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Negativity bias in attitude learning: A possible indicator of vulnerability to emotional disorders?

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Abstract

Negativity biases, i.e., tendencies for negative features and interpretations to predominate over positive, are known to play a role in the etiology and maintenance of emotional disorders. Both depression and anxiety have been associated with such negative cognitive styles. Recently, Fazio, R.H., Eiser, J.R., and Shook, N.J. [(2004). Attitude formation through exploration: Valence asymmetries. *Journal of Personality and Social Psychology*, *87*, 293–311] have observed similar valence asymmetries in the domain of attitude formation and generalization. The present research examined the possibility that the extent to which individuals display a learning bias in attitude formation is related to negative cognitive style and emotional disorder symptoms. Participants played a computer game that required learning whether novel stimuli produced positive or negative outcomes. Poorer learning was associated with more negative cognitive style, greater depression, and a tendency toward greater anxiety. Interestingly, these relations were most evident with respect to the learning of the positive stimuli, suggesting that an under-appreciation of positive objects and events may underlie vulnerability to emotional disorders. The potential value of various indices of negativity bias that can be assessed when examining attitude formation and generalization is discussed.

Keywords: Negativity bias; Depression; Anxiety; Attitudes

1. Introduction

Negativity biases—a tendency for negative objects, events, or information to predominate over positive—are common phenomena in many different areas of psychology. In the domain

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of emotional disorders, depression and anxiety are both marked by negativity biases. Cognitive theories of depression (Abramson, Metalsky, & Alloy, 1989; Beck, 1987) posit that negative or maladaptive cognitive styles increase vulnerability to depression when confronted with a negative life event. According to hopelessness theory (Abramson et al., 1989), individuals with negative cognitive styles tend to attribute negative life events to stable and global factors, believe that the negative event will be very consequential, and believe that it indicates that they are flawed or a failure. Beck's (1987) theory focuses on self-schemata. Individuals who have dysfunctional or negative self-schemata and base their self-worth on other's approval or perfectionist ideals are more prone to depression when faced with a negative life event. Both theories focus on negative cognitive style as a predisposing vulnerability to depressive episodes—a hypothesis that has received empirical support in prospective research (Alloy et al., 2006). Alloy et al. (2006) compared freshmen who scored in the upper versus lower quartile on two common measures of such cognitive styles—the Cognitive Style Questionnaire (CSQ; Abramson et al., 1998) and the Dysfunctional Attitudes Scale (DAS; Weissman & Beck, 1978). Over the subsequent 2.5 years, the students in the high-risk quartile were more likely to experience a major depressive episode.

Anxiety is also marked by attentional biases toward negative stimuli. Individuals with higher levels of anxiety have been shown to direct their attention to threatening or emotionally negative stimuli on dot-probe and emotional Stroop tasks (MacLeod, Matthews, & Tata, 1986; Matthews & MacLeod, 1985). Cognitive biases that enhance the likelihood of interpreting ambiguous situations as negative have been implicated in social anxiety disorder (e.g., Amir & Foa, 2001; Foa, Franklin, & Kozak, 2001; Huppert & Foa, 2004). The looming vulnerability model of anxiety (Riskind, 1997; Riskind & Williams, 1999) similarly emphasizes a negative cognitive style as a predisposing vulnerability. This looming maladaptive style involves a tendency to view potentially threatening situations as rapidly escalating toward dreaded outcomes, and has been associated prospectively with increases in anxiety and worry (Riskind, Williams, Gessner, Chrosniak, & Cortina, 2000).

The negativity biases that characterize emotional disorders bear a striking resemblance to the valence asymmetries observed by Fazio, Eiser, and Shook (2004) in the area of attitude formation and generalization. In a series of experiments, these researchers examined how individuals explore their environment, form attitudes toward objects that they encounter, and then how these attitudes generalize to similar novel targets. Fazio and colleagues developed a computer game, BeanFest, in which participants imagine themselves in a world of beans. In order to succeed at the game, participants had to learn which beans in this new world were good and which were bad. The beans varied in terms of their shape (10 levels from circular to oval to oblong) and in terms of number of speckles (from 1 to 10). A few examples are displayed in Fig. 1. On each trial of the game, players were presented with a single bean and given the option to select (approach) or not select (avoid) the bean. Some beans were positive and helpful, while others were negative and harmful. Thus, participants wanted to approach the good beans to increase their points and avoid the bad beans to keep from losing points. In this way, BeanFest permits a focus on the development of attitudes toward completely novel targets. No prior knowledge about the stimuli influences game behavior and attitude formation.

After presentation of each of the target beans multiple times during the game (or learning phase), the game was concluded and participants' learning of the beans was assessed. They were asked to indicate whether a bean was "good" (i.e., increased points

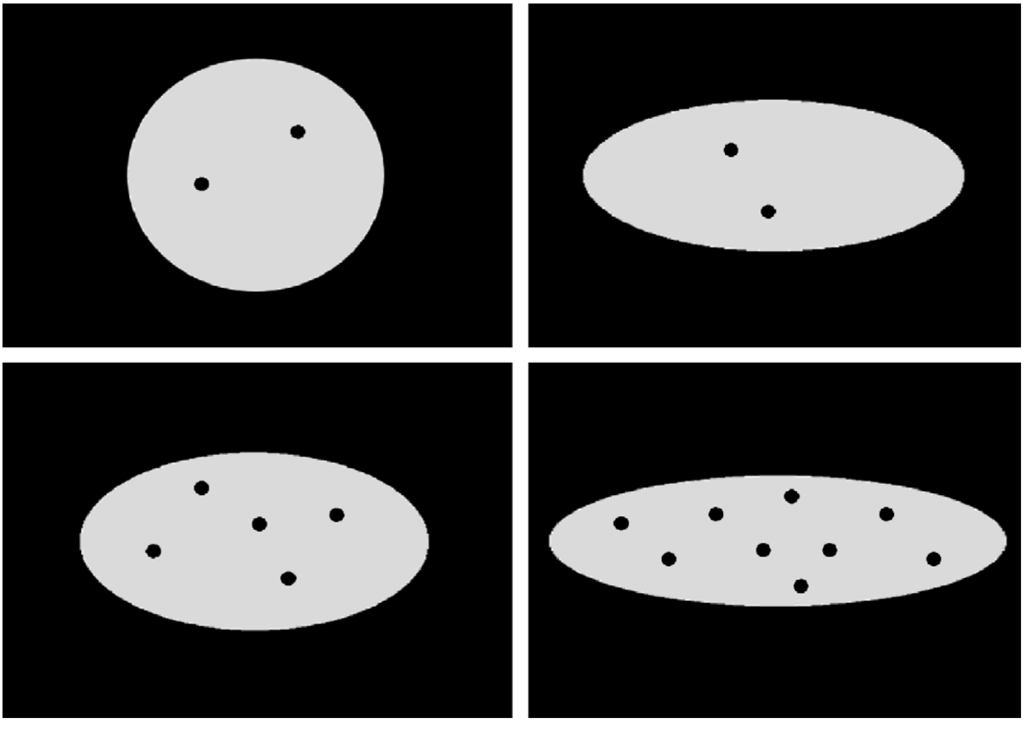

Fig. 1. Examples of game beans.

when selected) or "bad" (i.e., decreased points when selected). During this test phase, participants judged not only the specific beans that had appeared during the game, but also novel beans that resembled game beans to varying degrees. Responses to the novel beans served as the data for assessing attitude generalization.

Two intriguing phenomena emerged from the BeanFest paradigm. First, participants consistently exhibited a learning asymmetry. Negative attitudes were learned better than positive attitudes. Participants correctly classified as "bad" a greater proportion of the target beans than they correctly classified as "good". Second, these attitudes generalized to novel beans, such that those that more closely resembled known negatives were relatively likely to be categorized as "bad" and those that more closely resembled known positives as "good". However, an asymmetry was evident. Negative attitudes generalized to a greater extent than positive. Less similarity to a known negative was required for a bean to be categorized negatively than was true for categorizing a bean positively on the basis of its resemblance to a known positive.

Additional research revealed the learning asymmetry to be largely the result of sampling behavior during the game. One of the parameters of the Beanfest game was that feedback was contingent upon approach behavior. If approached, the true nature of the specific bean was revealed, because selection affected the accumulated point value. If participants chose to avoid a bean, however, they would not learn whether it was positive or negative. Both experimental and correlational findings indicated that individuals who engaged in more approach behavior during the game learned more about the bean world and about the true nature of each bean. For such individuals, the learning asymmetry was reduced. On the other hand, individuals who avoided many beans during the game did not obtain feedback that corrected negative misconceptions. Whether valid or not, assumptions that a bean was negative prompted avoidance. Hence, the assumption was not subjected to testing, the truth was never uncovered, and the false negative belief was not corrected.

Further evidence supporting this structural explanation for the learning asymmetry came from an experiment in which feedback contingency was manipulated. The standard situation in which feedback was contingent upon approach was compared to a situation in which participants received information about the true nature of each bean regardless of approach behavior. When they chose to avoid, they were provided with information about what would have happened if they had selected the bean. Provision of such noncontingent, full-feedback significantly reduced the learning asymmetry, to the point that it was not statistically evident on average. Thus, the overall learning asymmetry seemed to be largely a function of cautious sampling behavior that resulted in insufficient corrective feedback regarding beans falsely believed to be negative.

The generalization asymmetry was not affected by feedback contingency in the way that the learning asymmetry had been. For that reason, Fazio et al. (2004) concluded that the generalization asymmetry was due to a basic negativity bias. When considering the likely valence of a novel object, resemblance to a known negative was more influential than resemblance to a known positive.

To date, the BeanFest research has focused on average tendencies across individual participants. However, it is interesting to consider the potential utility of the BeanFest paradigm as a tool for assessing individual differences related to negativity biases. Indeed, three specific forms of negativity bias can be identified via appropriate implementations of the BeanFest game. The first concerns the generalization asymmetry, which is very clearly one form of a negativity bias. The past findings consistently revealed that participants required a lower threshold of similarity for classifying a novel target as negative than as positive. This relative tendency to weigh resemblance to a known negative more heavily than resemblance to a positive shall be referred to as a *weighting bias*.

The learning asymmetry is more complex and can be broken down into two separate forms of a negativity bias—a *sampling bias* and a *learning bias*. When the possibility to explore arises, some individuals exhibit a *sampling bias*, or a hesitance to sample objects that they suspect may be negative. Some individuals are not willing to test such negative suppositions. Instead, they are overly cautious and unwilling to risk the potential cost associated with approaching what may turn out to be a negative object in the interest of learning the object's true value. This sampling bias parallels the classic phenomenon of risk aversion in the judgment and decision-making literature (Kahneman & Tversky, 1988). When information gain is contingent upon approach behavior, such risk aversion leads to failures to correct false presumptions that an object may be negative. Because these invalid attitudes encourage avoidance, positive objects continue to be misconstrued as negative. Thus, individuals with a sampling bias will show better learning of negatives than positives when feedback is contingent upon approach behavior.

As noted earlier, the learning asymmetry is reduced when feedback about the valence of a bean is provided on each trial irrespective of the approach-avoidance decision. With full-feedback, i.e., when participants learn what would have happened if they had approached, the asymmetry is diminished, at least in terms of average performance. Nevertheless, some individuals do show a relative tendency to learn the negatively valenced beans better than the positive ones under these full-feedback conditions. They seem to pay more attention to and rehearse more strongly information that an object is bad than information that an object is good. To the extent that this pattern is displayed, it represents yet a third form of a negativity bias, which will be termed a *learning bias*.

The present research is exploratory in nature. This initial study was aimed at exploring the use of the BeanFest paradigm as a potential tool for assessing vulnerability to emotional disorders. The valence asymmetries that can be estimated via BeanFest may represent the same fundamental negativity biases that play a role in depression and anxiety. Moreover, BeanFest may provide a very pure assessment of such biases.

As noted earlier, current measures of negative cognitive style typically involve attempts to assess the perceived impact of negative versus positive events. Both the CSQ (Abramson et al., 1998) and the Looming Maladaptive Style Questionnaire (LMSQ; Riskind et al., 2000) provide individuals with scenarios and ask them to interpret the situation and/or the consequences likely to accrue. Other measures such as the DAS (Weissman & Beck, 1978) ask respondents to agree or disagree with a number of statements that imply momentous impact to positive or negative outcomes. These measures require that respondents specifically consider how positive or negative a given situation, introspect about their likely emotions, meaningfully project how the event might unfold in terms of its consequences for them, and then accurately report those forecasts on the response scale. Self-report measures related to emotional disorders have significant limitations (e.g., Vasey & Lonigan, 2000). Self-presentational concerns, including desires to demonstrate one's ability to cope with anxiety-provoking situations, can lead to underreporting of anxiety symptoms, whereas desires to meet the presumed expectations of the questioner can lead to overreporting (e.g. Kendall & Flannery-Schroeder, 1998). Thus, there appears to be considerable room for error in assessment of cognitive style via self-report measures, especially if what really matters is simply the extent to which negative aspects predominate over positive.

The BeanFest paradigm provides a simple performance-based measure for assessing negativity biases. Participants are not required to consider a social situation and introspect. Instead, they play a game and their behavior and judgments are recorded. Moreover, the game involves completely novel stimuli, which become differentially associated with positive and negative outcomes. The reactions to the stimuli are a function purely of those experiences, biased as they may be by the individual's learning, sampling, and/or weighting proclivities. As a result, the comparative estimate of negative to positive is untainted by the sort of a priori knowledge, history, and emotion that participants may bring to bear when they offer forecasts regarding specific social situations or events. (see MacLeod, 1993, for further arguments regarding the value of performance-based measures within the domain of pychopathology).

Although all three attitude biases may be associated with a predisposition to anxiety and/or depression, each bias requires different game parameters to properly assess the specific individual difference. To test the sampling bias, contingent feedback is necessary. It is under such conditions that individuals must weigh the value of information gain against the potential cost involved in approaching an object that may be negative. The learning bias, on the other hand, requires an implementation involving full-feedback. Individuals need to be exposed equally to positive and negative information, so that any difference in learning is due to differential attention and rehearsal, not to sampling exposure. Finally, to assess the weighting bias as purely as possible, there should be no indication of a learning asymmetry. Indeed, learning should be near perfect to ensure that a generalization asymmetry is due to the weighting of resemblance to known positives versus known negatives and not to differential learning. Both full-feedback and an extended learning phase may be necessary to achieve the desired level of learning.

As the three attitude biases require such different parameters and cannot be assessed properly in a single implementation, this first exploratory study was able to examine only one of the biases. The focus of this initial research was the *learning bias*—the extent to which individuals demonstrated superior learning of negative information. Thus, the BeanFest game employed in the present study involved full-feedback, not contingent upon approach behavior. After the game and test phase assessing learning, participants completed a series of measures related to depression and anxiety. Due to time limitations, we were able to include only a few measures: the CSQ (Abramson et al., 1998), the Beck Depression Inventory-II (BDI; Beck, Steer, & Brown, 1996), and the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988). The major interest concerned the relation between these measures and the learning of positive versus negative beans.

2. Method

2.1. Participants

Due to the preliminary nature of this experiment, a non-clinical analog sample was recruited. Fifty-three Ohio State University students enrolled in introductory psychology courses (31 females and 22 males) participated in this experiment for research credit. At most, four participants were present for each session.

2.2. Materials

BeanFest is a computer game in which participant's goal is to accumulate points by making judicious decisions about which specific beans to accept (approach) and which beans to reject (avoid). Each bean has its own positive or negative value. By accepting or approaching a bean, the participant's point value is adjusted according to the bean's value. Thus, accepting a positive bean increases the participant's point value, whereas accepting a negative bean produces a decrease. If the bean is rejected or avoided, the participants point value remains unchanged. At any given time, participant's cumulative point value ranges from 0 to 100.

The beans differ by shape and number of speckles. They can be represented as a 10×10 matrix involving 100 possible beans (see Fig. 2). The x-dimension of the matrix represents the shape of the bean, ranging from circular to oval to oblong. The y-dimension represents the number of speckles, ranging from 1 to 10. Within the matrix, six regions of beans, each containing five to seven beans, were selected for presentation during the game. These regions were selected very carefully, so that there was no linear relationship between the shape or number of speckles and the valence of the bean. Consequently, participants must associate each bean with the outcome that specific bean produces, as opposed to learning some simple linear rule.

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
X1	10	10	10			-10	-10	-10		
X2	10	10			-10	-10	-10			
X3						-10				
X4									10	
X5		-10						10	10	10
X6	-10	-10	-10						10	10
X7	-10	-10								
X8					10					
X9				10	10	10			-10	-10
X10			10	10	10			-10	-10	-10

Fig. 2. Bean matrix. $X =$ shape from circular (1) to oval to oblong (10), and $Y =$ number of speckles, from 1 to 10. Cells with a point value represent the beans presented during the game.

2.3. Procedure

When participants arrived at the lab, they were shown into a testing room consisting of four cubicles, each equipped with a Dell Optiplex computer, monitor, keyboard, and response box. Participants were seated in individual cubicles and provided written instructions for BeanFest. The experimenter read the instructions aloud, while the participants read along.

At the beginning of BeanFest, participants underwent a practice block of six trials. During these trials, one bean from each of the six regions of the matrix was presented. For each practice trial, the participants were asked to accept or respond "yes", so as to familiarize themselves with the feedback and point displays and begin to associate a few specific beans with their point values.

When finished with the practice phase, the participants started the actual game phase, which was divided into three blocks of 36 trials. The 36 trials consisted of the beans within the selected regions of the matrix. Each bean was presented once in each block; thus, all 36 beans were seen three times. Trials were randomly ordered except for the first 12 trials of the first block, which involved the presentation of two beans from each of the six regions in a fixed order. These 12 trials were fixed so as to avoid an unlucky string of negative beans, thus protecting participants from early losses in the game.

During a trial, participants were presented with a bean in the upper portion of the monitor. They had to indicate whether they wanted to accept or reject the bean. Participants indicated their response using the response box, which contained two buttons "yes" and "no". Thus, participants would indicate "yes" to accept or "no" to reject the bean.

After responding to a bean, the lower portion of the display adjusted according to the participant's decision. All of the information about the participant's point value was located in the lower right corner of the screen. The point value was represented numerically and graphically as a point bar ranging from 0 to 100. The point value and bar would fluctuate in response to the participants' decision to accept the bean and the bean's value. That is, the participant's points changed as a function of the bean's value only if the participant accepted the bean. In the lower left corner of the screen, participants were presented with information about their response and the value of the bean. The participant's responses appeared as either "yes" or "no". The effect or point value of the bean appeared below the response. Participants played a full-feedback version of the game, such that the point value of each bean was presented regardless of whether the participant approached or avoided the bean. This non-contingent feedback provided participants with the opportunity to learn all of the beans equally and, thus, allowed assessment of the learning bias unconfounded by sampling behavior.

Participants started the game with 50 points and were instructed to try to gain points and avoid losing points. If they reached 100, they won the game and if they reached zero, they lost the game. In either case, the game would restart at 50 points and participants would play again. The game restarted as many times as the participants won or lost. With any restarted games, the beans retained their original values. That is, participants did not have to relearn the beans if they played multiple games. Although the number of games played varied as a function of the individual's success, exposure to the game beans was the same for all participants. The learning phase always concluded after three blocks of 36 trials.

When all participants were finished playing BeanFest, the experimenter distributed the instructions for the test phase. During this phase, participants were randomly presented with all 100 beans from the matrix in two blocks of 50 trials. Participants were asked to indicate whether they believed the bean to be "good" or "bad." If the participants believed that the bean would have increased their points during the game, they were to respond "good" on the response box. Alternatively, if the bean was believed to have decreased points, participants were to respond "bad". During this phase, there was no point meter or feedback about the bean. Participants had 10 s to view and respond to each bean. The test phase assessed participants' learning of game beans.

When all participants were finished with the test phase, they were asked to complete a series of personality-related inventories. Participants were administered a modified form of the CSQ (Abramson et al., 1998) in which they were to consider 12 scenarios, six positive (e.g., You go to a party with some friends and throughout the whole party people act interested in you) and six negative (e.g., In an important class, you cannot get all the work done that your professor expects of you). For each scenario, participants rated on a scale from 1 to 7: (a) how likely it is that the event would lead to other positive (or negative) things happening to them; (b) to what extent the event indicated that they are a special (or flawed) person; and (c) how much the event matters to them. The difference between the average ratings of the positive and the negative scenarios (computed as negative minus positive) served as the score, thus indexing the extent to which individuals viewed negative events as more impactful than positive. Participants also completed the BDI (Beck et al., 1996) and the BAI (Beck et al., 1988). Upon completion of the questionnaires, participants were debriefed and excused.

3. Results

We first examined how well participants learned the game beans. A convenient way to do this is simply to calculate the correlation (i.e., a phi coefficient) between the valence of

Table 1
Means and standard deviations of behavioral and questionnaire measures

Measures	Mean	Standard deviation
Overall learning[a]	0.41	0.22
Learning asymmetry[b]	0.06	0.17
Proportion negative correct	0.73	0.15
Proportion positive correct	0.67	0.13
Cognitive Style Questionnaire	3.81	0.54
Beck Depression Inventory	11.65	10.77
Beck Anxiety Inventory	9.69	9.05

[a]Phi coefficient between actual valence of bean and participant's classification of the bean during the test phase.
[b]Proportion of negative beans correctly classified minus proportion of positive correctly classified.

the bean (positive/negative) and a participant's classification of that bean during the test phase (positive/negative). The average phi coefficient was .41, which is much better than chance, $t(52) = 13.15$, $p < 0.001$, indicating that, on average, participants did learn.

We also wanted to know whether learning varied by valence of the bean. That is, was a learning bias present? To assess this, the proportion of positive and negative beans correctly classified in the test phase was calculated. Overall, learning was well above chance for both the positive beans ($M = 0.67$), $t(52) = 9.30$, $p < 0.001$, and negative beans ($M = 0.73$), $t(52) = 11.65$, $p < 0.001$. However, the negative beans were learned better than the positive beans, $t(52) = 2.79$, $p < 0.01$. Thus, even though participants were provided with each bean's point value on every trial and had the opportunity to learn the beans equally, a learning asymmetry was evident.[1]

We next examined the relation between BeanFest performance and the three questionnaires concerning emotional disorder symptoms (the CSQ, BDI, and BAI). Means and standard deviations for the BeanFest performance measures and the three questionnaire measures are presented in Table 1. Correlations between the latter indices and various measures of learning are presented in Table 2. Overall learning of the game stimuli, as measured by each participant's phi coefficient, correlated with the scales such that poorer learning was associated with a more negative cognitive style, greater depression, and a tendency toward greater anxiety. Interestingly, the learning of negative stimuli was unrelated to these measures; the observed relations stemmed from the learning of the positive stimuli. Poorer learning of positives was associated with more negative cognitive style, greater depression, and greater anxiety.

4. Discussion

Overall, participants in this full-feedback version of the BeanFest game showed evidence of having learned the value of the beans. In general, they performed better than chance

[1]In the earlier full-feedback experiment (Fazio et al., 2004; Experiment 2), the learning asymmetry was significantly reduced, relative to a condition involving contingent feedback, and did so to the point that the asymmetry was statistically absent. That is, the average participant in the full-feedback condition did not display a learning asymmetry. The present finding differs in that the learning bias was apparent, on average. We would suggest that this difference is simply a function of sampling variability, with the current sample having included a greater number of individuals characterized by the negativity bias.

Table 2
Correlations between learning measures and the indices concerning emotional disorders

	Overall learning[a]	Learning asymmetry[b]	Proportion negative correct	Proportion positive correct
Cognitive Style Questionnaire	−0.34*	0.29*	−0.11	−0.48**
Beck Depression Inventory	−0.33*	0.20	−0.14	−0.42**
Beck Anxiety Inventory	−0.22	0.18	−0.07	−0.30*

*$p<0.05$; **$p<0.01$.
[a]Phi coefficient between actual valence of bean and participant's classification of the bean during the test phase.
[b]Proportion of negative beans correctly classified minus proportion of positive correctly classified.

when tested. However, they did not learn equally well, and the extent of learning participants exhibited was related to scores on both the CSQ and the BDI. Moreover, participants varied in the extent to which they showed an asymmetry reflecting better learning of the negatives than the positives. This asymmetry itself related to negative cognitive style. However, it was the extent to which participants evidenced learning of the positive beans (and not the negatives) that most strongly related to the measures of interest. Poorer learning of the positive beans was associated with more negative cognitive style, greater depression, and greater anxiety. These preliminary findings suggest that a lack of appreciation for positives, rather than increased rehearsal of negatives, may possibly underlie both the learning bias and predisposition to emotional disorders.

Although the present study was not prospective in nature and utilized a nonclinical, analog sample, it offers some promising initial findings. The data suggest that the negativity biases characteristic of emotional disorder symptoms are related to the learning bias evident in attitude formation. Most importantly, from our perspective, a cognitive style characterized by a tendency to view potentially negative events as more impactful than potentially positive events is related to a fundamental deficiency in learning to identify positive objects. Such a negative cognitive style has been shown to operate as a vulnerability marker for depression. Hence, the implication is that the under-appreciation of positive objects that is reflected in the learning bias may itself be a vulnerability factor. Further research, ideally prospective in nature, will have to be conducted to fully explore the relation between negative cognitive style and each of the attitude formation biases (sampling bias, learning bias, and weighting bias). Other measures of cognitive style, e.g., DAS and LMSQ, need to be examined as well.

Nevertheless, the results of this first undertaking point to the potential utility of the BeanFest game as a performance-based tool for assessing a predisposition for anxiety and/or depression. The advantage of the BeanFest paradigm is that it provides direct measures of various valence asymmetries and, hence, avoids the problems associated with questionnaire responses (Schwarz, 1999). Individuals are not required to introspect and offer forecasts about their likely reactions to specific imagined events—reports that have the potential to be tainted by unintended interpretations of the scenario and by social desirability concerns. The BeanFest game is a simple task that provides a wealth of information regarding individuals' willingness to approach novel objects, the valence of the feedback to which they are more attentive, and the generalizations they form on the basis of what they have learned. Thus, the game provides a vehicle for estimating the extent to which individuals are characterized by various forms of a negativity bias. Individual differences reflecting a sampling bias, a learning bias, or a weighting bias can each be assessed through different implementations of the BeanFest paradigm. Whether these assessments serve as useful prospective predictors of emotional disorders remains to be seen, but we are encouraged by the present initial findings.

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