

Low Spirits Keep Rewards Subdued: Decreases in Sensitivity to Reward and Vulnerability to Dysphoria

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Previous theories and research show clear divergences on the roles of the behavioral activation system (BAS) and the behavioral inhibition system (BIS) in depression. Across four studies, we examined the effects of a sad mood on the motivational pattern of sensitivity to reward and punishment. Psychological variables associated with such changes and implications for vulnerability to depression were also explored. For this purpose, we designed a state version of the extensively used BIS/BAS Scales (Carver & White, 1994). Using samples of undergraduate students, we found that both a natural (Study 1) and a laboratory-induced sad mood (Studies 2 and 3) generated a marked decrease in sensitivity to reward but did not alter sensitivity to punishment. Study 3a showed that participants' anxious attachment predicted larger decreases in sensitivity to reward after a sad mood induction. Study 3b extended these results by showing that sensitivity to reward, when assessed after the negative mood induction, predicted increases in dysphoria 7 weeks later. Implications of the results for research on vulnerability to depression are discussed.

Keywords: BIS/BAS; depression; mood; punishment; reward

MANY AUTHORS (e.g., Fowles, 1993; Gray, 1987; Lang, 1995) have proposed the existence of two independent motivational systems for the regulation

of behavior. Research on these motivational systems has mainly been conducted within the framework of Gray's (1987) reinforcement sensitivity theory. Gray's original model suggested that there are two neurobiologically independent systems of appetitive and aversive motivation. The behavioral activation system (BAS) motivates behavior in response to cues for reward and absence of punishment, and it is also responsible for escape behaviors. The behavioral inhibition system (BIS), in contrast, motivates behavior in response to cues for punishment and absence of reward, controlling for the reaction to novel stimuli. Activation of the BAS is associated with behaviors of approach toward desirable outcomes, feelings of euphoria, and reward seeking. Activation of the BIS is associated with avoidance behaviors, feelings of anxiety in the presence of signs of punishment, and feelings of frustration in the absence of reward (Gray, 1987).¹

Although the BIS/BAS proposal has been elaborated and investigated in a number of different respects (e.g., Gray & McNaughton, 2000), its implications for the field of psychopathology are particularly important (see Bijttebier, Beck, Claes, & Vandereycken, 2010, for a review). Gray's theory has had the most significant impact on the study of affective disorders. Regarding depression, Gray suggested that individuals exhibiting greater sensitivity to punishment would be more vulnerable to

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¹ When referring to the level of activation of the BIS and BAS, different authors have used various labels, such as impulsivity and anxiety (Gray, 1987), BIS and BAS sensitivities (Carver & White, 1994), and sensitivity to reward and punishment (Torrubia, Avila, Molto, & Caseras, 2001) among others. We employed the labels "sensitivity to reward" and "sensitivity to punishment" throughout this article because we believe they are more clear and neutral than the other labels.

anxious–depressive disorders, whereas greater sensitivity to reward would be related to impulsivity disorders (Gray, 1987). Later, Gray (1991) also hypothesized that low sensitivity to reward might also be related to anhedonic depression.

Similarly, the tripartite model of anxiety and depression proposed that low sensitivity to reward and low positive affect are specific to depression (L. A. Clark & Watson, 1991) but also noted that the BIS is a negative motivational-affective system that is important both in depression and anxiety (L. A. Clark, Watson, & Mineka, 1994; see also Zinbarg & Yoon, 2008). Thus, different theories suggest that depression is associated with lower sensitivity to reward and higher sensitivity to punishment. Various studies have confirmed that depressed individuals present significantly lower levels of sensitivity to reward (Kasch, Rottenberg, Arnow, & Gotlib, 2002; Pinto-Meza et al., 2006) and higher levels of sensitivity to punishment (Johnson, Turner, & Iwata, 2003; Pinto-Meza et al., 2006).

However, other theories have argued that only sensitivity to reward is relevant to understanding depression (Depue & Iacono, 1989; Fowles, 1993) and many research findings support this proposal. For example, although several studies have shown that clinically depressed individuals present reduced reactivity to positive stimuli in general (e.g., Rottenberg, Kasch, Gross, & Gotlib, 2002; see Bylsma, Morris, & Rottenberg, 2008, for a review) and to rewards in particular (Henriques & Davidson, 2000; Henriques, Glowacki, & Davidson, 1994; McFarland & Klein, 2008), they failed to find elevated reactivity or sensitivity to negative stimuli or punishments. The same pattern of results has been observed when analyzing life goals of depressed adolescents. Dickson and MacLeod (2004) found that depression was associated with an approach-motivational deficit but not with augmented avoidance motivation.

In longitudinal studies, only sensitivity to reward and reactivity to positive stimuli, not the BIS or reactivity to negative stimuli, have been able to predict better recovery of depressed patients (Kasch et al., 2002; McFarland, Shankman, Tenke, Bruder, & Klein, 2006; Rottenberg et al., 2002). On the other hand, the only study to our knowledge that examined the ability of sensitivity to reward or anhedonia to predict increases in depressive symptoms over time failed to find significant results (D. C. Clark, Salazar-Gruesco, Grabler, & Fawcett, 1984).

Thus, sensitivity to punishment has not been found to be relevant for depression in laboratory or longitudinal studies. Laboratory studies have found a BAS deficit in depressed individuals, but longitudinal studies have yielded divergent results depend-

ing on the sample used: BAS scores predicted changes in depressive symptoms in clinical samples, but no significant results were found when a nondepressed sample was used. What could be the reason for these contradictory findings? Motivational vulnerability may remain latent when individuals are in a euthymic mood state and be activated by negative life events. Consequently, it is possible that only sensitivity to reward assessed after the mood induction, but not before, predicts increases in depressive symptoms. Indeed, some prior work supports this mood-dependent hypothesis. Research on vulnerability to depression has found that a sad mood can activate vulnerability processes that remain concealed during a euthymic mood. For example, some studies have found that negative cognitive biases can predict increases of depressive symptoms over time when assessed after a sad mood induction but not when assessed during a euthymic mood (e.g., Beevers & Carver, 2003). Thus, exploring changes in sensitivity to punishment and reward after a sad mood may help to explain the role of such variables in the development of depression.

In summary, some researchers have suggested that depression is associated with a reduced sensitivity to reward and an increased sensitivity to punishment. However, others have hypothesized that only sensitivity to reward is associated with depression. Overall, results from longitudinal studies and from studies using methods other than self-report suggest that only sensitivity to reward is associated with depression. However, it is not entirely clear whether sensitivity to reward predicts an increase in depressive symptoms over time when a nondepressed sample is used.

Exploring the effects of the onset of a depressed mood on the motivational systems could shed light on these contradictory results. Surprisingly, the causal relationship between mood and changes in sensitivity to reward and punishment has not been explored yet. Perhaps the most important explanation for this absence of studies is the lack of self-report measures that assess state sensitivity to punishment and reward. Therefore, we developed a state measure of sensitivity to reward and punishment based on the BIS/BAS Scales (Carver & White, 1994), the characteristics of which will be detailed below. Some indirect evidence indicates that changes in sensitivity to punishment or reward after the onset of a sad mood are plausible. For instance, it has been found that hedonic capacity, which is theoretically related to the BAS, might diminish after a negative mood (Carson & Adams, 1980). More recently, another line of research has demonstrated that stress induction may reduce reward responsiveness (Bogdan & Pizzagalli, 2006).

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