

ABSTRACT

WRENN, SARA CORDELIA. Behavioral Inhibition, Behavioral Activation, and Spontaneous Attribution. (Under the direction of Katherine W. Klein).

Multilevel linear modeling was used to evaluate the effects of situation- and individual-level variables on participants' appraisals of event outcomes. Situation vignettes were manipulated to have positive or negative and expected or unexpected outcomes; 180 undergraduate participants rated the valence and expectedness of these outcomes and completed Carver & White's (1994) BIS/BAS scales. BIS/BAS scores accounted for significant variability in individuals' ratings of outcome valence and expectedness, beyond the significant main effects of the situational manipulations, and despite strong consensus on the direction of the manipulations. Results suggest that individuals vary in their appraisals of relatively unambiguous situations, and that individual differences in dispositional behavioral inhibition and activation systematically explain a meaningful component of this variation. These results suggest that further studies are warranted, to assess whether BIS and BAS are predictive of participants' propensities to engage in causal thinking in response to the same vignette manipulations, and whether BIS and BAS exert effects on causal thinking other than as a function of differences in appraisal.

Behavioral Inhibition, Behavioral Activation, and Spontaneous Attribution

by

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During graduate school at North Carolina State University, Sara developed an enduring love of teaching (statistics/research methods, social psychology, educational psychology, introduction to psychology). She has also taught courses offered by Duke University's Talent Identification Program for academically gifted youth, North Carolina State University's NCTEACH program for lateral entry teachers, and Meredith College. Her interest in promoting research ethics via undergraduate psychology instruction lead her to receive a North Carolina State University Research Ethics in Teaching Fellowship.

Sara's conference presentations and publications have touched on issues such as the effects of victim impact evidence on jurors' sentencing decisions, comprehensibility of judges' instructions to jurors in capital cases, potential impacts of conducting competency hearings via closed-circuit television, children's affective social competence, promoting condom use among women who use IV drugs/crack cocaine, and the dispositional and situational antecedents of causal thinking.

Sara's current research interests include the use of multilevel linear modeling to look at shifting intra-individual response tendencies, self-regulation, behavioral inhibition and attribution, and the interface between social psychology, cognitive neuroscience, and evolutionary theory.

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INTRODUCTION

The purpose of this research is to focus on physiologically-based systems underlying adaptive responses to environmental cues, and establish a rationale for exploring the relationships between the functioning of these neural systems and individuals' propensities for engaging in causal thinking in response to social stimuli. The neural systems in question are the Behavioral Inhibition System (BIS), and the Behavioral Activation System (BAS). According to Gray (1975, 2000), BIS is activated by cues predicting punishment or frustrative nonreward, and serves to promote the inhibition or cessation of ongoing behavior. Fowles (1980) proposed a complementary system, BAS, which responds to cues signifying potential rewards or escape from punishment and promotes goal-directed behavior. Fowles (1980) further suggested that BIS and BAS directly impact the appraisal of cues and construal of situations. Construal and appraisal are in turn relevant to attribution: causal thinking is more likely following outcomes construed as negative and/or unexpected (Wong & Weiner, 1981). Individual differences in BIS/BAS sensitivities may thus affect the outcome type-causal thinking relationship via the appraisal of cues and the construal of situations. The possibility that individual differences in BIS &/or BAS system sensitivities may affect the propensity to engage in causal thinking more directly is also considered. Before describing the particulars of the study that was conducted in this investigation and the proposed future research, the rationale behind this approach to understanding the initiation of causal thinking is presented in more detail.

The first set of findings presented herein summarize what is known about the situational antecedents and adaptive functions of causal thinking. Next, the contributions of automatic and inaccessible processes to social cognition and behavior in general are discussed, and the implications of these findings regarding causal thinking in particular are explored. At this point, the possibility that engaging in causal thinking may serve an adaptive function other than those already recognized in the literature (generation of inferences to guide subsequent behavior, self-enhancement, and affect regulation) is raised. BIS and BAS are next discussed as systems that enable humans to evaluate situations in terms of the likelihood of desirable versus negative outcomes and to promote appropriate responses. Evidence that there is a physiological basis for systems performing these functions is briefly introduced, and Gray's (2000) model of BIS and BAS functioning is explored in some detail. Next, the affective, cognitive and behavioral tendencies characterizing disorders in which BIS and BAS abnormalities are implicated is presented as evidence that there may be a relationship between BIS/BAS and attributional processes. In particular, it is argued that BIS and BAS as conceptualized by Gray (2000) should contribute to individuals' propensities to engage in causal thinking to the extent that these systems are activated by relevant situational cues. In addition, the possibility that causal thinking serves a previously unrecognized function (enhancement of behavioral inhibition) and or that it is simply an experiential correlate of underlying inhibitory processes is presented in more detail.

Antecedents and Functions of Causal Thinking

When do individuals engage in causal thinking—considering the possible antecedents of outcomes and constructing attributions of causality—and do they do so without being asked or prompted to do so? Because attribution research has taken place largely within the context of social psychology, the existing answers refer almost exclusively to the characteristics of situations that elicit spontaneous causal thinking. This focus on the situational utility of the attributions themselves has promoted a view of causal thinking as a volitional and goal-driven process. According to Wong & Weiner (1981), individuals do engage in causal thinking spontaneously, but not for every event or outcome that they experience. Instead, causal thinking is most likely to occur in response to outcomes that are negative or that violate expectations. This finding makes sense in light of the clear utility of reaching correct conclusions concerning the causes of events in one's environment; attributions that elucidate actual causal relationships can promote adaptive behavior in light of this understanding, enabling individuals to avoid undesirable outcomes and to better predict what will happen to them. When the individual's primary goal is understanding and adaptation, expected and/or positive outcomes are less likely to instigate causal thinking, presumably because the underlying causes are already adequately understood and managed.

Attributions also assist individuals with maintaining desired self-cognitions and emotional states, as in the case of self-serving attributional biases. When self-enhancement or affect regulation goals take precedence, the usefulness of an attribution is

less tied to the extent to which it accurately reflects the actual causes of events and outcomes, and the likelihood of initiating causal search is less dependent on the valence and expectedness of outcomes. In fact, individuals who are motivated to preserve or enhance their self-esteem may produce more attributions following successful outcomes (Moller, 1996), even when these outcomes are expected. However, attributions and the cognitive processes that produce them are primarily seen as phenomena serving the goal of producing adaptive behavior through enhanced understanding of contingencies—or at least through a goal-serving understanding of what has taken place.

In both of these cases, causal thinking is treated as a process that individuals engage in deliberately for the purpose of generating explanations for events and event outcomes. BIS and BAS could be implicated in this explicit and purposeful attributional processing, via the appraisal of relevant cues. However, several lines of inquiry and evidence suggest that automatic and inaccessible processes also contribute substantially to social cognition and social behavior (including cognitions regarding causality), and these will be considered as well.

Social Cognition and Behavior are Enabled by Automatic and Inaccessible Processes

One line of research suggesting that social cognition is influenced by underlying automatic processes produced the finding that people are often unable to accurately report on the causes of their own behavior (Nisbett & Wilson, 1977). This suggests that at least some of the time attributions may be post-hoc rationalizations for behaviors, betraying little or no awareness of the actual causes. Gazzaniga & LeDoux's (1978) work with

split-brain patients supported this conclusion; participants' speech-capable left hemispheres would respond to questions about why they had performed particular actions by producing explanations for the behaviors that incorporated references to and inferences about situational factors. In fact, these behaviors were responses to requests shown only to the right hemisphere, which could neither speak nor communicate this information to the left hemisphere. Thus the explanations offered (and apparently believed) by the speech-capable left hemisphere were spurious but plausible confabulations.

Research on phenomena such as attitude formation, motor influences on emotion and cognition, and mere exposure effects have also shown that inaccessible processes contribute to ongoing experience and behavior. To the extent that these processes involve the acquisition of associations and/or behaviors related to approach or avoidance goals, the possibility that BIS and BAS functioning underlie these processes should be considered.

Although no single definition of "attitude" currently satisfies all researchers and theorists, Eagly & Chaiken (1993) point to wide consensus on the idea that attitudes involve evaluation of a target. Attitudes may form as a result of classical conditioning based on either explicit or implicit associations (Breckler, 1993; Krosnick, Jussim, & Lynn, 1992). When the learner is unaware of the contingent relationship between stimuli, conditioning may still occur, "without deduction from beliefs about object attributes" (Krosnick, Jussim, & Lynn, 1992, p. 153). The operant conditioning of attitudes may

also involve implicit processes that occur outside of awareness. Cacioppo, Priester, & Berntson (1993) hypothesized that positive attitudes could be operantly conditioned to ideographs presented during arm flexions because “arm extension is temporally coupled with the onset of the unconditional aversive stimulus, whereas flexion is associated with its offset; when retrieving desirable stimuli, arm flexion is more closely coupled temporally to the acquisition or consumption of the desired stimuli than arm extension” (p. 5). This hypothesis was supported; participants did rate Chinese ideographs presented during flexion more positively, but only when the ratings were made at the time of presentation, suggesting that the effects of kinesthetic cues on attitude formation are dependent on the presence of the body state. Priester, Cacioppo, & Petty (1996) found similar effects of arm flexion and extension on attitudes towards words and non-words. Again, attitudinal preferences for the stimuli presented during arm flexion supported the hypothesis that implicit cues emerging from behavior or body states can lead to operantly conditioned attitudes. Neumann & Strack (2000, Study 2) tested the effects of another seemingly arbitrary kinesthetic cue, perceived motion towards versus away from a computer screen, on the processing of positive or negative concepts. They hypothesized that perceived movement away from the screen would activate an avoidance system and facilitate the categorization of negative words, whereas perceived movement towards the screen would activate an approach system and facilitate the categorization of positive words. Both positive and negative adjectives were assigned to categories more rapidly when presented in conjunction with compatible experiences of motion. Note that the

conditioning demonstrated in these studies relies on the automatic appraisal of stimuli taking place outside of awareness. Interpretation of the findings as suggestive of the activation of separable approach and avoidance systems is largely consistent with conceptualizations of BIS and BAS (Gray, 1975, 2000; Fowles, 1980).

Zajonc (1968) proposed that mere exposure to a stimulus is a sufficient condition for increased liking towards the stimulus. Mere exposure effects occur in the absence of reinforcement or obvious positive associations being paired with the attitude object. However, mere exposure can be explained in terms of classical conditioning, with the lack of aversive experiences associated with the stimulus serving as the unconditioned stimulus (Zajonc, 2001). Typically, individuals do not realize that their attitude toward a stimulus has been formed or altered on the basis of mere exposure—the effects take place on an implicit level, outside of awareness. Mere exposure has been shown to increase liking even when exposure times are extremely short, when the stimulus has been made unrecognizable, and when the stimulus has been presented so many times that habituation and boredom with the stimulus would appear likely (Harrison, 1977). Even stimuli that are initially disliked come to be viewed more positively after repeated exposures (Bornstein, 1989). Again, automatic affective appraisal of stimuli contributes to the acquisition of a preference or response tendency without requiring the individual's awareness of contingencies or associations; Zajonc (2001) and Bornstein (1989) both conclude that cognitive mediation is not necessary for mere exposure effects to occur. In addition, Bornstein's (1989) meta-analysis indicated that the observed magnitude of the

mere exposure effect is negatively related to the degree to which participants are aware of their exposure history with the stimulus. This suggests that knowledge of prior exposure contributes to participants' engaging in discounting—taking into account the possibility that familiarity may be biasing them towards greater liking for the stimulus than is apparently warranted, and revising their preference or liking for the stimulus downward. It is also possible that the reduced effect sizes observed when exposure is supraliminal rather than subliminal can be attributed to relatively greater between-participants variability when stimuli are subjected to explicit cognitive appraisal (Zajonc, 2001). Repeated exposure in the absence of explicit knowledge of this prior exposure, on the other hand, contributes to increased liking for stimuli and to a willingness to engage in causal search in order to offer ultimately spurious explanations for the acquired preference.

In sum, when asked to do so people will confidently offer plausible explanations for their responses to stimuli and will describe why they chose to behave in a particular way or why they like or dislike a given target; however, these explanations often fail to reflect any awareness of the influence of automatic processes such as prior exposure in the absence of aversive stimuli, associations between a stimulus and body postures or actions, or associations between a stimulus and affectively colored body states. In addition, Libet (1985) has shown that at least in some cases physiological events presaging simple motor responses begin prior to the experience of associated cognitions. Participants reported that their awareness of having an intention to perform a voluntary

action, moving a finger, occurred 350-400 milliseconds after the onset of brain activity associated with the initiation of this action. Thus the experience of willfully instigating the given behavior came after changes in the brain leading up to the behavior had already commenced. Drawing on evidence from this and other studies, Wegner & Wheatley (1999) conclude that “we can never be sure that our thoughts cause our actions, as there could always be unconscious causes that have produced them both” (p. 482).

Furthermore, processes operating outside awareness could be expected to contribute relatively more to the solution of problems that are complex, time-limited and ill-defined, to the point that they defy more algorithmic and straightforward approaches to problem solving; the problems of adequately understanding one’s social world and producing appropriate social behaviors in real-time therefore appear to be particularly likely to rely on automatic and inaccessible processing. In this case, the focus remains on the importance of generating explicit understanding of contingencies leading to desirable and undesirable outcomes.

The substantial contributions of automatic and inaccessible processes to cognition and behavior raises an additional possibility: it could be the case that the act of engaging in causal thinking (regardless of the content of the questions asked or conclusions reached) is not simply a direct and volitional method of generating attributions of cause or regulating self-cognitions and affect. Question generation and explanation seeking certainly can help individuals to understand the causal forces at work around them, and provide a basis for construing situations and adapting behavior to produce desired

outcomes; these activities may also contribute to self-esteem and affect regulation, regardless of whether they produce correct inferences or useful insights, as in the case of attributions that serve self-enhancement goals. However, stopping to think about the implications of what has just happened involves stopping, not just thinking. It is thus possible that engaging in causal thinking may serve some adaptive function tied more directly to the inhibition or cessation of ongoing behavior than the to the functions outlined above. This capacity to inhibit (and to initiate) behaviors appropriately in response to environmental or situational demands is not unique to humans or dependent on explicit or volitional reasoning, but is rather an evolved adaptation that is part of our biological makeup. Thus, in order to explore the possibility that the cessation of behavior associated with the engaging in causal thinking is itself adaptive, it becomes important to consider the biological bases of these processes.

Systems for Solving the Appraisal Problem: BIS and BAS

One extremely basic problem that organisms must solve involves differentiating between cues that are predictive of positive outcomes versus negative outcomes; this initial evaluation of circumstances should influence all subsequent construal and response, including the initiation of thoughts and behavior patterns serving approach and/or avoidance goals. Understanding the laws that govern behavior producing or following the activation of systems relevant to threat and/or opportunity is one way to explore the mechanisms underlying construal and the person x situation interaction. Affective neuroscience provides some insight into the physiological bases of systems that

perform these appraisal functions and promote the relevant responses. In their review of the literature, Davidson, Jackson, & Kalin (2000) point to a growing consensus on the existence of two brain-based emotional/motivational systems—an approach system and a withdrawal system. Approach- and avoidance-related behavior patterns do not directly correspond with positive and negative affective states—depending on the context, a negative emotion such as anger could suggest attack rather than withdrawal. Research showing that anger does not produce the pattern of prefrontal activity typical of withdrawal-related emotions such as fear and disgust (Harmon-Jones & Allen, 1998) suggests that at a physiological level it is more apt to think in terms of approach and avoidance modules, rather than in terms of separate systems for positive versus negative affect.

Although there is not complete consensus as to which neural circuits are involved in the functioning of the proposed approach and avoidance systems, Davidson et al. (2000) conclude that two structures, the prefrontal cortex (PFC) and the amygdala, are of particular importance in formulating adaptive evaluative responses to environmental cues. The PFC is implicated in several aspects of emotional processing. Left PFC lesions are related to depressive symptoms among stroke patients, interpreted as impairment in the capacity to experience positive affective states (Morris, Robinson, Raphael, & Hopwood, 1996). This deficit in experience can produce motivational disturbances by undermining the reward value of initiating and maintaining approach behaviors. More evidence for the approach-avoidance distinction and the probable

localization of some aspects of their functioning comes from considering the role of the PFC in affective aspects of learning. Hugdahl, (1998) and Hugdahl et al. (1995) reported increases in right PFC activity during extinction of a learned response, an avoidance-relevant context evoking withdrawal behavior. Damage to the ventromedial PFC is associated with inability to anticipate affective states associated with the consequences of behavioral choices; while individuals with this kind of damage can imagine the likely sequelae of given behaviors, they cannot imagine their own emotions in association with the consequences of their actions or use this kind of information in choosing among behavioral options. This disturbance in the emotional and motivational underpinnings of choosing and initiating appropriate behaviors and inhibiting inappropriate behaviors leads to problematic decision-making and social behavior, even when measured intelligence and cognitive functioning remain intact (Damasio, 1994). In this case, both approach and withdrawal functions appear to be impaired. The dorsolateral PFC is implicated in yet another aspect of emotion and self-regulation: the representation of goals (Davidson et al., 2000). Mental representations of desired future states are probably a necessary precondition for persisting in ongoing behavior towards a goal, a putative approach function. The amygdala is involved in the recognition and experience of negative emotion, especially fear, and is important for the acquisition of new aversive learning contingencies (Davidson et al., 2000). The amygdala, as such, is involved in processes relevant to withdrawal—the experience of avoidance-invoking emotional states and avoidance learning.

The Behavioral Inhibition System (BIS) (Gray, 1975) is a brain-based system activated by situational cues of impending punishment or frustrative nonreward. BIS broadly prohibits the initiation of behaviors that are likely to lead to bad outcomes and promotes the cessation of behaviors that are non-productive. The Behavioral Activation or Approach System (BAS), a complementary system, is responsive to cues signifying potential rewards or escape from punishment (Fowles, 1980). This system energizes and promotes relevant behavioral responses. Although Gray's (2000) conceptualization of BIS and BAS appears very similar to the approach and withdrawal systems described by Davidson et al. (2000), there are some important differences. Gray actually postulates 3 systems: BIS, BAS, and fight-flight-freeze. The behavioral approach (Gray, 1972) or activation (Fowles, 1980) system corresponds reasonably well with the approach system construct as described in Davidson et al. (2000); however, Gray's (2000) BIS is not simply an avoidance or withdrawal system—it is an anxiety system activated by cues that indicate conflict as opposed to a straightforward need for withdrawal. In the case of fear-provoking stimuli, if there is no reason to inhibit the prepotent fear response (as governed by the fight-flight-freeze system), actively avoidant behavior is initiated without requiring any BIS input. If on the other hand there is a conflict, such as when a rat must incur risk in order to leave its nest and forage for food, BIS activation results and produces functional changes that facilitate adaptive responses to conflict: inhibition of ongoing or prepotent behavior, increased arousal, and increased attention.

At moderate levels of activation, BIS even produces risk-assessment behaviors, although these behaviors are also inhibited when anxiety is very high. Thus Gray's (2000) BIS can only be activated when BAS is already activated; this is very different from the idea of a general withdrawal or avoidance system functioning independently from a parallel BAS. In terms of strength and sensitivity, the systems are still presumed to be orthogonal; an individual might have a very strong or sensitive BIS coupled with a weak or insensitive BAS, or vice versa. However, according to Gray (2000), BIS can only produce effects on behavior in conjunction with BAS.

The need for this additional level of complexity is clearer after considering the evidence Gray (2000) uses to support his theories, and the distinction that he draws between anxiety and fear. Gray's work is largely based on observations of the effects of anxiolytic drugs in animals and humans, and animal lesioning studies. All drugs that have been found efficacious for the treatment of anxiety in humans (and that produce apparently equivalent electrophysiological and behavioral changes in animals) induce characteristic changes in hippocampal theta activity—even when the drugs are not chemically similar. Gray refers to the regions receiving this altered theta-rhythm input as the septo-hippocampal system, his proposed neural substrate for BIS. The involved regions include the hippocampus, the dentate gyrus, the entorhinal complex, the subicular area, and the posterior cingulate cortex. These areas appear to be crucial for the processing of cues relevant to threats or aversive or potentially aversive stimuli that also evoke approach behaviors. Potential or real dangers that have no possible reward value

can simply be avoided or reacted to without involving the septo-hippocampal system; these relatively straightforward fear responses to real or potential threats are not altered by anxiolytic drugs or lesions to the septo-hippocampal system; however, anxiety responses to situations where safety needs conflict with other goals are reduced or eliminated by lesions and anxiolytics. (Similarly, drugs that block panic do not relieve anxiety.) These anxiety responses are the previously mentioned outputs of BIS activation: behavioral inhibition, increased arousal and attention, and risk assessment behavior. Thus Gray (2000) bases his distinction between anxiety and fear on the different kinds of cues that produce these states, the different patterns of behavioral response that each state entails, and the pharmacologically and electrophysiologically separable systems that appear to underlie these patterns.

While Gray would agree with Davidson et al. (2000) that the amygdala is implicated in fear-related avoidance, he would not consider this a BIS function, and would not include the amygdala as part of the physical basis of BIS. Gray would also agree with the growing consensus that the prefrontal cortex is critical for inhibiting situationally inappropriate behaviors, but again, because the effects of anxiolytics are not mediated by altered activity in the prefrontal cortex, Gray would not consider this region part of the BIS. Instead, he suggests that the inhibitory functions of the prefrontal cortex are a more sophisticated system superimposed over the evolutionarily older septo-hippocampal system. Unfortunately, much of the literature on BIS and BAS functioning does not acknowledge the ways that Gray's (2000) conceptualization of BIS and BAS

differ from the more widely accepted idea of parallel approach/avoidance systems, or even from the concepts of positive and negative affectivity. Some of the ambiguities regarding the ways in which BIS and BAS have been described and treated in the literature by other researchers may also be attributed to the fact that Gray has been refining his ideas since the late 1960's; many of the particulars of the theory have changed or become elaborated along the way, and aspects of the theory have been used in their various incarnations (with varying levels of precision) by many different researchers. Nonetheless, Gray's core ideas concerning the neural basis for anxiety have proven remarkably durable, even predicting the effects of anxiolytic drugs that were unknown when he first described the septo-hippocampal system as the seat of anxiety.

Affective, Cognitive and Behavioral Characteristics Associated with Atypical BIS/BAS Functioning

Several researchers have broadly outlined distinct patterns of cognitive, affective and behavioral tendencies associated with disorders in characterized by extremes of BIS and BAS functioning. Because atypical patterns of causal thinking are also associated with these disorders, each disorder will be described and considered as illustrative of the potential implications of BIS/BAS sensitivities for causal thinking. Mealey's (1995) discussion of primary and secondary sociopathy describes primary sociopaths as deficient in BIS functioning; they are insensitive to cues signifying bad outcomes, do not alter their behavior when faced with punishment, and do not learn in response to punishment contingencies. Primary sociopaths also differ from other individuals in the way that they

think about other people and engage in social perception and cognition. Whereas most people acquire a theory of mind based on empathy for others to facilitate their social interactions, the primary sociopath's theory of mind is based on nomothetic prediction of others' behaviors, rendering attributions concerning the probable reasons or causes for those behaviors unnecessary. Primary sociopaths think about and treat other people as if they were objects, without consideration or care for their internal thoughts and feelings. Blair, Sellars, Strickland, Clark, Williams, Smith, & Jones (1995) provide support for a less dramatic claim regarding the attributional tendencies and abilities of psychopaths; in their research they found that psychopathic individuals can attribute some emotional states (happiness, sadness, and embarrassment) appropriately, but that they tend to attribute happiness or indifference to story protagonists in situations that elicit attributions of guilt from control participants. In either case, the possibility that psychopaths/sociopaths differ from other individuals in their tendencies to engage in causal thinking is raised. As Mealey (1995) points out, these individuals may become adept predators as their assessments of others and their behavioral choices are unfettered by anxiety, empathic attachments to others, or the anticipation of guilt. Fowles (1987) explicitly states that the major clinical features of psychopathy correspond to behavioral and learning patterns indicative of a weak BIS and a normally functioning BAS.

On the other end of the spectrum, BIS overactivity or oversensitivity may contribute to the difficulties experienced by individuals who have anxiety disorders (Fowles, 1987). Again, the maladaptive behavior patterns are accompanied by consistent

attributional and emotional tendencies. Tracy, Ghose, Stecher, McFall, & Steinmetz (1999) provide evidence that under some task conditions, participants who make high scores on a measure of obsessive-compulsive tendencies show more rapid aversive conditioning than do controls. BIS sensitivity, which underlies the detection of cues indicating threat and conflict, may thus contribute to the rapid acquisition of inappropriate and anxiety-provoking associations between innocuous stimuli and fear-arousing outcomes. In addition, misplaced causal thinking can perpetuate anxiety and acquired maladaptive avoidant behavior, as when individuals come to believe that they continue to be spared from complete disaster via performance of compulsory behaviors.

Both BAS and BIS disturbances are implicated in depression. Kasch, Rottenberg, Arnow, & Gotlib (2002) found that clinically depressed individuals scored higher on a measure of BIS and lower on a measure of BAS than did control participants. Among the depressed participants, lower BAS drive and reward responsiveness scores were predictive of more severe depression and poorer clinical outcomes at an 8-month follow-up. A weak BAS paired with a strong BIS also corresponds to the cognitions and behaviors associated with the attributional learned helplessness model of depression. Learned helplessness contributes to the onset and perpetuation of depression in that the individual underestimates his or her likelihood of achieving desirable outcomes or escaping from aversive situations. The consequences include failing to engage in potentially constructive behaviors in response to external cues that do not dissuade most other individuals, and failing to learn from cues and repeat behaviors that can produce

desired outcomes. Seligman's (1975) initial learned helplessness model posited that experiencing negative and uncontrollable outcomes produced helpless behavior; however, this model was amended to acknowledge the role of attribution: negative experiences only result in learned helplessness and depression in humans when they are *attributed to* internal, stable, and global causes (Abramson, Seligman, & Teasdale, 1978).

BIS/BAS and Causal Thinking

Besides fitting into the general BIS/BAS framework, each of these patterns of dysfunction involves distinct implications for cognition in general and causal thinking in particular. This suggests that BIS/BAS functioning and interaction underlie and are directly relevant to how individuals habitually construe and respond to complex social stimuli. While the meaning of a given cue for a particular individual may be fairly idiosyncratic (is a test an opportunity, a threat, or both?), knowledge of the general implications for behavior following the elicitation of BIS or BAS responses should facilitate the prediction of what kind of response will be produced. In addition to conceptualizing BIS and BAS as forces inhabiting the internal life space and contributing to experience and behavior at discrete points in time, these systems should also be understood as dispositions that underlie learning, influencing construal and responding in a feed-forward loop (Gray, 2000). Zinbarg & Mohlman (1998) provide some support for the link between BIS, BAS, and learning; in their research BIS sensitivity was positively related to the speed of avoidance learning. BAS measures did not significantly predict speed of acquisition of reward expectancies when the potential reward was an ego-boost,

although results for one BAS manifestation (reward responsiveness) were significant and in the expected direction when a monetary incentive was offered.

Attribution can thus be integrated into the BIS/BAS framework as a social-cognitive process with predictable consequences that can help to explain subsequent behavior. Other correspondences between the functioning of BIS and BAS and what is already understood about attributional processes strengthen the case for exploring the relationship between these constructs. Individuals do not engage in causal analysis of every outcome that they encounter; the likelihood of causal search is enhanced when negative and/or unexpected events occur (Wong & Weiner, 1981), whereas other types of cognitions are more likely following successes (Moller & Koller, 1999). Cues associated with novelty or negative outcomes (at least those that are unavoidable or that must be risked) elicit BIS functioning and lead to anxiety and the cessation of ongoing behavior. Anticipated positive outcomes are usually associated with the commencement or strengthening of behaviors in progress, functions associated with BAS activation.

As a system that detects and responds to conflict and threat, it is reasonable to expect that BIS contributes to the construal of situational cues (Gray, 2000); Fowles (1987) has proposed that BAS is also involved in construal. Gomez & Gomez (2002) were able to demonstrate that BIS and BAS sensitivities do affect the ease with which different kinds of emotionally relevant information are processed, facilitating the processing of unpleasant and pleasant information, respectively. In this study, BIS sensitivity as measured using Carver & White's (2004) BIS/BAS scales was found to be

positively correlated with three measures of unpleasant emotional processing: the number of negative words provided in response to a word completion task, the number of negative words correctly identified as negative in response to a word recognition task, and the number of negative words provided in response to a free recall task. BIS sensitivity was not related to the analogous measures of pleasant emotional processing (counts of negative words provided in response to the same three tasks); BAS sensitivity, however, was positively correlated with pleasant emotional processing and unrelated to unpleasant emotional processing. Given that BIS and BAS sensitivities are generally predictive of affectively congruent information processing, these systems may further be implicated in aspects of information processing that involve evaluations of whether given cues are predictive of good or bad and expected or surprising outcomes. If so, BIS and BAS contribute to situational appraisals that are directly relevant to the instigation of causal thinking.

The search for correspondences between what is known about BIS/BAS and attribution also extends to the proposed functions of these constructs. BIS activation produces behavioral output that facilitates preparedness and adaptive response to threats: cessation of ongoing behavior and inhibition of prepotent responses, increased arousal and attention, and active risk-assessment (or freezing, when threat is extremely close). As such, BIS activation promotes information-gathering and processing, and the use of information to adjust behavior. These functions overlap with the informational and affect-regulating functions ascribed to attributional processes.

However, as mentioned earlier, it is also possible that the act of engaging in causal thinking serves or at least co-occurs with some adaptive function tied directly to the inhibition or cessation of ongoing behavior. It may be the case that pausing ongoing behavior in the face of uncertainty or potential threat and/or seeking explanations are adaptive responses in their own right, not simply preconditions for information-gathering and subsequent volitional adjustment of behavior. Freezing in response to fear-eliciting stimuli or overwhelming anxiety is observed in animals as well as humans, presumably without a great deal of reasoning taking place on the part of the animals. Stopping or inhibiting behavior, then, is an older and more primary way of responding to avoidance-relevant situational cues. The causal thinking observed in humans as a response to novel, surprising, and bad situations can be seen as an additional level of adaptive responding involving the explicit evaluation of contingencies, as a slave process that facilitates the inhibition of ongoing behavior, or as epiphenomenal “wheel-spinning.” (The first two possibilities raised may be the kind of sophisticated inhibitory fine-tuning that takes place in the prefrontal cortex, as opposed to the essential BIS functions of the septo-hippocampal system.)

The purpose of the study presented here is to look for evidence of lawful relationships between BIS/BAS and the variables already known to be associated with causal thinking: outcome valence and outcome expectedness. This will lay the groundwork for further research assessing whether BIS/BAS functioning affects the likelihood of engaging in causal thinking through either or both of the proposed

pathways: i.e., by affecting the way that individuals construe a given situation and/or by exerting effects on causal thinking that are not mediated by construal (see Figure 1).

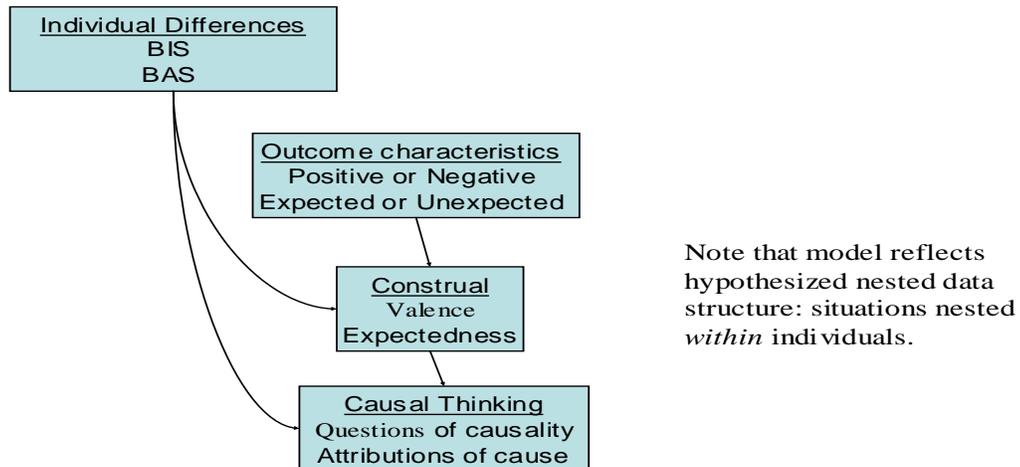


Figure 1. Hypothesized relationships between measured individual differences in BIS and BAS, manipulated outcome characteristics, and causal thinking.

As a first step towards evaluating the model shown in Figure 1, the present research was conducted to ascertain whether measures of BIS and BAS sensitivities do indeed predict how individuals will construe situations associated with outcomes that are good or bad and expected or unexpected (see Figure 2), and to permit the development and refinement of stimulus materials to be used in subsequent research.

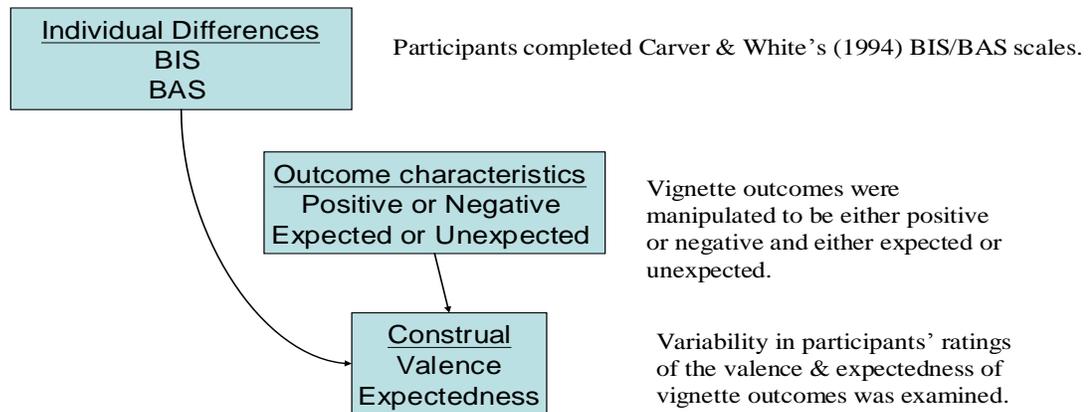


Figure 2. The present research was designed to assess hypothesized relationships between measured individual differences in BIS and BAS, manipulated outcome characteristics, and construal.

In addition, the present research allowed for the evaluation of a novel approach to analyzing the data. While measured BIS and BAS sensitivities are dispositional characteristics of individuals, the BIS and BAS systems themselves are activated only in the presence of relevant cues. It was therefore deemed appropriate to evaluate the possibility that the data could best be modeled as situations nested within individuals. (A more detailed discussion of the rationale for this approach is provided in the introduction to the present research.) Future research will attempt to replicate the major findings regarding BIS/BAS and construal, and to extend these findings by assessing whether BIS

and BAS also predict the amount of causal thinking produced in response to situational outcomes—both through the construal pathway and/or directly (see Figure 3).

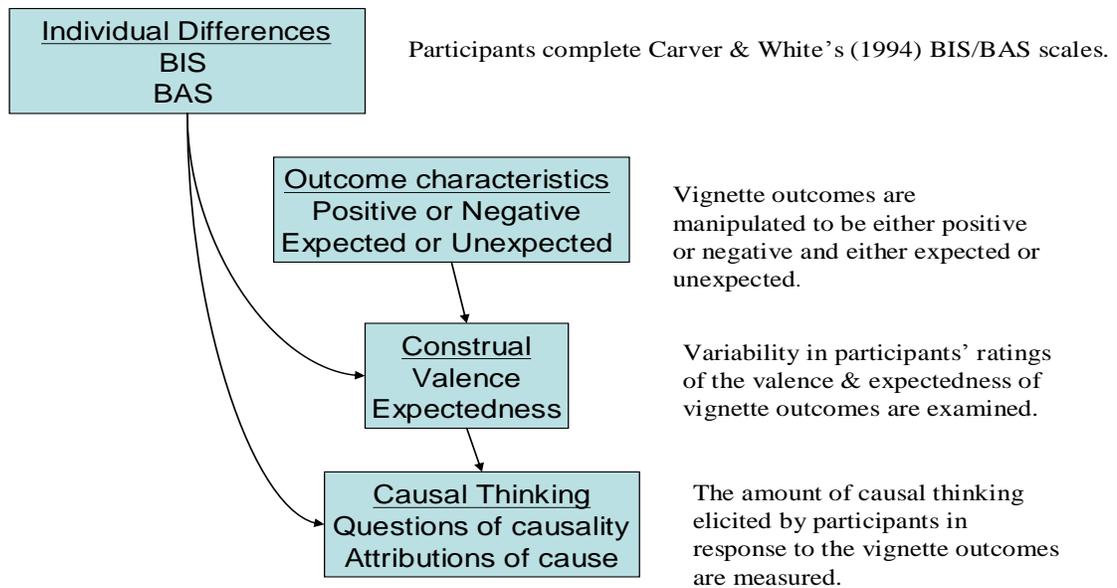


Figure 3. Future research will assess hypothesized relationships between measured individual differences in BIS and BAS, manipulated outcome characteristics, and causal thinking.

However, before undertaking more ambitious research regarding the hypothesized pathways between BIS/BAS and causal thinking it is desirable to obtain empirical validation of the basic notion that BIS and BAS are involved in construal, and of the utility of looking at situations nested within individuals.

THE PRESENT RESEARCH

This study served as groundwork for future research in three ways. First, it was designed to explore the relationships between participants' appraisals of the outcomes described in the stimulus materials and measures of BIS and BAS, & to provide a rationale for conducting further research relating BIS and BAS to the propensity to engage in causal thinking. Secondly, it informed the development of stimulus materials for suitable for conducting further research; these materials will make it possible to assess the amount of spontaneous causal thinking in response to manipulations of outcome valence and expectedness. Finally, it evaluated the utility of taking a multilevel approach in order to assess the random effects of outcome manipulations on construal, with outcome manipulations nested within participants.

Designing Stimulus Materials

The first goal for the present research was to develop a set of stimulus materials that could be used to elicit sufficient written responses for content analysis of individual preferences for engaging in causal thinking. Because past research has shown that the likelihood of attributional search is affected by the valence and expectedness of outcomes (Wong & Weiner, 1981; Weiner, 1985), a set of stimuli were constructed to contain instances of all four combinations of valence and expectedness of outcomes: positive and expected (P/E), positive and unexpected (P/U), negative and expected (N/E), and negative and unexpected (N/U). The set of stimuli also contained instances of outcomes from different contexts: primarily academic (A), primarily social (S), academic with

some social relevance (AS), and social with some academic relevance (SA). Although much past attribution research has focused on contexts relevant to performance evaluation (i.e., academic achievement, competitive sports), this measure was taken to insure that findings from the present study were not limited to such contexts and to allow for the assessment of any context effects. Finally, the stimulus materials were designed to elicit consensus in that given outcomes were generally good or bad and expected or unexpected, but were measured on scales allowing for variability in the *magnitude* of participants' ratings of valence and expectedness. Participants' valence and expectedness ratings were used as measures of outcome appraisal.

BIS/BAS and Appraisal

Secondly, this study was designed to assess whether BIS/BAS sensitivities are predictive of individuals' appraisals of the outcomes described in the stimulus materials. BIS sensitivity could affect outcome appraisals in at least two ways. First, there might be main effects for BIS such that greater sensitivity to novelty and the possibility of receiving bad outcomes is associated with rating outcomes as more negative and/or as more unexpected across all valence and expectedness manipulations. This seems unlikely, however, because BIS activation is theoretically dependent on the presence of cues relevant to impending punishment, threat, novelty, or frustration. Although BIS sensitivity may contribute to a tendency to over-interpret ambiguous cues in these terms, producing a main effect of BIS on construal, the vignettes designed for use in this study were constructed and selected to be non-ambiguous. Therefore, BIS should not influence

participants' outcome appraisals collapsed across the situational manipulations used in this study; main effects would suggest that BIS sensitivity is equivalent to other constructs, such as a global predisposition to experience negative affect or neuroticism. Carver & White (1994) demonstrated that while BIS is related to negative affectivity and neuroticism, it is distinct from these constructs as measured by instruments such as Watson, Clark, & Tellegen's (1988) PANAS (Positive and Negative Affectivity Schedule) and Eysenck & Eysenck's (1985) 10-item extraversion scale. Carver & White (1994) attribute this distinction to their efforts to create a measure of BIS sensitivity assessing "responses to anxiety-provoking situations rather than assessing general affective tone" (p. 326). Within the context of the current research, BIS is therefore more likely to interact with the outcome manipulations than to produce main effects, so that BIS sensitivity predicts valence and expectedness ratings differentially across outcome manipulations. The precise nature of these interactions is difficult to anticipate at present, due to a lack of relevant research using within-participants designs to compare individuals' responses across different situational manipulations. However, based on Gray's (2000) conceptualization of BIS functioning, BIS scores should account for more of the variability in valence and expectedness ratings in BIS-relevant contexts—when vignette outcomes are manipulated to be negative and/or unexpected. Research hypotheses therefore reflect the expectation that BIS scores should affect the magnitude of outcome ratings via interaction with both valence and expectedness outcome manipulations.

The situation with BAS is somewhat more complicated, due to a lack of consensus on how to describe and operationalize the construct. Carver & White (1994) acknowledged the issue when they created and evaluated their BIS/BAS scales by including three BAS subscales reflecting different aspects of BAS functioning: reward-responsiveness (BASRR), drive (BASD), and fun-seeking (BASFS). For the purpose of linking BAS sensitivity to outcome appraisal and subsequent causal thinking, the reward-responsiveness scale is most relevant, because it measures sensitivity to the possibility of obtaining good outcomes. High BASRR could thus contribute to more positive outcome appraisals as a main effect; however, as with BIS, the presence of such a main effect would run counter to our expectations for a system that is only recruited to action in the presence of relevant cues. {As with BIS, Carver & White (1994) found that their three BAS scales are correlated with but distinct from positive affectivity}. BASRR is more likely to interact with outcome manipulations to produce more positive outcome appraisals differentially across manipulations; for example, when outcomes are manipulated to be negative, individuals high on BASRR may find some reward potential present that other individuals miss.

It is unclear how and if BASRR scores might relate to expectedness appraisals. Again, if either BIS or BASRR do affect expectedness ratings, they should operate through interactions with the situational manipulations and not as main effects. The expectedness manipulation was included in this research primarily because disconfirmation of expectation has been identified as an elicitor of causal thinking (Wong

& Weiner, 1981). In addition, novelty (which is by definition related to disconfirmation of expectations) is a BIS-relevant cue, and novelty-seeking is a component of the BASFS scale as constructed by Carver & White (1994). While the preceding suggests that sensitivity to novelty is a function of BIS/BASRR sensitivity, it remains unclear exactly how BIS and BASRR might affect appraisals of outcome expectedness. If BIS/BASRR are found to influence expectedness ratings, however, the attribution research provides a good basis for suggesting that the effects will go on to affect the likelihood of causal thinking. Hypotheses regarding BASRR were more limited than those regarding BIS, and reflected the expectation that BASRR scores should affect the magnitude of outcome ratings via interaction with the manipulation of outcome valence. No predictions were made regarding interactions between BASRR and the expectedness manipulation.

It may also be that BIS and BASRR interact so that the effects of BIS sensitivity on outcome appraisal depend on BAS sensitivities within a given individual. However, as Fowles (1987) has pointed out, BIS and BAS may be measured in terms of sensitivity or in terms of the strength of the behavioral responses they recruit. The BIS/BAS measures used in this research are Carver & White's (1994) BIS/BAS scales, which reflect sensitivity to environmental cues. If compromise between BIS and BAS occurs at the level of sensitivity to cues, then outcome appraisal should depend on a BIS X BAS interaction. This outcome is unlikely, however, because BIS and BAS sensitivities are in theory independent of each other (Gray, 2000). It is also possible that a compromise occurs later, during the formulation and production of appropriate behavioral responses

(or not at all), and that no BIS x BAS interactions will be observed for outcome appraisals of valence or expectedness. As a result, no specific predictions were made regarding a BIS X BAS interaction. Nonetheless, any affirmative findings linking BIS/BAS sensitivity to outcome appraisals would support the utility of conducting further research regarding BIS/BAS and the propensity to engage in causal thinking. No specific predictions were made regarding the effects of outcome context or participant gender, although the variables were also included in the analyses.

Modeling Across Levels of Analysis

It is both reasonable and sometimes necessary to conduct research on variables at a single level of analysis, and it is not realistic to expect researchers to include all potentially relevant variables in a given study or even in a theoretical model. There are advantages, however, to considering the effects of variables that operate at different levels of analysis from the outcome of interest, beyond the utility of simply including more variables operating at the same level. In addition to explaining additional error on a single level on analysis, the exploration of variables across levels of analysis opens up the possibility of establishing the existence of cross-level interactions that are otherwise undetectable.

Explicitly modeling cross-level interactions can also allow researchers to explore the possibility that variables at a lower level of analysis may have different effects depending on the broader contexts in which they are nested—effects which would be lost or obscured using traditional methods of analysis. Another way of putting this is to say

that individuals' characteristics may take on different meanings and have different effects depending on the context. For example, the effects of aptitude (a child variable) on achievement could be different for children in different schools (a context variable), depending on school-level variables such as whether ability-grouping is used in making classroom assignments (Snijders & Bosker, 1999). In such a case, an overall slope describing the effect of aptitude on achievement, aggregated across schools, would be misleading, because the context in which that particular variable takes on meaning (and perhaps different meanings in different contexts) is not taken into account. Sampling individuals from a variety of contexts or settings and aggregating the data in order to improve the generalizability of one's research findings obscures the possibility that effects may be context-dependent, and fails to capitalize on cross-level interaction as a potential source of explainable variability.

For the purposes of the current research, it is also important to note that a multilevel modeling approach can be extended to repeated measures data (Snijders & Bosker, 1999), so that times of measurement are the lower-level units of analysis nested within individuals. As such, it becomes possible to explore interactions between manipulations associated with discrete measurements and individuals' characteristics, with situations or manipulations nested within individuals. The present research exploits this capability, but from a different perspective; in the case of this research, the goal is to evaluate the extent to which contextual characteristics may take on different meanings and have different effects depending on characteristics of the individual: BIS and BAS.

Here, aggregating data across measurements within individuals is likely to produce misleading results if the predictive ramifications of individuals' characteristics do in fact vary depending on the measurement context. In order to assess whether or not that is the case, the data will be modeled with situations nested within individuals.

Nesting within Individuals

The need to allow for the possibility of a situations-within-individuals nested data structure becomes more apparent when relevant characteristics of the constructs of interest—BIS/BAS and causal thinking—are considered. Given that the individual-differences variables are neural systems (BIS and BAS) activated in the presence of relevant environmental cues, the assumption that individuals should display uniform response tendencies across situations becomes suspect. Examining the random effects of stimulus manipulations nested within individuals permits us to evaluate this assumption and to analyze data for which this assumption does not hold. As Howard and Allen (1989) have pointed out, much of the attribution research relies on the related assumption that “identical texts are identical stimuli” (p. 280)—ignoring the role of individual differences in interpretation or construal. This assumption and the assumption of uniform response tendencies across situations both become particularly untenable where BIS and BAS functioning are concerned, because these systems are conceptualized as vehicles for initiating and energizing approach- or avoidance-relevant processes—but only in the presence of appropriate cues. For example, an individual might have a dispositionally strong or sensitive BAS, but that trait may not contribute much to his or her thinking or

behavior in situations where cues indicating reward potential are lacking. For this reason, a multilevel repeated-measures design was used, so that variability in responses to situational manipulations can be assessed within individuals as well as across situations.

The appropriateness of this approach to modeling the data can be evaluated as follows: if the materials describing positive or negative and expected or unexpected outcomes are actually equivalent for each respondent, then there should be no significant variability in the slopes describing participants' appraisals of the outcome manipulations, only variability around a random intercept, indicating variability in individuals' cross-situational appraisal tendencies. In that case, there would be no need to allow for a nested data structure and the model would reduce to an ordinary least squares (OLS) regression. If, however, as Howard & Allen (1989) suggest, the process of construal is creating subjectively different stimuli for individual participants to appraise and respond to, response heterogeneity within individuals as a function of situational cues will show up as significant random effects in the slopes of participants' appraisal ratings across the valence (positive/negative: P/N) and expectedness (expected/unexpected: E/U) manipulations. BIS/BAS effects on outcome appraisals could then be evaluated as variables with the potential to explain this response heterogeneity, and the utility of modeling situations nested within individuals will have been established.

Hypotheses

The hypotheses of primary interest regarding appraisals of valence and expectedness are given below. The multilevel modeling techniques used make it possible

to conduct many additional tests, which are explained in the section “Analytical Strategy.” Significant results not anticipated by these research hypotheses are presented and discussed in the results and discussion sections.

Hypotheses regarding valence ratings were as follows:

1. Individuals will vary in their overall tendency to rate outcomes as positive versus negative.
2. Individuals will vary in their responses to the outcome valence manipulation.
3. Any effects of BIS on valence ratings will depend on whether the outcome is manipulated to be positive or negative.
4. Any effects of BIS on valence ratings will depend on whether the outcome is manipulated to be expected or unexpected.
5. Any effects of BASRR on valence ratings will depend on whether the outcome is manipulated to be positive or negative.

Hypotheses regarding expectedness ratings were as follows:

6. Individuals will vary in their overall tendency to rate outcomes as expected versus unexpected.
7. Individuals will vary in their responses to the outcome expectedness manipulation.
8. Any effects of BIS on expectedness ratings will depend on whether the outcome is manipulated to be positive or negative.
9. Any effects of BIS on expectedness ratings will depend on whether the outcome is manipulated to be expected or unexpected.

METHOD

Participants

One hundred eighty undergraduates (82 male and 98 female, mean age = 18.66 years) participated to earn credit for an introductory psychology course. Only 6 participants (3.33%) reported that English was not their first language.

Materials

BIS/BAS Scales

Carver and White's (1994) BIS/BAS scales (Appendix A) were used to measure dispositional sensitivity to cues relevant to approach and avoidance. The BIS/BAS scales consist of four subscales, a unitary subscale measuring BIS sensitivity (BIS) and three subscales measuring aspects of BAS sensitivity. BIS scale items reflect sensitivity to punishment cues, and include references to the anticipation of undesirable outcomes. The three BAS subscales are as follows: reward-responsiveness (BASRR), drive (BASD), and fun-seeking (BASFS). The BAS subscales were created due to the lack of consensus concerning the most likely manifestations of BAS sensitivity. BAS reward responsiveness (BASRR) items serve as a measure of sensitivity to actual or potential rewards; BAS drive (BASD) items index the tendency to pursue desired goals; BAS fun-seeking (BASFS) items reflect both willingness to engage in spontaneous approach behaviors and motivation to seek novel rewards.

Reliability coefficients for the BIS, BASRR, and BASD scales are acceptable; Carver & White (1994) reported α 's of .74, .73, and .76, respectively. For BASFS, α was

marginal, at .66. Leone, Perugini, Bagozzi, Pierro, & Manetti (2001) reported α 's of .67-.74 for BIS, .68-.80 for BASRR, .74-.87 for BASD, and .79-.88 for BASFS. Jorm, Christensen, Henderson, Jacomb, Korten & Rodgers (1999) used a much larger sample size ($N = 2684$) than any other study using the BIS/BAS scales to date (for Carver & White (1994, Study 1), $N = 732$) and used a community sample rather than sampling college students exclusively. With their large, representative sample, Jorm et al. (1999) reported α 's of .76, .65, .80, and .70 for BIS, BASRR, BASD, and BASFS, respectively. Carver & White (1994) assessed test-retest reliability after an 8-week interval; the correlations were .66 for BIS, .59 for BASRR, .66 for BASD, and .69 for BASFS.

Carver and White (1994) reported adequate to good convergent and divergent validity for the scales, based on correlations with measures of related constructs such as extroversion, optimism, positive and negative affectivity; while BIS and BAS are related to positive and negative affectivity and to extraversion and neuroticism, they do not overlap those constructs completely. For example, BIS was found to correlate with negative affectivity ($r = .42, p < .001$) but not with positive affectivity ($r = -.06, p > .05$). None of the BAS scales were correlated with negative affectivity, but all were related to positive affectivity (BASRR $r = .31$; BASD $r = .28$; BASFS $r = .19$, all p 's $< .001$). Heubeck, Wilkinson, & Cologon (1998) and Jorm et al. (1999) also reported correlations between the BIS/BAS scales and measures of neuroticism, extroversion, and positive and negative affectivity that were generally supportive of hypothesized relationships between the constructs. Carver & White (1994) further demonstrated that BIS scores were

predictive of feelings of anxiety in response to anticipated punishments. BASD scores and to a lesser extent BASRR scores were predictive of feelings of happiness in response to anticipated rewards.

BIS and BAS sensitivities are proposed to be orthogonal constructs (Gray; 1975, 2000), and Carver & White's (1994) analyses provided some support for this: correlations between BIS and the BAS subscales were all small to moderate ($r = -.12$ with BASD, $r = -.08$ with BASFS, $r = .28$ with BASRR). Correlations among the BAS subscales were all higher: BASD with BASRR at $r = .34$, BASD with BASFS at $r = .41$, and BASRR with BASFS at $r = .36$. The relatively high correlation between BIS and BASRR is out of line with the expectation of orthogonality, and Heubeck, Wilkinson, & Cologon (1998) have expressed doubt that the BAS scale represents an uncontaminated measure of BAS. Leone, Perugini, Bagozzi, Pierro, & Manetti (2001) reported inter-factor correlations reflecting this problematic relationship between the BIS and BASRR scales; they found a .33 correlation between BIS and BASRR, but the BASFS and BASD scales were not significantly correlated with BIS. Jorm et al. (1999) found that BASRR was significantly correlated with neuroticism ($r = .21$).

Carver & White's (1994) exploratory factor analysis yielded a four-factor (BIS, BASD, BASRR, BASFS) oblique solution, with the BAS scale items all loading on a second-order BAS factor. Heubeck, Wilkinson, & Cologon (1998) have reproduced this solution, using both exploratory and confirmatory factor analysis. Leone et al. (2001) used confirmatory factor analysis to replicate those results with samples of students from

the U.S., U.K., and Italy, and they further demonstrated factor invariance across the three samples. Jorm et al. (1999) were able to support Carver & White's four-factor solution, but also reported a two-factor (BIS and BAS) solution using principal component analysis. They observed a very small inter-factor correlation, $r = .07$, which is more consistent with theory-based expectations than findings based on smaller samples and samples limited to college students.

Heubeck, Wilkinson, & Cologon (1998) concluded that while the BIS/BAS scales were not a theoretically exhaustive operationalization of Gray's constructs, they were potentially useful and distinct measures of dispositional sensitivities, the BIS scale more so than the BAS scales. Leone et al. (2001) reported that the BIS/BAS scales display satisfactory construct validity and a highly stable factor structure. Jorm et al. (1999) concluded that the BIS scale is a serviceable measure of the predisposition to experience anxiety, but that the BASRR scale is a somewhat compromised measure of BAS sensitivity due to its relationship with neuroticism and its low reliability.

Other researchers using the BIS/BAS scales (e.g., Carver, Meyer, & Antoni, 2000; Kasch, Rottenberg, Arrow, & Gotlib, 2002; Harmon-Jones & Allen, 1997; Gomez & Gomez, 2002) have produced results in accordance with the theoretical understanding of BIS and BAS that was used to create the scales, providing some evidence of the practical utility and construct validity of these measures. The BIS and BASRR scales are most clearly relevant to the present research, and all analyses were conducted using those scales to measure BIS and BAS, respectively.

Vignettes/Outcome Manipulations

Eight brief stories about events that could plausibly occur in the daily lives of undergraduate students were generated, two for each of the following content areas: academic outcomes (A), social outcomes (S), social outcomes with some academic relevance (SA), and academic outcomes with some social relevance (AS). The eight basic stories were expanded into 32 vignettes by varying the stories' endings—outcomes described in the endings were either positive (P) or negative (N) and either expected (E) or unexpected (U). The complete set of 32 vignettes is given in Appendix B. Each vignette thus contained one of 4 possible manipulations of outcome valence and expectedness: positive and expected (P/E), positive and unexpected (P/U), negative and expected (N/E), or negative and unexpected (N/U).

Outcome Ratings

Participants were asked to rate both the valence and the expectedness of each vignette using Likert-type items. Valence was assessed by asking, “How good or bad would you feel after having this experience?” with possible responses ranging from 1 = very good to 7 = very bad. Expectedness was assessed by asking, “Would you describe this experience as having an expected outcome or an unexpected outcome?” with possible responses ranging from 1 = very much expected to 7 = very unexpected.

Procedure

Because the full set of 32 vignettes and 64 items contained many that were very similar, vignette data were collected using a three-form design (Graham, Taylor, &

Cumsille, 2001), to prevent participant fatigue and boredom. Each of the 180 participants completed one of three alternate questionnaires, each containing roughly two thirds of the vignettes and associated valence and expectedness items, so that data from 120 participants were available for each vignette. One version of the vignette questionnaire, Form 1, is included as Appendix C. Participants completed the study materials in group testing sessions. Each participant's packet contained one of the three alternate vignette questionnaires, Carver and White's (1994) BIS/BAS scales, and demographic items. Presentation of the vignette questionnaires was counterbalanced with presentation of the BIS/BAS scales. In all cases, the demographic items assessing age, gender, ethnicity, and whether or not English was the participant's first language were presented at the end of the study packet.

Analytical Strategy

Details on model fitting will be presented along with the results of the analyses, with valence and expectedness ratings modeled separately. The multilevel equations comprising the model for valence ratings are given below. The Level 1 model may be thought of as an item- or situation manipulation-level model, and the Level 2 model may be thought of as a person-level model. The intercept and the outcome valence (positive versus negative or P/N) manipulation were entered as random effects at Level 1; variability in the random effects is further partitioned in terms of the fixed effects of person-level variables (BIS & BAS scores, sex) in the Level 2 model. Additional situation-level variables (outcome content type, expected versus unexpected or E/U

manipulation) and all 2-way interactions are included at Level 1 but are fixed and not random. The item-level model for valence ratings is as follows, with y_{ij} = valence rating for item i nested within participant j .

$$\text{Level 1: } y_{ij} = \beta_{0j} + \beta_{1j}P/N_{ij} + \beta_{2j}E/U_{ij} + \beta_{3j}\text{Content}_{ij} + \beta_4 (P/N_{ij} \times E/U_{ij}) + \beta_5 (P/N_{ij} \times \text{Content}_{ij}) + \beta_6 (E/U_{ij} \times \text{Content}_{ij}) + r_{ij},$$

where β_{0j} = the random intercept for each participant, β_{1j} = the random P/N slope for each participant, β_{2j}, β_{3j} = the fixed effects for the E/U manipulation and content, $\beta_4, \beta_5, \beta_6$ = the 2-way interactions at Level 1, and r_{ij} = a random error term for situation level disturbance. The level-1 residuals (r_{ij}) were assumed to be independent and normally distributed with mean = 0 and variance = σ^2 for every situation-level unit nested within each participant j . Although β_{2j}, β_{3j} reflect fixed effects, they carry the j subscript to indicate that the effects are allowed to interact with the j^{th} participants' BIS and BAS scores and sex at Level 2. Thus valence ratings are modeled as a function of a random intercept and slope + fixed effects of the E/U manipulation and context + fixed effects of the two-way interactions between Level 1 variables + situation-level error.

Level 2 equations 2a & 2b model the random variability of the intercept and slope, respectively, by incorporating variables operating at the level of individual participants: BIS and BASRR scores, sex, and the interaction between BIS and BASRR.

$$\text{Level 2a: } \beta_{0j} = \gamma_{00} + \gamma_{01}(\text{BIS}_j) + \gamma_{02}(\text{BASRR}_j) + \gamma_{03}(\text{Sex}_j) + \gamma_{04}(\text{BIS}_j \times \text{BASRR}_j) + u_{0j}$$

$$\text{Level 2b: } \beta_{1j} = \gamma_{10} + \gamma_{11}(\text{BIS}_j) + \gamma_{12}(\text{BASRR}_j) + \gamma_{13}(\text{Sex}_j) + u_{1j}$$

In equation 2a, β_{0j} is further partitioned into γ_{00} = the expected value of the valence ratings where all predictors = 0; γ_{01} - γ_{04} = fixed effects for BIS, BASRR, sex, and the two-way interaction between BIS and BASRR at Level 2; and u_{0j} = a random error term for individual level disturbance around the intercept. Similarly, in equation 2b β_{1j} is further partitioned into γ_{10} = the average slope of the valence ratings; γ_{11-13} = cross-level interactions between the P/N manipulation and BIS, BASRR, and sex; and u_{1j} = a random error term for individual level disturbance around the slope. The level-2 residuals (u_{0j} and u_{1j}) were assumed to be independent and normally distributed with mean = 0 and variance = σ^2 .

Level 2 equations 2c & 2d model the interactions between fixed Level 1 variables E/U and content, respectively, with variables operating at the level of individual participants: BIS scores, BASRR scores, and sex. As with β_{1j} , β_{2j} and β_{3j} are further partitioned: γ_{20} and γ_{30} = the average effects of each manipulation; γ_{21-23} and γ_{31-33} = cross-level interactions between the manipulations and BIS, BASRR, and sex. Because the Level 1 effects are fixed, no random error terms are included in equations 2c and 2d.

$$\text{Level 2c: } \beta_{2j} = \gamma_{20} + \gamma_{21}(\text{BIS}_j) + \gamma_{22}(\text{BASRR}_j) + \gamma_{23}(\text{Sex}_j)$$

$$\text{Level 2d: } \beta_{3j} = \gamma_{30} + \gamma_{31}(\text{BIS}_j) + \gamma_{32}(\text{BASRR}_j) + \gamma_{33}(\text{Sex}_j)$$

This multilevel partitioning of variability permits the testing of a variety of parameters (not all of which are involved in the research hypotheses). Starting at Level 1, the first question is whether or not there is significant variability around the intercept and slope (whether variances of u_{0j} and u_{1j} are significantly different from 0). If so, Level 2 variables can be evaluated as fixed predictors of this variability. (If neither the intercept nor slope exhibits significant variability, they can be treated as fixed effects and the model will reduce to an OLS regression.) The fixed effects of the Level 1 variables and interactions can be evaluated by testing whether β_1 - β_6 are significantly different from 0. The fixed effects of the Level 2 variables and interactions can be evaluated by testing whether γ_{00} - γ_{10} are significantly different from 0. Cross-level interactions can be evaluated by testing whether γ_{11} - γ_{13} are significantly different from 0.

In terms of the study hypotheses regarding valence ratings, significance tests of the following parameters were conducted:

1. Individuals will vary in their overall tendency to rate outcomes as positive versus negative. $H_0: u_{0j} = 0$.
2. Individuals will vary in their valence ratings in response to the outcome valence (P/N) manipulation. $H_0: u_{1j} = 0$.

3. Any effects of BIS on valence ratings will depend on whether the outcome is manipulated to be positive or negative. $H_0: \gamma_{11} = 0$.
4. Any effects of BIS on valence ratings will depend on whether the outcome is manipulated to be expected or unexpected. $H_0: \gamma_{21} = 0$.
5. Any effects of BASRR on valence ratings will depend on whether the outcome is manipulated to be positive or negative: $H_0: \gamma_{12} = 0$.

The same basic model also applies to the expectedness ratings, with the exception that the effects of the expectedness (E/U) manipulation are random and the valence (P/N) manipulation is entered as a fixed effect. The item-level model for expectedness ratings is as follows, with y_{ij} = expectedness rating for item or situation i nested within participant j .

$$\text{Level 1: } y_{ij} = \beta_{0j} + \beta_{1j}E/U_{ij} + \beta_{2j} P/N_{ij} + \beta_{3j} \text{Content}_{ij} + \beta_4 (E/U_{ij} \times P/N_{ij}) + \beta_5 (E/U_{ij} \times \text{Content}_{ij}) + \beta_6 (P/N_{ij} \times \text{Content}_{ij}) + r_{ij},$$

where β_{0j} = the random intercept for each participant, β_{1j} = the random E/U slope for each participant, β_{2j} - β_{3j} = the fixed effects for the P/N manipulation and situation content, β_4 - β_6 = the 2-way interactions at Level 1, and r_{ij} = situation level disturbance. The level-1 residuals (r_{ij}) were assumed to be independent and normally distributed with mean = 0 and variance = σ^2 for every situation-level unit nested within each participant j . β_{2j} - β_{3j}

again carry the j subscript to indicate that these effects are allowed to interact with the j^{th} participants' BIS and BAS scores and sex at Level 2. Thus expectedness ratings are modeled as a function of a random intercept and slope + fixed effects of the P/N manipulation and content + fixed effects of the 2-way interactions between Level 1 variables + situation-level error.

Level 2 equations a & b again model the random variability of the intercept and slope, respectively, by incorporating variables operating at the level of individual participants: BIS and BASRR scores, sex, and the interaction between BIS and BASRR.

$$\text{Level 2a: } \beta_{0j} = \gamma_{00} + \gamma_{01}(\text{BIS}_j) + \gamma_{02}(\text{BASRR}_j) + \gamma_{03}(\text{Sex}_j) + \gamma_{04}(\text{BIS}_j \times \text{BASRR}_j) + u_{0j}$$

$$\text{Level 2b: } \beta_{1j} = \gamma_{10} + \gamma_{11}(\text{BIS}_j) + \gamma_{12}(\text{BASRR}_j) + \gamma_{15}(\text{Sex}_j) + u_{1j}$$

In this case, β_{0j} is further partitioned into γ_{00} = the expected value of the expectedness ratings when all predictors = 0; γ_{01-04} = fixed effects for BIS, BASRR, sex, and the 2-way interaction between BIS and BASRR at Level 2; and u_{0j} = individual level disturbance around the intercept. Similarly, β_{1j} is further partitioned into γ_{10} = the average slope of the expectedness ratings; γ_{11-13} = cross-level interactions between the E/U manipulation and BIS, BASRR, and sex; and u_{1j} = individual level disturbance around the slope. The level-2 residuals (u_{0j} and u_{1j}) were assumed to be independent and normally distributed with mean = 0 and variance = σ^2 .

Level 2 equations c & d model the interactions between fixed Level 1 variables P/N and context, respectively, with variables operating at the level of individual participants: BIS and BAS scores and sex. Again, β_{2j} and β_{3j} are further partitioned: γ_{20} and γ_{30} = the average effects of each manipulation; γ_{21-23} and γ_{31-33} = cross-level interactions between the manipulations and BIS, BASRR, and sex, and no random error terms are included.

$$\text{Level 2c: } \beta_{2j} = \gamma_{20} + \gamma_{21}(\text{BIS}_j) + \gamma_{22}(\text{BASRR}_j) + \gamma_{23}(\text{Sex}_j)$$

$$\text{Level 2d: } \beta_{3j} = \gamma_{30} + \gamma_{31}(\text{BIS}_j) + \gamma_{32}(\text{BASRR}_j) + \gamma_{33}(\text{Sex}_j)$$

In terms of the study hypotheses regarding expectedness ratings, significance tests of the following parameters were conducted:

6. Individuals will vary in their overall tendency to rate outcomes as expected versus unexpected. $H_0: u_{0j} = 0$.
7. Individuals will vary in their expectedness ratings in response to the outcome expectedness (E/U) manipulation. $H_0: u_{1j} = 0$.
8. Any effects of BIS on expectedness ratings will depend on whether the outcome is manipulated to be positive or negative. $H_0: \gamma_{21} = 0$.
9. Any effects of BIS on expectedness ratings will depend on whether the outcome is manipulated to be expected or unexpected. $H_0: \gamma_{11} = 0$.

RESULTS

Vignette Selection and Manipulation Checks

Preliminary analyses were conducted to narrow down the full set of 32 vignette item pairs down to a subset that could be completed without fatiguing participants, and to eliminate any vignettes with ambiguous outcomes. Items' frequency distributions were examined to assess consensus on the valence (P/N) and expectedness (E/U) manipulations. Consensus was defined as the % of participants' ratings of an outcome that were either neutral or in the expected direction. Consensus was generally higher for the valence items than for the expectedness items, presumably because it is easier to label an outcome as good or bad for most people based on shared understanding of associated consequences. The expectedness of an outcome, however, should differ more across individuals, based on their unshared personal experiences. For this reason, consensus requirements were less restrictive for the expectedness items than for the valence items; vignettes with valence items showing less than 85% consensus were eliminated from further consideration, as were vignettes with expectedness items showing less than 60% consensus. Of the remaining 25 vignette items pairs, 16 were selected to yield a subset balanced across the four outcome manipulations [2 each of positive & expected (P/E), positive and unexpected (P/U), negative and expected (N/E), and negative and unexpected (N/U)], across content areas [2 each of social (S), academic (A), academic with some social relevance (AS), and social with some academic relevance (SA)], and

across story bases [2 vignettes created from each of the 8 original stories were used]. All subsequent analyses were performed on these 16 item pairs only.

The 16 selected valence items averaged 97.97% consensus ($SD = 2.67$), with a minimum of 89.17% of participants agreeing on the valence of the outcome; selected expectedness items averaged 86.41% consensus ($SD = 9.66$), with a minimum 64.17% of participants agreeing on the expectedness of the outcome. The relatively high manipulation consensus for valence and expectedness items was interpreted as evidence that the situational outcomes for these vignettes were clearly good or bad and clearly expected or unexpected. Participants' responses could still differ in the *degree* to which individuals appraised outcomes as good or bad and expected or unexpected; hence multilevel linear modeling was used to evaluate the effects of both situation valence and expectedness manipulations (Level 1 predictors) and individuals' BIS/BAS sensitivities (Level 2 predictors) on outcome appraisals.

Because each of the BIS/BAS subscales is comprised of a different number of items, scores on these BIS and BASRR scales were converted to z -scores prior to further analysis. Expectedness and valence items were centered at 0 = neutral on a scale from -3 to $+3$ to aid interpretability, such that positive valence ratings indicate good outcomes and positive expectedness ratings indicate expected outcomes. In addition, because preliminary analyses found no significant differences between the AS (academic/social) and SA (social/academic) context manipulations with regard to expectedness or valence ratings, these observations were collapsed into a "mixed" vignette content category,

which was contrasted with S (social) and A (academic) contexts. Gender was effect coded as male = -.5 and female = .5; the valence and expectedness manipulations were also effect coded so that positively valenced outcomes (P) = .5 and negatively valenced outcomes (N) = -.5, and so that expected outcomes (E) = .5 and unexpected outcomes (U) = -.5, respectively. As a result, the fixed intercept for the following models can be interpreted as the average valence or expectedness rating across all P/N and E/U manipulations for both males and females in the mixed context condition. Responses to valence and expectedness items were modeled separately.

Modeling Responses to Valence Items

Responses to valence items were first examined using an unconditional linear model (Model 1) with fixed effects for Level 1 variables (P/N and E/U manipulations, and situation content) and all 2-way interactions. A second unconditional model was fit, adding random effects for the intercept and the P/N manipulation (Model 2).

Examination of the random effects showed significant individual variability in both the intercept ($z = 2.54, p = .0055$) and slope ($z = 6.62, p < .0001$) of the responses to valence items, and that 49.28% of the variability in responses was explained by the P/N manipulation as indicated by the intraclass correlation ($ICC = .4928$). The inclusion of unconditional random effects in Model 2 produced a significant improvement in model fit ($\chi^2_{diff} = 165.64, df = 3, p < .0001$). A conditional model (Model 3a) was thus prepared to evaluate Level 2 variables as predictors of this variability, adding fixed effects for BIS, BAS reward responsiveness, gender, all 2-way interactions between Level 1 and Level 2

variables, and the interaction between BIS and BAS reward responsiveness. The inclusion of Level 2 variables again produced a significant improvement in model fit ($\chi^2_{diff} = 81.10, df = 13, p < .001$). A final conditional model was estimated (Model 3b), retaining all predictors from Model 3a that were involved in significant effects. This trimming did not significantly decrease model fit ($\chi^2_{diff} = 3.70, df = 8, p > .05$). See Table 1 for model fit indices and R^2 values.

Table 1

Summary of Nested Valence Models

Model	AIC	BIC	Deviance	R^2	χ^2 difference
1. Unconditional	5217.4	5278.5	5195.4	.7960 [†]	
2. Unconditional random effects	5057.7	5102.4	5029.7	.8385 [†]	
			Difference between Model 1 & Model 2 deviance		165.64*
3a. Conditional	5008.6	5104.2	4948.6	.8384 [†]	
				.4600 ^{††}	

Table 1 (continued).

Model	AIC	BIC	Deviance	R^2	χ^2 difference
Difference between Model 2 & Model 3a deviance					81.10*
3b. Trimmed conditional	4990.3	5050.9	4952.3	.8381 [†]	
				.4622 ^{††}	
Difference between Model 3a & Model 3b deviance					3.70

Note. Smaller values of AIC, BIC, & deviance indicate better fit; AIC & BIC reward more parsimonious models.

* $p < .005$

[†] interpretable as the proportion of total variability accounted for by the model.

^{††} interpretable as the proportion of variability in the random slope accounted for by the inclusion of Level-1 fixed effects.

For the final conditional model (Model 3b), overall Level-1 residuals (r_{ij}) were assumed to be independent and normally distributed with mean = 0 and variance = σ^2 for every situation-level unit nested within each participant j . Slight violations of these assumptions were detected for the Level 1 residuals: skewness = -.74; kurtosis = 4.12; Kolmogorov-Smirnov's $D = .0481$ with $p < .01$. However, given the large number of observations (1920), this deviation from the normality assumption is unlikely to

invalidate the tests of the fixed effects in the model. The Level-2 residuals for the valence items were assumed to be independent and normally distributed with mean = 0 and variance = σ^2 . With regard to the random intercept, tests for normality and quantile-quantile plots showed no violations of these assumptions. However, residuals for the effect of the valence manipulation evinced a slight negative skew: skewness = -.43; kurtosis = .58; Kolmogorov-Smirnov's $D = .07$, $p = .0155$. Removal of a single extreme observation yielded a set of residuals in accordance with model assumptions; Kolmogorov-Smirnov's $D = .06$, $p = .1306$. All subsequent analyses were performed with this outlier eliminated.

Model 3b results are given in Table 2, and discussed below.

Table 2

Effects of Level 1 and Level 2 Predictors on Valence Ratings

Level 1 Random Effect	Estimate	z	p -value
Intercept	.0214	2.18	.0146
P/N Manipulation	.3439	5.26	<.0001

Table 2 (continued).

Level 1 Fixed Predictor	Coefficient	<i>dft</i>	<i>t</i>	<i>p</i> -value
Intercept	.5687	175	19.10	<.0001
P/N Manipulation	3.4710	1721	49.24	<.0001
E/U Manipulation	.4922	1721	8.93	<.0001
Academic Context	-.4941	356	-10.27	<.0001
P/N * Academic Context	1.2785	1721	13.4	<.0001
P/N * Social Context	-1.0216	1721	-10.84	<.0001
E/U * Academic Context	-.3381	1721	-3.57	.0004
E/U * Social Context	.5022	1721	5.14	<.0001

Table 2 (continued).

Level 2 Fixed Predictor	Coefficient	<i>df</i>	<i>t</i>	<i>p</i> -value
BIS	.0295	175	1.27	.2046
BASRR	-.0427	175	-1.85	.0663
Sex	-.0833	175	-1.80	.0738
P/N * BIS	-.3445	1721	-5.65	<.0001
P/N * BASRR	-.2494	1721	-4.10	<.0001
P/N * Sex	.3481	1721	2.86	.0043

Note. Valence ratings were rescaled and centered at 0 = neutral; BIS and BASRR scores were standardized prior to analysis.

Significant random effects were found, indicating variability in both the intercept ($z = 2.18, p = .0146$) and slope ($z = 5.26, p < .0001$) of valence ratings, supporting hypotheses 1 and 2. Intercept and slope were not significantly correlated ($r = -.0076, p =$

.6674). As compared to Model 2 (random effects only) variability estimates, 46.22% of the variability in the slope of valence ratings was explained by the Level 2 variables retained in Model 3b; 19.12% of the intercept variability was explained by these Level 2 variables. The fixed intercept reflecting the average valence rating across the P/N and E/U manipulations and across gender for mixed context items was .5687, with $SE = .0298$ (on a scale of -3 to $+3$). This indicated a slight but significant positive bias in valence ratings; $t(175) = 19.10, p < .0001$. The fixed effect for the P/N manipulation served as an additional manipulation check, showing that on average vignettes with positive outcomes were rated $\beta = 3.4710$ points more positively than vignettes with negative outcomes; M positive = 2.3042, M negative = -1.1668, $SE = .0705, t(1721) = 49.24, p < .0001$. Vignettes with expected outcomes were also rated more positively than vignettes with unexpected outcomes, but the difference of $\beta = .4922$ between conditions was much smaller; M expected = .8148, M unexpected = .3226, $SE = .0551, t(1721) = 8.93, p < .0001$.

Vignette context (academic, social, and mixed) produced differences in valence ratings both as a main effect and in interaction with the valence and expectedness manipulations. While the overall average valence rating for mixed context vignettes was .5687, this positive bias was decreased in the social context ($M = .2102, SE = .0472, t(356) = -7.58, p < .0001$), and nearly eliminated in the academic context ($M = .0746, SE = .0481, t(356) = -10.27, p < .0001$) (Figure 1).

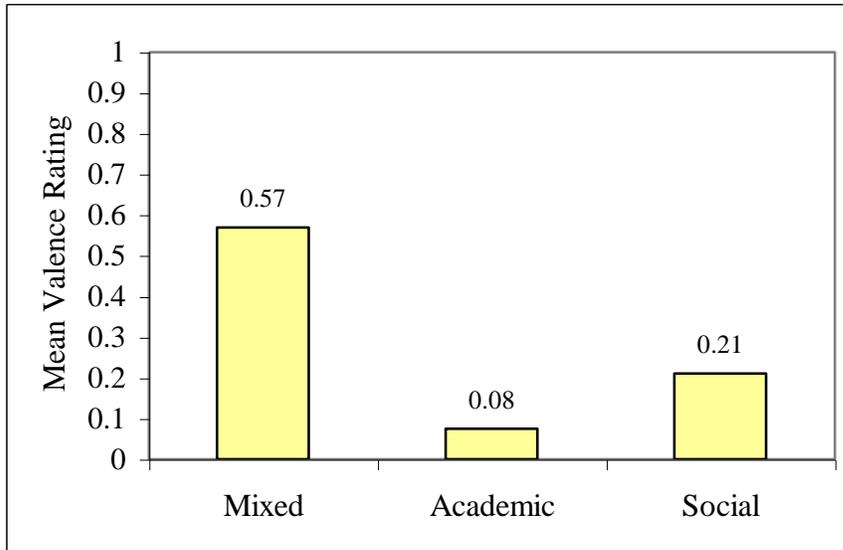


Figure 1. Valence ratings by context condition.

There were also significant interactions between the P/N and E/U manipulations and context. Compared to mixed context vignettes, differences in valence ratings across the P/N manipulation were exacerbated in the academic context ($\beta = 1.2785$, $SE = .0954$, $t(1721) = 13.40$, $p < .0001$) and attenuated in the social context ($\beta = -1.0216$, $SE = .0942$, $t(1721) = -10.84$, $p < .0001$) (Figure 2). Compared to mixed context vignettes, differences in valence ratings across the E/U manipulation were attenuated in the academic context ($\beta = -.3381$, $SE = .0947$, $t(1721) = -3.57$, $p = .0004$) and exacerbated in the social context ($\beta = .5022$, $SE = .0978$, $t(1721) = 5.14$, $p < .0001$) (Figure 3).

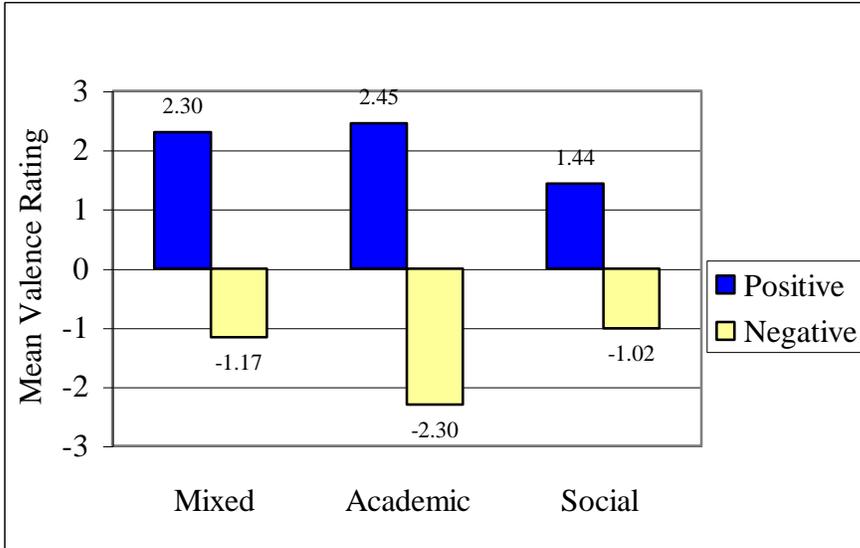


Figure 2. Valence ratings by P/N manipulation and context.

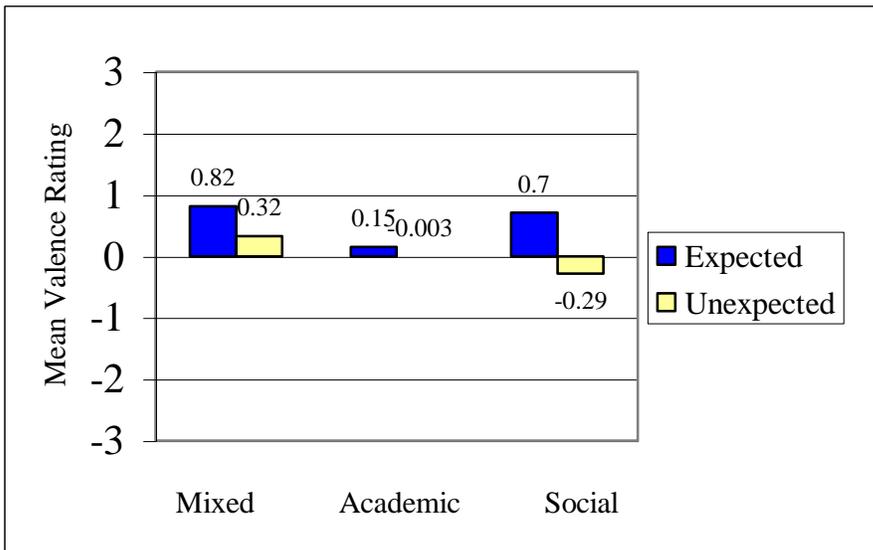


Figure 3. Valence ratings by E/U manipulation and context.

Turning to the effects involving the Level 2 variables (BIS, BASRR, and sex), none produced significant main effects on the valence ratings (although main effects of BASRR and sex were marginal; $t(175) = -1.85, p = .0663$ and $t(175) = -1.80, p = .0738$, respectively). As proposed in hypothesis 3, BIS interacted with the P/N manipulation ($t(1721) = -5.65, p < .0001$) such that each standard deviation increase in BIS scores produced a .3445 decrease in the difference between the positive and negative manipulations, attenuating the effect at higher levels of BIS (Figure 4).

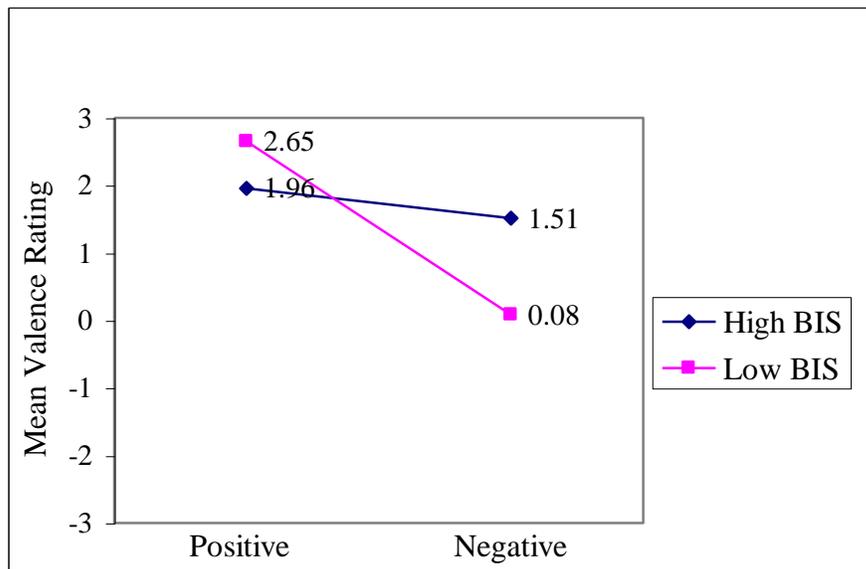


Figure 4. Valence ratings by BIS (+/- 2 SD) and P/N manipulation.

However, BIS did not interact with the E/U manipulation (failure to support hypothesis 4). BASRR also interacted with the P/N manipulation ($t(1721) = -4.10, p < .0001$), such

that each standard deviation increase in BASRR scores produced a .2494 decrease in the difference between the positive and negative manipulations, attenuating the effect at higher levels of BASRR (Figure 5). This result supports hypothesis 5. The interaction between BIS and BASRR was nonsignificant, as expected.

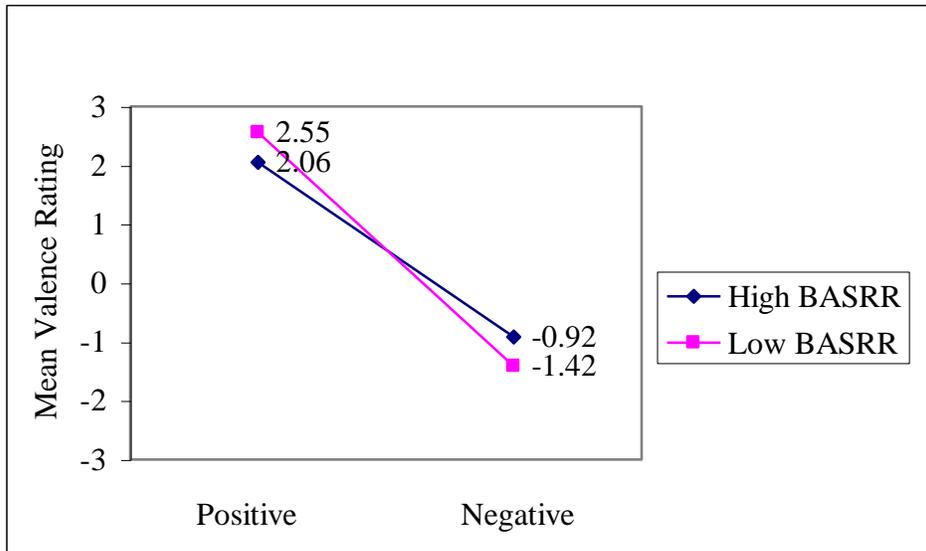


Figure 5. Valence ratings by BASRR (+/- 2 SD) and P/N manipulation.

Sex, however, did interact with the P/N manipulation, $t(1721) = 2.86, p = .0043$ (Figure 6). Females rated positive outcomes as more positive than did males (M females = 2.4366 vs. M males = 2.1718, $s.e. = .1219$), and rated negative outcomes as more negative than did males (M females = -1.3283 vs. M males = -.9511, $s.e. = .1219$) (Figure 6).

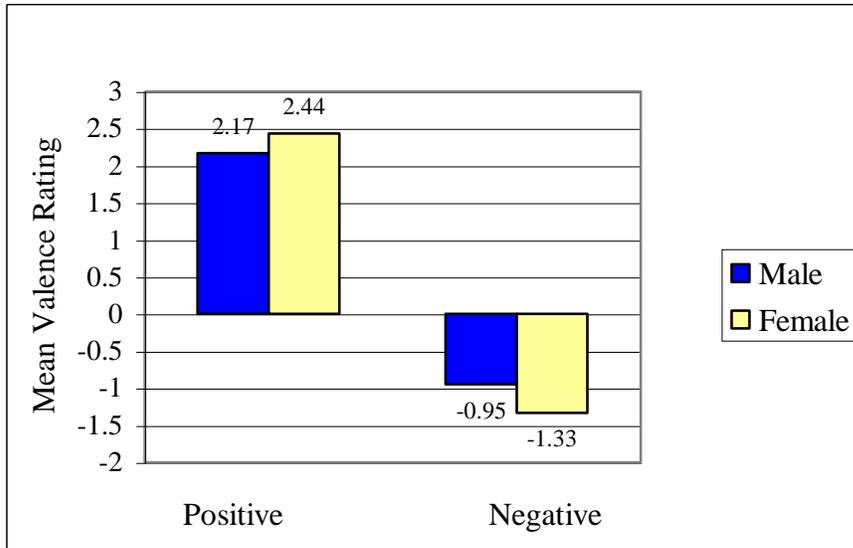


Figure 6. Valence ratings by P/N manipulation and sex.

Modeling responses to expectedness items

Responses to expectedness items were first examined using an unconditional linear model (Model 1) with fixed effects for Level 1 variables (P/N and E/U manipulations, and situation content) and all 2-way interactions. A second unconditional model was fit, adding random effects for the intercept and the E/U manipulation (Model 2). Examination of the random effects showed significant individual variability in both the intercept ($z = 4.10, p < .0001$) and slope ($z = 3.49, p = .0002$) of the responses to expectedness items, and the intraclass correlation indicated that 18.41% of the variability was explained by the E/U manipulation (ICC = .1841).

The inclusion of unconditional random effects in Model 2 produced a significant improvement in model fit ($\chi^2_{\text{diff}} = 20.93, df = 3, p < .005$). A conditional model (Model

3a) was prepared to evaluate Level 2 variables as predictors of this variability, adding fixed effects for BIS, BASRR sex, all 2-way interactions between Level 1 and Level 2 variables, and the interaction between BIS and BASRR. The inclusion of Level 2 variables again produced a significant improvement in model fit ($\chi^2_{\text{diff}} = 51.8, df = 20, p < .005$). A final conditional model was estimated (Model 3b), retaining all predictors from Model 3a that were involved in significant effects. This trimming did not significantly decrease model fit ($\chi^2_{\text{diff}} = 12.5, df = 9, p > .05$). See Table 3 for fit indices and R^2 values.

Table 3

Summary of Nested Expectedness Models

Model	AIC	BIC	Deviance	R^2	$\chi^2_{\text{difference}}$
1. Unconditional	5930.1	5990.9	5908.1	.4570 [†]	
2. Unconditional random effects	5915.2	5959.4	5887.2	.4911 [†]	
Difference between Model 1 & Model 2 deviance					20.93*

Table 3 (continued).

Model	AIC	BIC	Deviance	R^2	χ^2 difference
3a. Conditional	5895.4	5990.2	5835.4	.5009 [†]	
				.1525 ^{††}	
					Difference between Model 2 & Model 3a deviance 51.80*
3b. Trimmed conditional	5889.9	5956.3	5847.9	.4976 [†]	
				.1260 ^{††}	
					Difference between Model 3a & Model 3b deviance 12.50

Note. Smaller values of AIC, BIC, & deviance indicate better fit; AIC & BIC reward more parsimonious models.

* $p < .005$

[†] interpretable as the proportion of total variability accounted for by the model.

^{††} interpretable as the proportion of variability in the random slope accounted for by the inclusion of Level-1 fixed effects.

For the final conditional expectedness model (Model 3b), overall Level-1 residuals (r_{ij}) were assumed to be independent and normally distributed with mean = 0 and variance = σ^2 for every situation-level unit nested within each participant j . Slight violations of these assumptions were detected for the Level 1 residuals: skewness = -.74; kurtosis = 4.12; Kolmogorov-Smirnov's $D = .0301$ with $p < .0001$. Again, given the large number of observations (1920), this

deviation from the normality assumption is unlikely to invalidate the tests of the fixed effects in the model. The Level-2 residuals for the valence items were assumed to be independent and normally distributed with mean = 0 and variance = σ^2 . With regard to the effect of the expectedness manipulation, tests for normality and quantile-quantile plots showed no violations of these assumptions. However, residuals for the random intercept indicated a positive skew: skewness = 1.3160; kurtosis = 2.9778; Kolmogorov-Smirnov's $D = .1103$, $p < .00001$. Removal of six extreme observations yielded a set of residuals in accordance with model assumptions; Kolmogorov-Smirnov's $D = .0503$, $p > .1500$. All subsequent analyses were performed with these outliers eliminated. Model 3b results are given in Table 4, and discussed below.

Table 4

Effects of Level 1 and Level 2 Predictors on Expectedness Ratings

Level 1 Random Effect	Estimate	z	p -value
Intercept	.0131	.88	.1902
E/U Manipulation	.2407	3.01	<.0013

Table 4 (continued).

Level 1 Fixed Predictor	Coefficient	<i>df</i>	<i>t</i>	<i>p</i> -value
Intercept	-.0638	170	-1.63	.1047
E/U Manipulation	1.9615	1668	23.35	<.0001
P/N Manipulation	.3258	1668	4.28	<.0001
P/N * E/U	.7129	1668	6.69	<.0001
Academic Context	-.1623	346	-2.48	.0135
Social Context	-.0457	346	-.7	.4844
P/N * Academic Context	.4898	1668	3.74	.0002
P/N * Social Context	-.4956	1668	-3.72	.0002

Table 4 (continued).

Level 1 Fixed Predictor	Coefficient	<i>df</i>	<i>t</i>	<i>p</i> -value
E/U * Academic Context	1.1009	1668	8.42	<.0001
E/U * Social Context	-1.2894	1668	-9.90	<.0001
Level 2 Fixed Predictor	Coefficient	<i>dft</i>	<i>t</i>	<i>p</i> -value
BIS	.0822	170	2.84	.0050
BASRR	-.0909	170	-2.33	.0212
Cross-level Interaction	Coefficient	<i>dft</i>	<i>t</i>	<i>p</i> -value
P/N * BASRR	-.2144	1668	-5.65	<.0001

Table 4 (continued).

Cross-level Interaction	Coefficient	<i>dft</i>	<i>t</i>	<i>p</i> -value
E/U * BASRR	-.1743	1668	-2.68	.0075
BASRR * Academic Context	.0852	1668	1.29	.1979
BASRR * Social Context	.1324	1668	2.04	.0419

Note. Expectedness ratings were rescaled and centered at 0 = neutral; BIS and BASRR scores were standardized prior to analysis.

No significant effects were found for the random intercept term, indicating little or no individual variability the intercept of expectedness ratings ($z = .88, p = .1902$). This finding failed to support hypothesis 6, regarding the presence of variability in individuals' average ratings of expectedness. However, there was significant variability in the slope of the expectedness ratings ($z = 3.01, p = .0013$), supporting hypothesis 7. Intercept and slope were marginally negatively correlated ($r = -.0409, p = .0894$), such that individuals making higher expectedness ratings on average were slightly less affected by the expectedness manipulation.

As compared to Model 2 (random effects only) variability estimates, 7% of the variability in the slope of expectedness ratings was explained by the Level 2 variables retained in Model 3b; 2% of the intercept variability was explained by these Level 2 variables. The fixed intercept reflecting the average expectedness rating across P/N and E/U manipulations and across gender for mixed context items was $-.0638$, with a standard error of $.0391$ (on a scale of -3 to $+3$). This value was not significantly different from 0 ($t(170) = -1.63, p = .1047$), and indicated no overall bias in expectedness ratings. The fixed effect for the E/U manipulation served as an additional manipulation check, showing that on average vignettes with expected outcomes were rated 1.9615 points higher on expectedness than vignettes with unexpected outcomes; $M E = .9170, M U = -1.04, s.e. = .0840, t(1668) = 23.35, p < .0001$. Vignettes with positive outcomes were also rated as higher on expectedness than vignettes with negative outcomes, but the difference was much smaller; $M P = .2927, M N = -.4203, s.e. = .1066, t(1668) = 6.69, p < .0001$. The valence (P/N) and expectedness (E/U) manipulations also interacted significantly ($t(1668) = 6.69, p < .0001$). As shown in Figure 7, the difference between the expected and unexpected outcome manipulations was increased when outcomes were positive.

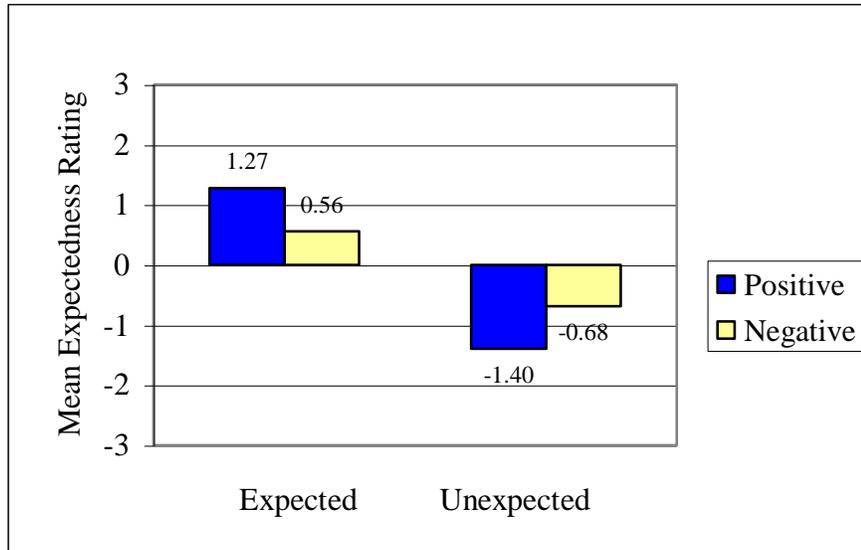


Figure 7. Expectedness ratings by P/N and E/U manipulations.

Vignette content (Academic, Social, and Mixed) produced differences in expectedness ratings both as a main effect and in interaction with the expectedness and valence manipulations. The overall average expectedness rating for mixed context vignettes was not significantly different from 0 ($-.0638$), and decreased nonsignificantly in the social context ($M = -.1095$, $s.e. = .07$, $t(346) = -.7$, $p = .4844$). However, the average expectedness rating was significantly lower in the academic context ($M = -.2261$, $s.e. = .0654$, $t(346) = -2.48$, $p = .0135$), indicating a slight bias towards interpreting academic outcomes as unexpected (Figure 8).

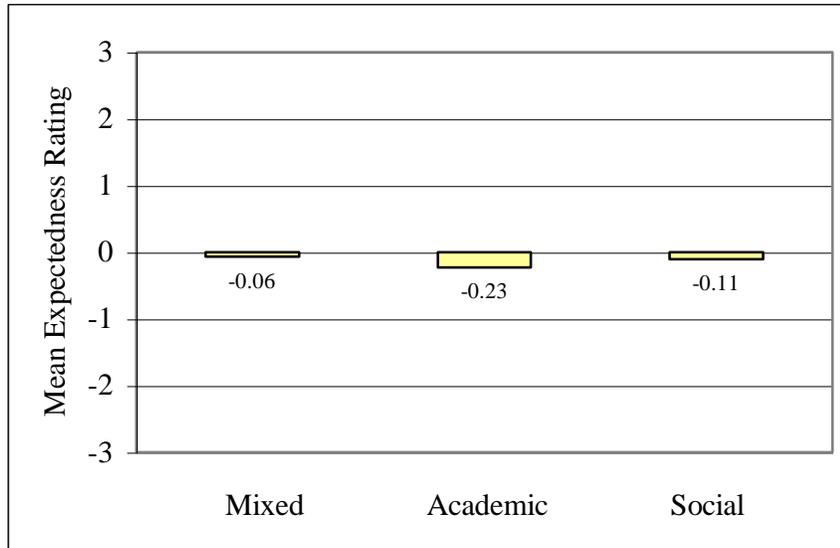


Figure 8. Expectedness ratings by context condition.

Compared to mixed context vignettes, differences in expectedness ratings across the E/U manipulation were exacerbated in the academic context ($\beta = 1.1009$, $s.e. = .1308$, $t(1668) = 8.42$, $p < .0001$) and reduced in the social context ($\beta = -1.2894$, $s.e. = .1302$, $t(1668) = -9.90$, $p < .0001$) (Figure 9).

Compared to mixed context vignettes, differences in expectedness ratings across the P/N manipulation were increased in the academic context ($\beta = .4898$, $s.e. = .1311$, $t(1668) = 3.74$, $p = .0002$) and decreased in the social context ($\beta = -.4956$, $s.e. = .1332$, $t(1668) = -3.72$, $p = .0002$) (Figure 10). Further, in social contexts, the tendency to rate positive outcomes as expected was nearly eliminated.

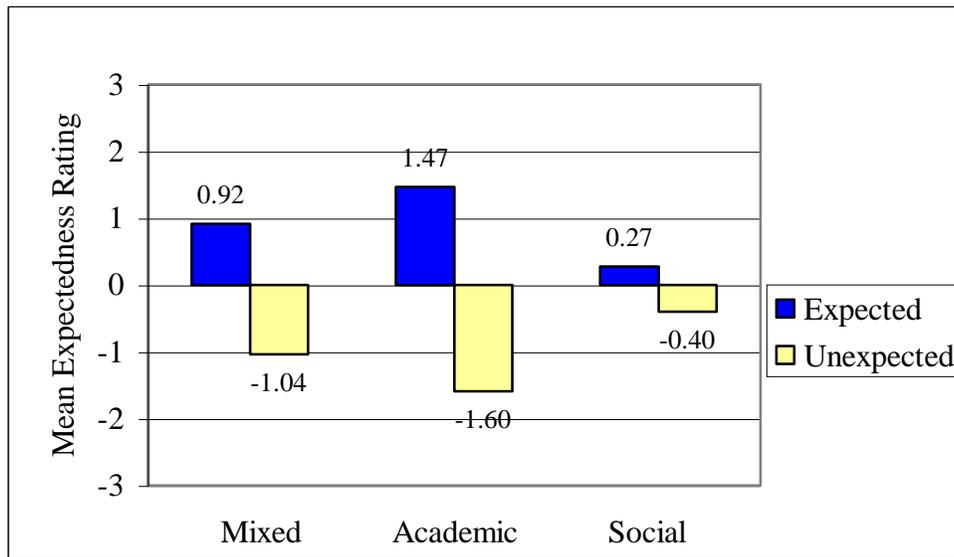


Figure 9. Expectedness ratings by E/U manipulation and context.

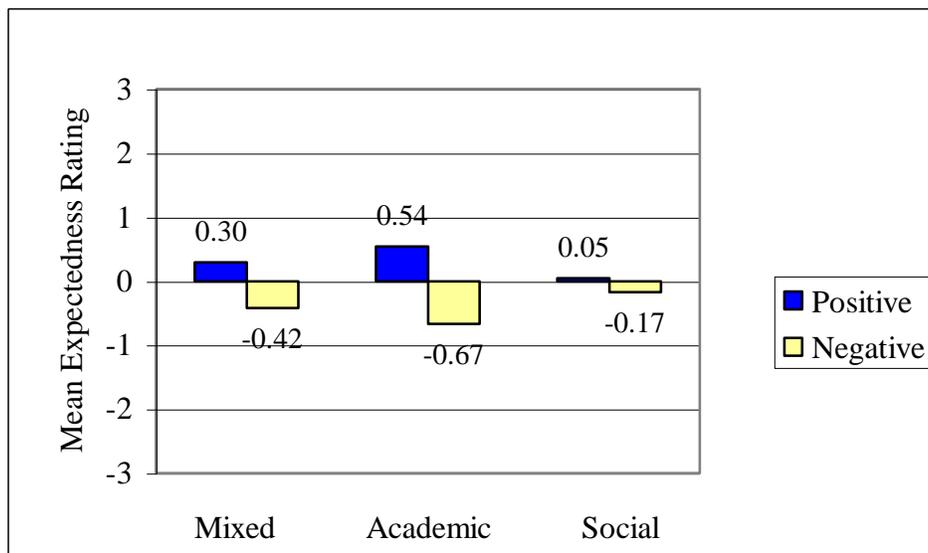


Figure 10. Expectedness ratings by P/N manipulation and context.

Turning to the main and interaction effects involving Level 2 variables (BIS, BASRR, and sex), BIS was only involved in a single significant main effect on expectedness ratings and no significant effects of participant sex were detected. For each standard deviation increase in BIS scores there was a .0822 increase in expectedness ratings ($s.e. = .0289$, $t(170) = 2.84$, $p = .0050$). However, hypotheses 8 & 9 regarding BIS interactions with the vignette manipulations were not supported; BIS failed to interact with either the P/N or E/U manipulation.

In contrast, BASRR produced both main and interaction effects with regard to expectedness ratings. For each standard deviation increase in BASRR scores there was a .0909 decrease in expectedness ratings ($s.e. = .0391$, $t(170) = -2.33$, $p = .0212$). BASRR interacted with the E/U manipulation ($\beta = -.1743$, $s.e. = .0651$, $t(1668) = -2.68$, $p = .0075$) and with the P/N manipulation ($\beta = -.2144$, $s.e. = .0536$, $t(1668) = -4.00$, $p < .0001$). Each standard deviation increase in BASRR scores produced a .17 decrease in the difference between the expected and unexpected manipulations, attenuating the effect at higher levels of BASRR (Figure 11).

Each standard deviation increase in BASRR scores produced a .21 decrease in the difference between the positive and negative manipulations, exacerbating the effect of the P/N manipulation at lower levels of BASRR (Figure 12).

The interaction between BIS and BASRR was nonsignificant. Sex was not involved in any significant main or interaction effects, and was dropped from the final expectedness model.

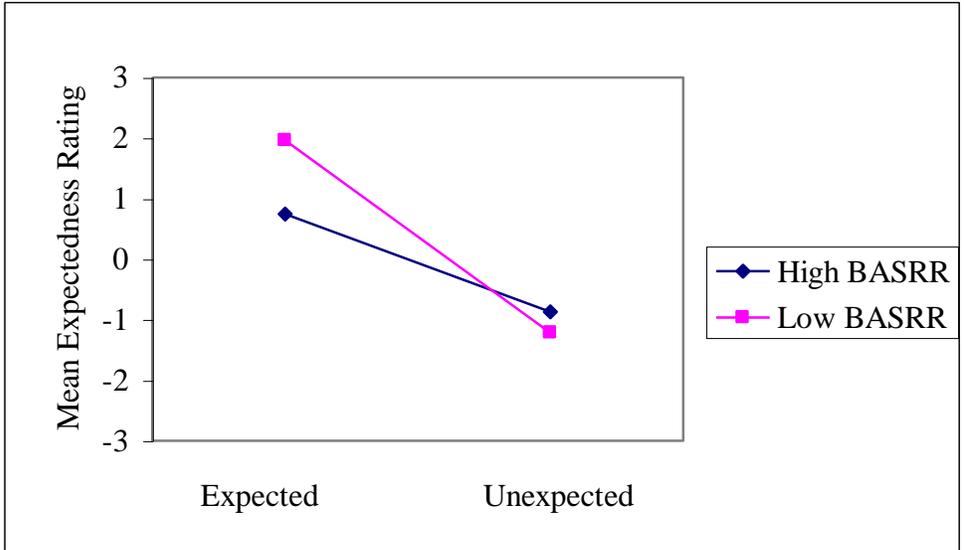


Figure 11. Expectedness ratings by BASRR (+/- 2 SD) and E/U manipulation.

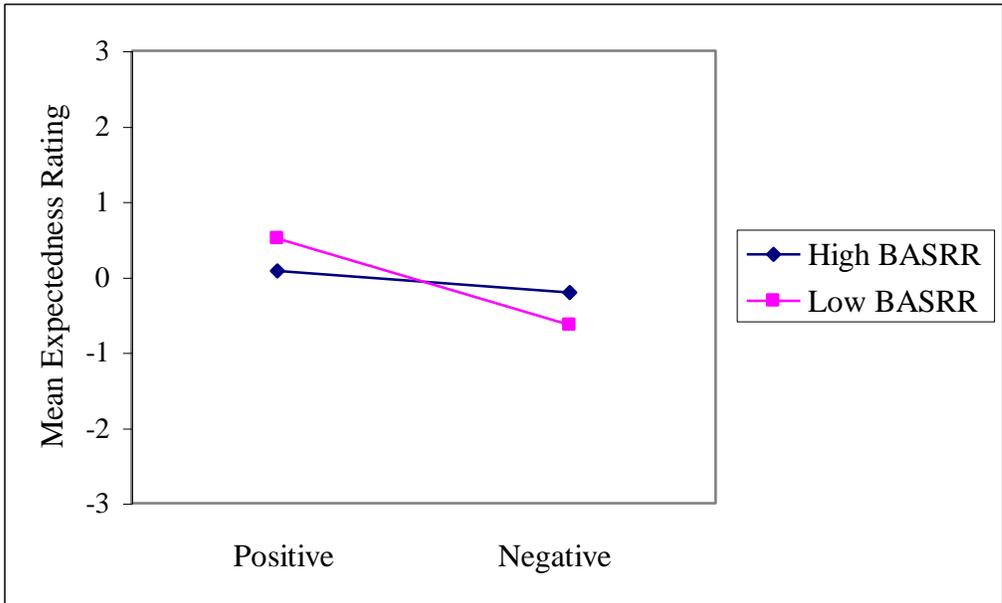


Figure 12. Expectedness ratings by BASRR (+/- 2 SD) and P/N manipulation.

DISCUSSION

Results of this study support the utility of a multilevel approach to predicting situational appraisal, in terms of both valence and expectedness ratings. In accordance with hypotheses 1 and 2 regarding valence ratings, individuals varied in their overall tendencies to rate outcomes as positive versus negative, and in their sensitivities to the (P/N) manipulation. In accordance with hypothesis 7 regarding expectedness ratings, individuals varied in their sensitivities to the outcome expectedness (E/U) manipulation, although they did not vary significantly in their overall tendency to rate outcomes as expected versus unexpected (non-support for hypothesis 6).

The implications of this finding reach beyond the context of the present research, and are generally applicable to research paradigms wherein participants must construe & respond to social stimuli presented as text, and may also apply to research involving stimulus presentations in the form of video or audio recordings, photographs, illustrations, structured interviews, etc... The assumption that standardized stimulus materials constitute identical stimuli across individuals and that variations in individuals' appraisals of these stimuli can be automatically treated as randomly distributed error is untenable, as Howard & Allen (1989) have already proposed; fortunately, multilevel analytical techniques currently obviate the need to rely on this assumption. Instead, researchers should explicitly address the possibility of significant heterogeneity in participants' responses to stimuli, in order to capitalize on the opportunity to explain this variability and to understand the ways in which individual differences contribute to

response heterogeneity. This point is underscored by the finding that individual differences in BIS and BAS scale scores interacted with outcome manipulations to explain a significant amount of the variability in response to the P/N and E/U manipulations (significant BIS x P/N and BAS x P/N effects on valence ratings supporting hypotheses 3 and 5, respectively; significant BAS x P/N and BAS x E/U effects on expectedness ratings). That the stimuli in question were relatively unambiguous manipulations of expectedness and valence (as indicated by pretest consensus measures and study manipulation checks) makes this finding more remarkable. The importance of modeling response heterogeneity would appear to be even greater as the likelihood that participants will construe stimulus materials idiosyncratically increases. This would be the case when more complex stimuli (such as videotaped or scripted live social interactions) are employed, when measurement scales that allow more varied responses are used (valence and expectedness ratings for each item were assessed using a 5-point scale), and/or when participants have more opportunity or motivation to engage in appraisal. This suggestion concurs with Zajonc's (2001) conjecture that reductions in mere exposure effect sizes observed with supraliminal as compared to subliminal stimuli can be attributed to greater between-participants variability associated with explicit cognitive appraisal. Research designs that do not model the random effects of situational characteristics such as the P/N and E/U manipulations will fail to detect nested data structures and may thus overlook and fail to explain meaningful variability in participants' responses to stimuli.

A second tacit assumption that these findings call into question is that of individuals' having uniform response tendencies across situations. At a theoretical level, social psychology has long emphasized the power of the situation and the importance of the person x situation interaction (Lewin, 1935). Social psychologists (notably Mischel, 1968) have also asserted that individuals display a lack of cross-situational consistency, citing the difficulty of accurately predicting behavior based on individual differences alone. The ability to demonstrate that given response tendencies (such as those associated with the activation of BIS and BAS) are affected by or even predicated upon the presence of relevant situational cues would appear to constitute an extremely strong demonstration of the importance of context in determining behavior. However, the additional acknowledgement that some individual differences manifest themselves as response tendencies primarily or only in the presence of the appropriate cues hold out the hope of providing a synthetic way of understanding of the potential for individual differences to contribute via interaction with situational characteristics—one that may be able to account both for findings that demonstrate cross-situational consistency and those that do not. It may be that some aspects of changing situations elicit different dispositions or sets of response tendencies from a given individual, i.e. that the expression of at least some individual differences depends on the situation in which individuals find themselves. This would appear to be the case regarding the effects of BIS and appraisals of valence. As expected (Gray, 2000) individual differences in BIS and BAS did not exert main effects on valence ratings; rather, BIS and BAS affected

valence ratings via cross-level interactions with the P/N manipulation (support for hypotheses 3 and 5). Main effects of BIS and BAS on expectedness ratings were superseded by BAS x P/N and BAS x E/U interactions. These findings concur with Gray's (2000) conceptualization of BIS and BAS as system which exert effects only when elicited by avoidance-relevant cues or approach-relevant cues, respectively. The relatively novel analytical strategy of modeling situations nested within individuals which was employed in this study is necessary for detecting relationships of this nature; aggregate measurements across situations per individual would fail to detect cross-level person x situation interactions, thus producing misleading results to the extent that the expression of the individual's characteristics vary depending on the measurement context. In any case, when theory suggests that the expression of response tendencies may vary depending on aspects of the situation, it is preferable to ascertain whether or not a nested data structure exists before proceeding with analyses that aggregate responses across manipulations within individuals.

Valence Ratings

Two of the three hypotheses regarding anticipated effects of BIS and BAS on valence ratings were supported. In accordance with Hypothesis 3, the effects of the P/N manipulation depended on individuals' BIS scores (Figure 4), such that lower BIS scores were associated with greater sensitivity to the manipulation, and more extreme ratings in each condition. This supports the expectation that BIS sensitivity should predict valence

ratings differentially across the P/N manipulation, however it is unclear why the effects of the manipulation were attenuated rather than exacerbated at higher levels of BIS. As stated earlier, the precise natures of the interactions between BIS (and BAS) and the outcome manipulations were difficult to anticipate, due to a lack of prior research using within-participants designs to compare individuals' responses across situational manipulations. It may be that high-BIS individuals are so sensitive to the presence of avoidance-relevant cues or so predisposed to appraise cues as having threat potential that the effects of the P/N manipulation are primarily manifested in the responses of low-BIS individuals.

Hypothesis 5 was also supported by the data; the effects of the P/N manipulation depended on individuals' BASRR scores (Figure 5). As was the case with the BIS x P/N interaction, lower BASRR scores were associated with greater sensitivity to the P/N manipulation, and more extreme ratings in each condition. In this case, it may be that high-BAS individuals are so sensitive to the presence of reward- or escape-relevant cues or so predisposed to appraise cues as having reward or escape potential that the effects of the P/N manipulation are primarily manifested in the responses of low-BAS individuals. However, it is also possible that lower BIS and BASRR sensitivities may contribute to more polarized assessments of outcome valence, while higher BIS and BASRR sensitivities contribute to either more biased or less labile appraisal tendencies.

Hypothesis 4 was not supported; the effects of the E/U manipulation on valence ratings did not depend on BIS. As novelty is one of the BIS-relevant cues identified by

Gray (2000), was suspected that that unexpected outcomes might be interpreted as cues signifying potential threat and thus invoke BIS response tendencies, affecting appraisals of valence; unexpected outcomes should thus be seen as more negative or at least less desirable. Despite the fact that findings from the present study do not support this expectation, the possibility remains that in situations where uncertainty or failure to accurately predict outcomes have more clear-cut or more serious negative consequences, expectedness could interact with BIS and/or BAS to affect appraisals of valence.

There was a modest main effect of the E/U manipulation in that participants rated expected outcomes as slightly more positive and unexpected outcomes as slightly less positive, but this difference is very small when compared to the effect of the P/N manipulation. The E/U manipulation did interact with context, such that unexpected social outcomes in particular were rated negatively; otherwise unexpected outcomes were simply rated as less positive than expected outcomes in the same context condition (Figure 3). The E/U manipulation did not interact with Level 2 variable, nor did interact with the P/N manipulation to predict valence ratings. Thus expectedness of outcomes appears to have little impact on assessments of valence either directly or in conjunction with BIS and BAS, at least when the outcomes are unambiguously good or bad as in the present research, and when the consequences of uncertainty or failure to make accurate predictions are not clearly of a serious nature. The fact that the E/U manipulation interacted with context to affect valence ratings probably reflects individual differences in expectations for success and failure across the different contexts, and individual

differences in the importance placed on doing well or badly in the different contexts. As was noted in the description of development of the stimulus materials, the manipulation of expectedness was weaker than the manipulation of valence in that there was less consensus regarding which vignettes contained unexpected outcomes and the degree to which the outcomes were expected or unexpected. As a result, the null finding regarding hypothesis 4 is not entirely surprising and may be artifactual.

There were some other results of interest with regard to the valence ratings. The interaction between BIS and BASRR did not approach significance, a null finding which is in line with theoretical expectations that BIS and BAS sensitivities are orthogonal (Gray, 2000). Context produced a main effect on valence ratings, showing that on average participants interpreted mixed context outcomes as somewhat positive and social context outcomes as slightly positive. Participants did not display this bias in reference to academic outcomes (Figure 1). Context also interacted with the P/N manipulation (Figure 2), so that the largest difference in valence ratings across the P/N manipulation was observed for academic outcomes. These last two findings raise the possibility that the academic outcomes used in this study were more clearly interpretable as good or bad and expected or unexpected via shared rather than idiographic standards than the social or mixed context outcomes.

Expectedness Ratings

Compared to the analysis of the random effects of the P/N manipulation on valence ratings, relatively little of the variability in expectedness ratings was explained

by the Level 2 variables. Taken with the observation that expectedness ratings varied more and exhibited lower consensus than valence ratings, it may be the case that assessments of expectation are more idiosyncratic than assessments of valence. A more adequate model of expectedness ratings would include additional individual-level variables reflecting the bases for context-specific expectations, such as measures of domain-specific self-concept and/or self-efficacy. For present purposes, however, the model is sufficient: expectedness was included in this study primarily because unexpected outcomes have been demonstrated to increase the likelihood of engaging in causal thinking. The expectedness of outcomes is thus relevant to issues that will be examined in future research, despite the small amount of variability in expectedness ratings explained by BIS and BAS. However, due to the way in which the stimulus materials & questionnaires were structured, it is premature to place much emphasis on the results obtained from modeling the expectedness ratings. Within each version of the stimulus materials/questionnaire packet, valence rating items for each scenario always appeared before the corresponding expectedness rating item. It is therefore impossible to ascertain whether the influence of outcome valence on expectedness ratings is a real effect or an artifact of the order in which the ratings were elicited. All other findings from the expectedness model must also be considered extremely tentative until they can be replicated, using a set of stimulus materials in which the presentation of valence and expectedness items has been counterbalanced.

Analysis of expectedness ratings produced a more complex pattern of results than analysis of valence ratings. Individuals who tended to give higher expectedness ratings on average were less affected by the expectedness manipulation, as indicated by the significant negative correlation between intercept and slope, whereas the intercept and slope for valence ratings were independent. While the E/U manipulation produced only trivial effects on valence ratings, the P/N manipulation assumed some importance for expectedness assessments. Positive outcomes were rated as slightly more expected than negative outcomes. In addition, the P/N and E/U manipulations interacted (Figure 7) such that the difference between the expected and unexpected outcome manipulations was exaggerated when outcomes were positive—expected positive outcomes were rated as more expected than expected negative outcomes. The P/N manipulation also interacted with context and BASRR to affect expectedness ratings. This is in striking contrast to the relatively small and limited effects of the E/U manipulation on valence ratings; for appraisals of expectedness the valence of the outcomes does seem to matter, in addition to and in combination with Level 1 and Level 2 variables.

In terms of the hypothesized effects involving Level 2 variables, neither hypotheses 8 nor 9 were supported by the data; no significant BIS x P/N or BIS x E/U interactions were detected. This failure to support hypothesis 8 and 9 is however consistent with findings from the model of valence ratings which suggest that the link between BIS activation and cues based on expectedness is tenuous or nonexistent, at least in the context of the stimulus materials used in this research.

Another problematic finding involved the significant main effects of BIS on expectedness ratings (main effects of BASRR were superseded by interactions with the P/N and E/U manipulations). As with the valence ratings, BIS should only produce effects in the presence of the appropriate eliciting cues—via interaction with the situational manipulations of valence and expectedness. It remains to be seen whether this finding can be replicated and thus poses a problem requiring refinement of the theoretical understanding of the BIS construct. However, in accordance with theoretically-based expectations the interaction between BIS and BASRR did not approach significance.

Although it was initially unclear how the BASRR might relate to expectedness appraisal and no hypotheses were made regarding BASRR and expectedness ratings, several significant effects were observed. BASRR interacted with both the E/U manipulation and the P/N manipulation. Lower BASRR scores were associated with greater sensitivity to the E/U manipulation and with greater reliance on the valence of outcomes when appraising expectedness; negative outcomes are rated as unexpected and positive outcomes are rated as expected. At higher levels of BASRR, the P/N manipulation had almost no effect on expectedness ratings. As with valence ratings, it may be that high-BAS individuals are so sensitive to the presence of reward- or escape-relevant cues or so predisposed to appraise cues as having reward or escape potential that the effects of the P/N and E/U manipulations are primarily manifested in the responses of low-BAS individuals. However, it is also possible that lower BASRR sensitivities may

contribute to more polarized assessments of outcome valence, while higher BASRR sensitivities contribute to either more biased or less labile appraisal tendencies.

Context effects were much more pervasive for the expectedness ratings than for the valence ratings. For valence ratings, content produced a main effect and interacted with only the P/N and E/U manipulations. Context produced differences in expectedness ratings as a main effect, through interaction with the E/U and P/N manipulations, and by interacting with BIS. Academic outcomes tended to be appraised as unexpected, while no such bias existed in the mixed or social contexts. Differences in expectedness ratings across the E/U manipulation were exacerbated in the academic context and reduced in the social context. A similar pattern was observed for the P/N manipulation; differences in expectedness ratings across the P/N manipulation were greatest in the academic context and least in the social context, but the tendency to rate positive outcomes as expected was reversed in the social context. Finally, BIS interacted with context such that in the social condition the tendency for low BIS scores to be associated with rating outcomes as unexpected was reversed—high BIS scores predicted lower expectedness ratings in this condition.

Conclusions

Results of the present research supports the existence of a linkage between BIS/BAS sensitivities and the appraisal of outcomes along two dimensions that prior research and theory suggest are relevant to the instigation of causal thinking: valence and expectedness. Based on the finding that situational construal is partly a function of

individuals' BIS and BAS sensitivities responding to situational manipulations of valence and expectedness, and the proposal that construal contributes directly to the instigation of causal thinking, further research exploring the relationship between BIS/BAS and causal thinking is in order. The results also support the utility of taking a multilevel repeated-measures approach, treating BIS and BAS as individual-level characteristics capable of explaining response variation within individuals and across situations.

The stimulus materials and measures designed for this research were also found to be adequate for eliciting and detecting effects that largely conform to theoretically based expectations. Despite strong consensus on the direction of the P/N and E/U manipulations, individuals varied in their ratings of the magnitude of valence and expectedness, and BIS and BAS measures predicted significant portions of this variability, particularly for valence ratings. As expected, BIS and BAS did not interact with each other to produce effects on either valence or expectedness ratings, and the single theoretically problematic finding—a main effect of BIS on expectedness ratings—appeared in the context of a model that is difficult to interpret due to flaws in the way that expectedness ratings were collected. As hypothesized, BIS and BASRR were observed to be sensitive to the P/N manipulation in predicting valence ratings. BIS did not interact with the E/U manipulation in this model, the reasons for which are still not clear, but this finding does not appear to undermine the general usefulness of this approach to understanding appraisals of valence in conjunction with BIS and BAS. Regarding the expectedness ratings, the hypothesized interaction between BIS and the P/N manipulation

was observed, but BIS failed to interact with the P/N and E/U manipulations. However, BASRR did exert significant interaction effects on the expectedness ratings; suggesting that BAS contributes to construal of expectedness and may thus be implicated in the instigation of causal thinking. Again, the general usefulness of this approach is not undermined by this failure, especially considering the problems with interpreting any of the findings from based on the expectedness ratings.

Expectedness appraisals may be more complexly-determined than valence appraisals, subject to more individual-level input such as past experiences of success and failure within specific contexts. Expectedness may receive more input from BAS sensitivity than do valence appraisals. No clear conclusions regarding expectedness appraisals should be drawn, however, unless findings from this study can be replicated, using a set of stimulus materials in which the presentation of valence and expectedness items has been counterbalanced.

Research has been planned which will address these methodological issues, and examine the relationships between BIS/BAS and the amount of spontaneous causal thinking produced in response to valence and expectedness manipulations.

Future research will also address the question of whether BIS/BAS functioning affects the likelihood of engaging in causal thinking solely by affecting the way that individuals construe situations, by exerting effects on causal thinking that are not mediated by construal, or via both of these proposed pathways. This raises the possibility that causal thinking serves a previously unrecognized role in self-regulation, one which

enhances the capacity to inhibit and initiate behaviors appropriately in response to environmental or situational demands independent of the content of the attributions produced. If it can be demonstrated that the act of engaging in causal thinking itself serves an adaptive function tied directly to the BIS-regulated inhibition or cessation of ongoing behavior, this would help to explicitly contextualize a highly-derived and uniquely human capability within a biological/evolutionary framework—as an elaboration upon self-regulatory systems that we share with other organisms. To the extent that psychology is currently a fragmentary discipline which could benefit from the recognition of unifying principles that cut across specialties and areas of inquiry within specialties (Kimble, 1994), the further research into the relationships between BIS and BAS, appraisal, and spontaneous causal thinking could contribute to this agenda.

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APPENDICES

Appendix A

Carver & White's (1994) BIS/BAS Scales

Please circle the number that best indicates how well you think each of the following items describes you (1=strongly agree-4=strongly disagree).

Note: Instructions to participants are boldfaced, explanatory material is italicized, & questionnaire items are in plain text. Items are marked as belonging to the BIS, BASRR, BASD, or BASFS subscales.

BIS

1. If I think something unpleasant is going to happen I usually get pretty “worked up.”

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASRR

2. When I get something I want, I feel excited & energized.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASD

3. When I want something, I usually go all-out to get it.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BIS

4. I worry about making mistakes.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASFS

5. I will often do things for no other reason than that they might be fun.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASRR

6. When I'm doing well at something, I love to keep at it.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BIS

7. Criticism or scolding hurts me quite a bit.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASD

8. I go out of my way to get things I want.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASFS

9. I crave excitement and new sensations.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BIS

10. I feel pretty worried or upset when I think or know somebody is angry with me.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASRR

11. When good things happen to me, it affects me strongly.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASD

12. If I see a chance to get something I want, I move on it right away.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BIS, reverse coded

13. Even if something bad is about to happen to me, I rarely experience fear or nervousness.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASFS

14. I'm always willing to try something new if I think it will be fun.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASRR

15. It would excite me to win a contest.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BIS

16. I feel worried when I think I have done poorly at something.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASD

17. When I go after something I use a "no holds barred" approach.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASFS

18. I often act on the spur of the moment.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BIS, reverse coded

19. I have very few fears compared to my friends.

1	2	3	4
strongly agree	agree	disagree	strongly disagree

BASRR

20. When I see an opportunity for something I like, I get excited right away.

1
strongly agree

2
agree

3
disagree

4
strongly disagree

Please go on to the next page.

Half of the participants will move on to the vignette items, and half will have completed that section of the study materials prior to starting this section. In all cases, the demographic items will be presented last, as shown in Appendix B.

Appendix B

Complete set of 32 vignettes (8 story bases x 4 manipulations)

Asterisks indicate vignettes selected for further analysis and use in Study 2.

Exam grade (academic vignette # 1)

P/E: You get back an exam for a class that you are doing very well in, and find that you have received a very high grade on the exam.

P/U: You get back an exam for a class that you are doing very poorly in, and find that you have received a very high grade on the exam.

*N/E: You get back an exam for a class that you are doing very poorly in, and find that you have received a very low grade on the exam.

*N/U: You get back an exam for a class that you are doing very well in, and find that you have received a very low grade on the exam.

Called on in class (academic & social vignette # 1)

P/E: The professor calls on you to answer a question in a class that you are doing very well in, and compliments you on your answer to the question in front of the class.

*P/U: The professor calls on you to answer a question in a class that you are doing very poorly in, and compliments you on your answer to the question in front of the class.

N/E: The professor calls on you to answer a question in a class that you are doing very poorly in, and criticizes your answer to the question in front of the class.

*N/U: The professor calls on you to answer a question in a class that you are doing very well in, and criticizes your answer to the question in front of the class.

Call me on Friday (social vignette # 1)

P/E: You meet a potential new friend at a party, and invite them to go with you to a movie on Friday. They tell you that they will get your number from someone you both know and promise to call you on Friday. On Friday, your new friend calls you to make plans for seeing a movie.

P/U: You meet a potential new friend at a party, and invite them to go with you to a movie on Friday. They tell you that they can get your number from someone you both know and might call you on Friday. On Friday, your new friend calls you to make plans for seeing a movie.

*N/E: You meet a potential new friend at a party, and invite them to go with you to a movie on Friday. They tell you that they can get your number from someone you both know and might call you on Friday. Friday comes, but they never call.

*N/U: You meet a potential new friend at a party, and invite them to go with you to a movie on Friday. They tell you that they will get your number from someone you both know and promise to call you on Friday. Friday comes, but they never call.

Study partner (social & academic vignette # 1)

*P/E: A classmate asks you to help them study for a test on a subject that you know a lot about. After the test, they thank you for the help and ask if they can study with you for the final.

P/U: A classmate asks you to help them study for a test on a subject that you know very little about. After the test, they thank you for the help and ask if they can study with you

for the final.

*N/E A classmate asks you to help them study for a test on a subject that you know very little about. After the test, they remark that they would prefer to study separately for the final.

N/U: A classmate asks you to help them study for a test on a subject that you know a lot about. After the test, they remark that they would prefer to study separately for the final.

Term Paper (academic vignette # 2)

*P/E: Your professor hands out instructions, telling you what kind of information she wants you to include in your term paper. You follow the instructions, which clearly explain how to write the kind of paper she wants, and you receive a very high grade.

*P/U: Your professor hands out instructions, telling you what kind of information she wants you to include in your term paper. You find the instructions confusing and aren't sure if you've written the kind of paper she wants, but you receive a very high grade.

N/E: Your professor hands out instructions, telling you what kind of information she wants you to include in your term paper. You find the instructions confusing and aren't sure if you've written the kind of paper she wants, and you receive a very low grade.

N/U: Your professor hands out instructions, telling you what kind of information she wants you to include in your term paper. You follow the instructions, which clearly explain how to write the kind of paper she wants, but you receive a very low grade.

Raising your hand (academic & social vignette # 2)

P/E: You raise your hand in class to answer a question that you are sure you know the

answer to, and the TA says that your answer is correct.

*P/U: You raise your hand in class to answer a question that you aren't sure you know the answer to, and the TA says that your answer is correct.

*N/E: You raise your hand in class to answer a question that you aren't sure you know the answer to, and the TA says that your answer is wrong.

N/U: You raise your hand in class to answer a question that you are sure you know the answer to, and the TA says that your answer is wrong.

Buffet (social vignette # 2)

*P/E: You find a really cheap all-you-can eat buffet restaurant, and talk several of your friends into going there with you. The food tastes pretty good to you, your friends really like it, and they congratulate you on the great find.

*P/U: You find a really cheap all-you-can eat buffet restaurant, and talk several of your friends into going there with you. The food tastes pretty nasty to you, but your friends really like it, and they congratulate you on the great find.

N/E: You find a really cheap all-you-can eat buffet restaurant, and talk several of your friends into going there with you. The food tastes pretty nasty to you, and your friends agree; they complain that this was a real waste of money.

N/U: You find a really cheap all-you-can eat buffet restaurant, and talk several of your friends into going there with you. The food tastes pretty good to you, but your friends think it is nasty. They complain that this was a real waste of money.

Group Project (social & academic vignette #2)

*P/E: You are assigned to work with a group of classmates to create a presentation on a subject that you think is very interesting. The other group members really like your ideas, and you have a good time working with them.

P/U: You are assigned to work with a group of classmates to create a presentation on a subject that you aren't very interested in. However, the other group members really like your ideas, and you have a good time working with them.

N/E: You are assigned to work with a group of classmates to create a presentation on a subject that you aren't very interested in. The other group members don't listen to your ideas, and you have a difficult time working with them.

*N/U: You are assigned to work with a group of classmates to create a presentation on a subject that you think is very interesting. However, the other group members don't listen to your ideas, and you have a difficult time working with them.

Appendix C

Form 1 version of vignette questionnaire1

You are going to read about some experiences that could happen to you, and answer questions about how you would react to these experiences. Each experience has an outcome or result that you might or might not like. Some of the experiences may be similar, so be sure to read each one carefully.

For each experience, you will be asked to rate how good or bad you would feel after having the experience and how expected or unexpected the outcome would be to you. Please answer these questions by circling the number that best represents your response.

1. You get back an exam for a class that you are doing very well in, and find that you have received a very high grade on the exam.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

2. You find a really cheap all-you-can eat buffet restaurant, and talk several of your friends into going there with you. The food tastes pretty good to you, but your friends think it is nasty. They complain that this was a real waste of money.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

3. The professor calls on you to answer a question in a class that you are doing very well in, and compliments you on your answer to the question in front of the class.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

4. You are assigned to work with a group of classmates to create a presentation on a subject that you think is very interesting. However, the other group members don't listen to your ideas, and you have a difficult time working with them.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

5. You get back an exam for a class that you are doing very poorly in, and find that you have received a very high grade on the exam.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

6. A classmate asks you to help them study for a test on a subject that you know very little about. After the test, they thank you for the help and ask if they can study with you for the final.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

unexpected

7. You find a really cheap all-you-can eat buffet restaurant, and talk several of your friends into going there with you. The food tastes pretty nasty to you, but your friends really like it, and they congratulate you on the great find.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

8. The professor calls on you to answer a question in a class that you are doing very poorly in, and criticizes your answer to the question in front of the class.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

9. You get back an exam for a class that you are doing very well in, and find that you have received a very low grade on the exam.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

10. You find a really cheap all-you-can eat buffet restaurant, and talk several of your friends into going there with you. The food tastes pretty good to you, your friends really like it, and they congratulate you on the great find.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

11. The professor calls on you to answer a question in a class that you are doing very well in, and criticizes your answer to the question in front of the class.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

12. You are assigned to work with a group of classmates to create a presentation on a subject that you think is very interesting. The other group members really like your ideas, and you have a good time working with them.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

13. Your professor hands out instructions, telling you what kind of information she wants you to include in your term paper. You follow the instructions, which clearly explain how to write the kind of paper she wants, and you receive a very high grade.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

14. A classmate asks you to help them study for a test on a subject that you know a lot about. After the test, they remark that they would prefer to study separately for the final.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

15. You meet a potential new friend at a party, and invite them to go with you to a movie on Friday. They tell you that they can get your number from someone you both know and might call you on Friday. Friday comes, but they never call.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

16. You raise your hand in class to answer a question that you aren't sure you know the answer to, and the TA says that your answer is correct.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

17. Your professor hands out instructions, telling you what kind of information she wants you to include in your term paper. You find the instructions confusing and aren't sure if you've written the kind of paper she wants, and you receive a very low grade.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

18. You meet a potential new friend at a party, and invite them to go with you to a movie on Friday. They tell you that they can get your number from someone you both know and might call you on Friday. On Friday, your new friend calls you to make plans for seeing a movie.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

19. You raise your hand in class to answer a question that you aren't sure you know the answer to, and the TA says that your answer is wrong.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

20. You are assigned to work with a group of classmates to create a presentation on a subject that you aren't very interested in. The other group members don't listen to your ideas, and you have a difficult time working with them.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

21. Your professor hands out instructions, telling you what kind of information she wants you to include in your term paper. You follow the instructions, which clearly explain how to write the kind of paper she wants, but you receive a very low grade.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected

22. A classmate asks you to help them study for a test on a subject that you know a lot about. After the test, they thank you for the help and ask if they can study with you for the final.

How good or bad would you feel after having this experience? I would feel:

1	2	3	4	5	6	7
very good			neither good nor bad			very bad

Would you describe this experience as having an expected outcome or an unexpected outcome? I would describe the outcome as:

1	2	3	4	5	6	7
very much expected			neither expected nor unexpected			very unexpected