Journal of Personality and Social Psychology
1994, Vol. 67, No. 2, 319-333

0022-3514/94/$3.00

Behavioral Inhibition, Behavioral Activation, and Affective Responses to Impending Reward and Punishment: The BIS/BAS Scales

Charles S. Carver and Teri L. White

Gray (1981, 1982) holds that 2 general motivational systems underlie behavior and affect: a behavioral inhibition system (BIS) and a behavioral activation system (BAS). Self-report scales to assess dispositional BIS and BAS sensitivities were created. Scale development (Study 1) and convergent and discriminant validity in the form of correlations with alternative measures are reported (Study 2). In Study 3, a situation in which Ss anticipated a punishment was created. Controlling for initial nervousness, Ss high in BIS sensitivity (assessed earlier) were more nervous than those low. In Study 4, a situation in which Ss anticipated a reward was created. Controlling for initial happiness, Ss high in BAS sensitivity (Reward Responsiveness and Drive scales) were happier than those low. In each case the new scales predicted better than an alternative measure. Discussion is focused on conceptual implications.

The past several years have seen renewed interest in physiological models of personality. Of course, Hans Eysenck (e.g., Eysenck, 1967) has long held that two basic dimensions of personality (extraversion and emotionality) reflect differences in the functioning of two aspects of the nervous system. In more recent years, more has been learned about brain functioning, and others have incorporated the newer information into their own views of personality.

Gray's Theory of Brain Functions and Behavior

A theory that is often contrasted with Eysenck's, and on which we focus here, was proposed by Gray (1972, 1981). This theory also postulates two dimensions of personality, but in this case the dimensions are called *anxiety* (or *anxiety proneness*) and *impulsivity*. These two qualities of personality represent individual differences in the sensitivity of two neurological systems in their responses to relevant environmental cues (see also Fowles, 1987, 1993).[1] One of these systems regulates aversive motivation; the other regulates appetitive motivation.

The aversive motivational system is called the *behavioral inhibition system* (BIS). It comprises the septohippocampal system, its monoaminergic afferents from the brainstem, and its neocortical projection in the frontal lobe. Gray has argued that this physiological mechanism controls the experience of anxiety in response to anxiety-relevant cues (Gray, 1972, 1977, 1978, 1982, 1987b, 1990). The BIS, according to Gray, is sensitive to signals of punishment, nonreward, and novelty. It inhibits behavior that may lead to negative or painful outcomes. Thus, BIS activation causes inhibition of movement toward goals. Gray has also held that BIS functioning is responsible for the experience of negative feelings such as fear, anxiety, frustration, and sadness in response to these cues (Gray, 1978, 1981, 1987b, 1990). In terms of individual differences in personality, greater BIS sensitivity should be reflected in greater proneness to anxiety, provided the person is exposed to the proper situational cues.

The physiological mechanism believed to control appetitive motivation has been called the *behavioral approach system* (Gray, 1981, 1987a, 1990) or *behavioral activation system* (BAS; Fowles, 1980). The neural basis of the BAS is less clearly specified than that of the BIS, though catecholaminergic, especially dopaminergic, pathways are believed to play a central role (cf. Stellar & Stellar, 1985). This system is said to be sensitive to signals of reward, nonpunishment, and escape from punishment. Activity in this system causes the person to begin (or to increase) movement toward goals. Gray has also held that the BAS is responsible for the experience of positive feelings such as hope, elation, and happiness (Gray, 1977, 1981, 1990). In terms of individual differences in personality, greater BAS sensitivity should be reflected in greater proneness to engage in goal-directed efforts and to experience positive feelings when the person is exposed to cues of impending reward. Similar lines of thought have also been developed by Depue and his colleagues (e.g., Depue & Iacono, 1989; Depue, Krauss, & Spoont, 1987) and by Cloninger (1987).

Each of these two motivational systems is presumed to be related to one broad affective quality (the BAS to positive affect

Charles S. Carver and Teri L. White, Department of Psychology, University of California, Los Angeles.

Preparation of this article was facilitated by National Science Foundation Grant BNS90-11653. We thank André Perwin for developing the computer programs used in Studies 3 and 4 and Herb Quay for comments on a draft of the article.

Correspondence concerning this article should be addressed to Charles S. Carver, who is now at Department of Psychology, University of Miami, Coral Gables, Florida 33124-2070.

[1] Gray (1987a, 1990) also assumes a third system, the fight–flight system, which is responsible for organizing behavior in response to unconditioned punishment and unconditioned nonreward. Activity in this system is assumed to relate to the far extremes of negative emotion: panic and rage (Gray, 1990). The role of this system in personality has not been discussed much by Gray, and this aspect of the theory has been disregarded in the work reported here.

and the BIS to negative affect) and to be unrelated to the alternative affect. Furthermore, because the BAS and BIS represent distinct structures in the nervous system (being separable both pharmacologically and by brain lesions), their sensitivities are presumed to be orthogonal (Gray, 1987a, 1987b; Quay, 1993). Thus, within a given population there should exist people with all combinations of high and low BIS and BAS sensitivity.

Significance of Gray's Theory

Gray's work has been focused primarily on animal behavior and the effects of drugs, rather than on nonpharmacological studies of human behavior or affect. The theory has obvious implications for personality, however (Gray, 1981). Its relevance to human behavior has been discussed primarily in terms of stable individual differences in the responsiveness of the two systems to the two classes of stimuli to which they pertain. Given that starting point, the theory provides a plausible way of accounting, in terms of brain functioning, for several sorts of psychopathology. For this reason, it has a considerable following among psychologists interested in various kinds of behavior problems (e.g., Fowles, 1987, 1988, 1993; Newman & Kosson, 1986; Quay, 1988, 1993).

Recall that the theory attributes sensitivity to signals of reward—in terms of both behavioral approach and the creation of positive affect—to BAS activity. People with high BAS sensitivity should respond behaviorally to cues of reward and should experience positive affect in the presence of such cues (compared to people with lower BAS sensitivity). At an extreme, a heightened BAS sensitivity may underlie the sociopathic personality (although many discussions of this problem also assume a role for a weak BIS and thus weak inhibition of impulses, see Fowles, 1980; Gray, 1985). Depue and colleagues have also argued that a behavioral engagement or facilitation system, conceptually similar to the BAS, is one underpinning of bipolar disorder (Depue & Iacono, 1989; Depue et al., 1987).

Recall also that the theory attributes sensitivity to signals of punishment—resulting in inhibition and the creation of negative affect—to the activity of the BIS. People with high BIS sensitivity should be especially responsive behaviorally to punishment cues and should experience great anxiety in situations with cues of impending punishment (compared to people with lower BIS sensitivity). At an extreme, heightened BIS sensitivity may render the person susceptible to anxiety or depressive disorders (Fowles, 1993).

Along these same lines, Quay (1988, 1993) has summarized and integrated findings from animal and human studies to classify several childhood disorders in terms of levels of BAS and BIS functioning. He argued that an overactive BAS, causing extreme responses to signals of reward, is implicated in the development of conduct disorder; that an underactive BIS, causing impaired inhibition in the face of signals of punishment and nonreward, is implicated in attention-deficit hyperactivity disorder; and that an overactive BIS, causing hypersensitivity to conditioned signals of punishment or nonreward, is implicated in childhood anxiety disorders.

Nor do these illustrations exhaust the ways in which an understanding of the effects of appetitive and aversive motivational systems may inform models of psychopathology (Fowles, 1988, 1993) and indeed normal behavior. Further empirical evaluation of the model's applicability to human experience thus would seem an important goal.

Assessment of BAS and BIS Sensitivity

Although Gray (1972, 1981) postulated two personality dimensions defined by variation in BAS and BIS sensitivities, no consensus has been reached about how to assess these dimensions in humans so that their manifestations can be studied. Some researchers have used instruments that were developed for other purposes to investigate Gray's ideas, but there is reason to be concerned about the adequacy or appropriateness of such measures for this task.

For example, the Extraversion scale from the EPQ (Eysenck & Eysenck, 1975) has been used to test individual-difference predictions deriving from Gray's theory (e.g., Larsen & Ketelaar, 1991). Using this scale for this purpose is problematic, however, because its conceptual content does not fit the theory. Gray (e.g., 1981) has viewed extraversion as a derived quality that reflects the balance between impulsivity and anxiety (more impulsivity leading to more extraversion and more anxiety leading to more introversion). However, EPQ extraversion has a large component of sociability, with very little impulsivity (e.g., Wolfe & Kasmer, 1988; Zinbarg & Revelle, 1989). Because sociability plays no obvious role in Gray's theoretical scheme, the two conceptualizations of extraversion differ in a fundamental way. Given this difference, Eysenck's measure of extraversion cannot be expected to provide a wholly adequate measure of BAS sensitivity.[2]

It might be argued that other scales reflect BAS sensitivity, on the basis of the reasoning that BAS functioning is related to impulsive or antisocial tendencies. For instance, the Socialization scale of the California Psychological Inventory measures tendencies toward delinquency and antisocial acts (Gough & Peterson, 1952; Megargee, 1972). Similarly, the Psychopathy Checklist (Hare, 1980) assesses antisocial behavior. Although it

[2] An issue that is tangential to the point under discussion here, but which has been a part of the ongoing debate between advocates of Gray's and Eysenck's theories, concerns how the dimensions posited by the two theorists relate to one another in conceptual space (cf. Diaz & Pickering, 1993). Gray (e.g., 1981) has argued that his dimensions represent a 45° rotation of Eysenck's dimensions. We view this statement as a useful metaphor, but one that disregards a great deal of empirical reality. For one thing, as just noted, Eysenck's conceptualization and measures of extraversion incorporate facets that are not included anywhere in Gray's theory. For another thing, measures of emotionality derived from Eysenck's theory selectively assess negative emotionality (thus the dimension is also called *neuroticism*). Gray, however, treats emotionality as a summation of the sensitivities of anxiety proneness (which leads to negative emotions) and impulsivity (which leads to positive emotions). This obviously is a very different conception. Given these differences in conceptions of emotionality, it is no surprise that measures of neuroticism (emotionality) are very highly correlated with measures of trait anxiety—so much so that many researchers treat them as interchangeable (e.g., Smith, Pope, Rhodewalt, & Poulton, 1989). This empirical reality does not accord well with the notion of one of these dimensions being a 45° rotation of the other. In sum, we think that the metaphor of the 45° rotation may have outlived its usefulness.

is reasonable to see such behaviors as reflecting reward seeking, there is nothing in Gray's theory to suggest that people who are highly sensitive to rewards are also inclined to illegal activities, as opposed to other rewarding activities. Consequently, use of these scales to assess BAS sensitivity would likely lead to very biased sampling.

Some researchers have used measures of impulsiveness to assess BAS sensitivity, following the lead of Gray's label for this dimension of personality (e.g., Diaz & Pickering, 1993). However, even within Gray's conceptual framework, there are reasons to be concerned about whether impulsive behavior should derive solely from BAS sensitivity, as opposed to a combination of BAS sensitivity and BIS insensitivity (see also Gray, Owen, Davis, & Tsaltas, 1983). Indeed, it may turn out that Gray's choice of impulsivity as a label for this quality of personality is misleading. We do not, of course, mean to imply that impulsive action is not an important phenomenon to understand (see, e.g., Newman, Widom, & Nathan, 1985; Patterson & Newman, 1993; Wallace, Newman, & Bachorowski, 1991). However, whether impulsiveness per se is the most direct reflection of BAS sensitivity is another matter (the issue of impulsiveness is taken up again later in the article).

Vulnerability Versus Typical Experience

A more subtle but nonetheless important issue in assessing BAS or BIS sensitivity pertains to distinguishing the *sensitivity* of the system from the person's *typical experiences* in day-to-day life. The issue is perhaps most clearly illustrated with regard to the BIS. Gray characterized the quality of personality deriving from BIS sensitivity as anxiety proneness. This dimension appears relatively straightforward conceptually. Moreover, it would seem obvious that BIS sensitivity is readily measured by trait anxiety scales, for example, the Taylor (1953) Manifest Anxiety Scale (MAS). The problem is that although a person with high BIS sensitivity is vulnerable to anxiety in certain situations, this person may also learn to avoid anxiety-provoking situations much of the time and consequently experience relatively little anxiety on a day-to-day basis (for more detail of this line of reasoning see Fowles, 1987). Thus, although there surely is likely to be a substantial positive correlation between BIS sensitivity and measures of trait anxiety that focus on the day-to-day experience of anxiety, it does not seem wise to assume that the latter measures perfectly reflect BIS sensitivity.

The problem just outlined is also implicit in Tellegen's (1985) suggestion that measures of positive emotionality and negative emotionality might be thought of as reflecting BAS and BIS sensitivity, respectively. That is, although a person with a highly sensitive BIS may be quite vulnerable to states of anxiety and other negative affects, one who realized the vulnerability and arranged his or her life to avoid threatening situations would not be especially prone to experience negative affect moment to moment and thus would not have a high standing on the Negative Emotionality scale. In brief, assessment of BIS and BAS sensitivities would seem to benefit from assessing responses to appropriate classes of situations rather than assessing general affective tone.

Measures Based on Gray's Model

As we noted earlier, much of the research conducted to investigate Gray's theory in humans has used measures with other conceptual origins. This has not invariably been so, however. At least three attempts have been made to develop assessment devices from the perspective of Gray's theory. One of them is MacAndrew and Steele's (1991) measure of BIS sensitivity. We find two aspects of this measure problematic. The first is that it is focused on ambient anxiety rather than on vulnerability to anxiety (the issue raised in the preceding paragraph). The second is that this measure is unaccompanied by a measure of BAS sensitivity. Thus, it stands alone as a measure of trait anxiety. Another scale designed to assess BIS sensitivity, reported by Torrubia and Tobeña (1984), has similar problems. This measure is focused somewhat more on vulnerability than is the MacAndrew and Steele measure, but its item content frequently is one step or more removed from cues of punishment (e.g., "Do you prefer not to ask for something when you are not sure you will obtain it?"). This measure also stands alone as a measure of trait anxiety that is unaccompanied by a measure of BAS sensitivity.

Another measure developed with Gray's theory as background was devised by Wilson, Barrett, and Gray himself (1989; Wilson, Gray, & Barrett, 1990). This instrument was developed by writing items that would reflect one of six behavioral tendencies that animal research suggests are related to the functioning of the BIS, the BAS, or the fight–flight system. Unfortunately, factor analysis of this instrument provided little support for the existence of factors corresponding to the a priori scales (Wilson et al., 1990). Instead, the factors that emerged were composites of items from divergent scales (with the relatively clear exceptions of the item sets intended to assess fight and flight, respectively). This instrument thus does not seem very well suited to its purpose.[3]

One more instrument deserves mention in this context: the Tridimensional Personality Questionnaire (TPQ), developed by Cloninger (1987) to assess the three dimensions of personality he regards as fundamental. Cloninger's model stems partly from some of the same background as underlies Gray's theory and is similar enough to Gray's that it might be invoked as a conceptual equivalent. The three dimensions assessed by the TPQ are as follows:

1. Harm avoidance concerns sensitivity to, and avoidance of, punishing stimuli. This resembles Gray's BIS sensitivity; indeed, Cloninger referred to a "behavioral inhibition system" in describing the brain system he argued underlies it.
2. Novelty seeking concerns a tendency toward exhilaration or excitement in response to cues of potential reward or relief of punishment, causing exploration in pursuit of potential rewards. This resembles Gray's descriptions of BAS sensitivity;

[3] Although factors for the intended fight and flight item sets did tend to emerge in the analysis, we would argue that many items of the two sets are only loosely related to Gray's conceptualization of this system, which presumably comes into play only under relative extremes of unconditioned aversive stimulation. This raises questions about the usefulness of even these scales.

indeed, Cloninger referred to a "behavioral activation system" in describing the brain system he argued underlies it.

3. Reward dependence concerns a tendency toward responsiveness to unconditioned signals of reward and a tendency toward maintaining behavior previously associated with reward. Cloninger proposed this dimension as the basis for individual differences in resistance to extinction and the ability to delay gratification. It does not correspond directly to any dimension in Gray's theory. On the other hand, it might be argued on conceptual grounds that qualities reflected in this dimension represent the BAS as well as does Novelty Seeking.

There is, however, reason to doubt that the TPQ provides an ideal operationalization of BAS and BIS sensitivities. For one thing, the BAS-relevant dimensions (each of which is a composite of subscales) are not very consistent internally. That is, Novelty Seeking and especially Reward Dependence have been found not to form clean second-order factors (Waller, Lilienfeld, Tellegen, & Lykken, 1991). Furthermore, many items of the Reward Dependence scale appear to have a critical ambiguity: They reflect a dependence on other people that could be motivated as easily by desire to avoid social disapproval as by desire to gain social reward (e.g., "I like to please other people as much as I can"; "Even if there are problems in a friendship, I nearly always try to keep it going anyway"; and "I don't go out of my way to please other people" [reverse scored]). Such a concern over disapproval may reflect a highly active BIS, rather than a dependence on reward. Additional information bearing on the TPQ as a potential measure of BIS and BAS sensitivity is discussed later in this article.

The lack of what we regarded as a fully satisfactory set of measures to assess BAS and BIS sensitivity led to the work reported here. In this article, we describe the development and initial validation of such a set of measures. Study 1 reports the development of the BIS/BAS scales. Study 2 reports convergent and discriminant validity with regard to a variety of other measures. Study 3 is a laboratory test of the BIS scale, showing that it predicts individual differences in the experience of anxiety when exposed to cues of impending punishment in a controlled situation and does so better than does an alternative measure of trait anxiety. Study 4 is a comparable laboratory study of the BAS scales, predicting individual differences in the experience of positive affect in response to cues of impending reward.

Study 1: Scale Development

Method and Results

We began by generating a pool of items that were intended to reflect either BAS or BIS sensitivity. All items were written in a Likert-type format, with responses made on a 4-point response scale with 1 indicating strong agreement and 4 indicating strong disagreement (with no neutral response). We did not take Wilson et al.'s (1989) approach of trying to write items that would correspond structurally to diverse domains of laboratory findings. Rather, we considered the overall conceptualization of BIS and BAS functioning—particularly the postulated role of these systems in generating emotional reactions—and wrote items on that basis.

In approaching the assessment of BIS sensitivity, we attempted to create statements that reflected a concern over the possibility of a bad occurrence ("I worry about making mistakes") or a sensitivity to such events when they do occur ("Criticism or scolding hurts me quite a bit"). All potential BIS items thus referenced potentially punishing events and asked how people respond to them. It is known that how people react behaviorally when they confront circumstances that induce anxiety depends on a wide range of factors other than the existence of the anxiety state per se, for example, confidence of being able to cope with the anxiety (cf. Carver, Blaney, & Scheier, 1979; Carver & Scheier, 1986). Because of this, rather than introduce the influences of these additional factors by assessing BIS sensitivity in terms of reports of behavioral reactions, we focused instead on the experience of anxiety per se in situations in which there are punishment cues.

In approaching the assessment of BAS sensitivity, we used a somewhat more divergent strategy, consistent with the absence of complete consensus about exactly how BAS sensitivity is likely to be manifest. We attempted to create statements that would reflect one of the following: strong pursuit of appetitive goals ("I go out of my way to get things I want"), responsiveness to reward ("When I get something I want I feel excited and energized"), a tendency to seek out new potentially rewarding experiences ("I'm always willing to try something new if I think it will be fun"), or a tendency to act quickly in pursuit of desired goals ("I often act on the spur of the moment"). These various qualities all reflect BAS sensitivity as portrayed in one or more of the theoretical discussions cited earlier in the article.[4] Thus, all BAS items that were generated referenced potentially rewarding events and assessed how people respond to them.

Subscales and Factor Structure

The item sets went through several iterations of item generation and testing (e.g., factor analyses and correlations with other scales), with items being tested, and revised or discarded as necessary. Our goal was an instrument that would be relatively brief and would be narrowly focused on the specific psychological qualities we intended to measure. We eventually arrived at four scales: A BIS or punishment sensitivity scale includes all items referencing reactions to the anticipation of punishment. In contrast to this unidimensional character of the BIS scale, there are three BAS-related scales. The Drive scale is made of items pertaining to the persistent pursuit of desired goals. The Fun Seeking scale has items reflecting both a desire for new rewards and a willingness to approach a potentially rewarding event on the spur of the moment. The Reward Responsiveness scale has items that focus on positive responses to the occurrence or anticipation of reward.

Factor analysis of the final set of BIS/BAS items was conducted on a sample of 732 college students (374 women and 358 men), using oblique rotation to permit correlations among the factors. The analysis yielded four factors with eigenvalues greater than 1, which together accounted for 49% of the overall

[4] We note that it is possible to take issue with one or more of these proposed manifestations. This is a point that should be borne in mind through the remainder of this article.

Table 1
BIS/BAS Scales: Items, Alpha Reliabilities, Means, Standard Deviations, and Factor Loadings

Scale and items	α	*M*	*SD*	1	2	3	4
1. BIS	.74	19.99	3.79				
If I think something unpleasant is going to happen I usually get pretty "worked up."				72			
I worry about making mistakes.				70			
Criticism or scolding hurts me quite a bit.				68			
I feel pretty worried or upset when I think or know somebody is angry at me.				66			
Even if something bad is about to happen to me, I rarely experience fear or nervousness.				58			
I feel worried when I think I have done poorly at something.				50			
I have very few fears compared to my friends.				49			
2. BAS Reward Responsiveness	.73	17.59	2.14				
When I get something I want, I feel excited and energized.					74		
When I'm doing well at something, I love to keep at it.					69		
When good things happen to me, it affects me strongly.					67		
It would excite me to win a contest.					67		
When I see an opportunity for something I like, I get excited right away.					65		
3. BAS Drive	.76	12.05	2.36				
When I want something, I usually go all-out to get it.						81	
I go out of my way to get things I want.						73	
If I see a chance to get something I want, I move on it right away.						71	
When I go after something I use a "no holds barred" approach.						68	
4. BAS Fun Seeking	.66	12.43	2.26				
I will often do things for no other reason than that they might be fun.							81
I crave excitement and new sensations.					[39]		73
I'm always willing to try something new if I think it will be fun.							66
I often act on the spur of the moment.						[39]	57

Note. Decimals and loadings below .35 are omitted; two BIS items have been reverse coded. $N = 732$. BIS = Behavioral Inhibition System; BAS = Behavioral Activation System.

variance. The items and factor loadings are shown in Table 1, along with the internal reliabilities of the scales.[5] Although the scales are brief, three of the four have quite reasonable alpha reliabilities; the alpha for Fun Seeking was somewhat lower. Sample means and standard deviations for the four scales are also listed in Table 1. In this large sample there were two gender differences in scale means: BIS scores were lower among men ($M = 18.84$) than among women ($M = 21.09$), as were Reward Responsiveness scores (Ms = 17.27 for men and 17.90 for women).

In theory, the sensitivity of the BIS and BAS physiological systems should be independent. Consistent with this assumption, the BIS scale was relatively independent of the BAS subscales in this sample, although the degree of independence varied across subscales. The BIS scale correlated −.12 with Drive, .28 with Reward Responsiveness, and −.08 with Fun Seeking. Consistent with their shared conceptual origins, the latter three scales were more closely related to one another, although not as strongly as might have been expected. Drive was correlated .34 with Reward Responsiveness and .41 with Fun Seeking. Reward Responsiveness was correlated .36 with Fun Seeking. A factor analysis of scale scores, however, confirmed that the three BAS scales all loaded strongly on one second-order factor (all at above .75 in the unrotated factor matrix), whereas the BIS scale loaded strongly on a second factor (.93). To assess reliability across time, a sample of 113 subjects was retested approximately 8 weeks after an initial testing. Test–retest correlations were .66 for BIS, .66 for Drive, .59 for Reward Responsiveness, and .69 for Fun Seeking.

Study 2: Convergent and Discriminant Validity

Method

Once a final item set had been established, the scales were administered along with other instruments so that we could begin to establish convergent and discriminant validity. Measures used for this purpose included a 20-item form of the MAS (which has been found to correlate .93 with the full MAS [Bendig, 1956]) and a 10-item extraversion scale (Eysenck & Eysenck, 1985, p. 84). We expected moderately strong convergence between these scales and our BIS and BAS scales, respectively. We also administered the Minnesota Multiphasic Personality Inventory (MMPI) Hypomania scale and the Socialization scale from the California Psychological Inventory (CPI, Gough, 1956, 1960), both of which were expected to be related to one or more BAS scales.

Some subjects also completed Scheier and Carver's (1985) Life Orientation Test (LOT), a measure of optimism versus pessimism. We expected this measure to be related to the BIS/BAS scales, but not strongly so, for the following reason. The BIS/BAS scales were intended to assess

[5] Separate analyses conducted on the male and female subsamples yielded only one tendency toward a gender difference. Among women but not among men, the two BIS items that were worded so as to reflect low anxiety tended to separate from the rest of the BIS items. Even among the women, however, the alpha for the BIS scale was .70.

the sensitivity of systems that react to punishment and reward cues, respectively. As noted earlier in the article, sensitivity (or reactivity) conveys no information about how frequently such cues are encountered. In contrast, the LOT assesses the belief that good versus bad things will happen. To put it differently, this variable reflects expectations of the likelihood (or frequency) of encountering cues of reward versus punishment. Given this difference between sensitivity to a class of stimuli (on the one hand) and the perceived likelihood of exposure to the stimuli (on the other hand), relationships between the LOT and the BIS/BAS scales should not be too strong.

The dispositional form of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), a measure of the tendencies to experience positive and negative affects (assessed as two distinct tendencies), was also administered to some subjects. We expected the Negative Affectivity scale to correlate with our BIS scale, the Positive Affectivity scale to correlate with our BAS-related scales, and each to be unrelated to conceptually unrelated BIS/BAS scales. We also administered Watson and Clark's (1993) General Temperament Survey (GTS), which includes measures of Positive Temperament, Negative Temperament, and Disinhibition–Constraint. As with the PANAS, we expected Negative Temperament to be related to the BIS scale, Positive Temperament to be related to the BAS-related scales, and each of these to be unrelated to conceptually unrelated BIS/BAS scales. Of additional interest regarding this measure was the pattern of correlations pertaining to Disinhibition–Constraint, which we tentatively hypothesized would be related to indexes of both BIS and BAS functioning.

Also administered to some subjects were three measures that are more closely related to the line of reasoning from which this research derives. The first was MacAndrew and Steele's (1991) measure of BIS sensitivity. This measure, a 30-item MMPI-derived scale, was developed according to a criterion-groups strategy, in which initial selection of items was based on their ability to distinguish between prostitutes (presumably a low-anxiety-prone group) and female psychiatric outpatients (a more anxiety-prone group). The second scale was Torrubia and Tobeña's (1984) Susceptibility to Punishment scale. The third instrument was the TPQ (Cloninger, 1987), which yields measures of Harm Avoidance, Novelty Seeking, and Reward Dependence.

Results

Correlations between the BIS/BAS scales and the other measures administered are in Table 2 (as these are largely nonoverlapping samples, *n*s vary from one row to another). Consider first the correlations with the MAS and with Extraversion. The MAS correlated fairly strongly with the BIS, as expected, but not prohibitively so. Consistent with the relative lack of association between BIS and BAS scales, the MAS was not strongly correlated with any BAS scale. A complementary pattern emerged from the correlations with Extraversion. Extraversion related moderately strongly to all the BAS scales, the strongest relationship being with Fun Seeking. In contrast, Extraversion was nearly unrelated to the BIS. The patterns displayed in these two rows suggest that the BIS and BAS scales are related to these measures as they should be, but not so closely related as to be indistinguishable from them.

The MMPI Hypomania scale and the CPI Socialization scale were both moderately related to the Fun Seeking scale of the BIS/BAS, and the Hypomania scale was also related to the Drive scale, but neither was related to the Reward Responsiveness scale. To put it differently, the Hypomania scale partially captures two of the three manifestations of BAS functioning reflected in our scales, but the only one that is captured (in part) by CPI Socialization is Fun Seeking. The relative weakness of all these correlations hints that these two scales are measuring qualities that may diverge somewhat from BAS sensitivity, as we suggested in the article's introduction with regard to the Socialization scale.

The pattern of correlations for the Socialization scale raises questions about the wisdom of its use as an operationalization of BAS sensitivity on two grounds. It is unclear at present whether any specific manifestation of BAS functioning is more important than others. The Socialization scale assesses only one

Table 2
Correlations of BIS, Drive, Reward Responsiveness, and Fun Seeking Scales With Other Measures: Study 2

Scale	*n*	BIS	Drive	Reward	Fun Seeking
MAS	371	.58***	−.10	.13	−.03
Extraversion	381	−.14	.41***	.39***	.59***
MMPI Hypomania (9)	138	−.03	.33***	.17	.37***
CPI Socialization scale	304	.22***	−.14	.10	−.25***
Optimism (LOT)	371	−.22***	.16**	.08	.11
PANAS	498				
Negative Affectivity		.42***	−.07	.05	−.05
Positive Affectivity		−.06	.31***	.28***	.19***
GTS	207				
Negative Temperament		.45***	.06	.05	.03
Positive Temperament		−.12	.39***	.35***	.25***
Disinhibition–Constraint		−.16*	.18*	−.03	.39***
Susceptibility to Punishment	107	.39***	−.07	.05	−.21**
MacAndrews & Steele BIS	172	.59***	−.14	.06	−.10
TPQ	174				
Harm Avoidance		.59***	−.23**	−.03	−.27***
Novelty Seeking		−.11	.08	.08	.51***
Reward Dependence		.42***	.09	.28***	.15

Note. BIS = Behavioral Inhibition System; MAS = Manifest Anxiety Scale; MMPI = Minnesota Multiphasic Personality Inventory; CPI = California Psychological Inventory; LOT = Life Orientation Test; PANAS = Positive and Negative Affect Schedule; GTS = General Temperament Survey; TPQ = Tridimensional Personality Questionnaire.
* $p < .05$. ** $p < .01$. *** $p < .001$.

of the qualities that our BAS scales measure. Thus, if either of the other qualities is important, reliance on the Socialization scale would result in failing to obtain the effect. Second, the significant association between the Socialization scale and the BIS raises questions about the purity of the Socialization scale as a reflection of BAS functioning rather than BIS functioning.

The correlations between BIS/BAS scales and the LOT were modest, as was expected. We view the modest size of these associations as reflecting the difference between a vulnerability, or susceptibility, to a particular class of cues and an expectation that one or the other class of cues is likely to be frequently encountered in life. As indicated earlier, the former is embodied in the logic behind the BIS/BAS scales, whereas the latter is embodied in the LOT.[6]

Correlations between the BIS/BAS scales and the two subscales of the PANAS also took the expected form: The PANAS Negative Affectivity scale was related to the BIS scale but not to any of the BAS-relevant scales; the latter but not the former were related to the Positive Affectivity scale of the PANAS. The only surprising aspect of this pattern of correlations was the relative weakness of the associations obtained. One reason for the weakness is probably that the PANAS taps a wider range of specific affects than our measures directly relate to. Another reason, we believe, is that the PANAS asks respondents to what extent they experience each affect in day-to-day life, whereas we aimed to assess a vulnerability to the experience given the appropriate stimulus.

A pattern of associations emerged with respect to the GTS that closely resembled the pattern for the PANAS, which doubtlessly reflects the shared conceptual origins of the two instruments (although it should be noted that the instruments have completely different response formats). The additional information provided under GTS in Table 2 concerns the dimension of Disinhibition–Constraint. This dimension was positively related to Fun Seeking and (more weakly) to Drive, but it was also inversely related (albeit not terribly strongly) to the BIS scale. A multiple regression analysis in which Disinhibition–Constraint scores were predicted from Fun Seeking and BIS scores revealed that both made significant independent contributions to prediction (βs = .36 and −.13, respectively). This suggests that the impulsive quality that is measured by the Disinhibition–Constraint scale has contributions from both BAS and BIS sensitivity.

The correlations between the BIS/BAS scales and the measures of MacAndrew and Steele (1991) and Cloninger (1987) are also of particular interest. Not surprisingly, our BIS scale was fairly strongly correlated with both alternative measures of anxiety proneness—indeed, at about the same level as with the MAS. Correlations among the latter scales showed that the MacAndrews and Steele measure was closely aligned with both the MAS (r = .72) and the TPQ Harm Avoidance scale (r = .74); the latter correlated with the MAS at .62. This pattern suggests that our BIS scale is a bit removed from all of these measures, as was intended by our focus on sensitivity to anxiety-provoking stimuli rather than on ambient affective tone. The correlation of the BIS scale with the Susceptibility to Punishment scale was lower than with the other measures. It will also be noted that the TPQ Harm Avoidance scale was correlated not only with the BIS but also with two of the BAS scales (one of which was also related to the Susceptibility to Punishment scale). These associations raise questions about the extent to which the Harm Avoidance scale (and to a lesser extent the Susceptibility to Punishment scale) reflects BIS functioning independent of BAS functioning.

With respect to the two scales from Cloninger's TPQ that we are treating as relevant to BAS sensitivity, the picture is clear and simple for one but more complex for the other. Novelty Seeking correlated fairly strongly with our Fun Seeking scale, but it was unrelated to any other BAS scale. It resembled the Socialization scale in that respect, although unlike the Socialization scale it was not related to BIS. Reward Dependence was related to our Reward Responsiveness scale, but it was even more strongly related to the BIS scale. A regression analysis in which TPQ Reward Dependence was predicted from BIS and Reward Responsiveness scores found that both contributed significantly to prediction (βs = .38 and .21, respectively). This strong association with BIS appears to indicate a problem for the TPQ Reward Dependence scale as a potential measure of BAS sensitivity. As we noted earlier, many of its items reflect a dependence on other people that could be motivated as easily by a desire to avoid social disapproval as by a desire for social reward. This ambiguity apparently is reflected in the pattern of associations shown in Table 2.

Discussion

The data bearing on convergent and discriminant validity indicate that the BIS and BAS scales are related to, but also distinguishable from, alternative measures of similar constructs and measures of important alternative constructs. With respect to the BIS, the pattern of correlations for anxiety-related measures is consistent with the position that the alternative measures tested here are more similar to each other than they are to our BIS scale. In our view, this is because our BIS scale was designed to measure sensitivity to anxiety-provoking stimuli rather than ambient affective tone, which is not true of the other scales. Whether this is a reasonable interpretation of this pattern is examined from a different direction in Study 3, reported later in the article. With respect to one alternative measure of anxiety proneness, the TPQ Harm Avoidance scale, the data suggest a possible lack of specificity, because this measure is related not only to the BIS but also to two BAS scales, which was not true of any other measure of anxiety proneness.

---

[6] Although tangential to the main points of this article, it is also of interest that the correlation between the LOT and the BIS is not as high as that obtained in the past between the LOT and other measures of anxiety proneness (Smith et al., 1989). Indeed, the LOT was related to the MAS in this sample significantly more strongly (r = −.45) than to the BIS (T = 5.38, $p < .01$; Steiger, 1980). We suggest that this greater discrimination between BIS and LOT than between MAS and LOT has substantive meaning. That is, there is a conceptual basis for believing that expectancies, as assessed by the LOT, should relate to manifest anxiety (cf. Carver & Scheier, 1990), but there is less conceptual basis for expecting a strong relation between expectancies and sensitivity to the occurrence of either reward or punishment. Thus, this pattern of differential discrimination is one source of information suggesting that the BIS measures vulnerability to anxiety in reaction to anxiety cues, rather than measuring anxiety as affective tone.

The pattern for the BAS-related measures suggests that our BAS scales can be differentiated from alternative measures without undue difficulty. The strongest associations were between Fun Seeking and Extraversion and Novelty Seeking from the TPQ. The remaining correlations were at the moderate levels we were anticipating. There is also some suggestion in the data that our BAS scales provide a broader array of possibilities for assessing BAS sensitivity than do the alternative measures tested. If novelty seeking or fun seeking ultimately proves to be the critical manifestation of BAS sensitivity, both the TPQ and the BIS/BAS have relevant scales; the extraversion measure and to a lesser extent the Hypomania scale of the MMPI also tap into this quality. If, however, another psychological quality were a critical manifestation of BAS sensitivity, the options would be fewer. If either Drive or Reward Responsiveness were critical, Extraversion would appear to provide the best alternative of those examined here, with Positive Temperament a close second. Neither of these provides much discrimination, however, among the qualities that are assessed by our scales as Drive, Reward Responsiveness, and Fun Seeking.

By itself, the fact that our scales are not prohibitively correlated with alternative measures does not tell us that our scales are better than the others, but only that the measures are assessing somewhat different qualities. Thus far, we have presented no information to indicate whether our scales outperform other measures in theoretically meaningful settings. This was the next step in our research strategy: to test the scales' predictive ability in contexts that provide information concerning basic psychological processes.

Recall that our reason for developing the scales concerned the presumed involvement of BIS and BAS physiological systems in important aspects of human behavior. Of particular interest to us is how these systems may be involved in people's emotional reactions to emotion-relevant cues. For this reason, the criterion measure for the next step in the validation process was an emotional reaction. In Study 3, we attempted to create a situation in which subjects would be induced to experience anxiety. It was predicted that BIS scores would predict the amount of anxiety reported. Recall also our earlier emphasis on the idea that a measure of BIS sensitivity should assess responses to anxiety-provoking situations rather than assessing general affective tone. To evaluate this aspect of our reasoning, we also included the MAS (a measure of general affective tone) as a predictor variable in Study 3.

Study 3: BIS Sensitivity and the Experience of Anxiety

To validate the BIS scale, we wished to create a situation that engages the BIS but not the BAS. Because the BIS is assumed to be responsive to cues of punishment, in this study we exposed subjects to cues of impending punishment. It was necessary that the cues be unambiguous, in the sense that there should be no implication of a possible reward (which would engage the BAS). Thus, we created a situation in which subjects would have reason to anticipate the occurrence of what they know to be an aversive event. In theory, differences in internal BIS sensitivity should lead to differences in how subjects respond affectively to this impending punishment. If our BIS scale is a valid measure of this internal BIS sensitivity, subjects' BIS scores should predict their nervousness in response to the punishment cues. BAS scores should not be related to the nervousness experienced, because the physiological BAS is not engaged in this situation.

Method

Subjects were 69 undergraduates (31 men and 38 women) from the University of Miami who completed the procedures of this study in partial fulfillment of a course requirement. Five additional subjects completed the procedures of the study described below, but they were omitted from the sample before data analysis because postexperimental debriefing revealed that they had guessed the point of the experimental procedures. Potential subjects completed the BIS/BAS, the 20-item version of the MAS (Bendig, 1956), and the 10-item Extraversion scale described earlier (Eysenck & Eysenck, 1985) during large questionnaire sessions at the beginning of the semester. Later, they came to the laboratory for individual sessions.

Subjects were met at the experimental site by an experimenter who was blind to the specific hypotheses of the study and the pretest scores of the subjects. They were led to the experimental room, where they were given a brief overview of the project and were asked to give their informed consent to participate before continuing. They then received a standard set of orienting remarks, in which the experiment was portrayed as part of a project concerning pattern recognition. Subjects were told that ability to recognize patterns or sequences is related to intelligence, learning ability, and intuition and that the project was aimed at getting a clearer idea of what variables influence the intuitive aspect of the process.

The experimenter then described the task that subjects would be performing and illustrated it with two sample items. For each item, six characters were presented in a line on a computer screen. The first five were ostensibly the first five elements of a sequence; the final character either was or was not the next element in the sequence. The subject was to assess whether it was or was not—within 8 s—and press either Y (for yes) or N (for no) on the keyboard. Except for the two sample items (used to illustrate one obviously correct sequence and one obviously incorrect sequence), the items were not real patterns, but strings of numbers, letters, and characters constructed to appear to be genuine sequences. The 8-s time limit was imposed to keep subjects from studying the sequence long enough to realize that no pattern actually existed. Subjects were told that forcing quick responses encourages the use of intuition instead of logic. Subjects were told explicitly not to try to figure out the pattern logically, but to use their intuitive judgment to decide whether the final character was correct.

Assessing the Dependent Measure

The experimenter continued by saying that many factors influence people's intuitive skills, including transient emotional states that the person may not even be particularly aware of. Because affect changes frequently over periods of even an hour, affect-relevant information would be collected periodically while the subject was working on the task. This ostensibly would permit the research team to control for the effects of these small shifts in emotion in analyzing the data.

This statement provided a rationale for collecting the data that compose the study's dependent measure. At two points during the experiment—after the explanation of the task and at a point that ostensibly was midway through the session—subjects completed mood rating scales to assess their affect. The target affect for this study was nervousness. Because we did not want subjects to focus too much on the affect assessment, we did not use an extensive set of items to measure nervousness, but a single item. Burisch (1984a, 1984b) has shown that such brief measures typically provide as much information as longer instruments, particularly when the quality being measured is highly intuitive.

The scale measuring nervousness was embedded in scales measuring other affective qualities, which served as distractors.

The affect-rating scales were presented on the computer screen and subjects responded to each by choosing a number (1–9) to indicate how much they were currently experiencing that emotional quality. The first set of ratings was made immediately after completion of the task instructions that were just outlined. The experimenter made an excuse and left the room while the subject made the ratings.

Punishment Cue Manipulation

After making this set of ratings, subjects were given another cover story to justify the subsequent delivery of punishment cues. This cover story concerned an additional factor that ostensibly has an influence on intuition. The experimenter said that there is evidence that what is called "reticular activation" helps sharpen people's intuitive judgments. One of the easiest ways to increase reticular activation, the experimenter continued, is the cold-pressor procedure—placing a hand into ice water. To increase reticular activation (and thus to enhance their task performance), subjects were asked to place their hand in ice water for 60 s as the experimenter continued with the task instructions. In reality, the reason for this exposure to the cold pressor was to ensure that subjects would realize that it creates sensations of discomfort and thus constitutes a punisher. (Subjects were casually asked to judge the discomfort produced by this procedure after they completed it; the ratings averaged 7.88 on a scale of 1–10.)

The experimenter continued by saying that subjects' performance would be monitored by the computer across blocks of the task. The critical information came next: At the midpoint of the session, the task would be interrupted to give subjects another dose of the cold pressor to increase reticular activation again. This time, however, the amount of exposure to the cold pressor would be individualized. The experimenter continued by saying that different people reach different levels of activation at the beginning of the session. To control for that, activation would have to be adjusted for each person according to how well he or she had done in the first half of the session. How much more ice water time the subject would get at midsession would depend on how well he or she had done thus far. The more blocks on which the subject had done worse than average, the more his or her reticular activation presumably would need to be boosted, and the more exposure to the cold pressor could be expected. This set of instructions ensured that later feedback of poor performance would constitute a cue of impending punishment.

After these aspects of the procedures were fully explained, the experimenter left the subject to work alone at the task. Subjects received feedback from the computer at the end of each task block (10 items each). This feedback was identical for all subjects regardless of their response choices. In particular, the feedback indicated that the subject had produced sub-par performance on each of the first seven blocks except the second one (one nonfailure block was included to increase credibility). Each failure message was accompanied by a message reminding the subject that performances below 50% result in increased amounts of cold-pressor exposure.

After the feedback for the seventh block of items was presented, a message appeared indicating that there was a need to reassess mood to control for shifts during the first half of the session. The subject then made the second set of mood ratings, at a point where it would have been reasonable to expect that more exposure to the cold pressor was imminent. After the last mood rating was made, a scale appeared on which subjects were asked to rate the amount of cold-pressor time they had accumulated during the first half of the session. Then a message told the subject to get the experimenter, who was seated outside the laboratory room. The experimenter asked several questions to assess the subjects' understanding of the events of the session and their suspicions regarding the various aspects of the task and the procedures of the study. After doing this, the experimenter debriefed the subject, awarded research credit, and requested that the subject not discuss the experiment with his or her fellow students.

Informed Consent Procedure

It was intended that the anticipation of a second exposure to the cold pressor would constitute the key stimulus for anxiety in this study. However, the requirement that subjects give fully informed consent made the situation somewhat more complicated than we had intended. That is, we had to tell subjects—well before collecting the initial mood measure—that they would be asked to complete the cold-pressor procedure and that most people find this procedure unpleasant. In fact, the University of Miami's human subjects committee required us to include a statement to the effect that in rare cases people with certain health problems have adverse reactions and to ask whether the potential subjects had any of these specific health problems. Thus, there is reason to believe that the consent procedure may have caused nervousness to be elevated well beyond a true baseline at the first point of measurement. This should be kept in mind in evaluating the findings.

Results

The outcome variable in this study was subjects' self-reported levels of nervousness. Subjects reported themselves to be moderately nervous even before exposure to the cold pressor (M = 4.09, SD = 2.10, on a 1–9 scale). Presumably this reflects both the general apprehensiveness that subjects often bring to their initial experience with research, plus anxiety generated by the informed consent procedure. Self-reported nervousness did not increase significantly overall from this initial measure to the second measure, taken at what subjects believed to be the midpoint of the session (M = 4.46, SD = 1.72). Presumably this lack of an overall change reflected two competing factors: There probably was a decrease in the initial apprehensiveness about the research experience in general, which was countered by an increase in anxiety from the ongoing feedback indicating that further exposure to the cold pressor would be forthcoming.

The predictor variables of greatest interest in this study were subjects' BIS scores (M = 20.28, SD = 4.02) and MAS scores (M = 27.54, SD = 4.14).[7] Correlations between these variables and self-rated nervousness at the two measurement points are shown in Table 3. Significant correlations were obtained between initial nervousness ratings and both of these personality measures. A multiple regression analysis indicated that the BIS was a better predictor of this initial rating of nervousness than was the MAS. That is, when both were entered simultaneously as predictors, the BIS scores made a significant unique contribution (β = .38, $p < .01$), but the MAS did not. The BIS was also significantly related to the later measure of nervousness, but the MAS was not.

These findings indicate that the BIS was a reliable predictor of nervousness in this laboratory situation, but they stop short of indicating that the BIS was a reliable predictor of vulnerability to nervousness as a function of exposure to cues of impending punishment. To test this hypothesis, we next related the BIS

[7] Preliminary tests revealed no gender difference or experimenter effect in either Study 3 or Study 4. Thus, data presented here are combined across gender and experimenters.

and MAS to the second measure of nervousness, controlling for the initial level of nervousness (thus removing any effect of either BIS or MAS in creating basal differences in nervousness). Partial correlations reflecting these tests are also shown in Table 3. As can be seen there, the BIS was a reliable prospective predictor of later ratings of nervousness, given this control, but the MAS was not. A multiple regression analysis entering BIS scores, MAS scores, and initial nervousness simultaneously yielded significant effects for initial nervousness rating ($\beta = .33$, $p < .01$) and for BIS scores ($\beta = .34$, $p < .02$), but no effect of MAS ($\beta = -.10$). Thus, BIS scores successfully predicted relative changes in nervousness that occurred as a function of punishment cues. The BIS effect remained significant when subjects' ratings of the aversiveness of the cold pressor was also added to the equation and when subjects' ratings of the amount of cold-pressor time they had accumulated were added to the equation.

The final question was whether the BIS scale was a discriminably better predictor of rated nervousness than measures of the BAS construct. Accordingly, further regression analyses were conducted in which extraversion and the BAS scales were included as predictors. The addition of these variables did not alter the outcome appreciably. The BIS remained a significant predictor of nervousness and was the only personality measure to contribute to the prediction of nervousness.

Discussion

Subjects in this study received an orientation to the research procedures which made clear to them that they would be asked to place their hands in ice water for 60 s, an experience that most people find moderately uncomfortable and that can cause adverse physical reactions in some people. Not surprisingly, when asked to rate their degree of nervousness a few minutes later, the average level reported was over 4 on a 9-point scale. The BIS was a significant predictor of these nervousness self-reports, as was the MAS (although more weakly). However, the variance that the MAS contributed to predicting these scores appeared to be limited to its overlap with the BIS. The BIS, in contrast, contributed unique variance over and above that contributed by the MAS.

After experiencing the cold-pressor test, subjects then completed a series of performance trial blocks in which they received feedback indicating that they would be receiving additional exposure to the cold pressor. After these blocks, they rated their nervousness again. Even when we took into account the initial nervousness ratings, the BIS was a significant predictor of the subsequent reports of nervousness. This effect remained significant when we took into account subjects' ratings of the unpleasantness of the cold pressor, their perceptions of the amount of exposure they would have to have to the cold pressor, and their scores on the MAS, the Extraversion scale, and the BAS scales. That these analyses adjusted for what was already a fairly substantial relationship between BIS and the earlier rating of nervousness makes this a rather stringent test.

The findings are quite consistent with Gray's view on the source of feelings of anxiety. That is, such feelings were related to a measure that was intended to reflect BIS sensitivity, but they were not predicted by measures intended to reflect BAS sensitivity. The findings are also consistent with the view that it is desirable to assess anxiety proneness in terms of people's reactions to anxiety-provoking situations rather than as general affective tone. The findings of this study thus provide one sort of evidence of construct validity for the BIS scale. Not only was it differentially related to self-reports of nervousness in response to cues of impending punishment (compared with measures of BAS sensitivity), but it also was related to these self-reports more reliably than was the alternative measure of anxiety proneness, the MAS.

Table 3
Correlations of BIS and MAS Pretest Scores With Self-Reports of Nervousness Before Exposure to the Cold Pressor and Midway Through the Session After Failure Feedback, and Partial Correlations With the Second Self-Reports, Adjusting for the First: Study 3

Scale	Initial rating	Midsession rating	Midsession, partialing out initial
BIS	.41**	.43**	.30**
MAS	.26*	.18	.07

Note. BIS = Behavioral Inhibition System; MAS = Manifest Anxiety Scale.
* $p < .05$. ** $p < .01$.

Study 4: BAS Sensitivity and the Experience of Happiness

To validate the BAS scales, we wished to create a situation that engages the BAS but not the BIS. Because the BAS is presumed to be responsive to cues of reward, this study exposed subjects to cues indicating an impending reward. As in Study 3, the cues had to be unambiguous, in the sense that there should be no implication of a possible punishment (which would engage the BIS). Thus, we created a situation in which subjects were led to anticipate that they would be receiving a positive reinforcer. Theory holds that differences in BAS sensitivity should lead to differences in how subjects respond affectively to such cues. If the BAS scales are a valid measure of BAS sensitivity, the BAS scale scores should predict subjects' affective reactions to the reward cues. BIS scores should not be related to the positive affect experienced, because the physiological BIS is not engaged in this situation.

As in Study 3, we also used Study 4 as an opportunity to conduct a substantive comparison between measures. In this case, we compared our BAS scales against a measure of extraversion as predictors of the target affective reaction (cf. Larsen & Ketelaar, 1991). Because we believe that our scales tap BAS sensitivity more directly than does a measure of extraversion, we expected that one or more of our scales should perform better than extraversion in predicting positive affect in response to reward cues. Such a finding would suggest that predictions derived from Gray's theory are better tested with a measure developed from that theory than with measures developed from other theoretical viewpoints, in this case Eysenck's viewpoint.

Method

Subjects were 90 undergraduates (47 men and 43 women) from the University of Miami. Two additional subjects completed the procedures described below, but were omitted from the sample before data analysis because postexperimental debriefing revealed they had guessed the point of the experimental procedures. Potential subjects completed the BIS/BAS, the 20-item version of the MAS (Bendig, 1956), and the 10-item measure of Extraversion (Eysenck & Eysenck, 1985) during large questionnaire sessions at the beginning of the semester. Later, they came to the laboratory for individual sessions. A requirement for participation was that this be the subjects' first research experience. Thus, when they arrived at this session, they had not yet earned any of the 6 experiment points required of them.

Subjects were met at the research site by an experimenter who was blind to the specific hypotheses of the study and the pretest scores of the subjects. They were led to the experimental room, where they were given a brief overview of the project and were asked to give their informed consent to participate before continuing. They then received the same set of orienting remarks used in Study 3, in which the session was portrayed as part of a project on pattern recognition. The description of the task procedure was identical to that used in Study 3.

Assessing the Dependent Measure

As in Study 3, the experimenter continued by saying that many factors influence people's intuitive skills, including transient emotional states that the person may not be particularly aware of. Because affect changes frequently over periods of even an hour, affect-relevant information would be collected periodically while the subject was working on the task. At two points during the experiment—after the explanation of the task and at a point that ostensibly was midway through the session—subjects completed mood-rating scales to assess their affect. The target affect for this study was happiness. As in Study 3, the scale measuring the target affect was embedded in scales measuring other affect qualities, which served as distractors. The first set of ratings was made immediately after completion of the task instructions just outlined, with the experimenter out of the room.

Reward-Cue Manipulation

When signing up for participation in this study, subjects had been informed that it would be possible to earn extra experiment points above and beyond the point they were earning by participating in the study. After the first set of affect ratings had been made, the experimenter explained to subjects that these extra credit points would be awarded for especially good task performances. The experimenter indicated that people who are good at this type of task are able to get about 70% of the items correct. If the subjects performed at that level or better, they would be rewarded.

Subjects' performance would be monitored by the computer across blocks of the task. For each block on which subjects guessed correctly at the rate of 70% or better, they would receive one "credit" toward extra experiment points. An extra experiment point would be awarded for every two "credits" earned. This set of instructions ensured that feedback of good performance would constitute a cue of impending reward.

After these aspects of the procedures were fully explained, the experimenter left the subject to work alone at the task. Subjects received feedback from the computer at the end of each task block (10 items each), feedback that was identical for all subjects regardless of their response choices. In this study, the feedback indicated that the subjects' performances entitled them to "credits" on six of the first seven blocks of task items (to enhance credibility, the second block was not a success). After each reward block, the computer presented a message on screen indicating that the subject had been successful at or above the criterion during that trial block and had thereby acquired one reward "credit" toward additional experiment points. Also presented was the total number of reward credits accumulated to that point. By the end of the seventh block, subjects had acquired enough credits for 3 bonus experiment points.

After the last reward message had been presented, a message appeared indicating that there was a need to reassess mood, to control for shifts during the first half of the session. The subject then made the second set of mood ratings. After the last rating was made, a message told the subject to get the experimenter. The experimenter asked several questions to assess the subjects' understanding of the events of the session and their suspicions regarding the various aspects of the task and study procedures. After this, the experimenter debriefed the subject, awarded research credit, and requested that the subject not discuss the experiment with his or her fellow students.

Results

The outcome variable in this study was subjects' self-reported levels of happiness. Subjects reported moderate levels of happiness in their initial ratings, which were made before they received instructions about how they might obtain bonus points (M = 5.68, SD = 1.63). Presumably this high baseline reflects the fact that the earlier sign-up procedure had indicated the possibility of earning extra credit during the session. Self-reported happiness increased significantly, however, from the initial measure to the measure taken at what subjects believed to be midsession (M = 7.09, SD = 1.50). By this point, all subjects had received feedback indicating that they would be receiving 3 bonus research participation credits.

The predictors of greatest interest in this study were the three BAS subscales—Drive (M = 12.03, SD = 2.90), Reward Responsiveness (M = 17.97, SD = 1.76), and Fun Seeking (M = 12.62, SD = 2.09)—and the Extraversion scale (M = 30.90, SD = 2.29). Correlations between these scales and self-ratings of happiness are shown in Table 4. A significant correlation was obtained between initial happiness and Extraversion, but comparable correlations with the BAS measures were not significant (the correlation for Fun Seeking was at $p < .07$). At midsession the picture changed, with all four personality measures being correlated significantly with self-reports of happiness.

These findings indicate that the BAS and Extraversion mea-

Table 4
Correlations of BAS Subscales and Extraversion Scores With Self-Reports of Happiness Before Receiving Complete Instructions and Midway Through the Session After Success Feedback, and Partial Correlations With the Second Self-Reports, Adjusting for the First: Study 4

Scale	Initial rating	Midsession rating	Midsession, partialing out initial
Drive	.14	.32**	.30**
Reward Responsiveness	.13	.28**	.25**
Fun Seeking	.20	.23*	.15
Extraversion	.29**	.28**	.16

Note. BAS = Behavioral Activation System.
* $p < .05$. ** $p < .01$.

sures were all reliable predictors of happiness in this situation. However, they stop short of indicating that any scale was a predictor of susceptibility to happiness as a function of exposure to cues of impending reward. To test for this susceptibility, we next related the BAS scales and Extraversion to the second measure of happiness, controlling for initial level of happiness (thus removing any effect of BAS or Extraversion in creating basal differences in happiness). Partial correlations reflecting these tests are shown in the right-hand column of Table 4. When initial happiness ratings were controlled, only two scales remained significant predictors of later happiness ratings: the Drive and Reward Responsiveness scales. The other two predictors only approached significance ($ps < .10$).

To test the ability of the Drive and Reward Responsiveness scales to predict responses to reward cues in comparison with Extraversion, multiple regression analyses were conducted separately for each of the two BAS scales, entering the relevant BAS scale, initial happiness, and Extraversion simultaneously. These analyses indicated that both Drive and Reward Responsiveness (when tested individually) remained significant predictors of midsession happiness after taking into account both Extraversion and initial happiness ($\beta = .24, p < .02$, and $\beta = .19, p < .05$, respectively). In neither case did Extraversion make a unique contribution to prediction. When Drive and Reward Responsiveness were both entered into the same analysis, however, only Drive contributed uniquely to prediction ($\beta = .21, p < .04$). Apparently, then, much of the predictive effect of the Reward Responsiveness scale in this context is attributable to its overlap with the Drive scale.

The final question was whether happiness was differentially predicted by the BAS scales, as opposed to the BIS scale. Accordingly, further regression analyses were conducted in which the BIS scale was also included as a predictor. The addition of this scale did not alter the outcome appreciably. Taken individually, the Drive and Reward Responsiveness scales each remained significant predictors of midsession happiness (and were the only personality measures to do so). When Drive, Reward Responsiveness, Extraversion, and BIS were all entered simultaneously (along with initial happiness), the unique effect of Drive remained significant ($\beta = .21, p < .04$) and the unique effect of Reward Responsiveness remained marginal ($p < .09$), with no other personality effect approaching significance.

Discussion

When arriving at the laboratory for this study, subjects knew it would be possible for them to earn a reward beyond the normal credit for participation. Extraversion was significantly related to self-reports of happiness at this point, but our BAS scales were not (only Fun Seeking approached significance, at $p < .07$). Subjects then completed a series of performance trial blocks in which they were given feedback indicating that they would be receiving bonus experiment participation points. The levels of happiness that were reported after this feedback were higher overall than those reported earlier and were correlated with all four of the personality measures.

Further analyses revealed, however, that only Drive and Reward Responsiveness significantly predicted this later happiness report after controlling for initial levels of happiness. Fun Seeking and Extraversion were only marginally significant predictors when tested in this way. Thus, they tended to represent more of a "main effect" in the data, that is, an initial effect on happiness that carried over into the subsequent rating but was not strongly responsive to the intervening events. In contrast, the BAS Drive and Reward Responsiveness scales more clearly predicted positive affective responses to the signals of impending reward. Multiple regression analysis revealed that the best predictor of this happiness response to the reward cues was the Drive scale, which made a unique contribution to prediction above and beyond the effects it shared with Reward Responsiveness, Extraversion, and earlier happiness ratings.

Taken as a whole, the pattern of the data is quite consistent with Gray's conceptual model, in that measures designed to reflect BAS sensitivity predicted positive emotional reactions to cues of impending reward. Also consistent with Gray's model was the fact that the BIS scale was not a significant predictor of this effect. In supporting the predictions of Gray's model, the pattern as a whole also appears to suggest considerable support for the construct validity of one of the BAS scales (Drive), moderate support for a second (Reward Responsiveness), and more modest support for the third (Fun Seeking).

We should note that at this stage of work it is difficult to know whether this pattern of support for the validity of the three BAS scales implies that the Drive scale will be the most important and useful of the three, or whether the three scales will prove to have differential usefulness in different research contexts. Only by testing their predictive ability in a broader range of settings can this be determined. For example, whereas Drive and Reward Responsiveness appear to have larger impact on how people respond to cues of impending reward in the midst of behavioral efforts, Fun Seeking may be more important in determining the extent to which people are enticed to enter potentially rewarding situations. To put this another way, these findings do not complete the validation process, but only begin it.

General Discussion

We have described here the development of a new set of brief self-report measures intended to assess individual differences in personality qualities that reflect the sensitivity of two physiological self-regulatory systems, one of which bears on appetitive motivation, the other of which bears on aversive motivation. The work reported here consisted of three steps. First we developed sets of items that reflected the kinds of responses that theoretically should be linked to the physiological regulatory systems in question. Then we correlated the resulting scales with theoretically related alternative measures. Finally, we used the scales to predict criterion variables that are clearly specified by the theory underlying the project and are also relevant to broader aspects of human behavior. In these latter two studies, we found that the BIS scale successfully predicted level of nervousness in response to an impending punishment and that BAS scales successfully predicted happiness in response to an impending reward. Taken as a group, the studies provide initial support for the idea that the BIS/BAS scales validly reflect individual differences in the sensitivity of the presumed underlying neurophysiological regulatory systems.

Comparisons Among Measures

Not only did the BIS/BAS scales predict the affective outcomes in Studies 3 and 4, but in each case they did so better than did an alternative measure with which they were being compared. In both instances, the superior prediction has conceptual significance.

With respect to Study 3, the results appear to indicate that measures of anxiety proneness are not all alike. That the BIS was a better predictor of nervousness than was the MAS in response to cues of impending punishment would seem to support our contention that a measure of anxiety proneness should be focused on assessing responses to anxiety-provoking situations rather than on assessing general affective tone (see also Endler, Parker, Bagby, & Cox, 1991). Some will ask whether the world really needs another measure of vulnerability to anxiety, but this question is answered at least in part by the data from Study 3. Certainly our measure is not without limitations. For example, it is not as differentiated as are some measures with respect to the situations that are invoked during assessment (e.g., Endler et al., 1991). On the other hand, it is very brief and thus is useful in contexts where longer measures would be hard to implement.

Study 4 incorporated a different kind of comparison between scales. In Study 4, two of the BAS scales were better predictors of positive affect in response to reward cues than was a measure of extraversion. These findings would appear to suggest that predictions about affective responses that are made from Gray's theory are better tested with measures such as our BIS/BAS scales than with measures deriving from other theoretical vantage points. If we had conducted this study using only the measure of extraversion, we would have been able to report that there was a relationship between extraversion and positive affect, much as was found by Larsen and Ketelaar (1991; see also Costa & McCrae, 1980). It would have been more ambiguous, however, whether the effect was attributable to BAS sensitivity (as hypothesized) or instead to extraversion per se (an ambiguity that was inherent in Larsen & Ketelaar's findings). Given the better prediction by the BAS scales than the Extraversion scale in Study 4, we are able to assert with greater confidence that the effect derived from variations in BAS sensitivity.

Broader Contexts and Future Directions

We close this article by briefly considering broader issues, which relate to the studies conducted here but also take us well beyond these studies. One issue concerns the somewhat artificial setting of the laboratory studies reported here. Subjects in Study 3 were exposed to a pain-inducing stimulus for a controlled period of time and then (in the context of an experimental task) received cues indicating that they would soon be exposed again to the same stimulus. Subjects in Study 4 received cues indicating that they would soon be awarded a desired commodity (bonus experiment points). We used these artificial situations because they constituted opportunities to exert close control over the stimulus context and in so doing permitted us to engage one of the two systems at a time.

It should be noted that although the situations we constructed were artificial, the psychological processes we engaged in these situations are extremely general. That is, affect is evoked by a great many circumstances in the natural flow of life. Our findings indicate that different people experience differing intensities of affect when in such situations and that the intensities of affect experienced are predictable from their earlier self-reports. Presumably this will be true in more naturalistic settings, as well as in the laboratory.

Furthermore, although affect can be viewed as an endpoint of a given study (as was the case here), affect is not necessarily the endpoint of a phenomenal chain. Experiencing affect can lead to many potential consequences. Affect creates a basis for learning, and affect can influence decisions a person makes about what subsequent behavior to engage in. The implications of this interrelation between affect and other aspects of human experience are potentially far reaching, certainly much farther than we have reached in our research on this topic thus far.

Our final point follows this line of thought one step further. Our focus in this research has been on affective manifestations of BAS and BIS functioning. There are, of course, other important manifestations of the functioning of these two systems. The systems are also presumed to influence the creation or withholding of overt behavior.

A quality of behavior that many theorists have related conceptually to BAS and BIS activity is impulsiveness (see, e.g., Gray et al., 1983; Newman, 1987; Newman, Widom, & Nathan, 1985; Wallace, Newman, & Bachorowski, 1991). Theorists disagree, however, regarding the source of impulsiveness. It is sometimes argued that impulsiveness reflects high levels of BAS activity, as the person is drawn strongly to desired stimuli. It is sometimes held that impulsiveness reflects low levels of BIS activity, such that the person displays an inability to restrain impulses in the face of impending punishment. It has also been argued that impulsive behavior does not stem intrinsically from either of these two systems, but derives instead from a more complex interweaving of forces, forces that go beyond the systems proposed by Gray (Newman, Patterson, Howland, & Nichols, 1990; Patterson & Newman, 1993).

Indeed, there is evidence that impulsiveness itself has several different facets (Parker, Bagby, & Webster, 1993). This raises questions about whether different conceptual models may be relevant to different manifestations of impulsiveness. In sum, the puzzle of the determinants of impulsive behavior appears to be one that will require considerably more work to solve.

The data reported in this article do not address these issues directly, but the scales reported here provide an empirical tool for doing so in future research. The scales are grounded in theory, in psychometric evidence concerning their convergence and divergence with other measures, and in laboratory tests of their predictive validity in the ongoing stream of behavior. In considering the nature of impulsivity, as well as in other research areas, a broad range of empirical predictions can be made relating to Gray's theory—and to other theories of the same broad family—that are worthy of further attention. We hope the BIS/BAS scales will be viewed as useful measures for examining these predictions.

References

Bendig, A. W. (1956). The development of a short form of the manifest anxiety scale. *Journal of Consulting Psychology, 20,* 384.

Burisch, M. (1984a). Approaches to personality inventory construction: A comparison of merits. *American Psychologist, 39,* 214–227.

Burisch, M. (1984b). You don't always get what you pay for: Measuring depression with short and simple versus long and sophisticated scales. *Journal of Research in Personality, 18,* 81–98.

Carver, C. S., Blaney, P. H., & Scheier, M. F. (1979). Focus of attention, chronic expectancy, and responses to a feared stimulus. *Journal of Personality and Social Psychology, 37,* 1186–1195.

Carver, C. S., & Scheier, M. F. (1986). Functional and dysfunctional responses to anxiety: The interaction between expectancies and self-focused attention. In R. Schwarzer (Ed.), *Self-related cognitions in anxiety and motivation* (pp. 111–141). Hillsdale, NJ: Erlbaum.

Carver, C. S., & Scheier, M. F. (1990). Origins and functions of positive and negative affect: A control-process view. *Psychological Review, 97,* 19–35.

Cloninger, C. R. (1987). A systematic method for clinical description and classification of personality variants. *Archives of General Psychiatry, 44,* 573–588.

Costa, P. T., & McCrae, R. R. (1980). Influence of extraversion and neuroticism on subjective well-being: Happy and unhappy people. *Journal of Personality and Social Psychology, 38,* 668–678.

Depue, R. A., & Iacono, W. G. (1989). Neurobehavioral aspects of affective disorders. *Annual Review of Psychology, 40,* 457–492.

Depue, R. A., Krauss, S. P., & Spoont, M. R. (1987). A two-dimensional threshold model of seasonal bipolar affective disorder. In D. Magnusson & A. Öhman (Eds.), *Psychopathology: An interactional perspective* (pp. 95–123). San Diego, CA: Academic Press.

Diaz, A., & Pickering, A. D. (1993). The relationship between Gray's and Eysenck's personality spaces. *Personality and Individual Differences, 15,* 297–305.

Endler, N. S., Parker, J. D. A., Bagby, R. M., & Cox, B. J. (1991). Multidimensionality of state and trait anxiety: Factor structure of the Endler multidimensional anxiety scales. *Journal of Personality and Social Psychology, 60,* 919–926.

Eysenck, H. J. (1967). *The biological basis of personality.* Springfield, IL: Charles C Thomas.

Eysenck, H. J., & Eysenck, S. B. G. (1975). *Manual for the Eysenck Personality Questionnaire.* London: Hodder and Stoughton.

Eysenck, H. J., & Eysenck, M. W. (1985). *Personality and individual differences: A natural science approach.* New York: Plenum.

Fowles, D. C. (1980). The three arousal model: Implications of Gray's two-factor learning theory for heart rate, electrodermal activity, and psychopathy. *Psychophysiology, 17,* 87–104.

Fowles, D. C. (1987). Application of a behavioral theory of motivation to the concepts of anxiety and impulsivity. *Journal of Research in Personality, 21,* 417–435.

Fowles, D. C. (1988). Psychophysiology and psychopathology: A motivational approach. *Psychophysiology, 25,* 373–391.

Fowles, D. C. (1993). Biological variables in psychopathology: A psychobiological perspective. In P. B. Sutker & H. E. Adams (Eds.), *Comprehensive handbook of psychopathology* (2nd ed., pp. 57–82). New York: Plenum.

Gough, H. G. (1956). *Manual for the California Psychological Inventory.* Palo Alto, CA: Consulting Psychologists Press.

Gough, H. G. (1960). Theory and measurement of socialization. *Journal of Consulting Psychology, 24,* 23–30.

Gough, H. G., & Peterson, D. R. (1952). The identification and measurement of predispositional factors in crime and delinquency. *Journal of Consulting Psychology, 16,* 207–212.

Gray, J. A. (1972). The psychophysiological basis of introversion–extraversion: A modification of Eysenck's theory. In V. D. Nebylitsyn & J. A. Gray (Eds.), *The biological bases of individual behaviour* (pp. 182–205). San Diego, CA: Academic Press.

Gray, J. A. (1977). Drug effects on fear and frustration: Possible limbic site of action of minor tranquilizers. In L. L. Iversen, S. D. Iversen, & S. H. Snyder (Eds.), *Handbook of psychopharmacology* (Vol. 8, pp. 433–529). New York: Plenum.

Gray, J. A. (1978). The 1977 Myers lecture: The neuropsychology of anxiety. *British Journal of Psychology, 69,* 417–434.

Gray, J. A. (1981). A critique of Eysenck's theory of personality. In H. J. Eysenck (Ed.), *A model for personality* (pp. 246–276). Berlin: Springer-Verlag.

Gray, J. A. (1982). *The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system.* New York: Oxford University Press.

Gray, J. A. (1985). Issues in the neuropsychology of anxiety. In A. H. Tuma & J. D. Maser (Eds.), *Anxiety and the anxiety disorders* (pp. 5–25). Hillsdale, NJ: Erlbaum.

Gray, J. A. (1987a). Perspectives on anxiety and impulsivity: A commentary. *Journal of Research in Personality, 21,* 493–509.

Gray, J. A. (1987b). *The psychology of fear and stress.* Cambridge, England: Cambridge University Press.

Gray, J. A. (1990). Brain systems that mediate both emotion and cognition. *Cognition and Emotion, 4,* 269–288.

Gray, J. A., Owen, S., Davis, N., & Tsaltas, E. (1983). Psychological and physiological relations between anxiety and impulsivity. In M. Zuckerman (Ed.), *Biological bases of sensation seeking, impulsivity, and anxiety* (pp. 181–217). Hillsdale, NJ: Erlbaum.

Hare, R. D. (1980). A research scale for the assessment of psychopathy in criminal populations. *Personality and Individual Differences, 1,* 111–119.

Larsen, R. J., & Ketelaar, T. (1991). Personality and susceptibility to positive and negative emotional states. *Journal of Personality and Social Psychology, 61,* 132–140.

MacAndrew, C., & Steele, T. (1991). Gray's behavioral inhibition system: A psychometric evaluation. *Personality and Individual Differences, 12,* 157–171.

Megargee, E. I. (1972). *The California Psychological Inventory handbook.* San Francisco: Jossey-Bass.

Newman, J. P. (1987). Reaction to punishment in extraverts and psychopaths: Implications for the impulsive behavior of disinhibited individuals. *Journal of Research in Personality, 21,* 464–480.

Newman, J. P., & Kosson, D. S. (1986). Passive avoidance learning in psychopathic and nonpsychopathic offenders. *Journal of Abnormal Psychology, 95,* 252–256.

Newman, J. P., Patterson, C. M., Howland, E. W., & Nichols, S. L. (1990). Passive avoidance in psychopaths: The effects of reward. *Personality and Individual Differences, 11,* 1101–1114.

Newman, J. P., Widom, C. S., & Nathan, S. (1985). Passive avoidance and syndromes of disinhibition: Psychopathy and extraversion. *Journal of Personality and Social Psychology, 48,* 1316–1327.

Parker, J. D. A., Bagby, R. M., & Webster, C. D. (1993). Domains of the impulsivity construct: A factor analytic investigation. *Personality and Individual Differences, 15,* 267–274.

Patterson, C. M., & Newman, J. P. (1993). Reflectivity and learning from aversive events: Toward a psychological mechanism for the syndromes of disinhibition. *Psychological Review, 100,* 716–736.

Quay, H. C. (1988). The behavioral reward and inhibition system in childhood behavior disorders. In L. M. Bloomingdale (Ed.), *Attention deficit disorder* (Vol. 3, pp. 176–186). Elmsford, NY: Pergamon Press.

Quay, H. C. (1993). The psychobiology of undersocialized aggressive conduct disorder: A theoretical perspective. *Development and Psychopathology, 5,* 165–180.

Scheier, M. F., & Carver, C. S. (1985). Optimism, coping, and health: Assessment and implications of generalized outcome expectancies. *Health Psychology, 4,* 219–247.

Smith, T. W., Pope, M. K., Rhodewalt, F., & Poulton, J. L. (1989). Op-

timism, neuroticism, coping, and symptom reports. *Journal of Personality and Social Psychology, 56,* 640–648.

Steiger, J. H. (1980). Tests for comparing elements of a correlation matrix. *Psychological Bulletin, 87,* 245–251.

Stellar, J. R., & Stellar, E. (1985). *The neurobiology of motivation and reward.* New York: Springer-Verlag.

Taylor, J. A. (1953). A personality scale for manifest anxiety. *Journal of Abnormal and Social Psychology, 48,* 285–290.

Tellegen, A. (1985). Structures of mood and personality and their relevance to assessing anxiety, with an emphasis on self-report. In A. H. Tuma & J. D. Maser (Eds.), *Anxiety and the anxiety disorders* (pp. 681–706). Hillsdale, NJ: Erlbaum.

Torrubia, R., & Tobeña, A. (1984). A scale for the assessment of "susceptibility to punishment" as a measure of anxiety: Preliminary results. *Personality and Individual Differences, 5,* 371–375.

Wallace, J. F., Newman, J. P., & Bachorowski, J. (1991). Failures of response modulation: Impulsive behavior in anxious and impulsive individuals. *Journal of Research in Personality, 25,* 23–44.

Waller, N. G., Lilienfeld, S. O., Tellegen, A., & Lykken, D. T. (1991). The Tridimensional Personality Questionnaire: Structural validity and comparisons with the Multidimensional Personality Questionnaire. *Multivariate Behavioral Research, 26,* 1–23.

Watson, D., & Clark, L. A. (1993). Behavioral disinhibition versus constraint: A dispositional perspective. In D. M. Wegner & J. W. Pennebaker (Eds.), *Handbook of mental control* (pp. 506–527). Englewood Cliffs, NJ: Prentice-Hall.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54,* 1063–1070.

Wilson, G. D., Barrett, P. T., & Gray, J. A. (1989). Human reactions to reward and punishment: A questionnaire examination of Gray's personality theory. *British Journal of Psychology, 80,* 509–515.

Wilson, G. D., Gray, J. A., & Barrett, P. T. (1990). A factor analysis of the Gray–Wilson personality questionnaire. *Personality and Individual Differences, 11,* 1037–1045.

Wolfe, R. N., & Kasmer, J. A. (1988). Type versus trait: Extraversion, impulsivity, sociability, and preferences for cooperative and competitive activities. *Journal of Personality and Social Psychology, 54,* 864–871.

Zinbarg, R., & Revelle, W. (1989). Personality and conditioning: A test of four models. *Journal of Personality and Social Psychology, 57,* 301–314.

Received July 1, 1993
Revision received March 14, 1994
Accepted March 20, 1994 ■