Similarities and differences in Revised Reinforcement Sensitivities Across Eating Disorder

Subtypes

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Abstract

Reinforcement Sensitivity Theory has been used to investigate personality in the development and maintenance of disordered eating. However, the vast majority of research from this perspective has been limited by the use of measures developed to assess the original theory, rather than the significantly revised theory, potentially overlooking key personality differences in eating disorder subtypes. The current study aimed to overcome limitations when using measures based on the original theory by investigating differences and similarities in reinforcement sensitivity across eating disorder subtypes and healthy controls. The measure based on the revised theory assesses i) reward sensitivity [goal-drive persistence; reward interest, reward responsiveness], ii) impulsivity, iii) behavioural inhibition, and iv) threat sensitivity. A total of 374 women from the community participated, including those with a past or present AN-R diagnosis (AN-R = 109); those with a past or present binge-type ED (Binge-type = 132); and healthy controls (HC = 133). Participants completed a questionnaire assessing personality, eating disorder symptoms, and past or present eating disorder diagnoses. Results showed that both the AN-R and Binge-type groups were higher in behavioural inhibition and threat sensitivity compared to the HC group. The Binge-type group showed higher impulsivity relative to the AN-R and HC group, and lower Goal-Drive Persistence relative to the HC group. The AN-R group showed lower Reward Interest and Reward Responsiveness relative to the HC group. This study supports and extends previous research with the findings of heightened threat and anxiety sensitivity in those with diagnosed eating disorders. Additionally, among those with a past or present eating disorder, the findings implicate impulsivity in differentiating bingeing versus restricting subtypes.

44 *Keywords:*

45 Anorexia Nervosa; Binge Eating; Reward Sensitivity; Anxiety; Impulsivity; Personality

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1. Introduction

Reinforcement Sensitivity Theory (Gray & McNaughton, 2000) is a biologically-based theory of personality that has been found fruitful in understanding a range of psychopathologies, including disordered eating (Bijttebier et al., 2009). Broadly, the theory is based on individual differences in sensitivity of brain systems that respond to rewarding and punishing stimuli (but see Corr & McNaughton, 2012, for a clarification). The original theory (o-RST; Gray, 1982) proposed two motivational systems: the Behavioural Approach System (o-BAS), which was thought to be responsible for mediating approach responses to rewarding conditioned stimuli; and the Behavioural Inhibition System (o-BIS), which was thought to be responsible for mediating avoidance responses to negatively valenced (conditioned) stimuli. However, the theory has since undergone a major revision (r-RST; Gray & McNaughton, 2000). The revised theory posits three systems as responsible for mediating approach and avoid behaviour. The r-BAS remains largely unchanged, and mediates approach responses to all rewarding stimuli, is related to activated affect, and can be thought of as a ‘*desire*’ system (Krupić & Corr, 2017). Whilst Gray originally labelled o-BAS at the personality level as impulsivity, subsequent research has distinguished between reward sensitivity (purposeful goal-driven approach behaviour) and “rash” impulsivity (RI; the inability to inhibit or modify approach behaviour (see Dawe & Loxton, 2004). The biggest change to o-RST, however, was the partitioning of the o-BIS into the Fight/Flight/Freeze System (FFFS), and the r-BIS. The FFFS mediates (active) avoidant behaviour in response to signals of punishment and is considered a ‘*fear*’ or threat sensitivity system. The r-BIS is activated in response to the activation of both the r-BAS and the FFFS and results in increasing arousal and the resolution of conflict in situations presenting signals of both reward and punishment. The r-BIS is considered the ‘*anxiety*’ system, is activated by goal conflict, and can result in either avoidance behaviour (if the threat outweighs the reward) or cautious approach behaviour

(when the reward outweighs the threat).

Despite almost two decades passing since the revisions to RST, applied research has lagged behind the progression of the theory with measures of the o-RST commonly used rather than new measures designed to address i) the distinction between r-BAS and impulsivity, and ii) the distinction between r-BIS and FFFS. The few studies using measures of the revised theory have investigated disordered eating behaviours in non-clinical, typically university populations (e.g., Hennegan, Loxton, & Mattar, 2013; Wilson & O'Connor, 2017). As yet no study has investigated r-RST in samples primarily recruited from eating disorder populations with a past or current eating disorder diagnosis.

1.1 Measurement and Research in RST

RST research has commonly used self-report questionnaires, however, scales designed based on the original theory are still the most commonly used in contemporary applied research. Accordingly, studies that have used o-BIS measures do not distinguish between fear and anxiety, whereas o-BAS measures lack a distinction between reward sensitivity and rash impulsivity (e.g., Loxton, 2018). Although fear/anxiety and reward sensitivity/impulsivity constructs are closely related, they have different hypothesised neurological underpinnings and are proposed to have independent mechanisms through which they influence maladaptive eating behaviours (Dawe & Loxton, 2004; Loxton, 2018; Smillie, Jackson & Dalgleish, 2006 – for a summary of RST scales, see Corr, 2016). This suggests conclusions drawn with data utilising the o-RST scales may not be congruent with current theory (Krupić, Corr, Ručević, Križanić, & Gračanin, 2016). The use of measures designed to assess the revised theory may therefore further tease apart the roles of fear, anxiety, impulsivity, and reward sensitivity in disordered eating subtypes. A measure of the revised theory that may address this issue is the RST-Personality Questionnaire (RST-PQ; Corr & Cooper, 2016). The RST-PQ consists of a BIS scale, a FFFS scale, and multi-faceted

BAS subscales assessing Reward Interest, Goal-Drive Persistence, Reward Reactivity and Impulsivity. Based on stages in the pursuit of reward, the BAS subscales assess 1) the tendency to notice and seek rewarding situations or activities (Reward Interest), 2) to put in continued effort and persistence to attain the reward (Goal-Drive Persistence), 3) to respond positively to attained rewards (Reward Reactivity), and 4) to engage in risky or unplanned behaviours (Impulsivity). The RST-PQ provides a measure that allows for the differences in reward sensitivity and impulsivity be explored in applied research, as well as subscales designed to distinguish fear (FFFS) from anxiety (r-BIS). Research highlights the utility of the RST-PQ in understanding unique pathways between the refined subscales and psychopathology. For example, Stoeber and Corr, (2015, 2017) used the RST-PQ and found the revised subscales explained different pathways between perfectionism and future directed thinking. Specifically, the differences between reward sensitivity/impulsivity and fear/anxiety was crucial in understanding adaptive as compared to maladaptive psychological outcomes.

1.2 RST and Eating Disorder Subtypes

Studies using o-BIS measures consistently show elevated punishment sensitivity in clinical populations of Anorexia Nervosa – Restrictive subtype (AN-R), Anorexia Nervosa – Bulimia (AN-BP) and Bulimia Nervosa (BN; Claes, Robinson, Muehlenkamp, Vandereycken, & Bijttebier, 2010; Harrison, O'Brien, Lopez, & Treasure, 2010). Additionally, o-BIS measures correlate positively with self-report measures of eating disorder pathology (e.g., subscales of the Eating Disorders Inventory (EDI); Garner, Olmstead, & Polivy, 1983) in non-clinical samples (e.g., Loxton & Dawe, 2006). Whilst this paints a clear picture of elevated punishment sensitivity across eating disorder subtypes, the relative influence of r-BIS and FFFS on these results is yet to be established.

The association between o-BAS and different eating disorders has been more variable. Those who exhibit binge eating behaviours (i.e., AN-BP, BN, Binge Eating

Disorder; BED) report higher self-report o-BAS than healthy controls, whilst those with predominantly restrictive eating behaviour (i.e., AN-R), score lower than healthy controls (e.g., Harrison, Treasure, & Smillie, 2011). However, some studies show elevated o-BAS in participants with AN-R (e.g., Glashouwer, Bloot, Veenstra, Franken, & de Jong, 2014), or no difference compared to controls (e.g., Monteleone, Scognamiglio, Monteleone, Perillo, & Maj, 2014). Results comparing o-BAS across binge-type eating subtypes also have mixed findings, with some studies showing AN-BP and BN groups to be no different from controls (Matton, Goossens, Vervaet, & Braet, 2015) nor AN-R (e.g., Claes et al., 2010). The use of o-BAS measures (that do not differentiate reward sensitivity from impulsivity) may explain such conflicting results. For example, studies finding lower o-BAS measures in AN-R typically report lower scores on o-BAS subscales that load more heavily on a factor representing impulsivity rather than reward sensitivity (Beck, Smits, Claes, Vandereycken, & Bijttebier, 2009; Franken & Muris, 2006). Individuals with AN-R score lower than AN-BP on other measures of impulsivity, and higher than individuals with AN-BP on measures assessing the ability to inhibit impulsive responding (Claes, Nederkoorn, Vandereycken, Guerrieri, & Vertommen, 2006; Claes et al., 2010). Overall, this data suggests that AN-R are characterised by low impulsivity while binge-type subgroups are characterised by greater impulsivity. As typical measures of reward sensitivity either include items that assess impulsivity (e.g., the o-BAS Fun-seeking subscale; Carver & White, 1994) or items relating to appearance (e.g., "Do you spend a lot of time on obtaining a good image" in the Sensitivity to Reward scale; Torrubia, Ávila, Moltó, & Caseras, 2001), Glashouwer et al. (2014) have argued that earlier reward sensitivity findings may reflect differences in the importance of appearance rather than reward sensitivity per se, thereby leading to less clarity as to the role of reward sensitivity in eating subtypes.

Thus, the key aim of the current study is to investigate the role of r-RST in

differentiating eating disorder subtypes using a measure that reflects the revised theory (RST-PQ; Corr & Cooper, 2016), compared to a reference group of healthy controls (HC; women not displaying any evidence of eating pathology). Consistent with previous research it is expected that those with a current or past eating disorder characterised by binge-eating behaviours (i.e., AN-BP, BN, BED), will score higher on impulsivity than those characterised by restrictive behaviours (AN-R). Given the variable results in the literature with measures of o-BAS, hypotheses regarding the other BAS subscales draw on research using the RST-PQ to investigate social described perfectionism and future directed thinking (Stoeber & Corr, 2017). It is expected that the ED groups will score lower on the BAS subscales of Reward Interest, Goal-Drive Persistence or Reward Responsiveness compared to the HC group. Consistent with previous research consistently showing higher levels of o-BIS in eating disorder groups (Harrison et al., 2010), it is expected that all eating disorder groups will score higher on r-BIS and FFFS than the HC group. It is expected that the effect size for the difference of r-BIS will be greater than for FFFS (Wilson & O'Connor, 2017).

2. Method

2.1 Participants

A total of 506 female participants began a battery of self-report questionnaires, of which 434 completed the scales relevant to this study. The sample was recruited internationally using an online survey and included individuals who had a range of current and previous eating disorder diagnoses, as well as individuals with no history of EDs. Of the total sample, 52% were from Australia, 39% from the United Kingdom, 4% from the United States, 2.8%, with other countries contributing to less than 1% each of the sample). In addition to eating disorder diagnostic information, the participants completed the Eating Disorders Inventory – 3 (EDI-3; Garner, 2004) to screen for participants with elevated scores of dysfunctional eating but reported never having received an eating disorder diagnosis. The

final sample for the analysis of the current study consisted of 374 (mean age = 27.6, SD = 9.31) female participants consisting of healthy controls with no history of EDs and scoring below the clinical cut-offs according to the EDI referral form (HC; $n = 133$); those with a past or present diagnosis of AN-R and no other comorbid eating disorder diagnosis (AN-R; $n = 109$); and those with past or present eating disorder diagnosis featuring binge behaviours (Binge-type; $n = 132$). The binge-type group was comprised of participants with past or present AN-BP ($n = 62$), BN ($n = 42$) or BED ($n = 28$). The sample included 16 participants who identified as having a past or present eating disorder but did not specify a specific diagnosis. Of these, 13 clearly demonstrated current or past history of binge symptoms through their responses in free text entry on the survey and/or behavioural and subscale scores of the EDI-3. As such, these participants were classified according to the Binge-type category that most reflected of their described symptoms (i.e., AN-BP, BN or BED), and are included in the sample sizes presented. Three participants were removed from the analysis who reported a past or present ED diagnosis but had no free text or EDI-3 information indicating a history of binge eating behaviours. A flow chart of the participants is shown in Figure 1. Participants indicated on the online survey if they had comorbid past or present mental disorder diagnoses. None were excluded from participating if they had comorbid disorders due to the high comorbidity with other psychiatric disorders found in those with ED (Swinbourne et al., 2012).

Figure 1. Participant flow chart.

2.2 Procedure

Participants with a past or present eating disorder diagnosis ($n = 241$) were primarily recruited through eating disorder support organisations and Australian-based clinicians working with eating disorder clients. Support organisations posted details about the study on their websites and social media pages after being contacted for recruitment assistance via e-mail. HC participants were recruited through the University's first year psychology student pool, research participation emails and social media posts. First year students participated in return for course credit, whilst the remaining participants were eligible to enter a random prize draw for one of two \$50 AUD VISA gift cards. Of the HC group, 57 of the initial 190 participants met the EDI-3 RF referral criteria for a formal eating disorder evaluation based upon EDI-3 subscale scores and BMI. Similar to studies investigating RST and eating pathology, (e.g., Harrison et al., 2011; Matton et al., 2015) these participants were excluded,

leaving a final sample of 133 for the HC group. Participants completed the questionnaire either online or hard copy. Hard copy surveys were handed out to clients accessing psychological support for eating disorders and were mailed directly back to the research team in reply paid envelopes to protect confidentiality. The study was approved by the University's Human Ethics Committee.

2.3 Measures

2.3.1 Demographic Information. Participants responded to items regarding their age, country of residence, sex, height, weight, and past and present eating disorder diagnoses.

2.3.2 Personality. The Reinforcement Sensitivity Theory Personality Questionnaire (Corr & Cooper, 2016) was used to measure the revised RST. In the current study we used the 4 BAS subscales, the BIS, and FFFS subscales: BAS Reward Interest (RI, 7 items); "*I regularly try new activities just to see if I enjoy them*", BAS Goal-Drive Persistence (GDP, 7 items); "*I am very persistent in achieving my goals*", BAS Reward Reactivity (RR, 10 items); "*I get a special thrill when I am praised for something I've done well*", BAS Impulsivity (IMP, 8 items); "*I find myself doing things on the spur of the moment*", BIS (23 items); "*When trying to make decisions, I find myself constantly chewing it over*", and FFFS (10 items); "*I am the sort of person who easily freezes-up when scared*". The scales are summed from a 1- 4 Likert scale, with higher scores reflecting greater sensitivity. The Cronbach's alphas for the current study were 0.78 (RI), 0.88 (GDP), 0.80 (RR), 0.76 (IMP), 0.96 (BIS) and 0.80 (FFFS).

2.3.3 Dysfunctional Eating. The Drive for Thinness (DFT), Bulimia and Body Dissatisfaction (BD) scales of the Eating Disorders Inventory-3 (EDI-3; Garner, 2004) assess eating disorder symptoms. The DFT scale items reflect a desire to be thin, diet concerns, fear of weight gain, e.g., "*I am terrified of gaining weight*", the Bulimia scale items reflect binge/purge behaviours, e.g., "*I have gone on eating binges where I have felt that I could not*

stop”, and the BD scale items tap dissatisfaction with one’s appearance, e.g., “*I think that my stomach is too big*”. Items are summed from a 0-0-1-2-3-4 scoring system, with greater scores indicating greater eating disorder symptoms. The Cronbach’s alphas in the current study were 0.92 (DFT), 0.88 (Bulimia) and 0.93 (BD).

2.4 Analysis Plan

Data was analysed using SPSS version 24. Relationships between the variables were explored using bivariate correlations. Group differences on RST-PQ variables were tested using a one-way ANCOVA, controlling for age. Post-Hoc analyses were interpreted using the Sidak adjustment.

3. Results

3.1 Diagnostic groups

Between-groups t-tests were used to investigate differences on RST variables between those with a past or current AN-R diagnosis. No group differences were found, so the past and present AN-R groups were combined. Between groups t-test were used to investigate differences on RST variables between those with a past or present binge-type eating disorder diagnosis. All RST variables showed non-significant group differences, with the exception of r-BIS ($p = .04$). To check the influence of this r-BIS difference on the main hypothesis testing, the main analyses were run excluding those with a past binge-type ED diagnosis ($n = 53$), with no difference to the interpretation of the results compared to combining past-and present binge-type groups. Given the borderline significance value, and the possibility of a Type 1 error, the past binge-type ED participants were included in the combined past and present binge-type group to retain sample size. To test for group differences between the binge-type groups (i.e., AN-BP, BN and BED), a one-way ANOVA was run using the RST-PQ scales as dependent variables. As there were no significant between group differences for

any of the RST variables, the AN-BP, BN and BED groups were combined to form a binge-type group for all future analyses ($n = 132$).

3.2 Group Differences

Table 1 shows the descriptive statistics for the demographic information and EDI-3 subscales for the three groups. The EDI-3 subscale scores for the eating disorder groups were similar to those obtained in previous research (Clausen, Rosenvinge, Friborg, & Rokkedal, 2011; Smith et al., 2017). Both eating disorder groups scored higher than HC on all EDI subscales, with the Binge-type group scoring higher than the AN-R group on the Bulimia subscale. The HC group was significantly older than the AN-R group, as such age was controlled for when running the main analyses. There was significant differences between all groups on BMI, with AN-R the lowest, and HC the highest.

Table 1.

Means, standard deviations and group differences on EDI-3 measures for AN-R, binge-type, and healthy control groups.

Measure	AN-R		BT		HC		F (2, 370)	P	Partial Eta Squared	Significant Post-Hoc Differences
	M	SD	M	SD	M	SD				
Age	25.76	8.39	27.88	8.94	28.84	10.29	3.18	.043	.02	HC > AN-R
Body Mass Index	18.95	3.79	22.57	7.60	24.85	5.69	27.45	.001	.13	HC > BT > AN-R
Drive for Thinness	19.41	7.70	20.96	5.97	7.18	5.16	185.03	.001	.50	AN-R, BT > HC
Bulimia	5.49	5.32	14.32	7.78	3.15	2.76	136.76	.001	.43	BT > AN-R > HC
Body Dissatisfaction	28.77	9.00	31.05	8.72	16.06	9.20	102.86	.001	.37	AN-R, BT > HC

Note: BMI = Body Mass Index; AN-R = Anorexia Nervosa – restricting type; HC = Healthy Controls; BT = Binge-type group; DFT = Drive for Thinness subscale; BUL = Bulimia subscale; BD = Body Dissatisfaction subscale.

Table 2 shows the means, standard deviations and group differences of the three groups on RST-PQ variables. There were significant differences between the three groups on all dependant variables. As such, post-hoc analyses using the Sidak adjustment were run to further investigate the differences on RST variables. As hypothesised, both the AN-R and Binge-type groups scored higher than the HC on the r-BIS and FFFS subscales. The AN-R and Binge-type groups did not score differently from each other on these subscales. As hypothesised, the Binge-type group scored higher than both the AN-R and HC group on the IMP subscale. The AN-R group scored significantly lower than the HC group on Reward Interest and Reward Responsiveness, which partially supported the hypothesis. For Goal Drive Persistence, the HC scored significantly higher than the Binge-type group, which partially supported the hypothesis. The scores for each RST-PQ subscale for each group is shown in Figure 2. The mean scores for the RST-PQ for the HC group were similar to the normative data (Corr & Cooper, 2016), with the exception of the FFFS scale, in which our sample scored significantly lower ($M_{\text{diff}} = 3.41$). As expected, the biggest difference between the groups was on the r-BIS scale.

297 Table 2.

298 *Marginal means and group differences between eating disorder and healthy control groups*

299 *on RST Variables, controlling for age.*

RST-PQ	AN-R		BT		HC		F (2,370)	P	Partial Eta Squared	Significant Post-Hoc Differences
	M	SD	M	SD	M	SD				
Reward Interest	16.15	4.69	16.78	4.17	18.00	3.96	5.66	.004	.03	HC > AN-R
Goal Drive Persistence	20.52	4.75	19.58	5.13	21.80	4.31	7.50	.001	.04	HC > BT
Reward Responsivity	24.50	5.43	25.74	6.06	26.8	5.13	5.84	.003	.03	HC > AN-R
Impulsivity	16.15	4.31	18.70	5.26	16.63	4.11	10.69	.001	.06	BT > AN-R, HC
Behavioural Inhibition System	77.96	11.61	75.47	11.48	54.57	14.25	129.91	.001	.41	AN-R, BT > HC
Fight, Fight, Freeze System	25.76	6.20	24.96	6.32	20.66	5.53	25.96	.001	.12	AN-R, BT > HC

300 *Note:* RST-PQ = Reinforcement Sensitivity Theory Personality Questionnaire; AN-R =
301 Anorexia Nervosa – restricting type; HC = Healthy Controls; BT = Binge-type group

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Note: AN-R = Anorexia Nervosa – restricting type; HC = Healthy Controls; BT = Binge-type group; BIS = Behavioural Inhibition System; FFFS = Fight, Flight, Freeze System. Error bars represent 95% confidence intervals. Exact p values for significant group differences are reported.

* $p < .05$, ** $p < .01$, *** $p < .001$

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Figure 2. Age adjusted RST-PQ scores for eating disorder and healthy control groups.

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4. Discussion

This study is the first to investigate an eating disorder population using a specific measure of the revised RST. As expected, both the AN-R and Binge-type groups scored higher than the HC on measures of anxiety (r-BIS) and fear (FFFS). This is consistent with previous research finding elevated levels of o-BIS in similar clinical and non-clinical populations (e.g., Harrison et al., 2011). Notably, the use of the RST-PQ provides the first evidence that both FFFS and r-BIS are elevated in eating disorder populations, although the effect size of r-BIS was considerably larger than FFFS. This suggests greater relative differences in a tendency to experience anxiety when exposed to signals of both reward and threat. Although the AN-R group scored higher than the Binge-type groups on r-BIS and FFFS, the differences were not significant, which is consistent with previous research suggesting that the two disordered eating subtypes do not differentiate when using measures of o-BIS (e.g., Harrison et al., 2011). This also provides further evidence to suggest that punishment and anxiety sensitivity are biologically-based traits common to a range of eating disorder diagnoses. This maps onto trans-diagnostic theories of eating disorders (e.g., Fairburn, Cooper, & Shafran, 2003), that pose common core psychopathology as being the central component across a range of eating disorders. According to RST, activation of FFFS or r-BIS results in behavioural inhibition in situations of aversive or conflicting stimuli (Gray & McNaughton, 2000). In eating disorders, this inhibited behaviour is reflective of the restrictive eating common to eating disorders (particularly in AN and BN) in the face of aversive stimuli (the fear of gaining weight and subsequent negative self-evaluation).

However, whilst restricted eating and heightened r-BIS and FFFS are elevated across groups of eating disorder diagnoses, approach behaviour (i.e., binge eating) that differentiates eating disorder subtypes (AN-R vs Binge-types) may be underpinned by differences in other personality traits. Recent research has implicated the role of impulsivity and reward

sensitivity as individual factors useful for understanding overeating behaviours (e.g., Loxton, 2018). The results provide evidence in support of the hypothesis that differences between binge-type EDs and AN-R may be underpinned by differences in impulsivity. Consistent with research by Claes and colleagues, the Binge-type group showed higher impulsivity than both the AN-R group and the HC group (Claes et al., 2006; Claes et al., 2010). For measures of Reward Interest, Reward Responsiveness and Goal Drive Persistence, there was no significant differences between the AN-R group and the binge-type group, suggesting that the binge behaviours associated with the latter group may be underpinned by impulsivity, rather than reward sensitivity. Compared to the HC group, the Binge-type group scored significantly lower on goal drive persistence. The AN-R group scored significantly lower than the HC group on both reward interest and reward responsiveness, suggestive that a general reduced tendency to have interest and gain pleasure from rewarding stimuli may underpin the restrictive behaviours associated with AN-R.

Taken together, it appears that among those with an eating disorder (underpinned by r-BIS and FFFS as described previously), the difference in impulsivity (and to a lesser extent, reward sensitivity), may influence the approach behaviour tendencies (i.e., binge eating) exhibited. The results are in line with the proposal that whilst reward sensitivity may be particularly relevant to the early stages of overeating, impulsivity has a greater role in the subsequent development of more pathological binge eating tendencies (Dawe & Loxton, 2004; Giel, Teufel, Junne, Zipfel, & Schag, 2017; Loxton, 2018; Schag, Schönleber, Teufel, Zipfel, & Giel, 2013). Similarly, Stice and colleagues have proposed that whilst reward sensitivity increases risk for the development of binge eating, chronic binge-eating results in a blunted reward response to food consumption, and reduced inhibitory control (Burger & Stice, 2011; Stice & Shaw, 2017). In sum, it appears that from a personality perspective, eating disorders may be conceptualised as being underpinned by r-BIS and FFFS, whereas

the type of eating disorder (relating to presence or absence of binge-eating) may be further explained on the basis of reward sensitivity and impulsivity.

Greater understanding of the implications of RST systems may shed light on the increased risk of the development of disordered eating in some individuals exposed to ubiquitous environmental factors. In cultures where the sociocultural portrayal of the thin ideal is pervasive, it could be that the negative connotations associated with being overweight (i.e., threat), along with the perceived rewarding aspects of weight loss and appearing thin are particularly salient to those with high r-BIS sensitivity (i.e., a tendency to respond to the activation of both threat and reward systems). Consequently, individuals high in r-BIS sensitivity may engage in restrictive eating behaviours in an attempt to achieve their desired body weight/appearance (achieve reward) and not gain weight (avoid punishment). The ability to maintain such restrictive eating behaviours in the long term despite metabolic requirements may be influenced by approach behaviours. Specifically, those low impulsivity, (as found in AN-R) may be more likely to maintain long-term restriction as a result of being less likely to eat impulsively when hungry. On the other hand, those higher on impulsivity (as found in the Binge-type) may find long-term food restriction difficult. When presented with certain conditions (e.g., hunger, presence of palatable food cues), they may be more likely to impulsively binge on foods high in rewarding value.

From a treatment perspective, the influences of personality may help inform treatment modalities. For example, those presenting with a Binge-type eating disorder may benefit from treatment modalities targeting impulsivity (e.g., Schag et al., 2015). Furthermore, the relative influence of fear and anxiety may be of importance for the effectiveness of treatment. For example, Wilson and O'Connor (2017) found that trait mindfulness moderated the relationship between r-BIS and disordered eating symptoms. At low levels of mindfulness, r-BIS had no effect on external eating. However, at high levels of trait mindfulness, the effect

of r-BIS on external eating became significant, suggestive that increased trait mindfulness was only protective for those with low r-BIS sensitivity. No such interaction was evident for FFFS. Additionally, research shows different mechanisms through which FFFS and r-BIS influence maladaptive psychological outcomes (Stoeber & Corr, 2017), and that personality factors moderate treatment outcomes (Accurso et al., 2016). This suggests that RST systems may operate through different pathways to disordered eating, and treatments may vary in their ability to have an impact on clients with differing personality traits. Further research is needed to determine the pathways through which RST variables influence disordered eating, and ascertain if RST systems moderate the effectiveness of some treatments, but not others.

4.1 Limitations

The current study is limited by the use of cross-sectional self-report data thereby preventing the ability to establish casual effects between the personality traits and disordered eating. Importantly, differences observed in self-reported RST systems may be due to the effect of starvation and nutritional deficiencies on the associated brain systems. Indeed, there is evidence to suggest that the consequences of starvation include long-term increases in obsessionality, perfectionism, harm avoidance and other personality traits associated with RST systems (Wonderlich et al., 2005). Prospective studies could establish the extent to which RST sensitivities represents a risk factor or ‘scar’ of eating disorder, or a combination of both. Furthermore, although recruitment used eating disorder support groups and clinical psychologists to target those women with a past or present eating disorder, the diagnoses were reported by the participants rather than via interviews. We endeavoured to support the validity of these diagnosis by the use of a well-established self-report measure of dysfunctional eating.

4.2 Conclusion

This study provides the first evidence of the personality mechanisms underpinning different eating disorder diagnoses in line with the current theory of r-RST. Specifically, the use of r-RST shows the joint influences of fear and anxiety, and the distinction of rash impulsivity versus reward sensitivity on eating behaviours. Identifying the personality correlates of eating disorder is important for informing selective prevention and treatment strategies. Personality factors are established before the peak onset age of eating disorder (Stice, Nathan Marti, & Rohde, 2013), such that identifying at-risk groups and implementing interventions prior to symptoms arising could be a profitable avenue for reducing onset of new cases, as has been found in substance abuse (Conrod, Castellanos, & Mackie, 2008).

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