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Mapping Gray's BIS and BAS constructs onto Factor 1 and Factor 2 of Hare's Psychopathy Checklist – Revised

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ABSTRACT

Reinforcement sensitivity theory (RST; Gray, 1987; Gray & McNaughton, 2000) has proven to be a valuable tool for understanding psychopathy (e.g., Fowles, 1980, 1988; Newman & Malterer, 2009; Poythress et al., 2008). Recent research has linked two RST constructs, the Behavioral Inhibition System (BIS) and the Behavioral Activation System (BAS), to individuals with primary psychopathy and secondary psychopathy (Lykken, 1995; Newman, MacCoon, Vaughn, & Sadeh, 2005): Primary psychopaths manifest low BIS reactivity and secondary psychopaths manifest high BAS reactivity. In the present study, we examine the relationships between the BIS/BAS constructs and Factors 1 and 2 of the Psychopathy Checklist – Revised (PCL-R) in a sample of 472 incarcerated male offenders. Paralleling their relationships with primary and secondary psychopathy, the BIS/BAS constructs were differentially related to the two PCL-R factors. Specifically, the influence of the BIS was found to be more prominent than the influence of the BAS for Factor 1, and the influence of the BAS was more prominent than that of the BIS for Factor 2.

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1. Introduction

Psychopathic individuals are known for their exceptionally poor judgment, penchant for acting in response to relatively low levels of motivation (i.e., on a whim), inability to learn from negative consequences, extreme egocentricity, and lack of remorse for misdeeds (Cleckley, 1976). Hence, these individuals are prone to engage in impulsive, maladaptive, and antisocial acts, which cause them to experience substantial marital, academic, and employment disruption. Furthermore, although the prevalence of psychopathy in the general population is only 1%, estimates of the prevalence among incarcerated offenders range from 15% to 25% (Hare, 1996), and psychopathic individuals re-offend 2–5 times more frequently than do non-psychopathic individuals (Hemphill, Hare, & Wong, 1998; Quinsey, Rice, & Harris 1995; Serin, 1996; Walters, 2003).

The use of Gray's reinforcement sensitivity theory (RST; 1975, 1987; Gray & Smith, 1969) to explain psychopathic behavior dates back nearly 30 years (e.g., Fowles, 1980). Briefly, the most recent formulation of RST (Gray & McNaughton, 2000) postulates three interacting brain systems. The Fight-Flight-Freeze System (FFFS) is activated in the presence of both conditioned and unconditioned aversive stimuli. Its activation is associated with the emotion of fear and with behaviors that diminish the perceived threat (e.g., escape or avoidance). The Behavioral Activation System (BAS) is activated in the presence of both conditioned and unconditioned appetitive stimuli (e.g., opportunities for reward). Increased BAS activity is associated with positive emotional states (e.g., optimism, hopefulness) and appetitive (e.g., approach) behavior, as well as with aggression (e.g., Carver 2004; Harmon-Jones & Peterson, 2008). Finally, the Behavioral Inhibition System (BIS) is activated when conflicts occur between concurrent goals (e.g., the classic approach-avoidance conflict); specifically, when both the BAS and the FFFS are activated (e.g., Corr, 2006). Increased activity of the BIS is associated with the emotion of anxiety, and causes the inhibition of ongoing behaviors and the initiation of information processing to resolve the conflict.

Fowles (1980,1988) proposed one of the initial explanations of psychopathy that made use of the BIS and BAS constructs, attributing psychopathy to a weak or hypo-reactive BIS (which leads to lower than normal levels of BIS activity in response to stimuli to which the BIS is sensitive). More recently, Lykken (1995) expanded upon Fowles' use of RST by focusing on the distinction between primary and secondary psychopathy (e.g., Blackburn, 1979; Hare, 1970; Skeem, Johansson, Andershed, Kerr, & Louden, 2007). Primary psychopaths are considered to be true or prototypical psychopaths (Cleckley, 1976). They are characterized by relatively low levels of anxiety, and their maladaptive, antisocial actions are considered to be the result, at least in part, of the failure to experience anxiety even when the likelihood of adverse consequences is high (e.g., Cleckley, 1976). On the other hand, secondary psychopaths experience higher-than-normal levels of negative

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emotions (e.g., anxiety), and their antisocial actions are thought to occur in response to intra-psychic conflicts or emotional distress (e.g., Cleckley, 1976).

Lykken (1995) proposed that primary psychopathy is associated with weak BIS reactivity (but normal BAS reactivity) and, in consequence, primary psychopaths are prone to experience smaller than normal reactions to BIS inputs. Conversely, secondary psychopathy is associated with strong BAS reactivity (but normal BIS reactivity); that is, secondary psychopaths are hyper-reactive to opportunities for reward. To test Lykken's hypotheses, Newman, MacCoon, Vaughn, and Sadeh (2005) administered two measures of the BIS and BAS constructs – the BIS/BAS Scales (Carver & White, 1994) and the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (Torrubia, Ávila, Moltó, & Caseras, 2001) – to a sample of incarcerated male offenders (and these same measures also were employed in the present study – see below). Consistent with Lykken's hypotheses, for individuals with primary psychopathy, the influence of low BIS reactivity predominated, whereas for those with secondary psychopathy, the influence of high BAS reactivity was most prominent.

Another way of conceptualizing the psychopathy construct (and thus the relationships between psychopathy and RST) involves the Psychopathy Checklist – Revised (PCL-R; Hare, 2003), which is the principal instrument used to identify psychopathic individuals in correctional settings. Of particular relevance to the present manuscript, factor-analytic studies have identified two broad PCL-R Factors with distinct personality, behavioral, physiological, and social correlates (e.g., Harpur, Hare, & Hakstian, 1989; Patrick, Bradley, & Lang, 1993; Ross et al., 2007). One of these factors (Factor 1), is hypothesized to reflect psychopathy's distinguishing characteristics, such as low anxiety and deficient emotion processing (e.g., Patrick, 1994; Patrick et al., 1993), whereas the second factor (Factor 2) relates to more general externalizing tendencies that are shared by persons having diagnoses such as Conduct Disorder and Antisocial Personality Disorder (Patrick, Hicks, Krueger, & Lang, 2005). Psychopathic individuals usually score above the mean on both PCL-R Factor 1 and Factor 2, although, for a particular psychopathic individual, the score on one factor may be substantially higher than the score on the other.

In this study, we examined the relationships among PCL-R Factors 1 and 2 and the BIS and BAS constructs in a large sample of incarcerated male offenders to determine whether the RST constructs are differentially related to the two principal factors derived from the PCL-R. In past research, inmates with high PCL-R scores (i.e., psychopathic individuals) displayed both lower BIS and higher BAS scores than non-psychopathic control participants (Book & Quinsey, 2004). However, paralleling results for primary and secondary psychopathy, such findings may mask the unique contributions of the two PCL-R Factors. To the extent that Factor 1, like primary psychopathy, is associated with low anxiety, we predicted that Factor 1 would be associated predominantly with low scores on measures of the BIS construct. Conversely, to the extent that Factor 2, like secondary psychopathy, is associated with general externalizing tendencies, we predicted that Factor 2 would be associated predominantly with high scores on measures of the BAS construct.

In addition to the two-factor model upon which we based our predictions, a four-factor model for the PCL-R has been proposed (see, for example, Neumann, Hare, & Newman, 2007). Hence, although comparing and contrasting the two- and four-factor models was not an aim of this study, we conducted post-hoc analyses to determine whether the two-factor results (see below) were moderated by underlying correlations involving the four-factor model.

2. Method

2.1. Participants

The sample consisted of 472 adult male offenders (13.8% African–American, 85.4% Caucasian) incarcerated in the Wisconsin prison system, ranging in age from 18 to 45 years of age (M = 31.66 years, SD = 7.38). Researchers selected potential participants from a comprehensive prison roster and screened out anyone older than 45 years, with diagnoses of Bipolar Disorder or Schizophrenia, or receiving psychotropic medication. Only participants for whom all relevant data points were available were included in this study. Hence, all correlations and analyses reported herein pertain to the same 472 participants.

2.2. Measures

2.2.1. PCL-R

The PCL-R (Hare, 1991, 2003) consists of 20 items indicative of psychopathic traits as delineated by Cleckley (1976). Each PCL-R item is scored on a 3-point scale (0 = clearly not present; 1 = may be present; 2 = clearly present), and the scores are summed to yield a total score (range 0–40). Scores are based on information derived from both a semi-structured interview and a review of institutional file information. The reliability and construct validity of the PCL-R are well established (see Hare, 1985, 1996; Hare et al., 1990). Early work with the Psychopathy Checklist revealed a replicable two-factor structure (Harpur et al., 1989) with Factor 1 assessing interpersonal and affective characteristics (e.g., pathological lying, shallow affect) and Factor 2 assessing impulsive and antisocial behavior. The internal consistency of the PCL-R Factors, as indexed by Cronbach's alpha, is reported in Table 1.

Table 1
Inter-correlations among scales and scale reliabilities.

	1	2	3	4	5	6	7	8
PCL-R F1	*0.829*							
PCL-R F2	.605**	*0.775*						
BIS	−.210**	−.181**	*0.744*					
BAS	0.068	.211**	.110*	*0.855*				
SP	−.214**	−.123**	.539**	0.071	*0.839*			
SR	.162**	.304**	0.075	.570**	0.072	*0.82*		
BIS/SP	−.242**	−.173**	.876**	.103*	.878**	0.084	*0.861*	
BAS/SR	.130**	.291**	.104*	.886**	0.081	.886**	.105*	*0.887*

Note: Values in the *diagonal* represent the internal consistency (Cronbach's alpha) of each scale. PCL-R, Psychopathy Checklist – Revised; BIS, Behavioral Inhibition System Scale; BAS, Behavioral Activation System Scale; SP, Sensitivity to Punishment Scale; SR, Sensitivity to Reward Scale.
N = 472.
* $p < .05$.
** $p < .01$.

2.2.2. Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ)

The SPSRQ (Torrubia et al., 2001) is a 48-item self-report measure consisting of two scales: Sensitivity to Punishment (SP; 24 items) and Sensitivity to Reward (SR; 24 items). Each item is answered dichotomously (*yes* or *no*). The SPSRQ has shown good reliability and construct validity (Caseras, Ávila, & Torrubia, 2003; Ávila & Parcet, 2000, 2001). The SP scale measures individual differences in BIS functioning, including (a) behavioral inhibition in response to novelty or aversive consequences and (b) cognitive processes or worry in response to failure or punishment cues. The SR scale measures individual differences in BAS functioning, including sensation seeking and approach behaviors in situations involving possible rewards. See Table 1 for the internal consistency of the SP/SR Scale scores.

2.2.3. BIS/BAS scales (BIS/BAS)

The BIS/BAS (Carver & White, 1994) is a 20-item self-report questionnaire consisting of 4 scales: BIS (7 items), BAS – Reward Responsiveness (5 items), BAS – Drive (4 items), and BAS – Fun Seeking (4 items). Each item is rated on a 4-point scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). The BIS scale measures sensitivity to punishment or aversive stimuli. The three BAS scales (Reward Responsiveness, Drive, and Fun Seeking) measure sensitivity or positive responses to anticipated rewards, persistent pursuit and motivation to achieve desired goals, and willingness to approach new reward stimuli and to do so on the spur of a moment, respectively. Because previous research (e.g., Jorm et al., 1999) suggests that the three BAS scales strongly load on a second-order (BAS) factor, we used the total BAS score for our analyses. Although the use of the BAS subscales, rather than the BAS Total Score, recently has been advocated (e.g., Heym, Ferguson, & Lawrence, 2008), in our sample the internal consistency of the BAS (i.e., the items comprising the BAS Total Score) exceeded not only that of the BIS, but also those of both the SPSPQ scales (SP and SR). See Table 1 for the internal consistency of the BIS/BAS scale scores.

We should also note here that the use of the BIS/BAS with samples of incarcerated offenders, as well as its validity as a measure of the RST constructs, have both been questioned (e.g., Poythress, Skeem, Lilienfeld, Douglas, & Edens, 2009; Poythress et al., 2008) and defended (e.g., Newman & Malterer, 2009). In any event, as described below, neither the BIS/BAS nor the SPSRQ is used as a stand-alone measure of the RST constructs in this study.

2.3. Procedure

All participants included in these analyses were informed of the components of the study, potential risks and benefits, and procedures for safeguarding information. Consent information was presented to participants both orally and in written form, and they were informed that their participation in the study would have no impact on their correctional status.

After providing informed consent, each participant was interviewed and assigned a PCL-R score based on information obtained during the interview and a post-interview review of his prison files (see Hare, 2003). In addition, each participant completed the BIS/BAS (Carver & White, 1994) and SPSRQ (Torrubia et al., 2001) – the same two measures of the BAS and BIS constructs that were used in the Newman et al. (2005) study. Hence, each participant generated two scores reflecting his status with respect to the BAS construct (BAS and SR) and two scores pertaining to the BIS construct (BIS and SP).

3. Results

Because the correlations between the corresponding components of the BIS/BAS and SPSRQ measures are moderate to high (see Table 1), and we had no *a priori* grounds to consider one measure or the other as a better operationalization of the RST constructs, we created composite variables using participants' scores from both the BIS/BAS and SPSRQ. Specifically, participants' raw scores on each scale were converted to z-scores. The two z-scores reflecting BIS functioning (i.e., BIS and SP) were then averaged, creating the composite BIS variable – BIS/SP. Likewise, the two z-scores pertaining to the BAS (i.e., BAS and SR) were averaged to create the BAS composite – BAS/SR. Using those two composite variables, we performed two correlational analyses, with the BIS composite as the criterion variable for one analysis and the BAS composite as the criterion variable for the other, and with PCL-R Factor 1 and Factor 2 as predictor variables in both analyses. Zero-order correlations for these and other variables are reported in Table 1.

For the BIS analysis, consistent with prediction, BIS/SP and PCL-R Factor 1 were significantly associated ($r = -.242$, $p < .001$), and this correlation was larger than the zero-order correlation between BIS/SP and Factor 2 ($r = -.173$, $p < .01$). To determine whether this difference was statistically significant, the correlations were transformed to z-scores and compared using the procedure described by Papoulis (1990). All subsequent comparisons of correlation magnitudes were computed using this method. In this case, the correlations of BIS/SP with Factor 1 and Factor 2 did not, in fact, differ significantly in magnitude.

To provide a more specific assessment of the association of the BIS construct with PCL-R Factor 1, we examined whether the association between BIS/SP and Factor 1 scores remained significant after removing the contribution of Factor 2. Even when the variance associated with PCL-R Factor 2 was removed using partial correlation, the association between BIS/SP and Factor 1 remained significant ($r_{partial} = -.175$, $p < .001$). Conversely, the previously significant correlation of BIS/SP with Factor 2 was rendered non-significant when controlling for Factor 1 ($r_{partial} = -.034$, $p > .6$). The difference between these two partial correlations (i.e., $-.175$ and $-.034$) was statistically significant, $p < .05$, indicating that the BIS composite was more strongly associated with PCL-R Factor 1 than with Factor 2.

For the BAS analysis, as predicted, BAS/SR was significantly associated with PCL-R Factor 2 ($r = .291$, $p < .001$). Moreover, this association was significantly larger in magnitude ($p < .01$) than the corresponding correlation with PCL-R Factor 1 ($r = .130$, $p < .05$).[1] As above, we also examined whether the association between BAS/SR and PCL-R Factor 2 scores retained its statistical significance after removing the contribution of PCL-R Factor 1 to this association. Even when the variance associated with PCL-R Factor 1 was removed using partial correlation analysis, the association of the BAS composite with Factor 2 remained statistically significant ($r_{partial} = .269$, $p < .001$). On the other hand, when we repeated this analysis partialling the contribution of Factor 2 from Factor 1, the previously significant association between the BAS/SR and PCL-R Factor 1 was no longer statistically significant ($r_{partial} = -.061$, $p > .3$). The difference between these two partial correlations (.269 and $-.061$) was statistically significant, $p < .001$, indicating that the BAS composite was more strongly associated with PCL-R Factor 2 than with Factor 1.

3.1. Supplementary Analyses

The PCL-R total score (PCL-R Total) was significantly associated with both BIS/SP ($r = -.229$, $p < .001$) and BAS/SR ($r = .245$,

[1] Although the BAS subscales were not a focus of this study, we provide the relevant zero-order correlations involving the BAS subscales for those having an interest in this issue: PCL-R Factor 2 was significantly associated with BAS drive ($r = .216$, $p < .001$) and BAS fun seeking ($r = .246$, $p < .001$), but not BAS reward reactivity ($r = .057$, $p = .217$). BAS drive was also significantly associated with PCL-R Factor 1 ($r = .124$, $p < .01$), but this correlation was smaller than that with PCL-R Factor 2.

$p < .001$). To address the extent to which the association between psychopathy and the BIS/BAS measures was due to the unique contributions of the PCL-R factors, we next investigated the association between PCL-R Total and the BIS/BAS constructs while partialling the effects of the PCL-R factors.

We first examined whether the association between PCL-R Total and BIS/SP scores remained significant after removing the contribution of PCL-R Factor 1 scores to this association. Once the variance associated with PCL-R Factor 1 was removed using partial correlation analysis, the previously significant association between the PCL-R total scores and BIS/SP was no longer significant ($r_{partial} = -.033$, $p > .4$). On the other hand, after removing the variance due to PCL-R Factor 2 scores, the association between PCL-R Total and BIS/SP scores remained significant ($r_{partial} = -.165$, $p < .001$).

Parallel analyses were performed to test whether the BAS/SR association with PCL-R Total was due primarily to the specific contribution of PCL-R Factor 2. After the variance associated with PCL-R Factor 2 scores was partialled, the previously significant association between PCL-R Total and BAS/SR was no longer significant ($r_{partial} = -.037$, $p > .4$). Conversely, after the variance associated with PCL-R Factor 1 was removed, the association between the PCL-R Total and BAS/SR remained significant ($r_{partial} = .273$, $p < .001$).

These analyses suggest that the association of psychopathy as indexed by PCL-R total scores with both low BIS reactivity and high BAS reactivity (e.g., Book & Quinsey, 2004) may be due largely to the specific contributions of Factors 1 and 2: The association of psychopathy with low BIS reactivity is due largely to the contribution of Factor 1, and the association of psychopathy with high BAS reactivity is due largely to the contribution of Factor 2.

Finally, a four-factor model for the PCL-R also has been described (e.g., Neumann et al., 2007), two factors of which (the Interpersonal and Affective factors) are associated with PCL-R Factor 1, and two of which (the Lifestyle and Antisocial factors) are associated with PCL-R Factor 2. Hence, we examined whether (1) the results pertaining to Factor 1 were moderated by underlying correlations involving the Interpersonal and Affective factors and (2) the results pertaining to Factor 2 were moderated by underlying correlations involving the Lifestyle and Antisocial factors.

None of the differences between the relevant pairs of correlations approached statistical significance. The zero-order correlations of BIS/SP with the Interpersonal and Affective factors were −.202 and −.237, respectively ($p > 0.5$), and the correlations with the Lifestyle and Antisocial factors were −.155 and −.160, respectively, ($p > 0.9$). The correlations of BAS/SR with the Interpersonal and Affective factors were .143 and .078, respectively, ($p > 0.3$), and the correlations with the Lifestyle and Antisocial factors were .289 and .227, respectively, ($p > 0.3$). Because none of the differences between any of these four pairs of correlations approached statistical significance, the results pertaining to Factors 1 and 2 reported above do not appear to be moderated by differential associations of the BIS and BIS measures with the constituent factors of the four-factor model of the PCL-R.

4. Discussion

The present study examined the associations between the BIS and BAS constructs and PCL-R Factors 1 and 2. As predicted, Factor 1 was significantly associated with the BIS composite and Factor 2 was significantly associated with the BAS composite. Moreover, supporting the specificity of the hypothesized relationships, the partial correlations between Factor 1 and BAS, and between Factor 2 and BIS, were low and non-significant ($r's_{partial} = -.061$ and −.034, respectively) after controlling for the effects of the other factor. Thus, just as primary psychopathy is associated predominantly with a weak BIS and secondary psychopathy is associated predominantly with a strong BAS (Newman et al., 2005), the influence of the BIS is significantly more prominent than the influence of the BAS for PCL-R Factor 1, and the influence of the BAS is significantly more prominent than that of the BIS for Factor 2.[2] That is, Factor 1 is associated with low BIS reactivity and Factor 2 is associated with high BAS reactivity.[3]

These findings also complement earlier reports (e.g., Patrick, 2007; Patrick et al., 2005) that PCL-R Factor 1 is associated with low anxiety and other affective deficits (e.g., weak fear-potentiated startle), which plausibly reflect, at least in part, individual differences in BIS functioning. Conversely, PCL-R Factor 2 is associated with impulsivity and disinhibited approach behavior, which plausibly reflect individual differences in BAS-mediated processes.

Finally, we conducted supplementary analyses to examine whether the results involving the two-factor model were moderated by underlying correlations involving the four-factor model. Because these analyses were of a post-hoc nature, we are hesitant to make general statements regarding the relative validities of the two models. Nonetheless, at least for the present data set, the four-factor model does not appear to add appreciably to the explanatory power of the two-factor variant.

We conclude by concurring with Lilienfeld (1994) and others (e.g., Frick, Lilienfeld, Ellis, Loney, & Siverthorn, 1999; Harpur et al., 1989; Patrick et al., 2005; Sellbom & Verona, 2007) that the explication of the independent contributions of psychopathy's major factors advances the understanding of psychopathy as a whole. Given the prominence of RST in theoretical formulations of psychopathy, as well as the burgeoning literature that links the RST constructs to diverse normal and psychopathological processes (e.g., Corr, 2008), continuing to clarify the associations between the PCL-R factors and the BIS and BAS is likely to be of considerable relevance. In addition, although the BAS and the BIS traditionally have been more prominent than the FFFS as explanatory mechanisms for understanding psychopathy, some of the observations associated with psychopathy (e.g., decreased fear-related startle response) might be conceptualized as reflecting deficient FFFS functioning. Hence, examining the role that the FFFS plays mediating psychopaths' deficits may well be a fruitful area for future study.

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[2] Although the results obtained by Newman et al. (2005) and those of the present study are similar, the data do not indicate that the primary/secondary psychopathy distinction and the PCL-R factors reference identical constructs (e.g., Newman, 2009).

[3] Results obtained using other measures of the psychopathy construct (e.g., Uzieblo, Verschuere, & Crombez, 2007), particularly those that employ different assessment methods such as self-report questionnaires, may not be entirely comparable to those obtained using the PCL-R (which uses a semi-structured interview and a review of participants' institutional files to assign designations to study participants).

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