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Effects of a CBT/Mindfulness Training Intervention:
A Cluster-Randomized Controlled Trial

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Intervention:

A Cluster-Randomized Controlled Trial

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Biographical Sketches

Rebecca Umbach is a Ph.D. candidate in criminology at the University of Pennsylvania. Her research interests include the negative cognitive effects of incarceration, and the relationship between cognition and antisocial behavior in youth and adolescents.

Adrian Raine is the Richard Perry University Professor of Criminology, Psychiatry, and Psychology at the University of Pennsylvania. His research focuses on the etiology and prevention of antisocial, criminal, and psychopathic behavior in children and adults. His latest book, *The Anatomy of Violence* (2013, Pantheon and Penguin), reviews the brain basis to violence. He is past-President of the Academy of Experimental Criminology, and received an honorary degree from the University of York (UK) in 2015.

Noelle R. Leonard, Ph.D. is a Senior Research Scientist at the New York University Rory Meyers College of Nursing with an expertise in designing, implementing, evaluating, and disseminating behavioral interventions for highly vulnerable youth and adults. These intervention involve a variety of modalities including mindfulness meditation and mobile health technology for homeless/runaway youth, youth involved in the criminal justice adolescent mothers with young children, and youth and adults at high risk for/infected with HIV/AIDS.

Abstract

This study primarily tests whether incarceration negatively affects cognitive functioning; namely emotion regulation, cognitive control, and emotion recognition. As a secondary interest, we test protective effects of a Cognitive Behavioral Therapy/Mindfulness Training (CBT/MT) intervention. Dormitories containing 197 incarcerated males aged 16-18 were randomly assigned to either a CBT/MT program or an active control condition. A cognitive task was administered pre-treatment and again four months later, upon treatment completion. Performance on all outcome variables was significantly worse at follow-up compared to baseline. There were marginally significant group by time interactions. While the control group performance significantly declined in both cognitive control and emotion regulation, the CBT/MT group showed no significant decline in either outcome. This is the first study to probe the effects of incarceration on these three processes. Findings suggest that incarceration worsens a known risk factor for crime (cognitive functioning), and that a CBT/MT intervention may help buffer against declines.

Keywords: Incarceration, Executive Functioning, Mindfulness, Adolescent, Cognitive Behavioral Therapy, Intervention, Cognition

Cognitive Decline as a Result of Incarceration and the Effects of a CBT/Mindfulness

Training Intervention: A Cluster-Randomized Controlled Trial

The negative outcomes associated with incarceration are argued to be well-documented and wide-ranging, including increased antisocial behavior of offspring (Mears & Siennick, 2016; Murray & Farrington, 2008; Rose, 1998) and impaired health of those previously incarcerated (Schnittker & John, 2007). Most studies have focused on psychological and social effects, resulting in a gap in the literature regarding the effects of incarceration on cognitive functioning. Compromised cognitive functioning, particularly executive functioning, is a well-replicated risk factor for antisocial behavior (Morgan & Lilienfeld, 2000; Ogilvie, Stewart, Chan, & Shum, 2011). Accordingly, this study uses a longitudinal design to look at cognitive functioning in young incarcerated males, providing a new social neurocriminological perspective on the criminogenic effects of incarceration (Choy et al., 2015). Evidence that incarceration negatively alters cognitive functioning of prisoners in a way that may promote future recidivism would also speak to the possible benefits of alternative forms of justice, including drug courts and restorative justice approaches.

As a secondary and exploratory aim, this study additionally experimentally investigates the effects of a group-based cognitive behavioral therapy/mindfulness training (CBT/MT) intervention. While programming directed at improving prisoner outcomes is commonplace in correctional settings, mindfulness training as an intervention has become popular only recently. Most studies looking at the effects of mindfulness in offender populations have focused on recidivism as the outcome of interest (Alexander & Orme-Johnson, 2003; Bleick & Abrams, 1987; Himmelstein, 2011), while effects on cognitive functioning remain a gap in the literature,

despite the possibility that improved cognitive functioning may be a mechanism for these reductions in recidivism. Leonard et al. (2013), using these data, provide a notable exception by looking at the effects of incarceration and CBT/MT on a task of attention. Because incarceration is hypothesized to lead to impaired cognitive functioning, and because executive functioning expands beyond attention to include a wide range of processes including emotion regulation and cognitive control, this study tests as a secondary aim whether CBT/MT can help mitigate negative effects on these processes specifically. Finally, this study discusses potential policy and criminal justice implications that follow from our findings.

Executive Functioning: Cognitive Control, Emotion Regulation, and Emotion Recognition

Executive functioning. Executive functioning is an overarching term used to refer to higher order cognitive processes, which include dynamic decision-making, attending, cognitive control, and emotion regulation, all of which are considered necessary for prosocial behavior (Morgan & Lilienfeld, 2000; Ogilvie et al., 2011). Although there are a number of executive functions that have been associated with antisocial behavior, the emotional go/no-go task used in this study measures three related but distinct processes: cognitive control, emotion regulation, and emotion recognition.

Cognitive control. Poor inhibition and low self-control are executive functions well acknowledged by the literature to be associated with antisocial behavior (Gottfredson & Hirschi, 1990; Ogilvie et al., 2011). Gottfredson and Hirschi's general theory of crime argues that low self-control is the single most important predictor of crime, although many argue the need to incorporate situational characteristics such as opportunity (Grasmick, Tittle, Bursik, & Arneklev, 1993; Osgood, Wilson, O'Malley, Bachman, & Johnston, 1996). An ability to inhibit

inappropriate responses is argued to be necessary in the achievement of future-oriented goals and prosocial behavior generally.

Emotion regulation. Impaired emotion regulation has been associated with antisocial behavior (Lewis, Granic, & Lamm, 2006; Long, Felton, Lilienfeld, & Lejuez, 2014; Robertson, Daffern, & Bucks, 2012; Robertson, Daffern, & Bucks, 2014). Under- and over-regulation of emotion are both considered pathways to aggressive behavior (Robertson et al., 2012). Those who under-regulate may act out to try to repair, end, or avoid uncomfortable emotional states, while those who over-regulate may have increased negative affect and physiological arousal, and reduced inhibitions against aggression (Robertson et al., 2012). Being unable to manage and modify one's reactions appropriately is maladaptive and therefore likely to result in negative immediate and long-term outcomes.

Emotion recognition. There is a strong body of evidence supporting a relationship between facial emotion recognition ability and antisocial behavior (Marsh & Blair, 2008). The prevailing hypothesis behind this relationship is that poor recognition of negative affect (particularly fear) is associated with impaired empathic development and thus a greater predisposition to antisocial behavior. This cognitive process is thought to derive from the same areas of the brain as emotion regulation and inhibition (Streit et al., 2003), although to date there is no existing support for the hypothesis that mindfulness may impact performance in this area.

Incarceration

After peaking in 2009, the incarceration rate in the United States has gradually declined, standing at 458 prisoners sentenced to more than 1 year per 100,000 U.S residents of all ages in 2015 (Carson & Anderson, 2016; Travis, Western, & Redburn, 2014). Despite this declining trend, the incarceration rate of the United States continues to be the highest in the world. A

variety of factors will influence an inmate's incarcerated experience, including facility physical characteristics and culture, resources such as academic and life skills training classes, recreational time, and correctional officers. In addition, characteristics of the prisoner will influence the stressors likely to be experienced (e.g., type of offense for which they were convicted).

Prison programming. The availability of prison programming reflects not only different mandates at the federal and state levels, but also shifting societal attitudes towards the purpose of incarceration and greater knowledge about the effectiveness of programming. Today there has been a shift away from academic programming towards practical, targeted interventions (e.g. budgeting and parenting classes) designed to help the prisoner succeed upon reentry (Phelps, 2011).

There are few recent reports on program offerings, however at least one paper suggests that while more prisons are offering more programs, overall rates of inmate participation are anemic or decreasing. This is because, despite increases in facilities offering programming, the burgeoning numbers of inmates and the logistical restrictions (e.g., class sizes cannot just expand to meet demand, given security risks) prevent a commensurate increase in the rate of inmate participation in educational, vocational, or prison industry programming (Travis et al., 2014).

Negative Effects of Incarceration. Despite programming intended to help with rehabilitation and reentry, incarceration remains an overwhelmingly negative experience for the majority of offenders. Considering the number of individuals impacted, it is important to examine the lived realities of incarceration. The literature surrounding "prisonization," or the process of socialization in a prison setting, suggests that prisoners develop coping mechanisms to adapt to the informal "code" practiced in prison. Studies suggest that the incarcerated experience

is characterized by bullying, substance use, emotional flattening, psychological distress, strain on social bonds, self-isolation, and violence (Ashkar & Kenny, 2008; Haney, 2012; Schnittker & John, 2007; Yang, Kadouri, Révah-Lévy, Mulvey, & Falissard, 2009).

Moreover, negative effects of incarceration appear to be enduring and widespread, extending outside of prison. In addition to mental and physical health issues, the formerly incarcerated experience reduced status in the labor market (Schnittker & John, 2007), increased rates of drug-related death and homicide (Lim et al., 2012), and greater incidence of delinquency in their offspring (Murray & Farrington, 2008).

Importantly, incarceration experiences likely vary significantly conditional on the specific characteristics of a facility (Travis et al., 2014). Naturally, jails and prisons will operate differently, as will correctional facilities at different levels of security, and state prisons as opposed to federal prisons. Even within facilities, the experience of inmates within will vary widely due to factors including physical layout (Wolff, Blitz, Shi, Siegel, & Bachman, 2007), resources (Duwe & Clark, 2014; Gallant, Sherry, & Nicholson, 2015), and quality of correctional staff (Reisig & Mesko, 2009). Moreover, all of those aforementioned factors likely feed into each other. For example, lesser resources may result in more prisoner misconduct, leading to frustrated and fearful staff and thus more prisoner misconduct, which could result in additional removal of resources as punishment, and so on.

Personal characteristics of the inmate such as criminal record, age, mental health, gender, and race, will also impact threats to personal safety and stress levels (Ashkar & Kenny, 2008). Young inmates, inmates with mental health disorders, and new offenders may be perceived as particularly vulnerable, and thus easy targets for victimization (Wolff, Blitz, & Shi, 2007; Wolff, Shi, Blitz, & Siegel, 2007). Certain types of offenders, such as domestic or child abusers and sex

offenders, may suffer significantly more prison victimization by dint of their crime (Wolff et al., 2007).

Psychological and cognitive effects of incarceration. Despite a large body of literature exploring the effects of incarceration, the impact of incarceration on cognitive functioning is largely understudied. Some have speculated that incarceration has negative psychological effects (Haney, 2003; Haney, 2012), and that such effects may range from subtle psychological deficits to clinical levels of mental illness. For example, in generating hypotheses on the effects of incarceration in a supermax prison, Haney (2003) notes that the rigid structure, lack of stimuli, and loss of autonomy may result in the loss of the prisoners' "...ability to initiate or to control their own behavior, or to organize their own lives" and may cause them to "...find it difficult to focus their attention, to concentrate, or to organize activity." Haney does not explicitly identify these symptoms as cognitive issues. Nevertheless, both of these purported consequences are arguably indicators of impaired executive functioning, on the one hand impaired attention, and on the other loss of self-control (Morgan & Lilienfeld, 2000; Ogilvie et al., 2011). Although supermax is the most extreme form of incarceration, others have suggested cognitive deficits could result from the loss of personal control associated with any type of incarceration (Goodstein, MacKenzie, & Shotland, 1984).

Beyond these high level potential risk factors, many other well-supported risk factors for executive function deficits are likely present in correctional facilities. Briefly, sustained stress or trauma and lack of enrichment activities, both physical and material (Colcombe & Kramer, 2003; Hackman & Farah, 2009; Kramer et al., 1999; Noble, Norman, & Farah, 2005; Noble, McCandliss, & Farah, 2007; Noble, Houston, Kan, & Sowell, 2012; Öhman, Nordin, Bergdahl, Birgander, & Neely, 2007; Sarsour et al., 2011); sleep deprivation (Durmer & Dinges, 2005;

Goel, Rao, Durmer, & Dinges, 2009) and institutional violence exposure (Glenn & Raine, 2014; Schretlen & Shapiro, 2003) all present as potential threats to cognitive integrity in incarcerated individuals. In this study in particular, exposure to institutional violence, and specifically violence inflicted by correctional staff, is of serious concern (United States, Department of Justice, Office of the United States Attorney Southern District of New York 2014).

Despite these obvious risk factors, and the significant hypothesizing by Haney and others, there's little to no empirical data on the effects of incarceration on cognitive functioning. An exception includes a cluster-randomized controlled trial conducted by Leonard et al. (2013) using these participants but a different cognitive task, the Attention Network Task (Fan, McCandliss, Sommer, Raz, & Posner, 2002). In the task, various cueing conditions were followed by a central arrow pointing left or right, either alone or sandwiched between arrows pointing in the same direction or the opposite direction. Participants were asked to press the arrow key corresponding to the direction of that arrow. Leonard et al. (2013) examined three separate attentional networks (alerting, orienting, and conflict monitoring). They found that, although CBT/MT somewhat mitigated the deleterious effects of incarceration, performance on the task significantly decreased from baseline to follow-up (approximately four months later) across participants. The observed decline due to incarceration is consistent with Haney's (2003) and Goodstein and colleagues' (1984) hypotheses that incarceration may have harmful psychological effects. As Leonard et al. (2013) focused on the effects of CBT/MT in buffering declines in attention, the current study aims to expand on these findings by probing the effects of incarceration on different types of executive function, i.e., inhibition and emotion regulation.

Mindfulness

Mindfulness, mindfulness training, and mindfulness meditation practices fall under the umbrella of general meditation practices. A general consensus definition of mindfulness involves two components: (1) the self-regulation of attention, and (2) detached self-observation of the present moment in a non-judgmental and accepting way (Bishop et al., 2004; Kabat-Zinn, 1982). Mindfulness is often incorporated into clinically-oriented, group-based meditation programs such as Mindfulness-Based Cognitive Therapy (Teasdale et al., 2000) and Mindfulness-Based Stress Reduction (Kabat-Zinn, 1982). Although specific programs may incorporate various complementary therapeutic approaches, mindfulness is associated with improved self-regulation through its focus on self-awareness, attentional control, and emotion regulation (Tang, Hölzel, & Posner, 2015).

With regard to cognition, mindfulness has been associated with improved executive functioning, particularly in the areas of attention (Chiesa, Calati, & Serretti, 2011; Eberth & Sedlmeier, 2012; Jha, Krompinger, & Baime, 2007), emotion regulation, and cognitive control (Eberth & Sedlmeier, 2012; Holzel et al., 2011; Tang, Yang, Leve, & Harold, 2012; Wupperman, Neumann, & Axelrod, 2008). It has been hypothesized that one mechanism underlying this relationship is the upregulation of brain areas associated with executive functioning that results in improved neurocognition (Holzel et al., 2011; Tang & Posner, 2009). This is supported by brain imaging studies that find increased activation of the prefrontal cortex following mindfulness (Chiesa & Serretti, 2010). It is also conceivable that stress reduction may play a large part in improving cognition, as stress is associated with impaired neurocognition (Öhman et al., 2007), and mindfulness is often specifically targeted at reducing stress (Goyal et al., 2014).

Studies on the efficacy of mindfulness in treating antisocial behavior and associated criminogenic constructs have focused predominantly on outcomes of substance abuse and recidivism in incarcerated adult populations (Shonin, Van Gordon, Slade, & Griffiths, 2013). Within offender populations, mindfulness is argued to reduce recidivism (Alexander & Orme-Johnson, 2003; Bleick & Abrams, 1987; Himelstein, 2011), decrease hostility and depression, and increase self-esteem (Shonin et al., 2013) and self-reported self-regulation, including suppression of aggression (Evans-Chase, 2013). Despite the increasing interest in the viability of mindfulness as an effective intervention in incarcerated populations, methodological issues are widespread in the current literature, as noted by Shonin et al. (2013) in their review. Among the various studies included in their review, they note unreported attrition rates, small sample sizes, and possible selection bias due to self-selection into the intervention group, among other issues.

Mindfulness has been shown to be effective in improving executive functions in community and clinical samples, but the current study will test whether it is successful in buffering deficits associated with the sustained stress of incarceration. Because chronic stress is associated with impaired cognitive functioning (Öhman et al., 2007), it seems plausible that stress reduction, perhaps the best-supported benefit of mindfulness (Barrett, 2016; Chiesa & Serretti, 2009), may provide a protective effect in a forensic sample. In addition, mindfulness encourages the meditator to acknowledge and accept his current emotions without acting on them, which may promote more effective and adaptive emotion regulation (Barrett, 2016; Eberth & Sedlmeier, 2012).

This Study

This study has primary and secondary research questions which aim to bring together several disparate literatures on the effects of incarceration and CBT/MT on cognitive functioning

and the effectiveness of CBT/MT in correctional settings. Our primary research question is as follows:

1. Does time spent incarcerated result in deficits in emotion recognition, cognitive control, and emotion regulation as measured by an emotional go/no-go task?

Assuming the answer to the first question is yes, our secondary research question is as follows:

2. Does CBT/MT protect against incarceration-related cognitive deficits?

Although Leonard et al. (2013) used this sample, they used a task of attention to focus particularly on the protective effects of CBT/MT. By expanding these findings to different tasks measuring other executive functioning processes, this study aims to build upon those findings and to test the extent to which incarceration impairs cognitive functioning more generally—a theory that has been put forth (Goodstein et al., 1984; Haney, 2003), but has so far remained untested empirically.

Methods

Participants

As part of a larger study, 268 sentenced or detained male youths ($M_{\text{age}} = 17.4$ years; $SD = 0.71$, range 16-18) were recruited from a large correctional facility in New York City between August 2009 and December 2010. Youth were invited to participate if they (1) had at least six weeks remaining on their sentence or estimated length of stay, (2) could complete an interview in English, and (3) were between the ages of 16-18. Youth at Rikers are assigned to one of two buildings depending on their status (sentenced vs. awaiting trial), which consist of multiple dormitories. Dormitories from both buildings and the participating participants within were assigned randomly to receive either a Cognitive Behavioral Therapy/Mindfulness Training

intervention or an active control intervention. This cluster-randomization was necessitated by concerns of contamination of the treatment effect.

Only a subset of participants completed both waves of data collection ($N = 197$) for the following reasons. As per the study protocol, participants ($n = 24$) who were transferred or released after the T1 assessment but before the intervention began were not contacted for follow-up assessment. Some participants ($n = 28$) completed the intervention but were later transferred to a facility where study activities were prohibited by correction officials, and thus were unable to complete the follow-up evaluation. In addition, nine computer files were entirely corrupted, four computer files were missing data specifically for the follow-up emotional go/no-go task, four participants refused to complete the T2 assessment entirely, one participant was deported out of the country, and one participant turned 19 before the intervention began. Participants with complete data did not differ in age, race, or days incarcerated at baseline from those excluded from the study.

Of the participants with complete data, 88 participants were enrolled into the control group and 109 participants were enrolled into the experimental CBT/MT group. The groups did not differ in race, percent reporting violent or non-violent crime, number of days in Rikers at baseline, or self-reported age of onset of offending. The experimental group was older than the control group by approximately one month (17.52 years vs 17.40 years, $p = 0.005$). 97% of the participants were Black or Latino, and mean length of time already spent in the correctional facility at baseline was non-normally distributed ($M = 103.93$ days; $Mdn = 73$ days; $IQR = 111$ days), with skewness of 3.43 ($SE = 0.17$) and kurtosis of 16.89 ($SE = 0.35$). Table 1 presents descriptive statistics for included participants. The participants also self-reported on types of offending, full details of which can be found in Table 2.

Variable	Full Sample, <i>N</i> = 197		Control, <i>N</i> = 88		Powersource, <i>N</i> = 109		<i>t</i>
	\bar{X}	<i>SD</i>	\bar{X}	<i>SD</i>	\bar{X}	<i>SD</i>	
Age	17.40	0.71	17.24	0.71	17.52	0.69	-2.83*
WRAT (reading subscore)	38.88	8.65	38.00	10.03	39.61	7.32	-1.32
Last Grade Completed	9.93	1.38	10.00	0.94	9.87	1.66	0.69
Black	0.51	0.50	0.55	0.50	0.51	0.50	0.70
Hispanic	0.30	0.46	0.28	0.45	0.31	0.47	-0.42
White	0.01	0.07	0.00	0.00	0.01	0.10	-0.90
Multiracial/Other	0.18	0.38	0.17	0.38	0.18	0.39	-0.24
Any violent crimes	0.57	0.50	0.56	0.50	0.58	0.50	-0.30
Nonviolent crimes	0.78	0.41	0.81	0.40	0.76	0.43	0.76
Number of Days in Rikers at Baseline	103.93	120.44	94.06	84.63	111.90	142.88	-1.09
Log Number of Days in Rikers at Baseline	4.15	1.02	4.15	0.94	4.16	1.07	-0.09
Days Between Baseline and Follow-Up Interviews	146.89	68.26	144.64	76.92	148.72	60.68	-0.42
Age at Onset of Offending	10.50	4.53	9.94	4.60	10.98	4.42	-1.50
Score on YSR subscales							
Anxious/Depressed	4.33	3.88	4.03	3.54	4.57	4.14	-0.96
Withdrawn	5.16	3.19	5.07	2.83	5.24	3.46	-0.38
Somatic Complaints	1.65	2.13	1.41	2.03	1.84	2.20	-1.43
Delinquent Behavior	10.45	4.57	10.90	4.12	10.09	4.88	1.23
Aggressive Behavior	7.76	4.99	8.40	5.02	7.25	4.93	1.61
Attention Problems	5.38	3.32	5.56	3.57	5.23	3.12	0.69
Other Problems	4.21	2.53	4.39	2.86	4.06	2.23	0.89

**p* < 0.01

COGNITIVE DECLINE AS A RESULT OF INCARCERATION

Type of Self-Reported Crime	Total	Power Source	Control
	Of Reporters, % Reporting Yes		
Carried a hidden weapon	72% n = 193	72.9% n=107	69.3% n=86
Purposely set fire to a house, building, car, or vacant lot	6.3% n = 192	3.8% n=106	9.3% n=86
Entered or broke into a building to steal something	31.3% n =192	30.2% n=106	32.6%* n=86
Stolen something from a store	66.0% n =191	61.9% n=105	70.9% n=86
Snatched someone's purse or wallet or picked someone's pocket?	22.5% n =191	21.9% n = 105	23.3% n=86
Taken something that did not belong to you from a car?	29.8% n =191	33.3% n =105	25.6% n=86
Stolen a car or motorcycle to keep or sell?	13.1% n =191	12.4% n = 105	14.0% n=86
Sold drugs such as marijuana, cocaine, crack, or heroin?	63.4% n =191	61.9% n = 105	65.1% n=86
Attacked someone with a weapon?	41.9% n =191	42.9% n = 105	40.7% n=86
Had or tried to have sexual relations with someone against their will?	1.0% n =191	1.9% n = 105	0.0%* n=86
Used a weapon or force to get money or things from people?	36.9% n =179	35.7% n = 98	38.3% n=81
Threatened someone with a gun or another weapon?	47.8% n =178	49.5% n = 97	45.7% n=81
Been loud, rowdy, or unruly in a public place?	52.2% n =178	50.5% n = 97	54.3% n=81
Avoided paying for things such as movies, trains, or bus rides	64.0% n =178	60.8% n = 97	67.9% n=181
Attempted to kill or seriously injure someone?	25.7% n =179	23.5% n = 98	28.4% n = 81

*p < 0.05

All youth incarcerated at Rikers are required to attend high school programming for five hours a day, unless in court or in solitary for rule infractions. All youth participating in this experiment continued to attend the GED program. There is no other educational or mental health programming offered to juvenile inmates. Youth who were 18 years old or legally emancipated signed informed consent. Youth less than 18 years of age signed informed assent, and parental consent was obtained for participation. All procedures were approved by the New York University Institutional Review Board and the New York City Department of Corrections.

Interventions

Cognitive behavioral therapy/mindfulness training. Power Source (PS) is a group-based cognitive behavioral therapy/mindfulness meditation therapy intervention for at-risk youth (Casarjian & Casarjian, 2003). Full details of the intervention and control condition can be found in Leonard et al. (2013). The theoretical underpinning of PS is the Process Model of Emotion Regulation (Gross, 1998), which outlines five major points of focus during emotion regulation: situation selection, situation modification, attentional deployment, cognitive change, and response modification. PS combines traditional CBT practices with mindfulness training, which aims to assist in modulating physiological responses to stressful and risky situations to encourage pro-social behavioral responses. PS is designed to blend the social-cognitive change components of CBT with the attentional and response modification (including inhibition) elements of mindfulness. Specifically, with regard to the latter elements, PS trains youth to attend to situational characteristics, identify personal triggers for antisocial behavior, and direct attention away from those triggers and towards elements of the situation that encourage prosocial behavior. While CBT itself is a stand-alone intervention for antisocial behavior (Lipsey, Chapman, & Landenberger, 2001), it has been suggested that mindfulness may complement

traditional CBT by increasing individuals' ability to be open to and acquire CBT skills and concepts (Teasdale, Segal, & Williams, 2003).

PS trains youth to choose prosocial peers and self-select into low-risk situations to reduce the likelihood of offending behavior. Youth are taught to identify high-risk situations and personal triggers for antisocial behavior, and direct their attention towards elements of situations that encourage prosocial behavior. Youth are trained to reappraise the meaning of situations to alter their emotional impact, reducing hostile attributional biases that may be present in an incarcerated sample (Dodge, Price, Bachorowski, & Newman, 1990).

The intervention consisted of weekly or biweekly group sessions with two clinicians trained in mindfulness meditation, and an accompanying book with role model stories and mindfulness meditation exercises that were practiced in the group sessions. Group sessions consisted of cognitive behavioral exercises, videos for meditation instruction, and formal meditation practice, including body scans, sitting meditation, and walking meditation. In order to maintain internal validity, adherence to the PS protocol (in cognitive behavioral exercises, types of meditations, and reading assignments) was accomplished through the use of a manual and the videos. In addition to the group sessions, participants were also encouraged to engage in independent mindfulness meditation practice.

Cognitive-perception control intervention. The control group consisted of weekly or biweekly group sessions in which participants received portions of two evidence-based interventions: a cognitive-perception intervention focused on attitudes and beliefs about substance use and violence (Sussman, Rohrbach, & Mihalic, 2004) and a sexual-risk reduction intervention (Rotheram-Borus et al., 2003). The curriculum of each intervention was modified to exclude any skills or concepts that were under investigation in the PS intervention, thus

controlling for the effects of common therapeutic factors such as therapeutic alliance, empathic counselors, attention, and group cohesion (Del Boca & Darkes, 2007; Safer & Hugo, 2006).

Treatment Procedure

The Cognitive Behavioral Therapy/Mindfulness Training and control groups met separately for a total of approximately 750 minutes over 3-5 weeks. Timing varied slightly based on the security demands of the separate housing areas. Each session was administered by two of four possible clinicians (dependent on the clinicians' schedules), lasted approximately 75 minutes, and each group contained between 8-12 participants. All four trained clinicians received weekly clinical supervision to ensure fidelity to the respective manuals. Additionally, sessions were audio recorded, and approximately 10% of session recordings were subject to quality assurance ratings for fidelity to both the control and PS interventions. Fidelity was high across both conditions. Make-up sessions were offered in small groups or individually for participants who missed sessions due to disciplinary infractions or court appearances as possible. Baseline interviews were conducted prior to onset of the intervention. Follow-up interviews occurred approximately 21 weeks after baseline (range 11-79 weeks), and there was no significant difference in time between interviews for the treatment group ($M = 21.3$, $SD = 8.6$) and the control group ($M = 20.7$, $SD = 11.0$; $t = -0.45$, $p = 0.66$). Participants in both groups received \$5.00 for every session they attended, and \$25.00 in their commissary accounts for participation in each interview.

Measures

Emotional Go/No-Go Task. Participants underwent two administrations of a computerized emotional go/no-go task. The emotional go/no-go task is a variant on the classic

go/no-go test, which allows for the measurement of the respondent's ability to inhibit responses to emotional stimuli. Because the traditional go/no-go task is considered a measure of behavioral inhibition and cognitive control, often the stimuli are neutral, such as objects (Rubia et al., 2001) and shapes (Schulz et al., 2007), however affective tests have become more common (e.g., Elliott et al., 2000).

Cognitive underpinnings of the emotional go/no-go. In this study cognitive control, emotion regulation, and emotion recognition are measured by the emotional go/no-go task (Tottenham, Hare, & Casey, 2011). The classic go/no-go task is commonly understood to be a test of executive functioning, a domain thought to be instantiated in the prefrontal cortex (Casey et al., 1997; Casey et al., 2011; Rubia et al., 2001). The emotional version of the task engages the amygdala (Hare, Tottenham, Davidson, Glover, & Casey, 2005) in addition to the prefrontal cortex (Wessa et al., 2007); allowing for a measure of emotion regulation, defined here as the ability to inhibit behavioral responding when presented with an emotionally stimulating situation (Tottenham, 2015).

Task procedure. As part of the interview process, participants completed two waves (one baseline and one approximately four months post-baseline) of a computerized emotional go/no-go paradigm. The task required participants to press a button when a given facial expression target (e.g., anger) was displayed, and to refrain from pressing if they saw any other expression (the "no-go" or distracter expression). The target trials occurred more frequently (70% of trials were "go" trials) in order to create a tendency to respond. In total, there were eight conditions, each consisting of a neutral expression paired with one of four possible emotional expressions (happiness, sadness, fear, and anger). Depending on the task, either the emotional expression or

the neutral expression served as the target. For example, there were two sad/neutral types of tasks: one in which the sad face was the target, and one in which the neutral face was the target.

The facial images were color photographs of 10 adult male and female faces drawn from the NimStim set (available at www.macbrain.org), representing a variety of races/ethnicities. Faces were pseudo-randomized across the block to control for order of presentation and the order of the eight blocks was randomized across participants. Stimulus duration was 500 msec with 1500 msec inter-stimulus intervals to ensure the participants had sufficient time to respond. Ten practice trials were administered to ensure that participants understood the task and could execute the responses. To fully capture the treatment-related changes in behavior, composites previously associated with this type of task were utilized (Casey, 2007; Schulz et al., 2007; Tottenham et al., 2010; Tottenham et al., 2011). The emotional go/no-go task has been validated for use with adults (Hare et al., 2008), as well as community and clinical samples of children and adolescents (Grunewald et al., 2015; Hare et al., 2008; Ladouceur et al., 2006; Tottenham et al., 2010; Tottenham et al., 2011). It has not been previously used in a forensic population.

Measures of three main constructs are derived from the emotional go/no-go task: emotion recognition, cognitive control, and emotion regulation.

Emotion recognition. D-prime provides an index of accuracy accounting for response bias and is considered a measure of emotion recognition. It is calculated by subtracting the z-transformed false alarm rate from the z-transformed hit rate. Higher scores reflect better performance.

Cognitive control. Overall false alarm (FA) rate was our index of cognitive control. In each trial, there are 10 possible false alarms wherein a participant “hits” on a distractor emotion. The FA rate is the average proportion of incorrect responses and was calculated for all eight

conditions, both when emotions were “go” and “no-go” stimuli. Higher scores indicate poorer performance.

Emotion regulation. False alarm (FA) rate to emotional “no-go” stimuli was an index of emotion regulation, with higher scores indicating poorer performance.

Covariates. WRAT-4 reading subscale scores, self-reported mental health problems, and duration of time between baseline and follow-up were considered as possible confounders. The mean WRAT-4 reading raw score was 38.88 (equivalent to a 7th grade reading level), and did not differ between groups ($p = 0.205$).

In addition to basic demographic information, participants completed a shortened version of the Youth Self Report questionnaire as a measure of mental health (Achenbach, 1991). The Youth Self Report is a well-used scale that has demonstrated significant generalizability (Ivanova et al., 2007). The six scales derived were Withdrawn, Somatic Complaints, Anxious/Depressed, Delinquent Behavior, Attention Problems, and Aggressive Behavior. The two groups did not differ on any of the subscales (all $ps > 0.109$).

Despite precautions taken to ensure even treatment application across the CBT/MT group, it seems possible that the clinicians could have improved over time, resulting in unintentional differences in treatment. This possibility was also examined through the use of repeated measures ANOVAs.

Finally, the length between baseline interview and follow-up interview was examined as a possible covariate. The groups did not differ on length of time between interviews ($p = 0.678$). Detailed descriptive statistics of the potential covariates can be found in Table 1.

Data Analyses

The initial analyses were conducted using SPSS statistical software (IBM SPSS Statistics Version 22.0). Fully factorial repeated measures ANOVAs were run on each of the three measures with a between-participants factor of treatment group (treatment, control group) and a within-participants factor of time (baseline, post-treatment). Within- and between-group changes in cognitive performance over time were used to assess whether incarceration caused declines in cognitive functioning, and whether CBT/MT affected those declines. We calculated the effect size f for the ANOVA main effects and interactions by using eta squared (η^2), which is the ratio between the between-groups variance and the total variance. Effect size f is commonly understood such that $f = 0.10$ is a small effect, $f = 0.25$ is a medium effect, and $f = 0.40$ is a large effect (Cohen, 1969). Post hoc paired-samples t -tests were used to examine whether follow-up differed from baseline within groups. We calculated effect sizes for the paired-sample t -tests using Cohen's d (Cohen, 1969). We corrected for dependence among the means using Morris and DeShon's (2002) equation 8.

A secondary concern was the potential effects of covariates of interest. We conducted repeated measures fully factorial ANCOVAs with additional within-participant factors of WRAT score, the six subscales of the Youth Self Report Questionnaire (Achenbach, 1991), and the duration of time between baseline and follow-up to determine whether any of the covariates had significant main or interaction effects (Thomas et al., 2009).

Finally, we supplemented our main repeated measures ANOVA analyses with a Bayesian approach, run using JASP statistical software (Version 0.8.0.1). We estimate a Bayes factor using Bayesian Information Criteria (Wagenmakers, 2007), comparing the fit of the data under the null hypothesis and the various alternative hypotheses. Bayesian analyses work to overcome

some of the limitations of pure null-hypothesis significance testing by providing more information about both the null and alternative hypotheses and reducing dependence on sample size (Jarosz & Wiley, 2014). In short, the Bayesian approach is a model selection procedure that provides information to prefer one model over the others. Although there are a number of equivalent statistics that can be derived from Bayesian analyses, here we prefer BF_{10} , which frame the results in the context of the alternate hypothesis as opposed to the null hypothesis. Thus, for example, a BF_{10} of two means the data is two times more likely under the alternate hypothesis than the null hypothesis.

Results

Primary Research Question

The primary research question of this paper was whether incarceration is associated with cognitive decline in cognitive control, emotion recognition, and emotion regulation. There was support for this hypothesis.

Cognitive control. There was a main effect of time, $F(1, 195) = 11.84, p = 0.001, \eta^2 = 0.06, f = 0.25$, demonstrating significant decline from baseline to follow-up.

Emotion regulation. There was a main effect of time, $F(1, 195) = 5.66, p = 0.018, \eta^2 = 0.03, f = 0.18$, again indicating significant decline from baseline to follow-up.

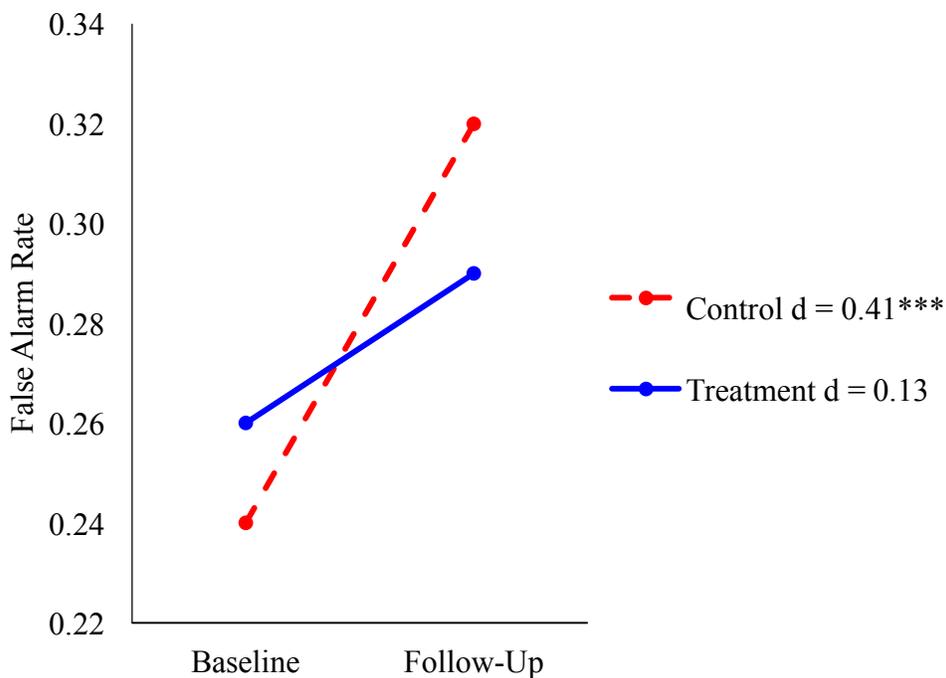
Emotion recognition. There was a main effect of time, $F(1, 195) = 65.55, p < 0.001, \eta^2 = 0.25, f = 0.58$, such that performance significantly declined from baseline to follow-up.

Secondary Research Question

Our secondary research question was, given a rejection of the null hypothesis in the primary research question, whether CBT/Mindfulness could buffer deleterious effects of

incarceration on cognition. This question was exploratory due to the gap in the literature regarding the effects of CBT/Mindfulness on cognitive functioning in an incarcerated population.

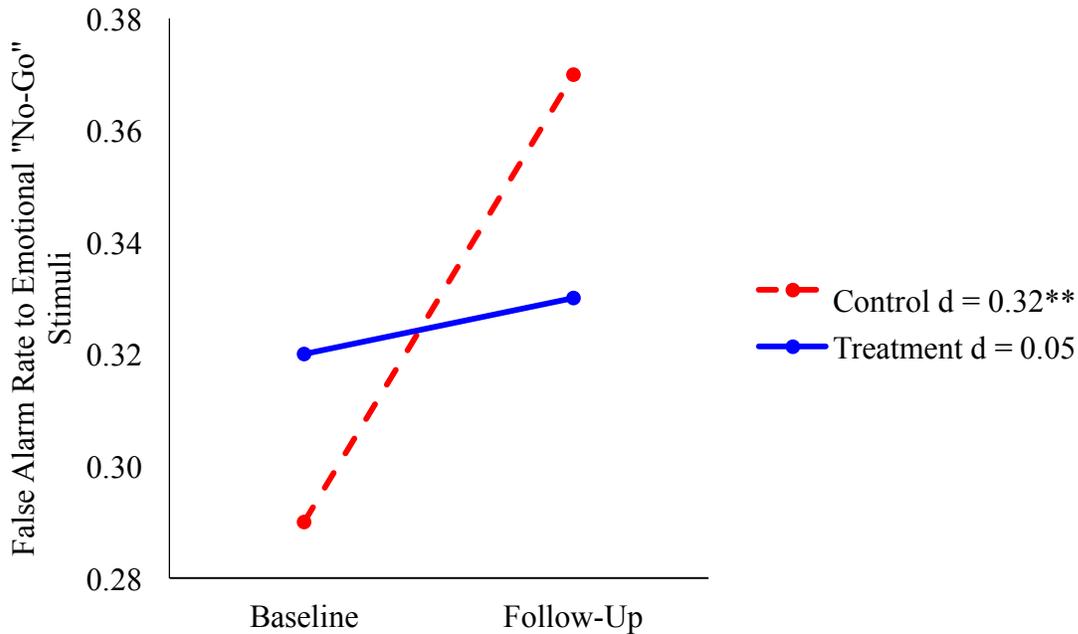
Cognitive control. The two-way interaction of time by treatment group, $F(1, 195) = 3.47, p = 0.064, \eta^2 = 0.02, f = 0.14$, did not reach the traditional significance threshold of $p < 0.05$. Paired sample t -tests were used to probe the treatment effects. As shown in Figure 1, the control group significantly declined from baseline, $M = 0.24, SD = 0.14$, to follow-up, $M = 0.32, SD = 0.19; t(87) = -3.71, p < 0.001$, Cohen's $d = 0.41$. In contrast, the treatment group demonstrated no significant difference in the scores for baseline, $M = 0.26, SD = 0.17$, and follow-up, $M = 0.29, SD = 0.19$, assessments; $t(108) = -1.14, p = 0.255$, Cohen's $d = 0.13$.



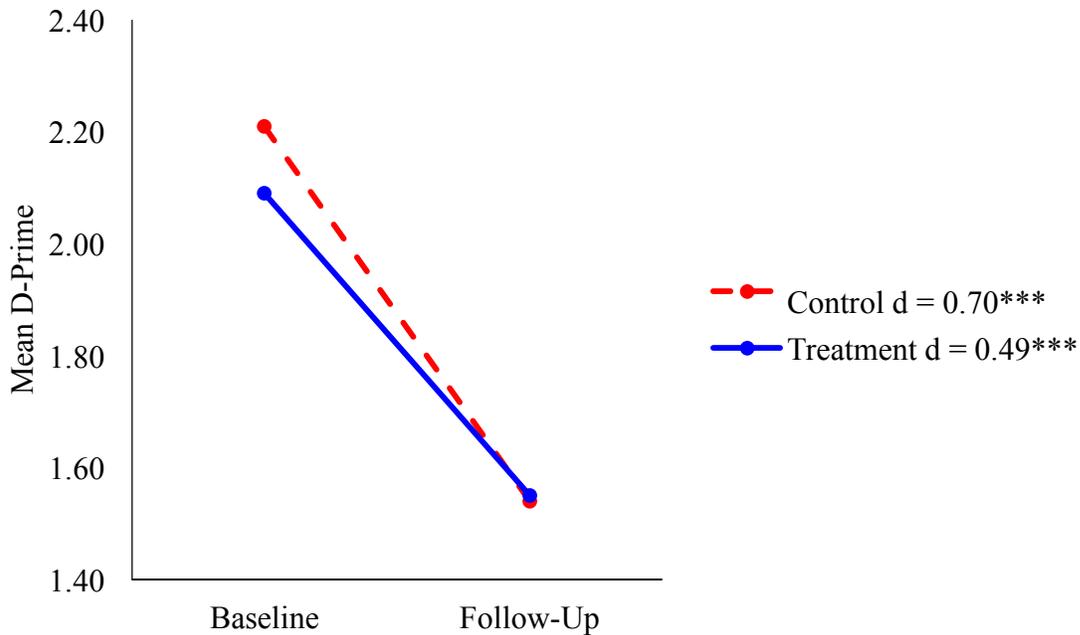
Emotion regulation. While the two-way interaction of time by treatment group, $F(1, 195) = 3.21, p = 0.075, \eta^2 = 0.02, f = 0.14$, also did not achieve traditional significance, the interaction term was probed by paired sample t -tests. As visually depicted in Figure 2, we observed significant decline in the control group performance from baseline, $M = 0.29, SD =$

0.15, to follow-up, $M = 0.37$, $SD = 0.33$, waves; $t(87) = -2.91$, $p = 0.005$, Cohen's $d = 0.32$.

However, in the treatment group, there was no significant decline from baseline, $M = 0.32$, $SD = 0.19$, to follow-up, $M = 0.33$, $SD = 0.22$; $t(108) = -0.43$, $p = 0.670$, Cohen's $d = 0.05$.



Emotion recognition. There was no significant two-way interaction, $F(1, 195) = 0.68$, $p = 0.410$, $\eta^2 = 0.00$, $f = 0.00$. As shown in Figure 3, paired sample t -tests showed significant decline in performance in both the control group, baseline $M = 2.21$, $SD = 0.83$; follow-up $M = 1.54$, $SD = 0.87$; $t(87) = 6.49$, $p < 0.001$, Cohen's $d = 0.69$ and the treatment group, baseline $M = 2.14$, $SD = 0.87$; follow-up $M = 1.55$, $SD = 0.95$; $t(108) = 5.14$, $p < 0.001$, Cohen's $d = 0.49$.



Potential Confounds

The data were re-analyzed using a repeated measures fully factorial ANCOVA, with additional within-participant factors of WRAT score, the six subscales of the Youth Self Report Questionnaire (Achenbach, 1991), and the duration of time between baseline and follow-up. This second part of the analysis allows us to examine the main effect of each of the covariates and the interaction of the covariates with our variables of interest (Thomas et al., 2009). None of the covariates had significant main or interaction effects (all $ps > 0.30$).

Despite adherence to a manual and the use of videos, it seemed possible that treatment may have differed over time, i.e., the trainers may have improved over time resulting in inconsistent treatment application. The treatment group was divided equally into “early” ($n = 54$) and “late” ($n = 55$) groups, which were then submitted to a repeated measures ANOVAs

using group type as the between-groups factor. Results demonstrated no significant differences between the two groups (all $ps > 0.182$).

Bayesian Supplemental Analyses

In addition to the standard repeated measures ANOVAs, Bayesian Repeated Measures ANOVAS with default prior scales were run. With regard to our primary research question, all models preferred the model with solely the within-participants measure of time to the null ($BF_{10} = 18.35, 19.10, \text{ and } 1.25 \times 10^{11}$, for the cognitive control, emotion regulation, and emotion recognition models, respectively).

With regard to our more exploratory secondary research question, all models preferred the model with solely the within-participants measure of time to the model incorporating the interaction term ($BF_{10} = 9.17, 8.96, \text{ and } 28.20$, for the cognitive control, emotion regulation, and emotion recognition models, respectively).

Possible Cluster Effects

As randomization was by dormitory to avoid treatment contamination and due to administrative reasons, we tested for possible effects due to individual dormitories using intra-cluster correlation (ICC) coefficients for performance on the three measures at baseline to investigate the variability within dormitories vs. between dormitories. Because treatment and dormitory effects cannot be separated at follow-up, analyses were restricted to baseline data. We used the following formula to account for variable cluster sizes (Shrout & Fleiss, 1979): $MS_{between} - MS_{within} / MS_{between} - MS_{within(m_0)}$ where $m_0 = [1/k - 1] [n - \sum m_i^2 / n]$, k is the total number of clusters, and m_i is the number of participants in each cluster. At baseline, the ICCs for cognitive control, emotion regulation, and emotion recognition were 0.00, 0.02, and 0.03, which are all

small in size (≤ 0.05) and can be interpreted as the proportion of overall response variation in individual responses that can be accounted for by within-dorm variation.

Effects of Out-of-Session Practice

We conducted additional analyses to assess the effects of out-of-session practice on cognitive performance by looking at participants in the CBT/MT arm who self-reported practicing ($n = 89$), and those in the CBT/MT arm who self-reported not practicing ($n = 20$). The groups did not differ in baseline performance (all $ps > 0.39$). Repeated measures ANOVAs revealed no differences between groups with regard to emotion recognition ($p = 0.159$). Repeated measures ANOVAs did find that the PS participants that independently practiced did better than the PS participants that did not independently meditate in emotion regulation ($p = 0.008$) and cognitive control ($p = 0.002$).

Discussion

This study set out to address a number of important gaps in the literature surrounding the cognitive effects of incarceration. We primarily hypothesized that incarceration negatively impacts the executive functions of emotion regulation, emotion recognition, and cognitive control. We found that incarceration was associated with significant declines in specific aspects of executive functioning. The current study is the first to use a cognitive battery to longitudinally and empirically demonstrate the negative impact of incarceration on emotion regulation, cognitive control, and emotion recognition, which are key processes implicated in antisocial behavior (Marsh & Blair, 2008; Ogilvie et al., 2011; Robertson et al., 2012). These findings provide empirical support for long-standing, but predominantly untested, hypotheses on the negative neuropsychological effects of incarceration (Goodstein et al., 1984; Haney, 2003;

Haney, 2012). A secondary, exploratory question was whether CBT/MT would have protective effects against any cognitive decline. Although the time x group interaction coefficients for cognitive control and emotion regulation did not reach the traditional significance threshold of $p < 0.05$, they are suggestive of the potential of CBT/MT interventions in buffering against some of these effects. Bayes factor repeated measures ANOVAs, which are model-based, preferred the “only time” model to both the null and interaction models in all three analyses.

Additional analyses incorporating potentially confounding covariates demonstrated no significant main or interaction effects, suggesting that cognitive decline due to incarceration can be expected regardless of initial reading ability, self-reported mental health, or length of time between baseline and follow-up. Furthermore, analyses revealed no significant facilitator improvement over time, supporting overall consistent treatment application.

We have documented cognitive declines in offenders over four months, but what may account for this decline? The methodology of this study restricted our ability to identify direct mechanisms for the relationship between incarceration and the decline in executive functioning. Aforementioned characteristics of prison, both designed and unintentional, may exert significant influence on individual psychological and cognitive functioning. Briefly, deprivation of self-determination and autonomy, sustained psychological and physical stress, lack of stimulation, victimization (physical and/or psychological), and sleep deprivation are potential mediators on a causal pathway from incarceration to impaired cognition (Blevins, Listwan, Cullen, & Jonson, 2010; Colcombe & Kramer, 2003; Durmer & Dinges, 2005; Goel et al., 2009; Hackman & Farah, 2009; Ireland & Culpin, 2006; Kamphuis, Meerlo, Koolhaas, & Lancel, 2012; Kramer et al., 1999; Maski & Kothare, 2013; Noble et al., 2005; Noble et al., 2007; Noble et al., 2012; Öhman et al., 2007; Sarsour et al., 2011; Shao et al., 2014; United States, Department of Justice,

Office of the United States Attorney Southern District of New York 2014; Vogler, Perkinson-Gloor, Brand, Grob, & Lemola, 2014).

One finding of note is the highly significant decline over time for both groups in emotion recognition, and the lack of even marginal mindfulness buffering effects for this task specifically. There are several plausible reasons for this finding. The decline in emotion recognition could be the result of short-term extreme sleep deprivation, which has been shown to impair emotion recognition in healthy adults (van der Helm, Gujar, & Walker, 2010). In addition, qualitative studies have suggested inmates self-isolate (Yang et al., 2009) or become emotionally numb in order to avoid displaying weakness or vulnerability to other inmates (Liem & Kunst, 2013). If offenders are exposed to a limited range of emotions for extended periods of time, their ability to identify emotions may be diminished. Finally, as noted earlier, of the three cognitive functions measured here, mindfulness has been shown to specifically affect emotion regulation and cognitive control (Eberth & Sedlmeier, 2012; Holzel et al., 2011; Tang et al., 2012; Wupperman et al., 2008). In contrast, to date there has been no support for a positive effect of mindfulness on emotion recognition. Furthermore, the strong decline in emotion recognition may have been too great for CBT/MT to remediate this cognitive deterioration, suggesting that any buffering attempts against the effects of incarceration on cognitive loss may need to be implemented relatively quickly.

Limitations

It is conceivable that this study may be underestimating the true effects of incarceration on cognition and the buffering effect of CBT/MT. With regard to the former, under normal conditions, performance at follow-up would be expected to be the same or even slightly better than at baseline, due to learning effects from repeating the same task (Morris & DeShon, 2002).

Learning, or retest, effects refer to the improvement often observed in participants when they are repeatedly administered the same or similar tests (Bachoud-Levi et al., 2001; Salthouse, Schroeder, & Ferrer, 2004). Such practice effects may well attenuate any effect of imprisonment on cognitive decline.

With regard to the effects of CBT/MT, institutional constraints dictated an active control group. Thus, it is plausible that a true control group, and one more representative of the lack of actual programming available in this facility (e.g., a waitlist comparison) would have deteriorated even more significantly, providing a clearer measurement of both the effects of incarceration on cognition and the potentially protective effects of CBT/MT. We further acknowledge the limitation that the intervention did not improve cognitive functioning, as has been seen in community samples (Diamond & Lee, 2011), but merely limited the decline.

Although we derived three measures of cognitive functioning, this study focuses on a single cognitive domain (executive functioning) using a single cognitive task. There are many other unexplored cognitive and brain processes that may be affected by incarceration and involved in recidivism, such as episodic memory and language processing, and at this point findings cannot be generalized to other cognitive functions.

Our secondary question only received mixed support. The results of the repeated measures ANOVAs and the group- by- time interactions for cognitive control and emotion regulation did not reach the traditional significance threshold of $p < 0.05$ ($p = 0.064$ and $p = 0.075$, respectively). Regardless, evolving notions of the role of the p value (Goodman, 1999; Kyriacou, 2016) suggest that blind observance of p values restricts the balanced judgment of experimental findings. Type II error may be of particular importance in the early phase of a field of study, where false rejection of a true effect may foreclose the development of a new field of

enquiry. Accordingly, we also ran a Bayes factor repeated measures ANOVA, which preferred the model with a main effect of time alone, as opposed to the model with the interaction term. Together, these results do not provide enough evidence to unilaterally support protective effects of mindfulness.

Despite this, in recognizing the potential protective effects of CBT/MT, we note both the marginal interactions from the repeated measures ANOVAs, and the traditionally significant results of the paired sample *t*-tests, which suggest some degree of buffering against cognitive decline in the CBT/MT group compared to the significant decline in the control group. Moreover, we submit that the clear deleterious effects of incarceration on cognition necessitate an ongoing pursuit of potential cognitive interventions. Replication and extension of this study with a larger sample would provide clarity as to the clinical significance of these marginal interactions.

This study intentionally incorporated elements of both CBT and mindfulness training, both of which have strong bodies of literature suggesting positive effects on various outcomes in incarcerated populations (e.g., recidivism, self-esteem) (Landenberger & Lipsey, 2005; Shonin et al., 2013). While the blending of the two interventions was intentional due to a belief in their complementary nature, it does restrict our ability to attribute the results solely to either CBT or mindfulness training.

We demonstrated the deleterious effects of incarceration on cognitive functioning and the positive effects of CBT/MT, however this study focused on a very specific population – 16-18-year-old males in one facility. Moreover, it has been documented in this particular facility that a disproportionate proportion of the youth inmates were subjected to serious physical harm by correctional staff at the time this study was being conducted (United States, Department of

Justice, Office of the United States Attorney Southern District of New York 2014). Therefore we cannot generalize findings to other populations, but we nevertheless do provide the basis for future studies on older males, women, and prisoners in other facilities.

Contributions and Future Directions

The above limitations should be viewed in the context of several strengths of the current study. While there is a significant body of literature identifying lasting psychological and social effects of incarceration, including negative outcomes both for the former convicts and their families (e.g., marital instability, offspring antisocial problems, physical and mental health problems (Murray & Farrington, 2008; Schnittker & John, 2007), this paper identifies another negative outcome that has largely been ignored – cognitive impairments, particularly in executive functions associated with antisocial behavior (Ogilvie et al., 2011; Robertson et al., 2012; Robertson et al., 2014). In addition to being a risk factor for antisocial behavior (Morgan & Lilienfeld, 2000; Ogilvie et al., 2011), impaired executive functioning is also associated with a variety of other negative life states, including substance use (Giancola, Shoal, & Mezzich, 2001; Giancola, Mezzich, & Tarter, 1998), impaired social integration (Hanks, Rapport, Millis, & Deshpande, 1999), and other psychopathology (Donohoe & Robertson, 2003; Moritz et al., 2002). Perhaps most fundamentally, our findings with regard to our primary research question speak to the benefits of alternatives to traditional incarceration, such as drug courts and restorative justice practices, especially for low-level offenders.

This randomized controlled trial also makes a second contribution by recognizing the possible role of CBT/MT in buffering against these impairments. Although analysis of the effects of CBT/MT on recidivism in this particular sample was beyond the scope of this study, this study provides a context to previous findings regarding the efficacy of CBT/MT in reducing recidivism

likelihood (Alexander & Orme-Johnson, 2003; Bleick & Abrams, 1987; Himelstein, 2011). While the literature suggests positive effects of CBT/MT on recidivism likelihood, there is a lacuna as to the actual mechanisms driving that relationship. The experimental nature of this study goes beyond previous literature by allowing for a more rigorous exploration of the potential buffering effects of CBT/MT in protecting against cognitive decline. It seems possible that protective effects of CBT/MT on executive functioning may help account for some reduction in recidivism likelihood. Implementing an intervention such as CBT/MT or other cognitive interventions may be costly in the short term, but could be cost-effective in the long term by helping former prisoners transition successfully back into society (Dafoe & Stermac, 2013). While the lack of significance of the interaction precludes any definitive rejection of the null hypothesis, we hope that these initial results will encourage future work in this field.

This preliminary work can provide a basis for expansion and replication. We were restricted in our methodology to cognitive tasks, but future studies can expand on these cognitive findings by incorporating other measures of brain functioning, including EEG, event-related potentials, and brain imaging (Raine, 2013). Additionally, future interventions may use four groups to separate mindfulness from cognitive behavioral therapy to assess whether in isolation or in combination these treatments may protect against cognitive decline. Future studies may also work to identify the mediating variable between incarceration and cognitive decline, looking at variables such as victimization (by staff and/or other inmates) and stress, among others. It would also be informative to examine recidivism as an outcome to test whether cognition predicts recidivism likelihood. Finally, in addition to replication and extension, understanding the mechanism of action of how CBT/MT appears to buffer against cognitive decline remains an important future challenge.

Conclusion

There are already numerous causes of concern regarding the effects of incarcerating youth. For example, aggregating troubled youth with other antisocial youth could lead to a peer contagion effect (Dishion & Dodge, 2005). In addition, more recent analyses of labeling theory have affirmed the notion that official interventions in adolescence may result in exclusionary circumstances, reducing opportunities for conventional success and contributing toward increased risk for adult offending (Bernburg & Krohn, 2003). Finally, the aforementioned well-supported experiences of being incarcerated could be exacerbated in youth, who may well be being separated from their family and friends for the first time and are characterized by many of the risk factors for victimization within prison (Wolff et al., 2007). This study provides another compelling reason to try to keep adolescents with still-developing cognitive functioning out of correctional facilities.

Treatment of youth by the criminal justice system in recent years has reflected competing interests—on the one hand, state and federal courts have retained the ability, and in some cases, the mandate, to waive particularly violent youth to the adult court system. On the other hand, Supreme Court decisions (e.g., *Roper v. Simmons* [2005], *Graham v. Florida* [2010], *Miller v. Alabama* [2012]) in the past two decades have recognized that youth offenders are fundamentally different from their adult counterparts, and present more potential for maturation into prosocial members of society. Such decisions suggest that a reversal from harsh, punitive treatment of youth offenders, helped by growing research into characteristics of adolescence. Furthermore, from a purely economic, cost-saving perspective, there is evidence that treatment oriented policies (e.g., multi-systemic therapy, aggression-oriented programs) are far more cost-effective than retributive incarceration (Travis et al., 2014).

This study provides another cause of concern, which is that cognitive functioning may decline as a result of incarceration, particularly in domains and processes already tied to antisocial behavior. Given the fiduciary and ethical concerns surrounding the enormous cost of mass incarceration, this study provides even more support for the use of alternative methods of punishment, such as drug courts and restorative justice courts. Keeping youth out of the “system” and protecting them when they are most emotionally and cognitively susceptible to the negative effects of incarceration may well be the best policy in terms of both efficacy and cost-effectiveness. Barring such a substantial shift in criminal justice policy, however, it is important for researchers and policy-makers alike to continue to seek out and evaluate potential interventions to mitigate the negative effects of incarceration on inmates.

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Table 1.

Descriptive Statistics

Variable	Full Sample, $N = 197$		Control, $n = 88$		Powersource, $n = 109$		t
	\bar{X}	SD	\bar{X}	SD	\bar{X}	SD	
Age	17.40	0.71	17.24	0.71	17.52	0.69	-2.83*
WRAT (reading subscore)	38.88	8.65	38.00	10.03	39.61	7.32	-1.32
Last Grade Completed	9.93	1.38	10.00	0.94	9.87	1.66	0.69
Black	0.51	0.50	0.55	0.50	0.51	0.50	0.70
Hispanic	0.30	0.46	0.28	0.45	0.31	0.47	-0.42
White	0.01	0.07	0.00	0.00	0.01	0.10	-0.90
Multiracial/Other	0.18	0.38	0.17	0.38	0.18	0.39	-0.24
Any violent crimes	0.57	0.50	0.56	0.50	0.58	0.50	-0.30
Nonviolent crimes	0.78	0.41	0.81	0.40	0.76	0.43	0.76
Number of Days in Rikers at Baseline	103.93	120.44	94.06	84.63	111.90	142.88	-1.09
Log Number of Days in Rikers at Baseline	4.15	1.02	4.15	0.94	4.16	1.07	-0.09
Days Between Baseline and Follow-Up	146.89	68.26	144.64	76.92	148.72	60.68	-0.42
Interviews							
Age at Onset of Offending	10.50	4.53	9.94	4.60	10.98	4.42	-1.50
Score on YSR subscales							
Anxious/Depressed	4.33	3.88	4.03	3.54	4.57	4.14	-0.96
Withdrawn	5.16	3.19	5.07	2.83	5.24	3.46	-0.38
Somatic Complaints	1.65	2.13	1.41	2.03	1.84	2.20	-1.43
Delinquent Behavior	10.45	4.57	10.90	4.12	10.09	4.88	1.23
Aggressive Behavior	7.76	4.99	8.40	5.02	7.25	4.93	1.61
Attention Problems	5.38	3.32	5.56	3.57	5.23	3.12	0.69
Other Problems	4.21	2.53	4.39	2.86	4.06	2.23	0.89

Note. * $p < 0.01$

Table 2.

Self-Reported Crime by Group

Type of Self-Reported Crime	<i>Of Reporters, % and Number Reporting Yes</i>		
	Total	Power Source	Control
Carried a hidden weapon	72% N = 193	72.9% n = 107	69.3% n = 86
Purposely set fire to a house, building, car, or vacant lot	6.3% N = 192	3.8% n = 106	9.3% n = 86
Entered or broke into a building to steal something	31.3% N = 192	30.2% n = 106	32.6%* n = 86
Stolen something from a store	66.0% N = 191	61.9% n = 105	70.9% n = 86
Snatched someone's purse or wallet or picked someone's pocket?	22.5% N = 191	21.9% n = 105	23.3% n = 86
Taken something that did not belong to you from a car?	29.8% N = 191	33.3% n = 105	25.6% n = 86
Stolen a car or motorcycle to keep or sell?	13.1% N = 191	12.4% n = 105	14.0% n = 86
Sold drugs such as marijuana, cocaine, crack, or heroin?	63.4% N = 191	61.9% n = 105	65.1% n = 86
Attacked someone with a weapon?	41.9% N = 191	42.9% n = 105	40.7% n = 86
Had or tried to have sexual relations with someone against their will?	1.0% N = 191	1.9% n = 105	0.0%* n = 86
Used a weapon or force to get money or things from people?	36.9% N = 179	35.7% n = 98	38.3% n = 81
Threatened someone with a gun or another weapon?	47.8% N = 178	49.5% n = 97	45.7% n = 81
Been loud, rowdy, or unruly in a public place?	52.2% N = 178	50.5% n = 97	54.3% n = 81
Avoided paying for things such as movies, trains, or bus rides	64.0% N = 178	60.8% n = 97	67.9% n = 181
Attempted to kill or seriously injure someone?	25.7% N = 179	23.5% n = 98	28.4% n = 81

Note. * $p < 0.05$

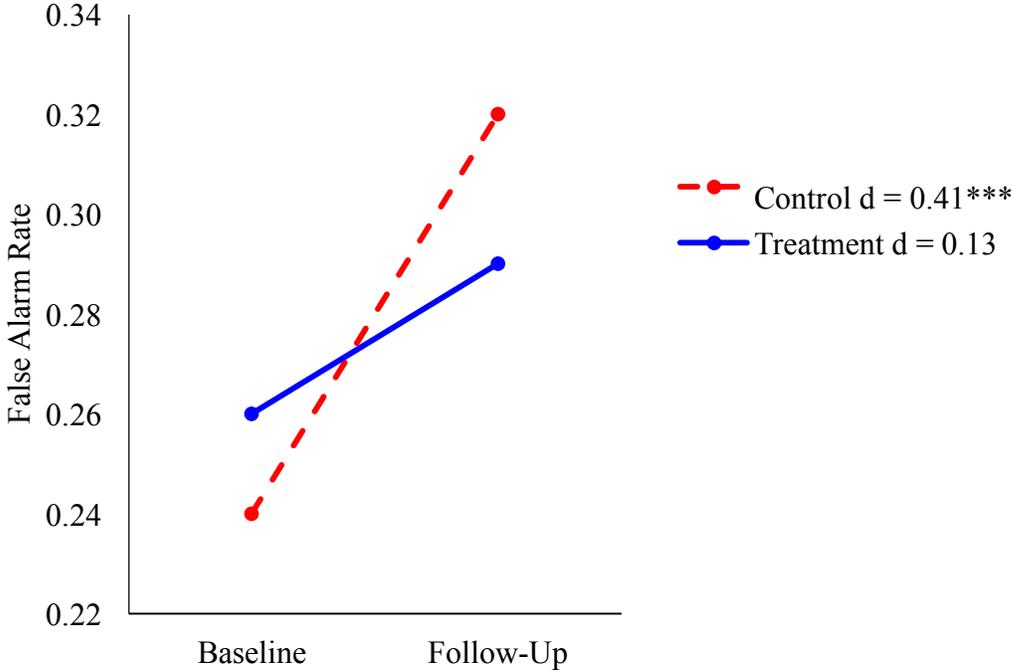


Figure 1. Cognitive Control at Baseline and Follow-Up as a Function of Treatment Group

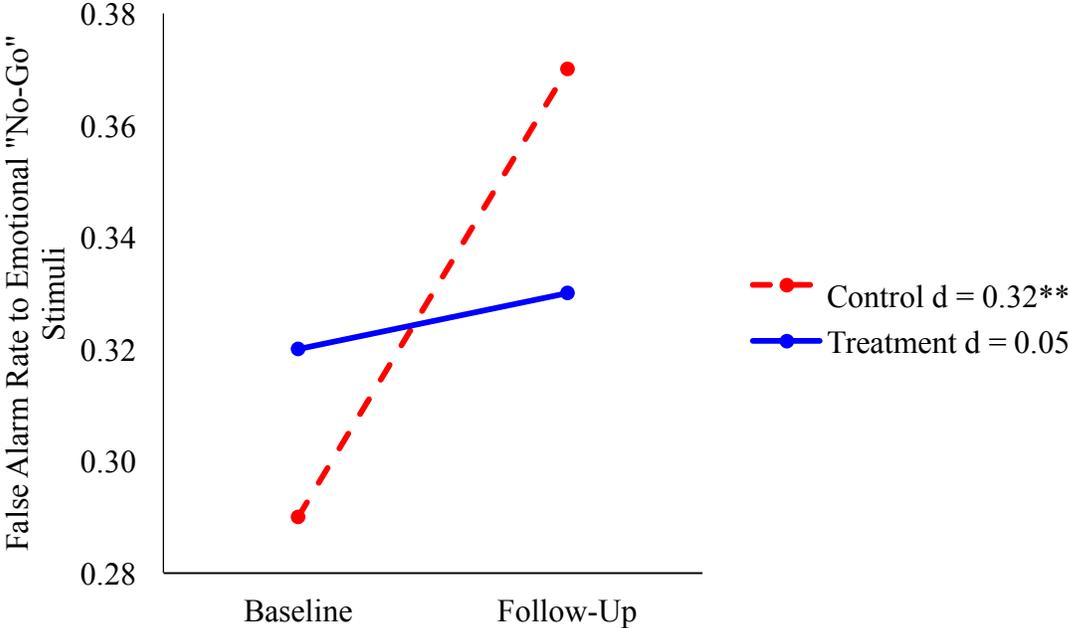


Figure 2. Emotion Regulation at Baseline and Follow-Up as a Function of Treatment Group

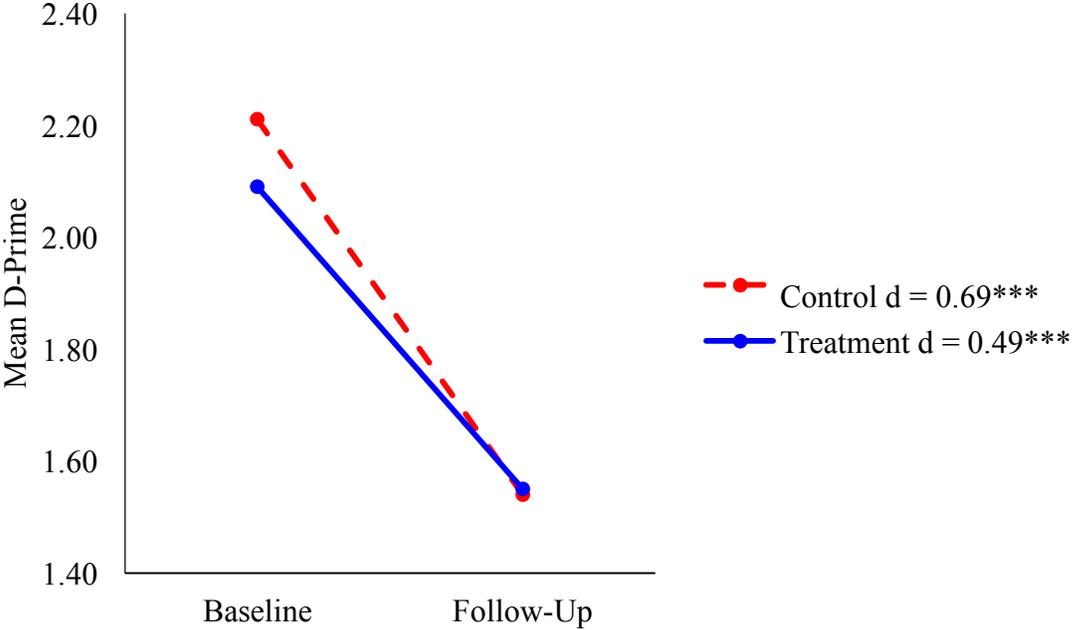


Figure 3. Emotion Recognition at Baseline and Follow-Up as a Function of Treatment Group