Jackson-5 scales of revised Reinforcement Sensitivity Theory (r-RST) and their application to dysfunctional real world outcomes

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A B S T R A C T

Revised Reinforcement Sensitivity Theory (r-RST) is a neurobiological theory of personality which has many differences compared to the original version. This highlights the need for measurement scales to reflect the revised theory. Study 1 uses exploratory and confirmatory factor analysis to develop and test new scales (the 'Jackson-5') which are shown to be internally reliable, have scale inter-relationships matching theory, and to have desirable construct validity properties. Study 2 compares r-RST with original RST in the prediction of delinquency and psychopathy in students. Results suggest the new scales capture the main properties of r-RST and indicate that r-RST provides a substantially different explanation of the personality basis of dysfunctional behavior compared to original RST.

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1. Introduction

Gray and McNaughton's (2000) revised Reinforcement Sensitivity Theory (r-RST) represents an important theoretical advance in the neuropsychology of personality. Despite substantial interest in r-RST (e.g., Corr, 2002a,b, 2004; McNaughton & Corr, 2004; Smillie, 2008; Smillie, Dalgleish, & Jackson, 2007; Smillie, Pickering, & Jackson, 2006), there has been little attempt to operationalize the theoretical developments into a set of personality scales which will effectively measure r-RST. Therefore the aims of the current research are to develop scales which provide appropriate measurement of r-RST and then to compare r-RST against original Reinforcement Sensitivity Theory (o-RST) in the predictiveness of a range of behaviors. An important point is that such aims might appear to be psychometric but in fact the measurement issues raised will suggest the need for substantial theory refinement and development.

In o-RST, Gray (1982a,b, 1987a,b) postulated three independent biological systems which regulate behavior: a behavior approach system also sometimes referred to as a behavior activation system (o-BAS), a behavior inhibition system (o-BIS), and a fight/flight system (o-FFS). In r-RST, there are three biological systems which have similar names (r-BAS, r-BIS and the Fight/Flight/Freezing system – the r-FFFS). The three systems in r-RST remain anatomically separate from each other (Corr, 2004; Gray & McNaughton, 2000; McNaughton & Gray, 2002). Although various authors (e.g. Corr,

2002a, 2004) have argued that systems within r-RST might be expected to functionally interact with each other under various experimental conditions, this does not alter the important point that their anatomical independence suggests the need for an orthogonal or near orthogonal solution (a viewpoint confirmed by Corr in private correspondence and debated by Smillie, Pickering, et al., 2006). Therefore, although statistical interaction between the scales is possible, the anatomical independence of the three systems in r-RST leads to:

(H1) The scales of r-BAS, r-BIS and r-FFFS should be orthogonal.

In o-RST, o-BAS mediates responses to reward and relief (resulting in approach behavior and active avoidance behavior, respectively) and was thought to be the biological basis of Impulsivity (Gray, 1970). This perspective has been increasingly questioned in the literature because researchers (e.g. Quilty & Oakman, 2004; Smillie, Jackson, & Dalgleish, 2006; Zelenski & Larsen, 1999) have argued that existing measures of o-BAS are comprised of trait clusters related to Extraversion (i.e. being gregarious and excitement seeking) and rash impulsivity (i.e. behaving recklessly and lacking foresight). This is important because recent converging evidence from several perspectives argues that just the Extraversion trait cluster is more consistent with r-RST (see Smillie, Pickering, et al., 2006). From a theoretical perspective, Depue and Collins (1999) proposed that BAS mediating dopaminergic processes are mainly related to Extraversion (also see Reuter, Schmitz, Corr, & Hennig, 2005). From an experimental perspective, Smillie and

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Jackson (2006) report o-BAS measures associated with Extraversion and functional impulsivity (which is rash impulsivity only when appropriate) predict rewarding choices in a go/no-go discrimination learning paradigm better than rash impulsivity measures. From a clinical perspective, concerns have also been raised regarding a link between o-BAS and rash Impulsivity (Dawe, Gullo, & Loxton, 2004; Dawe & Loxton, 2004).

It is also important to also note that r-BAS should be conceptualized as a single scale as this corresponds with the requirements of r-RST. The widely used broader operationalization of o-BAS as three scales (e.g. Carver & White, 1994) is not appropriate for r-RST.

All this leads to the following hypothesis regarding r-BAS:

(H2) The scale of r-BAS should be highly related to Extraversion and functional impulsivity.

In the previous version of the theory, the o-FFS system mediated responses to unconditioned aversive stimuli in terms of rapid escape (Flight) or defensive aggression (Fight). In r-RST, the r-FFFS, denoting a Fight, Flight, and Freezing System (Gray & McNaughton, 1996, 2000), mediates responses to both conditioned and unconditioned stimuli. Distal threat stimuli lead to flight or freezing responses in which an animal experiences fear and tries to escape from the aversive stimuli. Proximal threat stimuli lead to fight responses such that a threatened animal will 'fight' if cornered. Fight is a rapid and desperate response to a serious threat and is an expression of fear much like Flight or Freezing (Blanchard & Blanchard, 1990a,b). In r-RST, r-Fight is theoretically different to predatory aggression because predatory aggression is often reward mediated and therefore likely to be partially linked with r-BAS. All three systems (r-Fight, r-Flight and r-Freezing) should therefore be *positively* related to the r-FFFS because they are all positively related to fear.

All this implies that r-Fight, r-Flight and r-Freezing could be seen as primary scales of r-FFFS. The possibility of a hierarchical structure to r-FFFS such that r-Fight, r-Flight and r-Freezing are primary scales of r-FFFS has not to the knowledge of the author been clearly articulated within r-RST theory but it is nevertheless a reasonable and logical consequence of r-RST as it has so far been developed. This leads to:

(H3) r-Fight, r-Flight and r-Freezing are primary scales of r-FFFS and are positively related to r-FFFS.

However there are at least two reasons to think that r-Fight might not clearly relate to r-Flight and r-Freezing as much as r-RST suggests. The first reason is that the requirements for the design of an r-Fight scale are different to r-Flight and r-Freezing. As noted, r-Fight items need to be proximal, desperate, and/or very threatening such that individual differences in a fight response are measured with little chance of flight or freezing. On the other hand, r-Flight and r-Freezing items should be either distal and/or less desperate such that individual differences in flight and freezing are measured with little chance of a fight response. From this perspective, r-Fight is clearly different from r-Flight and r-Freezing.

The second reason is that people habitually high in r-Fight seem likely to be high in predatory aggression since they are overlapping behaviors, both may thwart a predator's intentions,[1] and some have speculated that predatory aggression is

a natural development from defensive aggression in the behavioral repertoire of early man (Leakey, 1967). Since people high in predatory aggression are likely low in fear, the likely overlap between r-Fight and predatory aggression seems likely to reduce the relationship between r-Fight and the other scales of the r-FFFS.

These issues suggest that evidence in favor of H3 may not be straightforward to find. A simpler hypothesis which accepts dissimilarities between the scales of r-FFS, but which is less rigidly associated with r-RST, is:

(H4) Scales of r-Flight and r-Freezing should be more strongly related to each other than r-Fight.

In o-RST there is a major emphasis on o-BIS which is related to anxiety. However, while previously serving to regulate responses to conditioned aversive stimuli, r-BIS is now activated by all sources of conflict. Consequently, r-BIS is no longer a punishment system, but serves in conflict detection and resolution such that it inhibits ongoing behavior (both r-BAS and r-FFFS mediated), while simultaneously directing arousal and attentional resources towards the source of the conflicting stimuli. In r-RST, r-BIS mediates defensive approach, passive avoidance and emphasizes the need to be careful. It is therefore different from o-BIS scale which had more of an emphasis on passive avoidance and extinction (Wilson, Barrett, & Gray, 1989).

In scale development of o-RST, fear and anxiety seem to have been treated as virtually indistinguishable concepts associated with o-BIS. For example, although the Gray–Wilson Personality Questionnaire (GWPQ; Wilson et al., 1989) was designed to separately measure o-FFS and o-BIS, Jackson (2003) demonstrated that o-Flight, a primary scale of o-FFS, was highly related to o-BIS. Similar conclusions were drawn by the original authors of the GWPQ (Wilson, Gray, & Barrett, 1990). Smillie, Pickering, et al. (2006) argue that the most likely explanation for this finding is the failure to clearly locate fear with o-FFS and instead relate it to o-BIS. As a further example, item 2 ('Even if something bad is about to happen to me, I rarely experience fear or nervousness') and item 22 ('I have very few fears compared to my friends') of Carver and White's (1994) o-BIS scale seem likely to refer to fear. Similarly, it seems likely that the high bandwidth scale of Neuroticism will also generally contain a mix of fear, anxiety and other constructs (e.g. item 31. I rarely feel fearful or anxious of Costa and McCrae's, 1992, NEO-FFI). Evidence to support r-RST requires:

(H5) A scale of fear should be more related to r-FFFS and its primary scales than r-BIS.

Such issues need to be addressed if r-FFFS and r-BIS independence is to be achieved in r-RST. In particular, r-BIS must be reconceptualized in terms of anxiety as opposed to a mix of anxiety and fear (Perkins, Kemp, & Corr, 2007). White and Depue (1999, p.866) focus on the differences between fear and anxiety and state: 'anxiety involves a tendency to respond with escalating distress to situations that involve uncertainty and social-evaluative judgments by others (such as testing, failure, social embarrassment, rejection) which culminates as catastrophic anticipations of impending personal disaster. As such, anxiety can be conceptualized as an emotional system that is sensitive to uncertainty and social-evaluative stimuli ..., which we believe are important precursors to ostracization from social groups.' Smillie, Pickering, et al. (2006) develop this theme and argue r-BIS could be represented by sensitivity to uncertainty, social comparison, and failure of one's efforts since they are good examples of goal conflict. This definition

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[1] A good non-human example of predatory aggression as an adaptive alternative to defensive aggression in times of great danger is that groups of male baboons have been observed launching high speed organized assaults on predatory cheetahs (Cloudsley-Thompson, 1965).

of r-BIS represents a substantial departure from the broader item content of o-BIS scales (e.g. GWPQ: Wilson et al., 1989; BAS/BIS: Carver & White, 1994; SRSP: Torrubia, Avila, Caseras, & Molto, 2001) and leads to the following hypotheses:

(H6) The scale of r-BIS should be highly positively related to another measure of social comparison, lack of confidence and sensitivity to one's own efforts.
(H7) The scale of r-BIS should be only moderately positively related to Neuroticism and o-BIS.

A potential way of generating a new r-BIS scale might be to cut the fear items (i.e. items 2 and 22) from Carver and White's (1994) o-BIS scale. The main concepts underlying the remaining items are: 8. Criticism hurts me; 13. I feel upset when somebody is angry at me; 16. If something unpleasant I get worked up; 19. Worried when I have done poorly; 24. I worry about mistakes. Examination of these items suggests that they are quite related to the proposed new definition of r-BIS. However, it seems likely that these items will still provide an unsatisfactory measure of r-BIS because they lack the specific design requirement of being distinct from r-FFFS. This leads to a hypothesis which will suggest that o-BIS with fear items removed fails to be a useful r-BIS measure:

(H8) A scale of o-BIS with the fear items removed will be positively related to r-FFFS.

In summary, the main focus of the current research is to develop new scales of r-RST which provide evidence in favor of the hypotheses. Study 1 presents the development of the r-RST scales in terms of EFA, CFA, reliability and construct validity as part of a theoretically developed nomological network. Study 2 presents further initial evidence of construct validity in terms of prediction of appetitive dysfunctional behavior (delinquency and psychopathy).

2. Study 1

2.1. Method

2.1.1. Participants and procedure

A total of 972 participants (Mean age = 22 yrs, SD = 4.22; 28% males; 72% females) in tertiary education, completed the following scales under the direct supervision of a research assistant. Adhering to established guidelines for psychometric assessment and design (e.g., Kline, 1986), a deductive methodology was utilized to generate an initial pool of items. In this case, the pool of items was self-generated by the author as opposed to alternative methods such as interview and focus groups or relying on items written by others. This should be judged as a reasonable process since r-RST requires very strict understanding of underlying theory, especially given the need to clearly differentiate fear from anxiety and defensive aggression from predatory aggression. Items on the following scales were generated by the author and used to provide an item pool for an initial measure r-RST: (1) Jackson's Appetitive Motivation Scale (JAMS; Cooper, Smillie, & Jackson, 2008; Jackson & Smillie, 2004; Smillie & Jackson, 2005). This is a 20 item published questionnaire designed to measure o-BAS already developed by the author; (2) Anxiety and defensive approach resulting from social comparisons, avoidance and anxiety (11 items); (3) Defensive fight reflecting a tendency to fight back to strong, proximal stimuli when faced with verbal, physical and mental aggression (19 items); (4) Freezing reflecting a tendency to physically or mentally stop in 'one's

tracks' when faced with an unpleasant stimulus or a choice of options; also designed to be more distal or less threatening than the content of the r-Fight options (10 items); (5) Flight reflecting a tendency to escape from an unpleasant stimulus which is more distal or less threatening than the content of the fight items (12 items). To avoid issues of data fishing, only items from these pre-planned initial scales were used to develop scales of r-RST and only items from the relevant scales were used to select items for that scale. A further point to understand the items is that behavior associated with RST can be mental as opposed to physical, such that flight for example, might be imagined as opposed to performed (Jackson, 2003). The item pool is shown in Appendix A.

Also administered was an 11 item Anxiety scale which consisted of the following items: "I have sweaty palms when things go wrong", "I get anxious very easily", "I instinctively avoid difficult situations", "I really dislike criticism", "People say I focus on problems", "I am very sensitive to peoples' comments about me", "I worry about disease and illness a lot", "I have panic attacks more than most people", "My heart races when I get scared", "I get nervous about things very easily", "I find it hard to make decisions easily." The purpose of the Anxiety scale was to provide an alternative measure of BIS based on a broad definition of anxiety which would provide a possible alternative to the more restrictive measure of r-BIS which was proposed as necessary by Smillie, Jackson, et al. (2006).

A seven item fear scale was administered which consisted of the following items: "I do not get scared easily (R)", "Noises at night-time frighten me", "Strangers are scary", "I am not scared of mice (R)", "I am frightened of the future", "I think the world is not a safe place", "I find it hard to make decisions easily". The purpose of the fear scale was to examine its relationship with r-BIS and r-FFFS and its primary scales. All items on all of the above scales were scored on a five point scale: 1 = completely disagree, 2 = disagree, 3 = undecided, 4 = agree, 5 = completely agree.

To aid in assessing construct validity as part of a nomological network the following highly respected and widely understood questionnaires were also measured: The Eysenck Personality Questionnaire (EPQ-R; Eysenck & Eysenck, 1991) which measures Psychoticism, Extraversion and Neuroticism; BIS/BAS Scales which measures three components of o-BAS and one of o-BIS (Carver & White, 1994); Goal orientation Scales (VandeWalle, 1997) which measure learning goal orientation, proving goal orientation and avoidance goal orientation, Functional and Dysfunctional Impulsivity (Dickman, 1990); General Self efficacy (Chen, Gully, & Eden, 2001; Chen, Gully, Whiteman, & Kilcullen, 2000) and the five factor model of personality was measured by the International Personality Item Pool (IPIP: Goldberg, 1999) which measures Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness.

3. Results and discussion

The sample was split into two halves. The first half (n = 486) was used for model development and the second half (n = 486) for model confirmation. Principal components analysis (PCA) with varimax rotation was used to select items from the item pool. Items were rejected if they did not load on the expected component or if they cross loaded with another component. Six items from each of the five scales were retained after several iterative attempts at finding a satisfactory solution. Although there are limitations with using PCA, results and methodology are easy to understand and results are generally very similar to more complex

Table 1
Exploratory principal components analysis of the Jackson-5: revised-RST questionnaire (Sample 1 of Study, $n = 486$).

	1 r-BAS	2 r-Fight	3 r-BIS	4 r-Freezing	5 r-Flight
% var	11.54	9.90	9.38	9.11	8.93
Cumulative % var	11.54	21.44	30.82	39.93	48.86
BAS1: like things new and different	**.779**	−.007	.038	−.103	−.044
BAS2: like to do things spontaneously	**.674**	.001	−.009	−.080	−.047
BAS3: actively look for new experiences	**.771**	−.012	.066	−.059	−.061
BAS4: feel for how things work	**.589**	.031	.226	−.026	−.087
BAS5: look for new sensations	**.828**	.047	.126	−.091	−.008
BAS6: excited by what is new in my field	**.657**	−.028	.216	−.108	−.083
BIS4: prefer projects prove my ability	.081	.061	**.630**	.102	−.089
BIS3: like peers to know I'm doing well	.151	.036	**.762**	−.028	−.048
BIS2: want to do well compared to peers	.230	−.025	**.725**	−.089	.024
BIS1: aim better than peers	.233	.051	**.621**	−.037	−.028
BIS5: want to avoid looking bad	.064	.194	**.577**	−.047	.179
BIS6: avoid work makes me look bad	−.139	.091	**.618**	.146	.143
FI1: fight back	.064	**.799**	−.002	−.093	−.003
FI4: if someone stealing I attack	.054	**.757**	.055	−.063	.102
FI3: if burglar would look for a weapon	.066	**.635**	−.037	−.068	.052
FI2: provoked get into a fight	−.059	**.577**	.166	.131	−.070
FI5: somebody is going to hit I hit first	−.130	**.565**	.107	.093	−.178
FI6: I would retaliate	.005	**.736**	.109	.033	−.012
FL1: if approached I run away	−.176	−.064	.050	**.636**	.101
FL2: run if harassed by a stranger	−.096	.019	.023	**.632**	.179
FL3: if dog barks run away	−.046	−.118	.024	**.749**	.129
FL4: fire rush out of building	.053	.047	−.114	**.658**	.094
FL5: terrified if dangerous animal	−.020	.052	.073	**.636**	.270
FL6: hide behind chair as a child	−.218	.088	.011	**.443**	.092
FR2: remain motionless	.051	−.086	.034	.277	**.562**
FR3: not know what to say if stranger rude	−.076	−.181	.008	.202	**.687**
FR5: hard to decide what to buy	.046	.173	.047	.038	**.565**
FR4: if told contradictory things not know do	−.132	.004	.077	.029	**.705**
FR1: if something bad I would stop	−.141	−.044	−.064	.226	**.673**
FR6: in a crowd my mind freezes	−.098	−.011	.003	.181	**.581**

Extraction method: principal component analysis.
Rotation method: Varimax with Kaiser normalization.

methods.[2] For these reasons, PCA is quite widely used in exploratory analysis and questionnaire development (e.g. Lilienfeld & Andrews, 1996). Varimax rotation was used as it creates orthogonal principal components as required for the hypothesized orthogonal relationships between r-BAS and r-BIS. Final items in the Jackson-5 scales of r-RST measure are shown in Appendix B.

The scree plot (available upon request to the author) provides reasonably strong evidence of the planned five component solution. Parallel factor analysis also suggested a five factor solution was appropriate (using the procedure detailed by Hayton, Allen, & Scarpello, 2004). Table 1 shows that the first five components explain a total of 48.86% of the variance and all items load highly on their appropriate component and do not load highly on an inappropriate component. Results therefore suggest a neat five component solution.

Means, standard deviations, alpha reliabilities and correlations are shown in Table 2. The scale of r-FFFS is also shown and is computed as the sum of the r-Fight, r-Flight and r-Freezing items. Reasonable internal consistency of items is shown by Cronbach's alpha being 0.70 and all the proposed scales achieve this criterion. An independent *t*-test determined possible sex differences. No significant differences were found between males and females in r-BAS, r-BIS and r-FFFS at a conservative 1% level of significance, but

males scored higher on r-Fight ($t = 8.46$, $p < .001$) and females scored higher on r-Flight ($t = −5.23$, $p < .001$) and r-Freezing ($t = −3.83$, $p < .001$). The presence of sex effects in the primary scales of r-FFFS suggests that there may be a need to partial the effects of sex when examining the psychometric properties of these scales. This will be an important point in some subsequent analyses.

The scale of r-Flight is correlated with r-Freezing ($r = 0.43$, $p < .01$) but aside from this, correlations between the other scales of the proposed measure of r-RST are minimal. The moderate positive correlation between r-Flight and r-Freezing was expected given that they are both sensitive to distal threatening stimuli and are primary scales of r-FFFS. The smaller correlation between r-Fight and the other two r-FFFS scales was also expected given the issues raised in the Introduction.

Table 3 shows the correlations between the r-Fight items and the r-Flight and r-Freezing items. Given that significant sex effects were found for each of the three scales, correlations are also shown with the effects of sex partialed. In most cases, the pattern of correlations supports the idea that partialing the effects of sex generally acts to increase the positive relationship between the scales although the effect is small. Table 3 tends to confirm the overall picture provided by the correlations between the scales of r-Fight, r-Flight and r-Freezing which is that r-Fight has different properties compared to the other two scales of the r-FFFS.

Correlational results, and results of the PCA, therefore provide reasonable support for the relatively orthogonal nature of the higher order r-RST scales. Results also indicate a positive relationship between r-Flight and r-Freezing as well as a sex effect that increases the positive relationship between r-Fight and the other two r-FFFS scales of r-Flight and r-Freezing.

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[2] It could be argued that principal factor analysis (PFA) with oblique rotation might be a superior method. Results from both decomposition methods were compared and found to be virtually identical except that there were a few higher cross loadings between r-Flight and r-Freezing items using PFA with an oblique rotation. This might be expected as both these systems respond to similar distal threatening stimuli. In the end, I preferred the simpler and tidier PCA solution with varimax rotation which also offered an opportunity to assess the proposed orthogonal relationships between the higher order scales.

Table 2
Descriptive statistics and correlations of variables used in sample 1 of Study 1 ($n = 486$).

	M	SD	Alpha	r-BAS	r-BIS	r-Fight	r-Flight	r-Freeze	r-FFFS
r-BAS	23.22	3.80	.83						
r-BIS	21.82	3.85	.76	0.27**					
r-Fight	17.01	4.41	.78	0.03	0.18**				
r-Flight	15.71	3.88	.74	−0.24**	0.03	0.00			
r-Freezing (r-Freeze)	18.25	4.11	.70	−0.17**	0.05	−0.05	0.43**		
r-FFFS	48.55	7.57	.74	−0.18**	0.15**	0.56**	0.71**	0.66**	
Anxiety	32.43	7.94	.87	0.17**	0.26**	0.11*	0.43**	0.54**	0.52**
Fear	19.83	4.28	.69	−0.18**	.35**	.02	0.46**	0.54**	0.49**
C&W o-BAS drive	11.31	2.31	.76	0.43**	0.32**	0.12*	−0.09	0.14**	−0.04
C&W o-BAS fun	12.66	2.12	.70	0.60**	0.25**	0.15**	−0.14**	−0.07	−0.01
C&W o-BAS reward	17.35	1.97	.68	0.31**	0.25**	0.10*	0.08	0.08	0.15**
C&W o-BIS	20.98	3.55	.77	−0.13**	0.25**	−0.03	0.22**	0.37**	0.27**
Functional impulsivity	34.63	6.29	.78	0.41**	−0.02	0.12*	−0.18*	−0.30**	−0.15**
Dysfunctional impulsivity	32.28	7.54	.83	0.11*	0.15**	0.19**	−0.03	0.01	0.10*
Extraversion EPQ	15.55	4.83	.85	0.52**	0.14**	0.05	−0.17**	−0.24**	−0.15**
Neuroticism EPQ	13.26	5.55	.87	−0.14**	0.26**	0.18**	0.23**	0.37**	0.38**
Psychoticism EPQ	7.48	4.30	.74	0.08	0.08	0.32**	−0.13**	−0.13**	0.04
Lie scale EPQ	7.22	3.79	.73	−0.04	−0.24**	−0.21**	−0.02	−0.07	−0.18**
Extraversion NEO	33.41	6.66	.86	0.35**	0.07	0.01	−0.15**	−0.26**	−0.16**
Neuroticism NEO	30.30	7.07	.87	−0.12*	0.25**	0.15**	0.23**	0.33**	0.34**
Agreeableness NEO	38.94	4.65	.75	0.22**	−0.08	−0.19**	−0.03	0.08	−0.07
Conscientiousness NEO	32.63	4.97	.71	0.03	0.03	−0.11*	0.01	−0.10*	−0.11*
Openness NEO	35.68	5.11	.75	0.29**	0.19**	0.04	−0.14**	−0.17**	−0.11*
General self efficacy	31.85	4.44	.89	0.48**	0.21**	0.02	−0.22**	−0.25**	−0.21**
Learning GO	18.73	3.47	.83	0.52**	0.17**	−0.04	−0.22**	−0.24**	−0.24**
Prove GO	13.85	3.22	.79	0.26**	0.68**	0.12**	0.02	0.02	0.09
Avoid GO	12.11	3.47	.84	−0.06	0.50**	0.09	0.06	0.14**	0.15**

** $p < .01$ level.
* $p < .05$ level.

Table 3
Correlations between the items comprising r-Fight and the r-Flight and r-Freezing scales (sample 1, Study 1, $n = 486$).

	r-Fight items					
	FI1 Fight back	FI2 Provoked get into a fight	FI3 If burglar would look for a weapon	FI4 If someone stealing I attack	FI5 Somebody is going to hit I hit first	FI6 I would retaliate
r-Flight items						
FL1: if approached I run away	−0.07	−0.01	−0.04	−0.06	−0.04	−0.03
	−0.01	**0.01**	**0.03**	**0.01**	**0.06**	**0.03**
FL2: run if harassed by a stranger	0.01	0.01	0.05	0.09	−0.07	−0.02
	0.07	**0.03**	**0.11***	**0.16***	**0.02**	**0.03**
FL3: if dog barks run away	−0.17**	0.03	−0.12*	−0.12**	0.02	−0.03
	−0.14*	**0.04**	**−0.09**	**−0.09**	**0.08**	**0.01**
FL4: fire rush out of building	−0.04	0.01	−0.02	0.05	0.05	0.02
	−0.03	**0.01**	**−0.01**	**0.07**	**0.07**	**0.03**
FL5:terrified if dangerous animal	−0.04	0.09*	0.05	−0.02	0.00	0.06
	0.05	**0.12***	**0.10***	**0.04**	**0.08**	**0.11***
FL6: hide behind chair as a child	−0.04	0.13**	0.04	−0.01	0.09	0.08
	−0.03	**0.14***	**0.07**	**0.01**	**0.13***	**0.10**
r-Freezing items						
FR1: if something bad I would stop	0.08	0.08	0.09*	0.15**	−0.03	0.11*
	0.09	**0.09**	**0.11***	**0.16***	**−0.02**	**0.12***
FR2: remain motionless	−0.06	−0.04	0.00	−0.05	−0.06	−0.02
	−0.03	**−0.02**	**0.03**	**−0.02**	**−0.01**	**0.01**
FR3: not know what to say if stranger rude	−0.05	0.01	−0.05	−0.02	−0.11*	−0.07
	0.01	**0.03**	**0.01**	**0.05**	**−0.02**	**−0.02**
FR4: if told contradictory things not know do	−0.03	−0.01	0.05	−0.01	−0.05	−0.01
	0.00	**0.00**	**0.07**	**0.01**	**−0.02**	**0.01**
FR5: hard to decide what to buy	−0.14**	−0.08	−0.04	−0.12**	−0.13**	−0.12**
	−0.09*	**−0.06**	**0.02**	**−0.07**	**−0.06**	**−0.07**
FR6: in a crowd my mind freezes	−0.08	0.06	0.01	−0.08	0.07	−0.01
	0.08	**0.06**	**0.01**	**−0.09**	**0.07**	**−0.01**

Correlations in bold are with the effects of sex partialed.
** $p < .01$ level.
* $p < .05$ level.

The new scale of r-BAS correlates with EPQ-Extraversion ($r = 0.52$, $p < .01$) and NEO-Extraversion ($r = 0.35$, $p < .01$) which provides support for the theoretically required alignment between r-BAS and Extraversion. Moreover there are strong relationships between r-BAS and Functional Impulsivity ($r = 0.41$, $p < .01$) which provides further support for a relationship be

tween these constructs as argued by Smillie, Pickering, et al. (2006). In wider support for r-BAS, there is also evidence that it is strongly correlated with Carver and White's (1994) three measures of o-BAS, Chen et al.'s (2001) measure of general self-efficacy ($r = 0.48$, $p < .01$) and VandeWalle's (1997) measure of Learning Goal Orientation ($r = 0.52$, $p < .01$). All this evidence puts r-BAS firmly aligned with known and widely respected measures of the approach system (Gable, Reis, & Elliot, 2003).

In line with expectations, the correlations between r-BAS and Dysfunctional Impulsivity ($r = .11$, $p < .01$), Carver and White's o-BIS ($r = −0.13$, $p < .01$), EPQ Neuroticism ($r = −.14$, $p < .01$), NEO Neuroticism ($r = −.12$, $p < .05$) are minimal and suggest that r-BAS has divergent properties from these scales. This adds further support to the generally strong evidence in favor of the r-BAS construct such that it is more correlated with functional approach constructs than dysfunctional approach and avoidance constructs.

Scales of r-Fight, r-Flight, r-Freezing and r-FFFS are correlated with EPQ–Neuroticism ($r = 0.18$, $p < .01$; $r = 0.23$, $p < .01$; $r = 0.37$, $p < .01$; $r = 0.38$, $p < .01$, respectively), with NEO–Neuroticism ($r = 0.15$, $p < .01$; $r = 0.23$, $p < .01$; $r = 0.33$, $p < .01$; $r = 0.34$, $p < .01$, respectively); and Carver and White's o-BIS ($r = −0.03$, ns; $r = 0.22$, $p < .01$; $r = 0.37$, $p < .01$; $r = 0.27$, $p < .01$). These generally low to moderate correlations were expected because r-FFFS and its primary scales were designed to be aligned with the underlying construct of fear which has been argued to be also likely found in Neuroticism and o-BIS. The demonstration of this overlap fits with Smillie, Pickering, et al.'s (2006) assertion that o-BIS might contain elements of fear which make it an unsuitable measure of r-BIS. The scale of r-Fight seems to have somewhat different properties to r-Flight and r-Freezing such that it's relationship with Neuroticism and o-BIS is much less; however r-Fight still has a positive relationship with Neuroticism. In support of the argument that r-Fight likely overlaps with predatory aggression, r-Fight aligns itself positively with EPQ–Psychoticism ($r = 0.32$, $p < .01$) whereas this is not the case for r-Flight and r-Freezing. Altogether this adds reasonably strong but indirect initial evidence in support of r-FFFS and its primary scales. More direct evidence such as how r-FFFS and its primary scales relate to fear will be examined shortly but first it is necessary to examine r-BIS since it has been argued that the *lack* of a relationship between r-BIS and fear is as important to r-RST as a relationship between r-FFFS and fear.

The new scale of r-BIS has been designed to be substantially different from Neuroticism and Carver and White's o-BIS because it has been argued that r-BIS must not be related to fear whereas it should be related to anxiety. Smillie, Pickering, et al. (2006) argued r-BIS should be constructed to measure uncertainty, social comparisons and failure to achieve. From this perspective, it is therefore not surprising that r-BIS is strongly aligned with VandeWalle's (1997) measure of Proving Goal Orientation ($r = 0.68$, $p < .01$) and Avoidance Goal Orientation ($r = 0.50$, $p < .01$) which were designed to measure these kind of behaviors. As expected, r-BIS is only moderately correlated with Carver and White's o-BIS ($r = 0.25$, $p < .01$), EPQ Neuroticism ($r = 0.26$, $p < .01$) and NEO–Neuroticism ($r = .25$, $p < .01$). All this directly supports the argument that r-BIS measures anxiety given the new definition of anxiety suggested by Smillie, Pickering, et al. (2006) and indirectly suggests that r-BIS does not overly measure other constructs such as fear which are likely also measured in Neuroticism and o-BIS.

Moreover, r-BIS is very different to r-FFFS ($r = 0.15$, $p < .01$) and the three scales comprising r-FFFS (r-Fight, $r = 0.18$, $p < .01$; r-Flight, $r = 0.03$, ns; r-Freezing, $r = 0.05$, ns) which again indirectly suggests that r-BIS does not contain too many of the elements associated with fear. Interestingly, r-BIS has a positive correlation with r-BAS ($r = .27$, $p < .01$) which confirms the new status of

r-BIS as being a defensive approach system (i.e. approach with care) as opposed to an avoidance system.

Such indirect evidence concerning fear, r-FFFS and r-BIS can be supported by investigating the direct relationships between fear and the r-RST scales. Fear has a moderately high correlation with o-BIS ($r = 0.44$, $p < .01$; not shown in Table 2), with EPQ Neuroticism ($r = 0.55$, $p < .01$; not shown in Table 2), with NEO–IPIP Neuroticism ($r = 0.48$, $p < .01$; not shown in Table 2) and a lower, though still significant, correlation with r-BIS ($r = .35$, $p < .01$). A Steiger (1980) test indicates that the correlations between fear and o-BIS and between fear and r-BIS are just significantly different from each other ($z1 bar^* = 1.96$, $p = .05$). Fear is highly correlated with r-Flight, r-Freezing and r-FFFS ($r = 0.46$, $p < .01$, $r = 0.54$, $p < .01$, $r = 0.49$, $p < .01$, respectively) but not with r-Fight. However when sex is partialed from the correlation between fear and r-Fight, then it becomes significant ($r = 0.10$, $p < .05$) while little changing the correlations between fear and the other scales. All this indicates that fear is more strongly related to o-BIS than r-BIS and that fear is aligned with r-FFFS and all its primary scales (after the effect of sex is partialed for r-Fight).

The significant positive correlation between fear and r-Fight is quite weak so it was tested again in the second sample. Correlations between the r-RST scales and fear in the second sample tell a similar story to the correlations in the first. Fear (alpha = 0.74 in the second sample) has a high correlation with o-BIS ($r = 0.42$, $p < .01$) and a low correlation with r-BIS ($r = 0.15$, $p < .01$). A Steiger (1980) test shows that these two correlations are significantly different from each other ($z1 bar^* = 5.11$, $p < .001$). Fear also has high correlations with r-Flight, r-Freezing and r-FFFS ($r = .52$, $p < .01$, $r = 0.57$, $p < .01$, $r = 0.54$, $p < .01$, respectively) and again the correlation between fear and r-Fight is not significant. When sex is partialed, the correlation between fear and r-Fight becomes significant ($r = 0.11$, $p < .05$) and the correlations between fear and the other scales are little changed. It is interesting to note that the correlation between fear and r-BIS is much lower in the second sample than the first.

Also included in Table 2 is the measure of Anxiety which was developed as an alternative broad measure of BIS as opposed to the proposed specific measure of r-BIS. The relationship between Anxiety and the r-RST scales shows the need for the new definition of r-BIS since it is strongly related to r-FFFS and its underlying scales. In short, unless the definition of r-BIS is narrowed from a broad interpretation of Anxiety, it is not possible to separate r-BIS from r-FFFS.

Such a perspective is confirmed by examining the correlation between o-BIS with items 2 and 22 removed such that it does not contain specific fear items. The correlations of this scale (alpha = .77) with r-FFFS scales are generally positive and significant (r-Fight: $r = −0.01$, ns; r-Flight: $r = 0.16$, $p < 0.01$; r-Freezing: $r = 0.32$, $p < .01$; r-FFFS: $r = 0.24$, $p < .01$). These correlations are little different from the correlations between o-BIS and the r-FFFS scales reported in Table 2 and are substantially higher than the correlations between r-BIS and the r-FFFS scales reported in Table 2. In short, removing the specific fear items from o-BIS does not produce a satisfactory r-BIS scale. This is perhaps not surprising given that o-BIS with fear items removed still correlates highly with o-BIS ($r = 0.92$, $p < .01$) which suggests that little is gained from this procedure.

The second half of the sample was then used to cross-validate the proposed solution. I used structural equation modeling (SEM) using Goodness of Fit Index (GFI), the Adjusted Goodness of Fit Index, the Bentler Comparative Fit Index (CFI) and the Root Means Square Error of Approximation (RMSEA). CFI is interpreted in similar ways to the GFI and AGFI with values >0.90 indicating good fit whereas good fit of RMSEA is indicated by a value <.05. Chi-square is reported but is not interpreted as large data sets generally

produce a significant chi-square even if the discrepancy of the observed data from the implied data is trivial.

Various SEMs are used to develop the model. First, the goodness of fit of each of the congeneric models was assessed. All five congeneric models (r-BAS, r-BIS, r-Fight, r-Flight and r-Freezing) had strong goodness of fit (r-BAS:, $X^2(8) = 13.67$, $p = .09$, GFI = .98, AGFI = .95, CFI = .96, RMSEA = .04; r-BIS:, $X^2(7) = 24.00$, $p = .001$, GFI = .98, AGFI = .94, CFI = .90, RMSEA = .07; r-Fight:, $X^2(8) = 23.22$, $p = .003$, GFI = .99, AGFI = .96, CFI = .92, RMSEA = .06; r-Flight:, $X^2(8) = 5.33$, $p = .72$, GFI = .99, AGFI = .99, CFI = 1.00, RMSEA = .000; r-Freezing:, $X^2(9) = 13.88$, $p = .13$, GFI = .99, AGFI = .98, CFI = .95, RMSEA = .03). A congeneric model of r-FFFS and its associated 18 items was rejected due to poor goodness of fit.

SEM 1 represents an initial straightforward structural model in which all congeneric models of r-BAS, r-BIS and r-FFFS were included and latent variables were allowed to covary. This model was rejected due to poor goodness of fit ($X^2(401) = 1640$, $p < .001$, GFI = .74, AGFI = .69, CFI = .57, RMSEA = .08).

SEM 2 includes congeneric models of r-BAS, r-BIS, r-Fight, r-Flight and r-Freezing. Latent variables were allowed to covary. This provides a reasonable goodness of fit ($X^2(390) = 772$, $p < .001$, GFI = .90, AGFI = .89, CFI = .82, RMSEA = .05), but provides an incomplete representation of r-RST due the exclusion of r-FFFS.

SEM 3 provides a complete representation of r-RST. It develops SEM 2 by adding a higher order factorial structure (r-FFFS) between r-Fight, r-Flight, r-Freezing. Latent variables of r-BAS, r-BIS and r-FFFS were allowed to covary. The higher factorial structure is 'just-identified' unless a constraint is placed on at least one parameter in the upper level of the model. In line with Byrne (2001), who faced exactly the same problem but with a different questionnaire, equality constraints were placed on the residual variances of r-Fight, r-Flight and r-Freezing. Although goodness of fit was a little poor ($X^2(396) = 857$, $p < .001$, GFI = .89, AGFI = .87, CFI = .84, RMSEA = .05), a particular further problem was a non-significant standardized lambda between r-Fight and r-FFFS. This is contrary to a strict interpretation of r–RST which argues that r-Fight, r-Flight and r-Freezing should each have a positive relationship with r-FFFS due to a common basis in fear.

SEM 4 is shown in Fig. 1 and is the same as SEM 3 except that it includes sex (which is a measured variable in which females are coded 1 and males 0) as a further independent predictor of r-Fight. Sex was included in the model as sex differences in r-Fight were identified in the earlier exploratory analysis and sex has already been shown to have important effects on the relationships between r-Fight and other scales. Sex was allowed to covary with r-FFFS (the same use of sex but in a different context is demonstrated by Tabachnick & Fidell, 2007). Once the effects of sex are included, r-Fight now has a significant and positive relationship with r-FFFS, all paths are significant and positive, and reasonable goodness of fit is obtained ($X^2(407) = 706$, $p < .001$, GFI = .93, AGFI = .90, CFI = .91, RMSEA = .04). Standardized lambdas of the structural model of SEM 4 are shown in Fig. 1. Adding sex effects to r-Flight and r-Freezing, even though also identified in exploratory analysis, did not improve the fit of the model and are therefore not included.

An alternative model to SEM 4 produced almost exactly the same fit indices. This model is the same as Fig. 1 except r-Flight and r-Freezing are primary scales of r-FFFS and r-Fight is seen as
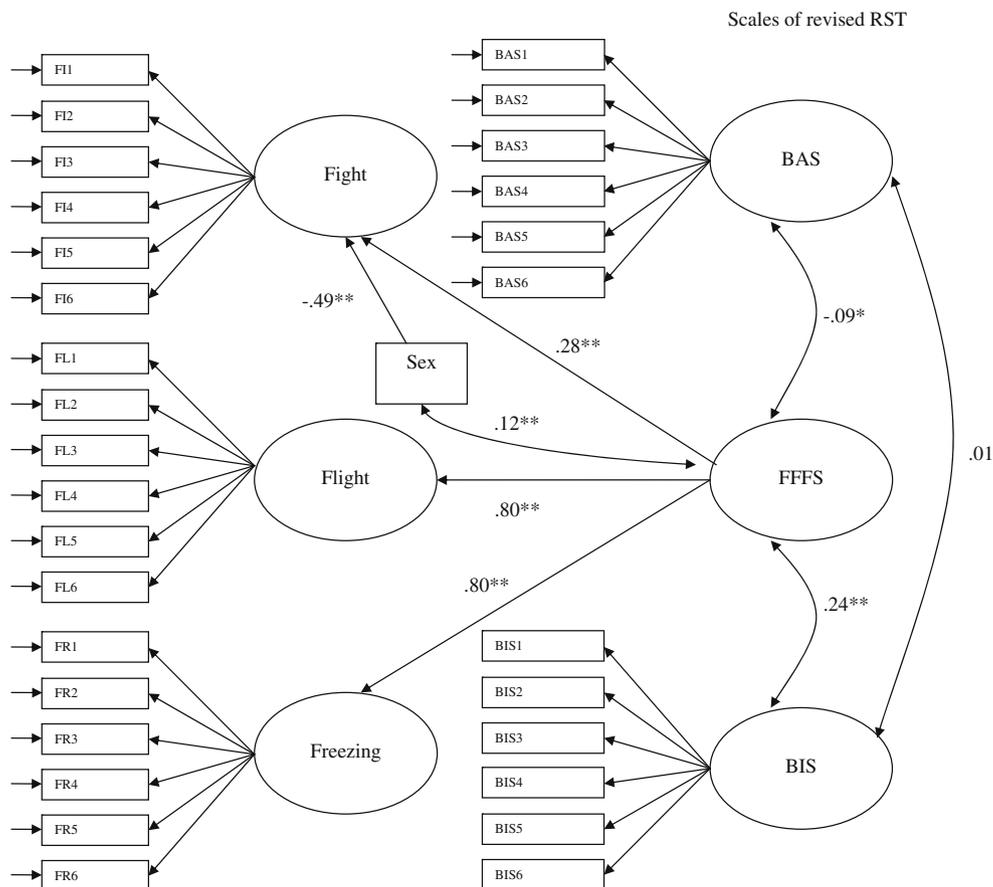
Scales of revised RST

Fig. 1. Structural model of the Jackson-5: scales of r-RST (sample 2, $n = 486$).

a fourth higher order scale. Although this model of r-RST takes into account the possibility that r-Fight is different to r-Flight and r-Freezing (as noted in the Introduction) it is ultimately a poor representation of r-RST since r-Fight should be associated with r-FFFS. It was therefore rejected.

In summary, results suggest that the proposed scales have more than adequate measurement properties and generally represent the latest theoretical requirements as specified by Smillie, Pickering, et al. (2006). Evidence in favor of all hypotheses was found and this provides good initial evidence in favor of the Jackson-5 scales of r-RST. The weakest parts of the proposed model are that r-Fight seems quite dissimilar to r-Flight and r-Freezing when a strict interpretation of r-RST suggests that they should be quite highly related and that r-BIS has a small relationship with fear when it should only be related to anxiety.

4. Study 2

The aim of Study 2 is to compare the new scales of r-RST against Carver and White (1994) scales of o-RST in their prediction of appetitive dysfunctional behavior consisting of delinquency (workplace deviance, self-reported delinquency and sexual proclivity) and psychopathy in the community. In general, trait clusters associated with a dominant o-BAS and weak o-BIS are widely theorized to underlie psychopathy and delinquent behaviors such as alcohol and drug use (e.g. Fowles, 2001; Gray, 1991, 1994; Lykken, 1995). Primary psychopathy is thought to result from low BIS and normal BAS whereas secondary (or neurotic) psychopathy results from high BAS and normal BIS. Even when a r-RST perspective is taken (e.g. Wallace & Newman, 2008), high r-BAS and to some extent low r-BIS are still implicated as the underlying personality cause for psychopathy with no major role for r-FFFS and its primary scales. This is unsurprising given the limited research on r-FFFS. However a central component of psychopathy is fearlessness (e.g. Lykken, 1995) so r-Fight, r-Freezing and r-Flight seem likely to be predictive of psychopathic behavior since the r-FFFS responds to fear. An interesting point here is that psychopaths seem likely to show low fear in terms of r-Flight and r-Freezing whereas they seem likely to also have a propensity to fight back (and therefore show high fear to the extent that high fear is related to r-Fight).

Kimbrel, Nelson-Gray, and Mitchell (2007) used o-RST to predict adult psychopathology. In their study, hierarchical regression analyses indicated high o-BAS and low o-BIS scores predicted drug abuse and psychopathy and higher o-BAS and lower o-BIS predicted alcohol abuse. Johnson, Turner, and Iwata (2003) and Loxton and Dawe (2001) also reported that o-BAS predicted drug abuse and dependence. Knyazev, Wilson, and Slobodskaya (2008) make no mention of a role for r-FFFS in how r-RST predicts anti-social and prosocial outcomes. With respect to psychopathy, Newman and colleagues recently reported primary psychopathy was associated with low BIS and normal BAS, and secondary psychopathy was associated with high BAS and normal to high BIS among a sample of inmates (Newman, MacGoon, Vaughn, & Sadeh, 2005). In line with the literature it is expected that:

(H9) The scales of r-BAS and o-BAS will positively predict appetitive dysfunctional behavior.

However in line with the r-RST in which r-FFFS has a greater role and r-BIS has a reduced role in mediating response to punishment and that fear scales can be good predictors of behavior (Perkins et al., 2007), it is expected that:

(H10) The primary scales of r-FFFS will be predictive of appetitive dysfunctional behavior such that r-Flight and r-Freezing will negatively predict appetitive dysfunctional behavior and r-Fight will positively predict appetitive dysfunctional behavior.
(H11) The scale of o-BIS will predict appetitive dysfunctional behavior.

5. Method

5.1. Participants and procedure

A total of 190 students (average age = 18.89 yrs; SD = 4.21; 61% female; 29% male) in tertiary education completed questionnaires on a computer in a quiet room, while supervised by a research assistant.

5.2. Materials

The Jackson-5 r-RST scales – as Study 1.
Carver and White's (1994) BIS/BAS scales – as Study 1.
Fear Scale – as Study 1.

A selection of functional and dysfunctional behaviors were measured which were relevant to students who were also young part-time workers. Functional behaviors were self and supervisor ratings using:

Workplace deviance (Bennett & Robinson, 2000). This workplace deviance scale (example item: "In the past year have you played a mean prank on someone at work?") measures deviant behavior directed toward the organization and other employees. All the students completed this questionnaire in relation to their job.

Self reported delinquency (Furnham & Thompson, 1991). This delinquency scale consists of 50 items on theft, tax avoidance, cheating, drug use and violence. Items were responded to on a two point scale of Yes or No. A sample item is: "I have sold an illegal drug".

Sexual proclivity (Bailey, Kirk, Zhu, Dunne, & Martin, 2000). A 15 item scale of sexual proclivity scored on five response categories (1 = completely disagree, 2 = disagree, 3 = unsure, 4 = agree, 5 = completely agree). Example items are: "Sometimes sexual feelings overpower me", "The thought of an illicit sexual affair excites me", and "The thought of a sex orgy is disgusting to me (R)".

Overall delinquency was computed as the sum of workplace deviance, self-reported delinquency and sexual proclivity.

Psychopathy in non-criminal populations (PPI-short 56 item version; Lilienfeld & Andrews, 1996). The inventory yields a total score, interpretable as a global index of psychopathy. Benning, Patrick, Hicks, Blonigen, and Krueger (2003) identified a two factor structure underlying the PPI which reflect two factors commonly thought to underlie psychopathy. Factor 1 (Stress immunity, Social potency, and fearlessness) reflects psychopathic personality associated with low trait anxiousness, social dominance, and fearless risk taking. Factor 2 (Impulsive nonconformity, Blame externalization, Machiavellian egocentricity, and Carefree nonplanfulness) reflects social deviance and is associated with impulsiveness, unconventionality, aggression, and estrangement. In this study, results are summarized in terms of Overall psychopathy (as recommended by Lilienfeld & Andrews, 1996), Factor 1 (Psychopathic Personality) and Factor 2 (Social deviance) as recommended by Benning et al. (2003).

6. Results and discussion

Means, standard deviations, intercorrelations and alphas of the r-RST scales are shown in Table 4 and are much the same as Study 1. For comparison between r-RST and o-RST, Carver and White's (1994) scales of o-BAS and o-BIS are also presented. Key observations from

Table 4
Descriptive statistics and correlations among the Jackson-5: scales for measuring Revised Reinforcement Sensitivity Theory (r-RST) Study 2 (n = 190 supervisees and n = 70 supervisors).

				Jackson-5 r-RST						C&W (1994) o-RST			
	M	SD	Alpha	r-BAS	r-BIS	r-Fight	r-Flight	r-Freeze	r-FFFS	o-BAS Drive	o-BAS Fun	o-BAS Reward	o-BIS
r-BAS	23.72	3.53	0.80										
r-BIS	22.30	3.45	0.74	0.07									
r-Fight	17.15	4.37	0.74	0.01	0.15*								
r-Flight	16.92	3.94	0.69	−0.13	0.28**	−0.07							
r-Freezing	18.69	3.87	0.70	−0.22**	0.29**	0.00	0.38**						
r-FFFS	50.20	7.13	0.70	−0.16*	0.36**	0.56**	0.67**	0.66**					
Fear	19.24	4.69	0.71	−0.31**	0.32**	0.11	0.45**	0.53**	0.55**	−0.01	−0.12	−0.00	0.52**
o-BAS drive	8.08	2.69	0.81	0.41**	0.21**	0.23**	0.18*	0.04	0.25**				
o-BAS fun seeking	9.28	2.52	0.74	0.49**	−0.01	0.20**	−0.17*	−0.05	0.01	0.50**			
o-BAS reward	13.61	2.48	0.78	0.25**	0.31**	0.04	0.15*	0.05	0.15*	0.48**	0.57**		
o-BIS	14.51	3.87	0.75	−0.19**	0.24**	−0.15*	0.35**	0.47**	0.31**	0.07	0.13*	0.43**	
Delinquency													
Work deviance	31.39	13.27	0.87	0.09	0.14*	0.39**	−0.13	0.03	0.17*	0.12	0.22**	0.06	−0.12
Self-reported delinquency	59.41	8.55	0.84	0.17*	0.03	0.44**	−0.31**	−0.11	0.05	0.10	0.34**	−0.03	−0.21**
Sexual proclivity	41.90	9.98	0.84	0.15*	0.05	0.25**	−0.31**	−0.05	−0.05	0.12	0.32**	−0.03	−0.26**
Overall delinquency	132.89	25.77	0.79	0.15*	0.10	0.45**	−0.29**	−0.05	0.09	0.14	0.35**	0.00	−.23**
Psychopathy													
Overall psychopathy	138.20	13.50	0.73	0.39**	−0.07	0.29**	−0.25**	−0.24**	−0.07	0.23**	0.32**	0.07	−0.46**
Factor 1	54.64	9.30	0.70	0.41**	−.19**	0.00	−0.40**	−0.48**	−0.42**	0.13	0.29**	0.08	−0.54**
Factor 2	71.24	9.63	0.76	0.16*	0.11	0.35**	0.05	0.17*	0.30**	0.20**	0.21**	0.05	−0.06

** p < .01 level.
* p < .05 level.

Table 4 are as follows. In the prediction of Overall Delinquency, r-BAS (r = .15, p < .05), r-Fight (r = .45, p < .01) and r-Flight (r = −.29, p < .01) are significant. In the prediction of Overall Psychopathy, r-BAS (r = .39, p < .01), r-Fight (r = .29, p < .01), r-Flight (r = −.25, p < .01) and r-Freezing (r = −.24, p < .01) are significant. On the other hand, o-BAS Fun Seeking (r = .35, p < .001), and low o-BIS (r = −.23, p < .−001) are predictive of Overall Delinquency, and o-BAS Fun Seeking (r = .32, p < .001), -BAS Drive (r = .23, p < .001) and low o-BIS (r = −.46, p < .−001) are predictive of Overall Psychopathy.

Using regression with r-RST scales as independent variables in the prediction of Overall delinquency, significant scales are r-Fight and r-Flight (B = .42, t = 6.50, p < .001; B = −.31, t = −4.38, p < .001, respectively; R^2 = .30). In the prediction of Overall delinquency from o-RST, o-BAS Fun seeking and o-BIS are significant (B = .38, t = 4.48, p < .001; B = −.17, t = −2.38, p = .019, respectively; R^2 = .17).

In the prediction of Overall Psychopathy by regression using r-RST, significant scales are r-BAS and r-Fight (B = .36, t = 5.59, p < .001; B = .29, t = 4.60, p < .001, respectively) and r-Flight approaches significance (B = −.13, t = −1.85, p = .066; R^2 = .29); when using o-RST, significant scales are o-BAS Fun seeking and o-BIS (B = .23, t = 3.22, p = .001; B = −.44, t = −6.91, p < .001, respectively; R^2 = .31).

In the prediction of these dysfunctional appetitive behaviors three conclusions can be drawn. First, delinquency can mainly be understood in terms of r-Fight and low r-Freezing. The lack of a relationship between delinquency and r-BAS provides support for r-BAS as being more functional and goal directed in nature. Psychopathy however can be explained in terms of r-BAS and r-FFFS. Potentially, the r-BAS is activated in psychopaths through the need to be socially powerful and being prepared to take risks in return for potential rewards. Second, in o-RST the scales o-BIS and o-BAS are significant in the prediction of Overall psychopathy and delinquency whereas r-FFFS scales and sometimes r-BAS are predictive. Again this leads to very different explanations of the personality basis of these behaviors depending upon use of r-RST or o-RST. For example, scales based on o-RST support the high BAS and low BIS theory of psychopathy (e.g. Fowles, 2001; Gray,

1991, 1994; Lykken, 1995) whereas scales based on r-RST do not. Third, r-RST is a better overall predictor of delinquency than o-RST and almost the same as o-RST in the prediction of psychopathy.

All the psychopathy primary scales of the PPI are predicted by at least one of the r-RST scales or at least one of the o-RST scales.[3] Overall, in the prediction of the primary scales of psychopathy, r-BAS, r-Fight, r-Flight and r-Freezing have a large predictive role in r-RST, and o-BAS Fun seeking and o-BIS have a large predictive role in o-RST. These relationships can be summarized by looking at the correlations between r-RST, o-RST and Factor 1 (Psychopathic personality) and Factor 2 (Social deviance) of Psychopathy. In the prediction of Factor 1 (Psychopathic personality), r-BAS (r = .41, p < .01), r-Flight (r = −.40, p < .01), r-Freezing (r = −.48, p < .01) and r-FFFS (r = −.42, p < .01) are significant and much less significant is r-BIS (r = −.19, p < .01) which contrasts with generally significant correlations with o-BAS Fun seeking (r = .29, p < .01) and o-BIS (r = −.54, p < .01). In the prediction of Factor 2 (Social deviance), the most predictive scales are r-Fight (r = .35, p < .01) and r-FFFS (r = .30, p < .01) whereas r-BAS (r = .16, p < .05) and r-Flight (r = .17, p < .05) are much less significant. Contrast this with the prediction of Factor 2 from o-RST scales in which o-BAS Drive (r = .20, p < .01) and o-BAS Fun seeking (r = .21, p < .01) are significant.

Using multiple regression, in the prediction of Factor 1 (Psychopathic personality) , r-BAS, r-Flight and r-Freezing are significant (B = .316, t = 5.25, p < .001; B = −.230, t = 3.57, p < .001; B = −.311, t = −.477, p < .001, respectively; R^2 = .38) which can be contrasted with significant effects from o-BAS Fun seeking and o-BIS (B = .199, t = 2.846, p = .005; B = −.547, t = −8.865, p = .000, respectively; R^2 = .36).

Again in regression, Factor 2 (Social deviance) is predicted by r-BAS, r-Fight and r-Freezing (B = .211, t = 3.07, p = .002; B = .36, t = 5.29, p < .001; B = .21, t = 2.83, p = .005, respectively; R^2 = .19) which can be contrasted with o-BAS Fun seeking as the only significant predictor from o-RST (B = .17, t = 2.04, p = .04; R^2 = .06).

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[3] Correlations between r-RST, o-RST and the primary scales of Psychopathy are available upon request.

It was noted in the introduction to this study that there is an apparent contradiction concerning the r-FFFS primary scales in the prediction of psychopathy since it was argued that people high in psychopathy would be likely to be low in r-Flight and r-Freezing whereas they would be high in r-Fight which suggests that both *low fear* and *high fear* is a component of psychopathy (at least to the small extent that high fear is associated with high r-Fight). Examination of the factors of psychopathy provides some resolution to this contradiction since low r-Flight and low r-Freezing are stronger predictors of Factor 1 (Psychopathic personality) compared to r-Fight; whereas high r-Fight is a stronger predictor of Factor 2 (Social deviance) compared to r-Flight and r-Freezing. The likely split therefore in the way r-FFFS primary scales work is reflected in the two scales of psychopathy and interestingly shows how r-Fight or the tendency to want to Fight back is implicated in Social deviance.

In summary, in the prediction of the two factors of psychopathy, r-BAS and some primary scales of r-FFFS are significant whereas o-BAS scales are predictive of Factor 1 and 2 and o-BIS is predictive of just Factor 1. In general r-RST explains as much as or more variance than o-RST in the prediction of the two factors underlying psychopathy. Again, results from o-RST tend to support the high BAS, low BIS theories of psychopathy (e.g. Fowles, 2001; Gray, 1991, 1994; Lykken, 1995) whereas results from r-RST highlight little support for them.

It was also decided to use the Study 2 data to examine the correlation between fear and r-Fight reported in the two large samples used in Study 1. In Study 2, fear has a high correlation with o-BIS ($r = .52$, $p < .01$) and a lower correlation with r-BIS ($r = .32$, $p < .01$). A Steiger (1980) test of the difference between these correlations shows that they are significantly different ($z1$ bar* = -2.60, $p < .01$). Fear also has high correlations with r-Flight, r-Freezing and r-FFFS ($r = .45$, $p < .01$, $r = .53$, $p < .01$, $r = .55$, $p < .01$, respectively) which confirms their high overlap in terms of content. However, as in Study 1, fear has a positive but non-significant relationship with r-Fight. When the effects of sex are partialed, the correlation between fear and r-Fight increases ($r = .12$, $p = .098$) and when o-BAS Fun Seeking is further partialed, then the correlation between fear and r-Fight is significant ($r = .15$, $p < .05$) while having little effect on the other correlations. It is not unreasonable to partial the effects of o-BAS Fun Seeking as well as sex, since low fear might be expected to overlap with impulsive fun seeking. The partialing of o-BAS Fun Seeking was necessary in Study 2 but was not required in either of the samples used in Study 1. This result confirms that it is possible to positively associate r-Fight with fear such that it might be seen as part of the r-FFFS but the effect remains quite weak.

Overall, hypotheses from Study 2 were reasonably supported such that very different conclusions are drawn between the personality basis of behavior from the perspective of r-RST compared with o-RST. In particular, there is a change of emphasis away from o-BIS to primary scales of r-FFFS. Moreover in terms of R^2, r-RST is at least very nearly as predictive and is generally more predictive of dysfunctional appetitive behaviors than o-RST.

7. General discussion

Smillie, Pickering, et al. (2006) make a vital contribution to the literature by arguing that existing measures of o-BIS are flawed through their inclusion of fear within the construct of o-BIS. Based on the work of White and Depue (1999), Smillie, Jackson, et al. (2006) provide a new representation of r-BIS which is quite radically different from existing measures of o-BIS. Drawing on this definition, the proposed new measure of r-BIS was designed to measure anxiety as social conflicts encompassing defensive approach, social comparison and failure of effort and was designed to avoid fear related constructs. Given the item content, it is not surprising that the r-BIS scale was shown to be highly similar to VandeWalle's (1997) scales of goal avoidance thereby providing strong support that r-BIS achieved desired item content in terms of the new representation of r-BIS provided by Smillie, Pickering, et al. (2006). As a result, it has proved possible to extract r-FFFS as the required third factor in r-RST. This success contrasts with previous research which has failed to extract a third factor within o-RST (e.g. Jackson, 2003; Wilson et al., 1990). The new higher order scale of r-FFFS and its primary scales of r-Fight, r-Freezing and r-Flight are not only now different from r-BIS but also predictive of dysfunctional behaviors as shown in Study 2.

Results of Study 2 indicate just how differently r-RST and o-RST provide personality based explanations of behavior. In o-RST, o-BAS and o-BIS are significant predictors of Overall Psychopathy whereas in r-RST, r-BAS, r-Fight, and r-Flight are significant and r-BIS is not significant. And similarly for Overall delinquency, r-Fight and r-Flight are predictors whereas o-BAS and o-BIS are predictors. The most important differences, and ones which are very much in line with the predictions of r-RST, are that r-BIS becomes much less important and the primary scales of r-FFFS much more important. The results certainly question Fowles–Gray–Lykken theory of psychopathy (Fowles, 2001; Gray, 1991; Lykken, 1995) which predicts that primary psychopathy results from low BIS and normal BAS and that secondary psychopathy results from high BAS and normal BIS. Although it is important not to over-interpret this finding until the model is tested on psychopaths and anti-social people at the clinical end of the scale, this is an important finding because it has implications regarding the understanding of appetitive dysfunctional behavior and the design of therapy and training interventions.

Evidence from Study 1 indicates r-Flight and r-Freezing have the strongest intercorrelation among all the proposed scales of r-RST and that both scales are more strongly correlated with fear than r-Fight. It was argued that r-Flight and r-Freezing are likely to be correlated with each other since they are both responses to distal punishing stimuli. Of the primary scales of r-FFFS, the scale of r-Fight was shown to be the most different of the r-FFFS primary scales. This is not surprising since r-Fight represents a *proximal* fear response to a very threatening stimulus. Differences therefore between r-Fight and the other two scales of r-FFFS could therefore be expected and suggest that r-Fight is likely to be a problematical primary scale of r-FFFS. The results of this study highlight exactly this finding.

Moreover, r-Fight only *positively* relates to fear and its higher order factor of r-FFFS if the effects of sex are partialed.[4] The need to partial the effects of sex is not unreasonable since research suggests that females have a tendency to be affiliative, whereas males have a tendency to be aggressive when they are stressed (e.g. Rose & Rudolph, 2006). Nevertheless a stronger positive correlation between r-Fight and fear might have been expected given that r-Fight is meant to be a response to a *proximal fear inducing stimulus*. There is however reason to think that the results of this study are not flawed in this respect but represent the possibility that r-Fight is potentially very difficult to measure separately to predatory aggression.

In discussion, it seems that few respondents seem to have any experience or knowledge of the vociferous fight response which happens when an animal is cornered and its life

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[4] In Study 2, it was necessary to further partial BAS-Fun Seeking as well.

threatened or even how defensive aggression is different to predatory aggression. This is perhaps not surprising given that the relationship between defensive and predatory aggression may be stronger in humans than other animals. Defensive aggression in a cornered rat, for example, might be understandable simply in terms of a fear induced desperate fight to avoid death at that point in time. Defensive aggression in humans however must also be understood in terms of concepts such as honor, revenge, training to control fear, and the principally male tradition of not expressing fear. All this probably means that some humans might easily disassociate defensive aggression from fear or even confuse defensive aggression with predatory aggression. Good examples can be found in many films (such as 'Shooter') in which the victim of violence at first 'fights back' but then becomes predatory and takes the fight to the perpetrator. In the complexity of human behavior in which events at one point of time influence events in another point of time, it is not clear if defensive aggression can easily be separated from predatory aggression.

A further point is that the victim of violence in such films often engages in vociferous defensive aggression for the purpose of self-preservation but there is a noticeable absence of fear even when life is threatened. People who wish to emulate the behavior of such characters in films may easily disassociate fight back from fear when completing questionnaires.

From all of these perspectives, as well as the arguments advanced in the Introduction, it seems likely that defensive aggression will be very hard to separate from predatory aggression. It remains to be seen if further item development can improve the relationship between r-Fight and the other two scales of r-FFFS.

It has been shown that fear has a significantly smaller relationship with r-BIS than o-BIS. These findings are generally supportive of r-RST. Yet some relationship between fear and r-BIS remains as the correlation between fear and r-BIS is significant in both samples of Study 1 and in Study 2. At present it is simply unknown if the relationship between fear and r-BIS can be reduced further. In my view, a small correlation between fear and r-BIS will be difficult to avoid as many situations will produce anxiety directly in response to fear inducing stimuli. An example anxiety cognition that might follow successful fight back from a fear inducing stimulus is: "Will I go to jail for injuring my attacker?" From this perspective, a correlation between fear and Anxiety may be unavoidable. Gray and McNaughton (2000) may agree because they trace fear and anxiety to separate but interacting brain systems.

The new scale of r-BAS was shown to be mainly related to Extraversion and Functional Impulsivity and less so to Dysfunctional Impulsivity as argued to be appropriate by Smillie, Pickering, et al. (2006). The finding of only a very small relationship with Delinquency further supports the functional nature of the r-BAS scale. The scale of r-BAS was however predictive of psychopathy but this may not be surprising given the approach orientation of psychopaths. In my view, this produces reasonably strong evidence in favor of the proposed construct.

More generally, this research suggests several new perspectives concerning r-BIS. First, r-BIS is meant to reflect a *biologically* based mechanism (Gray & McNaughton, 2000) which contrasts with VandeWalle's (1997) *social–cognitive* construct of goal avoidance. Is the high social–cognitive content of r-BIS in the proposed scale a problem? My view is that r-BIS is associated with social conflict resolution which, for higher order organisms such as humans, must involve a reasonable amount of cognitive evaluation given the complexity of stimuli which must be evaluated.

Second, r-BIS has a small *positive* relationship with r-BAS. This is desirable and unsurprising since r-BIS is now characterized as a defensive approach system and therefore likely to have a positive relationship with r-BAS. This small positive correlation contrasts with the more usual negative correlations between measures of approach and avoidance (e.g. see Jackson & Smillie, 2004).

Third, much has been made of a dual pathway of approach and avoidance in which o-BIS has been seen as a central component of the avoidance system (e.g. Elliot & Thrash, 2002; Gable et al., 2003; Smillie, 2008). If r-FFFS and its primary scales are now seen as responses to punishment and r-BIS is oriented towards defensive approach, there is a need to reconceptualize thinking about the construction of the avoidance pathway through personality. In particular, r-BIS may not be a central component of the avoidance system and this role may now be played by r-FFFS and its primary scales.

Fourth, the new definition of r-BIS might not only indicate problems with existing measures of o-BIS but also indicate problems with the higher bandwidth scale of Neuroticism. Neuroticism, like o-BIS, is also likely to confound anxiety with fear. From the perspective of r-RST, Neuroticism looks like a collection of a broad mix of correlated constructs but which, following the arguments produced in this paper, have very different origins.

Fifth, the new definition of r-BIS has led to fewer directly significant effects compared to o-BIS. In Study 2, r-BIS is a generally non-significant in the prediction of delinquency and psychopathy. In contrast, o-BIS is generally a significant negative predictor of delinquency and psychopathy. My view is that the reduced usefulness of r-BIS provides support for r-RST since r-RST argues that less emphasis should be placed on r-BIS (Smillie, Pickering, et al., 2006).

The results of this research need to be interpreted in the light of several limitations. First, both Study 1 and Study 2 utilized participants in tertiary education and it seems possible that results will not generalize to a broader population or to a clinical population. Second, it should be noted that while r-RST has its advocates (Corr, 2002a, 2004; McNaughton & Corr, 2004; Smillie, Jackson, et al., 2006), the case for r-RST and definition of scales within r-RST is far from proven (Corr, 2004; Smillie, Pickering, et al., 2006). It needs to be emphasized that not all researchers would be happy with the orientation of r-BAS towards Extraversion and not all researchers would be happy to reorient the definition of r-BIS towards goal avoidance and proving. For example, both Elliot and Thrash (2002) and Furnham and Jackson (2008) argue that o-BIS and goal avoidance and proving are separate constructs. Third, not all researchers are even that happy with the idea that r-RST is central to approach and avoidance theories of personality (e.g. Jackson, 2005, 2008a; O'Connor & Jackson, 2008 who argue that Sensation Seeking provides the biological basis of functional approach and Jackson, 2008b, who provides evidence that high avoidance can predict high approach). Fourth, untested in the current research is the possibility that the output of these systems will statistically interact together in various ways as suggested by Corr's joint sub-systems hypothesis (Corr, 2002a,b, 2004).

In summary, this research generally supports the argument that r-BAS and r-BIS should be independent of the r-FFFS trait cluster due to their anatomical and functional independence (McNaughton & Gray, 2002). EFA and CFA results from Study 1 provide general support for r-RST although some limitations of the proposed model have been highlighted. Evidence from Study 2 suggests that r-RST may provide new understandings of behavior compared to o-RST.

Appendix A

The item pool used to generate the r-RST items

Appetitive motivation
I believe that rules are stifling
I put plans into action
I like to be busy
I like to see how things work
Generally, I choose which rules to follow
I like to do things which are new and different.
I like to do things spontaneously.
I like to do things my way.
I tend to do several things all at the same time
It is important to enjoy the present moment
I actively look for new experiences
I have a feel for how things work
I look for new sensations.
I am excited by what is new in my field.
I often have lots of spontaneous ideas
I prefer not to plan things too much
I like to be rewarded for what I do
The here and now is what is important
I have new ideas all the time
I enjoy starting projects.

Anxiety and defensive approach
I aim to do better than my peers
I set my goals higher than my peers
I aim to work harder than my peers
Outperforming my peers motivates me
I prefer to work on projects where I can prove my ability to others
I want to do well compared to my peers
I like my peers to know I am doing well
I worry about doing badly
Low performance motivates me
I want to avoid looking bad
I avoid work that makes me look bad

Defensive fight
If someone stares at me, I react violently.
I would fight back if someone hit me first.
When provoked, I easily get into a fight.
I use harsh language when people play tricks on me.
When people order me about, I never submit.
When scolded by a person in authority, I fiercely argue my case
When people try to control me, I confront them.
If a fierce dog threatened me, I would hit it
If a burglar broke into my house, I would immediately look for a weapon.
If I am about to be hit by a passing vehicle, I generally curse the driver.
If I caught somebody stealing my belongings, I would attack.
I would ignore a stranger staring at me.
When people insult me, I usually hit them.
If I think somebody is going to hit me, I hit them first.
When I was a child, I used to be involved in physical fights.
I regularly yell at people.
When someone jumps the queue at the post office, I just let it pass.
If somebody does something bad to me, I retaliate
I always get revenge

Freezing
If there is a choice of products in a shop, I find it hard to decide what to buy

Appendix A. (continued)

If I got scared in my bed at night, I would remain motionless
I don't know what to say if a stranger is rude to me in the street
If somebody were about to hit me, I would freeze
If my boss told me to do two contradictory things, I would not know what to do.
If something very bad was just about to happen to me, I would just stop.
In a crowd, my mind freezes and then I never know what to say.
Sometimes I just freeze in difficult situations
Sometimes I just can't think clearly when confronted with a difficult problem
When I get scared, my mind stops working

Flight
If I am introduced to a new group of people, I try to leave as soon as possible
When I feel socially uncomfortable in a group, I leave.
If approached by a suspicious stranger, I run away.
I am likely to run if harassed by a stranger in an unfamiliar place.
If a dog barks at me, I would run away.
If the fire alarm rings, I immediately rush out of the building.
I always manage to maintain my composure during emergency situations.
If a fight starts, I leave the area as fast as possible.
I can't help but feel terrified if I see a dangerous animal.
I look for the fire exit when I go to a new building.
I never flee from danger
I used to hide behind a chair as a child when I watched a frightening TV show

Appendix B

The Jackson-5: scales for measuring Revised Reinforcement Sensitivity Theory (r-RST).

r-BAS
1. I like to do things which are new and different.	BAS1
2. I like to do things spontaneously.	BAS2
3. I actively look for new experiences	BAS3
4. I have a feel for how things work	BAS4
5. I look for new sensations.	BAS5
6. I am excited by what is new in my field.	BAS6

r-BIS
1. I aim to do better than my peers	BIS1
2. I want to do well compared to my peers	BIS2
3. I like my peers to know I am doing well	BIS3
4. I prefer to work on projects where I can prove my ability to others	BIS4
5. I want to avoid looking bad	BIS5
6. I avoid work that makes me look bad	BIS6

r-Fight
1. I would fight back if someone hit me first.	FI1
2. When provoked, I easily get into a fight.	FI2
3. If a burglar broke into my house, I would immediately look for a weapon.	FI3
4. If I caught somebody stealing my belongings, I would attack.	FI4
5. If I think somebody is going to hit me, I hit them first.	FI5
6. If somebody does something bad to me, I would retaliate	FI6

Appendix B. (*continued*)

r-Flight	
1. If approached by a suspicious stranger, I run away.	FL1
2. I am likely to run if harassed by a stranger in an unfamiliar place.	FL2
3. If a dog barks at me, I would run away.	FL3
4. If the fire alarm rings, I immediately rush out of the building.	FL4
5. I can't help but feel terrified if I see a dangerous animal.	FL5
6. I used to hide behind a chair as a child when I watched a frightening TV show	FL6
r-Freezing	
1. If something very bad was just about to happen to me, I would just stop.	FR1
2. If I got scared in my bed at night, I would remain motionless	FR2
3. I don't know what to say if a stranger is rude to me in the street	FR3
4. If my boss told me to do two contradictory things, I would not know what to do.	FR4
5. If there is a choice of products in a shop, I find it hard to decide what to buy	FR5
6. In a crowd, my mind freezes and then I never know what to say.	FR6

Scoring: 1 = completely disagree; 2 = disagree; 3 = undecided; 4 = agree; 5 = completely agree.

No reverse scoring on any items.

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