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Restrained eaters act on impulse

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Abstract

Impulsivity and bulimic symptoms often go together. It is not only the eating behaviour of bulimics that is impulsive; many studies show that the eating disorder frequently is accompanied by non-eating related impulsive behaviours like substance abuse, self-harm or theft. This co-morbidity suggests that there might be a more basic lack of inhibitory control that makes someone vulnerable for both the bulimic symptoms and the other impulsive behaviours. The present study tested whether an analogous group of 34 restrained eaters showed a basic inhibitory control deficit by using a stop-signal task, compared to 29 control women. It was found that the restrained eaters were significantly worse in inhibiting their basic non-food related motor responses than unrestrained eaters. Food exposure during the task did not affect motor performance. A fundamental lack of general response inhibition might play a role in the development of a specific eating disinhibition.

Keywords: Eating disorders; Impulsivity; Inhibitory control; Bulimia nervosa; Exposure; Stop-signal paradigm

1. Introduction

The eating disorder bulimia nervosa has often been associated with increased impulsiveness. Not only the binges, characterized by a lack of control over food intake, might be typified as a form of impulsive behaviour, a relation between bulimia nervosa and self-reported impulsivity has also been found: Bulimic patients score higher on questionnaires that measure a tendency to act on impulse in daily life, to seek sensation, to take risks, and to be more sensitive to reward (Claes, Vandereyken, & Vertommen, 2002; Loxton & Dawe, 2001; Steiger et al., 2001). In addition, bulimic patients are found to be engaged more often in other kinds of impulsive behaviours, like

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substance misuse, self-harm or theft (Dykens & Gerrard, 1986; Holderness, Brooks Gunn, & Warren, 1994; Nagata, Kawarada, Kiriike, & Iketani, 2000), and in a normal female sample, bulimic attitudes were found to correlate with impulsive behaviours (Lledo & Waller, 2001).

The fact that the impulsive behaviour of bulimic patients is not restricted to their eating behaviour, but stretches out to a broad-spectrum of behaviours, suggests that they have rather fundamental deficits in their impulse control. Considering the fact that multi-impulsivity is related to worse treatment outcomes in bulimic patients (Sohlberg, 1991), it might be fruitful to know whether a basically deficient impulse control system underlies the disorder.

A broad definition of an impulsive response is one that is executed with insufficient forethought, planning, or control, and is therefore inaccurate or maladaptive. More specific, inhibitory control is believed to be at the heart of impulsivity (Barkley, 1997). The ability to inhibit inappropriate responses is an important executive function, and related to self-regulation and goal-directed behaviour (Avila & Parcet, 2001; Barkley, 1997). Inhibition is a biologically based function, mediated by the frontal lobes, in particular the prefrontal cortex (Baddeley, 1986), but probably also sustained by a distributed cortical neural network (Andrés, 2003). If someone has insufficient inhibitory control, impulses and immediate reward will rule over secondary considerations and long-term consequences. Being vulnerable for immediate gratification is not limited to a certain type of action mostly, and generalizes to diverse kinds of behaviour. Eating behaviour might be one of the behaviours that is influenced by the vulnerability for immediate gratification. The sight, smell or thought of tasty food induces appetite in most people, and when someone is characterized by insufficient basic inhibitory control, the eating inhibition will of course fail, leading the subject into overeating. A fundamental deficit of inhibitory control might underlie binge eating disorders.

However, up to now there is hardly any experimental research over the role of inhibitory control in eating disordered people. Ferraro, Wonderlich, and Jocic (1997) found that bulimics showed more impulsivity and problem solving deficits in neuropsychological tests than controls. Ferraro, Wonderlich, and Johnson (1997) used a negative priming (NP) task and found that controls displayed the NP effect (responses on critical trials are slower than responses to control trials). Subjects at risk for an eating disorder failed to show a NP effect, and lack of this effect might have been due to a failure to inhibit responses to irrelevant information. Kane, Loxton, Staiger, and Dawe (2004) used a behavioural measure of reward responsiveness (speed of card sorting with and without financial reward) as an index of impulsivity and found that bulimic women were more responsive to reward. As expected, performance on the task was also related to self-reported impulsivity. Rossier, Bolognini, Plancherel, and Halfon (2000) found that bulimic women and anorectic women (bingeing/purging type) scored higher on a sensation seeking scale than controls, and restricting anorexics scored lower. Jansen, Klaver, Merckelbach, and Van den Hout (1989) found that high restrained eaters were rapidly habituating sensation seekers; they scored higher on a sensation seeking scale than unrestrained eaters, and their skin conductance responses habituated significantly quicker to a series of neutral auditory stimuli.

Restrained eaters are expected to serve as an analogue to bulimia nervosa: The continuity model suggests that restrained eaters have an intermediate position between unrestrained eaters and individuals with bulimia, in bulimic risk factors and bulimic symptoms (Lowe et al., 1996). Moreover, high scores on the selection questionnaire, the Restrained Scale (RS) are predictive of bulimic symptomatology (Kendler et al., 1991; Stice, Ozer, & Kees, 1997). This suggests that impulsivity is also an important feature of restrained eaters. In the current study, high and low restrained eating participants completed the computerized stop-signal task, which is a valid and reliable measure of the inhibition process (Avila & Parcet, 2001; Logan, 1994). Decreased performance on this task is related to impulsivity (Logan, Schachar, & Tannock, 1997) and impulsive disorders like ADHD (Schachar, Tannock, Marriot, & Logan, 1995). It was hypothesized that restrained eaters would show longer stop-signal delays than unrestrained eaters, representing a decreased ability to inhibit ongoing motor responses in restrained eaters. The stop-signal task was performed with and without exposure to food cues. According to the conditioned model of binge eating, exposure to food cues evokes craving for food and eventual leads to binge eating (Jansen, 1998). Indeed, exposure to food beforehand leads to increased food intake in restrained eaters during a subsequent taste test (Fedoroff, Polivy, & Herman, 1997; Jansen & Van den Hout, 1991). Apparently, food exposure triggered impulsive eating behaviour. In the current study we tested whether food exposure decreases the ability to inhibit responses in restrained eaters. Finally, it was expected that restrained eaters would score higher on self-report measures of impulsivity and disinhibition than unrestrained eaters.

2. Method

2.1. Participants

Two hundred and fifty six female undergraduates were asked to complete the RS as part of an assessment session, in which a large set of questionnaires was administered. Participants with scores lower than 6 and higher than 15 on this first administration of the RS were invited to take part in the experiment. Sixty three women were willing to participate. All participants filled in the RS again directly after the experiment, to obtain scores related to the time of the experiment. On base of this mean RS score (11.8), 29 women with lower scores were classified as unrestrained eaters (mean = 5.2, SD = 2.5) and 34 women with higher scores were classified as restrained eaters (mean = 17.7, SD = 3.4). Both groups were 19 years (SD = 1.1) on average ($F(1,61) = 0.1$, NS).

2.2. Measures

The RS (Herman & Polivy, 1980) is a self-report questionnaire, consisting of 11 items assessing attitudes towards weight, degree and frequency of dieting, disinhibition of eating, and weight fluctuations.

The trait impulsiveness of the Eysenck Personality Profiler (EPP, Eysenck, Wilson, & Jackson, 1996) was used to measure impulsivity. The scale consists of 20 items, higher scores indicate higher impulsiveness.

The BIS/BAS scales (Carver & White, 1994) were used to measure the behavioural inhibition system, which is related to trait anxiety, and the behavioural activation system, which is related to impulsivity. The questionnaire exists of 20 items and yields four subscales, one for BIS and three BAS-related scales, namely Reward Responsiveness (RR), Drive (DRV) and Fun Seeking (FS). Higher scores on the BIS scale imply higher anxiety, on the BAS scales higher impulsivity.

Craving and palatability of the food were both scored on 10 cm visual analogue scales (VAS), ranging from 0 (e.g. food is not palatable at all) to 10 (e.g. food is very palatable).

The stop-signal task was copied from Logan et al. (1997). It involves two concurrent tasks, a go task, which is a choice reaction time task, and a stop task, occurring on 25% of the go-trial and involving a stop signal that tells subjects to inhibit their responses to the go task. During the go tasks, the letters O or X were presented for 1000 ms on the centre of a PC computer screen, preceded by a 500 ms fixation point. The subject had to press a right button on a board with their right hand when an X was on the screen and a left button with their left hand when an O was on the screen. Between trials, the screen was blank for 1000 ms. The subjects were asked to press the buttons as fast as possible. The stop signal was a 100 ms, 1000 Hz tone, produced by the computer. Initially, the stop-signal delay was set at 250 ms after the presentation of the go signal (the O or the X) and then adjusted dynamically depending on the responses of the subject. When the subject failed to inhibit the response, the delay was decreased by 50 ms, thereby making it easier to inhibit the next stop-signal trial. When the subject succeeded in inhibiting the response, the delay was increased by 50 ms, thereby making it more difficult to inhibit the next stop-signal trial. The two variables measured in this task are the reaction time (RT) and the stop delay. The stop-signal reaction time (SSRT) is calculated by subtracting the stop delay from the reaction time. Higher SSRTs indicate poorer response inhibition. The task consists of four blocks, each containing 128 trials. There were an equal number of Xs and Os in a block and stop signals were presented on 25% of the trials, balanced over X and O trials. The order of trials was randomised. Between blocks, the subject was allowed to take a break of a few minutes.

3. Procedure

The participants were tested individually. They signed an informed consent prior to participation. Ethical approval was given from the ethical commission of the faculty. The participants started with the stop-signal task. They were instructed to respond as fast as possible to the choice reaction task, and were then told that on some trials, a tone could occur, which meant that they should not respond to the choice reaction task. It was explained that the delay of the tone would differ between trials, and that they thus sometimes would be successful in inhibiting their responses and sometimes not. They were explicitly told that their first priority was to respond as fast as possible to the choice reaction task and not to wait for the tone. Halfway through the task, after the second block, the food exposure started, which lasted about 2.5 min. Exposure was always after the neutral condition because it could have long lasting effects. During the exposure, four large bowls were presented to the subject, two containing crisps, natural flavour and paprika flavour; and the others containing small pieces of chocolate with nut pieces, either milk chocolate or plain chocolate. First the participant was asked to choose their favourite crisp and chocolate bowl. Then the participant was asked to smell the food thoroughly and taste a small piece of it. She was told that she would be free to eat as much of the food as she wanted after the computer task. During the exposure, she had to score for craving and palatability of the food. At the end of the exposure, the bowls were placed beside the computer screen and the third block started. At the end of the block, the exposure procedure was repeated and during the fourth block the bowls were placed beside the screen again. When the computer task was completed, the participant filled in the questionnaires. Finally, the participant was invited to eat as much food as she liked and she was paid a fee.

4. Analyses

The data of the stop-signal task were analyzed with 2 (group) × 4 (blocks) ANOVA for repeated measures. Separate ANOVA's are presented for the SSRT and RT measures. Data of the questionnaires are analyzed with *t*-tests. Seven participants were excluded from the analyses, four unrestrained and three restrained eaters. Three subjects were allergic to the food and did not taste the food during the exposure. One participant responded too slowly (over 1000 ms), and two participants inhibited only 25% of the trials, indicating they did not follow the instructions. Finally, one foreign student did not understand the instructions, due to language problems.

5. Results

The task is designed to let participants be able to inhibit 50% of the stop trials. The mean percentage of trials that was inhibited was 49.8 (SD = 2.1), close to the ideal of 50%, indicating that the task was executed well by the participants. No difference between groups was found ($F(1,55) = 0.005$, NS).

The first hypothesis was that restrained eaters show slower SSRTs, indicating a deficit in response inhibition. Indeed, restrained eaters had significantly slower SSRTs compared to unrestrained eaters (Table 1). This finding supports the idea of a basic motor inhibition control deficit in restrained eaters. No differences between groups were found on their reaction times (Table 1) which implies that restrained eaters have no deficit in responding per se.

The second hypothesis stated that the SSRT difference between restrained and unrestrained eaters will be even greater during food exposure, because the craving for food would increase the

Table 1
Means, standard errors and statistical effects of restrained and unrestrained eaters on the stop-signal task and questionnaires

	Low restrained mean (SE)	High restrained mean (SE)	Statistical effects
SSRT (in ms)	161.6 (5.4)	184.3 (4.9)	$F(3,52) = 9.8$, $p = 0.003$[a]
RT (in ms)	452.9 (20.3)	453.1 (18.3)	$F(3,52) = 0$, $p = 0.99$
Craving for food	6.3 (0.34)	5.7 (0.31)	$t(1,54) = 1.3$, $p = 0.21$
Palatability	6.6 (0.24)	6.7 (0.24)	$t(1,54) = 0.3$, $p = 0.75$
Impulsivity EPP	13.9 (1.3)	17.7 (1.4)	$t(1,54) = 1.9$, $p = 0.064$[b]
BAS-RR	15.3 (0.41)	16.9 (0.3)	$t(1,54) = 3.2$, $p = 0.002$[a]
BAS-DRV	9.2 (0.34)	10 (0.40)	$t(1,54) = 1.6$, $p = 0.13$
BAS-FS	11.6 (0.41)	12.4 (0.31)	$t(1,54) = 3.2$, $p = 0.11$
BIS	19.1 (0.71)	21.2 (0.66)	$t(1,54) = 2.2$, $p = 0.03$[a]

[a] Significant.
[b] Marginal significant.

tendency of restrained eaters to act on impulse. Although there was a significant effect of blocks on SSRTs ($F(3, 52) = 26$, $p < 0.01$), this effect was due to the improvement of both groups after the first block (overall mean SSRTs on successive blocks: 206, 161, 161 and 161 ms). Aside from this learning effect, no differences between blocks were found; analyses excluding the first block found no effect of blocks ($F(2, 53) = 0.01$, NS). This means that the expected effect of the exposure was not found. The interaction between group and blocks was also not significant ($F(3, 52) = 0.5$, NS): The food exposure thus did not have a differential effect on the two groups. Further, both groups reported the same levels of craving and food palatability during the exposure (see Table 1).

The third hypothesis was that restrained eaters would score higher on self-report measures of impulsivity and disinhibition than unrestrained eaters. As described in Table 1, restrained eaters scored marginally significantly higher on the trait impulsiveness of the EPP and significantly higher on the BAS RR subscale, not on the DRV and FS subscales. They also scored higher on the BIS scale, indicating higher trait anxiety.

6. Discussion

The first aim of this study was to test the hypothesis that restrained eaters are characterized by a decreased ability to inhibit ongoing responses, which would explain the unsuccessful dieting and the impulsive eating behaviour. Results provide strong support for this hypothesis; restrained eaters indeed performed poorer on the stop-signal reaction task, while their performance on the go task was not different from the unrestrained group. This means that restrained eaters do have a specific deficit in response inhibition, which is not a deficit in responding per se.

The second hypothesis stated that food exposure will increase the impulsivity of restrained eaters, thereby deteriorating their performance on the stop-signal task. However, this idea was not confirmed: The food exposure did not influence the ability to inhibit responses, neither of the restrained nor of the unrestrained eaters. Surprisingly, the food exposure did not elicit more craving in the restrained eaters than in the unrestrained eaters, which might mean that the food exposure was not intense enough to evoke further impulsive tendencies in restrained eaters.

The third hypothesis states that restrained eaters score higher on self-report measures of impulsivity. Indeed, they scored significant higher on the BAS scale, indicating higher impulsivity, and marginally higher on trait impulsivity. This again confirms the association between impulsivity and disordered eating behaviour. Restrained eaters also scored higher on the BIS scale than low restrained eaters, which means that restrained eaters are more anxious in general.

The present findings suggest that a basic deficit in motor response inhibition might underlie dysfunctional eating behaviour. Although no causal relation between a deficit response inhibition and impulsive eating has been established, it seems probable that for subjects who cannot stop responses very well, it is easier to develop dysfunctional eating patterns. Temptation of immediate gratification and uncontrolled emotions will prevail above rational decisions. The idea of a basic inhibition problem can also explain the co-morbidity with other impulsive behaviours.

Multi-impulsivity is related to worse treatment outcomes in bulimic patients (Sohlberg, 1991), and an important question is whether impulsivity or deficits in response inhibition, which is a hard-wired, biological based trait, can ever be changed. Therapy, or even drugs, which can improve response inhibition, should also improve eating disordered behaviour and might prevent the development of eating disorders. Indeed, some pilot studies show that treatment of bulimia nervosa with methylphenidate, a drug usually given to cases of attention deficit hyperactivity disorder (ADHD), might be effective (Schweickert, Strober, & Moskowitz, 1997; Sokol, Gray, Goldstein, & Kaye, 1999). Children with ADHD show deficits on the stop-signal task, comparable with the restrained eaters in this study (Schachar et al., 1995). However, this field is relatively unexplored. So far it can be concluded that a fundamental lack of general response inhibition is a main feature in impulsive eating behaviours, and this knowledge might be a suggestion for improvements of therapies for eating disorders.

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