Effects of High Calorie Preloads on Selective Processing of Food and Body Shape Stimuli Among Dieters and Nondieters

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Preloaded and nonpreloaded dieters (restrained eaters) and nondieters (unrestrained eaters) completed a modified version of the Stroop task to measure selective biases in cognitive processing. In two separate studies, a milkshake preload led to increased cognitive interference for body shape words, especially for restrained eaters. There were no differences between restrained and unrestrained eaters in Stroop interference for either common or forbidden food words, whether subjects were preloaded or not. Taken together, these results indicate that chronic dieting is associated with selective processing of body shape words. © 1993 by John Wiley & Sons, Inc.

Although the situational determinants of binge eating are well known (e.g., emotional distress or caloric preloading; cf. Heatherton & Baumeister, 1991; Heatherton, Polivy, & Herman, 1990; Ruderman, 1986), an understanding of the mental processes that underlie the binge phenomenon has remained elusive. Initial explanations of such overeating involved notions of loss of control (Herman & Mack, 1975), the mislabelling of emotional experiences (Bruch, 1961), and the importance of stimulus triggers (Schachter, 1971). More recent conceptualizations have focused on the motivational and mechanistic aspects of the binge. For example, various authors have proposed that the binge episode is a mechanism by which the binge eater gains control over or escapes from unpleasant emotions or painful self-awareness (Fairburn, Cooper, & Cooper, 1986; Heatherton & Baumeister, 1991; Herman & Polivy, 1988; Johnson & Connors, 1987).

In an attempt to understand better the binge process, researchers have focused recently on the thought processes of those who engage in binge eating.¹ There are a number of reasons for an interest in cognitive processes. First, a variety of evidence indicates

¹The term binge eater refers to individuals who engage in binge eating behaviors, such as chronic dieters or bulimia nervosa patients. Although these groups differ in a number of important ways, they share the common characteristic of binge eating, and are similar in a number of other ways (see Heatherton & Baumeister, 1991).
that the control of eating among binge eaters has a large cognitive component. For example, beliefs about the caloric content of food are more important than the actual caloric content in producing disinhibited eating (Knight & Boland, 1989; Polivy, 1976; Spencer & Fremouw, 1979). Similarly, Heatherton, Polivy, and Herman (1989) found that restrained eaters, but not unrestrained eaters, were susceptible to placebo effects of hunger state, eating more when told a placebo would make them feel hungry than when told a placebo would make them fell full. These results were interpreted as indicating that the eating of restrained eaters (who are known for their binge eating) is more dependent on cognitive cues than on physiological cues (see also Herman & Polivy, 1984).

A second reason for an interest in thought processes is that many binge eaters apparently hold a variety of distorted beliefs (Bauer & Anderson, 1989; Fairburn et al., 1986; Garner & Bemis, 1982; Ruderman & Grace, 1987). For example, Johnson and Connors (1987) outlined a number of common cognitive distortions that are observed in bulimia nervosa patients, such as faulty attributions, personalization, magnification, dichotomous thinking, filtering, overgeneralization, and magical thinking. Similarly, restrained eaters often engage in dichotomous thinking (e.g., all-or-none dieting), and are known to hold a variety of irrational beliefs (Heatherton & Baumeister, 1991; Ruderman, 1985). A third reason for an interest in the mental processes that accompany binge eating is that successful therapeutic interventions for eating disorders often include a substantial treatment component devoted to challenging and correcting faulty interpretations (e.g., Giliska, 1990). Thus, an understanding of the cognitive processes that underlie binge eating has both theoretical and clinical implications.

Given this importance, it is surprising that there have been relatively few systematic examinations of cognitive processes associated with binge eating (Vitousek & Hollon, 1990). Thus, although most theories propose that cognitive distortions or biased processing promotes or exacerbates problems with eating, there are relatively few empirical studies that illustrate the precise nature of these biases or distortions, or the conditions under which they operate. The goal of this research was to examine the association between selective processing of food and body shape stimuli and chronic dieting.

The current research uses the Stroop test to measure biases in cognitive processing. The original Stroop test involves naming ink colors of words while ignoring the content of the incompatible color words themselves (Stroop, 1935). The Stroop effect occurs when the word-reading response interferes with and slows down the color-naming response (MacLeod, 1991). The Stroop test can also be used as a subtle and indirect measure of cognitive biases, such as the relatively automatic interference caused by self-relevant stimuli ( Bargh, 1982). To the extent that individuals are threatened by or automatically focused on certain stimuli, these stimuli will interfere with color naming and produce greater Stroop interference (this occurs because such information receives a greater amount of cognitive processing, thereby slowing down color naming). Thus, delays in color naming can indicate the extent to which individuals are biased towards or threatened by specific stimuli.

The Stroop task has been used to examine cognitive processing biases among those suffering from eating disorders. Channon, Hemsley, and de Silva (1988) administered a modification of the Stroop task (with body shape and food words) to anorexia nervosa patients and control subjects and found that anorexic patients exhibited greater interference for food words, but not for body shape words. Ben-Tovim, Walker, Fok, and Yap (1989) found that both anorexic and bulimic patients had significantly greater interference on food words than did a control group. However, they found that al-
though bulimic subjects experienced significant interference from the body shape words, the anorexics and control subjects did not. In a related study, Ben-Tovim and Walker (1991) demonstrated that bulimia nervosa patients and anorexia nervosa patients displayed greater selective biases in the processing of food and shape words than did non-eating-disordered adolescents who were either high or low in drive for thinness. Fairburn, Cooper, Cooper, McKenna, and Anastasiades (1991) found that bulimia nervosa patients show selective processing on a list of combined food, shape, and weight words (see also Cooper, Anastasiades, & Fairburn, 1992). Thus, it appears that the Stroop task can be used to measure some types of cognitive biases successfully in those with eating disturbances.

The current study sought to extend these earlier findings in a number of ways. First, we were interested in examining whether chronic dieters (called restrained eaters) would show the same interference patterns as those with clinical eating disorders. Second, we were interested in examining whether the Stroop task could be used to elucidate mental processes that accompany disinhibited eating. One common method of disinhibiting restrained eaters is to preload them with high calorie foods (Herman & Mack, 1975; see review by Ruderman, 1986). Thus, we speculated that a diet-breaking preload might influence the thought processes of restrained eaters. Accordingly, we gave milkshake preloads to restrained and unrestrained eaters and compared their performance on modified Stroop tasks to comparable groups that had not been preloaded. To the extent that restrained eaters behave in ways similar to those with clinical symptoms of eating disorders, we expected them to show greater interference on the food and body words than do unrestrained eaters. Moreover, we anticipated that the preload would increase interference in Stroop scores for restrained eaters on the body and food words, but we did not expect this manipulation to have much, if any, impact on unrestrained eaters.

STUDY 1 METHOD

Subjects
Subjects were 47 female Harvard students whose primary language was English. Subjects were recruited by way of sign-up posters. Each subject participated in one 40- to 50-minute experimental session, and received $5.00 for her participation. Subjects were classified as chronic dieters if they scored 16 or higher on the Restraint Scale (Herman & Polivy, 1980), according to previous custom (with 15 or 16 being the previous values used in restraint research). There were no significant differences in body mass index (BMI) between restrained \( M = 22.2 \) and unrestrained eaters \( M = 21.8 \), \( t < 1 \).

Materials

Stroop Task
The color-naming stimuli consisted of words written on cards in different colored inks. Each modified Stroop card consisted of a set of 12 words, presented 8 times in randomized order (i.e., 12 words per line, 8 lines). Each card thus had 96 words, presented in four colors—red, green, blue, and purple—with no color appearing more than twice consecutively in each line. Food, body-size, and neutral words were those used by
Channon et al. (1988); neutral words were matched with food and body-size words on frequency, length, number of syllables, and part of speech (noun or adjective). There were six color-naming tasks altogether: (1) control color Stroop (asterisks "∗" written in series in place of words), (2) color conflicting color Stroop (words: "red," "green," "blue," and "purple" printed in incompatible colors), (3) food Stroop (words: "food," "dinner," "baker," "sugar," "meal," "butter," "cream," "toast," "picnic," "potato," "cake," "sandwich"), (4) control food Stroop (neutral words: "hall," "record," "ocean," "pencil," "lane," "powder," "clock," "brass," "shower," "piano," "boot," "luggage"), (5) body-size Stroop (words: "large," "figure," "heavy," "weight," "shape," "fat," "stomach," "massive," "waist," "monstrous," "hips," "bulky"), (6) control body-size Stroop (neutral words: "far," "morning," "easy," "source," "rose," "harbor," "sky," "gentle," "gift," "hopeful," "print," "carefree"). Before each set of tasks, subjects were given one practice line to read. For all six tasks, subjects were instructed to name the colors as quickly and as accurately as possible. The total time for each task was recorded in seconds. Subjects always completed the standard Stroop task first, followed by the food Stroop task, and then the body Stroop task. The control cards were presented with the target cards in counterbalanced fashion (i.e., half the subjects completed the target card first, the other half completed the control card first). Thus, because Stroop scores for each target card were computed by a comparison to its own control card, practice effects would be cancelled out by the ordering procedure.

Procedure

Subjects were informed that the experiment was designed to investigate the effects of personality on perceptual vividness. After completing a consent form, half of the subjects were randomly assigned to the experimental condition, and were required to drink a 15-oz chocolate milkshake, being told that this was necessary to "ensure that everyone begins with the same internal state"; the other half of the subjects did not receive milkshakes. Next, all subjects completed the "perceptual task," which consisted of the six parts of the Stroop. Finally, subjects completed the Restraint Scale and some postexperimental questionnaires.

RESULTS

A series of analyses revealed that there were no initial differences as a function of dieting status or condition on initial hunger ratings or in the amount of time since subjects had last eaten (all Fs < 1).

Stroop interference for the standard Stroop and the modified Stroops were calculated by subtracting the subject's time in seconds on the control card from the time on the conflicting cards. Thus, positive numbers represent greater interference. A series of three two-way analyses of variance (ANOVAs) were conducted to assess the influence of restraint status and condition on the three Stroop interference measures. These analyses revealed no main effects or interactions of restraint and condition on either the standard Stroop task or on the food words (all ps > .10). However, the analysis on the body words revealed a main effect of condition, \( F(1,43) = 4.07, p < .05 \), in which the preload led to increased interference \( (M = 0.01) \) compared to the no preload condition \( (M = -0.013) \). As may be seen in Table 1, this effect is attributable primarily to the restrained subjects. Although the interaction between restraint and condition was non-
significant ($F < 1$), we had predicted that this effect would occur primarily for restrained eaters. A specific analysis of this prediction shows that the preload led to increased interference for chronic dieters, $t(43) = 2.17$, $p < .05$, but only marginally so for nondieters, $t(43) = 1.85$, $p < .10$.$^2$

**DISCUSSION**

As expected, preloading restrained eaters increased interference on some aspects of a revised Stroop task. However, these effects were not entirely as anticipated and unrestrained eaters also appeared to be affected by the preload. Both restrained and unrestrained eaters experienced more interference from the body words when they had been preloaded than when they had not received a preload, although this effect occurred primarily for restrained subjects. These results indicate that consuming a high calorie preload had effects on the thought processes of most subjects, and not just on those who had inhibitions about eating.

Although these results were quite interesting to us, we were surprised that there were no significant differences between restrained and unrestrained subjects on food or body words in the no preload condition. Moreover, it was surprising that there was no interference of the milkshake on the processing of the food words. Thus, our results differ from those obtained using subjects with clinical eating disorders. We propose that there are two possible reasons for these differences. First, it is possible that chronic dieters process information about food issues differently from those with clinical eating disorders. Restrained eaters differ from bulimics and anorexics in many ways (Polivy, 1989), especially in terms of psychopathology unrelated to eating (Heatherton & Baumeister, 1991). Thus, cognitive interference on the Stroop task by food words might be limited to those with more serious eating problems. Alternatively, it is possible that the food words were not very meaningful for restrained eaters. Channon's words (Channon, Hemsley, & de Silva, 1988) were common foods (such as picnic, food, po-

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**Table 1. Seconds of Stroop interference in study 1**

<table>
<thead>
<tr>
<th></th>
<th>Unrestrained No Preload</th>
<th>Preload</th>
<th>Restained No Preload</th>
<th>Preload</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M(s)$</td>
<td>34.6</td>
<td>30.4</td>
<td>31.4</td>
<td>36.8</td>
</tr>
<tr>
<td>$SD$</td>
<td>11.3</td>
<td>13.7</td>
<td>7.9</td>
<td>6.9</td>
</tr>
<tr>
<td><strong>Food words</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M(s)$</td>
<td>2.7</td>
<td>1.7</td>
<td>1.2</td>
<td>2.0</td>
</tr>
<tr>
<td>$SD$</td>
<td>5.2</td>
<td>6.2</td>
<td>5.4</td>
<td>4.6</td>
</tr>
<tr>
<td><strong>Body words</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M(s)$</td>
<td>-0.9</td>
<td>1.8</td>
<td>1.1$^*$</td>
<td>5.1$^*$</td>
</tr>
<tr>
<td>$SD$</td>
<td>5.2</td>
<td>6.4</td>
<td>3.4</td>
<td>6.0</td>
</tr>
</tbody>
</table>

$^*$Means within this row are significantly different, $p < .05$.

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$^2$Some researchers recommend examining the subfactors of the Restraint Scale, concern for dieting (CD), and weight fluctuations (WF). Such an analysis (Factor X condition) reveals that both WF and CD have marginal effects on the body interference score (both $p s < .08$), and neither CD nor WF had an effect on the food interference score ($F s < 1$), nor were there any interactions between the factors and condition on food or body interference scores. Moreover, there was no effect of any measure of body weight (i.e., BMI) on these results.
tato) rather than fattening or forbidden foods. Given that only some types of food promote disinhibited eating among restrained eaters (Knight & Boland, 1989), we speculated that interference might only occur if the foods were forbidden. Accordingly, we decided to attempt to replicate and explore further the findings from Study 1. We changed the words on our food list from common food words to forbidden food words. We predicted that we would again find increased interference on the body words (especially for dieters) in the preload condition and we also expected to find interference for the forbidden food words following a preload, but only for restrained eaters.

**STUDY 2 METHOD**

**Subjects**

Subjects were 48 female Harvard undergraduate students whose primary language was English. Each subject participated in one 30- to 50-minute experimental session, and received $5.00 for her participation.

**Procedure**

Materials, measures, and procedure were similar to Study 1, with only one major change: the food Stroop card and its corresponding control card were revised. High calorie food words were chosen to be ones rated as highly forbidden (dietary) items, based on the work of Knight and Boland (1989), and corresponding neutral words were selected to match the food words on frequency (according to Kucera & Francis, 1967), length, number of syllables, and part of speech (noun or adjective). The food words were: "fudge," "cookies," "candy," "sugar," "pie," "butter," "cream," "chips," "pastry," "donut," "cake," "pudding." The corresponding control words were: "crypt," "actress," "alarm," "ocean," "pit," "holder," "clock," "bulbs," "poster," "camel," "boot," "kleenex."

**RESULTS**

The results of Study 2 were similar to those found in Study 1. For instance, there were no main effects nor interactions of restraint and condition on food word interference. Similarly, as in Study 1, there was a significant effect of condition on body word interference, \( F(1,44) = 5.40, p < .03 \), such that preloaded subjects experienced more interference (\( M = 3.1 \)) than nonpreloaded subjects (\( M = -1.4 \)). Again, the expected influence of preload on body interference was significant for dieters, \( t(44) = 2.61, p < .05 \), but not for nondieters, \( t(44) < 1 \), and again, the interaction between restraint and condition did not reach significance (see Table 2). An examination of the means (see Table 2) indicates an interesting pattern in which restrained subjects were faster on the body words than the control words in the no-preload condition, whereas the opposite occurred in the preload condition. In fact, 91.7% of restrained subjects were faster on the body words than on the control words in the no-preload condition, whereas the opposite occurred in the preload condition. In fact, 91.7% of restrained subjects were faster on the body words than on the control words in the no-preload condition, compared to only 33.3% of unrestrained subjects who were faster on the body words in the no-preload condition, \( \chi^2(1, N = 48) = 8.71, p < .005 \). In the preload condition, there were no significant differences in the number of restrained (28.6%) or unrestrained (50%)
Table 2. Seconds of Stroop interference in study 2

<table>
<thead>
<tr>
<th></th>
<th>Unrestrained</th>
<th>Restrained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Preload</td>
<td>Preload</td>
</tr>
<tr>
<td><strong>Standard</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M(s)</td>
<td>33.5*</td>
<td>32.1</td>
</tr>
<tr>
<td>SD</td>
<td>7.3</td>
<td>8.2</td>
</tr>
<tr>
<td><strong>Food words</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M(s)</td>
<td>2.7</td>
<td>1.5</td>
</tr>
<tr>
<td>SD</td>
<td>5.3</td>
<td>5.3</td>
</tr>
<tr>
<td><strong>Body words</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M(s)</td>
<td>1.4</td>
<td>3.7</td>
</tr>
<tr>
<td>SD</td>
<td>4.6</td>
<td>9.9</td>
</tr>
</tbody>
</table>

*Means within this row are significantly different, $p < .05$.

subjects who were faster on the body words than control words, $\chi^2(1, N = 48) = 1.14$, $p = ns$.

One surprising finding in Study 2 was that there was a main effect of restraint status on the standard Stroop scores, such that dieters were faster (experienced less Stroop interference) than nondieters, $F(1,44) = 4.37, p < .05$. Further analysis revealed that this was true in the no-preload condition, $t(44) = 2.81, p < .05$, but not in the preload condition, $t < 1$.

**DISCUSSION**

The findings from Study 2 were quite consistent with those from Study 1. In both studies, a caloric preload produced increased interference on Stroop performance for body words, and in both studies this effect occurred primarily for chronic dieters. There were no significant differences between dieters and nondieters—or between caloric conditions—on the food words. Thus, it did not appear to matter whether the food words represented forbidden or common foods; neither list produced color-naming interference.

The effect on the body words indicates that high calorie milkshakes activate body shape concerns, especially for dieters (as demonstrated by the significant CD by condition interaction in Study 2, see Footnote 3). In both studies, and as was predicted, a milkshake preload interfered with Stroop performance on body words to a greater extent for dieters than for nondieters. An interesting pattern that emerged in Study 2 suggests that nonpreloaded dieters might have been attempting to suppress or avoid thoughts of body shape. That is, when they had not been preloaded, dieters showed a *facilitation* of Stroop performance on the body words, which indicates that dieters might

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3An examination of the subfactors reveals some interesting patterns that largely replicate the findings obtained using the whole scale. There were no main effects of CD or WF on food Stroop interference or body Stroop interference ($Fs < 1$). However, there was a significant interaction between CD and condition on body words, $F(1,44) = 4.69, p < .05$ (but not for WF and condition, $F < 1$). One hundred percent of those scoring above the median on CD were faster on the body than the control words in the no-preload condition whereas in the preload condition the opposite happened; 78.6% of those high in CD became slower on the body than control words following a preload, $\chi^2(1, N = 21) = 11.55, p < .001$. When subjects are divided by a median split on WF, the parallel analysis is marginally significant, with 72.7% of the high WF faster in the no-preload condition on body words compared to 66.7% who are slower after a preload, $\chi^2(1, N = 20) = 3.10, p < .08$. As in Study 1, there were no effects of body weight on any of these results.
have been actively trying to avoid thinking about their bodies. This fits in well with Heatherton and Baumeister's (1991) theory that chronic dieters are motivated to avoid self-awareness. However, because this finding did not emerge in Study 1, it must be viewed with caution.

The lack of significant effects of the preload on food words for either restrained or unrestrained eaters indicates that chronic dieters do not appear to have the same cognitive biases regarding food words as have been reported for those with clinical eating disorders. Whereas a number of researchers have found increased cognitive interference among anorexics and bulimics for food words (Ben-Tovim et al., 1989; Ben-Tovim & Walker, 1991; Channon et al., 1988; Cooper et al., 1992; Fairburn et al., 1991), we obtained no evidence for cognitive biases in the processing of food words for either dieters or nondieters. Moreover, preloading subjects with high calorie milkshakes did not increase Stroop interference for food words. Thus, it appears that neither dieters nor nondieters show selective biases in cognitive processing of food words. Moreover, it appears that high calorie preloads do not promote selective biases among these nonclinical subjects. This was surprising because Channon and Hayward (1990) found that a 24-hour fast increased selective biases in non-eating-disordered controls (note that there were no significant differences between our restrained and unrestrained eaters on hunger level). Hence, it is possible that hunger and satiety have different effects on the processing of food stimuli.

One unexpected finding in the current research was that chronic dieters performed better than nondieters on the standard Stroop task. Such a finding is reminiscent of early research that showed that obese individuals outperformed normal weight individuals on a variety of cognitive tasks (e.g., Rodin, 1975). This result was interpreted in a number of different ways, such as being due to increased externality, the effects of social desirability, or increased basal levels of arousal. In a related series of studies, Herman, Polivy, Pliner, Threlkeld, and Munic (1978) proposed that restrained eaters were more distractible on proof-reading tasks than unrestrained eaters because they were hyperaroused (or hyperarousable), and a later study by Polivy, Herman, and Warsh (1978) also indicated that restrained eaters behaved in ways indicative of heightened levels of chronic arousal. Because increased arousal levels lead to superior Stroop performance (Agnew & Agnew, 1963), it does seem possible that restrained eaters might have outperformed unrestrained eaters on the standard Stroop task because of higher levels of chronic arousal. Thus, future studies should consider the possible influence of arousal on Stroop task performance.

This study is the first to examine the effects of high calorie preloads on thoughts about food and body shape. Although the method apparently was effective in eliciting some selective biases, a refinement in the method of Stroop presentation might increase the sensitivity of these measures. For instance, the procedures used by McNally, Riemann, and Kim (1990) for panic disorder and by Gotlib and McCann (1984) for depression use a computerized stimulus presentation. Such a method might allow for a more sensitive test of the effects of preloads and other common disinhibitors (such as distress). Moreover, such a technique might be useful for testing hypotheses derived from the eating disorder literature. For instance, one could examine the effect of preloads on other aspects of psychological functioning, such as whether diet-breaking preloads activate feelings of social rejection or low self-esteem.

In summary, this research demonstrated that high calorie preloads led to selective processing of body shape words. Moreover, this effect occurred primarily for individuals who chronically restrain their eating and who are concerned about body image.
Thus, these studies provide some initial indication of how preloads might promote disinhibited eating. For instance, caloric preloads may heighten awareness of body dissatisfaction and thereby promote attempts to escape self-awareness. Future research should examine the relation between preloads and the activation of other weight-related schematic information (Markus, Hamill, & Sentis, 1987). Such information may have treatment implications, and may also further our understanding of the basic cognitive processes that lead to binge eating behaviors.

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REFERENCES


