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Resting heart rate and psychopathy: Findings from the Add Health Survey

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Abstract

Despite the large body of research linking low resting heart rate to antisocial behavior broadly, significantly less work has been done linking heart rate to psychopathic traits. The small body of research on the topic that has been conducted, has found an overall inverse relationship between the two constructs. A significant minority of studies have found the opposite results, however, and many prior studies have been limited by small sample sizes and unrepresentative samples. The current study attempts to help clarify the relationship between resting heart rate and psychopathic traits in a large, nationally representative sample using an alternative measure of psychopathic traits that is less focused on antisocial processes. No significant relationship between heart rate and psychopathic traits, or heart rate and a measure of cold heartedness, was found after controlling for age, sex, and race. Implications of the findings, study limitations, and directions for future research are discussed.

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Resting heart rate and psychopathy: Findings from the Add Health Survey

The past few decades have witnessed a resurgence of criminological research exploring potential biological predictors of antisocial and criminal behavior (Raine, 2002, 2015; Raine, Venables, & Williams, 1995; Sijtsema et al., 2010). One factor in particular, low autonomic arousal has emerged as a robust predictor of antisocial behavior across the life course, ranging from childhood into adulthood (Lorber, 2004; Ortiz & Raine, 2004; Raine, 2002). Indeed, multiple meta-analyses, analyzing dozens of empirical studies, have repeatedly suggested that low autonomic arousal, measured via resting heart rate, is predictive of aggression, conduct problems, and violence in juveniles. Providing further support for the link between autonomic arousal and crime, Raine, Venables, and Williams (1995) in a longitudinal study of adolescents in the UK found that a higher resting heart rate at age 15 was a protective factor against criminal behavior at age 29.

Two possible explanations have been offered to explain the link between resting heart rate and antisocial behavior. First, fearlessness theory suggests that lower levels of arousal are biomarkers of lower levels of fear (Raine, 1993). Individuals with lower resting heart rates, the argument goes, experience diminished levels of fear and anxiety and are less conditionable to the aversive consequences of their riskier behavior (Lykken, 1995; Raine, 2002). Owing to these diminished states of relatively low fear and anxiety, a resulting predisposition toward engaging in antisocial behavior or violence becomes more pronounced (Raine, 1993; 2002). Several studies have found that low physiological arousal correlates strongly with temperamental features of behavioral disinhibition early in the life-course, thus providing convergent evidence to support the fearlessness perspective (Fowles, Kochanska, & Murray, 2000; Kagan, 1994; Kagan, Reznick, & Snidman, 1987; Scarpa, Raine, Venables, & Mednick, 1997).

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The second explanation that might account for the inverse correlation between heart rate and antisocial behavior suggests that individuals with lower levels of resting arousal tend to score higher on measures of sensation seeking (Eysenck & Eysenck 1967; Eysenck, 1977; Raine, Reynolds, Venables, Mednick, & Farrington, 1998). The explanation posits that individuals with low resting heart rates experience their low arousal states as uncomfortable and are driven to seek stimulation or novelty in order to increase their arousal to a more comfortable homeostatic level. Thus, antisocial behavior and violence are explained as the efforts of chronically under-aroused individuals engaging in sensation seeking behavior (Horvath & Zuckerman, 1993). Recent research supports this hypothesis with findings that sensation seeking mediates the relationship between low resting heart rate and aggression (Portnoy et al., 2014).

Most importantly for the current study, the constructs of both fearlessness and sensation seeking have been linked to psychopathy (Hare, 1965; Patrick, 1994), a construct that is also a consistent predictor of antisocial behavior and crime (Coid, 1998; Hare, 1991). Psychopathy represents a constellation of personality traits and behaviors, generally consisting of callousness, grandiosity, manipulativeness, dishonesty and impulsivity, as well as overt forms of antisocial behavior. Psychopaths also tend to exhibit deficits in emotion, remorse, and attention (Fox, Jennings, & Farrington, 2015; Frick & White, 2008; Hare, 1991, Patrick, Fowles, & Krueger, 2009). Especially pertinent to the current study, psychopathic individuals have also been found to be high on sensation seeking (Hare, 1991; Zuckerman, Buchsbaum, & Murphy, 1980) and prior research has often attempted to explain their behavior as a consequence, at least in part, of diminished fear arousal (Birbaumer et al., 2005; Hare, 1965; Patrick, 1994).

The consistent link between low autonomic arousal and antisocial behavior, coupled with the overlap between psychopathy and antisocial behavior, suggests an additional possible

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pathway leading from individual differences in arousal to individual differences in antisocial outcomes. To the extent that individuals with low levels of arousal also evince traits consonant with psychopathy, this may help clarify some of the reasons why low resting heart rate correlates with criminal behavior.

To date, however, there has been significantly less research examining the relationship between heart rate and psychopathy than has examined heart rate and antisocial behavior generally (Kavish et al. 2017). While one meta-analysis found no relationship between resting heart rate and psychopathy (Lorber, 2004), a subsequent systematic review and meta-analysis found an overall inverse relationship using different inclusion/exclusion criteria (d = -.19; Portnoy & Farrington, 2015). The existing research that Portnoy and Farrington (2015) analyzed has some important limitations. The first drawback of the existing literature is that the majority of the studies available to be included in the meta-analysis seem to have measured psychopathy via the PCL/PCL-R and other closely related measures (e.g. Lobbestael et al., 2009; Ogloff & Wong, 1990; Raine et al., 2014).

While the PCL-R is generally considered the gold standard measure for assessing psychopathy, there is also a substantial body of research that assesses psychopathy from a dimensional personality perspective (e.g. De Vries & van Kampen, 2010; Lee & Ashton, 2005; Miller et al., 2001; Miller & Lynam, 2003). To date, however, there is a lack of research focusing on the relationship between physiological variables and psychopathic personality features. Furthermore, Portnoy and Farrington (2015) were only able to analyze eight effect sizes for the relationship between resting heart rate and factors of psychopathy, with five effect sizes for the interpersonal/affective Factor 1 and only three for the lifestyle/antisocial Factor 2. Analysis of these few studies revealed no significant differences between heart rates relation to

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the two factors; however, a more recent study found a significant inverse correlation between resting heart rate and some of the affective features of psychopathy (callousness, unemotionality) in juveniles (Kavish et al., 2017). Caution is warranted, however, given that the study by Kavish et al. (2017) was conducted using a small, non-representative sample.

Another important point regarding the research analyzed in Portnoy and Farrington (2015) is that the existing literature from which the authors had to draw contains an overabundance of effect sizes drawn from incarcerated and institutionalized samples, along with a lack of large, representative samples. Portnoy and Farrington (2015) themselves point to the overrepresentation of child and juvenile samples and the theoretically inconsistent finding of no moderating effect of age as evidence of a need for more research with adult populations. Given these limitations in the existing research, and thus the limitations placed on what the authors of the meta-analysis had to work with, further research is needed to better elucidate the possible link between heart rate and psychopathy.

Current Study

The association between heart rate and psychopathy is a relatively novel finding, about which not much is deeply understood at the current juncture. Despite being able to possibly shed light on the link between heart rate and criminal behavior, this line of research is in its infancy and prior evidence (Kavish et al., 2017) has relied mostly on small samples and overt measures of antisocial behavior. As a result, it remains important to probe this finding in greater detail using larger, national samples and alternative measures of key constructs. The current study accomplishes this using a national sample of American respondents and a measure of psychopathy that is relatively free of antisocial processes in order to further scrutinize the association of resting heart rate and psychopathic personality tendencies.

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Methods

Participants

The data for the current study were drawn from the National Longitudinal Study of Adolescent to Adult Health (Add Health; Udry, 2003). The Add Health is a widely used data source of scholars across academic disciplines. The nature of the data collection, including sampling strategy, measurement, and availability of the data have been repeatedly described elsewhere (Beaver et al., 2013; Harris, Halpern, Smolen, & Haberstick, 2006). To date, 4 waves of data have been collected and made widely available for research proposes. Wave one consisted of two parts: a self-report survey administered within schools to over 90,000 adolescents and an in-person interview of a stratified sub-sample of those who completed the survey. The interviews were conducted in the presence of the adolescents' primary caregiver and sought more in-depth information regarding their social relationships, risk taking behavior, and family life. In total, 20,745 adolescents and 17,700 caregivers completed the Wave 1 in-home component of the study (Harris et al., 2003). The fourth wave (Wave 4) was conducted from 2007 to 2008 with 15,701 of the original participants being re-interviewed. Questions now addressed employment history, behavior, personality traits, and lifetime contact with the criminal justice system (Harris et al., 2003). The current study draws its data from Wave 4 of the Add Health study.

Measures

Physiological Arousal

Physiological arousal data for the current study is drawn from the cardiovascular measurements of Wave 4. In Wave 4, trained and certified field interviewers used factory calibrated Microlife BP3MC1-PC-IB oscillometric blood pressure monitors (MicroLife USA,

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Inc.; Dunedin, FL) to measure pulse rates in beats per minute. Measurements were taken 3 times at 30 second intervals. Participants were seated during the measurements and the 2nd and 3rd readings were averaged (Entzel et al., 2009). In line with prior research (Anselmino, Öhrvik, & Rydén, 2010; Carnethon et al., 2008; Maliphant, Watkins, & Davies, 2003; Murray et al., 2016; Sandset et al., 2014), the heart rate measure was divided in quartiles (i.e. 1st quartile=66 or lower, 2nd quartile=67-73, 3rd quartile=74-82, and 4th quartile=83 or higher).

Psychopathic Personality Styles

In Wave 4, respondents were asked questions which assessed their personality traits based on the Five Factor Model (FFM) of personality as well as their levels of self-control and self-regulation. The current study uses a psychopathic personality traits scale (for further details on the development of this scale, see Beaver, Barnes, May, & Schwartz, 2011; Beaver, Rowland, Schwartz, & Nedelec, 2011) that was developed based on research that revealed that certain FFM items can be used to create a continuous measure of psychopathic personality traits (Derefinko & Lynam, 2007; Gudonis, Miller, Miller, & Lynam, 2008; Lynam, 2002; Lynam et al., 2005; Lynam & Derefinko, 2006; Lynam & Widiger, 2001; Miller & Lynam, 2003; Miller, Lynam, Widiger, & Leukefeld, 2001). The scale's 23 items assess the respondents' ability to sympathize, feel other's emotions, and whether or not the respondent cares about others. Higher scores on this scale represent more psychopathic personality traits ($\alpha = .80$) and it should be noted that this scale has previously been used in multiple other studies (Beaver, Barnes, et al., 2011; Beaver, Boutwell, et al., 2015; Beaver, Rowland, et al., 2011).

Cold heartedness

Wave 4 data of the Add Health survey was collected before many of the currently popular psychopathy measures (e.g. Inventory of Callous Unemotional Traits; ICU) had been

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validated. Therefore, the current study utilized a Cold heartedness scale comprised of 8 items in the survey. The same items were used in a callous-unemotional scale created by Markowitz, Ryan, and Marsh (2015). Higher scores on this scale represent more cold heartedness traits. The scale's validity has not been tested in other research, but the items contained map well onto items in the ICU (Markowitz, Ryan, & Marsh, 2015).

Control variables

The current study used participants' ages at Wave 4 and treated them as a continuous variable. We also controlled for race, which was coded as White, Black, or Other and White was used as the reference. Finally, sex was included and was coded as either Male or Female and Male is the reference.

Statistical Analysis

The Add Health[1] is a longitudinal and school-based survey derived from a nationally representative sample of adolescents in grades 7-12 first interviewed in 1994-1995 (Harris, Halpern, Smolen, & Haberstick, 2006). The fourth wave of the study was conducted in 2008 with original sample aged 32-42 and the response rate was 80.3%. Among 15,701 participants, 901 were excluded from the final analysis due to missing values. The primary independent variable was the quartile of heart rate. In order to assess the relationship between physiological arousal and psychopathic personality, we utilized a straightforward analytical approach. The means of psychopathy and cold heartedness were estimated. Then, we examined the relationship between the heart rate measure and psychopathy using ordinary least squares (OLS) regression and controlling for age, gender and race variables. We further examined the extent to which an affective personality feature was predicted by arousal by testing the relationship between heart rate and the cold heartedness scale. The weighted means, regression coefficients and standard

[1] http://www.cpc.unc.edu/projects/addhealth/design

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errors were reported. Statistical significance was determined by p-value < 0.05. The design variables and sampling weights were incorporated in the analysis using SAS survey procedures (SAS Institute Inc. 2015).

Results

Table 1 depicts the mean values of the FFM psychopathy and cold heartedness scales. The higher scores represent a more psychopathic and cold hearted character.

Insert Table 1 about here

Table 2 presents the relationship between psychopathy and resting heart rate as well as the cold heartedness measure and resting heart rate using linear regression. Resting heart rate was associated with psychopathy and cold heartedness. Specifically, the estimated psychopathy scores were significantly greater in the first quartile of resting heart rate (e.g. heart rate<66/minute) than in the fourth quartile of resting heart rate (i.e. heart rate>81/minutes). The estimated cold heartedness scores were greater in the first and second quartile of resting heart rate (e.g. heart rate<66/minute and 66<heart rate<73.5/minute) than in the fourth quartile of resting heart rate (i.e. heart rate>81/minutes), respectively. While it is common to examine the effects of resting heart rate across quartiles, we also analyzed our models using resting heart rate as a continuous variable. In general, the result remained unchanged. In particular, some evidence of a bivariate association between HR and cold-heartedness emerged. Nonetheless, HR failed to evince a significant effect in the multiple regression model for either psychopathy or cold heartedness.

Insert Table 2 about here

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After controlling for sex, age and race, neither of the relationships between resting heart rate and psychopathy or the association between resting heart rate and cold heartedness was significant. Table 3 contains the results of the two models that include the additional covariates. Our analyses, contrary to predictions and earlier research, found no significant relationship between any quartile of resting heart rate and scores on the psychopathy measure after adjustment for sex, age, and race. Additionally, no relationship was found between resting heart rate and scores on the cold heartedness scale following these adjustments. Each of the demographic variables was significantly associated with both psychopathy and cold heartedness personality traits. Every additional year in age and females were significantly associated with lower psychopathy and cold heartedness scores. African Americans were associated with greater psychopathy and cold heartedness scores than Whites. Implications of the results and study limitations are discussed.

*****Insert Table 3 about here*****

Discussion

There has been a great deal of concern recently regarding the reproducibility of research across the field of psychology and across science broadly (Benjamin et al., 2017; Crandall & Sherman, 2016), following a widely publicized failure to replicate a large number of famous psychological studies (Open Science Collaboration, 2015). These concerns have generated a number of conversations about the importance of registered reports, open data, and even reevaluating our arbitrary standards for statistical significance (Benjamin et al., 2017). Most importantly, however, these conversations have been a reminder of the importance of replication of past research: both conceptually and with alternative samples and measures in order to assess the generalizability of a given finding.

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The current study sought to replicate and extend the existing body of research on the relationship between low resting heart rate and psychopathy by using a measure that is relatively free of antisocial behavior. To date, research has been mixed on the effects of resting heart rate on psychopathic traits (Lorber, 2004; Portnoy & Farrington, 2015). Most recently, Kavish et al. (2017) using a small convenience sample uncovered a significant effect of heart rate on scores on the Inventory of Callous Unemotional Traits (ICU) as well as the Youth Psychopathy Inventory (YPI). Given the small circumscribed sample, it remains an open question whether similar findings will emerge using alternative and more generalizable samples.

We sought to expand the analysis of Kavish et al. (2017) by examining other personality constructs—cold heartedness—in order to try and further unpack the effect of heart rate on personality constructs that increase the risk of antisocial and criminal behavior. Consistent with previous work, we found that low resting heart rate was associated with psychopathic personality traits in the bivariate analyses. However, when sex, age and race were taken into account, our results failed to support the conclusions of previous work by revealing no significant relationship between heart rate and psychopathic personality features. Our findings suggest that the relationship between resting heart rate and psychopathic personality traits can be better explained by age, sex and race. The role of age and sex, in particular, are not surprising given previous research which has found resting heart rate differs with age (Shinebourne, 1974 as cited in Raine, Venables, & Mednick, 1997) and by sex, even explaining as much as 17% of the gender gap in crime (Choy, Raine, Venables, & Farrington, 2017).

It is important to consider the limitations inherent in the current study. First, and perhaps foremost, the measure used to assess psychopathic personality features is based on items drawn from FFM personality items, and not from typical clinical measures of psychopathy. Prior

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research has utilized this measure before, and the constituent items appear to possess adequate validity (Beaver, Barnes, May, & Schwartz, 2011; Beaver, Rowland, Schwartz, & Nedelec, 2011), yet the extent to which the measure captures the same variation in psychopathic tendencies as other classic measures of psychopathy remains an open question. Similarly, the cold heartedness scale was constructed from questions in the Wave 4 survey, as formal measures of callous and unemotional traits were not utilized in the Add Health data collection. The cold heartedness scale has not been validated by other research and is in need of further study before strong conclusions can be drawn.

Despite its drawbacks, the current study still provides an important contribution to the literature. It utilizes a large, national sample of adults, as well as an alternative method of assessing psychopathic traits. Although the scale used in this study may not capture the antisocial behavior components assessed in traditional measures of psychopathy, it does provide an opportunity to examine the relationship between heart rate and the psychopathy construct from a FFM personality perspective. Ultimately, the current study emphasizes the necessity for more research into the relationship between resting heart rate and psychopathy using large, representative samples and alternative measures along with rigorous controls.

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Table 1. Descriptive characteristics of the sample.

	Mean	SE	Minimum	Maximum
Psychopathy	66.72	0.11	3.00	98.00
Cold Heartedness	21.79	0.06	3.00	40.00
Age	28.51	0.12	24.00	34.00
Male %	50.68	0.62		
Race				
White	79.18	2.39		
African-American	16.67	2.14		
Other	4.16	0.85		

Note: SE: standard errors.

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Table 2. Bivariate analysis of heart rate and total psychopathy score and cold heartedness.

	Model 1: Psychopathy		Model 2: Cold Heartedness	
	b	SE	*b*	SE
1st quartile of heart rate	0.45*	0.20	0.55**	0.13
2nd quartile of heart rate	0.11	0.34	0.40**	0.14
3rd quartile of heart rate	-0.07	0.21	0.05	0.11
4th quartile of heart rate	Reference		Reference	

b: slope; Note: SE: standard error; *Significant at $p<0.05$; **Significant at $p<0.01$.

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Table 3. Ordinary least squares regression analysis for total psychopathy score and cold heartedness.

	Model 1: Psychopathy		Model 2: Cold Heartedness	
	b	SE	*b*	SE
1st quartile of heart rate	-0.26	0.19	0.04	0.77
2nd quartile of heart rate	-0.23	0.32	0.16	0.12
3rd quartile of heart rate	-0.17	0.18	-0.03	0.09
4th quartile of heart rate	Reference		Reference	
Age	-0.13**	0.04	-0.05*	0.02
Female	-3.69**	0.21	-2.70**	0.08
Race				
Black	0.74**	0.20	0.88**	0.13
Other	0.17	0.35	0.47**	0.17
White	Reference		Reference	

b: slope; Note: SE: standard error; *Significant at $p<0.05$. **Significant at $p<0.01$.