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Review

A critique of Carver and White's (1994) behavioral inhibition scale (BIS) for investigating Lykken's (1995) theory of primary psychopathy

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ABSTRACT

In a 1995 monograph, Lykken asserted that an innate fearless temperament underpins the development of primary psychopathy as described by Cleckley (1941). To embed this insight in a larger theory of behavior, Lykken embraced constructs from Gray's (1982) reinforcement sensitivity theory (RST). Specifically, he hypothesized that in primary psychopaths the behavioral inhibition system (BIS) lacks normal sensitivity to cues of conditioned punishment or non-reward. Subsequent researchers have embraced Carver and White's (1994) BIS scale as the instrument of choice for testing Lykken's theory of primary psychopathy, a practice that this review calls into question. We note (a) a dearth of research using the BIS scales in offender samples, where more psychopathic individuals are likely to be found and (b) limited BIS scale coverage of the functions attributed to the behavioral inhibition system in RST. In addition, (c) we review literature suggesting that rather than assessing the fear sensitivity function critical to Lykken's theory, the BIS scale instead functions primarily as an index of negative emotionality. We recommend a moratorium on the use of the BIS scale to test Lykken's theory of primary psychopathy.

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1. Psychopathy and Lykken's theory of psychopathic subtypes

Psychopathy is one of the most heavily researched personality disorder constructs (Hare, 1996). Modern conceptualizations of psychopathy date to Cleckley's (1941, 1976) classic text, *The Mask of Sanity*, which "embodied... the idea that psychopathy entails

the juxtaposition of severe underlying pathology against the overt appearance of robust mental health" (Patrick, 2007, p. 113). Psychologically adaptive features of psychopathy that Cleckley identified include, among others, superficial charm and good intelligence, absence of delusions and other signs of irrational thinking, and absence of nervousness or "psychoneurotic" manifestations. Psychologically maladaptive features included indicators of both emotional-impersonal deficits (e.g., untruthfulness and insincerity; lack of remorse or shame) and behavioral deviance

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(e.g., poor judgment and failure to learn by experience; sex life impersonal, trivial, and poorly integrated).

Even as Cleckley was introducing this syndrome, Karpman (1941, 1948a) expressed the need to distinguish the *primary* psychopath, whose disorder was assumed to arise from a constitutional deficit of unknown origin, from the *secondary* psychopath, whose psychopathic features, Karpman argued, arise from adverse environmental influences. Over time others have theorized about distinctions among subtypes of psychopathy based on differences in etiology (e.g., Mealey, 1995; Porter, 1996; for a review, see Skeem, Poythress, Edens, Lilienfeld, & Cale, 2003), although it was not until 1995, with the publication of Lykken's monograph, *The Antisocial Personalities*, that a comprehensive theory of psychopathy subtypes based on different etiologies was advanced.

Briefly, Lykken hypothesized that *primary* psychopaths are born with an innately fearless temperament. As a consequence, they are especially difficult to socialize because of diminished sensitivity and responsiveness to the threats or punishments that their parents or other caregivers may apply in trying to shape their behavior and instill prosocial attitudes and tendencies. Absent extraordinary effort by parents to socialize these fearless youths, they are at risk for becoming psychopathic in the tradition of Cleckley (1941, 1976). In contrast, Lykken described the *secondary* psychopath as an individual who manifests many overt features similar to those of the primary psychopath; however, the underlying deficit is hypothesized to be an abnormal sensitivity to cues to reward. Lykken viewed many of these individuals as capable of being socialized and of developing a conscience, empathy, and intentions toward prosocial behavior. However, these internal restraints often fail in the face of excessive excitation in response to cues of reward. Finally, in Lykken's nosology both primary and secondary psychopaths were distinguished from a third class for which he reserved the label *sociopath*, a much larger group of individuals with substantial overt psychopathic features but whose psychopathic behavior he attributed largely to adverse environmental influences (e.g., ineffective or inadequate parenting).

To embed these insights in a larger theory of behavior, Lykken drew on the work of Fowles (1980) and Gray (1982, 1987), utilizing constructs from Gray's reinforcement sensitivity theory (RST). Gray's theory emphasized the roles of two theoretically orthogonal systems – the behavioral approach system (BAS) (also called the behavioral activation system, Fowles, 1980) and the behavioral inhibition system (BIS). The BAS mediates sensitivity to potential rewards, and its purpose "... is to initiate exploratory, approach behavior that brings the organism closer to final biological reinforcers (e.g. food, sexual partners, etc.)" (Corr, Pickering, & Gray, 1995, p. 48). BAS activity is associated with the anticipation of pleasure, and Gray used the term *impulsivity* to describe behavioral manifestations associated with anticipation of reward and the driven quality of reward seeking behavior. BAS-driven impulsivity overlaps conceptually with Zuckerman's (1984) construct of "sensation-seeking" and Cloninger's (1987) construct of "novelty seeking," among others.

The BIS, in contrast, "... is sensitive to: (a) conditioned stimuli associated with punishment, and the omission or termination of reward (frustrative nonreward), (b) extreme novelty, (c) innate fear stimuli (conspecifics and "special evolutionary dangers", e.g. snakes, dead bodies, etc.), and (d) high-intensity stimuli. Upon activation by these adequate inputs, the BIS produces behavioral inhibition (i.e. interruption of ongoing behavior) and an increase in level of arousal and attention. The purpose of the BIS is to suppress behavior that is expected to lead to punishment" (Corr et al., 1995, p. 48). Consequently, this system plays a major role in passive avoidance learning, that is, learning to inhibit behaviors that often lead to punishment.

Carver and White's (1994) behavioral inhibition and behavioral activation (BIS/BAS) scales have become the measures of choice in recent investigations (e.g., Newman, MacCoon, Vaughn, and Sadeh

(2005), Ross, Benning, Patrick, Thompson, & Thurston, in press, Uzieblo, Verschuere, & Crombez, 2007) that examined associations between psychopathy and the BIS and BAS functioning in offender samples. These investigators appear to have assumed that the BIS/BAS scales are valid for use with offender samples and that they accurately assess the relevant properties of their respective RST systems. This review challenges these assumptions, particularly insofar as the BIS scale is being used to index low fear sensitivity thought to underlie the features of primary psychopathy. We first note briefly that there has been limited investigation of the BIS/BAS scales with offenders and review findings from this body of research that raise concerns about the psychometric integrity of the BIS scale in particular. We then note the limited content validity of the BIS scale items for providing adequate coverage of the array of functions attributed to the behavioral inhibition system in RST. The primary focus of our critique is a review of studies that, collectively, demonstrate that the BIS scale is mainly a measure of neuroticism/anxiety/ negative affectivity rather than fearlessness. We conclude that the BIS scale is not a valid index of fear sensitivity, the construct crucial to Lykken's theory of primary psychopathy, and we discourage the use of the BIS scale in future investigations that aspire to test Lykken's theory.

2. The BIS/BAS scales

Carver and White's (1994) BIS/BAS scales were designed to measure both inhibitory and excitatory tendencies in behavior. These self-report scales were identified using factor analysis of a large item pool based on scores from an undergraduate sample. BIS items ($n = 7$) capture subjective distress associated with bad occurrences (e.g., "If I think something unpleasant is going to happen I usually get pretty 'worked up'"). Four items appear to relate mainly to worry or anxiety (e.g., "I worry about making mistakes", "I feel worried when I think I have done poorly at something"). Two items relate in some fashion to fear, one of which refers explicitly to the breadth of fear concerns ["I have very few fears compared to my friends" (reverse scored)], and the other refers to both fear and anxiety ["Even if something bad is about to happen to me, I rarely experience fear or nervousness" (reverse scored)]. Three separate scales assess different aspects of BAS functioning. Reward Responsiveness (RR, 5 items) taps excitement associated with attaining a reward (e.g., "When good things happen to me, it affects me strongly"). Drive (DR, 4 items) relates to persistence in the pursuit of goals (e.g., "When I want something, I usually go all-out to get it"). Fun Seeking (FUN, 4 items) assesses both a desire for new rewards (e.g., "I crave excitement and new sensations") and a tendency to approach a potentially rewarding opportunity precipitously (e.g., "I often act on the spur of the moment"). Cronbach's α for the BIS, RR, DR, and FUN scales in the derivation sample were .74, .73, .76, and .66, respectively.

3. Critique of the BIS scale

3.1. Psychometric issues

A general concern regarding the use of the BIS scale to test Lykken's theory of primary psychopathy is that the psychometric properties of the BIS/BAS scales have not been thoroughly examined in offender samples, which are those in which psychopathic behavior tends to be prevalent. Numerous studies have examined the factor structure and psychometric properties of the BIS/BAS scales in community (e.g., Johnson, Turner, & Iwata, 2003; Jorm et al., 1999) and (predominately female) undergraduate samples (e.g., Franken, Muris, & Rassin, 2005; Heubeck, Wilkinson, & Cologon, 1998; Ross, Millis, Bonebright, & Bailley, 2002), with widely

mixed results. For example, in most studies with student and community samples the internal consistency reliability of the BIS scale has been satisfactory; in offender samples, internal consistency has ranged from $\alpha = .71$ in a sample of female offenders (Gremore, Chapman, & Farmer, 2005) to $\alpha = .58$ in a male offender sample (Uzieblo et al., 2007).

Of specific relevance to the present review is that a variety of problems with the two BIS scale items that relate to fear sensitivity (as opposed to anxiety) have been noted. In several structural analyses one or both of the BIS fear items has performed poorly, e.g., had low factor loadings (Cogswell, Alloy, van Dulmen, & Fresco, 2006; Sava & Sperneac, 2006), cross-loaded with BAS subscales (Cogswell et al., 2006; Heubeck et al., 1998; Jorm et al., 1999), or loaded primarily on one of the BAS scales (Knyazev, Slobodskaya, & Wilson, 2004). One investigation (Johnson et al., 2003) even reported that the two fear items formed a separate couplet (i.e., a fifth factor). These findings are of particular concern because the fear sensitivity property of the behavioral inhibition system in early RST-models is critical to Lykken's (1995) theory of primary psychopathy.

In summary, a number of concerns have been raised about the BIS scale in research that has been based, in large part, on predominantly female undergraduate samples. In contrast, offenders are disproportionately males. There is the potential that both site and gender differences may affect responses to the BIS scale, which may evince more extreme variation in offenders than in collegiate samples. It therefore seems risky to extend the BIS scale directly for use with offenders without first knowing more about how the measure works with that population.

3.2. Poor domain coverage of the BIS scale

As described in Section 1, the behavioral inhibition system is complex. In the version of RST to which Carver and White referred in constructing the BIS/BAS scales, the behavioral inhibition system is responsible for sensing a wide range of cues that warn of potential threat, harm, or non-reward [in the revised RST, this function was reallocated to the fight/flight/freeze system (FFFS), Gray & McNaughton, 2000]. In response to such cues, the behavioral inhibition system executes a variety of functions that include suppressing ongoing behavior, increasing the individual's level of arousal, and focusing attention on information gathering in an effort to determine the optimal response. During this period of activity the individual experiences discomfort, which Gray described as 'anxiety', associated with the uncertainty of the situation.

We earlier presented five of the seven BIS scale items, one of which solicits a report of the breadth of one's array of fear stimuli (but not the degree of fear sensitivity), and one which references increased arousal (getting "worked up"). Other items relate mainly to general anxiety or worry. Two additional items ("I feel pretty worried or upset when I think or know somebody is angry at me", "Criticism or scolding hurts me quite a bit") appear to tap social anxiety or concerns about social acceptance. Except for soliciting reports of anxiety, the BIS items appear to tap few, if any, of the additional functions that are attributed in RST to the behavioral inhibition system. Although our present focus is on inadequacies of the BIS scale for testing Lykken's theory, we note in passing that the content of BIS items does not appear to adequately capture behavioral inhibition system functions relevant to other RST-models of psychopathy. For example, the BIS items do not appear to assess the attentional and information processing functions critical to Newman's theory of psychopathy (Hiatt & Newman, 2006; Wallace & Newman, 2008), which emphasizes cognitive rather than motivational deficits.

Our assessment of these items echoes conclusions reached by earlier investigators who have argued that the BIS scale provides

poor coverage of the range of behavioral inhibition system properties. As Heubeck et al. (1998) noted, Carver and White's "... definition of BIS responsivity included concerns over bad events and sensitivity to them when they do occur, but not other aspects like responses to extreme novelty or innate fears. They also excluded, quite deliberately, behavioral responses to potential punishment. As a result, their item pool may have been restricted in terms of coverage of all indicators of BIS sensitivity" (p. 797).

Moreover, at the expense of adequate coverage of the fear sensitivity properties of the behavioral inhibition system, which are particularly critical for Lykken's model of primary psychopathic behavior, the majority of the BIS scale items tap "sensitivity" to bad events in a broader (i.e., more trait-like) fashion than that called for by Gray's characterization of BIS-related anxiety. We explore this latter criticism in detail in the next section.

3.3. The BIS scale as a measure of negative emotionality

The BIS/BAS literature is rife with criticisms of the BIS scale as indexing merely, or at least primarily, negative emotionality (NE), a broad dimension of emotional maladjustment that predisposes people to experience unpleasant emotions of many kinds, including anxiety, guilt, hostility, and mistrust (Tellegen & Waller, 1994; Watson & Clark, 1984). In one of the first investigations of the BIS/BAS scales, Heubeck et al. (1998) concluded that their findings questioned "the validity of the new scales in so far as their claim is based on BIS and BAS expressions at the personality level which are different from Extraversion and Neuroticism" (p. 796). Jorm and colleagues (1999) also asserted that the "the BIS factor is largely a measure of a neuroticism/negative affectivity superfactor" (p. 56), a sentiment echoed by Brenner, Beauchaine, and Sylvers (2005). We review below several lines of research that explore the relationship of the BIS scale to constructs in the NE spectrum.

First, we reviewed published studies that reported associations between the BIS scale and measures of neuroticism (NEU), trait anxiety (ANX), and negative affectivity (NA), cognate constructs that tend to correlate highly (Watson & Clark, 1984). Our review was limited to studies with adult participants and, to avoid potential complications in interpreting findings from samples with clinical anxiety or comorbid anxiety disorders, we included only studies that involved non-psychiatric samples. Table 1 details the findings from these studies.

To summarize the results of these studies more quantitatively, we meta-analyzed the effect sizes reported in Table 1 using the SPSS macro "MeanES" (Lipsey & Wilson, 2001). This macro computes central tendency statistics and weights each z , by the inverse variance (i.e., $n-3$) to create a summary statistic, $z+$, and a 95% confidence interval (CI). Heterogeneity among the reported effect sizes was examined using the Q statistic (Hedges & Olkin, 1985), which is distributed as a chi-square with k (i.e., the number of studies) - 1 degrees of freedom. Because Q is dependent on the number of studies in a meta-analysis, we also report the I^2 statistic (Higgins & Thompson, 2002). This statistic is not influenced by k and indicates the percentage of total variation among effect sizes attributable to heterogeneity rather than sampling error.

Meta-analytic results at the bottom of Table 1 reveal medium to large weighted effect sizes for measures of NEU, ANX and NA. Higgins and Thompson (2002) suggested that I^2 values greater than or equal to .3 indicate "moderate" heterogeneity, whereas those greater than or equal to .5 signify "severe" heterogeneity. By these criteria, an examination of the Q and I^2 statistics reveals that the weighted mean effect sizes are extremely heterogeneous across NEU and ANX, and to a lesser extent, NA. It is noteworthy, however, that the heterogeneous effect sizes for both NEU and ANX suggest that this variability essentially ranges within a medium to large

Table 1
Carver & White's BIS scale correlations with measures of neuroticism, trait anxiety, and negative affectivity

Study		Sample	N	% Female	Neuroticism	Trait anxiety	PANAS NA
Carver and White (1994)	(2) [®]	S	371	51		.58	.42
		S	498				
Heubeck et al. (1998)		S	336	68		.60	.37
McHoskey, Worzel, and Szyarto (1998)		S	99	72	.55		
Jorm et al. (1999)		C	2725	52	.64	.44	
Zelenski and Larsen (1999)		S	86	73	.62		
Caseras et al. (2003)		S	538	78	.54	.51	
Harmon-Jones (2003)	(1)	S	164	–			.17
		S	41	–			
Leen-Feldner, Zvolensky, Feldner, and Lejuez (2004)		S	90	67			.49**
Slessareva and Muraven (2004)	(1)	S	126	–	.34		
		S	146	–		.28	
Brenner et al. (2005)		S	50	56			.48
Chi et al. (2005)		S	68	53	.34		.17
Franken et al. (2005)		S	246	67	.58		
Gremore et al. (2005)		P	127	100	.48	.41	
Meyer, Olivier, and Roth (2005)		S	202	100			.48
Muller and Wytykowska (2005)	(3)	S	140	–	.52	.42	.53
		S	62	–			
Newman et al. (2005)		P	251	0		.35	
Smillie and Jackson (2005)		S	144	63			.21
Smits and Kuppens (2005)	(1)	S	323	85	.55		
Holzwarth and Meyer (2006)		C	163	63			.26
Sava and Sperneac (2006)		S	345	69		.55	
Smolewska, McCabe, and Woody (2006)		S	851	70	.35		
Perkins et al. (2007)	(2)	M	101	41	.48	.48	
Suhr and Tsanadis (2007)		S	87	52			.23
Uzieblo et al. (2007)		S	431	58		.47	
Weighted <i>r</i>					.50	.48	.36
SD of <i>r_w</i>					.11	.07	.10
95% CI					.42/.59	.42/.53	.30/.43
<i>Q</i>					65.95	24.87	20.41
<i>I</i> ²					.83	.60	.46
Total <i>n</i>					5352	5433	1983

Note: S = student sample; C = community sample; M = military training corps sample; P = prisoner sample. [®]Indicates sample or study from report with multiple samples/studies. [†]MPQ Negative Emotionality Superfactor. [‡]Study employed three separate measures of Neuroticism. BIS = behavioral inhibition scale. PANAS = positive and negative affectivity scales (Watson, Clark, & Tellegen, 1988).

effect size. Consistent with this interpretation, no studies reported negative correlations, nor were there any statistical outliers (effect sizes ≥ 3 standard deviations above or below the mean effect size) across any of the studies.

In theory, measures of BIS should correlate to some extent with measures of NE. In scanning the environment and conducting a risk assessment to determine the optimal behavior in a conflict situation, the behavioral inhibition system is biased toward negative information (i.e., evidence of potential harm; Gray & McNaughton, 2000). Although this bias functions to protect and ensure the survival of the individual, it may also lead individuals with a relatively strong behavioral inhibition system to be too cautious on some occasions and therefore to miss rewards that others with more normal functioning attain. Highly inhibited individuals may be deprived of some of the joys in life associated with novel (but ultimately safe) experiences or with the exhilaration associated with taking relatively minor risks. Indeed, Tellegen (see Tellegen & Waller, 1994) referred to such individuals as high on the dimension of "Constraint" because their life opportunities tend to be markedly limited. As a consequence, they may be prone to experiencing resentment (similar to Alienation, a lower-order marker of NE that is weakly, but positively, associated with Constraint; Tellegen, 1982) that they, more so than others, have difficulty overcoming minor hurdles and achieving these ultimately positive experiences.

For these reasons, at least a small positive correlation between BIS scales and certain measures of NE may be plausible on theoretical and empirical grounds. However, the association should not be strong enough to conflate BIS with constructs in the NE spectrum. Not only does the BIS scale consistently correlate highly with mea-

asures of NEU, ANX, and NA, but the magnitude of these associations is often comparable to, if not higher than, correlations of the BIS scale with other indices of behavioral inhibition system functioning. Zelenski and Larsen (1999) reported $r = .24$ between BIS and the Punishment Expectancies scale (PE; Ball & Zuckerman, 1990), but $r = .62$ between BIS and the neuroticism scale from the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975). Caseras, Avila, and Torrubia (2003) reported correlations for the BIS scale with three other indices of behavioral inhibition system functioning: $r = .53$ with the Sensitivity to Punishment scale (SP; Torrubia, Avila, Moltó, & Caseras, 2001), $r = .37$ with PE, and $r = .53$ with the MacAndrew and Steele (1991) behavioral inhibition system measure. However, the BIS scale correlated nearly as highly, $r = .51$, with the Trait Anxiety index from the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970). In a third study, Sava and Sperneac (2006) obtained a correlation of $r = .50$ for BIS with SP, but an even higher correlation, $r = .55$, with an index of anxiety derived from EPQ. Only Smillie and Jackson (2005) found that the BIS scale correlated more highly with another index of behavioral inhibition functioning (SP, $r = .56$) than with an index of NA ($r = .21$). Collectively these findings offer some support for the convergent validity of the BIS scale as an indicator of behavioral inhibition; however, the comparable or even higher correlations with measures of constructs such as NEU and ANX indicate poor discriminant validity and offer further evidence that the BIS scale is largely a measure of NE.

A third line of research relevant to this analysis comprises studies that have conducted scale level factor analyses of the BIS/BAS scales along with scales from other measures. This type of analysis

provides the opportunity for the BIS scale and other measures of behavioral inhibition system functioning to load together on a separate factor from one on which scales of NEU, ANX, or NA load, thus demonstrating statistical and conceptual independence from NE. In the five studies of this type we have identified, however, this has not happened. Heubeck et al. (1998) found that BIS loaded with indices of NEU and NA to create a single “negative personality” factor. In Jorm et al. (1999) BIS loaded with indices of NEU and NA to identify a single neuroticism/negative affectivity factor. Zelenski and Larsen (1999) found that BIS, along with PE, loaded on a factor that included an index of NEU. Comparable results were obtained in studies by Caseras et al. (2003) and Smillie and Jackson (2006).

Some findings in the literature suggest, at least superficially, that the BIS scale adequately indexes fearfulness. Several studies (Carver & White, 1994; Caseras et al., 2003; Franken & Muris, 2006; Zelenski & Larsen, 1999) have reported BIS scale correlations ranging from .45 to .64 with the harm avoidance (HA) scale from Cloninger (1987) Tridimensional Personality Questionnaire. However, other research has demonstrated that the name of this scale is something of a misnomer. Rather than functioning as a true index of fearful temperament, the HA scale has instead been shown to be primarily a marker of NE (Waller, Lilienfeld, Tellegen, & Lykken, 1991). Thus, these findings are actually consistent with other literature reviewed above in demonstrating that the BIS scale is primarily an index of NE.

3.4. Limitations of the BIS scale for testing Lykken’s model of primary psychopathy

That the BIS scale is essentially a measure of NE can create problems in research aimed at testing RST-models of psychopathy. Although trait anxiety (or neuroticism) may bear little or no relevance to RST conceptualizations of the behavioral inhibition system, the construct is relevant to the assessment of psychopathy. In his original delineation of the criteria for psychopathy, Cleckley (1941) described such individuals as “usually free from any marked nervousness or other symptom of a psychoneurosis” (p. 239, emphasis in original). Subsequent clinical descriptions of psychopathic offenders (e.g., Karpman, 1946, 1948b) focused on anxiety as a valuable indicator for distinguishing primary (low anxious) from secondary (high anxious) psychopaths. The bulk of research on psychopathy with offenders has used Hare’s (1991, 2003) Psychopathy Checklist – Revised (PCL-R), but although the PCL-R was based substantially on Cleckley’s criteria, the lack of nervousness/neurosis was not a feature that Hare incorporated into the PCL-R. Therefore, some investigators (e.g., Newman et al., 2005; Skeem, Johansson, Andershed, Kerr, & Eno Loudon, 2007) have incorporated an independent measure of trait anxiety or neuroticism to supplement their PCL-R assessments of psychopathy. Problems can arise when investigators who assess psychopathy in this fashion then use the BIS scale as a dependent measure to test the validity of putative psychopathic subgroups.

The study by Newman et al. (2005) illustrates our concern. In this investigation the authors used a combination of below-median scores on the Welsh Anxiety Scale (WAS) and high scores (>29) on the PCL-R in an offender sample to define an experimental group of primary psychopaths. The WAS is a self-report measure of anxiety that correlates highly with measures of NE (Watson & Clark, 1984, p. 468, Table 1). The BIS scale was used as a criterion variable for purposes of validating the putative primary psychopathic group. As predicted, the mean BIS score of this primary psychopathy group was significantly lower than that of a comparison offender group, a finding that the authors interpreted as consistent with Lykken’s (1995) theory.

Based on the foregoing analysis, however, we do not find this conclusion compelling. Both the independent variable (WAS-de-

finied primary psychopathy group) and the dependent variable (BIS scale) were substantially operationalized using measures highly related to NE, and no plausible index of either fear sensitivity or of other BIS functions (e.g., inhibitory behavior) appears on either side of the “equation”. In the absence of valid measures of either fear sensitivity or BIS functioning, and in the presence of criterion contamination, the relevance of these findings to Lykken’s theory remains unclear. To their credit, Newman et al., at p. 322, noted that WAS and BIS correlated $r = .35$ and conducted additional analyses that controlled for anxiety. The relevant group differences were still found when residualized BIS scores were compared; there was no indication, however, that the residualized scores index either low fear sensitivity or other specific functions ascribed to the behavioral inhibition system.

Not all theorists are in complete accord with Lykken regarding the respective roles of anxiety and fear with respect to primary psychopathy. Blackburn (2006) argued that the accumulated data on the validity of the BIS scale “provide equivocal support for the view that either lack of anxiety or fear and a weak BIS are intrinsic characteristics of psychopaths” (p. 44). Similarly, Fowles and Dindo (2006) concluded that “. . . it is not completely clear that the deficit in psychopathy is specifically one of low fear rather than a combination of low fear and low anxiety. An attractive possibility is that the most important contribution is poor fear conditioning and that low fear, in turn, makes anxiety less likely. That is, in the absence of conditioned fears, there is little for the future-oriented anxiety process to anticipate” (p. 29). Without taking a stand regarding these controversial issues, the point to be made here is that research to clarify relationships among these constructs will require valid instruments that assess fear sensitivity, anxiety, and behavioral inhibition system functioning separately.

To examine the role of trait anxiety, fear sensitivity, or both, in Lykken’s theory of primary psychopathy will require a different measure from the Carver and White BIS scale. As noted earlier, in the latest revision to RST the function of sensitivity to conditioned fear stimuli has been reallocated from the behavioral inhibition system to the fight/flight/fear system (FFFS). In our view it is unlikely that adequate representations of FFFS fear and behavioral inhibition anxiety can be obtained simply by stripping out the two current BIS scale “fear” items as an index of FFFS fear sensitivity, leaving the remaining five “anxiety” items as an index of behavioral inhibition system activity. Neither of these residual scales is likely to be up to the task.

We doubt that the two current BIS scale fear items, or for that matter any *two-item* scale, is likely to represent adequately the fearfulness construct. To assess fearful temperament, Lykken (1995), Lykken (2006) recommended the harm avoidance scale from Tellegen’s Multidimensional Personality Questionnaire (MPQ, Tellegen, 1982; Tellegen & Waller, 1994) [not to be confused with Cloninger (1987) HA scale, discussed earlier]. This is a self-report, forced choice scale that assesses an individual’s willingness to endorse preference for risky activities (e.g., “Being chosen as the “target” for a knife-throwing act”) over safer ones (e.g., “Being sick to my stomach for 24 h”). The endorsement of a higher number of risky activities presumably indicates a relatively fearless temperament and thus a dispositional “talent” toward primary psychopathy.

The MPQ-HA scale may be the best available measure of fearful temperament, although we note a potential limitation of this scale as well. Several MPQ-HA items juxtapose a risky option (e.g., “Riding a long stretch of rapids in a canoe”) with one that is boring and tedious (e.g., “Waiting for someone who’s late”). A feature attributed to secondary psychopathic individuals is susceptibility to boredom and a (higher) need for stimulation. Thus, in the face of only boring/tedious alternatives, secondary psychopathic individuals, too, might express a preference for risky activities, although not because they possess a fearless temperament. Investigators

should be aware of this potential problem and be prepared, perhaps, to sum scores for different groups of HA items depending on whether the alternative to a risky activity is a boring/tedious one versus merely a safer one.

Similarly, the remaining BIS items, both in overt content and in terms of associations with external measures, relate more strongly to the broad constructs of trait anxiety and neuroticism than to the operations that revised RST allocates to the behavioral inhibition system. There are a variety of purpose-built measures of behavioral inhibition system functioning for researchers to consider using, several of which were mentioned above – the Punishment Expectancies scale (PE; Ball & Zuckerman, 1990), the Sensitivity to Punishment scale (SP; Torrubia et al., 2001), and MacAndrew and Steele (1991) behavioral inhibition system measure. However, we are unaware of any systematic literatures that address the validity of their use with offenders or of the extent to which they, like Carver and White's BIS scale, index constructs in the NE spectrum more strongly than features and functions that RST ascribes to BIS.

What is needed is a measure that comprehensively assesses the variety of features and functions that RST ascribes to the behavioral inhibition system. As noted above, BIS activation is associated with transient "states of anxiety" (Gray & McNaughton, 2000, p. 338, emphasis added), as opposed to broad trait anxiety, that arise in conflict situations and represent an adaptive function. In the active mode the BIS suspends both prepotent approach and avoidance behavior, increases subjective arousal, and undertakes a systematic evaluation of the current context (including memory search, i.e., rumination, regarding prior similar contexts) to resolve approach-avoidance problems. Given that emotional (states of anxiety), cognitive (memory search), and focused external sensory scanning (risk assessment) features are involved, the optimal measure of behavioral inhibition system functioning may need to include multiple scales.

4. Summary and conclusions

Carver and White's (1994) BIS/BAS scales have been used in dozens of studies to investigate personality functioning within the framework of RST theory, and investigators have recently relied upon the BIS scale in testing Lykken's (1995) theory of primary psychopathy with offender samples. The present review suggests that this extension is premature. Concerns about the structural reliability of the BIS scale in studies with community and student samples provide grounds for caution in extending its use to offenders. Further, content analysis and empirical studies suggest that the BIS scale provides poor coverage of the features ascribed to the BIS in either the earlier or the revised version of RST. Particularly critical for investigating Lykken's model of primary psychopathy is the finding that the BIS scale primarily assesses negative emotionality. Both conceptually (Lykken, 1995) and empirically (Perkins, Kemp, & Corr, 2007; White & Depue, 1999), fear and anxiety are different constructs, and the BIS scale includes too little of the former and too much of the latter to provide a valid index of the crucial motivational component, low fear sensitivity, that underlies Lykken's theory. In light of these findings we recommend a moratorium on the use of Carver and White's BIS scale for testing Lykken's model of primary psychopathy.

As a final caveat, readers should not infer from our exclusive focus on the BIS scale that we tacitly endorse Carver and White's (1994) BAS scales as adequately measuring behavioral activation functioning generally or for purposes of evaluating Lykken's (1995) theory of secondary psychopathy in particular. We recommend an excellent review by Smillie, Pickering, and Jackson (2006) that contrasts the older (Gray, 1982) and newer (Gray &

McNaughton, 2000) versions of RST and the implications of these models for assessing both behavioral inhibition and behavioral activation system functioning.

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