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The relationship between low resting heart rate, systolic blood pressure and antisocial behavior in incarcerated males☆

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ABSTRACT

Purpose: This study examined the relationship between resting heart rate (RHR), systolic blood pressure (SBP) and antisocial behavior in a sample of incarcerated, adult male offenders.
Methods: Data from 333 health, psychology and institutional files were analyzed to assess the relationship between RHR, SBP and a range of antisocial outcomes, including criminal convictions.
Results: Consistent with prior research, results revealed a significant negative relationship between RHR and total prior offending and age of onset of antisocial behavior. RHR was positively associated with sexual offending. Slightly larger effect sizes were found with respect to SBP, and the pattern of results mirrored those for RHR. For RHR and SBP, many of the bivariate associations were still significant when control variables were included in multivariate analyses.
Conclusion: To our knowledge, this is the first study of RHR/SBP and offending within an institutionalized adult population that raises questions about the generalizability of this relationship to sexual offending.

1. Introduction

There is a substantial body of research demonstrating a relationship between low resting heart rate (RHR) and antisocial behavior (Raine & Portnoy, 2012). Low RHR is associated with a range of antisocial outcomes such as aggression (Portnoy et al., 2014), delinquency (Raine, Venables, & Mednick, 1997), psychopathy (Gao, Raine, & Schug, 2012), conduct problems, and criminal offending (Armstrong, Keller, Franklin, & Macmillan, 2009). The relationship has been demonstrated throughout the life-course, in children, adolescents and adults (Armstrong et al., 2009; Van de Weijer, de Jong, Bijleveld, Blokland, & Raine, 2017); in male and female populations (Moffitt, Caspi, Rutter, & Silva, 2001); and using a range of measures of antisocial behavior including clinical diagnoses of conduct disorder, child psychopathology (Raine, Fung, Portnoy, Choy, & Spring, 2014), self-reports (Murray et al., 2016), observational measures (Kindlon et al., 1995) and criminal records (Armstrong, Boisvert, Flores, Symonds, & Gangitano, 2017; Cauffman, Steinberg, & Piquero, 2005; Jennings, Piquero, & Farrington, 2013). The relationship has been replicated internationally using different approaches to measure RHR in general, clinical/treatment-seeking, and correctional populations (Murray et al., 2016; Raine, 2002).

Most of the research in this area has used cross-sectional designs: there are very few longitudinal studies of RHR and antisocial behavior. However, three major meta-analyses examining this relationship have been conducted to date. All three have reached the conclusion that low RHR is a significant, independent correlate of antisocial behavior. The averaged effect sizes (*d*) were −0.38 (based on 46 effect sizes; Lorber, 2004), −0.44 (based on 45 effect sizes; Ortiz & Raine, 2004) and −0.20 (based on 115 effect sizes; Portnoy & Farrington, 2015). A notable strength of the Portnoy and Farrington meta-analysis was that they overcame several methodological limitations of the previous meta-analyses (see Portnoy & Farrington, 2015, pp. 35–36): they ruled out several study confounds and demonstrated that the effect is not moderated by sex, study design, length of follow-up period, sample age or antisocial behavior type. They concluded that low RHR "should continue to be incorporated into antisocial behavior research and confirm resting heart rate's status [as] an important correlate of antisocial behavior" (Portnoy & Farrington, 2015 p. 42). Research has also examined the association between heart rate *reactivity* and antisocial outcomes, although the findings to date have been less consistent than those for *resting* heart rate (Jennings, Pardini, & Matthews, 2017).

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Because of its sturdiness as a predictor, researchers have argued that RHR should be included in longitudinal studies as a risk factor (Choy, Farrington, & Raine, 2015) and a protective factor for antisocial (Portnoy, Chen, & Raine, 2013) and health outcomes (Jennings et al., 2017). It should also be noted that additional research has ruled out the possibility that antisocial behavior *causes* low RHR (Moffitt & Caspi, 2001; Raine et al., 1997).

Why is understanding the relationship between RHR, and more generally, autonomic nervous system (ANS) functioning and antisocial behavior important? Van Goozen and Fairchild (2008) argue that having a depressed autonomic nervous system (ANS) produces an insensitivity to stress, and it is this lack of ANS excitation that may attenuate one's fight or flight response and/or ability to process emotional cues. The result is that individuals with a relatively low RHR might be less likely to learn from their experiences or benefit from certain treatments, particularly those that incorporate punishment-based learning (Van Goozen & Fairchild, 2008), thus, making antisocial behavior more likely. An obvious implication is that some individuals might not benefit from traditional treatment programs (e.g., cognitive behavioral) unless they also receive some sort of intervention (e.g., transcranial magnetic stimulation) aimed at their underlying physiology. From a crime prevention perspective, it would therefore be helpful to measure RHR along with other relevant biosocial variables so that resources can be allocated intelligently to those who pose a greater risk for offending (e.g., the risk principle: Andrews & Bonta, 2010). From a theoretical perspective, it is important to isolate the relative strength of individual biological factors from other (e.g., family, peer, neighborhood) factors, and to understand the circumstances under which they are most likely to produce antisocial behavior.

Two recent large-scale studies (Latvala et al., 2016; Latvala, Kuja-Halkola, Almqvist, Larsson, & Lichtenstein, 2015) confirm the growing body of research linking low RHR to antisocial outcomes. What is novel about these studies, however, is that they expanded the range of biosocial predictors to include systolic blood pressure (SBP). In a study with a sample of over 710,264 Swedish men followed up > 18 years, Latvala et al. (2015) demonstrated that low RHR predicted a range of rule-breaking behaviors including minor violence, drug-related, property, and traffic crime, but especially serious violence. Study participants in the lowest RHR quintile were 31% more likely to experience unintended injuries and 41% more likely to be injured as a result of an assault compared to those in the topmost quintile, even after adjusting for potential confounding variables. Interestingly, the authors also found similar relationships between SBP and violent and non-violent criminality. An important exception is that no significant association was observed between low RHR/SBP and sexual offending, leading the authors to call on future studies to further clarify this relationship.

In a follow-up study, Latvala et al. (2016) extended this analysis to measure the relationship between RHR and SBP in relation to a range of psychiatric disorders in a prospective longitudinal study. They studied a very large sample of Swedish men whose RHR (n = 1,039,443) and SBP (n = 1,555,979) were measured at military conscription (*mean* age = 18.3 years) and followed up three decades later, on average. They found that *higher* RHR and SBP were associated with a greater likelihood of having a diagnosis of OCD, anxiety disorder, or schizophrenia. The strongest effect was found for OCD, where a 10-point increase in RHR increased the chance of this diagnosis by 18%. Conversely, having a lower RHR and SBP were associated with higher rates of substance use disorders and violent criminality, and these risks were even higher when physical fitness was controlled for. Each 10-point decrease in either RHR or SBP increased the risk of being diagnosed with a substance use disorder by 5% and increased the risk of having a violent conviction by 10%.

Aside from the Latvala studies, there is a relatively small research base examining the relationship between SBP and antisocial and psychological outcomes. For example, in a sample of 122 Swedish schoolchildren, Borres, Tanaka, and Thulesius (1998) demonstrated that children with three or more psychosomatic or psychological symptoms had significantly lower SBP compared to children with no symptoms. Rapoza et al. (2014) examined the relationship between child maltreatment and a range of health outcomes in early adulthood and found that higher self-reported anger, but not child maltreatment per se, was significantly correlated with low SBP. Capitalizing on a very large sample from the Western Australian Pregnancy Cohort Study (n = 2900), Louise et al. (2012) found a significant association between low SBP and aggression at age 14 for boys, but not for girls. Finally, in a cross-sectional study, Gower and Crick (2011) extended the analysis to include relational aggression in a sample of preschoolers (aged 43 to 66 months, M = 54.0, SD = 7.0) and found that low SBP was significantly correlated with relational aggression in older, but not younger children.

While it is clear that there is an empirical link between low RHR (and apparently also low SBP) and antisocial behavior, the precise mechanisms mediating these relationships are not precisely known. Two main theories have been proposed to explain the relationship between low RHR and antisocial behavior: 1) fearlessness theory, and 2) sensation-seeking theory. The first asserts that, in the face of anxiety provoking stimuli, some individuals will not experience a rise in their heart rate, which reflects a relative lack of fear. Without internal cues, such as a pounding heart or sweaty palms, to signal that they are about to engage in risky behaviors, individuals are more easily able to follow through on their actions without being inhibited by the fear of potential negative consequences (Raine, 1993, 2002). The sensation-seeking hypothesis postulates that for some a state of low arousal is uncomfortable, and these individuals will seek out stimulation to increase their arousal to more normative levels (Eysenck, 1997; Quay, 1965; Raine, 2002). Because individuals with a low RHR are in a chronic state of under-arousal, they seek out opportunities to increase stimulation, including participation in antisocial behavior and crime.

To date, only a handful of studies have tested these two theories. Based on data from 151 university students, Armstrong and Boutwell (2012) used a rational choice framework to study the association between RHR and antisocial behavior. They concluded that fearlessness and not sensation-seeking best explained the relationship between low RHR and participants' perceived probability of conviction for assault. Studies examining RHR in relation to sensation-seeking are relatively more common. For example, using data from a large Dutch prospective population study, Sijtsema et al. (2010) found that the statistical relationship between low RHR and aggression and rule breaking was mediated by a parent-reported measure of sensation seeking in adolescent boys. Portnoy et al. (2014) assessed the influence of RHR on antisocial outcomes in a subsample (N = 335) of boys in the Pittsburgh Youth Study and found that sensation-seeking, and not fearlessness, mediated the relationship between low RHR and antisocial behavior, defined as aggression and non-violent delinquency. A methodological strength of this study was that the researchers included a measure of state fear to more directly test its potential mediating influence for decisions to commit antisocial acts.

1.1. The present study

This study sought to expand the knowledge base on the relationship between physiological indices of arousal (i.e., RHR and SBP) and antisocial behavior. As noted earlier, aside from the studies by Latvala et al. (2015, 2016), virtually no work has been done to measure the association between SBP and antisocial outcomes. In addition, although prior research has used official offending as an outcome variable in relation to RHR in adolescent populations (e.g., Cauffman et al., 2005; de Vries-Bouw et al., 2011; Raine, Venables, & Williams, 1990), only one prior study (i.e., Armstrong et al., 2017) has examined the relationship in an adult correctional context using official criminal records. Furthermore, and consistent with Latvala et al. (2015), we subdivided criminal offending into mutually exclusive categories (i.e.,