The Impact of Emotion upon Eating Behavior:  
The Role of Subliminal Visual Processing of  
Threat Cues

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Abstract: Objective: Previous research has demonstrated that subliminal threat cues can influence eating behavior. The present study examined whether this effect is due to general emotional activation (by comparing positive and negative emotional cues), whether it is a product of specific negative emotional activation, and whether it can be achieved by activating appetite-related schemata. Method: One hundred women avoided food for at least 4 hr and then completed a task where they were exposed to one of five subliminal visual cues. The dependent variable was the amount eaten subsequently. Results: Women who were exposed to the abandonment cue (lonely) ate significantly more than those who were exposed to the neutral cue (gallery), the positive emotional cue (happy), or the appetitive cue (hungry). Those with unhealthy eating attitudes also ate more after the hostile emotion cue (angry) than after the neutral cue. Conclusions: The results support cognitive models that stress an important role for threat processing in the facilitation of eating, rather than models advocating the centrality of food-related information. Abandonment schemata appear to be activated at an earlier stage than appetite-related schemata. © 1999 by John Wiley & Sons, Inc. Int J Eat Disord 25: 319–326, 1999.

Key words: subliminal cues; eating behavior; cognitive models

INTRODUCTION

Cognitive theories of bulimia nervosa have long stressed the centrality of food-, shape-, and weight-related concerns (Fairburn, 1997). Such theories have influenced the development and practice of cognitive-behavioral therapy for bulimia nervosa and related disorders (Fairburn & Cooper, 1989; Wilson, Fairburn, & Agras, 1997), with its focus on food-related cognitions. However, it has been suggested that this model is too simplistic (Cooper, 1997a). In particular, clinicians and researchers have suggested that overeating can serve the function of reducing an individual’s awareness of intolerable cognitions and

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emotions (Lacey, 1986; McManus & Waller, 1995; Root & Fallon, 1989). This model of emotionally driven eating has received support from research showing that women with bulimic attitudes and disorders show attentional biases towards self-directed ego threats (McManus, Waller, & Chadwick, 1996; Waller, Watkins, Shuck, & McManus, 1996) as well as the well-replicated bias towards food- and shape-related cues (Cooper, 1997b; Schotte, McNally, & Turner, 1990). It is also apparent that bulimic women have an attentional bias towards negative emotion words (Reiger et al., in press). Overall, these findings suggest that bulimic psychopathology is associated with overelaborated cognitive representations (schemas) of both food- and threat-related information.

The majority of studies providing evidence for threat sensitivity in bulimia have used conscious processing tasks, where the threat cue is readily perceived and consciously processed. However, studies using subliminal processing tasks suggest that the effects of emotionally threatening information can occur preconsciously (i.e., without conscious awareness). Subliminal tasks are thought to control for demand characteristics and the conscious motivations of the individual. Similarly, it is claimed that subliminal presentation of stimuli bypasses defense processes, thus allowing a direct measure of the behavioral effects of cues (Silverman, 1983). Two paradigms have been used to assess the impact of subliminal cues—dichotic listening and brief visual presentation. Dichotic listening tasks involve shadowing an “attended” message in one ear, while an “unattended” message is given in the other ear. The participant is then asked to respond to target words within either message. Schotte et al. (1990) found that bulimic women detected the target word (fat) more often than a neutral word (pick) within the unattended message. They concluded that this result demonstrates the centrality of shape- and weight-related cognitions in the disorder. However, the validity of dichotic listening tasks has been questioned, since it is not clear whether the unattended message consistently achieves unawareness (Treisman, Squire, & Green, 1974).

The most reliable and valid methodology used to assess the impact of preconscious cues is the subliminal visual processing task (Trandel & McNally, 1987). Such tasks involve the presentation of very brief (usually 4 ms) stimuli, which are below the individual’s level of awareness. At this presentation time, participants report being unable to see any stimulus (Weinberger & Hardaway, 1990). Despite this lack of perception, several studies have found that visual cues presented subliminally can directly affect conscious experience (Brewin, 1988; Wells & Matthews, 1994). To date, two studies have used subliminal visual methods to influence eating behavior.

Patton (1992) used a subliminal visual processing task in order to assess the impact of preconscious threat cues on eating behavior. The task involved subliminal presentation of either an abandonment message (Mama is leaving me) or a neutral message (Mama is loaning it). In a subsequent bogus taste discrimination task, women with unhealthy eating attitudes ate significantly more if they had been exposed to the abandonment message. Patton suggested that the central issue in determining her results was the women’s abandonment fears and she concluded that binge eating is one method used to alleviate such concerns. Although this explanation is compatible with other models of bulimic psychopathology (Lacey, 1986), several methodological issues must be addressed. First, in Patton’s study, it is possible that the increase in eating reflected a difficulty in decision-making rather than an avoidance of threat per se. Second, it is possible that the overeating reflected a response to threat processing in general, rather than a specific fear of abandonment. Third, Patton’s study did not assess the effects of food-related cues on the facilitation of eating. Finally, it is possible that Patton’s results were specifically due to the use of a maternal cue, rather than abandonment per se.
The first two of these methodological issues were addressed in the second such study. Waller and Mijatovich (in press) used the messages “Mum sees me” (neutral), “Mum hurts me” (physical threat), and “Mum hates me” (ego threat). In order to avoid the potential confounding impact of disrupted decision-making, the researchers simply left the individual alone with the opportunity to eat (rather than using a taste discrimination task). They found that women with unhealthy eating attitudes ate more following exposure to both physical and ego threats, but particularly following the ego threat cue.

In summary, previous research has suggested that the subliminal presentation of maternal abandonment and ego threat cues facilitates eating in women with bulimic eating attitudes. However, these studies have not assessed the full range of cues that might be expected to have an impact on eating behavior. Reiger et al. (in press) suggest that one should test the hypothesis that eating behavior is a correlate of general activation of emotional schemata (i.e., that eating would occur in response to positive emotional cues as well as to negative cues). It is also clear from recent models of bulimia (Cooper, 1997a; McManus & Waller, 1995) that one should consider the possibility that eating behavior can be stimulated by exposure to an appetitive cue.

The aim of the current study is to test the hypothesis that the subliminal visual activation of threat-related schemata stimulates eating in nonclinical women, particularly those with unhealthy eating attitudes. In order to remove the relationship context (mother) from the cues, single-word stimuli will be presented. Five such cues will be used: neutral (gallery); appetitive (hungry); positive emotion (happy); hostile emotion (angry); and abandonment (lonely). The use of positive and negative emotion cues will determine whether overeating is a specific consequence of negative emotional stimulation (hostile; abandonment), rather than a response to general emotional arousal. Given Patton’s (1992) findings, it is predicted that eating will be facilitated by exposure to the abandonment cue. Waller and Meyer’s (in press) findings suggest that the women will eat more following exposure to the hostile cue. No specific predictions are made regarding the impact of the positive emotion and appetitive cues.

**METHOD**

**Design**

This was an independent sample experimental study using a nonclinical female population. First, the participants were asked to complete a self-report measure of eating psychopathology and were assigned to one of two groups (healthy vs. unhealthy eating attitudes). Second, each participant was presented with one of five subliminal stimuli. The dependent variable was the amount of food consumed during the subsequent 5 min.

**Participants**

The participants were 120 female university students. All were volunteers who received no payment or course credits for taking part. They were recruited either from a psychology department or from university halls of residence.

**Measures and Procedure**

**Selection of Experimental Groups (Stage 1)**

Initially, 120 women completed a shortened version of the Eating Disorders Inventory (EDI; Garner, 1991). This consisted of the three EDI subscales that directly reflect eating-
related attitudes and behavior (Drive for Thinness, Bulimia, and Body Dissatisfaction). The women’s total scores on these subscales were used to divide them into a high-EDI group (with relatively unhealthy eating attitudes) and a low-EDI group (with relatively healthy eating attitudes). This procedure and these scales have previously been used for this purpose by Patton (1992) and Waller and Mijatovich (in press). The 50 women with the highest scores ($M = 27.7$; $SD = 7.79$; range = 18–50) were allocated to the high-EDI group and the 50 women with the lowest scores ($M = 5.40$; $SD = 3.45$; range = 0–12) were allocated to the low-EDI group. The mean age of women in the healthy eating attitudes group was 20.5 years ($SD = 3.87$) and the mean age of women in the unhealthy eating attitudes group was 20.0 years ($SD = 3.45$, $t = 0.06$, NS). These 100 women then went on to take part in Stage 2 of the study (the subliminal processing task). Stage 2 took place at least a week after Stage 1 to avoid priming effects. During this second stage, the women were told that the study was designed to test their ability to perceive stimuli when they were mildly hungry. Therefore, they were required not to eat for at least 4 hr prior to the task. This abstinence was confirmed on arrival at the testing laboratory.

**Subliminal Processing Task (Stage 2)**

The processing task was designed to assess the impact of different types of subliminal stimuli on eating behavior. A tachistoscope was used to provide very brief presentation of the stimuli. The participants were told that the experimenter would flash words in the center of the tachistoscope screen very quickly and that the words would be very hard to see. At the beginning of the task, a mask slide was visible with a fixation box (consisting of a rectangular array of four white circles, which was 2 cm high × 10 cm wide). The mask was removed and a single-word stimulus was presented in the center of the fixation box for a duration of 4 ms. Immediately following exposure to the stimuli, the mask slide was again visible. This stimulus was presented 10 times, separated by 5-s intervals. Following these exposures to the stimulus, the women were asked to report whether they could see the word. None of them reported being able to do so.

**Subliminal Stimuli**

The 100 participants were allocated to one of five conditions describing the nature of the subliminal cue used (neutral, appetitive, positive emotion, hostile emotion, abandonment). Ten high- and 10 low-EDI women were allocated to each condition. Each participant was exposed to only one of the five words: gallery (neutral); hungry (appetitive); happy (positive emotion); angry (hostile emotion); or lonely (abandonment). These words were matched for frequency of English usage using the criteria of Johansson and Hofland (1989).

**Eating Behavior**

Following exposure to the subliminal stimuli, the participants were told that the experimenter needed to leave the room to set up a further task. Upon leaving, the participant was told: “In case you are hungry after not eating for so long, there are some crackers for you.” A bowl containing 200 g of cheese-flavored crackers (Mini Cheddars; calorific value = 224 kcal per 100 g) was placed on the desk in front of the participant. After exactly 5 min, the experimenter returned and explained that there was no need to continue with the next stage of the study. It was also explained that the participant would be debriefed once all Stage 2 trials were complete. All participants agreed that this was acceptable. Following completion of all Stage 2 trials, the participants received a letter explaining the
full aims of the study. They were given a contact number and told to contact the experimenter should they have any questions.

**Data Analysis**

The data were not normally distributed. Therefore, nonparametric statistical analyses were used. First, Mann-Whitney tests were used to compare the differences in the amount eaten by the high- and low-EDI groups in each condition (i.e., following each of the five types of word). Second, Kruskal-Wallis analyses of variance (ANOVAs) were used to compare the amount eaten following exposure to each cue. These ANOVAs were conducted for each of the two groups and for the group as a whole. Where there was a significant main effect on a Kruskal-Wallis test, Mann-Whitney multiple comparisons ($p < .05$) were used to determine the specific pairwise differences that were responsible for the overall effect.

**RESULTS**

Table 1 shows the amount eaten (grams of crackers) by each group and by the whole sample following each of the five subliminal cues. It also shows the results of the statistical analyses. There were no significant differences in the amount eaten by the high- and low-EDI groups following exposure to any word type.

When considering the mean amount eaten by the women under the five conditions, the largest quantity was eaten by the women who had been exposed to the two negative emotion cues (angry and lonely). Taking the sample as a whole, the results of the Kruskal-Wallis test indicate that there was a significant difference in the amount eaten by the women following exposure to the different subliminal cues. Mann-Whitney multiple comparison tests ($p < .05$) showed that this overall difference was due to the women eating more following the subliminal abandonment cue than after the neutral, appetitive, or positive emotion cues. The amount eaten following the hostile cue was higher than after

<table>
<thead>
<tr>
<th>Group</th>
<th>Mann-Whitney*</th>
<th>Overall</th>
<th>Low-EDI</th>
<th>High-EDI</th>
</tr>
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<tbody>
<tr>
<td>Neutral (gallery)</td>
<td></td>
<td>9.20</td>
<td>12.2</td>
<td>6.20</td>
</tr>
<tr>
<td>(SD)</td>
<td></td>
<td>(10.4)</td>
<td>(12.8)</td>
<td>(6.70)</td>
</tr>
<tr>
<td>Appetitive (hungry)</td>
<td></td>
<td>8.60</td>
<td>9.20</td>
<td>8.00</td>
</tr>
<tr>
<td>(SD)</td>
<td></td>
<td>(6.91)</td>
<td>(4.92)</td>
<td>(8.70)</td>
</tr>
<tr>
<td>Positive emotion (happy)</td>
<td></td>
<td>10.7</td>
<td>10.0</td>
<td>11.4</td>
</tr>
<tr>
<td>(SD)</td>
<td></td>
<td>(11.9)</td>
<td>(7.80)</td>
<td>(15.4)</td>
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<tr>
<td>Hostile emotion (angry)</td>
<td></td>
<td>14.3</td>
<td>14.0</td>
<td>14.6</td>
</tr>
<tr>
<td>(SD)</td>
<td></td>
<td>(13.3)</td>
<td>(16.9)</td>
<td>(9.52)</td>
</tr>
<tr>
<td>Abandonment (lonely)</td>
<td></td>
<td>19.4</td>
<td>19.8</td>
<td>19.0</td>
</tr>
<tr>
<td>(SD)</td>
<td></td>
<td>(12.9)</td>
<td>(16.9)</td>
<td>(8.18)</td>
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Kruskal-Wallis test

<table>
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<tr>
<th>$X^2$</th>
<th>$p$</th>
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<tbody>
<tr>
<td>16.2</td>
<td>.003</td>
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</tbody>
</table>

Note: EDI = Eating Disorders Inventory.

*Comparing low- and high-EDI groups.
the neutral, appetitive, and positive emotion cues, and lower than the amount eaten after the abandonment cue. However, those differences were not significant.

These analyses were then repeated for the two groups individually. The difference between amounts eaten was not significant for the low-EDI group, but there was a reliable overall difference between the conditions for the high-EDI group. Mann-Whitney multiple comparison tests ($p < .05$) showed that this was due to the high-EDI women eating significantly more after the abandonment cue than after the neutral, the appetitive, or the positive emotion cues. They also ate significantly more after the hostile cue than after the neutral cue. However, it should be remembered that the differences between the two groups under each condition were minimal. Therefore, it is probably more appropriate to treat the results as applying to the group as a whole, rather than stressing the different patterns across the high- and low-EDI groups.

**DISCUSSION**

The aim of this study was to determine whether the subliminal activation of threat-related schemata stimulates eating in nonclinical women with unhealthy eating attitudes. There were three central findings, which partially support the original hypotheses. First, in support of Patton’s (1992) fear of abandonment hypothesis, women ate significantly more after exposure to the abandonment cue (lonely). This finding supports the hypothesis that the function of overeating may be specifically to reduce activation of abandonment schemata. Second, in support of Waller and Meyer’s (in press) findings, the high-EDI women ate more following exposure to the hostile emotion cue than following the neutral cue. Third, exposure to the positive emotion cue (happy) did not lead to an increase in eating relative to the neutral cue (gallery), indicating that eating is facilitated specifically by negative emotional stimulation rather than general emotional arousal (cf. Reiger et al., in press). Finally, exposure to the appetitive cue (hungry) did not lead to any greater level of eating. This finding supports cognitive models of bulimia that suggest a strong role for threat-related schemata (Heatherton & Baumeister, 1991), rather than those models advocating the centrality of food- and weight-related schemata (Fairburn & Cooper, 1989).

The findings are compatible with a cognitive model where overeating serves the function of reducing activation of abandonment schemata (Patton, 1992), and that these schemata are accessible via preconscious processing (Dixon, 1981). In contrast, the well-established food-related schemata (Cooper, 1997b; Schotte et al., 1990) do not appear to be activated in this way. This difference may relate to the functional utility of being able to detect specific forms of information at an early stage. For example, it may be necessary to detect threats early in order to initiate a successful dissociative or “blocking” response (such as overeating), while such a reaction to food-related information may have less functional utility.

The current experimental design differs from those of Patton (1992) and Waller and Mijatovich (in press) since the maternal context of the cue was removed. However, the current results showed a similar pattern of increased eating following the abandonment stimulus. Patton interpreted her findings as indicating that specific maternal abandonment schemata were activated and that this was the critical factor in the amount eaten. In contrast, the current findings suggest that the facilitation of eating might be due to the activation of more general abandonment schemata (particularly in women with unhealthy eating attitudes). There was also an effect (among the high-EDI group) of the hostile
emotion cue (angry). This suggests that overeating may be a response to activation of a broader range of negative schemata in women with greater levels of eating psychopathology. This is similar to the concept of ego threat (Heatherton & Baumeister, 1991). Recent research has demonstrated functional differences in the relationship between eating behavior and cognitive processing of different forms of threat (McManus et al., 1996; Waller & Meyer, in press). The use of different types of threat cues in future studies might clarify the links among different types of stimuli, activation of specific schemata, and eating behavior.

Although the current findings support previous work (Patton, 1992; Waller & Mijatovich, in press), all of these existing studies have used nonclinical populations. The amount eaten in this study was substantially less than the amount typically consumed during a binge episode. It will be important to repeat this study with clinical groups, where the target of study would be binge-eating behavior (with its concurrent feelings of loss of control), rather than a simple increase in the amount eaten. Such a paradigm might also be extended to develop our understanding of other impulsive behaviors such as alcohol and substance misuse. However, such clinical research raises clear ethical issues, which would require close attention.

In summary, it has been demonstrated that schemata relating to abandonment and loneliness can be activated rapidly relative to food-related schemata. Such activation leads to overeating, although clinical trials are necessary to determine whether this result applies to binge-eating behavior. Within clinical settings, it may be helpful to employ therapies that have the potential to reduce abandonment concerns (Young, 1994) rather than focusing exclusively on food- and shape-related issues.

REFERENCES


