COGNITIVE DECLINE AS A RESULT OF INCARCERATION AND THE EFFECTS OF A CBT/MT INTERVENTION

A Cluster-Randomized Controlled Trial

REBECCA UMBACH
ADRIAN RAINE
University of Pennsylvania
NOELLE R. LEONARD
New York University

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 to 18 years were randomly assigned to either a CBT/MT program or an active control condition. A cognitive task was administered pretreatment and again 4 months later, upon treatment completion. Performance on all outcome variables was significantly worse at follow-up compared with 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

AUTHORS' NOTE: *This study was supported by a grant from the National Institute on Drug Abuse (R01 DA 024764; Noelle R. Leonard, PhD, Principal Investigator [PI]). We would like to thank the young men who participated in the study, Bethany Casarjian, PhD, and Robin Casarjian, and the project staff: Angela Banfield; Leslie Booker; Christina Laitner, PhD; Jessica Linick PhD; Rita Mirabelli; Michael Pass; Isaiah Pickens; Audrey Watson, PhD; and Michelle Silverman for data preparation. We would also like to extend our appreciation to the New York City Department of Corrections staff, particularly Deputy Wardens Winette Saunders-Halyard and Erik Berliner, and Officers John Hatzaglou and Maywattie Mahedeo. Marya V. Gwadz, PhD; Charles M. Cleland, PhD; and Nim Tottenham, PhD, provided significant scientific input to the methods of the study. Correspondence concerning this article should be addressed to Rebecca Umbach, Department of Criminology, Jerry Lee Center of Criminology, University of Pennsylvania, 3809 Walnut Street, Philadelphia, PA 19104; e-mail: rumbach@sas.upenn.edu.*

CRIMINAL JUSTICE AND BEHAVIOR, 201X, Vol. XX, No. X, Month 2017, 1–25.
DOI: 10.1177/0093854817736345

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; Himelstein, 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, provided 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; Roberton, Daffern, & Bucks, 2012, 2014). Under- and overregulation of emotion are both considered pathways to aggressive behavior (Roberton et al., 2012). Those who underregulate may act out to try to repair, end, or avoid uncomfortable emotional states, while those who overregulate may have increased negative affect and physiological arousal, and reduced inhibitions against aggression (Roberton 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 the physical and cultural characteristics of a facility, academic resources and life skills training classes, recreational time, and correctional officers. In addition, characteristics of the prisoner (e.g., type of offense for which they were convicted) will likely influence the stressors experienced.

PRISON PROGRAMMING

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

There is a dearth of reports evaluating the recent history of 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 affected, 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 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, the 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.

Inmate characteristics, 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 (Wolff, Shi, 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, 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) noted 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" (p. 139). 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, Houston, Kan, & Sowell, 2012; Noble, McCandliss, & Farah, 2007; Noble, Norman, & Farah, 2005; 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, specifically violence inflicted by correctional staff, is of serious concern (U.S. 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 is 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 4 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: (a) the self-regulation of attention and (b) detached self-observation of the present moment in a nonjudgmental 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, 2017; 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, 2017; 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:

Research Question 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:

Research Question 2: Does CBT/MT protect against incarceration-related cognitive deficits?

Although Leonard et al. (2013) used this sample, they used a task of attention and focused 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.

METHOD

PARTICIPANTS

As part of a larger study, 268 sentenced or detained male youths (M_{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 (a) had at least 6 weeks remaining on their sentence or estimated length of stay, (b) could complete an interview in English, and (c) were between the ages of 16 to 18 years. 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 CBT/MT 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 nonviolent crime, number of days in Rikers at baseline, or self-reported age of onset of offending. The experimental group was older than the

TABLE 1: Descriptive Statistics

	Full sample, $N = 197$		Control, $n = 88$		Power source, $n = 109$		
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*t*
Age	17.40	0.71	17.24	0.71	17.52	0.69	–2.83*
Wide Range Achievement Test (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 Youth Self-Report (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

*$p < .01$.

control group by approximately 1 month (17.52 years vs. 17.40 years, $p = .005$). In all, 97% of the participants were Black or Latino, and mean length of time already spent in the correctional facility at baseline was nonnormally distributed ($M = 103.93$ days, $Mdn = 73$ days, interquartile range [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.

All youth incarcerated at Rikers are required to attend high school programming for 5 hr a day, unless in court or in solitary for rule infractions. All youth participating in this experiment continued to attend the General Educational Development 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

CBT/MT

Power Source (PS) is a group-based CBT/MT intervention for at-risk youth (Casarjian & Casarjian, 2003). Full details of the intervention and control condition can be found in

TABLE 2: Self-Reported Crime by Group

	Of reporters, % and number reporting yes		
Type of self-reported crime	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* = l81
Attempted to kill or seriously injure someone?	25.7 *N* =179	23.5 *n* = 98	28.4 *n* = 81

*$p < .05$.

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 prosocial 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 toward 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 toward 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. 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 CBT/MT and control groups met separately for a total of approximately 750 min over 3 to 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), each session lasted approximately 75 min, and each group contained between 8 and 12 participants. All four trained clinicians received weekly clinical supervision to ensure fidelity to the respective manuals. In addition, 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 ($M = 20.7$, $SD = 11.0$; $t = -0.45$, $p = .66$). Participants in both groups received US$5.00 for every session they attended, and US$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, Rubinsztein, Sahakian, & Dolan, 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., 2011; Casey et al., 1997; 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 4 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) 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 pseudorandomized across the block to control for order of presentation, and the order of the eight blocks was randomized across participants. Stimulus duration was 500 ms with 1,500 ms interstimulus 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., 2011; Tottenham et al., 2010). 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., 2011; Tottenham et al., 2010). 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 (FA) rate from the *z*-transformed hit rate. Higher scores reflect better performance.

Cognitive control. Overall FA rate was our index of cognitive control. In each trial, there are 10 possible FAs 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. FA rate to emotional "no-go" stimuli was an index of emotion regulation, with higher scores indicating poorer performance.

Covariates

Wide Range Achievement Test-4 (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 seventh-grade reading level) and did not differ between groups ($p = .205$).

In addition to basic demographic information, participants completed a shortened version of the Youth Self-Report (YSR) questionnaire as a measure of mental health (Achenbach, 1991). The YSR 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 $> .109$).

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 ($p = .678$). 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 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-4 score, the six subscales of the YSR 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. For example, a BF_{10} of two means the data are 2 times more likely under the alternate hypothesis than the null hypothesis.

RESULTS

PRIMARY RESEARCH QUESTION

The primary research question of this article 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, $F(1, 195) = 11.84$, $p = .001$, $\eta^2 = 0.06$, $f = 0.25$, demonstrating significant decline from baseline to follow-up.

Emotion Regulation

There was a main effect of time, $F(1, 195) = 5.66$, $p = .018$, $\eta^2 = 0.03$, $f = 0.18$, again indicating significant decline from baseline to follow-up.

Emotion Recognition

There was a main effect of time, $F(1, 195) = 65.55$, $p < .001$, $\eta^2 = 0.25$, $f = 0.58$, 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/MT could buffer deleterious effects of incarceration

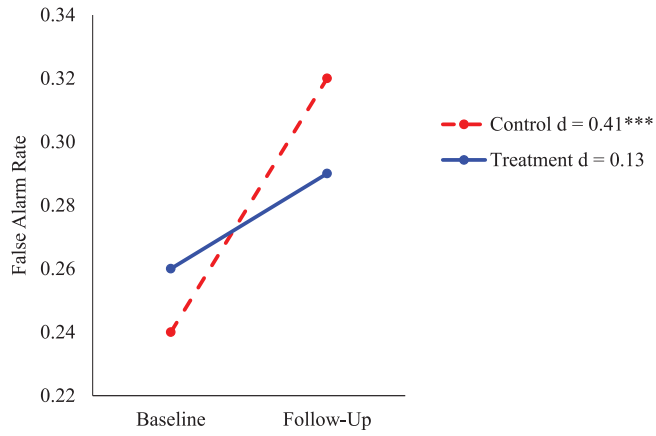

Figure 1: Cognitive Control at Baseline and Follow-Up as a Function of Treatment Group

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

Cognitive Control

The two-way interaction of time by treatment group, $F(1, 195) = 3.47$, $p = .064$, $\eta^2 = 0.02$, $f = 0.14$, did not reach the traditional significance threshold of $p < .05$. 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, $M = 0.32$, $SD = 0.19$; $t(87) = -3.71$, $p < .001$, 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; $t(108) = -1.14$, $p = .255$, Cohen's $d = 0.13$.

Emotion Regulation

While the two-way interaction of time by treatment group, $F(1, 195) = 3.21$, $p = .075$, $\eta^2 = 0.02$, $f = 0.14$, 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; $t(87) = -2.91$, $p = .005$, 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, $M = 0.33$, $SD = 0.22$; $t(108) = -0.43$, $p = .670$, Cohen's $d = 0.05$.

Emotion Recognition

There was no significant two-way interaction, $F(1, 195) = 0.68$, $p = .410$, $\eta^2 = 0.00$, $f = 0.00$. 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: $M = 1.54$, $SD = 0.87$; $t(87) = 6.49$, $p < .001$, Cohen's $d = 0.69$—and the treatment group—baseline: $M = 2.14$, $SD = 0.87$; follow-up: $M = 1.55$, $SD = 0.95$; $t(108) = 5.14$, $p < .001$, Cohen's $d = 0.49$.

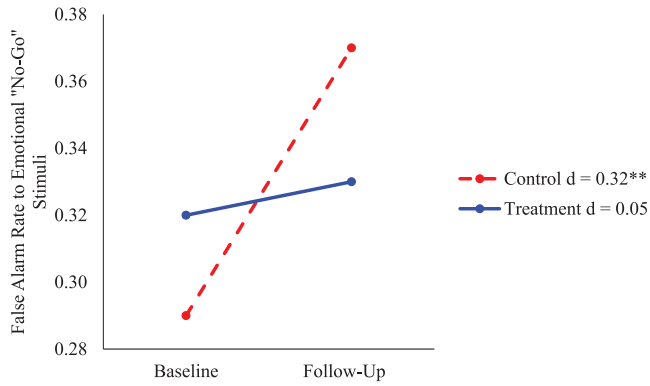

Figure 2: Emotion Regulation at Baseline and Follow-Up as a Function of Treatment Group

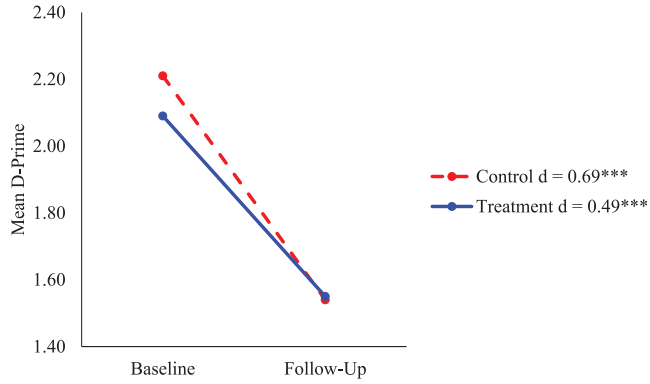

Figure 3: Emotion Recognition at Baseline and Follow-Up as a Function of Treatment Group

POTENTIAL CONFOUNDS

The data were reanalyzed using a repeated-measures fully factorial ANCOVA, with additional within-participant factors of WRAT-4 score, the six subscales of the YSR 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 *p*s > .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 *p*s > .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, and 1.25×10^{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, 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 intracluster correlation (ICC) coefficients for performance on the three measures at baseline to investigate the variability within dormitories versus 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): $MS_{between} - MS_{within}/MS_{between} - MS_{within(m0)}$ 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 .00, .02, and .03, which are all small in size (≤.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 > .39). Repeated-measures ANOVAs revealed no differences between groups with regard to emotion recognition (p = .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 = .008) and cognitive control (p = .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 affects 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; Roberton 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 × Group interaction coefficients for cognitive control and emotion regulation did not reach the traditional significance threshold of $p < .05$, 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., 2012; Noble et al., 2007; Öhman et al., 2007; Sarsour et al., 2011; Shao et al., 2014; U.S. 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 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 $p < .05$ ($p = .064$ and $p = .075$, 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 with 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- to 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 (U.S. 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 article identifies another negative outcome that has largely been ignored—cognitive impairments, particularly in executive functions associated with antisocial behavior (Ogilvie et al., 2011; Roberton et al., 2012; Roberton 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, Mezzich, & Tarter, 1998; Giancola, Shoal, & Mezzich, 2001), 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 electroencephalogram (EEG), event-related potentials, and brain imaging (Raine, 2013). In addition, 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, Shi, 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 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., multisystemic 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 policymakers alike to continue to seek out and evaluate potential interventions to mitigate the negative effects of incarceration on inmates.

REFERENCES

Achenbach, T. M. (1991). *Manual for the youth self-report and 1991 profile*. Burlington: Department of Psychiatry, University of Vermont.

Alexander, C. N., & Orme-Johnson, D. W. (2003). Walpole study of the transcendental meditation program in maximum security prisoners II: Longitudinal study of development and psychopathology. *Journal of Offender Rehabilitation*, *36*, 127-160.

Ashkar, P. J., & Kenny, D. T. (2008). Views from the inside: Young offenders' subjective experiences of incarceration. *International Journal of Offender Therapy and Comparative Criminology*, *52*, 584-597. doi:10.1177/0306624X08314181

Bachoud-Levi, A. C., Maison, P., Bartolomeo, P., Boisse, M. F., Dalla Barba, G., Ergis, A. M., . . . Peschanski, M. (2001). Retest effects and cognitive decline in longitudinal follow-up of patients with early HD. *Neurology*, *56*, 1052-1058.

Barrett, C. J. (2017). Mindfulness and rehabilitation: Teaching yoga and meditation to young men in an alternative to incarceration program. *International Journal of Offender Therapy and Comparative Criminology*, *61*, 1719-1738. doi:10.1177/0306624X16633667

Bernburg, J. G., & Krohn, M. D. (2003). Labeling, life chances, and adult crime: The direct and indirect effects of official intervention in adolescence on crime in early adulthood. *Criminology*, *41*, 1287-1318.

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., . . . Velting, D. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, *11*, 230-241.

Bleick, C. R., & Abrams, A. I. (1987). The transcendental meditation program and criminal recidivism in California. *Journal of Criminal Justice*, *15*, 211-230.

Blevins, K. R., Listwan, S. J., Cullen, F. T., & Jonson, C. L. (2010). A general strain theory of prison violence and misconduct: An integrated model of inmate behavior. *Journal of Contemporary Criminal Justice*, *26*, 148-166.

Carson, E. A., & Anderson, E. (2016). *Prisoners in 2015*. Washington, DC: Office of Justice Programs, Bureau of Justice Statistics, U.S. Department of Justice.

Casarjian, B., & Casarjian, R. (2003). *Power source: Taking charge of your life*. Boston, MA: Lionheart Press.

Casey, B. J. (2007). Frontostriatal connectivity and its role in cognitive control in parent-child dyads with ADHD. *The American Journal of Psychiatry*, *164*, 1729-1736.

Casey, B. J., Somerville, L. H., Gotlib, I. H., Ayduk, O., Franklin, N. T., Askren, M. K., . . . Shoda, Y. (2011). Behavioral and neural correlates of delay of gratification 40 years later. *Proceedings of the National Academy of Sciences*, *108*, 14998-15003. doi:10.1073/pnas.1108561108

Casey, B. J., Trainor, R. J., Orendi, J. L., Schubert, A. B., Nystrom, L. E., Giedd, J. N., . . . Cohen, J. D. (1997). A developmental functional MRI study of prefrontal activation during performance of a go-no-go task. *Journal of Cognitive Neuroscience*, *9*, 835-847.

Chiesa, A., Calati, R., & Serretti, A. (2011). Does mindfulness training improve cognitive abilities? A systematic review of neuropsychological findings. *Clinical Psychology Review*, *31*, 449-464. doi:10.1016/j.cpr.2010.11.003

Chiesa, A., & Serretti, A. (2009). Mindfulness-based stress reduction for stress management in healthy people: A review and meta-analysis. *The Journal of Alternative and Complementary Medicine*, *15*, 593-600.

Chiesa, A., & Serretti, A. (2010). A systematic review of neurobiological and clinical features of mindfulness meditations. *Psychological Medicine*, *40*, 1239-1252.

Choy, O., Raine, A., Portnoy, J., Rudo-Hutt, A., Gao, Y., & Soyfer, L. (2015). The mediating role of heart rate on the social adversity-antisocial behavior relationship: A social neurocriminology perspective. *Journal of Research in Crime and Delinquency*, *52*, 303-341.

Cohen, J. (1969). *Statistical power analysis for the behavioral sciences*. New York, NY: Academic Press.

Colcombe, S., & Kramer, A. F. (2003). Fitness effects on the cognitive function of older adults: A meta-analytic study. *Psychological Science*, *14*, 125-130.

Dafoe, T., & Stermac, L. (2013). Mindfulness meditation as an adjunct approach to treatment within the correctional system. *Journal of Offender Rehabilitation*, *52*, 198-216.

Del Boca, F. K., & Darkes, J. (2007). Enhancing the validity and utility of randomized clinical trials in addictions treatment research: I. treatment implementation and research design. *Addiction*, *102*, 1047-1056.

Diamond, A., & Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science*, *333*, 959-964. doi:10.1126/science.1204529

Dishion, T. J., & Dodge, K. A. (2005). Peer contagion in interventions for children and adolescents: Moving towards an understanding of the ecology and dynamics of change. *Journal of Abnormal Child Psychology*, *33*, 395-400.

Dodge, K. A., Price, J. M., Bachorowski, J., & Newman, J. P. (1990). Hostile attributional biases in severely aggressive adolescents. *Journal of Abnormal Psychology*, *99*, 385-392.

Donohoe, G., & Robertson, I. (2003). Can specific deficits in executive functioning explain the negative symptoms of schizophrenia? A review. *Neurocase*, *9*, 97-108.

Durmer, J. S., & Dinges, D. F. (2005). Neurocognitive consequences of sleep deprivation. *Seminars in Neurology*, *25*, 117-129.

Duwe, G., & Clark, V. (2014). The effects of prison-based educational programming on recidivism and employment. *The Prison Journal*, *94*, 454-478.

Eberth, J., & Sedlmeier, P. (2012). The effects of mindfulness meditation: A meta-analysis. *Mindfulness*, *3*, 174-189.

Elliott, R., Rubinsztein, J. S., Sahakian, B. J., & Dolan, R. J. (2000). Selective attention to emotional stimuli in a verbal go/no-go task: An fMRI study. *Neuroreport*, *11*, 1739-1744.

Evans-Chase, M. (2013). Internet-based mindfulness meditation and self-regulation: A randomized trial with juvenile justice involved youth. *Journal of Juvenile Justice*, *3*(1), 63-79.

Fan, J., McCandliss, B. D., Sommer, T., Raz, A., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience*, *14*, 340-347.

Gallant, D., Sherry, E., & Nicholson, M. (2015). Recreation or rehabilitation? Managing sport for development programs with prison populations. *Sport Management Review*, *18*(1), 45-56.

Giancola, P. R., Mezzich, A. C., & Tarter, R. E. (1998). Executive cognitive functioning, temperament, and antisocial behavior in conduct-disordered adolescent females. *Journal of Abnormal Psychology*, *107*, 629-641. doi:10.1037/0021-843X.107.4.629

Giancola, P. R., Shoal, G. D., & Mezzich, A. C. (2001). Constructive thinking, executive functioning, antisocial behavior, and drug use involvement in adolescent females with a substance use disorder. *Experimental and Clinical Psychopharmacology*, *9*, 215-227.

Glenn, A. L., & Raine, A. (2014). Neurocriminology: Implications for the punishment, prediction and prevention of criminal behaviour. *Nature Reviews Neuroscience*, *15*(1), 54-63.

Goel, N., Rao, H., Durmer, J. S., & Dinges, D. F. (2009). Neurocognitive consequences of sleep deprivation. *Seminars in Neurology*, *29*, 320-339. doi:10.1055/s-0029-1237117

Goodman, S. N. (1999). Toward evidence-based medical statistics. 1: The P value fallacy. *Annals of Internal Medicine*, *130*, 995-1004.

Goodstein, L., MacKenzie, D. L., & Shotland, R. L. (1984). Personal control and inmate adjustment to prison. *Criminology*, *22*, 343-369.

Gottfredson, M. R., & Hirschi, T. (1990). *A general theory of crime*. Stanford, CA: Stanford University Press.

Goyal, M., Singh, S., Sibinga, E. M., Gould, N. F., Rowland-Seymour, A., Sharma, R., . . . Shihab, H. M. (2014). Meditation programs for psychological stress and well-being: A systematic review and meta-analysis. *JAMA Internal Medicine*, *174*, 357-368.

Graham v. Florida, 560 U.S. 48 (2010)

Grasmick, H. G., Tittle, C. R., Bursik, R. J., & Arneklev, B. J. (1993). Testing the core empirical implications of Gottfredson and Hirschi's general theory of crime. *Journal of Research in Crime and Delinquency*, *30*, 5-29.

Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of General Psychology*, *2*, 271-299.

Grunewald, M., Stadelmann, S., Brandeis, D., Jaeger, S., Matuschek, T., Weis, S., . . . Döhnert, M. (2015). Early processing of emotional faces in a go/no go task: Lack of N170 right-hemispheric specialisation in children with major depression. *Journal of Neural Transmission*, *122*, 1339-1352.

Hackman, D. A., & Farah, M. J. (2009). Socioeconomic status and the developing brain. *Trends in Cognitive Sciences*, *13*(2), 65-73.

Haney, C. (2003). The psychological impact of incarceration: Implications for post-prison adjustment. In J. Travis & M. Waul (Eds.), *Prisoners once removed: The impact of incarceration and reentry on children, families, and communities* (pp. 33-66). Washington, DC: The Urban Institute.

Haney, C. (2012). Prison effects of in the age of mass incarceration. *The Prison Journal*, *92*, 1-24.

Hanks, R. A., Rapport, L. J., Millis, S. R., & Deshpande, S. A. (1999). Measures of executive functioning as predictors of functional ability and social integration in a rehabilitation sample. *Archives of Physical Medicine and Rehabilitation*, *80*, 1030-1037.

Hare, T. A., Tottenham, N., Davidson, M. C., Glover, G. H., & Casey, B. (2005). Contributions of amygdala and striatal activity in emotion regulation. *Biological Psychiatry*, *57*, 624-632.

Hare, T. A., Tottenham, N., Galvan, A., Voss, H. U., Glover, G. H., & Casey, B. (2008). Biological substrates of emotional reactivity and regulation in adolescence during an emotional go-nogo task. *Biological Psychiatry*, *63*, 927-934.

Himelstein, S. (2011). Meditation research: The state of the art in correctional settings. *International Journal of Offender Therapy and Comparative Criminology*, *55*, 646-661. doi:10.1177/0306624X10364485

Holzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., & Ott, U. (2011). How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspectives on Psychological Science: A Journal of the Association for Psychological Science*, *6*, 537-559. doi:10.1177/1745691611419671

Ireland, J. L., & Culpin, V. (2006). The relationship between sleeping problems and aggression, anger, and impulsivity in a population of juvenile and young offenders. *Journal of Adolescent Health*, *38*, 649-655.

Ivanova, M. Y., Achenbach, T. M., Rescorla, L. A., Dumenci, L., Almqvist, F., Bilenberg, N., . . . Döpfner, M. (2007). The generalizability of the youth self-report syndrome structure in 23 societies. *Journal of Consulting and Clinical Psychology*, *75*, 729-738.

Jarosz, A. F., & Wiley, J. (2014). What are the odds? A practical guide to computing and reporting ayes factors. *The Journal of Problem Solving*, *7*(1), 2-9.

Jha, A. P., Krompinger, J., & Baime, M. J. (2007). Mindfulness training modifies subsystems of attention. *Cognitive, Affective, & Behavioral Neuroscience*, *7*, 109-119.

Kabat-Zinn, J. (1982). An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. *General Hospital Psychiatry*, *4*(1), 33-47.

Kamphuis, J., Meerlo, P., Koolhaas, J. M., & Lancel, M. (2012). Poor sleep as a potential causal factor in aggression and violence. *Sleep Medicine*, *13*, 327-334.

Kramer, A. F., Hahn, S., Cohen, N. J., Banich, M. T., McAuley, E., Harrison, C. R., . . . Boileau, R. A. (1999). Aging, fitness and neurocognitive function. *Nature*, *400*, 418-419.

Kyriacou, D. N. (2016). The enduring evolution of the P value. *The Journal of the American Medical Association*, *315*, 1113-1115. doi:10.1001/jama.2016.2152

Ladouceur, C. D., Dahl, R. E., Williamson, D. E., Birmaher, B., Axelson, D. A., Ryan, N. D., & Casey, B. (2006). Processing emotional facial expressions influences performance on a go/NoGo task in pediatric anxiety and depression. *The Journal of Child Psychology and Psychiatry*, *47*, 1107-1115.

Landenberger, N. A., & Lipsey, M. W. (2005). The positive effects of cognitive–behavioral programs for offenders: A meta-analysis of factors associated with effective treatment. *Journal of Experimental Criminology*, *1*, 451-476.

Leonard, N. R., Jha, A. P., Casarjian, B., Goolsarran, M., Garcia, C., Cleland, C. M., . . . Massey, Z. (2013). Mindfulness training improves attentional task performance in incarcerated youth: A group randomized controlled intervention trial. *Frontiers in Psychology*, *4*, 792.

Lewis, M. D., Granic, I., & Lamm, C. (2006). Behavioral differences in aggressive children linked with neural mechanisms of emotion regulation. *Annals of the New York Academy of Sciences*, *1094*, 164-177.

Liem, M., & Kunst, M. (2013). Is there a recognizable post-incarceration syndrome among released "lifers"? *International Journal of Law and Psychiatry*, *36*, 333-337.

Lim, S., Seligson, A. L., Parvez, F. M., Luther, C. W., Mavinkurve, M. P., Binswanger, I. A., . . . Kerker, B. D. (2012). Risks of drug-related death, suicide, and homicide during the immediate post-release period among people released from New York City jails, 2001-2005. *American Journal of Epidemiology*, *175*, 519-526. doi:10.1093/aje/kwr327

Lipsey, M. W., Chapman, G. L., & Landenberger, N. A. (2001). Cognitive-behavioral programs for offenders. *The ANNALS of the American Academy of Political and Social Science*, *578*, 144-157.

Long, K., Felton, J. W., Lilienfeld, S. O., & Lejuez, C. W. (2014). The role of emotion regulation in the relations between psychopathy factors and impulsive and premeditated aggression. *Personality Disorders: Theory, Research, and Treatment*, *5*, 390-396.

Marsh, A. A., & Blair, R. (2008). Deficits in facial affect recognition among antisocial populations: A meta-analysis. *Neuroscience & Biobehavioral Reviews*, *32*, 454-465.

Maski, K. P., & Kothare, S. V. (2013). Sleep deprivation and neurobehavioral functioning in children. *International Journal of Psychophysiology*, *89*, 259-264.

Mears, D. P., & Siennick, S. E. (2016). Young adult outcomes and the life-course penalties of parental incarceration. *Journal of Research in Crime and Delinquency*, *53*, 3-35. doi:10.1177/0022427815592452

Miller v. Alabama, 567 U.S. 460 (2012)

Morgan, A. B., & Lilienfeld, S. O. (2000). A meta-analytic review of the relation between antisocial behavior and neuropsychological measures of executive function. *Clinical Psychology Review*, *20*, 113-136.

Moritz, S., Birkner, C., Kloss, M., Jahn, H., Hand, I., Haasen, C., & Krausz, M. (2002). Executive functioning in obsessive–compulsive disorder, unipolar depression, and schizophrenia. *Archives of Clinical Neuropsychology*, *17*, 477-483.

Morris, S. B., & DeShon, R. P. (2002). Combining effect size estimates in meta-analysis with repeated measures and independent-groups designs. *Psychological Methods*, *7*, 105-125.

Murray, J., & Farrington, D. P. (2008). The effects of parental imprisonment on children. *Crime and Justice*, *37*, 133-206.

Noble, K. G., Houston, S. M., Kan, E., & Sowell, E. R. (2012). Neural correlates of socioeconomic status in the developing human brain. *Developmental Science*, *15*, 516-527.

Noble, K. G., McCandliss, B. D., & Farah, M. J. (2007). Socioeconomic gradients predict individual differences in neurocognitive abilities. *Developmental Science*, *10*, 464-480.

Noble, K. G., Norman, M. F., & Farah, M. J. (2005). Neurocognitive correlates of socioeconomic status in kindergarten children. *Developmental Science*, *8*, 74-87.

Ogilvie, J. M., Stewart, A. L., Chan, R. C., & Shum, D. H. (2011). Neuropsychological measures of executive function and antisocial behavior: A meta-analysis*. *Criminology*, *49*, 1063-1107.

Öhman, L., Nordin, S., Bergdahl, J., Birgander, L. S., & Neely, A. S. (2007). Cognitive function in outpatients with perceived chronic stress. *Scandinavian Journal of Work, Environment & Health*, *33*, 223-232.

Osgood, D. W., Wilson, J. K., O'Malley, P. M., Bachman, J. G., & Johnston, L. D. (1996). Routine activities and individual deviant behavior. *American Sociological Review*, *61*, 635-655.

Phelps, M. S. (2011). Rehabilitation in the punitive era: The gap between rhetoric and reality in US prison programs. *Law & Society Review*, *45*(1), 33-68.

Raine, A. (2013). *The anatomy of violence: The biological roots of crime*. New York, NY: Vintage.

Reisig, M. D., & Mesko, G. (2009). Procedural justice, legitimacy, and prisoner misconduct. *Psychology, Crime & Law*, *15*, 41-59.

Roberton, T., Daffern, M., & Bucks, R. S. (2012). Emotion regulation and aggression. *Aggression and Violent Behavior*, *17*, 72-82.

Roberton, T., Daffern, M., & Bucks, R. S. (2014). Maladaptive emotion regulation and aggression in adult offenders. *Psychology, Crime & Law*, *20*, 933-954.

Roper v. Simmons, 543 U.S. 551 (2005)

Rose, D. R. (1998). Incarceration, social capital, and crime: Implications for social disorganization theory. *Criminology*, *36*, 441-480.

Rotheram-Borus, M. J., Song, J., Gwadz, M., Lee, M., Van Rossem, R., & Koopman, C. (2003). Reductions in HIV risk among runaway youth. *Prevention Science*, *4*, 173-187.

Rubia, K., Russell, T., Overmeyer, S., Brammer, M. J., Bullmore, E. T., Sharma, T., . . . Andrew, C. M. (2001). Mapping motor inhibition: Conjunctive brain activations across different versions of go/no-go and stop tasks. *NeuroImage*, *13*, 250-261.

Safer, D. L., & Hugo, E. M. (2006). Designing a control for a behavioral group therapy. *Behavior Therapy*, *37*, 120-130.

Salthouse, T. A., Schroeder, D. H., & Ferrer, E. (2004). Estimating retest effects in longitudinal assessments of cognitive functioning in adults between 18 and 60 years of age. *Developmental Psychology*, *40*, 813-822.

Sarsour, K., Sheridan, M., Jutte, D., Nuru-Jeter, A., Hinshaw, S., & Boyce, W. T. (2011). Family socioeconomic status and child executive functions: The roles of language, home environment, and single parenthood. *Journal of the International Neuropsychological Society*, *17*, 120-132.

Schnittker, J., & John, A. (2007). Enduring stigma: The long-term effects of incarceration on health. *Journal of Health and Social Behavior*, *48*, 115-130.

Schretlen, D. J., & Shapiro, A. M. (2003). A quantitative review of the effects of traumatic brain injury on cognitive functioning. *International Review of Psychiatry*, *15*, 341-349.

Schulz, K. P., Fan, J., Magidina, O., Marks, D. J., Hahn, B., & Halperin, J. M. (2007). Does the emotional go/no-go task really measure behavioral inhibition? Convergence with measures on a non-emotional analog. *Archives of Clinical Neuropsychology*, *22*, 151-160.

Shao, Y., Lei, Y., Wang, L., Zhai, T., Jin, X., Ni, W., . . . Ye, E. (2014). Altered resting-state amygdala functional connectivity after 36 hours of total sleep deprivation. *PLoS ONE*, *9*(11), e112222.

Shonin, E., Van Gordon, W., Slade, K., & Griffiths, M. D. (2013). Mindfulness and other Buddhist-derived interventions in correctional settings: A systematic review. *Aggression and Violent Behavior*, *18*, 365-372.

Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin*, *86*, 420-428.

Streit, M., Dammers, J., Simsek-Kraues, S., Brinkmeyer, J., Wölwer, W., & Ioannides, A. (2003). Time course of regional brain activations during facial emotion recognition in humans. *Neuroscience Letters*, *342*, 101-104.

Sussman, S., Rohrbach, L., & Mihalic, S. (2004). *Blueprints for violence prevention, book twelve: Project towards no drug abuse*. Boulder, CO: Center for the Study and Prevention of Violence.

Tang, Y., Hölzel, B. K., & Posner, M. I. (2015). The neuroscience of mindfulness meditation. *Nature Reviews Neuroscience*, *16*, 213-225.

Tang, Y., & Posner, M. I. (2009). Attention training and attention state training. *Trends in Cognitive Sciences*, *13*, 222-227.

Tang, Y., Yang, L., Leve, L. D., & Harold, G. T. (2012). Improving executive function and its neurobiological mechanisms through a Mindfulness-Based intervention: Advances within the field of developmental neuroscience. *Child Development Perspectives*, *6*, 361-366.

Teasdale, J. D., Segal, Z. V., & Williams, J. M. G. (2003). Mindfulness training and problem formulation. *Clinical Psychology: Science and Practice*, *10*, 157-160.

Teasdale, J. D., Segal, Z. V., Williams, J. M. G., Ridgeway, V. A., Soulsby, J. M., & Lau, M. A. (2000). Prevention of relapse/recurrence in major depression by mindfulness-based cognitive therapy. *Journal of Consulting and Clinical Psychology*, *68*, 615-623.

Thomas, M. S., Annaz, D., Ansari, D., Scerif, G., Jarrold, C., & Karmiloff-Smith, A. (2009). Using developmental trajectories to understand developmental disorders. *Journal of Speech, Language, and Hearing Research*, *52*, 336-358.

Tottenham, N. (2015). Social scaffolding of human amygdala-m PFCcircuit development. *Social Neuroscience*, *10*, 489-499.

Tottenham, N., Hare, T. A., & Casey, B. (2011). Behavioral assessment of emotion discrimination, emotion regulation, and cognitive control in childhood, adolescence, and adulthood. *Frontiers in Psychology*, *2*, 39.

Tottenham, N., Hare, T. A., Quinn, B. T., McCarry, T. W., Nurse, M., Gilhooly, T., . . . Eigsti, I. (2010). Prolonged institutional rearing is associated with atypically large amygdala volume and difficulties in emotion regulation. *Developmental Science*, *13*, 46-61.

Travis, J., Western, B., & Redburn, S. (Eds.). (2014). *The growth of incarceration in the United States: Exploring causes and consequences*. Washington, DC: National Academy Press.

U.S. Department of Justice, Office of the United States Attorney Southern District of New York. (2014). *CRIPA investigation of the New York City Department of Correction Jails on Rikers Island*. New York, NY: Author.

van der Helm, E., Gujar, N., & Walker, M. P. (2010). Sleep deprivation impairs the accurate recognition of human emotions. *Sleep*, *33*, 335-342.

Vogler, N., Perkinson-Gloor, N., Brand, S., Grob, A., & Lemola, S. (2014). Sleep, aggression, and psychosocial adjustment in male prisoners. *Swiss Journal of Psychology*, *73*, 167-176.

Wagenmakers, E. (2007). A practical solution to the pervasive problems of p values. *Psychonomic Bulletin & Review*, *14*, 779-804.

Wessa, M., Houenou, J., Paillère-Martinot, M. L., Berthoz, S., Artiges, E., Leboyer, M., & Martinot, J. L. (2007). Fronto-striatal overactivation in euthymic bipolar patients during an emotional go/nogo task. *American Journal of Psychiatry*, *164*, 638-646.

Wolff, N., Blitz, C. L., & Shi, J. (2007). Rates of sexual victimization in prison for inmates with and without mental disorders. *Psychiatric Services*, *58*, 1087-1094.

Wolff, N., Blitz, C. L., Shi, J., Siegel, J., & Bachman, R. (2007). Physical violence inside prisons: Rates of victimization. *Criminal Justice and Behavior*, *34*, 588-599.

Wolff, N., Shi, J., Blitz, C. L., & Siegel, J. (2007). Understanding sexual victimization inside prisons: Factors that predict risk. *Criminology & Public Policy*, *6*, 535-564.

Wupperman, P., Neumann, C. S., & Axelrod, S. R. (2008). Do deficits in mindfulness underlie borderline personality features and core difficulties? *Journal of Personality Disorders*, *22*, 466-482.

Yang, S., Kadouri, A., Révah-Lévy, A., Mulvey, E. P., & Falissard, B. (2009). Doing time: A qualitative study of long-term incarceration and the impact of mental illness. *International Journal of Law and Psychiatry*, *32*, 294-303.

Rebecca Umbach is a PhD 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, PhD, 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 interventions 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.