



Reinforcement Sensitivity as Predictor of Test Anxiety

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Abstract In an attempt to advance the revised Reinforcement Sensitivity Theory (RST), this study investigates the implications of RST to test anxiety. 217 college-level students participated in the study. The Behavior Inhibition System (BIS) and the Fight, Flight, Freeze System (FFFS) of the RST correlate with test anxiety, but not the Behavior Activation System (BAS). Using multiple regression, findings reveal that FFFS, specifically freeze, best predicts test anxiety, worry, and emotionality. Moreover, fight also predicts worry, while flight predicts emotionality. These results generally support the current conceptualization of the revised RST.

Keywords: Reinforcement Sensitivity Theory, test anxiety

The idea that one's personality is a reflection of biological processes is nothing new. Early theories, such as Murray's Personology, have long argued that personality is rooted in the physiological activities of the brain (Schultz and Schultz, 2005). Intuitively, it does seem logical to assume the validity of this position, given that the brain is generally understood to be responsible for most activities of a human person, including the manifestation of personality.

Among the theories that explain personality in the light of biological-based systems, Gray's Reinforcement Sensitivity Theory (RST) remains to be one of the most influential (Smillie, 2008a). Created during the 70s, RST has undergone a considerable revision in the past decade (Pickering & Corr, 2008; Smillie, Pickering & Jackson, 2006). In its current conceptualization, it proposes that there are three brain-based systems concerned with motivation, emotion, and learning that are believed to mediate individuals' responses to stimuli that are rewarding (i.e., incentive), punishing (i.e., threat or non-reward), or conflicting (i.e., stimuli that signify both incentive and threat) (Smillie, 2008a). Respectively, the systems are termed as the following: behavioral activation system (BAS), fight-flight-freeze system (FFFS), and behavioral inhibition system (BIS) are neurological-based, (Pickering & Corr, 2008; Smillie, 2008a; Smillie, et al., 2006) but may also be viewed behaviorally.

According to Pickering and Corr (2008), Smillie (2008a), and Smillie et al. (2006), behaviorally, activities of the BAS is observed in an individual's approach response to appetitive or rewarding stimuli, both conditioned and unconditioned. The FFFS mediates defensive avoidance responses to conditioned and unconditioned threats or punishing stimuli. Furthermore, the specific response (i.e., fight, flight, or freeze) depends on certain ecological characteristics of the threat. If the threat is proximate and escape is not an option, 'fight' is the likely response. If the threat is distant, and there is a possibility for escape, the likely response is 'flight'; but if escape is not possible, 'freezing' is more likely. It is important to note that the three behavior manifestations under FFFS are different from one another, but they are functionally woven into a single system (Eilam, as cited in Perkins, Kemp, & Corr, 2007). Meaning, all three behaviors serve the general purpose of defensive avoidance. If the stimuli present conflicting valences (i.e., a goal that presents both possible incentive, and threat or non-reward), the BIS mediates a defensive approach response. According to Smillie et al. (2006), BIS can be seen as sensitivity to situations characterized by uncertainty, social comparison, and goal conflict.

It is generally thought that individual differences in the sensitivity of these systems are reflected in individual personalities (Smillie, 2008a). Theoretically, some traits are assumed to be the manifestations of the systems, such that, extraversion is thought to manifest the reactivity of BAS (i.e, reactivity to rewards); fearfulness for FFFS (i.e., reactivity to punishment), and anxiety in the case of BIS (i.e., reactivity to conflicting stimuli) (Smillie, 2008a). However, more recent investigations suggests that there is a need for a new conceptualization of BIS of the revised RST since anxiety seems to correlate more with FFFS, than it does with BIS (Jackson, 2009). There has been much difficulty in separating the constructs of fear and anxiety, since both are negative emotions aroused when confronted with perceived threats (Smillie et al., 2006). A review by Perkins et al. (2007) of by various studies has found consistent relationship between anxiety and fear. While there is no finality as regards this issue, it is best to understand BIS and FFFS in terms of their behavioral manifestations and functional value, rather than assuming them to represent known trait labels.

Given the abovementioned theoretical descriptions, we may anticipate that an individual with high BAS sensitivity can be readily attracted to perceived rewards, and has the tendency to be impulsive, given certain appropriate situations. Individuals with high FFFS sensitivity readily perceive, and are easily incapacitated by punishments and threats. They tend to be avoidant of discomfort, and evasive of perceived dangers, whenever escape is possible, and will react with defensive aggression when cornered or desperate. As for individuals with high BIS sensitivity, they are likely to be tentative in engaging what might be an incentive-gaining behavior, due to perceived threats. They are inhibited by risk assessment and are careful in their actions (Mitchelle et al., 2007).

One critical area in RST is measurement. Being based on neurological systems, direct measures of the reactivity of the systems are possibly better captured using neurological or biological paradigms (Smillie, 2008a). While neurological methods seem promising, they are still in its infancy, and are confronted with their own challenges (Smillie, 2008a). Most psychologists,

on the other hand, who are trained as social scientists, rely on the development of purpose-built scales to assess these constructs (Jackson, 2009). Corr (cited in Smillie, 2008b) argues that questionnaires that assess reinforcement sensitivity should be theoretically faithful. As with current convention, the use of self-reports is still an invaluable tool in measuring surface behaviors produced by biological systems. Perkins et al. (2007) suggests that the used of questionnaires remain suitable and informative at these early stages of reinforcement sensitivity theorizing. One of the more recent purpose-built psychometric measurements constructed in the light of the most recent revision of the RST is Jackson's (2009) *Jackson-5 scale of Revised Reinforcement Sensitivity Theory*.

The personality construct is ubiquitous, and is thus relevant to a wide array of behaviors in a variety of contexts. The appreciation of personality has always been in behavioral terms, in such a way that if someone is identified to be strong in a particular trait, another may expect specific behavioral manifestations of that trait. The RST is no exemption. For example, Van Der Linden, Beckers, and Taris (2007) found out that work stress is partly determined by one's sensitivity to punishment (i.e., FFFS).

In order to advance revised RST, it is necessary to examine its usefulness and implications in other areas. To date, the revised RST has not been well advanced in terms of its impact to real-life contexts. One area that is not well explored is the implication of RST on behaviors in the context of education. There are limited studies that directly implicate RST to student performance, behaviors, motivation, or emotions. Those that are available were done in the context of the original RST, and not the revised theory. For example, in the study of Heimpel, Elliot, and Wood (2006), BIS positively correlated with avoidance achievement goals, while BAS negatively correlated to achievement goals.

Being a personality theory concerned with motivation, emotion, and learning (Smillie, 2008a), it would be interesting to know the extent to which reinforcement sensitivity determines education-related emotions. That is, can individual differences in responding to potential rewards, threats, and conflicts predict patterns in context-specific student emotions?

Among the different emotion variables educational psychologists are concerned about, one that has been extensively examined is test anxiety. In simple terms, test anxiety is defined as a kind of situation-specific trait anxiety that is experienced by students when they are subjected to evaluation, such as an examination, or test (Putwain, Woods, & Symes, 2010).

From a practical standpoint, interest in studying test anxiety has been focused on its implications to academic achievement of students, given that achievement is largely measured through their performance in tests. Several studies have identified small to moderate negative relationships between test anxiety and academic performance (Wong, 2008). This is important because it suggests that evaluation in school, through the use of tests, may not be reflective of the actual skills and knowledge of students. Moreover, since current convention in most educational systems is the reliance on evaluative tests, such may result to increase in anxiety, particularly test anxiety, among students (Casbarro; Milloy, Winans, Jehlen, Loschert, & O'Neil as cited in Sena, Lowe, & Lee,

2007). Methia (cited in Sena et al., 2007) reports that 33% of children and adolescents experience test anxiety.

Most researchers recognize the multidimensionality of test anxiety. Wong (2008) cites that different models of test anxiety have suggested that the construct is composed of cognitive, emotional/physiological, and behavioral components. From a psychometric perspective, popular measure of test anxiety, such as the Test Anxiety Inventory, focuses on two dimensions: worry and emotionality (Spielberger, 1980). Identification of these two components is based on the 1967 conceptualization of Liebert and Morris, where worry is referred to as a cognitive component about the consequences of failure in the test, while emotionality pertains to a host of physiological responses in wake of assessment and evaluation situations (Spielberger, 1980).

Current Study

The current study investigates the relationship between students' individual differences in their sensitivities to reinforcement and their test anxiety. In the context of schools, there are rewards and threats a student may perceive. Among these perceived rewards and threats are academic evaluations in the form of tests. In one hand, a test may be perceived as partly rewarding, since it is instrumental in obtaining good grades which is an outcome that can validate one's self worth. However, the nature of tests presupposes that the aforementioned rewarding scenario is inevitably tied with a threat - the prospect of the difficulties in reviewing, the possibility that the student may fail the test, or perform less than what he expects of himself. The typical response to the perception of this threatening aspect of tests is test anxiety. As cited by Putwain et al. (2010), Meijer and Zeidner emphasized fear of failure as an important characteristic of the construct, while Spielberger (1980) highlights negative social evaluation and threat to position. Moreover, arriving at the reward is only after the hurdles of reviewing for and being subjected to evaluation are dealt with.

Not everyone who takes tests experience test anxiety. While test anxiety may be prompted by evaluative situations, individuals vary in their responses. Some are more prone to test anxiety others are not. It is critical to identify those who are more likely to be test anxious as it was estimated by Schwazer (cited in Putwain et al., 2010) that two thirds of students who have low test anxiety would outperform an average high-test anxious student. Furthermore, it is of interest if RST, as a theory of personality, can predict test anxiety variations.

One possible predictor of anxious response to tests is perhaps an individual's dispositional sensitivity to threats, or threat-reward conflicts, as explained by RST. As mentioned earlier, tests may be perceived as rewarding and threatening at the same time. If that is the case, we may expect that sensitivities of neurological systems to such may be correlated to test anxiety. For one, the BIS, or the RST system that monitors conflict between incentives and threats are expected to correlate with test anxiety, since tests can be perceived as having both. Therefore:

(H1) BIS will correlate with test anxiety, and its subscales.

However, if one thinks of which among the reward or threat component is more salient in tests, as perceived by students, it is intuitive that they may lean towards the latter. After all, we rarely, if at all, hear students become excited over the prospect of taking a test. This leads to:

(H2) Test anxiety, and its subscales will have a stronger correlation with FFFS, than BIS.

(H3) BAS will not correlate with test anxiety and its subscales.

Since FFFS can be manifested in three ways (i.e., fight, flight, and freeze), we also take into account the ecological nature of tests in terms of the proximal-distal continuum, as well as the possibility of escape. It is difficult to define whether tests are proximal or distal, particularly since items in the measure of test anxiety used in this research draws from several temporal perspectives: before, during, and after the test. For certain, the items do not strictly refer to during-tests scenarios only. Similarly, the prospect of future tests is prevalent in school situations. Hence, tests may be construed more often than not, as distal threats. At the same time, tests are not necessarily escapable. There are typically no alternatives to it, except if the student chooses to simply ignore the test, or to walk out in the middle of it, which is rather unlikely. With these conditions, that is, tests are often regarded as distal threats, and that there is virtually no option to escape, it is predicted that:

(H4) Freeze will correlate more to test anxiety and its subscales compared to fight or flight.

Method

Research Design

This study is a cross-sectional, predictive study. Johnson (2001) describes this design as a study that attempts to determine capacity of a set of variables to predict other set of variables, using data from a single point in time. This method is deemed appropriate since the researcher intends to determine how sensitivity to reinforcement predicts students' level of test anxiety.

Participants

217 college level students, predominantly female (89.5%) adolescents ($M=18.5$, $SD=1.51$), from a university in Manila, participated in study.

Instruments

Informed consent was sought from the participants and two self-report questionnaires were administered.

Jackson-5 Scales of Revised Reinforcement Sensitivity Theory. A purpose-built measurement for reinforcement sensitivity composed of 5 scales (i.e., BAS, BIS, Fight, Flight, and Freeze). There is also a total score for FFFS, which is the sum of the Fight, Flight, and Freeze scales. Each scale is comprised of six items and are rated and scored using a five point scale: 1 = completely disagree; 2 = disagree; 3 = undecided; 4 = agree; 5 = completely agree. All scales have reasonable internal consistency with Cronbach's Alpha of 0.70 and higher (Jackson, 2009).

Test Anxiety Inventory (TAI). This instrument intends to measure individual differences in a situation-specific trait, test anxiety. There is a total score for Anxiety, but there are subscales for two components, Worry (TAI/W) and Emotionality (TAI/E). The instrument has 20 items that are rated using a four-point scale: 1=almost never; 2 sometimes; 3=often; 4=almost always. Item number 1 is reverse-scored. It is reported that the TAI has an Alpha of 0.92 or higher, while TAI/W and TAI/E subscales have median alphas of 0.88 and 0.90, respectively (Spielberger, 1980).

Data Analysis

The retrieved data were analyzed using SPSS. Pearson r correlation and multiple regression analysis were used to meet the objectives of the study.

Results

Descriptive and Correlation

Table 1 shows the zero order correlation matrix and descriptive statistics of the different variables. Results generally support the hypotheses stated above. As predicted in H3, BAS did not correlate with any of the text anxiety scales. On the other hand, BIS had low correlation with total test anxiety, as well as worry and emotionality, as predicted in H1 ($r = .227, p < .01$; $r = .199, p < .01$; $r = .206, p < .01$, respectively). Furthermore, as predicted in H2, FFFS had moderate correlation with total test anxiety, worry, and emotionality ($r = .457, p < .01$; $r = .407, p < .01$; $r = .412, p < .01$, respectively). As for the primary scales of FFFS (fight, flight, and freeze), it is freeze that consistently had the highest correlation coefficients, having moderate relationship with total test anxiety, worry, and emotionality ($r = .452, p < .01$; $r = .410, p < .01$; $r = .401, p < .01$, respectively), as predicted in H4. Other primary scales of FFFS also had low to moderate correlation with test anxiety and its subscales, with the exemption of fight and emotionality.

Table 1
Descriptive Statistics and Correlation

	M (SD)	Correlations (r)								
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1 BAS	25.11 (2.83)	-								
2 BIS	23.32 (3.09)	.26**	-							
3 FFFS	58.16 (8.09)	.08	.31**	-						
4 FIG	18.93 (4.08)	.17*	.29**	.63**	-					
5 FLI	19.48 (3.91)	.01	.17	.76**	.12	-				
6 FRE	19.75 (3.54)	-.13	.25**	.74**	.12	.50**	-			
7 TA	44.66 (9.66)	.06	.23**	.46**	.20**	.33**	.45**	-		
8 WOR	18.02 (4.27)	.06	.20**	.41**	.22**	.24**	.41**	.91**	-	
9 EMO	17.73 (4.40)	.03	.21**	.41**	.12	.36**	.41**	.92**	.69**	-

Note: N=217; BAS = behavioural activation system; BIS = behavioural inhibition system; FFFS = fight-flight-freeze system; FIG = fight; FLI = flight; FRE = freeze; TA = Test Anxiety; WOR = Worry; EMO = Emotionality

Regression Analysis

Taking from the results of the correlation, subsequent simultaneous regression analyses were made among RST variables that showed relationship with test anxiety and its subscales. Initial regression analyses (not in the table) with test anxiety total, worry, and emotionality were made by entering BIS and FFFS (composite) as a block ($R^2 = .217$, $F [2,214] = 29.580$, $p < .001$; $R^2 = .171$, $F [2,214] = 22.148$, $p < .001$; $R^2 = .177$, $F [2,214] = 29.950$, $p < .001$, respectively). All three models were significant. Consistently, FFFS, rather than BIS, predicted test anxiety total ($\beta = .428$, $t [214] = 6.718$, $p < .01$), worry ($\beta = .382$, $t [214] = 5.837$, $p < .01$), and emotionality ($\beta = .385$, $t [214] = 5.901$, $p < .01$).

Tables 3, 4, and 5, provide more detailed models, wherein the correlated primary scales of FFFS are entered, instead of the FFFS composite.

Model 1: Test Anxiety and its Predictors

The first model tested for the collective and unique contributions of BIS, fight, flight, and freeze in predicting test anxiety as a whole, as presented in Table 3. It indicates that the model is significant ($R^2 = .245$, $F [4,212] = 17.224$, $p < .01$), and approximately explained 24.5% of the variance in text anxiety. However, if accounts of the individual variables are considered, freeze is the lone predictor of test anxiety ($\beta = .351$, $t [212] = 4.970$, $p < .01$).

Table 3
Summary of Regression Analysis for Model 1

	Unstandardized B	Std. Error	Beta
BIS	0.278	0.200	0.089
FIGHT	0.270	0.148	0.114
FLIGHT	0.327	0.171	0.132
FREEZE	0.958	0.193	0.351**

Model 2: Worry and its Predictors

Table 4 shows the multiple regression results for worry, wherein the predictors BIS, fight, flight, and freeze were entered as a block into the model. Analysis indicates that the model is significant ($R^2 = .202$, $F [4,212] = 13.440$, $p < .01$), explaining 20.2% of the variance of worry. It is interesting, however, that a slightly different pattern emerged as significant predictors of worry. The model suggests that worry is predicted by both fight ($\beta = .158$, $t [212] = 2.450$, $p < .05$) and freeze ($\beta = .359$, $t [212] = 4.939$, $p < .01$).

Model 3: Emotionality and its Predictors

As for the last model, which analyzes the prediction of emotionality, Table 5 shows that only BIS, flight, and freeze were entered since BAS, and fight did not correlate with emotionality.

Table 4
Summary of Regression Analysis for Model 2

	Unstandardized B	Std. Error	Beta
BIS	0.080	0.091	0.058
FIGHT	0.165	0.067	0.158*
FLIGHT	0.041	0.077	0.038
FREEZE	0.432	0.088	0.359**

Table 5 shows that, again, the model is significant ($R^2 = .208$, $F [3,213] = 18.619$, $p < .01$). The multiple regression suggests that the model accounts for 20.8% of the variance in emotionality. Among the three predictors in the block, it is flight ($\beta = .216$, $t [213] = 3.072$, $p < .01$) and freeze ($\beta = .265$, $t [213] = 3.667$, $p < .01$) that yield significant results.

Table 5
Summary of Regression Analysis for Model 3

	Unstandardized B	Std. Error	Beta
BIS	0.162	0.090	0.114
FLIGHT	0.243	0.079	0.216**
FREEZE	0.329	0.090	0.265**

Discussion

The aim of this study is to advance the revised RST by understanding its implications on test anxiety experienced by college students. Results support the status of BAS as a system that facilitates responses to rewards and incentives (Pickering & Corr, 2008; Smillie, 2008a; Smillie, et al., 2006) as evidenced by its lack of relationship with test anxiety. While tests may be instrumental in eventually obtaining rewards such as good grades and esteem, there is nothing inherently rewarding about being evaluated. On the contrary, society's emphasis on performing well in a test places students under stress and pressure in meeting these expectations (Casbarro; Milloy et al., as cited in Sena et al., 2007). Test anxiety is experienced in the context of threats that accompany evaluative situations; hence, reactivity to rewards, as indicated by BAS, is by no means associated with the experience of test anxiety.

Although there may be perceived threats in the case of evaluations or tests, these academic exercises are unavoidable. Meaning, the education system entails that it is necessary for students to go through such evaluations regularly. Here, the student is, in a way, obliged to approach the situation despite the perceived threats. Hence, it is not surprising the BIS somehow had a low correlation with test anxiety and its subscales. The BIS is identified as a conflict detection system, and facilitates the attempt to find solutions (Pickering & Corr, 2008; Smillie, 2008a; Smillie, et al., 2006). In this case, the conflict may be between the goal of taking a test,

as required by the educational system, and the pressure doing well enough so as not to be perceived as incompetent, or the sheer difficulty in preparing for and being subject to evaluation. Moreover, the BIS scale is said to measure sensitivity to uncertainty and social comparison (Jackson, 2009); that which is likewise highlighted as, in part, a determinant of test anxiety (Liebert & Morris, as cited by Spielberger, 1980). According to Mitchell, et al, (2007), those who are sensitive BIS are wary due to risk assessment.

Among the three RST systems, it is FFFS that had the most significant relationship with test anxiety and its subscales. When BIS and FFFS were entered into the regression model, FFFS also emerged as the significant predictor of total test anxiety. The FFFS is a system that facilitates responses to threats or punishing stimuli (Pickering & Corr, 2008; Smillie, 2008a; Smillie, et al., 2006). As mentioned earlier, threats in evaluation seem to overshadow the instrumentality of test in obtaining rewards and that these threats lead to test anxiety (Spielberger, 1980). It is because of this, that FFFS, indicative of sensitivity to threats, became a significant predictor of test anxiety. Findings, such as that of Van Der Linden et al. (2007) have linked sensitivity to punishment to other negative emotions, such as work stress. Similarly, Heimpel et al. (2006), found that sensitivity to punishment positively correlated with the adoption of maladaptive motivations, such as avoidance achievement goals.

Looking more closely, it is freeze, one of the primary scales of FFFS, that mostly accounts for the prediction of test anxiety and its components (i.e., worry and emotionality). Freezing, as a defensive behavior, happens in the context of threats that are perceived to be distal or non-desperate, yet, inescapable (Pickering & Corr, 2008; Smillie, 2008a; Smillie, et al., 2006). Since the taking tests does not necessarily lead to desperation and at the same time is often oriented in the future, while being inescapable for the most part, it is logical that anxiety responses to such is well accounted for by freezing. In the context of tests, freezing is likely to be observed as confusion in terms of which to prioritize in reviewing, procrastination, or the classic experience of having mental block as the test draws near, or even during the test itself.

Together with freezing, fight is also a significant predictor of worry, while flight is a predictor of emotionality, albeit to a lesser degree. As a component of test anxiety, worry pertains to cognitions about the untoward consequences of tests. On the other hand, emotionality refers to physiological responses, such as nervousness, that are reported when confronted with evaluation (Liebert and Morris, as cited by Spielberger, 1980). As stated above, it is not surprising that freezing is a typical response that predicts test anxiety and its subscales because of the ecological nature of tests (i.e., distal/non-desperate and mostly inescapable). But how is it possible that fight and flight responses are also related to test anxiety components, worry and emotionality, respectively? How does fighting or fleeing behaviors manifest in the context of tests?

The study shows that freeze and fight are significant predictors of worry. One commonality between freeze and fight responses is that they are done so when the threat is inescapable (Pickering & Corr, 2008; Smillie, 2008a; Smillie, et al., 2006). When a threat is inescapable, as it is in tests,

it is expected that a student would cognitively wallow about possible consequences, or perhaps even think about possible maneuvers to deal with the situation. Hence, worrying may serve as an attempt to deal with the situation and may be observed more among students who demonstrate freezing (described above) and fighting responses when faced with threats. Fighting or warding off threats that come along with evaluations may be in the form of actively confronting the situation; especially, among those who may perceive tests more desperately. Seriously preparing for exams, cramming a few minutes before the test, or employing focused determination during the test in order to succeed, are likely manifestations of this response.

On the other hand, freeze and flight responses are typical for threats that are distal or non-desperate (Pickering & Corr, 2008; Smillie, 2008a; Smillie, et al., 2006). The model indicates that freeze and fight responses are predictive of emotionality, or a set of physiological responses in the context of tests. If that is so, emotionality may be an experience that is more salient in situations outside the actual test, or most likely, during the anticipation of the test, or test results. Those who are likely to be nervous are those who display freezing (described above) and fleeing behaviors. Flight responses may be in the form of active attempts to ignore the prospect of taking tests, or ultimately, those who deliberately do not show up for the testing schedule.

Conclusion

As a whole, the RST maps out well with the construct of test anxiety and its subscales. While BIS and FFFS are related to test anxiety, it is FFFS, particularly freeze, which accounts much of the prediction of test anxiety. On the other hand, BAS is not related to test anxiety. These findings are in support of the revised RST. Test anxiety is, in a way, related to RST's conflict detection and resolution system (BIS) since tests are needed to be engaged with, despite possible threats that accompany it. The need to clarify the conventional thinking that BIS manifests as anxiety, and that FFFS manifests as fear, needs to be further clarified by future researchers, as findings reveal that test anxiety is more closely related to FFFS. Threats in the context of tests, that lead to test anxiety, are well accounted for by the significant contributions of the RST's threat response system (FFFS) into the models. Moreover, the finding provides evidence for the variations among fight, flight, and freeze responses, despite having similarity in general function (Eilam, as cited by Perkins et al., 2007), as indicated by the different models for total test anxiety, worry, and emotionality.

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