



## Revised Reinforcement Sensitivity Theory: Implications for psychopathology and psychological health

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### ABSTRACT

We examined the utility of revised Reinforcement Sensitivity Theory (r-RST) in comparison with original Reinforcement Sensitivity Theory (o-RST) in further understanding psychopathology and well-being. In line with theory, we found o-BIS to be a non-specific predictor of anxiety and stress whereas r-BIS and r-FFFS scales were predictors of anxiety and stress. Consistent with the joint systems hypothesis, depression was associated with r-BIS, but only when r-BAS was low. The r-BAS, low o-BIS and low r-Freeze were the only predictors of psychological well-being. These findings suggest that r-BAS as we measured it reflects more functional approach behaviour than measures of o-BAS. Further, while o-BIS appears to be associated with broad negative affective states, the parsing of r-BIS from fear potentially provides r-RST with a more refined understanding of psychopathology and reduced well-being.

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### 1. Introduction

Reinforcement Sensitivity Theory originally proposed by Jeffrey Gray in 1970 (o-RST; Gray, 1970) and, to a lesser extent, its *revision* in 2000 (r-RST; Gray & McNaughton, 2000) have been used to help explain individual differences in human functioning. In o-RST, the Behavioural Activating System (o-BAS) acts as a motivational system sensitive to signals of reward that lead to positive emotions and approach behaviour. The Behavioural Inhibition System (o-BIS) is sensitive to signals of punishment and is associated with anxiety, fear and avoidance behaviour. A major departure of r-RST from o-RST is the parsing of o-BIS into two separate neurological and conceptual systems—a Fight, Flight, Freeze System (r-FFFS), which detects threat and punishment and elicits the subjective experience of *fear*, and r-BIS which is concerned with conflict detection and resolution and elicits *anxiety*.

RST has been applied to the study of problematic behaviours, such as substance abuse, eating disorders, pathological gambling, depression and anxiety disorders (Bijttebier, Beck, Claes, & Vandereycken, 2009), as well as functional behaviours, including work performance (Izadikhah, Jackson, & Loxton, 2010). Most research has been from the perspective of o-RST, given the lack of valid and reliable measures of the r-RST constructs.

Attempts to use existing o-RST scales as proxy measures of r-RST by separating fear and anxiety items into separate measures of r-BIS and r-FFFS (e.g., Heym, Ferguson, & Lawrence, 2008) have been criticised on the grounds that existing measures of o-BIS lack sufficient items assessing fear and anxiety and no items reflecting the cautious approach component of o-BIS (Dissabandara, Loxton, Dias, Daghli, & Stadlin, 2012). A further potential problem is that the word “anxiety” as understood in the English language might be different from more constrained definitions such as employed by White and Depue (1999). Thus, simply dividing items into those seemingly related to fear and anxiety would not provide good measurement of the underlying constructs. Jackson (2009) presented scales designed to measure the five systems of r-RST (known as the Jackson 5, or J5), thus providing a means of investigating the relationship between personality and behaviour from an r-RST perspective. In the J5, r-BAS is a single scale associated with generally functional reward seeking behaviour, r-BIS is associated with social anxiety in line with the perspective taken by White and Depue (1999) and r-FFFS comprises of three scales r-Fight (defensive aggression), r-Flight and r-Freezing. The aim of the present study is to investigate psychopathology (anxiety and depression) and well-being from the perspective of both o-RST and r-RST (as measured by the J5).

#### 1.1. RST and anxiety

We used the Depression, Anxiety and Stress Scale (DASS; Lovibond & Lovibond, 1995) as a measure of psychopathology. The DASS does not distinguish anxiety and fear as conceptualised

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in r-RST, with several of the “anxiety” items on this scale including symptoms of fear or panic (e.g., ‘I was worried about situations in which I might panic and make a fool of myself’) and several “Stress” items including symptoms of anxiety (e.g., ‘I found it difficult to relax’). Given this mixture of anxiety and fear items it seems likely that a measure of o-BIS would be more strongly associated with the DASS Anxiety and Stress scales than the J5 measure of r-BIS which assesses conflict and anxiety in terms of the evaluation of personal adequacy during social interactions (White & Depue, 1999). This suggests:

**Hypothesis 1.** The o-BIS will show a stronger positive correlation with the Stress and Anxiety sub-scales of the DASS than the r-BIS.

Support for H1 would confirm how fear and anxiety are generally confounded in both our understanding of o-RST and anxiety and stress, rather than suggest that o-RST is a superior model to r-RST.

### 1.2. RST and depression

As high BAS sensitivity is associated with positive affect and low BAS sensitivity with dejected emotions, the approach system may play an important role in the aetiology of depression (Trew, 2011). At the behavioural level, Trew (2011) suggested low BAS activity leads to approach deficits and thus a reduction in positive rewarding experiences. Indeed, mildly depressed individuals show a reduction in exercise and social activities, have lower expectations of rewarding experiences, and experience potentially rewarding experiences as less rewarding (Hopko, Lejuez, Ruggiero, & Eifert, 2003; Jones & Day, 2008). Lower BAS functioning has predicted slower recovery from depressive episodes and less clinical improvement at follow-up (Kasch, Rottenberg, Arnow, & Gotlib, 2002; McFarland, Shankman, Tenke, Bruder, & Klein, 2006).

The avoidance system may also play a role in depression. While at least two studies have failed to find an association between the o-BIS scale and positive affect (Carver & White, 1994; Heubeck, Wilkinson, & Cologon, 1998), Campbell-Sills, Liverant, and Brown (2004) found that in a clinical sample, patients high in o-BIS reported less positive affect. Pinto-Meza et al. (2006) found people suffering from a major depressive disorder reported low o-BAS and high o-BIS. These results are consistent with the joint subsystems hypothesis (Corr, 2002) that conceptualises the r-RST systems as a dynamically interacting network in which the behavioural output of each of the motivational systems is determined by an interaction between the systems. For example, FFFS activity includes inhibitory output to the BAS, reducing overall BAS output (Smillie, Pickering, & Jackson, 2006b). It is possible that high r-BIS/r-FFFS activity may lower r-BAS output (resulting in reduced positive emotionality), exacerbating the depressive symptoms to a clinically significant level. The above leads to the following hypotheses in relation to depression:

**Hypothesis 2.** o-BAS and r-BAS will be negatively correlated with depression and o-BIS and r-BIS will be positively correlated with depression.

**Hypothesis 3.** r-BIS will moderate the relationship between r-BAS activity and depression, specifically, clinically significant levels of depression will be reported when r-BAS activity is low, but only if r-BIS is at least moderately high.

### 1.3. RST and well-being

While the relationship between personality and well-being has received relatively little attention, it is widely agreed that

activation of the o-BAS is associated with positive affective well-being (Carver & White, 1994; Erdle & Rushton, 2010) and happiness (Jorm et al., 1999). However, how BAS operates to influence personality is uncertain (see Pickering & Smillie, 2008). One conceptualisation, common in measures of o-BAS, is that BAS activation influences a number of traits, including novelty seeking, rash impulsivity and reward dependence (Pickering & Smillie, 2008). In the development of the J5, Jackson (2009) argued that an r-BAS scale should primarily measure functional approach behaviour, as rash approach behaviour may reflect activity at the cortical level rather than BAS functioning (Dawe & Loxton, 2004; Gullo & Dawe, 2008; Smillie & Jackson, 2006; Smillie, Jackson, & Dalgleish, 2006a). This suggests that r-BAS, as measured by the J5, is more likely than o-BAS to be associated with wellbeing (Smillie & Jackson, 2005; Smillie & Jackson, 2006).

While the role of personality as an influence on affective well-being is quite strong, there is only weak support for personality variables directly influencing cognitive well-being. Cognitive well-being, as a general rating of life satisfaction, is likely to be influenced by factors other than personality (Ryff & Keyes, 1995). Jovanovic (2011) found a relationship between personality variables (activity, low neuroticism) and affective well-being, but not cognitive aspects of well-being when affective well-being was partialled. Erdle and Rushton (2010) found self-esteem (an index of cognitive well-being) showed only a small-moderate positive correlation with o-BAS and a negative correlation with o-BIS ( $r \sim .25$ ). Desiardins, Zelenski, and Coplan (2008) found Diener's Satisfaction With Life Scale to be negatively correlated with o-BIS ( $-.33$ ) but uncorrelated with o-BAS. This leads to the following hypotheses:

**Hypothesis 4.** o-BAS will be less strongly correlated with well-being than r-BAS.

**Hypothesis 5.** r-BAS will be positively correlated with measures of well-being and r-BIS/r-FFFS will be negatively correlated with measures of well-being.

**Hypothesis 6.** r-RST measures will show a stronger correlation with measures of affective well-being than cognitive well-being.

## 2. Methods

### 2.1. Participants

Participants from two related studies were included in the analysis. The first sample comprised 174, the second 167 undergraduate students. In both samples 76% of participants were female, with a mean age of 19.7 (range 16–45 years). The majority (60%) were Caucasian, 28% Asian, and 12% ‘other’ ethnicity. Participants received course credit.

## 3. Measures

### 3.1. r-RST

The J5 (Jackson, 2009) is a 30-item scale measuring r-BAS, r-BIS, r-Fight, r-Flight and r-Freeze, as described above. Items are scored on a 5-point Likert scale from 1 (completely disagree) to 5 (completely agree) with higher scores reflecting higher activity of the motivational systems. The internal consistency of the scales in this study were; r-BAS ( $\alpha = .80$ ), r-BIS ( $\alpha = .70$ ), r-Fight ( $\alpha = .75$ ), r-Flight ( $\alpha = .62$ ) and r-Freezing ( $\alpha = .61$ ). Other studies have re-

ported higher levels of alpha on r-Flight and r-Freezing (e.g. Jackson, 2009).

### 3.2. o-RST

The Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia, Avila, Molto, & Caseras, 2001) comprises the Sensitivity to Punishment (SP) and Sensitivity to Reward (SR) scales. Based on o-RST, the SP scale assesses responses to ambiguous situations that contain elements of reward and threat as well as avoidance of threat potential. Higher scores reflect higher sensitivity. The internal reliability of the scales in the present study were: o-BAS ( $\alpha = .84$ ) and o-BIS ( $\alpha = .74$ ).

### 3.3. Psychopathology

The Depression, Anxiety and Stress Scale (DASS; Lovibond & Lovibond, 1995) includes a depression scale measuring dysphoria, hopelessness, anhedonia; an anxiety scale measuring the subjective experience of anxious affect; and a stress scale measuring difficulty nervous arousal, and agitation. Higher scores reflect higher levels of psychological distress. The internal reliability of the scales in the present study were: depression ( $\alpha = .86$ ), anxiety ( $\alpha = .75$ ), and stress ( $\alpha = .83$ ).

### 3.4. Affect

The Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) was used as a measure of affective well-being. Participants rated five positive (e.g. excited, alert) and five negative (e.g., nervous, scared) emotions on a 5-point rating scale. The internal reliability of the scales were: PANAS-positive ( $\alpha = .70$ ) and PANAS-negative ( $\alpha = .76$ ).

### 3.5. Psychological and social well-being

The Mental Health Continuum-Short Form (MHC; Keyes, 2002) is a 14-item 5-point Likert scale developed to measure affective well-being (positive affect), psychological well-being (e.g., self-acceptance, purpose in life) and social well-being (thriving in social relationships). Higher scores reflect greater well-being.

### 3.6. Life satisfaction

The Satisfaction With Life Scale (SWL; Diener, Emmons, Larsen, & Griffin, 1985) was included as an index of cognitive well-being. The SWL consists of five general statements (e.g. "I am satisfied with my life"). The internal reliability in the present study was  $\alpha = .91$ .

### 3.7. Hope

The Hope Scale (Snyder et al., 1991) assesses participants' sense of successful determination of past and future goals and was included as a further index of cognitive well-being. The internal reliability was  $\alpha = .77$ .

## 4. Procedure

Online questionnaires were completed in university research laboratories under supervision. Only participants in the second sample completed the wellbeing measures.

## 5. Results and discussion

### 5.1. Associations between r-RST and o-RST

Table 1 presents the descriptive statistics and correlations between the J5 and the SPSRQ. r-BAS correlated positively, albeit weakly with SR and negatively with SP. These results are consistent with the idea that the J5 r-BAS measures functional approach while the o-BAS measure includes items reflecting failure of behavioural inhibition (e.g., 'when you start to play with a slot machine, is it often difficult for you to stop?'). Similar to Jackson (2009), r-BIS correlated with SP and also with r-BAS and r-Fight. Further, although a small positive association was found by Jackson (2009), in the current sample there was a small negative correlation between r-BIS and r-Freeze. Together, these findings support the r-BIS scale as assessing a defensive approach response that is separate from FFFS-fear.

### 5.2. Associations between RST, anxiety, stress and depression

Table 1 presents the descriptive statistics and correlations between the r-RST subscales and mental health variables. In support of H1, a Steiger (1980) test found the association between SP and anxiety ( $r = .42$ ) was significantly stronger than the association between r-BIS and anxiety ( $r = .19$ ,  $z1bar^* = 3.58$ ,  $p < .05$ ), and the association between SP and stress ( $r = .41$ ) was stronger than the association between r-BIS and stress ( $r = .21$ ,  $z1bar^* = 3.12$ ,  $p < .05$ ). The three FFFS scales were each correlated with anxiety and stress, with the exception that r-Flight was not significantly associated with anxiety. Hypothesis 2 was partially supported with r-BAS negatively correlated with depression. Contrary to previous research, o-BAS showed a significant positive correlation with depression, which is consistent with the suggestion that the o-BAS (SR) scale taps into dysfunctional behaviour while the r-BAS scale assesses functional behaviour. Both o-BIS and r-BIS were associated with depression, although the association between r-BIS and depression was significantly weaker ( $r = .11$ ) than the association between o-BIS and depression ( $r = .42$ ,  $z1bar^* = 4.77$ ,  $p < .05$ ). While we found an expected negative correlation between r-BAS and depression, our primary hypothesis was that r-BIS would moderate the relationship between BAS functioning and depression. To test this hypothesis, a moderated multiple regression analysis was performed. DASS depression was entered as the DV. r-BAS and r-BIS scores (mean-centred) were entered in the first step. A two-way cross-product (r-BIS  $\times$  r-BAS) was entered at the second step. As shown in Table 2, r-BAS was significantly associated with lower depression symptoms and r-BIS was positively associated with depression symptoms. As predicted, there was a significant r-BIS  $\times$  r-BAS interaction at the second step. Tests of simple slopes were performed to probe this interaction. r-BAS was regressed on DASS Depress at high (+1.5 SD), moderate (mean) and low (−1.5 SD) levels of BIS. As shown in Fig. 1, the steepest slope between r-BAS and DASS was found at high r-BIS (beta =  $-.39$ ,  $p < .001$ ). The slope at moderate levels of BIS was also significant, but lower in magnitude (beta =  $-.25$ ,  $p < .001$ ). The slope at low levels of r-BIS was not significant (beta =  $-.10$ ,  $p = .16$ ). These results were consistent with the hypothesis that depression is associated with low levels of r-BAS only when r-BIS is at least moderately high. From a clinical perspective, these results suggest that for mild levels of depression interventions such as activity scheduling may be sufficient to treat depression, but for more severe levels of depression the negative emotionality related to BIS activity will also need to be addressed.<sup>1</sup>

<sup>1</sup> Tests for potential interaction were also performed on the SP and SR scales. There was no significant interaction between these measures of o-RST on depression.

**Table 1**  
Descriptive statistics and correlations of o-RST, r-RST's mental health and well-being variables (n = 341 except where stated otherwise).

|                                       | Mean  | SD   | r-BAS  | r-BIS  | r-FIGHT | r-FLIGHT | r-FREEZE | o-BAS | o-BIS  |
|---------------------------------------|-------|------|--------|--------|---------|----------|----------|-------|--------|
| r-BAS                                 | 21.83 | 3.89 |        |        |         |          |          |       |        |
| r-BIS                                 | 21.68 | 3.78 | .26**  |        |         |          |          |       |        |
| FIGHT                                 | 16.97 | 4.44 | .02    | .14**  |         |          |          |       |        |
| FLIGHT                                | 16.80 | 3.89 | -.16** | .10    | .03     |          |          |       |        |
| FREEZE                                | 18.51 | 4.00 | -.26** | -.15** | -.15**  | .40**    |          |       |        |
| o-BAS                                 | 10.97 | 4.04 | .14**  | .32**  | .30**   | .05      | .08      |       |        |
| o-BIS                                 | 12.60 | 5.41 | -.37** | .19**  | -.03    | .26**    | .54**    | .08   |        |
| DASS anxiety                          | 7.76  | 6.98 | -.13** | .19**  | .11*    | .09      | .26**    | .16*  | .42**  |
| DASS stress                           | 13.60 | 8.61 | -.11*  | .21**  | .09*    | .14**    | .28**    | .22** | .41**  |
| DASS depression                       | 8.81  | 8.10 | -.17** | .11*   | .16*    | .05      | .17**    | .14** | .42**  |
| <i>Affective wellbeing measures:</i>  |       |      |        |        |         |          |          |       |        |
| PANAS – PA <sup>a</sup>               | 17.41 | 2.84 | .35**  | .15*   | -.03    | -.06     | -.25**   | .10   | -.39** |
| PANAS – NA <sup>a</sup>               | 10.81 | 3.43 | -.23** | .11    | .18*    | .14      | .30**    | .10   | .50**  |
| Emotional well-being <sup>a</sup>     | 14.12 | 2.64 | .23**  | .04    | -.13*   | .02      | -.16*    | .09   | -.37** |
| <i>Cognitive wellbeing measures:</i>  |       |      |        |        |         |          |          |       |        |
| Psychological well-being <sup>a</sup> | 26.17 | 6.11 | .34**  | .07    | -.08    | -.02     | -.27**   | -.05  | -.51** |
| Social well-being <sup>a</sup>        | 18.40 | 5.74 | .27**  | .12    | -.05    | .06      | -.10     | .01   | -.29** |
| Hope Scale <sup>a</sup>               | 24.25 | 3.21 | .47**  | .16*   | -.10    | -.12     | -.34**   | .10   | -.51** |
| Life satisfaction <sup>a</sup>        | 24.13 | 7.13 | .22**  | .01    | -.18*   | .02      | -.16*    | -.08  | -.46** |

Note: r-BAS, Revised Behavioural Approach (J5); r-BIS, Revised Behavioural Inhibition (J5); r-FIGHT, Revised Fight (J5); r-FLIGHT, Revised Flight (J5); r-FIGHT, Revised Fight (J5); o-BAS, Sensitivity to Reward; o-BIS, Sensitivity to Punishment; DASS, Depression, Anxiety, Stress Scale.

<sup>a</sup> n = 167.

\* p < .05.

\*\* p < .01.

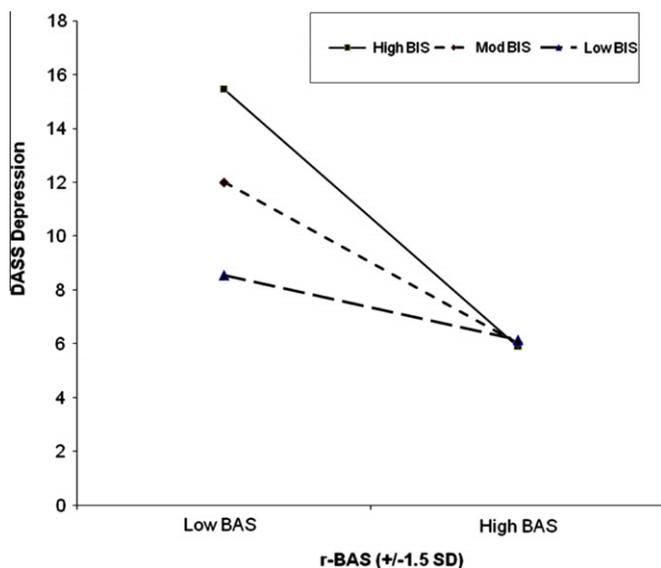
**Table 2**  
r-BAS and r-BIS scales as Predictors of DASS Depression (N = 341).

|               | B    | B <sub>se</sub> | β       | R   | R <sup>2</sup> | Δ R <sup>2</sup> | Df     | ΔF      |
|---------------|------|-----------------|---------|-----|----------------|------------------|--------|---------|
| Step 1        |      |                 |         | .24 | .06            | .05              | 2, 338 | 9.96*** |
| r-BAS         | -.45 | .11             | -.22*** |     |                |                  |        |         |
| r-BIS         | .36  | .12             | .17**   |     |                |                  |        |         |
| Step 2        |      |                 |         | .27 | .07            | .02              | 1,337  | 5.72*   |
| r-BAS x r-BIS | -.05 | .02             | -.13*   |     |                |                  |        |         |

\* p < .05.

\*\* p < .01.

\*\*\* p < .001.



**Fig. 1.** Regression lines for the relationship between r-BAS and depression as moderated by r-BIS.

5.3. Associations between RST and well-being

Supporting Hypothesis 5, r-BAS was positively correlated with all well-being measures and negatively correlated with negative

effect, while o-BIS was negatively correlated with all well-being measures and positively associated with positive affect (see Table 2). Again, this suggests the J5 measure of r-BAS assesses functional approach. The r-BIS scale was weakly positively associated with positive affect and the Hope Scale whereas o-BIS was strongly negatively associated. The negative association with o-BIS was predicted given that it measures both BIS and the negative affectivity associated with FFFS. The weak positive relationship with r-BIS is also predicted given that in r-RST, r-BIS is a conflict resolution system involving defensive approach independent of r-FFFS. Of the r-FFFS scales, r-Freeze was the most consistently and significantly associated with all indices of positive well-being (with the exception of the Social Well-being scale). The r-Fight measure showed a weak negative association with several well-being scales, while r-Flight showed a weak positive association with negative effect. Together, the associations with o-BIS and the r-Freeze scales with low affective and cognitive well-being and the absence of an association with r-BIS suggest that the tendency to inhibit in response to threat (rather than defensively approach) impacts negatively on a sense of psychological well-being. With the exception of Emotional Wellbeing, correlations between r-BAS and indices of well-being were significantly stronger than correlations between o-BAS and well-being z1bar\* ranging from 2.59 to 3.92). Thus, a tendency to engage in functional goal-oriented approach is associated with better psychological health.

We predicted that r-RST measures would have a stronger association with affective well-being than cognitive well-being as affective well-being is a more proximal outcome of RST activity compared to cognitive well-being which likely involves higher level cognitive factors. Contrary to expectations the strength of the significant correlations between the RST systems and both affective and cognitive well-being measures were of a similar magnitude. Interestingly, r-BAS, low r-Freeze and (less consistently) r-Fight were the personality measures from r-RST most consistently related with measures of well-being. We had expected the negative affectively of anxiety, the output of BIS activity, would erode a sense of well-being. Surprisingly, r-BIS was not significantly associated with affective or cognitive well-being. This may be because the J5 r-BIS is conceptualised as personal inadequacy and social anxiety (based on White & Depue, 1999) and therefore different

from broader definitions of anxiety that might be expected to reduce a sense of well-being. We did find that r-BAS and the functioning of the FFFS, or specifically the r-Freeze system, were both significantly associated with well-being—the strongest association occurring between r-BAS and the Hope Scale. One interpretation of this is that an individual's appraisal of life is related to achieving goals. r-BAS has been linked to a greater goal-mastery orientation (Jackson, 2011) leading people to pursue activities and realise goals that, in turn, result in a greater sense of satisfaction in life. However, the r-Freeze system is sensitive to distal threat stimuli resulting in escape from perceived aversive stimuli. Thus, a person with a high sensitivity to threat and tendency to freeze would be less likely to take risks and realise goals, thereby eroding their sense of life satisfaction. Potentially, moderate to high BAS activity may result in higher goal-mastery orientation, while moderate to high FFFS activity may result in avoidance behaviour leading to an accumulating experience of failure to attain goals and dissatisfaction with life.

## 6. Summary

Overall, the J5 representation of r-RST provides several notable improvements in comparison with previous conceptualizations of o-RST. The J5 r-BAS appears to provide a scale aligned with reward seeking along the lines envisaged by Gray and McNaughton (2000). The J5 does not consider rash impulsivity to be part of r-RST, which is in agreement with latest thinking by other researchers (Dawe, Gullo, & Loxton, 2004; Dawe & Loxton, 2004). This contrasts with Carver and White's (1994) multi-dimensional model of o-BAS, which was only weakly related to the o-BAS theoretical construct and less correctly featured rash impulsivity as part of o-BAS (Smillie et al., 2006b). Following White and Depue (1999), the J5 r-BIS scale aligns with a narrow definition of anxiety based on social interaction and peer comparison (e.g., 'Want to do well compared with others'). Moreover the scale correctly identifies r-BIS as defensive approach and therefore we argue that it should be positively correlated with r-BAS (as shown by Jackson, 2009). This contrasts with broader definitions of anxiety such as that proposed by Carver and White (1994) which have failed to differentiate anxiety from fear and which are negatively related to BAS (see Smillie et al., 2006b). We advocate that the J5 is a representation of r-RST that is tightly aligned to latest thinking (Smillie et al., 2006b; White & Depue, 1999). Its precision in aligning to theory seems likely to identify limitations in the application of r-RST whereas it could be argued that Carver and White's (1994) broad model of o-RST misled researchers through identifying relationships unrelated to o-RST and through poor conceptualization o-BAS and o-BIS.

The present study has the usual limitations associated with using cross-sectional data (lack of causality) and a university population (possible poor generalisation). Future research should expand upon the current study to investigate r-RST in clinical populations and to track change over time. However, we believe our research provides useful evidence on how r-RST relates to behaviour and how r-RST will lead to a debate that questions much of the previous research relating behaviour to o-BAS and o-BIS. We conclude that while the revised formulation of RST may lead to a better and more precise understanding of human behaviour, further research to establish the validity of existing measures is required.

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