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Analysis of an Anxiety Model and the Process of Change During Exposure Plus Response Prevention Treatment of Bulimia Nervosa

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An experimental analysis of an anxiety model of bulimia nervosa was conducted in five patients by examining the effects on various response systems of an exposure plus response prevention treatment paradigm. The major findings were: (a) During treatment sessions self-reported anxiety and the urge to vomit increased while subjects ate but declined after they stopped eating even though they were not allowed to vomit; (b) Except for one subject, heart rate did not show a parallel rise and fall during and after eating; (c) While eating, some subjects reported an increase in anxiety prior to an increase in the urge to vomit, while others reported that these two measures increased in tandem; (d) Across treatment sessions and phases, the amount of food consumed tended to increase, and the mean levels of anxiety and the urge to vomit tended to decrease. However, there was no evidence that increased eating was predicated on a prior reduction in anxiety, or vice-versa; (e) At the end of treatment four of the five subjects had either substantially reduced or completely stopped vomiting and binge-eating. Improvement on self-report measures of eating attitudes, depression, and self-esteem was also observed.

Although self-induced vomiting after eating is a commonly observed symptom in many anorexia nervosa patients (Casper, Eckert, Halmi, Goldberg, & Davis, 1980), women who are of normal weight, who do not otherwise starve themselves, also engage in habitual bouts of binge-eating and vomiting. Thus, this gorging-purging syndrome, sometimes called bulimia nervosa (Russell, 1979) or bulimarexia (Boskind-Lodahl, 1977), has been increasingly recognized as an independent disorder distinct both from anorexia nervosa and episodic binge-eating in obesity. Although the exact incidence in the general population is still unknown, recent estimates

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suggest that 5 to 10% or more of college women in the United States may be gorging and purging on a regular basis (Clement & Hawkins, 1980; Crowther, Chernyk, Hahn, Hedeen, & Zaynor, 1983; Halmi, Falk, & Schwartz, 1981; Schwartz, Thompson, & Johnson, 1982).

Women suffering from bulimia nervosa induce vomiting after binge-eating or after eating even small quantities of "forbidden" foods they consider dangerous (fattening). They report that thoughts about weight gain and body appearance are extremely anxiety provoking and that vomiting after eating certain foods reduces this anxiety. In an earlier paper (Rosen & Leitenberg, 1982) we hypothesized that vomiting in bulimia nervosa may serve an anxiety reducing function similar to compulsive handwashing and checking rituals in obsessive-compulsive neuroses. Accordingly, in line with recent developments in behavioral treatment of obsessive-compulsive neuroses, an exposure plus response prevention model of treatment for bulimia nervosa (eating frightening foods without allowing vomiting afterwards) might prove effective. Using a multiple baseline design in which exposure plus response prevention therapy sessions were provided in sequence for different food groups, we found preliminary support for this model (Gross, Leitenberg, & Rosen, 1982; Rosen & Leitenberg, 1982). A similar parallel has recently been drawn for anorexia nervosa, where after eating, compulsive exercise rather than vomiting was prevented (Mavissakalian, 1982).

The goal of the present study was to explore further this mode of treatment, focusing primarily on the process of change within and across successive exposure plus response prevention therapy sessions in five bulimia nervosa patients. In exposure-based treatments of any supposed anxiety disorder the question arises as to which components—subjective reports of anxiety, avoidance behavior, physiological arousal, self-statements pertaining to current fears and future expectations—change first, and what the relationship is between change in any one anxiety modality and another. Studies with phobic and obsessive-compulsive patients which have simultaneously measured various response systems on a session-by-session basis have yielded a variety of patterns, some synchronous and some not (cf., Barlow, Mavissakalian, & Schofield, 1980; Foa & Chambless, 1978; Foa & Goldstein, 1978; Grey, Sartory, & Rachman, 1979; Leitenberg, Agras, Butz, & Wincze, 1971; Marks, Marset, Boulougouris, & Huson, 1971; Rachman & Hodgson, 1974; Sartory, Rachman, & Grey, 1977). Although the implications of synchrony and/or desynchrony for long-term treatment outcome in either agoraphobia or obsessive-compulsive neuroses are still unknown, these studies do clearly reveal that anxiety reduction can be a consequence of prior behavioral change as well as vice versa. One purpose of the present study was to determine if the same holds true in treatment of bulimia nervosa. That is, if patients are prevented from their usual pattern of vomiting after eating, will anxiety and the urge to vomit eventually decline across sessions, and if so, before, simultaneous with, or after increased eating is observed?

A detailed analysis of multiple measures of anxiety obtained on a ses-

sion-by-session basis should also provide a further test of the anxiety model of bulimia nervosa and demonstrate how patients with this disorder respond to an exposure plus response prevention treatment paradigm. For example, although generally assumed to be the case, it has not yet been empirically confirmed that if vomiting is prevented, eating will, in fact, cause an increase in anxiety. Moreover, we do not know if this predicted rise in anxiety precedes or follows the urge to vomit. Similarly, after a patient reaches a peak level of anxiety and refuses to eat any more, does the anxiety and urge to vomit decline without recourse to vomiting, and, if so, how long does it take and which declines first? Is there any evidence of increased heart rate while eating, and, if so, how does this measure correspond to self-report measures of anxiety and the urge to vomit? These questions all pertain to data collected within individual treatment sessions. A number of related questions about changes across treatment sessions were also considered. As therapy progresses are patients able to consume more food? Does amount of anxiety diminish? Does the urge to vomit diminish? Does the time needed to overcome the urge to vomit decline? Is there any parallel course between changes in these measures and changes in the valence of self-statements about eating difficulties, appearance, concern with weight gain, expectations about overcoming the problem?

Finally, this study also tried to relate measures of change within and across treatment sessions to more global pre- and posttreatment outcome measures, such as eating and vomiting behavior at home, attitudes toward eating and weight, depression and self-esteem.

METHOD

Subjects

Patients for this study were recruited from referrals by physicians and mental health professionals in the community and through advertisement in the local press. To be accepted for the study, subjects had to be: (a) within normal weight range for their height and frame (i.e., obese and anorexic women were excluded); (b) engaged in vomiting at least several times per week; (c) unable to eat normal portions of certain designated foods when asked not to vomit afterwards; (d) able to refrain from using other purgatives such as laxatives for relief from eating; (e) free of signs of psychosis or high suicide risk at initial interview.

Out of the first six individuals who contacted us in regard to this project, only one did not meet the above criteria. The five patients who served as subjects in this study were all females, between the ages of 21 and 35, four single and one married. They all either worked or attended school full time. Subjects 1 through 5, in that order, had been suffering with bulimia nervosa for, respectively, 6, 6, 10, 3, and 1 years and the mean numbers of eating-vomiting episodes per day during a 3-week baseline period were, respectively, 4, 1.2, 10, 1.6, and 1. Only subject 5 had shown any past signs of anorexia nervosa, 10 years earlier.

Procedure

During an initial interview, subjects were instructed how to keep daily records of their food intake, vomiting episodes, and ratings of anxiety and urge to vomit each time they ate any food or drank any liquid. During the next 3 weeks these records as well as a number of other baseline and pretest measures to be described later were obtained.

After the 3-week baseline period, subjects began treatment. For four of the five subjects, 18 individual treatment sessions were scheduled, divided into three 2-week phases of six sessions each, three sessions per week. For the fifth subject only 12 sessions were scheduled, broken into three 2-week blocks of four sessions each.

Each 2-week treatment phase made use of a separate food group: (a) large meal—a large entrée with several side dishes; (b) sweets or snack foods—including candy, cookies, desserts, chips; (c) pasta—including different forms of pasta. For all subjects "large meal" was the food group used in the first 2-week treatment phase. This was followed by pasta and sweets for subjects 1, 3, and 4 and sweets/chips and pasta for subjects 2 and 5. The sequence was based on each subject's perceived order of difficulty. Food was obtained at local restaurants and stores and brought in by subjects.

The treatment rationale given to each subject covered the following main points: They were told that binge-eating was being maintained by vomiting; if they learned to gain control over vomiting, binge-eating would not be as likely to occur; that therapy sessions were designed to allow them to get in touch with the anxiety they experienced when eating; that they would learn to overcome their anxiety without vomiting.

Each treatment session had two basic parts: (a) exposure to the feared stimulus, i.e., eating particular foods or particular amounts of food; (b) prevention of the habitual escape response, i.e., vomiting. During each treatment session subjects were instructed to eat an amount of food which caused a strong urge to vomit, past the point where vomiting would ordinarily occur. The specific food items within a group varied across subjects, the choices depending on what they found most anxiety provoking. The amount of food provided within each food group, however, was constant across subjects, e.g., when candy bars were used, 3 were provided each time; pasta could be either 1 quart of spaghetti or 3 slices of pizza from the same take-out restaurant; pastry could be 3 doughnuts or 3 brownies, etc. These amounts could be considered within or slightly above the range most people could eat comfortably. Extremely large amounts were intentionally avoided and unnecessary, because in the absence of vomiting even very small quantities of these foods (e.g., two bites of a brownie) could provoke intense anxiety. Also, by instructing subjects to eat "as much as you can, until you have a strong urge to vomit, past the point where you would normally vomit afterwards" rather than specifying exactly how much they should eat, we were able to use amount consumed in treatment sessions as one of our dependent measures.

The subjects were told that they would not be allowed to vomit immediately after eating, and that the therapist would stay with them until the urge to vomit was under control. They were also told that treatment would be most beneficial if they did not vomit within 2½ hours after the end of any treatment session, and that it was best to stay with the therapist until they felt they could safely leave without vomiting afterwards.

In each therapy session, the therapist tried to direct the subject's attention to whatever anxiety-provoking thoughts and feelings were induced while eating. These usually centered around negative body image, sensations of feeling full, gross, fat, wanting to vomit, fears of weight gain and binge-eating in public, and relationship issues with spouses, parents, friends and co-workers including themes of anger, loss, and rejection.

During sessions when bulimia nervosa patients were repeatedly exposed to eating without vomiting, the therapist tried to help the patient make several discoveries:

1. In the absence of planned vomiting they do not have an uncontrollable craving to consume huge amounts of food; instead they have an obsessive craving to be slim, to eat as little as possible, to not gain weight;
2. Physical sensations of immediate weight gain and feelings of gross changes in bodily appearance (particularly stomach, thighs, and buttocks) following consumption of normal or even less than normal amounts of food are distorted, and these feelings are capable of being relieved without recourse to vomiting;
3. They are able to eat certain foods without "having to" vomit afterwards;
4. The anxiety they experience after eating forbidden foods is not as overwhelming as they first thought it would be and is capable of diminishing to tolerable levels even if they do not vomit;
5. Their desire to maintain a strict diet and their criteria of "bad" foods, "having eaten too much," "having blown it" are distorted and serve to trigger the impulse to eat even more and to vomit afterwards;
6. The obsessive desire to achieve a "perfect" slim body usually stems from a complex mix of disturbed family relationships, low self-esteem and associated fears of rejection and abandonment, a variety of guilt feelings, and cultural values and stereotyped beliefs about appropriate feminine appearance and behavior.

Therapy sessions were conducted at a set time of day for each subject, either at noon or 6 p.m. The length of each treatment session varied, depending on how long it took for a subject's urge to vomit to decline to negligible levels.

In order to assess unprogrammed transfer effects during the experimental phase of the study, subjects were not explicitly instructed to stop binge-eating or vomiting at home between sessions. After the three phases of supervised exposure and response prevention sessions were completed, however, further therapy sessions were scheduled if vomiting between sessions had not, in fact, ceased. During these postexperimental sessions, subjects no longer ate in front of the therapist; instead the focus was

placed on what the patient could do at home and a schedule of gradually decreased vomiting was arranged. Three subjects availed themselves of these postexperimental sessions: subject 1 for 30 sessions, subject 3 for 10 sessions, and subject 4 for 8 sessions; subjects 2 and 5 had stopped vomiting by the end of the experimental phase and did not feel a need for further treatment.

Measures

Within-treatment sessions. At the start of each session and every 6 min thereafter, the therapist interrupted ongoing conversation and eating to let the subject know that a 3-min data collection interval was to begin. During this time, subjects rated their anxiety on a 0 to 100 scale where 0 was defined as no discomfort or anxiety and 100 was defined as extreme discomfort or anxiety. Subjects also rated their urge to vomit on a 0 to 100 scale where 0 was defined as no urge and 100 was defined as an overwhelming urge to vomit. These ratings were obtained in the first minute of each 3-min sampling interval. The next 2 min were devoted to thought sampling and recording heart rate. For thought sampling, subjects were instructed to "say aloud whatever you are thinking during the next 2 minutes." These remarks were tape-recorded and subsequently transcribed and coded for positive, negative and neutral food-related and non-food-related content. Twenty-one percent of the transcripts were rated independently and exact interrater agreement was 81%. Food related thoughts included any reference to eating, binge-eating, vomiting, dieting, body image and appearance, weight, or exercise. Non-food-related thoughts concerned friendships, family, work, school, etc. During each of these 2 min "think aloud" periods, heart rate was also recorded with a Grass finger plethysmograph (PTTI-G) in conjunction with a Grass Model 7 polygraph. In summary, then, every 6 min within every therapy session, a 3-min interval was devoted to recording thoughts, heart rate, and ratings of anxiety and the urge to vomit. The first 3-min recording interval took place before the subject began eating and then continued every 6 min until the session was over.

Other measures obtained on a session-by-session basis were: amount eaten (percentage of total calories consumed) and time to overcome the urge to vomit (from the time a subject stopped eating until the end of the session). To assure the accuracy of the measure of food eaten the 4 experimenters independently calculated these percentages on 24 different food samples, and the interrater agreement was 88%.

At home measures of eating behavior. Subjects recorded daily all food and liquid intake. Time eaten, type and amount of food, method of preparation, anxiety, and urge to vomit were noted for each eating episode. (As a check on the accuracy of subjects' estimates of amount eaten at home, they were occasionally asked in treatment sessions to make these estimates to see if they corresponded to the therapist's estimates.) Subjects also recorded whether they considered an eating episode a "binge" and whether or not they vomited.

These daily food diaries were used subsequently as the source of two outcome measures: a daily vomiting frequency and a daily caloric analysis of food consumed that was vomited and food consumed that was not vomited, excluding days on which treatment sessions or test meals were scheduled. Caloric transformations of the data contained in the daily food diaries were calculated based on Pennington and Church (1980). Both calories vomited and nonvomited were calculated because we were concerned that in suppressing vomiting, subjects might develop an anorexic method of coping with their anxiety. Calories vomited was based on the sum of all calories consumed 1½ hours prior to vomiting. This method is only a rough estimation of the actual caloric value of food vomited since it does not take into account variable digestion rates for different foods.

Another measure of at-home eating behavior was obtained via standardized test meals. During baseline, at the end of treatment, and at follow-up, subjects were instructed to arrange three test meals on three separate days to determine how much they could eat without vomiting. Subjects were instructed to eat these test meals by themselves and to try to eat as much as they could keep down knowing in advance that they were not supposed to vomit for 2½ hours afterwards. They were also instructed to eat what they normally would prior to the time of these test meals but not to vomit for 1½ hours beforehand. One food from each of the three targeted food groups (large meal, sweets/snack food, pasta) was chosen as a standard stimulus for each subject. For example, for subject 1 the large test meal consisted of a 4 oz. hamburger, ½ cup cooked vegetables, 1 pint tossed salad, 1 baked potato, and 2 slices of bread; sweets consisted of 3 candy bars; and pasta consisted of 1 quart of spaghetti with tomato sauce. Although no reliability check could be obtained on what subjects said they ate during these test meals or whether or not they were telling the truth about vomiting, the validity of these reports is suggested by the facts that the same amount and type of food was used each time and the data were discrete, easily quantifiable, and corresponded to what they were able to eat during treatment sessions when they were under observation.

The follow-up measures of daily food diaries and test meals were obtained during three consecutive weeks 6 months after treatment was terminated for subjects 1 through 4 and 3 months after treatment was terminated for subject 5. As in the case of the baseline phase, the days on which test meals were scheduled were excluded from calculations of daily intake and vomiting behavior. Thus in both baseline and follow-up, 17 days of data are reported.

Pre- and postoutcome measures. A number of other measures were obtained before and after treatment: (a) Weight—Each subject was weighed in the office on a standard scale during the baseline period, during the first week following the conclusion of the 18 supervised exposure and response prevention sessions and at follow-up. (b) Questionnaires—For four out of the five subjects a pre- and posttreatment battery of ques-

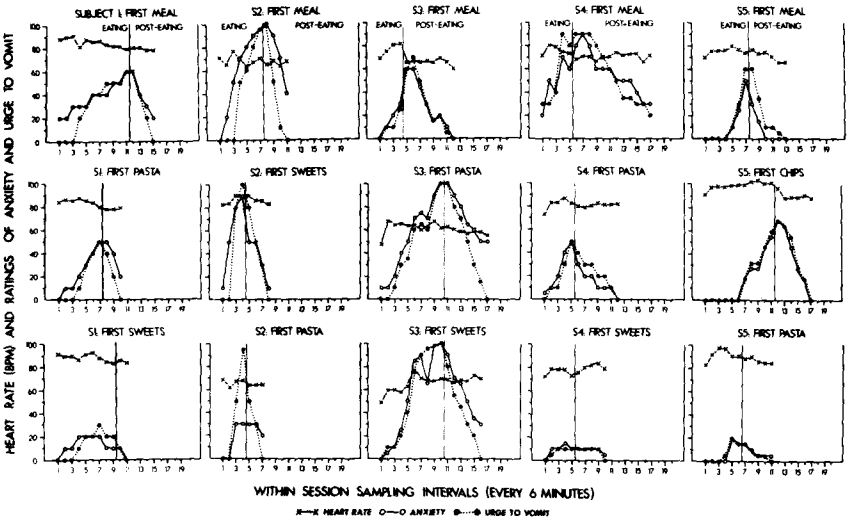

FIG. 1. Within-session sampling of heart rate, ratings of anxiety and urge to vomit during and after eating: first session of each treatment phase (food group).

tionnaires was administered (inadvertently this battery was not administered to subject 2 prior to treatment). The questionnaires were: the Beck Depression Inventory (Beck, 1972); the Rosenberg Self-Esteem Questionnaire (Rosenberg, 1979); the Lawson Social Self-Esteem Questionnaire (Lawson, Marshall, & McGrath, 1979); and the Eating Attitudes Test, a scale devised by Garner and Garfinkel (1979) to measure eating disturbance including anorexia nervosa and bulimia.

RESULTS

During the individual treatment sessions, while subjects were eating in the presence of a therapist without planning to vomit afterwards, ratings of anxiety and of the urge to vomit as well as heart rate were recorded every 6 min. In order to conserve space, these data are plotted only for the first session of each treatment phase rather than for every treatment session (see Fig. 1). These data, however, are quite representative of the pattern obtained in other sessions. The first and most evident result is that for each subject self-reported anxiety and the urge to vomit increased as eating in a session progressed. Second, both these measures gradually declined after subjects stopped eating even though their usual method for reducing anxiety—vomiting—was unavailable. Heart rate, on the other hand, did not show any consistent corresponding rise and fall during and after eating except in the case of subject 5. These within-session data also reveal that in some instances subjects reported an increase in anxiety before they reported an increase in the urge to vomit (subject 1 and 3); in other instances these two self-report measures generally corresponded

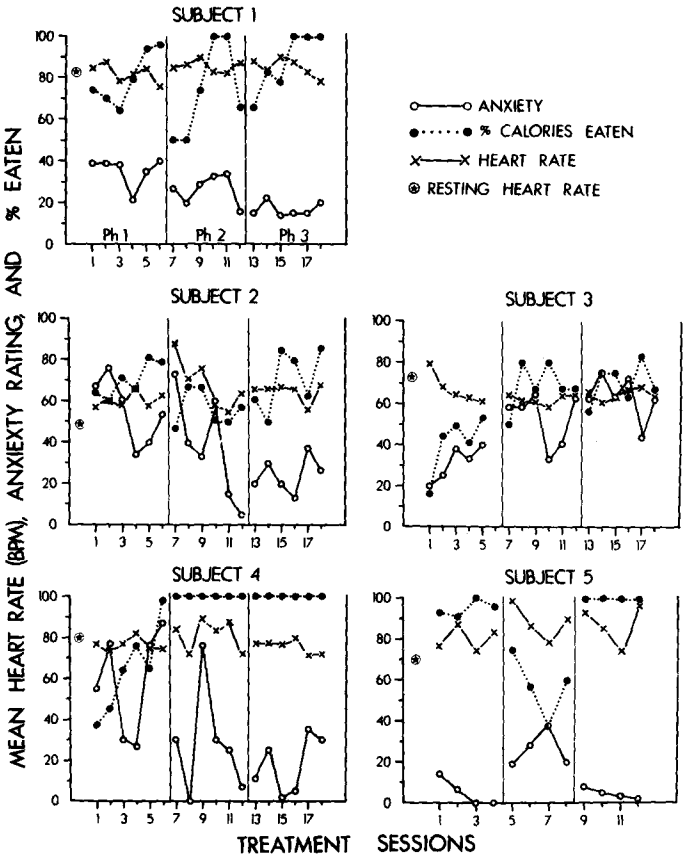

FIG. 2. Mean percentage eaten, anxiety rating, and heart rate across treatment sessions for each subject.

to one another, neither increasing before the other (subjects 4 and 5). Subject 2 exhibited a still different pattern of response. During the first treatment phase (large meals) the pattern was similar to subjects 1 and 3; while eating, anxiety rose prior to the urge to vomit, and after eating, anxiety declined more slowly than the urge to vomit. However, in the pasta phase of treatment, for this same subject, anxiety did not increase before the urge to vomit did, and the peak levels of the ratings of the urge to vomit during both the sweets and pasta phases were higher than were the ratings of anxiety.

The next analysis concerns changes across successive treatment sessions rather than within individual treatment sessions. The amount of food consumed, the mean anxiety rating, and the mean heart rate while eating during each treatment session are plotted for each subject in Fig. 2 (mean ratings of the urge to vomit are omitted from this figure because they

were highly correlated with anxiety ratings for all but subject 2). As can be seen in Fig. 2, percentage of calories consumed within each treatment phase generally increased over successive sessions. There were a few exceptions, however, to this pattern. Subjects 4 and 5 started out phases 2 and 3 and phases 1 and 3, respectively, by eating nearly all of the food presented and thus had no room to show much, if any, further increase across subsequent sessions. Subject 5 also diverged from the usual consumption pattern during phase 2 when snack foods were targeted; she actually decreased rather than increased the amount eaten across sessions. It is also interesting to note that subjects 1 and 2 did not show any transfer of improvement in consumption from the end of one phase or food group to the beginning of another. Instead, initial consumption for each new food was approximately at the same level and then increased over successive sessions. Subject 3, on the other hand, showed a fairly continuous increase in food consumption both within and across phases.

Although anxiety ratings usually decreased across successive treatment phases, this pattern was not quite as striking nor as consistent within each treatment phase as was the increase in food intake. For example, although there was a general downward trend in anxiety across successive phases, subject 4 showed no decline in anxiety across sessions *within* any single phase. In addition, subject 1 in phases 1 and 3, subject 2 in phase 3, subject 3 in phases 1 and 2, and subject 5 in phase 2 failed to show any decline in mean anxiety ratings across successive treatment sessions. In some of these instances anxiety may not have declined across sessions because subjects were progressively eating more across sessions. Thus, perhaps there was not sufficient opportunity to habituate to a single level of a feared stimulus.

As for heart rate, the first thing to note in Fig. 2 is the levels recorded during treatment sessions when subjects were eating as compared with the "resting" level obtained in baseline when food was not present. Only subjects 2 and 5 showed a substantial elevation during treatment sessions relative to resting heart rate, and at no point in the course of treatment did heart rate while eating decline to the level recorded during baseline for either of these subjects. Nevertheless, decreased heart rate across successive treatment sessions was observed for these subjects as well as several other subjects in particular phases. For example, for subject 1 mean heart rate declined 9 and 10 beats per minute, respectively, from the first to the last session in treatment phases 1 and 3. Subject 2 showed a dramatic decrease in heart rate over successive sessions in treatment phase 2, starting at 87.7 BPM and ending at 63 BPM. Declines can also be seen for subject 3 in phase 1, subject 4 in phase 3, and subject 5 in phase 2, and in no case did heart rate ever show an increase greater than 6 BPM in the last session of a treatment phase relative to the first.

What, then, do these data reveal about the relationship between the amount subjects were able to eat during therapy sessions and the anxiety they reported or the heart rate they registered while treatment progressed? First, consider eating behavior and self-reported anxiety. Although, in

TABLE 1
PERCENTAGE OF POSITIVE AND NEGATIVE FOOD-RELATED THOUGHTS

Subjects		Phase 1	Phase 2	Phase 3
1	Positive	4	14	18
	Negative	62	28	44
2	Positive	32	28	22
	Negative	44	46	40
3	Positive	4	11	20
	Negative	63	61	49
4	Positive	11	32	35
	Negative	50	38	24
5	Positive	19	17	23
	Negative	35	37	12

general, subjects ate more and reported less anxiety over time, no simple one-to-one relationship between these two measures emerged. For example, there was no evidence that a sustained decline in anxiety over several sessions was a necessary prelude to increased food intake or vice versa, that a sustained increase in amount eaten was a necessary precursor to a drop in anxiety. And on a session-by-session basis, the correlation between amount consumed and anxiety was inconsistent. In some cases anxiety was higher during sessions in which a subject ate more; in other sessions anxiety was lower when she ate more. When correlation coefficients were calculated between these two variables, a significant inverse relationship (more food eaten when less anxious) was obtained for only two of the subjects ($-.48$ for subject 4 and $-.95$ for subject 5).

The relationship between heart rate and eating behavior was even more desynchronous. No significant correlation was obtained for any of the subjects. Moreover, to our surprise there was a significant negative correlation between heart rate and self-reported anxiety for two of the subjects ($-.52$ for subject 3 and $-.54$ for subject 1) and only one significant positive correlation between self-reported anxiety and heart rate (.42 for subject 2).

Along with ratings of anxiety, ratings of the urge to vomit, and heart rate, 2 min of thought sampling were also recorded every 6 min throughout each therapy session. Statements were classified into food-related and non-food-related categories and rated as positive, negative, and neutral. Focusing solely on food-related thoughts (which for all subjects comprised between 53 and 76% of the total thoughts recorded), Table 1 shows how the percentage of negative and positive food-related statements during the eating portion of each treatment session changed over the three treatment phases. (These do not add up to 100% because the percentage of neutral statements is not included.) With the exception of subject 2, each subject decreased her negative statements and increased her positive state-

ments over the course of treatment. Despite these improvements, however, it should be noted that the percentage of positive statements was greater than the percentage of negative statements in only two instances: subjects 4 and 5 in the last treatment phase.

When examining the relationship between self-statements and other measures obtained simultaneously within individual treatment sessions, there was no consistent correlation between food-related negative thoughts and ratings of anxiety, heart rate, urge to vomit, or amount eaten for any of the subjects.

Another measure collected on a session-by-session basis was the amount of time it took for the urge to vomit to decline to "safe" levels after a subject stopped eating. Unfortunately, since subjects knew that the session, and therefore the opportunity to be with the therapist, would end when they indicated they no longer felt the urge to vomit, they may have delayed such an indication in order to prolong their contact with the therapist. The mean time from the point they stopped eating to the end of the urge to vomit across all sessions for all five subjects combined was 54 minutes. Only one subject (5) showed a steady downward trend across successive sessions within each treatment phase.

Prior to the start of treatment, throughout treatment, and at follow-up, subjects were asked to keep detailed daily records of eating and vomiting behavior at home. Fig. 3 summarizes these data. With the exception of subject 4, each of the other subjects showed a substantial decrease in vomiting frequency during treatment. Subject 1 was vomiting on the average of 4 times a day during baseline and less than once a day at 6-month follow-up (one time each on 9 days out of 17); subject 3 declined from a mean of 10 binge-eating and vomiting episodes per day to less than once per day (vomited 4 times one day out of 17 days); and subjects 2 and 5 had completely stopped vomiting. Moreover, as indicated in Fig. 3, each of these subjects (again except subject 4 who showed no improvement) either maintained or increased the amount of daily calories she digested relative to the calories vomited. In other words they did not compensate for the decrease in vomiting by starving themselves.

Another illustration of these subjects' increased ability to eat more on their own without vomiting is contained in the "test meal" results presented in Table 2. These standardized test meals made use of foods that were particularly threatening to subjects. In general each subject consumed more during these test meals after treatment was completed than before treatment began. In some cases, however, such gains were evident for one food group but not for another, e.g., subject 5 increased her intake in both "large meals" and "pasta" but not in "chips."

Table 3 summarizes the results of pre- and postquestionnaire measures administered to four of the five subjects (because of an oversight these were not given to subject 2 during baseline). On the Beck Depression Inventory and the Eating Attitudes Test lower scores indicate a positive change, and on the two self-esteem measures higher scores indicate a

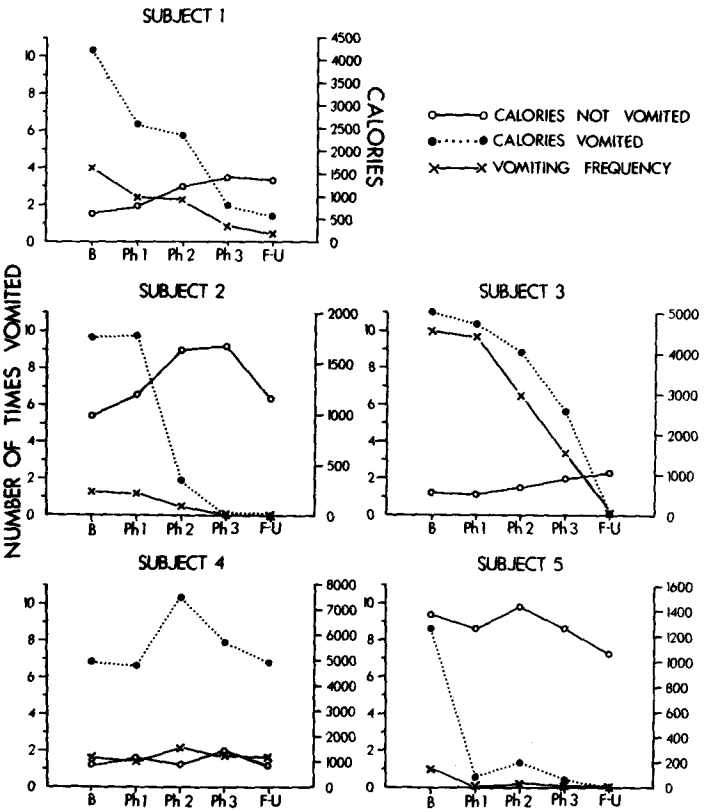

FIG. 3. Daily vomiting frequency, calories vomited and not vomited during baseline, treatment, and follow-up for each subject.

positive change. As can be seen in Table 3 all of the subjects tended to show gains on these measures. Although subjects 1 and 4 were in the moderately and severely depressed range, respectively, at pretest, by the end of the experimental phase of treatment none of the subjects was any longer in the clinically depressed range.

A final result to be considered is weight change during the course of exposure plus response prevention treatment. Subject 1 gained 10 pounds, subject 2 gained 6 pounds, subject 3 gained 9 pounds, subject 4 remained unchanged, and subject 5 gained 1 pound. These gains for subjects 1, 2, and 3 did not bring them out of the normal range. Given their initial extreme fear of weight gain, however, it is noteworthy that the three subjects who did, in fact, gain weight were nonetheless less anxious when eating, were able to eat without vomiting, had greater self-esteem and a less negative attitude about eating, appearance, and weight at the conclusion of treatment.

TABLE 2

PERCENT CALORIES CONSUMED DURING TEST MEALS

Subjects		Pre	Post	Follow-up*
	Large meal	36	61	72
1	Pasta	10	48	52
	Sweets	8	33	66
	Large Meal	30	68	68
2	Pasta	0	33	33
	Sweets	0	0	33
	Large meal	58	41	74
3	Pasta	50	50	21
	Sweets	33	100	50
	Large meal	40	100	67
4	Pasta	16	13	0
	Sweets	0	17	3
	Large meal	71	90	84
5	Pasta	25	19	44
	Chips	38	25	33

* 6-month follow-up for subjects 1 through 4; 3-month for subject 5.

TABLE 3

QUESTIONNAIRE DATA

	Subjects	Pre	Post
Beck Depression Inventory	1	20	9
	3	13	7
	4	31	15
	5	2	0
Eating Attitudes Test	1	55	21
	3	46	40
	4	67	36
	5	24	6
Rosenberg Self-esteem	1	20	23
	3	28	28
	4	14	24
	5	24	40
Lawson Social Self-esteem	1	103	130
	3	127	153
	4	84	135
	5	139	178

DISCUSSION

For the most part the results of this study are consistent with the anxiety model of bulimia nervosa we have proposed, namely that in the absence of the opportunity to vomit, food intake and associated thoughts and feelings about weight gain provoke anxiety. Also, in accord with behavioral treatments of other anxiety-based disorders, repeated exposure to feared stimuli (eating without vomiting) will eventually lead to both decreased anxiety while eating and an increased ability to eat more normal amounts of food. The specific findings in support of the above were:

1. Within treatment sessions, while subjects were eating, self-reported anxiety and the urge to vomit increased; after subjects stopped eating, anxiety and the urge to vomit eventually declined even though subjects were not permitted to vomit.
2. Across treatment sessions, the mean anxiety provoked by eating tended to decrease as did the mean urge to vomit.
3. Across treatment sessions, the mean amount of calories consumed in therapy sessions tended to increase.
4. As treatment progressed, self-statements in therapy sessions about eating problems tended to become more positive and/or less negative.
5. Finally, in four out of the five subjects, binge-eating and vomiting at home were substantially reduced or entirely eliminated even though the focus of treatment sessions was primarily on vomiting rather than binge-eating.

A question often asked is: If bulimia nervosa patients are so anxious about eating and weight gain, why then do they binge? The answer is that they seldom, if ever, do binge unless they plan to vomit afterwards. This is not to deny that other factors contribute to binge-eating, e.g., self-nurturance, cravings for specific foods, boredom and loneliness, feelings of deprivation, depression, anxiety, and so on. These factors are probably as applicable, if not more so, to people suffering from bulimia nervosa as they are to people in the general population who occasionally binge but who do not vomit. However, in women suffering from bulimia nervosa, such distressing feelings are likely to be relieved for a while only when binge-eating is coupled with vomiting afterwards. Once vomiting is habitually established, this becomes the driving force that sustains binge-eating and not vice-versa. In fact, in the typical progression of bulimia nervosa once self-induced vomiting is learned, binge-eating usually becomes more severe and frequent (Abraham & Beumont, 1982). Anticipation of vomiting frees bulimia nervosa patients from the normal inhibitions against binge-eating. In other words, anxiety (and other negative feelings) in bulimia nervosa patients are habitually reduced via the linked behaviors of gorging and purging. When these patients know that vomiting is not possible, however, then eating even normal amounts of food generates considerable anxiety.

It should be noted that the present study did not directly measure whether vomiting normally reduces anxiety in bulimia nervosa patients. Instead this study simply demonstrated that when the chain is broken,

when vomiting is blocked, eating is associated with a rise in anxiety. Unlike the analogous situation in studies of classic obsessive-compulsive neuroses, where the anxiety-reducing properties of engaging in compulsive hand washing rituals following exposure to "contaminating" stimuli has been directly measured (Hodgson & Rachman, 1972), we felt constrained against asking our subjects to vomit in the laboratory. However, in a recent study, Johnson and Larson (1982) had 15 bulimia nervosa patients rate mood every 2 hours throughout the day for 1 week. Consistent with the laboratory results of the present study, they found that vomiting relieved negative feelings of anger, inadequacy, and lack of control. Based on these results, they similarly suggested that vomiting rather than binge-eating may be the "primary mechanism for tension regulation" in bulimia nervosa and that vomiting comes to maintain binge-eating rather than the reverse.

One finding of the present study clearly failed to provide general support for the anxiety model of bulimia nervosa. Along with self-reported anxiety and the urge to vomit, it was expected that heart rate would also increase while subjects were eating and then decline after they stopped eating. This pattern, however, was observed only in one of the five subjects. This was surprising because in other anxiety-based disorders, such as agoraphobia and obsessive-compulsive neuroses, heart rate has been relatively reactive to exposure to feared stimuli. Why the difference? One possible explanation is that we just happened to have a pool of subjects who were not "physiological responders," or at least not in the heart rate modality. Another possibility is that despite their self-report data, the degree of anxiety was not severe enough to be reflected in elevated heart rate while eating. A recent study by Calloway, Fonagy, and Wakeling (1983) may shed some light on this issue. These researchers compared skin conductance changes in four groups of women: anorexics who had lost weight solely through dieting; anorexics with bulimic features; normal weight bulimia nervosa patients; and control subjects who had no eating disorders. The two groups who were vomiting were found to have significantly fewer spontaneous skin conductance responses and habituated significantly faster to loud tones than either normal controls or restricting anorexic patients. In other words, there is some reason to believe that repetitive vomiting may be associated with decreased autonomic arousability (hyporesponsiveness). In a related study, Salkind, Fincham, and Silverstone (1980) also observed that in a mixed group of nine anorexia nervosa and bulimia nervosa subjects skin conductance response to imagined food and weight-related stimuli was minimal, although interestingly two of these subjects had a greater response to nonfood related phobic stimuli.

As far as the relationship between various anxiety measures during treatment is concerned, the results failed to yield any strong evidence of synchronous change or dependence of change of one measure upon a prior change in another, with one minor exception. When two of the subjects were eating during therapy sessions, anxiety ratings tended to increase prior to an increase in the urge to vomit, suggesting that the urge to vomit was more a consequence of increased anxiety rather than vice versa.

However, even here, the relationship was inconsistent; two other subjects showed a parallel rise and fall of these two measures as a function of eating and stopping eating; and the remaining subject whose anxiety originally tended to precede the urge to vomit only demonstrated this pattern with one type of food, large meals. In the other food categories this subject reported that the urge to vomit was either parallel to or independent of anxiety.

When examining changes in the various measures across successive therapy sessions, it was quite clear that some of the more obvious sequential patterns that might have emerged, in fact, failed to do so. For example, reduced anxiety across successive sessions or reduced negative self-statements were not prerequisites for increased eating behavior or vice versa.

Finally, it should be noted that improvement as measured during therapy sessions did not necessarily correspond to overall outcome outside of therapy sessions. Subject 4, who along with the other subjects demonstrated an increased ability to consume more food in therapy sessions, reported less anxiety, and emitted fewer negative and more positive self statements in therapy sessions, was nevertheless a treatment failure in terms of her eating behavior at home. She was binge-eating and vomiting as much at the end of treatment as before. The other four subjects, however, all had excellent outcomes, including not only the significant reduction or complete elimination of vomiting at home but also changes on such global measures as eating attitudes, self-esteem, and self-reported depression. It seems that although exposure and response prevention may be a worthwhile treatment approach for bulimia nervosa, it is by no means uniformly so; gains made in eating behavior during therapy sessions do not always generalize to the home setting. We are currently evaluating procedures which might optimize such generalizations and directly comparing the relative effectiveness of the exposure plus response prevention model of treatment for bulimia nervosa to other alternative interventions.

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