to provide further insight into links between particular components of cognitive control and various forms of offending and violence.

Keywords

violence; criminality; substance use; South Africa; cognitive control; executive function; self-control

Violence and criminality are serious public health concerns globally (Butchart, Mikton, Dahlberg, & Krug, 2015) and in South Africa (SA) (Davids & Gaibie, 2011; Demombynes & Özler, 2002; Leoschut, 2008), with significant widespread social, economic and health consequences (Lemanski, 2004; Wessels & Ward, 2015). Worldwide 1.3 million people die each year as a result of violence and approximately half a million people are murdered (Butchart et al., 2015). The burden of violence and crime is particularly marked in low and middle income countries, with a broad range of negative impacts on the perpetrator, the victims, and civil society (Butchart et al., 2015). In SA, violence and injury is the second leading cause of death after HIV/AIDS (Seedat, Van Niekerk, Jewkes, Suffla, & Ratele, 2009). In particular, young men are most likely to be both perpetrators, as well as the victims of violence and crime in SA (Seedat et al., 2009). Furthermore, SA has one of the highest rates of imprisonment globally, with 97% of inmates being male (Walmsley, 2016). As many as 50% of SA males aged 12–22 admit to having perpetrated violent crime (Pelser, 2008), and in most cases against a victim they knew (Jonck, Goujon, Testa, & Kandala, 2015). Chief among the factors contributing to crime and violence in SA are both historical patterns associated with apartheid and current dominant social forces such as poverty, unemployment, inequality, access to firearms, widespread alcohol and substance use, and weaknesses in the mechanisms of law enforcement (Seedat et al., 2009). The links between criminality and substance use are well documented, with reports indicating that 45% of arrestees in SA test positive for illicit substances (typically marijuana, methamphetamine, and mandrax) (Parry, Plüddemann, Louw, & Leggett, 2004). While it is important to understand the socioeconomic and cultural factors that contribute to violence and crime, it is also important to explore the possible role of temperamental and neurocognitive factors (such as self-control deficits and executive dysfunction) as both risk and maintaining factors in conceptualizing the landscape of violence and criminality in SA.

Self-control theory (Gottfredson & Hirschi, 1990), arguably one of the most influential frameworks for conceptualizing deviant behavior (Tittle, 2011), asserts that self-control deficits are associated with a range of health compromising behaviors including violence and criminality (Moffitt et al., 2011). Three systematic reviews have concluded that there is strong and convincing evidence of a link between low self-control and deviant behavior; a finding which appears to be consistent across study designs (both cross-sectional and longitudinal), measures of deviance, and different populations drawn from diverse cultural

settings (de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Pratt & Cullen, 2000; Vazsonyi, Mikuška, & Kelley, 2017). While there is widespread empirical support for self-control theory, there is controversy about how the contrast should be measured and what exactly the concept entails (Vazsonyi et al., 2017). The concept of *self-control* has much in common with the neuropsychological construct of *cognitive control*; both terms refer to the ability to pursue long-term goals and moderate behavioral responses to environmental stimuli (Scherbaum, Frisch, Holfert, O'Hora, & Dshemuchadse, 2018). However, there is some evidence to suggest that the types of behavior which are "controlled" under these two process differ; cognitive control is exercised in the regulation of attention and inhibiting habitual responses, while self-control is exercised in curbing short-term impulses and giving in to temptations (Kim & Lee, 2011; Scherbaum et al., 2018). It has been suggested that underlying both self-control and cognitive control is a single common neurological control process (behavioral inhibition) (Hare, Camerer, & Rangel, 2009; Peters & Büchel, 2011), although the evidence for this is contradictory with some neuroimaging studies indicating that there may be distinctly different neurological processes underlying these two constructs (Scherbaum et al., 2018). There are at least three reasons why it may be important, for theoretical and practical purposes, to investigate criminality and violence through the lens of cognitive control. Firstly, cognitive control has been identified as one of the domains within the Research Domain Criteria (RDoC) framework proposed by the National Institute for Mental Health (NIMH) and has been clearly operationalized (Cuthbert, 2015). Secondly, there has been an explosion in cognitive neuroscience research on violence in the last decade and the increasing awareness of the potential for this line of enquiry to identify novel treatments beyond those already developed within the framework of elf-control theory (Blair, 2019). Thirdly, measures of cognitive control can be de-aggregated into distinct sub-domains, which could allow for a more nuanced understanding of how particular domains of cognitive control are associated with different forms of violence and criminality. It is within this context that we set out to investigate associations between different forms of violence and criminality and nine distinct dimensions of cognitive control within a community sample of young men living in low resource peri-urban communities in SA. Below we briefly explain how cognitive control has been understood within this study and we present some of the evidence for associations between cognitive control defects and deviant Behaviour. Before moving on the present our study.

Cognitive control refers to the capacity to modulate other cognitive and emotional responses, in the service of goal-directed behaviour. It is an important domain of executive functioning, and consists of distinct processes such as: the inhibition of behaviour and impulse control; nonverbal and verbal working memory; affect regulation; self-monitoring; task-monitoring; motivation and arousal; planning and organizing; problem solving and cognitive flexibility (Lezak, Howieson, Loring, & Fischer, 2012). The cognitive control system is integral to making decisions about adaptive behavioural responses, particularly in novel situations where typical or habitual responses may be inappropriate or inadequate (Hofmann, Schmeichel, & Baddeley, 2012). Deficits in cognitive control give rise to a range of health compromising behaviours, including high-risk sexual behaviour, aggressive or violent responses, and hazardous substance use (Golub, Starks, Kowalczyk, Thompson, & Parsons, 2012). Cognitive control deficits result in maladaptive behaviour and impede the ability of

individuals to interact with their environments in efficient, adaptive and socially desirable ways (Miyake & Friedman, 2012). Cognitive control dysfunction, particularly in the domain of impulsivity, is associated with adolescent drug use, behavioural problems and risk taking (Romer et al., 2009; Steinberg, 2007). Cognitive control dysfunction is also implicated in maintaining cocaine use disorders among adults, and has been identified as an important target for interventions to reduce substance use (Garavan & Hester, 2007). A large body of research from diverse fields suggests that impaired executive functioning plays an important role in the aetiology of aggression and violent behaviour (Blair, 2019) as well as criminality (Giancola, 2000; Hancock, Tapscott, & Hoaken, 2010; Marsh & Martinovich, 2006; Paschall & Fishbein, 2002).

Impairments in cognitive control can result from traumatic brain injuries, degenerative neurocognitive diseases, and substance use, particularly when these result in insults to the prefrontal cortex of the brain, the striatum or limbic system (Lezak et al., 2012; Sadock, Sadock, & Ruiz, 2015). High potency marijuana, MDMA, and cocaine use have also been shown to impair executive function (Ramaekers et al., 2006; Verdejo-García, López-Torrecillas, Aguilar de Arcos, & Pérez-García, 2005). Although brain injury and chronic substance use can lead to marked executive dysfunction, more subtle (subclinical) deficits in cognitive control can result from a variety of hereditary, behavioural, and environmental factors, including poor nutrition, poverty, and exposure to violence (Sadock et al., 2015). Deficits in cognitive control are found in the general population, and may not be associated with obvious signs of neuropsychiatric pathology (Lezak et al., 2012). There is a good empirical foundation for research on the epidemiology of impaired cognitive control as a risk factor for aggression and violent behaviour (Blair, 2019; Paschall & Fishbein, 2002). However, most research in this area has involved clinical, incarcerated and other non-generalizable populations (Paschall & Fishbein, 2002) and comparatively little attention has been paid to exploring these associations in the general population.

Methods

We used a cross-sectional research design for this study, analysing baseline data collected as part of a randomised control trial (authors, blinded for peer review) between January 2016 and February 2017 from a clustered community sample of young men (n=654) living in Khayelitsha and Mfuleni (two townships in the greater Cape Town area). Within each of these settlements we used aerial maps to identify 18 neighbourhoods matched on density, ratio of dwellings to shebeens (bars), access to day-care and healthcare clinics, and the availability of water and toilets on-site. Within each of the 18 neighbourhoods, there was formal and informal housing and each neighbourhood contained approximately 450–600 households.

Sampling and recruitment:

Approximately 50 young men aged 18–29 years old from each of the 18 neighbourhoods in Khayelitsha and Mfuleni where approached and invited to participate in the study. Trained recruiters went from dwelling to dwelling, randomly selecting the first household (by flipping a coin on a hardcopy of the neighbourhood map) and then systematically

approaching houses in concentric circles, to identify potential participants. To be included in the study the young men had to have slept at least four nights per week in the household for the two months prior to recruitment and be able to speak isiXhosa or English. Young men meeting the inclusion criteria were invited to participate in an assessment interview conducted in a confidential setting at a time convenient to them. A total of 654 out of the 900 young men we approached, agreed to participate in the study (yielding a participation rate of approximately 72.7%).

Data collection:

Data were collected by trained interviewers who administered a one-hour assessment recording participants' responses on mobile phones using Mobenzi data capture software. Participants received reimbursement of ZAR120 (approx. US$9) for their time. The following data were collected:

1. *Sociodemographic information*: Participants were asked their age, number of years of completed education, relationship status, monthly family income, type of housing (formal or informal), if they had access to electricity in their homes, and current living arrangements (i.e. whether or not they were living with partner, parents and/or children).
2. *Substance use:* We utilized rapid diagnostic tests on urine samples to assess use of the following substances: tetrahydrocannabinol (marijuana) in the last 10 days; methaqualone (mandrax) in the last 2–3 days; methamphetamine (tik) in the last 1–2 days; and ethyl glucuronide (alcohol) in the last 24 hours.
3. *History of violence and criminal activity:* We assessed the following:
    a. *Involvement in group violence*: We asked participants if during the last three months they had: (1) been part of a group who was attacked; (2) chosen to get involved in a physical fight to support others or; (3) been a member of a gang. Involvement in group violence was coded as yes if a participant endorsed any of these behaviours.
    b. *Recent involvement in physical fights*: Participants were asked if they had been in any physical altercations with friends or members of their family in the past six months. Responses were coded as yes or no.
    c. *Contact with the criminal justice system*: We asked participants if they had ever been arrested or received a prison sentence. Contact with the criminal justice system was coded as yes or no.
    d. *Forced sexual contact.* We asked participants if they had ever had forced sexual contact with a female. Responses were coded as yes or no.
    e. *Intimate partner violence (IPV):* Participants were asked if they had ever hit, pulled, dragged or used a weapon on a girlfriend or partner. Responses were coded as yes or no.
4. *Cognitive control deficits*: We used the Behavior Rating Inventory of Executive Function-Adults Version (BRIEF-A) to assess cognitive control. The BRIEF-A is

a standardized self-report instrument, designed to measure cognitive control (i.e. executive cognitive functions and self-regulation) in an individual's everyday environment. The instrument, which is recommended by the NIMH to assess cognitive control within the RDoC framework, is composed of 75 items that cover nine non-overlapping scales: (1) *Inhibit* (ability to control impulses and curb inappropriate responses); (2) *Shift* (the capacity to move freely from one situation or aspect of a problem to another, an solve problems flexibly); (3) *Emotional Control* (ability to moderate or regulate emotions), (4) *Self-Monitor* (capacity to monitor one's own behaviour and track one's impact on others); (5) *Initiate* (the ability to begin tasks and generate ideas); (6) Working Memory (the ability to hold information in mind for the purpose of completing a task or solving a problem); (7) *Plan/Organize* (the ability to anticipate future events, set goals, develop steps to achieve a goal, and carry out tasks in a systematic manner); (8) *Task Monitor* (ability to assess performance during and after completing a task to ensure attainment of the goal); and (9) *Organization of Materials* (capacity to keep workspace, living area and materials in order). Questions are answered on a three point scale consisting of never (1 point), sometimes (2 points) and often (3 points), where higher scores indicate a higher level of cognitive dysfunction. The total scores on the first four sub-scales are summed to yield a *Behavioural Regulatory Index* (BRI) and the scores for the last five sub-scales yield a *Metacognition Index* (MI). BRI represents an individual's ability to maintain regulatory control of their behaviour and emotions; normative regulatory control enables cognitive processes which effectively guide problem solving and maintain self-regulation. MI represents an individual's ability to problem solve through planning and organizing while also sustaining task-completion efforts in memory and managing attention. The two indexes can be further combined to generate a *Global Executive Composite* (GEC) index, which provides an aggregate measure of global cognitive executive dysfunction. We used the clinical cut-off points identified in the BREIF-A manual to identify participants with significant deficits in each of the assessed domains of cognitive control (i.e. BRI raw score: 60 or higher; MI raw score: 79 or higher; GEC raw score; 136 or higher).

Data analysis:

Descriptive statistics were used to describe the sample characteristics, prevalence of violence and criminality, and prevalence of substance use. Univariate and multivariate analysis were employed to identify associations between sociodemographic variables, measures of cognitive control, and involvement in violence and criminal activity. First, we employed univariate models using simple linear regression to identify: (1) sociodemographic variables associated with violence and criminality; (2). sociodemographic variables associated with deficits in behavioural control, metacognition control, and global executive functions; (3) cognitive control deficits associated with violent behaviour and contact with the criminal justice system; and (4) cognitive control deficits associated with substance use. Finally, we used multivariate logistic regression models to identify which of the de-aggregated measures of cognitive control were associated with different types of violent behaviour and criminal

activity, controlling for substance use and the significant sociodemographic variables identified in the preceding univariate analysis. In all analyses, we set the level of significance at $\alpha = .05$. The results of the analysis are presented as p-values for all continuous measures and as odds ratios (ORs) with 95% confidence intervals (95% CIs) for all categorical variables. All analyses were conducted using R software Version 1.1. All de-identified data used in the analysis are available on request form the authors. We have included as supplementary material a complete zero-order correlation matrix for all data analysed in this study.

Ethics:

The institutional review boards of the University of California, Los Angeles (IRB#14–001587) and Stellenbosch University (N14/08/116) approved the study protocol. Informed consent was obtained from all participants prior to data collection. Privacy and confidentiality were protected by collecting data in a private space and storing de-identified data in a password-protected, cloud-based database.

Results

Sample characteristics:

The sample (N=654) consisted of men aged 22.7 ± 2.8 years (range 18–29 years), of which only 27% reported a monthly household income greater than ZAR2000 (approx. $150). The average number of completed years of education was 10 years (range 4–12 years). Only 8% of the sample reported being either married or living with a partner, and 6% said they lived with their children. The majority of the sample reported living in informal housing (57%), having access to electricity in their homes (56%), and living with their parents (64%). A total of 57% tested positive for tetrahydrocannabinol, 30% for methaqualone, 25% for methamphetamine, and 32% for alcohol use.

Table 1 summarizes the results of the measures of cognitive control. The mean BRI score for the sample was 47.0 ± 10.7 (range 30–80) and the mean MI score was 62.2 ± 13.9 (range =40–107). The mean GEC score was 109.24 ± 24.0 (range=70–187). A total of 10% (n=66) scored in the clinically significant range for deficits in BRI, while 13% (n=86) and 23% (n=149) had deficits in MI and GEC, respectively.

Prevalence of violence and criminal behaviour

Fifteen percent of the sample reported involvement in group violence over past 3 months, and 27% said they had been in physical fights with family or friends in the preceding six months. Approximately, 10% reported contact with the criminal justice system, 4% reported perpetrating forced sexual contact, while 26% said they had perpetrated IPV.

Sociodemographic correlates of violence and criminality

The results of the univariate logistic regression analysis of associations between sociodemographic variables and recent involvement in violence and criminal activity are shown in Table 2, as ORs with 95% CIs. Older age and being married or living with a partner were associated with increased likelihood of IPV. Higher levels of education were

negatively associated with previous arrests and IPV. Living with one's children was significantly associated with increased likelihood of physical fights in the last 6 months. We found no significant associations between any of the risk behaviours we investigated and income, type of housing, access to electricity, or living with one's parents.

Sociodemographic correlates of cognitive control deficits

The results of the univariate logistic regression analysis of associations between cognitive control and sociodemographic variables are shown in Table 3. Lower levels of education were associated with behavioural regulation dysfunction, deficits in metacognition, and with global cognitive executive dysfunction. Lower levels of education were also associated with deficits in the following domains of cognitive control: impulse control, emotional control, ability to initiate tasks and ideas, and working memory. Lower levels of family income were associated with difficulties shifting between components of a problem and impairments in the capacity to initiate tasks and ideas. Living in a home without electricity was associated with deficits in the capacity to organise materials. No other significant associations were found between sociodemographic variables and measures of cognitive control.

Cognitive control deficits associated with violence, criminality and substance use

The results of the univariate logistic regression analysis of associations between cognitive control deficits and involvement in violent behaviour and criminal activity are presented in Table 4. All measures of violence were consistently associated with deficits across all domains of cognitive control. A history of contact with the criminal justice system was associated with deficits in impulse control, emotional control, the capacity to plan/organize, task monitoring, organization of materials, behaviour regulation, metacognition and global executive function.

Table 5 shows the results of the univariate logistic regression analysis of associations between cognitive control deficits and substance use. Tetrahydrocannabinol use in the last 10 days and methamphetamine use in the last 1–2 days were associated with deficits in all domains of cognitive control. However, methaqualone use in the last 2–3 days and alcohol use in the last 24 hours, were not associated with any deficits in cognitive control.

Table 6 shows the results of the multivariate logistic regression models to investigate how measures of cognitive control dysfunction are associated with violent behaviour and criminal activity, when controlling for sociodemographic variables and substance use. Contact with the criminal justice system and involvement in physical fights were significantly associated with deficits in behaviour regulation, metacognition, and global executive function. No relationship between recent involvement in group violence and cognitive measures were found. Forced sexual contact was only significantly associated with deficits in behaviour regulation, while IPV was significantly associated with deficits in behaviour regulation and global executive dysfunction, but not with metacognition.

Discussion

Our data draw attention to endemic problems with violence and criminality among young unemployed men living in low resource neighbourhoods in peri-urban areas around Cape

Town. It is significant that 4% of our sample of men between the ages of 18 and 24, reported perpetrating forced sexual contact, 26% said they had perpetrated IPV, and 10% had a history of contact with the criminal justice system. Risk of recidivism is high among individuals with a history of violence and contact with the criminal justice system (Kurlychek, Brame, & Bushway, 2006). These findings highlight the importance of public health interventions to address the risk factors associated with violence and criminality in this community and the need for effective programmes to divert young men with a history of these behaviours in order to reduce the risk of recidivism. Although a number of scholars have previously called attention to the need for community based violence prevention interventions, this problem has received little attention and few violence prevention programs have been thoroughly tested for efficacy in SA (Matzopoulos, Myers, Bowman, & Mathews, 2008; Wessels & Ward, 2015). Furthermore where violence prevention interventions have been implemented they have tended to focus on reducing deprivation and inequality, and promoting early education rather than targeting behaviour change or improving domains of cognitive control such as self-regulation, impulse control or affect regulation (Matzopoulos et al., 2008; Wessels & Ward, 2015).

It is significant that we found strong associations between cognitive control deficits and prior involvement in violence and criminal activity, even when controlling for the influence of sociodemographic variables and substance use. While our data do not allow us to draw conclusions about causal links, our findings are broadly consistent with empirical research conducted within the framework of “self-control theory” (de Ridder et al., 2012; Pratt & Cullen, 2000; Vazsonyi et al., 2017), and lend support to the idea that the general theory of crime proposed by Gottfredson & Hirschi in 1990, might be applicable when conceptualising interventions in low resource SA communities. In this context it is interesting to note that while Gottfredson and Hirschi have identified self-control as an essential construct in limiting criminality and argued for the importance of promoting self-control as a means of addressing antisocial behaviour (Gottfredson & Hirschi, 1990), Woessner and Schneider (2013) have shown that impulsivity is not a prerequisite for criminal behaviour (Woessner & Schneider, 2013), suggesting that interventions which only promote self-control may not be enough to reduce all criminal behaviour or violence.

Regardless of potential causal links between the observed cognitive control deficits and the deviant behaviour our participants reported, we know from other longitudinal studies that individuals with a history of deviant behaviour and individuals with cognitive control deficits are at increased risk of engaging in future acts of violence and lawlessness (Caspi & Moffitt, 2018; Cui et al., 2016; de Ridder et al., 2012; Giancola, 1995; Hawkins & Trobst, 2000; Moffitt, 1993, 2017; Moffitt et al., 2011; Morgan & Lilienfeld, 2000; Paschall & Fishbein, 2002; Vazsonyi et al., 2017). The cognitive control defects we observed among young men with a history of deviant behaviour thus point to a high risk of recidivism in our sample, and suggest that young men in this community may benefit from interventions to improve their cognitive control as a means of protecting them from future engagement in violence and criminal behaviour. This line of reasoning makes sense given that cognitive control is critically involved in planning, initiation, and regulation of goal-directed behaviour (Luria, 1980; Paschall & Fishbein, 2002) and deficits in these areas result in behaviour dysregulation, poor social skills, impaired judgment, self-control deficits, and increased

likelihood of perpetrating future violent offences (Paschall & Fishbein, 2002; Woessner & Schneider, 2013). Subclinical impaired executive function has been shown to predict aggression and violent behaviour in nonclinical samples (Hawkins & Trobst, 2000).This literature suggests that interventions to build the deficits in cognitive control among the men in our sample (particularly those with a history of violence and criminality) could help to mitigate the risk of recidivism and future violent behaviour.

Crucially, we found differences in the associations between different forms of deviant behaviour and de-aggregated measures of distinct domains of cognitive control. Contact with the criminal justice system and recent involvement in violence were associated with deficits in all domains of cognitive control, while forced sexual contact was only associated with behavioural dysregulation, and IPV was associated with behaviour dysregulation and executive control dysfunction. These data tentatively suggest that it may be fruitful for subsequent research in this area to consider how sub-domains of cognitive control may be implicated in particular forms of violence and criminality. This may have important theoretical implications for designing interventions which seek to enhance cognitive control.

Assuming a causal link between cognitive control deficits and future aggression and criminality, it makes sense to make use of violence prevention interventions that explicitly seek to enhance cognitive control, especially if such interventions can be shown to improve self-control and curb impulsivity (DeWall, Baumeister, Stillman, & Gailliot, 2007). In this context it is interesting to note that scholars have suggested that many educational interventions designed to curb adolescents' risk behaviours are ineffective because they focus narrowly on changing knowledge, beliefs, and attitudes and thus fail to target the deficits in cognitive processes that are the main forces behind risk taking and antisocial behaviour (Steinberg, 2007). Interventions which seek to promote cognitive control may be more effective in curbing problematic behaviour than interventions which seek to change how individuals think about risk or psycho-educational interventions which only provide information (Romer, 2010). Although cognitive control is strongly influenced by genetic contributions and appears to be developmentally stable (Miyake & Friedman, 2012), there is some evidence that interventions can be used to enhance executive function and promote behaviours such as self-regulation (Blair & Diamond, 2008) and social and emotional competence in children and adolescents (Riggs, Jahromi, Razza, Dillworth-Bart, & Mueller, 2006). Cognitive training can result in significant improvements in a number of cognitive domains, including executive functions and cognitive control (Kesler et al., 2013; Matthias Kliegel, 2017).

Much of the work on cognitive training has targeted clinical populations, including patients with traumatic brain injuries (Cicerone, Levin, Malec, Stuss, & Whyte, 2006), older adults with symptoms of cognitive decline and other degenerative neurological conditions (Sammer, Reuter, Hullmann, Kaps, & Vaitl, 2006), and children with intellectual and learning disabilities (Kirk, Gray, Riby, & Cornish, 2015). There would appear to be scope to develop effective cognitive control interventions which are culturally appropriate and acceptable to young men who grow up in resource constrained environments in SA, as an integral component of community-based violence prevention programmes.

Limitations

There are a number of limitations to this study, including the fact that we used a cross-sectional research design which did not include prospective measures or longitudinal data. Furthermore we relied on self-reports and only recruited men from two neighbourhoods in peri-urban townships in the Western Cape. Nonetheless we collected data from a relatively large sample of young men who were randomly recruited to be representative of other young unemployed men living in per-urban townships in SA. We also collected data on a wide range of antisocial and criminal activity, making this study the first of its kind in Africa to investigate associations between cognitive control deficits and a history of engagement in violence and criminal behaviour.

Conclusion

This study is the first of its kind to assess associations between violent criminal behaviour and levels of cognitive control in a community sample of young men in resource constrained communities in SA using the BRIEF-A, a standardised instrument which is widely used in international neurocognitive research and which is recommended for the assessment of cognitive control in the RDoC framework (Christ, Kanne, & Reiersen, 2010; Koven & Thomas, 2010; Rabin, Fogel, & Nutter-Upham, 2011). The findings draw attention to associations between cognitive control deficits and a history of deviant behaviours suggesting that programmes which seek to reduce the risk of recidivism in this community should include strategies to enhance cognitive control and self-regulation. Furthermore, our findings suggest that future studies may benefit from using de-aggregated measures of self-control to provide further insight into potential links between particular components of cognitive control and different forms of offending and violence.

Acknowledgements

Thank you to Josh Yeatman for editing and proof reading earlier versions of this manuscript.

Funding

This research was supported by the National Institute on Drug Abuse (R34DA030311); the National Institute of Mental Health (T32MH109205); the UCLA Center for HIV Identification, Prevention and Treatment Services (P30MH58107); the UCLA Center for AIDS Research (P30AI028697); the UCLA Clinical and Translational Science Institute (UL1TR000124); National Institute on Drug Abuse (R01DA038675); and the South African Medical Research Council (Career Development Grant awarded to JB). Funders had no role in the design of the study, nor in the collection, analysis, and interpretation of data or the preparation of the manuscript.

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Table 1:

Summary of measures of cognitive control in a community sample of young men living in low resource communities in the Western Cape Province of South Africa (n=654)

Score	Mean Score	SD	Min	Max	Caseness (n)
Behavioral Regulation Index	47.0	10.7	30	80	66
Metacognition Index	62.2	13.9	40	107	86
Global Executive Composite	109.2	24.0	70	187	149

Table 2:

Univariate analysis of associations between sociodemographic variables and violence in a community sample of young men living in low resource communities in the Western Cape Province of South Africa (n=654)

	Involvement in group violence over past 3 months		Physical fights with friends / family in last 6 months		Contact with criminal justice system		Forced sexual Contact		I Intimate partner violence	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Age	1.00	0.92–1.09	1.00	0.93–1.09	0.98	0.87–1.11	1.15	0.95–1.38	**1.13**	**1.04–1.23**
Education	0.92	0.82–1.04	0.90	0.80–1.00	**0.71**	**0.61–0.83**	1.03	0.79–1.34	**0.85**	**0.76–0.95**
Marital status (*ref*=single)	0.87	0.42–1.81	0.91	0.46–1.81	0.93	0.31–2.73	1.16	0.26–5.24	**2.33**	**1.25–4.36**
Income	0.92	0.62–1.37	1.13	0.77–1.67	1.71	0.88–3.32	0.92	0.38–2.19	0.99	0.67–1.46
Informal Housing	0.62	0.09–4.24	1.07	0.18–6.43	--	--	--	--	0.49	0.07–3.36
Electricity	0.95	0.64–1.40	1.15	0.79–1.68	1.19	0.66–2.15	0.58	0.26–1.31	--	--
Participant living with parents	0.53	0.23–1.21	0.82	0.41–1.64	1.00	0.37–2.71	0.91	0.20–4.10	0.96	0.66–1.40
Participant living with their children	1.57	0.64–3.86	**2.40**	**1.02–5.64**	2.60	0.65–10.33	2.00	0.40-10.00	1.52	0.81–2.88

*
Bold indicates p ≤ 0.05

Table 3:

Univariate analysis of associations between cognitive control deficits and sociodemographic variables in a community sample of young men living in low resource communities in the Western Cape Province of South Africa (n=654)

	Behavioral Regulation					Metacognition						Global Executive Composite (GEC) index
	Inhibit	**Shift**	**Emotional Control**	**Self-Monitor**	**Behavioral Regulatory Index (BRI)**	**Initiate**	**Working Memory**	**Plan/ Organize**	**Task Monitor**	**Organizatio n of Materials**	**Metaco gnition Index (MI)**	
Age	0.01	0.00	0.06	−0.03	0.04	−0.01	0.03	0.02	0.00	0.04	0.08	0.12
Education	**−0.21** **	−0.05	**−0.29** **	−0.06	**−0.61** *	**−0.18** *	**−0.16** *	−0.17	−0.10	−0.08	**−0.70** *	**−1.31** *
Marital status	−0.46	−0.34	−0.02	−0.25	−1.07	−0.66	−0.03	−0.38	−0.19	−0.22	−1.48	−2.55
Income	0.46	**0.49** *	0.46	0.11	1.52	**0.61** *	0.44	0.58	0.25	0.21	2.09	3.61
Informal Housing	0.00	−0.20	−0.30	−0.55	−1.05	−0.23	−0.58	−0.66	−0.22	−0.92	−2.61	−3.66
Electricity	−5.50	0.00	−2.50	−3.00	−11	−3.50	−3.50	−5.50	−1.00	**−5.50** *	−19.0	−30.0
Living with parents	0.23	0.19	0.13	0.35	0.90	−0.05	−0.02	0.08	0.15	−0.04	0.12	1.03
Living with children	−0.25	0.11	0.40	0.26	0.51	−0.37	0.07	−0.26	−0.16	−0.26	−0.98	−0.47

***Bold** indicates $p \leq 0.05$

****Bold** indicates $p \leq 0.01$

Table 4.

Univariate analysis of associations between cognitive control deficits and involvement in violent behaviour and criminal activity in a community sample of young men living in low resource communities in the Western Cape Province of South Africa (n=654)

	Involvement in group violence over past 3 months		Physical fights with friends / family in last 6 months		Contact with the criminal justice system		Force sexual contact		Intimate partner violence	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Behavioral Regulatory Index (BRI)	**1.05**	**1.03–1.07**	**1.05** *	**1.03–1.07**	**1.02** *	**1.00–1.05**	**1.08** *	**1.04–1.13**	**1.05** *	**1.03–1.07**
Inhibit	**1.18** *	**1.11–1.26**	**1.21** *	**1.14–1.28**	**1.10** *	**1.01–1.20**	**1.26** *	**1.11–1.44**	**1.19** *	**1.12–1.27**
Shift	**1.18** *	**1.08–1.28**	**1.18** *	**1.09–1.27**	1.12	0.99–1.26	**1.20** *	**1.00–1.45**	**1.15** *	**1.06–1.24**
Emotional Control	**1.13** *	**1.07–1.18**	**1.14** *	**1.09–1.19**	**1.07** *	**1.00–1.14**	**1.27** *	**1.13–1.43**	**1.14** *	**1.09–1.20**
Self-Monitor	**1.20** *	**1.11–1.30**	**1.21** *	**1.12–1.30**	1.04	0.94–1.17	**1.32** *	**1.10–1.58**	**1.18** *	**1.09–1.27**
Metacognition Index (MI)	**1.03**	**1.02–1.04**	**1.03** *	**1.02–1.05**	**1.02** *	**1.00–1.04**	**1.05** *	**1.02–1.08**	**1.03** *	**1.02–1.05**
Initiate	**1.11** *	**1.05–1.18**	**1.15** *	**1.08–1.22**	1.07	0.98–1.16	**1.22** *	**1.07–1.40**	**1.14** *	**1.08–1.21**
Working Memory	**1.14** *	**1.07–1.21**	**1.15** *	**1.09–1.23**	1.06	0.97–1.16	**1.22** *	**1.06–1.42**	**1.14** *	**1.07–1.21**
Plan/Organize	**1.10** *	**1.05–1.16**	**1.11** *	**1.06–1.16**	**1.07** *	**1.00–1.15**	**1.19** *	**1.05–1.33**	**1.11** *	**1.06–1.17**
Task Monitor	**1.15** *	**1.06–1.25**	**1.15** *	**1.06–1.24**	**1.13** *	**1.00–1.27**	**1.22** *	**1.02–1.46**	**1.13** *	**1.05–1.22**
Organization of Materials	**1.16** *	**1.09–1.23**	**1.16** *	**1.10–1.23**	**1.12** *	**1.02–1.22**	**1.19** *	**1.05–1.34**	**1.19** *	**1.12–1.27**
Global Executive Composite (GEC) index	**1.02** *	**1.01–1.03**	**1.02** *	**1.01–1.03**	**1.01** *	**1.00–1.02**	**1.03** *	**1.01–1.05**	**1.02** *	**1.01–1.03**

OR : odds ratio

95% CI = 95% confidence interval

* **Bold** indicates $p \leq 0.05$

Table 5.

Univariate analysis of associations between cognitive control deficits and substance use in a community sample of young men living in low resource communities in the Western Cape Province of South Africa (n=654)

	Tetrahydrocannabinol use in the last 10 days		Methaqualone use in the last 2–3 days		Methamphetamine use in the last 1–2 days		Alcohol use in the last 24 hours	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Behavioral Regulatory Index (BRI)	**1.03** *	**1.01–1.04**	1.01	0.99–1.03	**1.03** *	**1.01–1.04**	1.01	0.99–1.02
Metacognition Index (MI)	**1.02** *	**1.00–1.03**	1.00	0.98–1.02	**1.01** *	**1.00–1.03**	1.01	0.99–1.02
Global Executive Composite (GEC) Index	**1.01** *	**1.00–1.02**	1.00	0.99– 1.01	**1.01** *	**1.00–1.02**	1.00	0.99–1.01

OR : odds ratio

95% CI = 95% confidence interval

* **Bold** indicates $p \leq 0.05$

Table 6:

Results of multivariate logistic regression analysis of cognitive control deficits as a predictor of violent and criminal behaviour, adjusted for socio-demographic variables and substance use. in a community sample of young men living in low resource communities in the Western Cape Province of South Africa (n=654)

	Predictor	OR	95% CI	P-Value
Involvement in group violence over past 3 months	BRI	1.03	1.00–1.06	0.07
	MI	1.01	1.00–1.03	0.26
	GEC	1.01	1.00–1.02	0.15
Physical fights with friends / family in last 6 months	BRI	**1.05**	1.02–1.08	**0.00** **
	MI	**1.04**	1.02–1.06	**0.00** **
	GEC	**1.02**	1.01–1.04	**0.00** **
Contact with criminal justice system	BRI	**1.07**	1.01–1.12	**0.02** *
	MI	**1.07**	1.02–1.12	**0.00** **
	GEC	**1.04**	1.01–1.07	**0.00** **
Forced Sexual Contact	BRI	**1.10**	1.00–1.20	**0.05** *
	MI	1.05	0.99–1.12	0.13
	GEC	1.04	1.00–1.08	0.08
Intimate Partner Violence	BRI	**1.04**	1.01–1.08	**0.01** **
	MI	1.01	1.00–1.04	0.13
	GEC	**1.01**	1.00–1.03	**0.04** *

OR : odds ratio

95% CI = 95% confidence interval

*
Bold $p \leq 0.05$;

**
Bold $p \leq 0.01$

BRI= Behavioral Regulatory Index MI = Metacognition Index

GEC = Global Executive Composite Index