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ORIGINAL ARTICLE

Case Control Study

Self-reported and behavioural impulsivity in anorexia nervosa

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Abstract

AIM

To examine how self-reported and behavioural impulsivity are related in anorexia nervosa (AN).

METHODS

Twenty-four females with AN and 25 healthy controls (HC) participant in the study. Self-reported impulsivity was assessed with the Barratt Impulsiveness Scale (BIS-11). The scale yields three second-order factors: Attentional, motor and non-planning. Behavioural impulsivity was investigated with the continuous performance test (CPT), a computer-based task of sustained attention in which numbers are flashed briefly on screen and participants are required to click the mouse when the same number appears consecutively. The rate of commission and omission errors can be used a measure of behavioural impulsivity.

RESULTS

AN participants self-reported increased attentional [AN: 20.67 (3.64), HC: 13.88 (2.91), P = 0.001] and reduced motor impulsivity [AN: 11.55 (2.28), HC: 14.08 (2.78), P = 0.002]. The rate of omission or commission errors on the CPT did not differ between groups (P > 0.05). BIS-11 and CPT measures did not significantly correlate, but attentional impulsivity was related to negative mood states in AN (depression: r = 0.52, P = 0.010, anxiety: r = 0.55, P = 0.006, stress: r = 0.57, P = 0.004).

CONCLUSION

The discrepancy between self-reported and behavioural impulsivity are discussed in terms of perfectionism in AN. Furthermore, it is suggested that improving negative mood states may resolve this inconsistency in AN.

Key words: Eating disorder; Continuous performance; Anorexia nervosa; Attention; Inhibition

Core tip: The findings of the study suggest a discrepancy between self-reported and behavioural impulsivity in anorexia nervosa (AN). Although AN patients did not demonstrate differences from healthy controls in behavioural impulsivity, they self-reported reduced motor impulsivity and greater attentional impulsivity. Attentional impulsivity was associated with negative mood states in AN, suggesting that improving these symptoms may improve patients' perceptions of their attentional impulsivity.

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INTRODUCTION

Anorexia nervosa (AN) is a psychiatric illness whose core characteristics include significantly low body weight, a fear of weight gain and disturbed perception of one's own body shape or weight. AN is also frequently associated with obsessive behaviours and perfectionistic tendencies[1,2]. In particular, individuals with AN display elevated concerns over making mistakes[3], and relatedly, often self-report lower rates of impulsivity[4]. However, it is unclear whether self-reported rates of impulsivity are influenced by eating disorder symptomatology or are stable traits exhibited by these individuals. It is also unclear whether these self-reported rates of impulsivity translate to behavioural performance on cognitive tasks of inhibition.

For example, Pieters *et al*[5] reported reduced impulsivity on a speeded choice-reaction task in AN; whereas, Butler, Montgomery[4] found increased errors of commission and shorter response times in AN on a continuous performance task (CPT), but lower rates of self-reported impulsivity.

The CPT is typically utilised as a broad measure of sustained attention and vigilance. However, by examining different components of task performance, researchers have also used it to examine impulsivity. In the visual variant of this task, numbers of letters are typically flashed briefly on screen to participants. The task requires a response (usually a mouse click) when the same number appears twice in a row. Errors of omission describe when the same number appears twice consecutively in sequence, but the participant fails to respond (*i.e.,* inattention); whereas errors of commission involve responding when two consecutive numbers do not match (*i.e.,* impulsivity)[6]. The CPT has been utilised to assess both sustained attention and impulsivity in a variety of conditions associated with these features; predominantly attention deficit hyperactivity disorder (ADHD) which is characterised by both inattention and increased impulsivity[7].

The aim of this study was to investigate the relationship between self-reported impulsivity and behavioural impulsivity in AN, assessed through neuropsychological task performance. It was hypothesised that participants with AN would self-report lower levels of impulsivity than healthy controls, and would similarly demonstrate reduced behavioural impulsivity (*i.e.,* fewer commission errors on the CPT). A further aim was to examine whether differences in impulsivity between AN and healthy control groups were related to eating disorder-related factors, including eating disorder symptomatology, negative mood states, illness duration and body mass index (BMI).

MATERIALS AND METHODS

This study was approved by the human research ethics departments at The University of Melbourne, Swinburne University of Technology, The Melbourne Clinic, The Austin Hospital and St Vincent's Hospital; all in Melbourne,

Australia. Informed written consent was obtained from all participants. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Participants

Participants were 24 right-handed females with AN and 25 healthy controls (HC) matched for age and premorbid intelligence quotient (IQ). HCs were recruited through public advertisements, whereas AN participants were recruited through public advertisements; the Body Image and Eating Disorders Treatment and Recovery Service at the Austin and St Vincent's Hospitals; and The Melbourne Clinic; all in Melbourne, Australia.

All participants were English speaking and had no history of significant brain injury or neurological condition. Controls were required to have no history of an eating disorder or other mental illness. The Mini International Neuropsychiatric Interview, 5.0.0 (MINI)[8] was used to screen all participants for major Axis I psychiatric disorders according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). It was also used to confirm diagnoses of AN, with the exception of the amenorrhea criterion which is no longer included in the current DSM-5. AN was required to be the primary diagnosis of the AN group. AN participants with comorbid psychiatric conditions, other than psychotic conditions, were not excluded as this would not have represented a typical AN sample.

Assessments

Premorbid intelligence was estimated using the Wechsler Test of Adult Reading (WTAR)[9]. Eating disorder symptomatology was investigated with the Eating Disorders Examination Questionnaire (EDE-Q)[10], and negative emotional states with the Depression Anxiety Stress Scale (DASS)[11]. Self-reported impulsivity was assessed with the Barratt Impulsiveness Scale (BIS-11)[12]. The scale yields three second-order factors: attentional (consisting of the first-order factors attention and cognitive instability), motor (consisting of the first-order factors motor and perseverance) and non-planning (comprised of the first-order factors self-control and cognitive complexity).

Behavioural impulsivity was assessed with the Continuous Performance Test - Identical Pairs (CPT-IP), a computer-based task of sustained attention in which numbers are flashed on the screen for 50 ms and participants are required to click the mouse when the same number appears consecutively. The task consists of two-, three- and four-digit conditions, each consisting of 150 trials in which the total number of possible hits is 30 (*i.e.,* the inverse of omission errors), the total number of possible false alarms is also 30 (*i.e.,* commission errors), and total number of possible random responses is 90 (detailed findings of this task which contained the current sample and additional participants are presented in[13]). Response times (*i.e.,* the time taken to click the mouse from the presentation of the stimulus) are also recorded for omission and commission errors.

Statistical analysis

Following normality checking and the removal of outliers, group differences in BIS-11, EDE-Q, DASS and CPT-IP scores were examined with analyses of variance (ANOVAs). Group differences in BIS-11 subscale scores and CPT-IP scores were further explored with Pearson's correlations between these measures and illness duration, BMI, and EDE-Q and DASS scores. Due to the large number of correlations, alpha was set to 0.01 to account for multiple comparisons.

RESULTS

Table 1 presents the group comparisons in BIS-11, EDE-Q and DASS scores. AN participants had significantly higher EDE-Q and DASS scores, relative to controls. BIS-11 scores significantly differed in the second order factor "attentional", and its two first-order factors "attention" and "cognitive instability", with AN participants reporting higher impulsivity. AN participants also reported significantly lower impulsivity in the first-order factor "motor".

Table 2 describes the CPT-IP findings. Groups were not found to differ in the proportion of hits (inverse of omission errors), false alarms (commission errors) or random responses. AN participants were, however, found to have increased false alarm response times, and greater intra-individual variability in this response.

Pearson's correlation analyses did not reveal any significant correlations between measures for the HC group. A number of significant correlations were revealed in the AN group. The first-order factor, "attention" of the BIS-11 was positively correlated with state depression (r = 0.53, P = 0.007), anxiety (r = 0.58, P = 0.003) and stress (r = 0.65, P = 0.001) as measured by the DASS. The second-order factor, "attentional" was also positively correlated with depression (r = 0.52, P = 0.010), anxiety (r = 0.55, P = 0.006) and stress (r = 0.57, P = 0.004).

DISCUSSION

The findings of the current study suggest that individuals with AN self-report different levels of impulsivity relative to healthy individuals, but do not display behavioural impulsivity (*i.e.,* increased commission errors on the CPT).

AN patients reported lower levels of motor impulsivity, compared to the healthy control group. This subscale relates to acting without thinking[13,14], and suggests that individuals with AN regard themselves as controlled individuals who think before they act. Although the AN group reported lower impulsivity on this subscale, they reported increased impulsivity in terms of attention and cognitive instability - *i.e.,* an

Table 1 Participant information

	AN		HC		
	M	SD	M	SD	*P*
Age	23.07	6.88	22.67	3.19	0.798
Premorbid IQ	104.67	8.19	105.6	7.00	0.670
BMI	16.52	1.14	22.4	3.59	0.001
Illness duration	6.67	7.66	-	-	-
Age of illness onset	16.04	3.50	-	-	-
EDE-Q restraint	3.93	1.42	0.43	0.40	0.001
EDE-Q eating concern	3.78	1.24	0.20	0.20	0.001
EDE-Q shape concern	5.01	0.90	0.99	0.59	0.001
EDE-Q weight concern	4.5	1.41	0.42	0.47	0.001
EDE-Q global score	4.3	1.12	0.60	0.43	0.001
DASS depression	25.08	12.41	1.08	1.29	0.001
DASS anxiety	16.00	9.48	1.88	2.13	0.001
DASS stress	24.92	10.23	3.78	2.78	0.001
BIS-11 attentional	20.67	3.64	13.88	2.91	0.001
BIS-11 attention	13.67	2.99	8.48	2.12	0.001
BIS-11 cognitive instability	7.00	1.44	5.40	1.44	0.001
BIS-11 motor	19.67	3.61	21.28	4.02	0.146
BIS-11 motor	11.55	2.28	14.08	2.78	0.002
BIS-11 perseverance	7.54	1.74	6.92	1.96	0.247
BIS-11 nonplanning	23.21	4.33	22.16	5.71	0.474
BIS-11 self-control	11.75	3.98	11.32	3.87	0.703
BIS-11 cognitive complexity	11.46	2.54	10.84	3.04	0.444
BIS-11 total score	61.88	8.48	57.32	10.98	0.112

AN: Anorexia nervosa; HC: Healthy controls; Premorbid IQ: Standardised Wechsler Test of Adult Reading Score; BMI: Body mass index; EDE-Q: Eating Disorders Examination Questionnaire; DASS: Depression, Anxiety, Stress Scale; BIS-11: Barratt Impulsiveness scale; Age: Age of illness onset and duration illness are reported in years.

inability to focus attention or concentrate[14]. Rosval *et al*[15] similarly reported increased rates of attentional impulsivity in AN. However, attentional impulsivity was not related to eating disorder symptomatology, nor was it related to indicators of potential malnutrition (*i.e.,* BMI and illness duration), or to behavioural impulsivity in the current study. It was, however, significantly correlated with all three measures of negative mood state, *i.e.,* depression, anxiety and stress. This findings suggests that attentional impulsivity in AN may not be related to starvation or to the severity of the eating disorder, but the associated negative mood states. Though, this conclusion remains speculative as the findings are based on statistical association, and also do not take into account longitudinal data. Unlike attentional impulsivity, though, motor impulsivity was not correlated with any measure suggesting that a perceived decrease in motor impulsivity is unrelated to eating disorder symptoms, mood state or behavioural impulsivity.

Groups were also found to not differ in behavioural performance on the majority of measures of the CPT-IP. Groups did not significantly differ in the proportion of correct hits, false alarms or random responses. Groups also did not significantly differ in response times of correct hits, but showed similar response times to a large sample of healthy female participants, who had significantly longer response times than male participants[16]. Groups in the current study did, however, differ in the mean and intraindividual variability (IIV) of response times of false alarms, with the AN group demonstrating increased response times and IIV of false alarms. However, this finding is somewhat limited as only a very small proportion of false alarms were elicited in each group (*i.e.,* 11% and 10% for AN and HC, respectively, of 90 potential responses). Similarly to the current findings, a lack of significant group differences in performance on the CPT-IP has also been reported in a small number of other studies in AN[17,18]. Furthermore, the same group of participants were not found to differ on typical saccadic eye movement measures of impulsivity (*i.e.,* antisaccade or no-go saccade error rates), further supporting the lack of behavioural impulsivity in AN (saccadic eye movement findings are to be reported elsewhere).

The findings of the study, however, are subject to a number of potential limitations. First, given the conservative sample size and the number of statistical comparisons, the statistical power of the study is limited. The DASS and BIS-11 are also restricted in their divergent validity, and further, the conclusions based on these measures are based on statistical association and do not take into account longitudinal validity. The findings of the current study do, however, provide preliminary evidence for divergent self-reported and behavioural impulsivity in AN, which requires replication in a larger sample.

The findings of this study have a number of important implications. Firstly, they suggest that self-reported impulsivity in AN may be unrelated to behavioural

Table 2 Continuous performance test - identical pairs results

	AN		HC		
	M	SD	M	SD	*P*
Proportion of hits	0.83	0.97	0.86	0.9	0.319
Hits RT	547.34	59.41	533.94	53.06	0.409
Hits RT IIV	123.35	28.91	115.38	26.31	0.318
Proportion of false alarms	0.11	0.06	0.09	0.06	0.314
False alarms RT	504.65	151.18	365.41	137.89	0.002
False alarms RT IIV	68.38	32.98	46.48	29.28	0.039
Proportion of random responses	0.01	0.01	0.01	0.01	0.278

AN: Anorexia nervosa; HC: Healthy control; RT: Response time; IIV: Intraindividual variability (a comparison of individual's standard deviations).

performance. This finding may be related to the "control paradox" often reported in AN, in which individuals seek to control their surrounding environment as much as possible but report feeling like they are out of control[19]. Furthermore, this may be related to perfectionistic tendencies reported in AN; thus, further research in this area utilising measures of control and perfectionism would be advantageous to further elucidate this inconsistency in AN. The findings also suggest increased reports of attentional impulsivity in AN is related to negative mood state. Thus, addressing negative mood symptoms may be beneficial in resolving the inconsistency and potential distress in how individuals with AN think they behave and how they actually behave.

In conclusion, overall, the findings of the study suggest that individuals with AN report lower rates of motor impulsivity, and higher rates of attentional impulsivity than HCs; the latter of which is associated with increases in negative mood state symptoms. Reported rates of impulsivity were, however, unrelated to behavioural performance. Therefore, the findings suggest an inconsistency between self-reported impulsivity and behaviour in AN, which may be resolved by improving negative mood states in these individuals.

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COMMENTS

Background

Anorexia nervosa (AN) is associated perfectionistic tendencies, particularly displaying increased concerns over making mistakes. Relatedly, patients often self-report lower rates of impulsivity. However, it is unclear whether self-reported rates of impulsivity are influenced by eating disorder symptoms or are stable traits in AN. It is also unclear whether these self-reported rates of impulsivity translate to behavioural performance on cognitive tasks of inhibition in AN.

Research frontiers

Self-reported and behavioural impulsivity appear to be discrepant in AN.

Innovations and breakthroughs

This study found inconsistencies between self-reported and behavioural impulsivity in AN. The results also indicated that self-reported attentional impulsivity in AN was related to negative mood states.

Applications

Improving negative mood symptoms may improve perceived attentional impulsivity in AN.

Peer-review

In this article, the authors claim that there is a discrepancy between self-reported and behavioural impulsivity in patients with AN. The study appears to have been carefully planned with appropriate tests and adequate controls. The results are interesting and can lead to novel therapeutic approaches in AN.

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