doi:10.1080/13803390903264122

Please cite this article as:

This is an Accepted Manuscript of an article published in Journal of Clinical and Experimental Neuropsychology on 1st Otober 2009, available online: http://www.tandfonline.com/10.1080/13803390903264122

Copyright (2009) Psychology Press, an imprint of the Taylor & Francis Group, an Informa business. All rights reserved. Please note that any alterations made during the publishing process may not appear in this version.
Preliminary Evidence for a Role for Impulsivity in Cognitive Disinhibition in Bulimia Nervosa

Eva Kemps and Alexandra Wilsdon

Flinders University

Running head: Cognitive disinhibition and bulimia nervosa

Correspondence to: Eva Kemps

School of Psychology
Flinders University
GPO Box 2100
Adelaide, SA 5001
Australia
Phone: +61 8 8201 3963
Fax: +61 8 8201 3877
E-mail: Eva.Kemps@flinders.edu.au
The present study investigated cognitive disinhibition in bulimia nervosa (BN), and examined whether impulsivity could account for this neuropsychological deficiency. Inhibitory processing of 13 women with BN (16-29 years) was compared against that of 13 healthy control participants matched for age, education and socio-economic status on a battery of widely used tasks: Stroop task, Haylings sentence completion test, excluded letter fluency and Matching Familiar Figures test. The women were also administered the Barratt Impulsiveness Scale (BIS-11). The BN patients displayed significant impairments on all inhibition measures, and posited significantly higher impulsivity scores than the controls. Moreover, controlling for impulsivity reduced the group differences in Stroop colour naming and excluded letter fluency to non-significance, indicating that poor inhibitory control in BN is at least partly attributable to an impulsive disposition.

*Keywords*: eating disorders; bulimia nervosa; neuropsychological dysfunction; cognitive disinhibition; impulsivity
Over the past two decades, there has been a surge in studies of neuropsychological functioning in eating disorders (Lena, Fiocco & Leyenaar, 2004). The majority of these have focused on individuals with anorexia nervosa (AN) (Duchesne et al., 2004). Nevertheless, an increasing number of investigations in patients with bulimia nervosa (BN) has shown selective neuropsychological deficits in attention and executive function (Lauer, 2002). Of the various executive functions, inhibitory control has been of particular research interest in BN. Inhibitory control, or inhibition, refers to a set of related abilities, including the ability to time or delay a response, the ability to suppress an inappropriate response, and the ability to ignore distractions (Lezak, Howieson & Loring, 2004).

Findings to date suggest that BN patients show poor inhibitory control. However, cognitive disinhibition has not been demonstrated consistently in this clinical population. For example, Toner, Garfinkel and Garner (1987) showed that patients with bulimic symptoms made more errors than those with anorexic symptoms and healthy controls on the Matching Familiar Figures test, while Kaye, Bastiani and Moss (1995) reported that BN patients were faster to make their initial response on this inhibition measure than were AN patients. In contrast, Southgate, Tchanturia and Treasure (2008) found no differences in the performance of BN individuals on the Matching Familiar Figures test compared to AN and healthy control samples. Likewise, Rosval et al. (2006) found that BN patients made more errors than AN patients and non-eating disordered controls on the go/no-go task, whereas Claes, Nederkoorn, Vandereycken, Guerrieri and Vertommen (2006) observed no differences among these participant groups on a similar measure, the stop-go task. In addition, Ferraro, Wonderlich and Jocic (1997) inferred cognitive disinhibition from a speed-accuracy trade-off in performance on the Symbol-Digit Modalities test.
Specifically, they found that BN patients showed faster but less accurate substitutions than non-eating disordered control participants. The authors also noted that the patients made more errors on the Wisconsin Card Sorting test, which they attributed to an inability to inhibit irrelevant information. Most recently, Marsh et al. (2009) showed that women with BN were faster and made more errors than healthy control participants on the incongruent trials of the Simon spatial incompatibility task, which corresponded with a reduced activation of the fronto-striatal brain circuits in the BN group.

Several explanations could account for these mixed findings. In particular, different measures of inhibition have been used across studies. Additionally, most studies included only one measure of inhibition. Moreover, not all previously used measures were specifically designed to assess inhibitory control. For example, the Symbol-Digit Modalities test was developed to measure attention, while the Wisconsin Card Sorting test assesses cognitive flexibility. Thus the aim of the present study was to conduct a more extensive investigation of inhibitory functioning in BN using a battery of widely used measures of inhibition.

Lena et al. (2004) suggested that poor inhibitory control in BN reflects an impulsive response style. However, this suggestion remains to be empirically tested. Thus a further aim of this study was to explicitly examine impulsivity as a potential mechanism underlying inhibitory dysfunction in BN.

Impulsivity is characteristic of the personality and behaviour of individuals with BN. Some common manifestations of impulsivity in BN include alcohol or substance abuse, self-harm and shoplifting, with reported incidence rates across these co-morbidities ranging from 12 to 56% (Bridgeman & Slade, 1996; Holderness, Brooks-Gunn & Warren, 1994; Ruuska, Kaltiala-Heino, Rantanen & Koivisto, 2005).
Patients with BN also show elevated levels of impulsive thoughts and actions on assessments via self-report questionnaires (Claes, Vandereycken & Vertommen, 2005; Diaz-Marsa, Carrasco & Saiz, 2000; Penas-Lledo, Vaz, Ramos & Waller, 2002). Additionally, bulimic symptomatology in non-clinical samples has been found to correlate positively with impulsivity scores (Fischer, Smith & Anderson, 2003; Penas-Lledo & Waller, 2001).

Support for a role for impulsivity in inhibitory dysfunction comes from the attention deficit hyperactivity disorder (ADHD) literature. Impulsivity is a core diagnostic criterion for this developmental disorder (DSM-IV, American Psychological Association, 2000). Furthermore, it is well-documented that individuals with ADHD exhibit deficient inhibitory control (Campbell, Douglas & Morgenstern, 1971; Leung & Connolly, 1996). Importantly, a number of studies has linked inhibitory dysfunction in ADHD to impulsivity, as evident from correlations between performance on tasks of inhibitory control and impulsivity ratings from parents and teachers in children with ADHD (Barkley, 1991; Solanto et al., 2001). More generally, several studies have demonstrated a relationship between self-report ratings of impulsivity and inhibitory control performance in non-clinical adult samples (Keilp, Sackeim & Mann, 2005; Logan, Schachar & Tannock, 1997). It follows that impulsivity could contribute to poor inhibitory processing in BN, particularly in view of recent evidence of a co-morbidity of BN with ADHD (Beiderman et al., 2007; Surman, Randall & Biederman, 2006).

Thus the present study investigated inhibitory processing in BN, and examined whether impulsivity could account for poor inhibitory control in this clinical population. To achieve this, we compared the performance of women with BN on a battery of inhibition tasks against that of healthy controls matched for age, education
and socio-economic status. In the emergence of group differences in inhibitory functioning, we then assessed the potential contribution of impulsivity. We also administered a measure of general intellectual ability to ensure that any inhibitory deficits in the BN sample could not be attributed to a more general intellectual deficit.

Method

Participants

Participants were 26 women aged 16 to 29 years: 13 eating disordered patients who were receiving outpatient treatment for BN involving psychiatric oversight at the Flinders Medical Centre Weight Disorder Unit and 13 healthy controls recruited from the Flinders University undergraduate student population. All patients met the DSM-IV-TR diagnostic criteria for BN purging subtype as determined by the consulting psychiatrist at the Weight Disorder Unit. Mean age of onset was 16.73 years (SD = 4.72). Duration of illness ranged from 1 to 10 years, with all but 2 patients having had the disorder for more than 3 years. None met criteria for alcohol or substance abuse, major depression, anxiety, ADHD or other co-morbid psychiatric disorders. Four patients were taking selective serotonin reuptake inhibitors.

Control participants were individually matched to the BN patients on the basis of age, years of education and socio-economic status. Socio-economic status was derived from father’s current occupation, or occupation prior to retirement, and was classified as recommended by Crawford, Nelson, Blackmore, Cochrane and Allan (1990): 1 = professional; 2 = intermediate; 3 = skilled; 4 = semi-skilled; 5 = unskilled.
Control participants were administered the Eating Disorder Examination Questionnaire (EDE-Q; Fairburn & Beglin, 1994) to screen for symptoms of a current eating disorder. Only diagnostic questions were used. Participants were excluded if they reported either or both of the following behaviours over the previous four weeks: (a) episodes of binge eating accompanied by a loss of control and clinical levels of weight and shape concerns (scoring 4-6 on 0-6 Likert scales), and/or (b) purging or fasting (e.g., not eating for eight or more waking hours for the purpose of controlling weight or shape) at least once per week. Participants were also excluded if they had lifetime diagnoses of eating or psychiatric disorders, had a family history of eating disorders, were currently on a diet to lose weight, or had been on a diet in the past 4 weeks, as any of these conditions could adversely affect cognition (Burt, Zembar & Niederehe, 1995; Green, Elliman & Rogers, 1997; Lena et al., 2004). These exclusion criteria were assessed via a series of yes/no questions (e.g., “Have you ever been diagnosed with an eating disorder?”).

Measures

Inhibition

Inhibition was assessed by four established paper-and-pencil measures: the Stroop task (Stroop, 1935), the Haylings sentence completion test (Burgess & Shallice, 1996), excluded letter fluency (Bryan, Luszcz & Crawford, 1997), and the Matching Familiar Figures test (Kagan, 1966). Originating from diverse psychological domains, these measures have been widely used to assess the same theoretical construct of inhibitory processing.

Stroop task. Participants are presented with two consecutive lists of 112 colour words (red, blue, green and yellow) arranged in four columns. On the first
list, the words are printed in congruent coloured ink (e.g., the word ‘red’ is printed in red ink). On the second list, they are printed in incongruent coloured ink (e.g., the word ‘red’ is printed in blue ink). For each list, participants are asked to name as quickly as possible the colour of the ink in which the words are printed within a 60-second period. Colour naming accuracy for each list is recorded. Performance is scored as the ratio of the number of correctly named colours on the incongruent list to the number of correctly named colours on the congruent list, such that higher scores reflect more inhibitory control.

Haylings sentence completion test. Participants are presented with two sets of 15 sentences from which the last word has been omitted. For each sentence, there is a high probability of a particular response occurring (e.g., “The captain wanted to stay with the sinking ____”). In the first set of sentences, participants are asked to provide a word that could fit at the end of the sentence (e.g., “ship”). In the second set, they are asked to provide a word that makes no sense in the context of the sentence (e.g., “pencil”). The sentences are read to participants at a normal reading pace. Participants are instructed to respond as quickly as possible. Performance is scored as the ratio of the number of unrelated sentence completions on the second set to the number of reasonable sentence completions on the first set, with higher scores reflecting better inhibitory control.

Excluded letter fluency. Participants are asked to generate as many words as possible that do not contain the letter E within a period of 60 seconds, and thus suppress any response that violates this rule. Additionally, the words must have more than 3 letters and cannot be proper nouns. Scores represent the total number of correctly produced words.
Matching Familiar Figures test. On each of 12 trials, participants are presented with a picture of a familiar object, the target, and asked to select from a set of 6 or 8 highly similar pictures the one that is identical to the target by pointing to it. Participants are given feedback on the accuracy of their response, and asked to try again if their selection is incorrect. Participants continue to make selections for a given trial until their response is correct. The mean latency to the first response on each trial and the total number of errors across trials are recorded, from which a cognitive dyscontrol index is calculated using the equation $Z_{\text{score errors}} - Z_{\text{score latency}}$.

Impulsivity

Impulsivity was assessed by the Barratt Impulsiveness Scale Version 11 (BIS-11; Patton, Stanford & Barratt, 1995). The scale consists of 30 statements pertaining to impulsive thoughts and behaviours (e.g., “I act on the spur of the moment”). Participants rate how often each statement is true for them on a 4-point scale (1 = rarely/never; 2 = occasionally; 3 = often; 4 = almost always/always). Responses are averaged to produce an impulsivity score ranging from 1 to 4, with higher scores reflecting a higher degree of impulsivity. The BIS-11 comprises three subscales: attentional, motor and non-planning impulsiveness. Although some studies have reported subscale scores in eating disordered samples (e.g. Claes et al., 2006), in line with most previous eating disorder research (see Culbert & Klump, 2005), the current study used the total scale score. Internal consistency coefficients ranging from .79 to .85 have been reported across populations of undergraduate students, psychiatric patients, eating disordered patients and prison inmates (Engel...
et al., 2005; Patton et al., 1995). The internal consistency coefficient for the present sample was .87.

General intellectual ability

General intellectual ability was assessed by the Spot-the-Word task, a widely used measure of crystallised intelligence and estimate of verbal IQ (Baddeley, Emslie, & Nimmo-Smith, 1993). The task consists of 60 paired items comprising a real word (e.g., kitchen) and a nonsense word designed to look like a real word (e.g., harrick). Participants are asked to circle the real word in each pair, but not to guess if they do not know the answer. Scores are calculated by adding the number of correctly circled words, and then subtracting the number of incorrect responses to correct for guessing.

Body mass index

Body mass index was calculated as the ratio of weight in kilograms to height in meters squared. Height and weight were measured by the researcher.

Procedure

Participants were tested individually in a quiet room at the Weight Disorder Unit (BN patients) or the Applied Cognitive Psychology Laboratory (controls) in a single session of 45 minutes duration between the hours of 9:00 a.m. and 5:00 p.m. All participants first completed the inhibition measures (Stroop task, Haylings sentence completion test, excluded letter fluency, Matching Familiar Figures test), followed by the Spot-the-Word task. Participants then completed a questionnaire booklet that comprised the Barratt Impulsiveness Scale-11, and for control
participants the Eating Disorder Examination Questionnaire. No restrictions regarding food intake were imposed prior to testing.

Results

For all variables, cases that were ± 3 standard deviations from the mean were identified as outliers, and adjusted by assigning a score one unit removed from the next most extreme score in the distribution (Tabachnick & Fidell, 2001). Cohen’s $d$ was used as the effect size measure for all inferential analyses, with cut-off values of .20, .50, and .80 for small, medium and large effects, respectively (Cohen, 1988).

Participant characteristics

Independent samples $t$-tests were conducted to assess group differences in demographics, BMI and general intellectual ability. Descriptive statistics for these variables are presented in Table 1. Not surprisingly, the groups did not differ in terms of age, education or socio-economic status ($ts < 1, ps > .05$). Neither were there significant group differences in BMI, $t(24) = 1.01, p > .05$, or general intellectual ability, $t(24) = 1.14, p > .05$. However, as can be seen in the table, the groups were not as well matched on the latter measure.

Inhibition

A series of independent samples $t$-tests showed that the BN patients performed significantly more poorly than the control participants on all four inhibition tasks: Stroop task, $t(24) = 1.69, p < .05, d = .69$, Haylings sentence completion test, $t(24) = 2.84, p < .01, d = 1.16$, excluded letter fluency, $t(24) = 2.69, p < .01, d = 1.10$, and
Matching Familiar Figures test, $t(24) = 2.32, p < .05, d = .95$. Descriptive statistics for these measures are presented in Table 2.

Possible confounding variables

Age, general intellectual ability and medication were examined as possible confounding variables. As the brain continues to undergo many developmental changes before the age of 18, and the current sample included four participants (2 patients, 2 controls) younger than 18, age was examined as a possible confounding variable. Analyses of covariance conducted on the inhibition measures, with age as the covariate, however, showed the same effects (.05 < $p$s < .01). Likewise, when controlling for general intellectual ability, to adjust for the groups not being well matched on the Spot-the-Word task, the group differences in inhibition remained (.05 < $p$s < .01). Finally, excluding the four patients taking medication from the analyses did not alter the pattern of results (.05 < $p$s < .01).

Impulsivity

An independent samples $t$-test conducted on the BIS-11 scores indicated that the BN patients ($M = 2.43$, $SD = 0.38$) reported significantly higher levels of impulsivity than the controls ($M = 2.11$, $SD = 0.37$), $t(24) = 2.14, p < .05, d = .87$.

The role of impulsivity in cognitive disinhibition

To investigate whether impulsivity could account for the observed group differences in inhibition, analyses of covariance were conducted on the inhibition measures, with impulsivity as the covariate. The previous group differences in performance on the Stroop task, $t(23) = 1.12, p > .05$, and excluded letter fluency,
\( t(23) = .78, p > .05, \) were no longer significant. However, the group differences on the Haylings sentence completion, \( t(23) = 2.70, p < .05, d = 1.10, \) and the Matching Familiar Figures tests, \( t(23) = 2.20, p < .05, d = .90, \) remained significant.

**Discussion**

The present study represents the first attempt to conduct a systematic investigation of inhibitory processing in BN using a battery of widely used measures of inhibition. Women with BN performed more poorly than healthy matched controls on all four inhibition tasks, indicative of cognitive disinhibition. This supports and extends previous findings of inhibitory dysfunction in BN (Kaye et al., 1995; Marsh et al., 2009; Rosval et al., 2006; Toner et al., 1987). The consistently poorer performance of the patient sample across tasks attests to the robustness of inhibitory deficiency in BN. Importantly, this deficit in inhibitory control could not be attributed to a general intellectual deficit.

The BN patients also reported higher levels of impulsivity than the controls. This finding is consistent with previous questionnaire studies (Claes et al., 2005; Diaz-Marsa et al., 2000; Penas-Lledo et al., 2002) and with observations of impulsive traits and behaviours in BN individuals (Bridgeman & Slade, 1996; Holderness et al., 1994; Ruuska et al., 2005).

Furthermore, the data provide partial support for Lena et al.’s (2004) suggestion that cognitive disinhibition in BN is indicative of an impulsive nature. Specifically, controlling for impulsivity reduced the previous group differences in Stroop colour naming and excluded letter fluency to non-significance. However, impulsivity did not explain the observed group differences on the Haylings sentence completion and Matching Familiar Figures tests. Nevertheless, the current findings
provide the first preliminary evidence for a role for impulsivity in cognitive disinhibition in BN. An alternative view proposes instead that inhibitory dyscontrol is a component of impulsivity (e.g., Enticott & Ogloff, 2006). However, contrary to this view, controlling for any of the inhibition measures did not reduce the group difference in impulsivity to non-significance ($p < .05$).

The differential contribution of impulsivity to group differences across tasks could be because the various inhibition measures tap different cognitive processes. For example, the Stroop task assesses the ability to ignore distractions (Barkley, 1997), whereas the Haylings sentence completion test assesses the ability to suppress a contextually-cued response (Burgess & Shallice, 1996). It is possible that not all inhibitory processes are associated with impulsivity. Alternatively, different inhibitory processes may be associated with different aspects of impulsivity. Recent developments indicate that impulsivity is a multi-component construct. In particular, Whiteside and Lynam (2001) identified four impulsivity facets: urgency, premeditation, perseverance and sensation seeking. Subsequent applications of this four-factor model in the eating disorders domain have consistently shown greater urgency in BN patients (Claes et al., 2005) and non-clinical samples with bulimic symptoms (Fischer et al., 2003; Miller, Flory, Lynam, Leukefeld, 2003); however, results regarding the other three facets are mixed. Future research might usefully determine whether a greater sense of urgency could account for the observed group differences on the Haylings sentence completion and Matching Familiar Figures tests. Additionally, other variables not measured here could have contributed to these group differences, such as nutritional intake or depression. However, none of the patients had a co-morbid diagnosis of depression, and controlling for anti-depressant medication did not affect the inhibition results. Moreover, although BN patients
generally report more depressive symptoms than non-eating disordered controls, Marsh et al. (2009) found no contribution from depression to cognitive disinhibition in BN. More generally, depression has not been found to account for neuropsychological dysfunction in most other studies of BN (Beatty, Wonderlich, Staton & Ternes, 1990; Cooper & Fairburn, 1993; Gorzewski, Gerlinghoff, Backmund & Zihl, 1999; Lopez, Tchanturia, Stahl & Treasure, 2008; Lauer, Pendleton-Jones, Duncan, Brouwers & Mirsky, 1991; Tchanturia et al., 2004).

The findings have potential clinical implications. Although Cognitive Behaviour Therapy (CBT) is the treatment of choice for BN (Shapiro et al., 2007; Wilson, Grilo & Vitousek, 2007), and approximately 80-95% of patients show improvement with this psychological intervention (Fairburn et al., 1991; Garner et al., 1993), only 40-50% cease bingeing and purging completely (Wilson, Fairburn, Agras, Walsh & Kraemer, 2002). It is possible that inhibitory dysfunction presents a barrier to treatment in unremitting individuals (Lauer et al., 1999), particularly in view of the proposed link between binge eating and poor inhibitory control in BN (Steiger, Lehoux & Gauvin, 1999). Cognitive remediation exercises that address inhibitory processing prior to, or concurrently with CBT, may help yield a more favourable outcome. These could involve targeted practice at identifying or locating targets while ignoring irrelevant information, such as spotting the differences between two visually similar pictures, or crossing out one or more target letters on a page of random letters of the alphabet. Emerging evidence has shown success of this therapeutic approach in improving neuropsychological limitations (i.e., cognitive inflexibility and weak central coherence) in patients with anorexia nervosa (Davies & Tchanturia, 2005; Tchanturia, Whitney & Treasure, 2006).
A number of potential limitations need to be acknowledged. First, the sample size was relatively small; hence, replication with a larger sample is warranted. Nevertheless, the number of BN patients in our study is commensurate with that of several other studies of inhibitory processing in BN (Kaye et al., 1995; Southgate et al., 2008). Moreover, we clearly detected statistically significant group differences in inhibition and impulsivity, which were all of moderate to large effect size. Second, the researcher was not blind to diagnosis. The use of paper-and-pencil neuropsychological tests therefore had the potential for bias. Future studies might usefully conceal the diagnostic status of participants from the researcher and/or use computer administered tests.

In summary, the present study adds to a growing body of research on cognitive disinhibition in BN. Consistent with Lena et al.’s (2004) suggestion, we showed that this neuropsychological deficit was at least partly attributable to an impulsive disposition.
Cognitive disinhibition and bulimia nervosa

References


AD/HD: A supplement to the NIMH multimodal treatment study of AD/HD. *Journal of Abnormal Child Psychology*, 29, 215-228.


Acknowledgements

Eva Kemps and Alexandra Wilsdon, School of Psychology, Flinders University, Adelaide, Australia.

We thank Dr. Peter Gilchrist of the Weight Disorder Unit at the Flinders Medical Centre for his assistance with recruitment of BN patients.

Correspondence concerning this article should be addressed to Eva Kemps, School of Psychology, Flinders University, GPO Box 2100, Adelaide, SA 5001, Australia. Electronic mail may be sent to Eva.Kemps@flinders.edu.au
Table 1

**Descriptive Statistics for Sample Characteristics**

<table>
<thead>
<tr>
<th></th>
<th>BN</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>M</em></td>
<td><em>SD</em></td>
</tr>
<tr>
<td>Age (years)</td>
<td>22.17</td>
<td>3.88</td>
</tr>
<tr>
<td>Education (years)</td>
<td>14.23</td>
<td>2.20</td>
</tr>
<tr>
<td>Socio-economic status</td>
<td>2.15</td>
<td>1.68</td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td>23.61</td>
<td>2.61</td>
</tr>
<tr>
<td>General intellectual ability</td>
<td>34.15</td>
<td>9.76</td>
</tr>
</tbody>
</table>
Table 2

*Descriptive Statistics for BN and Control Participants on Inhibition Measures*

<table>
<thead>
<tr>
<th>Test</th>
<th>BN</th>
<th>SD</th>
<th>Control</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroop task</td>
<td>0.47</td>
<td>0.11</td>
<td>0.55</td>
<td>0.14</td>
</tr>
<tr>
<td>Haylings sentence completion test</td>
<td>0.79</td>
<td>0.16</td>
<td>0.94</td>
<td>0.10</td>
</tr>
<tr>
<td>Excluded letter fluency</td>
<td>8.92</td>
<td>2.40</td>
<td>11.69</td>
<td>2.84</td>
</tr>
<tr>
<td>Matching Familiar Figures test</td>
<td>0.76</td>
<td>1.55</td>
<td>-0.76</td>
<td>1.78</td>
</tr>
</tbody>
</table>