

ANXIETY, FATIGUE AND PHYSIOLOGICAL
RESPONSIVITY OF PATIENTS WITH
ANOREXIA NERVOSA AND/OR BULIMIA

BY

AVERY TECTER

A thesis submitted to the Faculty of Graduate Studies
in partial fulfilment of the requirements for the degree

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Abstract

The present study utilized the pupillary response of anorexic, bulimic and control subjects in order to further investigate the etiological theories of these eating disorders and to investigate differences in the physiological response patterns between the three groups. Subjects were all female and included 10 psychiatrically diagnosed anorexics, 9 psychiatrically diagnosed bulimics and 7 controls. Subjects were presented with: (1) randomly presented words which were sex-related, food-related, family-related or neutral; and (2) three sets of light flashes consisting of an initial baseline condition, threat condition (subjects were asked to think about eating a chocolate bar), and removal of threat, a final baseline condition. Following these trials subjects were asked to rate their anxiety levels for each word and the chocolate bar.

Analysis of the manipulation check indicated the subjects did not identify feelings of anxiety or arousal when thinking about the various word types. As subjects did not rate the words as anxiety provoking, the results for the word type condition were inconclusive and interpretation of the pupillary responses questionable. Results of the light flash conditions revealed that anorexics and bulimics differed significantly physiologically when presented with a food-related stressor (chocolate bar), with bulimics displaying significantly higher levels of arousal. Delayed occurrence of natural fatigue in anorexics and bulimics was

not evident as all subjects displayed a natural fatigue pupillary response pattern when administered the light flashes.

The findings support the division of anorexia and bulimia into separate disorders by use of a physiological measure. These groups respond with differing levels of arousal when presented with a relevant stressor suggesting differentiation between the groups. Further research should pursue identifying relevant stressors for these groups within the sex-, food- and family-related word categories to further investigate the differing physiological functioning of these groups when aroused. It was felt the presence of a natural fatigue pattern for all subjects negates the theory that these individuals do not feel hunger and fatigue but rather that they deny it.

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Appetite disturbances are observed in a variety of organic and psychiatric illnesses (Bruch, 1973; Dally, 1969) but few are as distinctive as anorexia nervosa. It is comprised of psychophysiological signs (Bemis, 1978) which include physical, emotional, and behavioral changes in individuals who experience an extreme fear of becoming fat. Crucial to the development of anorexia nervosa appears to be the necessity to gain absolute conceptual and perceptual control of the body, self, parents and other significant object relations (Chediak, 1977). For some time investigators did not feel anorexia nervosa was a specific disease entity (Bliss and Branch, 1960; Kay and Leigh, 1954; and Thoma, 1967); however, in recent years anorexia nervosa has become accepted as a psychiatric disorder with well-defined diagnostic criteria (Bruch, 1974; Feighner, Robins, Woodruff, Winokur and Munoz, 1972 and Garrow, Crisp, Jordan, Meyer, Russell, Silverstone, Stunkard and van Itallie, 1976).

Current research in the area of eating disorders and anorexia nervosa has identified a group of individuals who manifest a disorder similar to anorexia nervosa yet distinctly different; that of bulimia nervosa (Russell, 1979). Reference to this disorder was made by Bruch (1973) when she reported on a sub-group of chronic dieters whom she called 'thin - fat' people whose psychological orientation was not clearly distinguishable from that of patients with anorexia nervosa, except that they did not manifest the clinical weight loss. As researchers in anorexia nervosa (Beumont,

George and Smart, 1976; Casper, Eckert, Halmi, Solomon, Goldberg, and Davis, 1980; and Garfinkel, Moldofsky, Garner, 1980) have increasingly noted the phenomenon of bulimia nervosa within their patients, bulimia nervosa has become identified as a separate psychiatric diagnosis (Russell, 1979). In the following sections recent research addressing the issue of bulimia and anorexia nervosa as separate disorders will be discussed. However, prior to this descriptions of the two disorders are in order.

Anorexia Nervosa

Individuals who develop anorexia nervosa have been described as children who were introverted, conscientious and well behaved, who presented few problems in either their home or school environment (Bruch, 1973; Dally, 1969; Garfinkel, 1974; Halmi 1974; Kay and Leigh, 1954; Morgan and Russell 1975; Thoma, 1967; and Warren 1968). As a group, anorexics have been found to be introverted, neurotic, anxious, emotional and depressed (Crisp, Stonehill and Fenton, 1971; and Smart, Beumont and George, 1976). Numerous studies have also found that anorexics have a distorted body image, (e.g. Garfinkel, Moldofsky and Garner, 1977). It is generally thought that through this syndrome the person makes a painful struggle for control, a sense of identity and effectiveness (Bruch, 1973).

During the 1960s Bruch (1966) began to define and expand her descriptions of individuals with anorexia, defining three primary characteristics of this eating disorder: (1) a disturbance in body

image of delusional proportion, (2) a disturbance of the accuracy of perception or cognitive interpretation of stimuli in the body, and (3) a paralyzing sense of ineffectiveness which pervades all thinking and activities. However, with increased research a more comprehensive diagnostic criteria was required. Feighner et al (1972) developed the following diagnostic criteria for primary anorexia nervosa:

1. age of onset prior to 25 years of age
2. anorexia with accompanying weight loss of at least 25% of original body weight
3. a distorted, implacable attitude toward eating, food, or weight that overrides hunger, admonitions, reassurance and threats
4. no known medical illness that could account for the anorexia and weight loss
5. no other known psychiatric disorder with particular reference to primary affective disorders, schizophrenia, obsessive-compulsive and phobic neurosis
6. at least two of the following: amenorrhea, lanugo, bradycardia, periods of overactivity, episodes of bulimia, vomiting.

In 1980 the Diagnostic and Statistical Manual of Mental Disorders published a third edition of the diagnostic criteria for anorexia nervosa (see Table 1).

TABLE 1

Diagnostic Criteria for Anorexia Nervosa
from the Diagnostic and Statistical Manual
of Mental Disorders (Third Edition)

Diagnostic Criteria for Anorexia Nervosa

- A. Intense fear of becoming obese, which does not diminish as weight loss progresses.
- B. Disturbance of body image, e.g., claiming to "feel fat" even when emaciated.
- C. Weight loss of at least 25% of original body weight or, if under 18 years of age, weight loss from original body weight plus projected weight gain expected from growth charts may be combined to make the 25%.
- D. Refusal to maintain body weight over a minimal normal weight for age and height.
- E. No known physical illness that would account for the weight loss.

Pillay and Crisp (1977) studied anorexics who had been newly restored to their healthy weight and found they were characterized as having low self esteem, being highly sensitive to social interactions and of being obsessive.

Bulimia

Similar to anorexic patients, children who developed bulimia were described as shy, timid, anxious, well behaved, perfectionistic and competitive (Russell, 1979, and Casper, Eckert, Halmi, Goldberg, and Davis, 1980). However, Garfinkel, Moldofsky, and Garner (1980) found them to be less socially withdrawn and involved in more heterosexual activity than anorexics.

Individuals with bulimia manifest symptoms which bear a close resemblance to anorexia nervosa but do not conform to its diagnostic criteria. Russell (1979) described a series of patients who did not necessarily reduce their food intake but were overly concerned with weight loss and had a fear of becoming fat. The constant feature of this disorder was episodes of overeating. The episodes of overeating were the immediate precursor of self-induced vomiting or purgation which was regarded as the individual's attempt to counteract the effects of ingestion of excessive food. Russell contrasted diagnostic criteria of bulimics and anorexics on the following points: (1) bulimics were only slightly underweight and some were normal or even excessive in weight, (2) amenorrhea was neither a constant nor a persistent feature and (3) vomiting or

purging in bulimics took place after excessive food intake. Clinical diagnostic criteria of bulimia as outlined by the Diagnostic and Statistical Manual are found in Table 2.

Anorexia Nervosa and Bulimia as Separate Disorders

Initially, indication of a subgroup of anorexia nervosa, which has become known as bulimia, was made by Bruch in 1973 when she identified a group of chronic dieters who did not lose any significant amount of their body weight. Beumont, George and Smart (1976) further developed this when they studied a group of anorexics which they were able to divide into two groups: 'Dieters' and 'Vomiters and Purgers'. Both groups were totally preoccupied with food, eating, and losing weight, however there were clear differences between the groups. The 'dieters' were characterized as intense, introverted, highly competitive and socially withdrawn. They lost their weight through total abstention from food. The 'vomiters and purgers' were characterized as outgoing, most previously obese, as they had been unable to remain thin by abstaining from food as they would binge eat and consequently used other means to control their weight such as vomiting and abusing purgatives. They found prognosis was poorer for 'purgers and vomiters'.

Crisp, Hsu and Stonehill (1979) studied personality and body weight in abstaining anorexics and binge-vomiting anorexics. They found binge/vomiting anorexics scored significantly higher on the extraversion scale of the Eysenck Personality Inventory than did

TABLE 2

Diagnostic Criteria for Bulimia Nervosa
from the Diagnostic and Statistical
Manual of Mental Disorders (Third Edition)

Diagnostic Criteria for Bulimia

- A. Recurrent episodes of binge eating (rapid consumption of a large amount of food in a discreet period of time, usually less than two hours).
- B. At least three of the following:
 - 1) consumption of high-caloric, easily ingested food during a binge,
 - 2) inconspicuous eating during a binge,
 - 3) termination of such eating episodes by abdominal pain, sleep, social interruption, or self-induced vomiting,
 - 4) repeated attempts to lose weight by severely restrictive diets, self-induced vomiting, or use of cathartics or diuretics,
 - 5) frequent weight fluctuations greater than ten pounds due to alternating binges and fasts.
- C. Awareness that the eating pattern is abnormal and fear of not being able to stop voluntarily.
- D. Depressed mood and self-deprecating thoughts following eating binges.
- E. The bulimic episodes are not due to Anorexia Nervosa or any known physical disorder.

abstainers. The binger appeared to have problems with impulse control in relation to food, as well as in the wider social and sexual context.

Russell (1979) studied a group of dieters who did not necessarily reduce their intake of food, but followed episodes of overeating with self-induced vomiting or purgation. These methods were identified as attempts to counteract the effects of the ingestion of excessive food. It should be noted that occasionally anorexics also will vomit or use purgatives to rid themselves of food. In the bulimic group, however, periods of overeating were frequent, often daily, and in each patient the vomiting and purging had become frequent, habitual and established over a period of time.

Within Russel's study other significant differences were evident between the two groups. The bulimic group weighed significantly more than the anorexic group, and frequency of amenorrhea was considerably less and more variable among the bulimic group. Bulimics tended to be more social and sexual activity was more frequent in this group than for anorexics. Binge eating, for the bulimics was often associated with obtrusive preoccupation with food, and the frequency of these binges was influenced by the opportunity for privacy, particular social settings and the tendency for binges to be repeated once the patient had succumbed to the first orgy. Bulimics tended to deny overeating was due to hunger. Although the basic psychopathology

was similar - depression and fear of becoming fat - anorexics appeared to be able to starve themselves, while bulimics could resist eating only for so long.

The growing evidence of a separate group within anorexia nervosa led Casper et al (1980) to conduct quite an extensive comparison of anorexic and bulimic patients. They found 47% of anorexic patients were experiencing frequent bulimic episodes. Bulimic patients were found to weigh more and to be significantly older than anorexics. Contrary to Russel's (1979) findings 69% of the bulimics admitted to strong appetite and greater desire to eat meat. Significantly fewer anorexics indicated feelings of hunger suggesting that those who successfully deny hunger don't binge. Fewer bulimics liked to cook than anorexics, as bulimics felt they would be unable to resist the food. Bulimics were more extraverted, sexually experienced and sensitive to interpersonal relationships than the fasting group. Both groups were shy, timid, well behaved, perfectionistic and competitive.

The psychopathological symptoms that were greater in the bulimic group were: depression, obsessiveness, somatization, anxiety, guilt, vomiting and sleep disturbance. Prognosis was poorer for the bulimic group as after seven days of treatment they had gained less weight.

Garfinkel, Moldofsky and Garner (1980) also found bulimics had a poor prognosis. In studying a group of bulimics and anorexics they found bulimics weighed more, vomited and misused laxatives,

manifested impulsive behavior including stealing, drugs and self mutilation. They defined bulimia as an abnormal increase in one's desire to eat, with episodes of excessive ingestion of large quantities of food that the individual viewed as ego-alien and beyond her control. Anorexics were relatively isolated and formed few friendships while bulimics were more active and more likely to use oral contraceptives. Of importance in this study was that no differences were found between the bulimic and anorexic groups in age of onset or duration of illness, arguing against bulimia simply representing a manifestation of chronicity.

Contrasting these results, Ben-Tovim, Marilov, and Crisp (1979) did not find any substantial differences between anorexic and bulimic populations. They found the predominant feature of the group was depression and that obsessional symptoms were also predominant. However, they found suicide and social unease was more frequent in the anorexic group. The significance of these findings is questionable in view of the small number of subjects involved.

In summary, there remains controversy and a need for an understanding as to whether anorexia nervosa and bulimia are distinct disorders or interrelated conditions. From the above discussion, it would seem that bulimic symptoms constitute a distinct psychiatric disorder or a distinct subcategory of anorexia nervosa and the present study identified the groups and investigated them as two separate diagnostic categories. The

research by use of the pupillary response, attempted to yield further information on the distinguishing characteristics of the two groups, as well as to provide further confirmation of anorexia nervosa and bulimia as separate disorders.

Theories of the Etiology of Anorexia Nervosa and Bulimia

In the following section discussion will center around the controversy which surrounds the theories of the cause of development of anorexia nervosa and bulimia. The etiology of the anorexic-type disorder has been discussed within the following models: family interaction model, psychodynamic model, medical model and the behavioral model. An understanding of these models is important to the present research and their significance will be discussed at a later point.

Family Interactional Model

Early descriptions of anorexia nervosa ascribed an important place to family influences in the course and outcome of the illness (Kalucy, Crisp and Harding, 1977). Blitzler, Rollins and Blackwell (1961), Dally (1969) and Bruch (1973) described parents of anorexics as upwardly mobile, middle class, with strict moralistic values who often placed emphasis on appearance, conformity and obedience. High expectations and rigid attitudes were the norm.

Mothers of the anorexic patients were commonly described as dominant, overprotective and intrusive; as well, a peculiar relationship and striking ambivalence between mother and child were frequently mentioned (Cobb, 1950; Goodsitt, 1974; Katz, 1975;

Rowland, 1970; Ziegler and Sours, 1968). In contrast to the prominence of the 'scolding and overbearing mother' in clinical reports (Cobb, 1950), fathers were briefly characterized as passive and ineffectual figures who played a minor role in the family structure (Groen and Feldman-Toledano, 1966; Katz, 1975; King, 1963; Rowland, 1970).

More specifically, Bruch (1973) found parents of anorexics were out of tune with their children. Expressions of affect emanating from the child were routinely ignored, as parents responded instead in a manner which gratified their own needs. Thus, anorexic children learnt to respond to externally initiated cues rather than to recognize their own somatic sensations, such as hunger and anxiety. She felt the inability to recognize their needs was an acquired perceptual disturbance characterized by a failure to distinguish hunger from other bodily needs. This confusion, Bruch felt, resulted from inappropriate maternal responses to the infant's cues when the infant was in a state of nutritional need. This lack of awareness developed feelings of ineffectiveness and ultimately a failure of autonomy. This lack of autonomy lead the child to look for extreme means of obtaining control, that of reduced food intake.

A study by Crisp, Harding and McGuiniss (1974) suggested that pathological needs within the family were instrumental in developing and maintaining anorexia nervosa. They found that the psychoneurotic states of family members were not greatly abnormal

at the time the anorexic individual was hospitalized, but that the level of parental neurosis increased significantly following the patient's recovery. In conclusion they suggested, "in anorexia nervosa the family psychopathology and morbidity is . . . displaced into the patient" (p. 172).

Similarly, Minuchin and his co-workers suggested that the "pathological organization of the family around the symptom provides a mechanism through which family members can avoid interpersonal conflicts" (p. 850). They felt families with anorexic children shared general patterns of interaction, which included enmeshment, or overinvolvement, overprotectiveness, rigidity and poor conflict resolution. Minuchin (1974) felt disordered eating behavior should be viewed as an interpersonal rather than an individual problem and felt treatment must restructure the dysfunctional family system.

In a study of interactional patterns of families, Amdur, Tucker, Detre, and Markhus (1969) found that the issue of food was an indication of more dynamic family issues. They found problems of dependency and separation consistently emerged in family interactions. They concluded that with the focus on the anorexic child and her eating behavior, the family could ignore issues of separation and independence.

In summary, it would appear that there is a good deal of evidence that anorexia nervosa development may be related to family interaction factors, parental expectations and a consequent lack of

autonomy on the part of the child. Kalucy et al (1977) concluded that:

These families have an unusual interest in food, weight, and shape, an unusual incidence of phobic avoidance and obsessive compulsive character traits, an unusual vulnerability to seemingly ordinary life events and a tendency to be unusually close, loyal and mutually interdependent. The common denominator of our description seems to us to be that these families are ill-equipped for and prepare their children inadequately for the adolescent phase of development (p. 394).

However, this evidence has been gathered mainly through self reports and questionnaires which, as will be discussed later, are less than reliable measures of anorexics' or bulimics' attitudes. Therefore, to further investigate the influence of family-related factors, the present research utilized other methods, such as physiological responses to family oriented stimuli, in order to avoid the difficulties with self report measures with this group of individuals.

Psychodynamic Model

The classic psychoanalytic interpretation of anorexia nervosa is associated with Freud (1918/1959) and the equation of eating behavior with sexual instinct. Of key significance in this model is the typical age of onset (Jessner and Abse, 1960; Meyer, 1971; Thoma, 1967). These individuals suggested that adolescents who

were unable to meet the demands of mature genitality might regress to a primitive level of which oral gratification was associated with sexual pleasure and fertility.

One early psychodynamic theory suggested that anorexia nervosa, with refusal of nourishment, was a defense against unconscious fantasies of oral insemination (Waller, Kaufman, Deutsch, 1940). Bulimia was conceptualized as a breakthrough of unconscious drives for gratification (Kaufman and Heiman, 1964). Amenorrhea was seen as a symbol of pregnancy (Kaufman and Heiman, 1964) and a denial of femininity (Lorand, 1943/1964).

More recently, Crisp and Stonehill (1971) have suggested that anorexia nervosa constituted a phobic-avoidance response to food, resulting from the sexual and social tensions generated by the physical changes associated with puberty. This view suggested self starvation and malnutrition lead to a reduction in sexual interest which in turn, lead to greater self starvation (Crisp, 1970).

Bruch (1973) has proposed that the patient's fear of fatness was due to failure to perceive bodily sensations appropriately and to perceptual distortions of body image. This lack of perception, Bruch felt, was due to a maladaptive mother-child relationship which relied on compliance and left the child with no clear conception of the self.

The relationship between anorexia nervosa and affective disorders was studied by Cantwell, Sturzenberger, Burroughs, Salkin, and Green (1977). They found there was a striking incidence of

affective disorders in the anorexic patient. A large number of the individuals manifested depressive symptomology in both the premorbid and postmorbid states. Also, a family history of affective disorder was quite common in the mothers of the anorexic patients.

Problematic with the psychodynamic models are the exclusive reliance on clinical data and the inferential nature of conclusions about etiology. However, even with these shortcomings the information these theories provide cannot be ruled out as the incidence of anorexia nervosa and bulimia frequently occurs during adolescence, with sexual concerns apparent. Therefore, the psychodynamic factors of sexual concerns require further investigation and consequently sexual related stimuli were included in the present research study.

Medical or Physiological Model

Medical research addresses a different question, not whether the disorder included somatic components, but whether these symptoms were primary or secondary to its etiology. From the research, if anorexia nervosa could be associated with an organic abnormality, the most plausible site for the dysfunction appeared to be the hypothalamus.

Several researchers have noted the similarity of symptoms in anorexia nervosa to those observed in animals with experimental lesions of the hypothalamus, including aversion to food as well as decreased intake; high levels of activity, behavior and emotional

disturbance, alternation between aphagia and hyperphagia and abnormal fluid balance, thermoregulation, carbohydrate metabolism, and gonadotropin secretion (Johanson and Knorr, 1974; Lundberg, and Walinder, 1967; Mecklenburg, Loriaux, Thompson, Anderson, and Lipsett, 1974; Templer, 1971). Russell (1970) has suggested that the hypothalamic disorder could account for the abnormal thinking and psychosexual disturbances found in the disorder.

The hypothalamus controls many diverse functions and is an extremely essential area of the brain. Many of the processes that it regulates are disturbed in anorexia nervosa, and hormone studies have suggested that hypothalamic malfunctioning of some type may be implicated (Bemis, 1978). As Bemis indicated "the hypothalamus is also a 'crossroads' area which is intimately interconnected by ascending and descending pathways to the higher brain centers of the cerebral cortex and limbic system, and the directionality of control in anorexia nervosa cannot be established conclusively with the present state of knowledge" (p. 609).

Mecklenburg, et al (1974) summarized the alternatives as follows, "At least three possibilities exist. It may be that starvation damages the hypothalamus, that psychic stress somehow interferes with hypothalamic function, or that the manifestations of anorexia nervosa, including the psychological aberrations, are relatively independent expressions of a primary hypothalamic defect of unknown etiology" (p. 155).

The physiological or medical theory of anorexia nervosa has been criticized in two main areas. Firstly, that the disorder does not appear to be associated with genetic transmission as suggested by the research on concordant and discordant identical twins. These reports (Bruch, 1969, Crisp, 1965; Debow, 1975, Halmi and Brodland, 1973) found approximately the same number of anorexics within each group of concordant and discordant twins.

Secondly, the physiological theory has been questioned due to the irregularity of distribution among the general population. Bruch (1973), Dally (1969), Morgan and Russell (1972) have found an over-representation of middle and upper socioeconomic groups in anorexic group samples, while others (Kendell, Hall, Hailey, 1973; Rowland, 1970) have found the disorder to be more normally distributed.

The physiological approach has addressed the issue of the symptoms and physiology of anorexia nervosa as due to malnutrition and self induced starvation, however again, discrepancies have been noted. The most striking being amenorrhea. Crisp (1965) suggested that amenorrhea was due to dieting prior to evident weight loss, in that the individuals were dieting for some time before loss of weight was seen and that the dieting lead to amenorrhea. However, Danowski, Livstone, Gonzales, Jung and Khurana (1972) pointed out that amenorrhea, in some cases, might precede visible weight loss as well as dieting by several years. Halmi (1974) concluded that 73% of his patients in his study experienced early amenorrhea which

he indicated gave further evidence that it could not be attributed to starvation.

The preceding discussion of the physiological model of anorexia nervosa suggests some involvement of the hypothalamus but there is a deficiency of reliable data which makes it difficult to support or refute physiological theories of anorexia nervosa. Clearly, there is a need for further physiological research into the disorder of anorexia nervosa to help clarify the inconsistencies. Consequently, the present research utilized a physiological measure, that of pupil size, in order to help provide further data about the physiological functioning of anorexics and bulimics.

Behavioral Model

Finally, the behavioral model suggested that food rejecting behavior was reinforced by the attention it produced (Allyen, Haughton and Osmond, 1964). Blinder, Freeman, and Stunkard (1970) observed that "the impairment of food intake in anorexia nervosa can be viewed as a specific learned behavior, perpetuated by environmental reinforcements. However, Leitenberg, Agras and Thomson (1968) have found that withdrawal of attention does not necessarily affect anorexic behavior. Problematic for the behavioral model is the sparseness of behavioral data, again indicating the need for further research.

From the above review of the etiological models it seems evident that the etiology of anorexia nervosa and bulimia is both

unclear and controversial, and that the symptoms are not readily classified. At present, it appears unlikely that any single model will be able to account for all aspects of the disorder. It should be noted that limited research has directly addressed the etiology of bulimia, rather it has been treated as a subgroup of anorexia nervosa with the assumption that it originates in a similar fashion to anorexia nervosa but manifests different symptomology.

The present research assessed the arousal effect of stimuli related to the above discussed theories of etiology between separately diagnosed groups of anorexics and bulimics. The arousal effect was physiologically measured by monitoring the pupillary response of the subjects. The individuals were presented with groups of words including family-related words, sex-related words, food-related words and neutral words. It was hypothesized that the anorexics and bulimics would manifest differential rates of autonomic arousal to the stimulus groups. It was felt the anorexics would respond with greater pupillary dilation to family-related words due to the apparent relationship between family interaction factors and the development of anorexia (e.g. Kalucy, 1977), than would bulimics or normals. It was thought bulimics would respond with greater pupillary dilation to food-related words due to their fear of eating and the consequent effect of triggering a binge (Russell, 1979). The group of normals, it was felt, would show greater pupillary dilation to sex-related words due to their

arousal effect with individuals (Janisse, 1977). The neutral words would be of equal arousal to all groups.

Hyperactivity Levels Displayed by Anorexics and Bulimics

Excessive activity of anorexic patients was described by Laseque as early as 1873. Janet (1929) identified a whole group of anorexic patients which were characterized with an excessive fondness for exercise. They were exceedingly fond of walks, runs and even when confined to their rooms or beds pursued gymnastic exercises.

Janet (1929) identified the hyperactivity as connected to the general disturbance and not just a need to be thin. He suggested the individuals suppressed their feeling of fatigue, lost the sensation of weakness and experienced general physical excitation. More recently clinical reports of hyperactivity in anorexic patients (Blitzer, et al, 1961; Bruch, 1973; Halmi, 1974; Thoma, 1967) have been confirmed by measurement (Stunkard, 1972).

Green and Rau (1977) studied a group of bulimics and found compulsive activity but lack of felt fatigue. They suggested that hyperactivity was due to neurological irregularity, in that, excitability of the nervous system was increased which lead to overactivity, general impulsivity and compulsive activity.

Goldberg, Halmie, Casper, Eckert, and Davis (1977) studied pretreatment predictors of weight change in anorexics and found that the greater the degree of hyperactivity and exercising the greater the gain in weight. These results indicated that

hyperactivity was not necessarily associated with loss of appetite, which was commonly found, again emphasizing the need to further investigate and understand the mechanisms of anorexia nervosa and bulimia.

The findings of these studies suggested that anorexics and bulimics were not aware or had suppressed their feelings of fatigue, which should have been heightened due to their emaciated condition. The concept that this group of individuals might not 'feel' fatigued was central to the use of Lowenstein and Loewenfeld's (1951) model which used the pupillary response to light to identify sympathetic/parasympathetic damage which was associated with delay in the occurrence of natural fatigue. Taking this a step further, if anorexics are not identifying fatigue accurately they may also be misidentifying hunger.

Pupillary Response to Light and Fatigue

Lowenstein and Loewenfeld (1951) have described the pupils' normal light reflex to be integrated at different levels of the nervous system. They suggested that at each level factors were added which contributed to the final shape of the normal pupillary reflex to light. They felt the final reflex shape was modified by the absence of any single factor normally integrated at a particular level. The following are the levels of integration of the pupillary reflex to light which the authors indicated: the efferent pathways (which if interrupted block the reflex entirely); the pretectal area; the third nerve nucleus; and the ciliary

ganglion. Lesions which took place at these four levels resulted in reflex shapes which had characteristics of parasympathetic damages. The various levels of sympathetic intergation further determined the shape of the pupillary reflex to light. Examples included, damage to the posterior hypothalamus through the third nerve nucleus which lead to tonohaptic reactions when the lesions were nonirritative, and when irritative lesions took place V and W shapes. Also, when interruption in the area of the cortex and its connection through the hypothalamus, or in its connection to the iris caused a slight increase in the extent of contraction.

The authors suggested that these shapes "may appear as transitory and reversible symptoms in the course of physiological fatigue by which the normal autonomic regulation is disintegrated in a certain sequence ... the low indicated that the cortical level is weakened, and its influence caused to disappear, prior to the subcortical level and the sympathetic reflex activity vanishes prior to the parasympathetic reflex activity. A certain sequence of reflex shapes is co-ordinated with these control processes: Increased contraction speed, with shifting to the left of the differential curve, is followed by W-shapes, V-shapes, tonohaptic reactions, shapes of delayed and inextensive reactions ..." (p. 594). These shapes, then, "are a measure of the actual condition of fatigue at the moment of reflex elicitation, (and) the length of the rhythmically appearing periods of decrement and increment of autonomic (pupillary) reflex activity and the rate of deterioration

of the reflex to light within each period are a measure of fatigability" (p. 581).

Lowenstein and Loewenfeld designed a number of studies to address these issues, one such which studied 'normal' individuals' response to light stimulations. The individuals displayed similar first reaction, but differences in their responses occurred as early as the second and third light presentation. These differences indicated tendencies toward a full development of the pathological pupillary light reflex curves.

To summarize, fatigue and defatigue are concepts which were identified with shifts in the sympathetic-parasympathetic balance, a sympathetic weakness being physiologically identical to initial fatigue. A consistent arousal of "physical or mental irritation, by which the sympathetic system stimulated and the sympathetic-parasympathetic chronically shifted in favour of the sympathetic system, results in delay of the occurrence of symptoms of natural fatigue" (p. 595). This is an important concept when referencing the subject groups of anorexics and bulimics as they manifest frequent periods of hyperactivity with limited feelings of fatigue and may be suggestive of increased sympathetic arousal in anorexia nervosa and bulimia which has been hypothesized by Mawson (1974). Other researchers (Bruch, 1973; Casper et al, 1980; and Russell, 1979) have found indication that this group of subjects failed to perceive bodily sensations, including fatigue and hunger

appropriately, perhaps due to a faulty sympathetic/parasympathetic balance.

The present research used the pupillary response to repeated light presentations to study the response patterns of fatigue of anorexics and bulimics. It was felt, even though very limited research has been done with this population, that the anorexia nervosa and bulimia groups would reveal a pattern of delayed fatigue as they manifest restless, overactive characteristics of a faulty sympathetic/parasympathetic balance.

SELF REPORT AS A METHODOLOGICAL CONCERN IN THE STUDY OF ANOREXIA
NERVOSA AND BULIMIA

Research in the area of anorexia nervosa has to a large extent relied on self report (questionnaires), hospital records, histories and the use of independent raters of behavior (Beaumont, George, and Smart, 1976, Casper et al, 1980; Garfinkel et al, 1980; Kalucy et al, 1977; Pillay and Crisp, 1977). This is problematic in any type of research as histories are often inaccurate due to time lapse. In a review of the literature, Hsu (1980) has identified self report as a concern in anorexic patient studies. He identified the problem with self report techniques in that denial of illness was common in anorexia nervosa and that their denial could affect the individuals' responses and therefore implied that questionnaires and interviews ran the risk of yielding inaccurate information. Beaumont et al (1976) stated that studies based on retrospective analysis of case records were necessarily subjective

and imprecise. In agreement were Garfinkel et al (1980) who suggested that data which relied on historical information must be treated with caution. They felt it must be recognized that patients with anorexia nervosa frequently denied aspects of their illness or lied, which might have distorted study results. The present research utilized the pupillary response in assessing response style differences between anorexic and bulimic groups on a variety of variables, combined with self report items, in order to reduce self report as a confounding factor.

PUPILLARY RESPONSE: INTROVERSION AND EXTRAVERSION

In the area of pupillary research the Eysenck Personality Inventory (1967) has been extensively used, as it has been successful in relating differential physiological responsivity to personality differences. Eysenck (1967) suggested that the dimensions of neuroticism and extraversion measured by the Eysenck Personality Inventory were tied to a physiological basis. Therefore, it has proven useful in identifying individual differences in physiological responding.

Stelmack and Mandelzys (1975) examined pupillary responses of introverts and extraverts to taboo and affective words. Their results generally revealed that introverts displayed the largest pupil size and the largest magnitude of change from pre-stimulus levels. Also the results showed that greatest pupil size change was found for taboo words over affective and neutral words. The authors related their results to Eysenck's hypothesized

relationship between extraversion and cortical arousal - that introverts were characterized by higher levels of arousal.

Using auditory stimuli, Dumoff and Janisse (1976) found the largest pupillary responses to be displayed by subjects scoring low on extraversion and low on neuroticism, although differences between neurotics and stables did not reach significance. Francis (1969) found that introverted subjects had the largest pupillary dilation to visual stimuli, and Holmes (1967) found that fast constrictors to light were more introverted than slow constrictors.

The research examining the relationship between the pupillary response and personality constructs has been successful in relating it to the extraversion-introversion dimension as measured by the Eysenck Personality Inventory. The research measured the rate and degree of pupillary dilation with anorexic and bulimic groups in order to examine their levels of autonomic arousal compared this with their placement on the extraversion-introversion dimension. It was hypothesized that anorexia nervosa patients would be identified as introverts and would display a greater degree of pupillary dilation than bulimics. It was hypothesized that the bulimic patients would be identified as extraverts and would have a lesser degree of pupillary dilation than would anorexics. The control group, it was felt would include individuals at various points on the introversion-extraversion continuum and therefore no significant difference would be found in their pupil dilation.

PUPILLARY RESPONSE AND AFFECT

Janisse (1977) has summarized the literature of the pupillary response as related to affect and anxiety, reporting that, in general, the response is one of dilation. For example, Nunnally, Knot, Duchnowski and Parker (1967) found greater pupillary dilation to novel (Berlyne, 1966) than to non-novel pictures, and to pictures of nude or semi-nude women than to the same women when clothed (subjects were male). Peavler and McLaughlin (1967) also tested the effects of stimulus content and stimulus affect on pupil size. Their results demonstrated that even in the presence of increased luminance, if a stimulus was sufficiently novel or arousing, pupillary dilation took place.

Janisse, in a group of studies (1974), found that the degree of affect was related to the rate and degree of pupil dilation. His conclusion from these studies was "pupil response is linearly related to the intensity continuum of affect and curvilinearly related to the valence of the continuum of affect" (p. 145).

As will be described later, it was felt that anorexic and bulimic patients would react with different degrees of dilation due to their self-reported felt degree of affect in relation to different groups of stimuli.

SELF REPORT MEASURES

The Eating Attitudes Test (EAT). This scale has been published and validated recently by Garner and Garfinkel (1979). The EAT was validated using two groups of female anorexia nervosa

patients and female control subjects. A significant ($p .001$) level of validity was found as the total EAT score was significantly correlated with the criterion group membership. The alpha reliability coefficient indicated a high degree of internal reliability. It consists of forty self administered items and has been shown to provide a score which reliably differentiates patients with anorexia nervosa and bulimia from normals. The authors suggested that denial may have an effect on the final score, but that it does not appear to be problematic in identifying group of individuals with anorexia nervosa. The EAT scale was chosen because of its relative ease of administration, in order to eliminate individuals displaying anorexic or bulimic characteristics from the control group.

Eysenck Personality Inventory (EPI). This measure has been used extensively and accurately to relate differential physiological responsitivity to personality differences. Anorexics have been described as introverts and bulimics as extraverts (Crisp, Hsu, and Stonehill, 1979) and therefore it appears important to identify these personality traits within the groups as differential physiological reactions are expected between the groups.

The extraversion dimension, Eysenck (1967) postulates is related to nervous system activity, as is the neuroticism dimension. The degree of introversion-extraversion is related to differences in the threshold of arousal in various parts of the

ascending reticular activating system. Introverts, as defined by the EPI, are characterized by lower thresholds of cortical arousal than extraverts. Activation of the reticular system is related to alertness, attention and cortical arousal. The lower reaction threshold of introverts should cause greater sensitivity to sensory stimulation.

As the introversion-extraversion dimension is hypothesized to relate to differences in the threshold of cortical activity, Dumoff (1978) felt differences in the pupil size along the personality dimension would suggest that the pupillary response was related to cortical activity. In his research introverts had a marginally larger pupil size. Other researchers have, however, found introverts to have larger pupil size and higher levels of arousal (Dumoff and Janisse, 1976; Boddicker, 1972; Stelmack and Mandelzys, 1975).

STATEMENT OF PURPOSE

The purpose of the research was to examine the effect hypothesized, thematically relevant words on the pupillary response of clinically diagnosed hospitalized and out-patient anorexia nervosa and bulimia nervosa patients. The research also examined the light constriction response to fatigue within the framework of Lowenstein and Loewenfeld's (1951) paradigm. The constriction response of the pupil was also investigated during a condition of anxiety or arousal. The variables which were considered are pupillary response including reflex pattern, rate of constriction

or dilation, mean pupil diameter and variance of pupil diameter.

The reviewed literature has indicated various etiological factors for anorexia and bulimia (Bruch, 1973; Bemis, 1978; Crisp and Stonehill, 1971; Cantwell et al, 1977; Russell, 1970; Mawson, 1974). These theories emphasize the contribution of familial and psychodynamic factors in the development of the disorder, however at present there are still many unanswered questions in this area. The present looked at the differential responses of these groups to food-, and family-, and sex-related words. As has been indicated by Janisse (1977) the pupillary response to affect and anxiety is dilation. Therefore it was hypothesized that the bulimics would display more dilation to food-related words due to their extreme difficulty controlling their urge to eat (Russell, 1979; Garfinkel et al, 1980). The anorexic group, it was felt, would display greater dilation to family-related words as this area has been hypothesized to be most threatening for them (Bruch, 1973; Minuchen, 1974; Crisp, Harding, and McGuinness, 1974).

The literature describes the hyperactive state and suppressed feelings of hunger and fatigue (Janet, 1929; Bruch, 1973; Green and Ray, 1977; Goldberg et al, 1977) among anorexics and bulimics. For this reason Lowenstein and Loewenfeld's (1951) paradigm, which is a measure of fatigue based on pupillary reaction to light tests, was hypothesized to be sensitive to these groups. The reviewed articles suggested that there may be increased sympathetic arousal (Mawson, 1974) in this group of individuals and therefore it was

felt that anorexics and bulimics would display a pupillary response pattern revealing a faulty sympathetic/parasympathetic balance.

Combined with the light test measure to assess rate of constriction for each group, a condition was added to assess the effect of anxiety upon the groups. This trial included thinking about eating a chocolate bar. Since bulimics are thought to fear a loss of control around food, it was hypothesized that this group would display less constriction during the light stimuli due to their increased anxiety and arousal level. However, it was predicted that anorexics would exhibit less pupillary constriction to light relative to normals, but more relative to bulimics, since they are hypothesized to be less concerned about being presented with food than bulimics.

Secondary variables to be examined are the paper and pencil measures. It was hypothesized that as in past studies (Beaumont et al, 1976, Casper et al, 1980) the anorexics would be more introverted and the bulimics more extraverted as measured by the Eysenck Personality Inventory. Also the Eating Attitude Test was administered to assess the subjects' attitudes towards eating with the expectation that anorexics and bulimics would display abnormal attitudes towards eating when compared with controls.

STATEMENT OF HYPOTHESES

The following hypotheses were drawn from the above literature review and the physiological arguments which have been discussed:

1. It was hypothesized that the anorexic and bulimic groups would display differential degrees of pupil dilation to the food-, sex-, and family-related words. Specifically it was felt that the anorexic group would display more dilation to sex- and family-related words and bulimics more dilation to food-related words.
2. It was hypothesized that the anorexic and bulimic groups would demonstrate differential rates of constriction to the presentations of light stimuli in the anxiety condition. Specifically it was felt the bulimic group would demonstrate less constriction during the light test when told they would be asked to eat a chocolate bar, as they would find this more anxiety provoking than would anorexics or normals. Therefore the bulimics' arousal level would be higher (the effect being less constriction), as they may fear that eating the chocolate bar would trigger a binge, while the anorexic group would not have this fear. In addition, the presentation of food would be more arousing to anorexics than normals; consequently the anorexics would show less constriction than normals but more constriction than bulimics.
3. It was hypothesized that the anorexic and bulimic groups would manifest a light response pattern indicative of central

sympathetic irritability. It was felt that the anorexic and bulimic groups would display this pattern of delayed fatigue as they do not report feelings of fatigue which may indicate increased sympathetic arousal.

METHOD

Subjects

Subjects were 10 clinically diagnosed female anorexia nervosa patients, between 16 and 40 years (\bar{x} =26.1) and 9 clinically diagnosed female bulimic patients, between 20 and 31 years (\bar{x} =26.4). The clinical diagnosis of anorexia or bulimia was made by a psychiatrist, who employed the DSM III criteria. A group of 7 female control subjects were matched for age (between 18-34 years (\bar{x} =24.6), chosen from an Introductory Psychology course at the University of Manitoba, who were required to participate in an experiment as one means of fulfilling a class requirement in their course. The control group was found to score significantly lower than the anorexic and bulimic groups on the EAT ($t(23)$ =3.95, p .01) indicating they had normal eating patterns and were not anorexic or bulimic. The subjects' cigarette, coffee, tea and food intake were measured.

Apparatus

Pupil Measure. The pupil response was recorded with a Whittaker Space Science Eyeview Monitor and Television Pupillometer System which measured the pupil 60 times a second. Data reported is the average of every .5 second epoch (30 readings). A 15 foot

candle light source was used to stimulate the pupillary reflex and was electronically controlled to emit 1 second flashes every 5 seconds.

Verbal Instructions. Verbal instructions (Appendix A) for all tasks were presented on a Sony two channel tape recorder. The words on the word lists (Appendix B) was presented 10 seconds apart, and 5 seconds after each word the subjects heard the word relax. Thus, the subjects were to concentrate on each word for 5 seconds, then relax for 5 seconds.

Scales

Eating Attitude Measure. The subject's attitude towards eating was measured by the Eating Attitude Test (Garner and Garfinkel, 1979). The reliability and validity information is located in the Introduction, pages 37-38. See Appendix C.

Introversion-Extraversion Measure. The Eysenck Personality Inventory (Eysenck, 1967) was administered to assess the groups on this dimension. The reliability and validity information is located in the Introduction, pages 38-39. See Appendix D.

Anxiety Rating Scale. The subject's self reported level of anxiety when thinking about the words and chocolate bar was measured on a five point rating scale. See Appendix E.

Procedure

All subjects began the experimental session by completing the paper and pencil measures which included: The Eating Attitude Scale and The Eysenck Personality Inventory. The questionnaires

were completed in a separate room from the pupillometer laboratory in order to reduce distraction and anxiety produced from viewing the pupillometer apparatus. All subjects were seen individually by the examiner.

Following completion of the questionnaires each subject was taken into the pupillometric laboratory and familiarized with the equipment until they felt comfortable with it. After this the subjects were be given a brief description of the purpose of the study and their cooperation was enlisted in keeping the information confidential.

The subject was then set up in the apparatus and an initial baseline pupil response was measured for 60 seconds. Following this the two treatment phases for which instructions and procedure were presented via the tape recorder were completed.

During Treatment One each individual heard randomly ordered words during which continuous pupil diameter measurements were taken. The words were presented in a fashion similar to Stelmack and Mandelzys (1975) in which there was a 5 second baseline period, a second 5 second period in which the word was presented and a final 5 second baseline. This allowed measurement of pre- and post-pupil diameter size with each word. The words consisted of 5 food-related words, 5 family-related words, 5 sex-related words and 10 neutral meaning words. Research reviewed by Janisse (1977) has indicated that words with high or low emotional factors have a differential effect on pupil size. Specifically, arousing words cause pupillary dilation.

Treatment Two consisted of light flashes administered in three phases; initial baseline, threat, and final baseline. During all three phases subjects were presented with 10 one second light flashes with four seconds between each presentation; and pupillary responses were recorded. During phase one (or Condition One) readings were taken in order to provide the initial baseline. During phase two (or Condition Two) subjects were told they would be asked to eat a chocolate bar following the next set of light flashes; the light flashes were then administered and the responses recorded. During phase three (or Condition Three) subjects were told they did not have to eat the chocolate bar and the final set of light flashes were administered in order to provide a final baseline.

Repeated stimulation with the light was chosen in order to assess the degree of physiological fatigue taking place for each subject. A pilot study indicated that when only one stimulation was presented the data was unclear.

Following the final treatment session subjects were be asked to complete the rating scale and then were thanked and released.

Summary of Procedure

As specific directional hypotheses were made regarding the outcome in certain conditions, they were examined using planned orthogonal comparisons. Subsequent to this, mixed model repeated measures ANOVAs were performed on the manipulation check, word type data and light flash data. Significant main effects and

interactions were investigated using the Scheffe multiple comparison which preserves the family-wise Type 1 error rates at .05 for complex comparisons (Keppel, 1973).

Following completion of the Eating Attitude Test and the Eysenck Personality Inventory, the pupil diameter measurements began for the randomly ordered words (sex, food, family and neutral word types). This treatment was analyzed using a 3 (Group) X 4 (Word Type) X 8 (Epoch) repeated measures ANOVA using change in pupil diameter as the dependent variable. The average pupil size was determined for the baseline periods prior to the onset of each word type. The appropriate average baseline measure was then subtracted from each data point within the corresponding word type data.

Following a period of relaxation, the light flashes began for the No Threat (baseline) condition. Next, the same procedure was repeated for the Threat condition, with the subjects being told that following the light flashes they would be asked to eat a chocolate bar. The final condition of light flashes began following removal of the threat. This was analyzed using a 3 (Group) X 3 (Condition) X 9 (Flash) X 10 (Epoch) repeated measures ANOVA. The degree of anxiety elicited by the words and threat in Condition Two was measured by a self report questionnaire rating level of anxiety for the words and chocolate bar. Analysis consisted of a 3 (Group) X 4 (Word Type) repeated measures ANOVA.

Results

Effectiveness of Manipulation

In order to examine these results in a general form a 3 (Group) X 4 (Word Type) mixed model repeated measures analysis of variance on the anxiety rating scale was performed. The ANOVA summary table is presented in Table 3, Appendix F. The significant group main effect ($F(2,23)=3.86, p .036$) indicated the groups reported differing degrees of anxiety when listening to the words, with bulimics feeling most anxious, followed by anorexics and finally controls. Post hoc Scheffe multiple comparisons revealed that the anorexic and bulimic groups reported feeling more anxious when thinking about the words than the control group ($F(2,23)=7.327, p .05$). However there was no difference between the anorexic and bulimic group in their reported feeling of anxiety produced from listening to the words ($F(2,23), p .05$).

The significant word type main effect ($F(3,69)=21.26, p .0001$) revealed that the different word groups elicited varying degrees of reported anxiety, with food words being most anxiety provoking followed by sex, family and neutral words. Post hoc Scheffe multiple comparisons revealed that when compared with sex, family and neutral words combined, food words were found to be significantly more anxiety provoking ($F(3,69)=130.83, p .001$). Neutral words were found to be significantly less anxiety provoking than sex-, food- and family-related words combined ($F(3,69)=143.50, p .001$). Further, food-related words were reported to be

more anxiety arousing than sex words ($F(3,69)=36.27, p .001$) or family-related words ($F(3,69)=56.27, p .001$). However sex-related words were not found to produce stronger feelings of anxiety than family-related words ($F(3,69), p .05$). The interaction for group and word type was not found to be significant ($F 1, p .05$). Table 4 presents the means for the ratings of anxiety for the various word types.

To further evaluate the subjects reported degree of anxiety when presented with the four word types and request to eat a chocolate bar, planned orthogonal comparisons were carried out. Contrary to expectation bulimic and anorexic subjects did not differ in their self reported anxiety to food-related words ($F(1,69), p .05$), which is displayed in Figure 1. As well the anorexic group did not display the expected degree of anxiety related to family and sex words when compared with the control or bulimic groups ($F(1,69)= 3.71, p .05$; and $F(1,69)=1.61, p .05$). However the anorexic and bulimic groups found the prospect of eating a chocolate bar significantly more anxiety provoking than the control group ($F(2,23) =7.27, p .01$). There was no significant difference between the anorexic and bulimic groups when rating anxiety level and eating the chocolate bar ($F(1,23)= 3.79, p .05$).

Pupillary Response and Word Type

To evaluate these data in an overall sense, these results were analyzed using a 3 (Group) X 4 (Word Type) X 8 (Epoch) mixed model

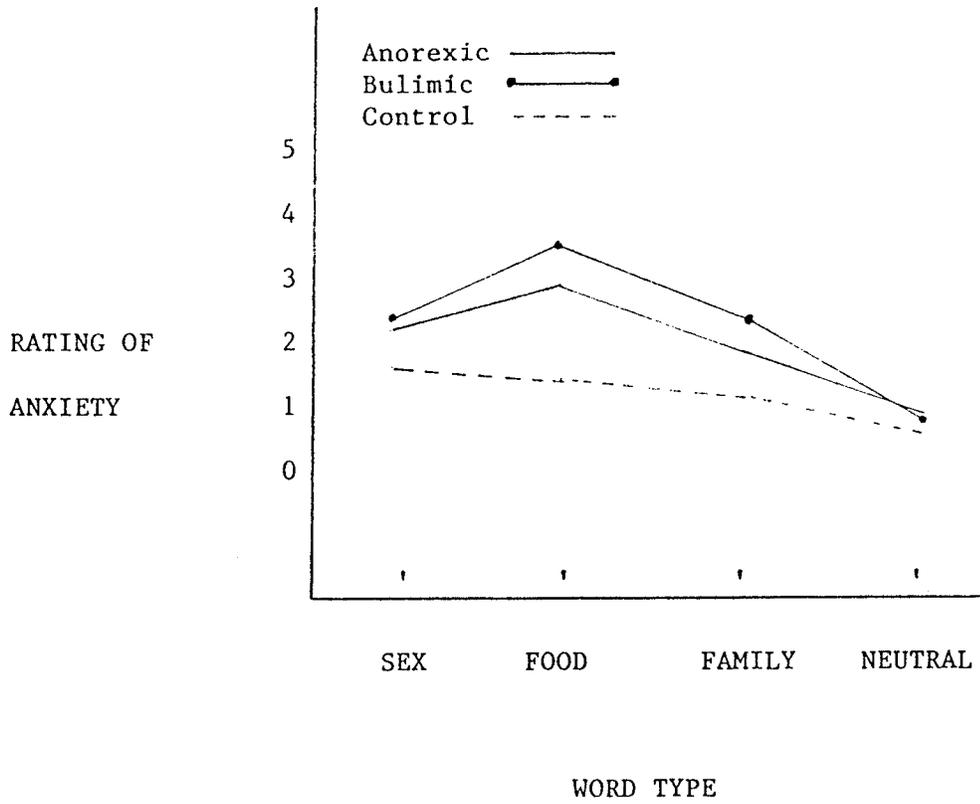


Figure 1. Average anxiety rating of subjects to the four word types.

repeated measures analysis of variance. See Appendix F, Table 5 for the ANOVA summary table. The results revealed a group main effect ($F(2,23)=2.84, p .07$) indicating that the groups' degree of pupil size changes were significantly different, with the control group revealing significantly greater pupillary changes than anorexics and bulimics. This was further examined with the Scheffe test which revealed that anorexics and bulimics did not respond with a significant change in pupil size while listening to the words when compared with controls ($F(2,23)=1.23, p .05$). Nor did anorexics or bulimics display significant differences in magnitude of pupil size change while listening to the words ($F(2,23)=.744, p .05$). However a trend was evident with bulimics displaying a smaller magnitude of pupil size change than controls ($F(2,23)=5.604, p .10$).

The main effect of word type was significant ($F(3,69)=3.40, p .023$) indicating that thinking about the word types effected pupil size, with family-related words having more effect on pupil size change, followed by food, sex and neutral words (See Figure 2). The Scheffe test was utilized to further investigate this effect. sex-related words were found to produce significantly less pupil size change when compared with the combination of food-related, family-related and neutral words ($F(3,69)=18.84, p .01$). The remaining multiple comparisons were not found to be significant ($F 1, p .05$).

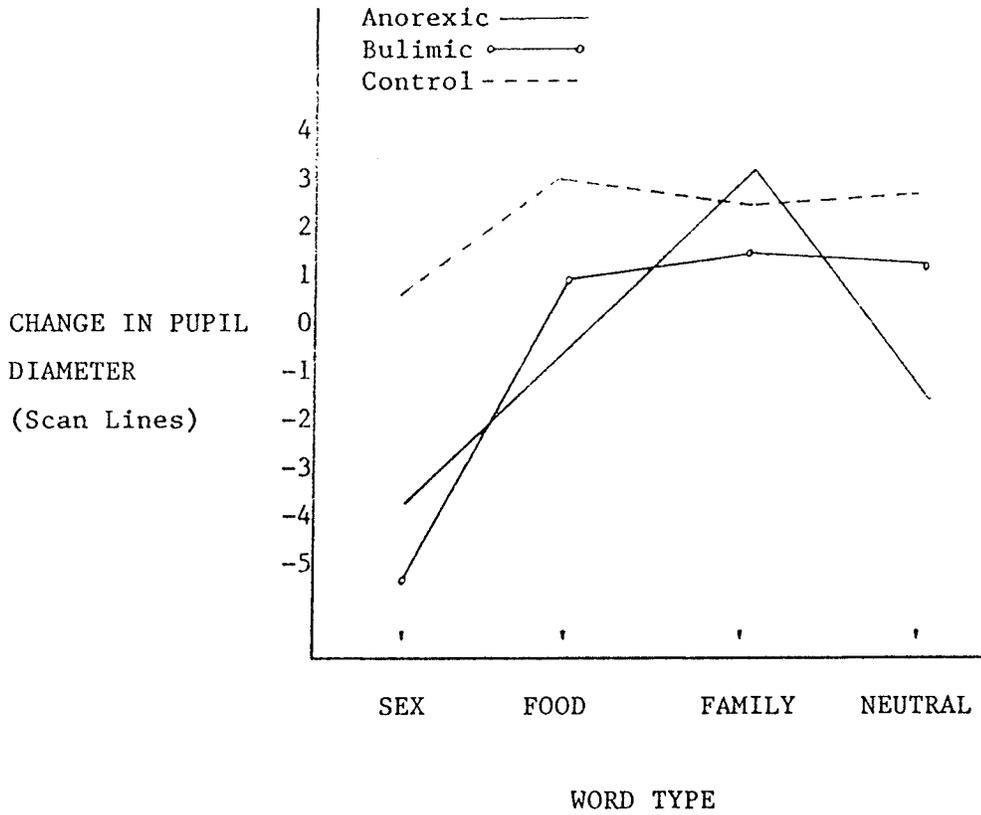


Figure 2. Average pupil diameter change of Anorexics, Bulimics and Controls for sex-related, food-related, family-related and neutral words.

The epoch main effect was not significant ($F(7,161)=.639$, $p .05$) indicating it was irrelevant what epoch was examined when evaluating the effect of the word types. None of the first or second order interactions were significant ($F 1, p .05$).

Contrary to expectations the planned orthogonal contrasts to support the proposals' hypotheses which predicted differential pupillary responses to the various word types were not significant. The anorexic and bulimic groups did not differ in the magnitude of change in pupil size when presented with family-related words ($F(1,69)=.7558, p .05$). Figure 3 displays this interaction. As well the bulimic group did not differ in magnitude of pupil size change when compared with anorexics and controls when listening to food-related words ($F(1,69)=.169, p .05$). Further, the control group did not display the expected magnitude of pupil size change for sex-related words when compared to the bulimic and anorexics groups ($F(1,69)=2.839, p .05$).

Pupil Response to Light Flashes

To evaluate these data in a general way an omnibus 3 (Group) X 3 (Condition) X 9 (Flash) X 10 (Epoch) mixed model repeated measures analysis of variance was done (ANOVA summary Table 6, Appendix F). The main effect of group was not significant ($F(1,20)=.27, p .76$) indicating the groups did not display significantly different pupil sizes.

The condition main effect was significant ($F(2,40)=3.30$, $p .047$), with Condition Two producing more pupillary dilation for

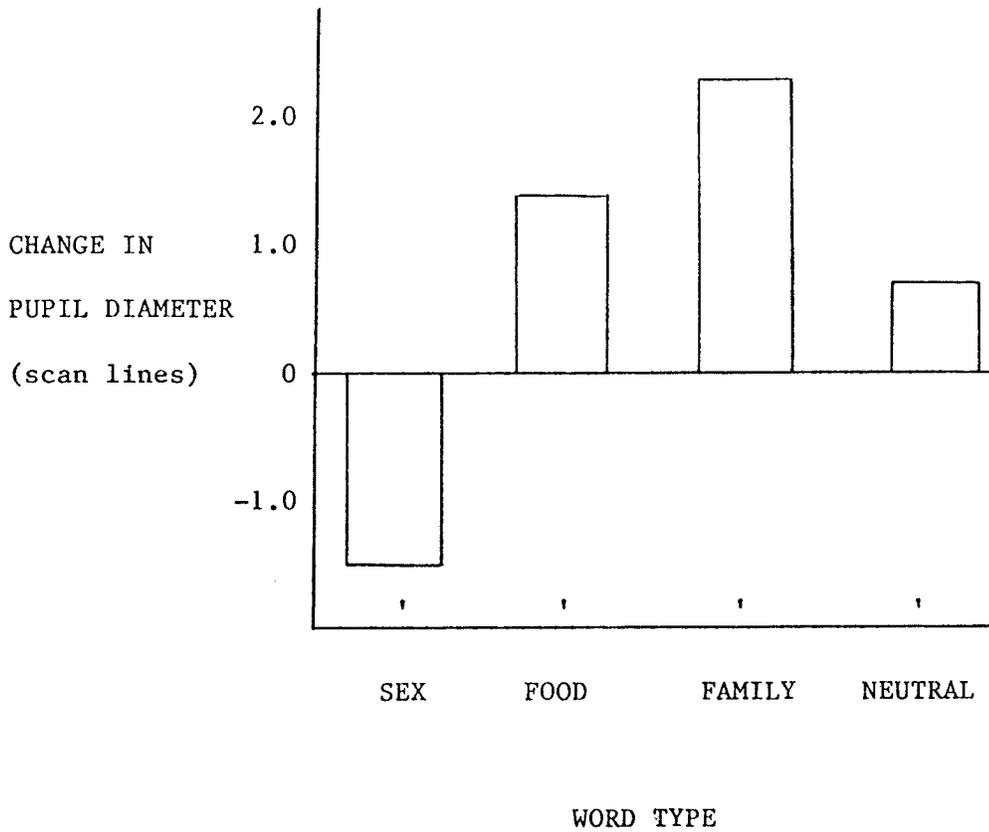


Figure 3. Pupil diameter change averaged over all groups during presentation of sex-related, food-related, family-related and neutral words.

the bulimics than the neutral and anorexic groups. Post hoc multiple comparisons using the Scheffe test indicated subjects had significantly larger pupil diameters during Condition Two when combining pupil diameters during Condition Two when combining Conditions One and Three ($F(2,40)=16.91, p .001$).

The main effect for flash was significant ($F(8,160)=2.07, p .04$), however the assumption of symmetry was violated. Therefore the Greenhouse Geisser correction (Keppel, 1973) was used to correct for this violation making it a conservative test which revealed a trend ($F(8,60)=2.07, p .09$). Decomposition of the flash main effect using a trend analysis (orthogonal polynomials) revealed a linear trend ($F(1,20)=3.80, p .065$). The linear trend indicated that as the number of flashes increased the pupillary response decreased. See Figure 4.

The epoch main effect was found to be highly significant ($F(9,180)=65.57, p .0001$) which, as expected, revealed the constriction/redilation pupillary response to light. Analysis of the results indicated an exponential trend. See Figure 5. None of the first, second or third order interactions were significant ($F 1, p .05$).

Contrary to expectations the planned orthogonal contrasts did not reveal significant physiological differences between the anorexic and bulimic groups ($F(1,40)=1.77, p .05$) during the baseline light flash condition (See Figure 6). However consistent with expectation, the bulimic group displayed less constriction

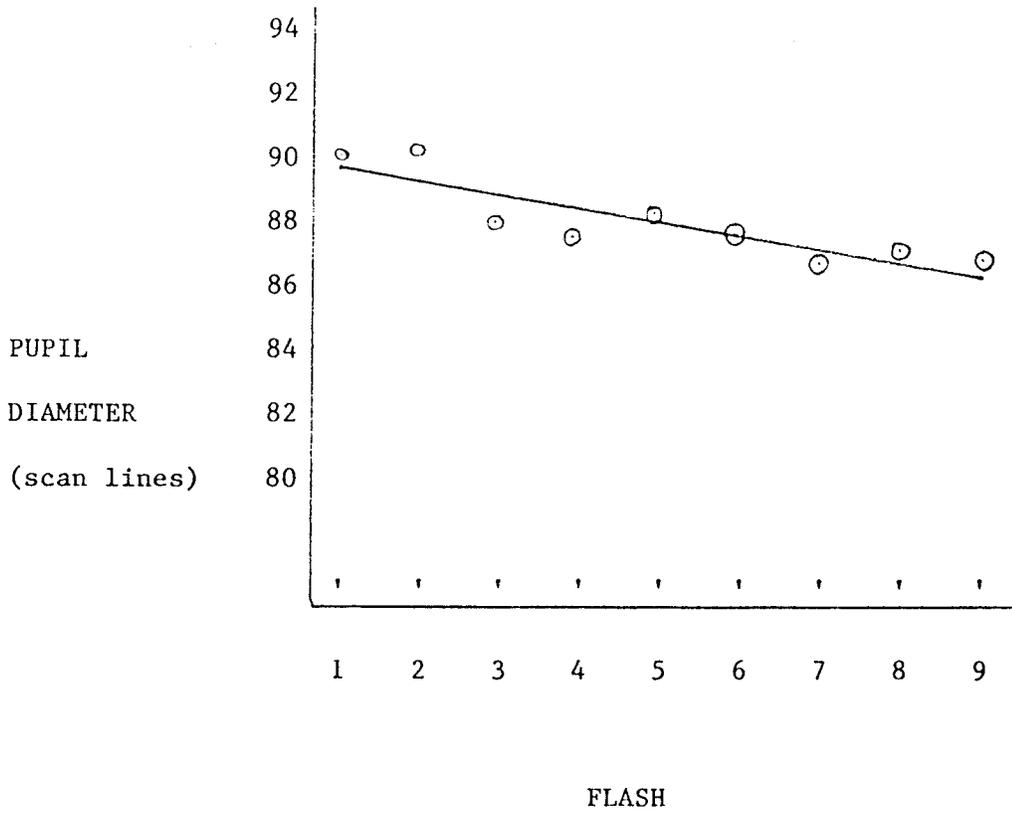


Figure 4. Pupil size averaged across all groups during Flashes.

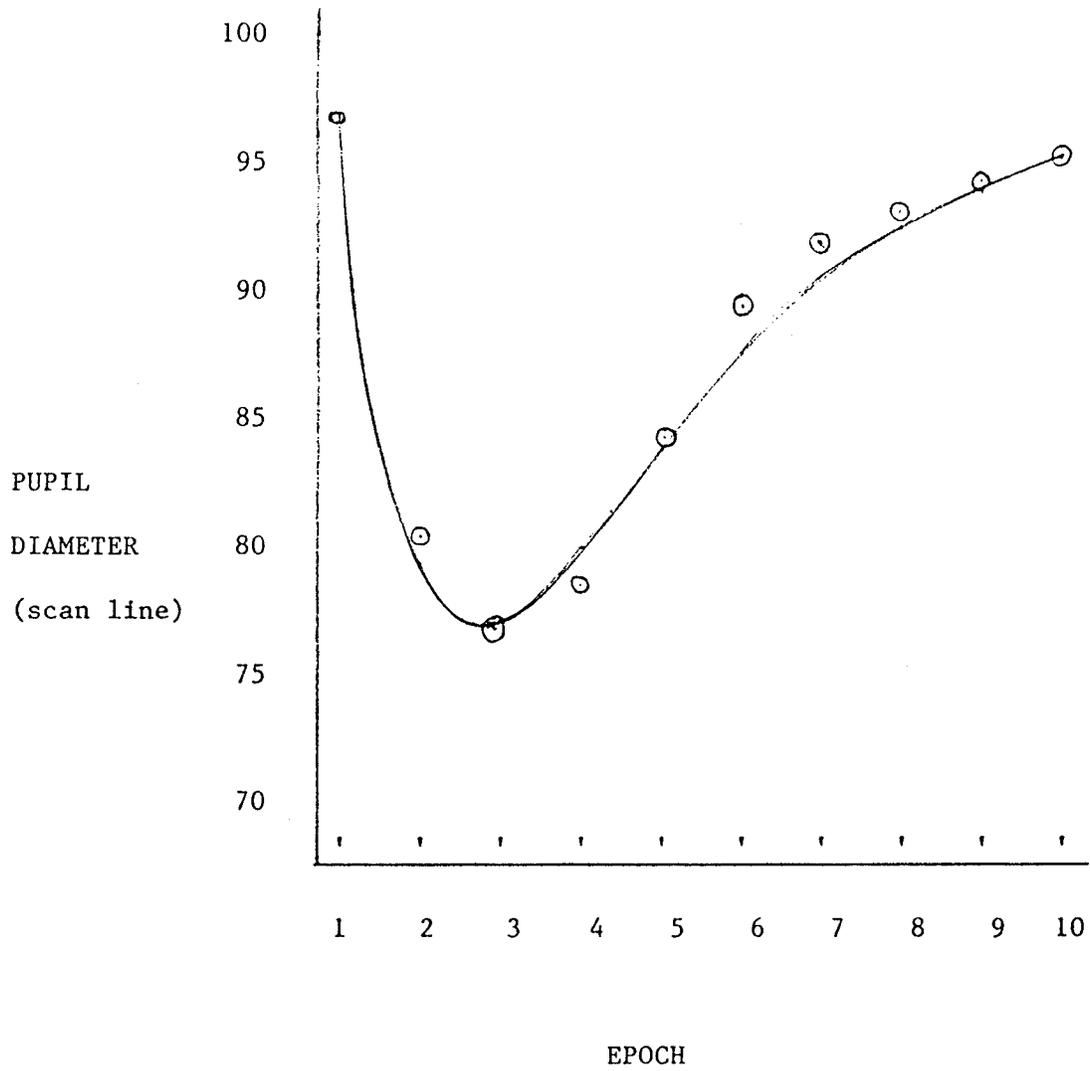


Figure 5. Pupil size averaged across all groups during Epochs.

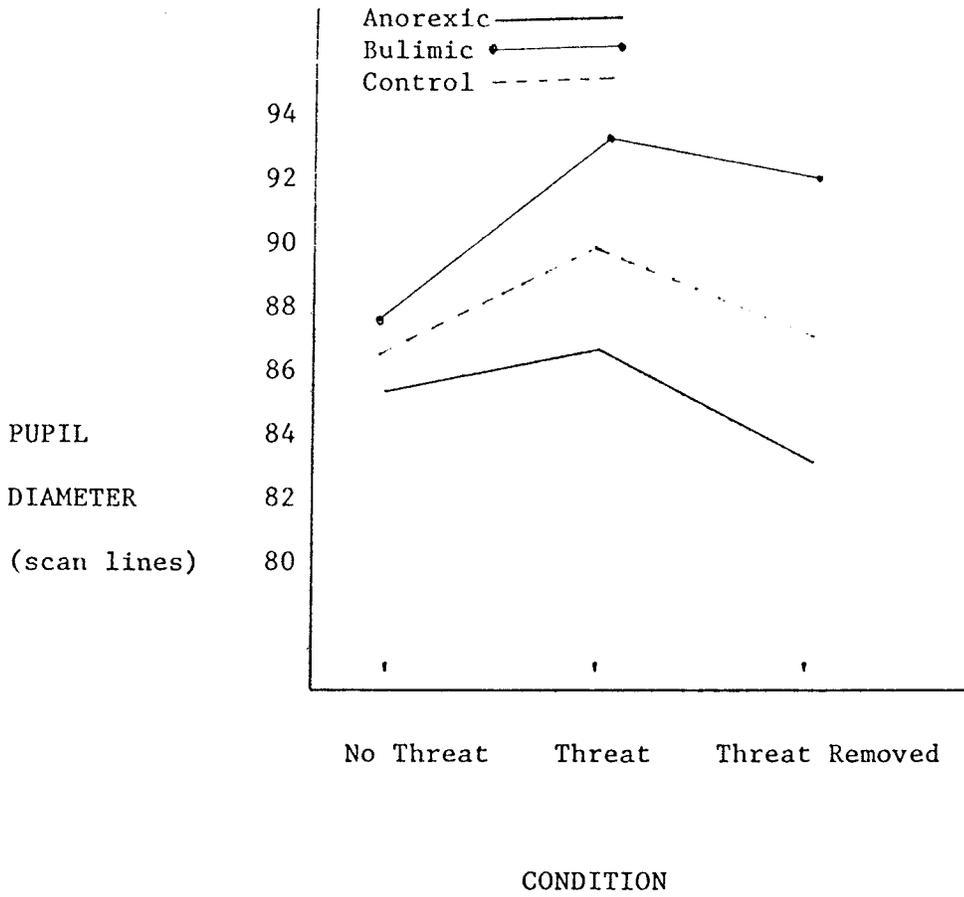


Figure 6. Average pupil size for Anorexics, Bulimics and Controls during No Threat, Threat and Threat Removed Conditions.

than the combined anorexic and control group when asked to think about eating a chocolate bar ($F(1,40)=9.596, p .01$). Further within Condition Two anorexics did not differ significantly from the control group ($F(1,40)=2.372, p .05$), contrary to prediction.

Personality Measure

The Eysenck Personality Inventory results were contrary to expectation with no significant difference found between the anorexics ($\bar{x} = 9.5$), bulimics ($\bar{x} = 10.2$) and controls ($\bar{x} = 11$) ($F(2,23)=.0615, p .05$). These results indicated the individuals in this study all fell within the introverted range.

Discussion

In summary, the present results generally did not support the hypothesis that anorexic and bulimic individuals differ from each other in physiological responsivity when at rest. However, bulimics and anorexics did respond differentially to stressful stimuli. Thereby supporting the notion that the two groups represent distinct patterns of relating to food. Support for the theories of the etiology of anorexia nervosa and bulimia was unclear, as the stimuli chosen to produce arousal were unsuccessful.

Manipulation Check

Janisse (1977), in a review of several studies, stated that the pupillary response to anxiety is generally one of dilation and

that the degree of pupil dilation is related to the degree of affect identified by the individual. The results of the manipulation check revealed that the sex, food, family and neutral words chosen to evoke differential anxiety and consequent physiological arousal within the subjects were unsuccessful. The failure of these words to produce the intended arousal, affects the interpretation of the pupillometric responses in the initial treatment phase of the study. As none of the groups identified or attributed feelings of anxiety to listening and thinking about the words, differential pupillary responses would not be expected.

The most notable result of the manipulation check was the significant feeling of anxiety of the anorexics and bulimics when asked to eat a chocolate bar, underscoring threat and concern which food holds for these individuals (Schlesier-Stropp, 1984 and Johnson and Larson, 1982).

The results of the manipulation check did not provide support for the family interactional or the psychodynamic models of anorexia and bulimia. Neither of the groups found the family-related or sex-related words to be anxiety arousing for them. This suggests that they do not perceive their family relationships or sexual identities as problematic for them. (However as Bruch (1973) has suggested the individuals may simply be unaware or unable to recognize these feelings towards their families or sexuality). Recent research by White (1983), has suggested that there is a link between anorexia nervosa and rigid and implicit

family beliefs. These beliefs are transmitted from generation to generation with a highly constraining effect on all family members. He suggests these beliefs include role prescriptions that are applied to certain daughters who became vulnerable to the symptoms of anorexia nervosa. These beliefs have consequences for all family member. White's theory suggests that the development of anorexia nervosa would be a result of the beliefs rather than created by a particular family members. Interpreting the present results in this context would predict that family words would not produce arousal as they do not trigger feelings related to family beliefs.

More simply the limited arousal effect of the words on the surface appears to be related to the limited graphic or imaginary vision they produced for the subjects. However, since anorexics and bulimics have been labelled as deniers (Hsu, 1980) or liars (Garfinkel et al, 1980) the results may not be an accurate representation of their feelings. This interpretation is tempered by the finding of the chocolate bar as significantly anxiety provoking, both in ratings and in of physiological functioning.

Another interpretation of these results relates to the treatment process. All anorexic and bulimic subjects who participated in this study were undergoing treatment. However length of treatment was not assessed at the time of their participation in the study. As the initial response to treatment is generally favourable, (Bruch, 1973 and Rowland, 1970) the subjects may have been feeling less anxious and concerned as a

result of therapy, therefore feeling little arousal when presented with the different word types. In a review of the literature, Bemis (1978), indicated most authors agree that the initial phase of treatment is relatively simple and successful, regardless of treatment method.

Pupillary Response and Word Type

The absence of differential responses to the various word types is surprising, when considering the consistency in the etiological studies which identify family interactional patterns, sexual confusion or preoccupation with food as the primary reasoning for developing these eating disorders (Kalucy et al, 1977; Crisp and Stonehill, 1971 and Bruch, 1973). However, the results of this condition must be considered with caution as the manipulation check revealed the words to be ineffective in producing anxiety in the subjects. Further, it may not be that the words were ineffective but rather that accuracy of the theories (family interactional and psychodynamic) utilized in choosing the words were simply not supported. In other words, it is possible that the anorexics and bulimics do not identify or associate their family or sexuality as sources of distress. Should this be the case, one would not expect them to experience anxiety responses when presented with family-related or sex-related stimuli.

Noteworthy were the pupillometric values in this condition as they revealed a number of negative values which were inconsistent with expectation of positive values indicating pupillary dilation.

However, Janisse (1977) cautioned that negative values need not mean constriction. He suggested that negative values for relative pupil size indicate less dilation to the stimulus word than to the average baseline period. Further research (Bradshaw, 1969; Simpson, 1969 and Nunnally et al, 1969) has found that anticipation increases pupil size and that effort and anticipation of the next word may also enhance pupil size during the baseline period.

Another interpretation may be that the subjects were not concentrating or picturing an image of the word, and when told to relax realized this and became aroused within the post-baseline period, creating the negative values. In support of this interpretation, attention and concentration difficulties have been associated with anorexics and bulimics (Casper and Davis, 1977; Small, Maders, Teagno and Ebert, 1983 and Schlesier-Stropp, 1984). Johnson and Larson (1982) have indicated that these individuals are preoccupied with thoughts of food, food related activities, bingeing and vomiting to the degree that they are unable to maintain their occupational and social activities .

Physiological Responsivity and Fatigue

Pupillary response following presentation of the light flashes did not reveal the anticipated differences in functioning between anorexics and bulimics. The similarity in their physiological functioning did not provide basis for identification of the disorders as separate entities. One inference from these results is that the disorders may not have a physiological base, as the

experimental groups did not significantly differ from each other. Recent research (Salkind, Fincham and Silverstone, 1980 and Calloway, Fonagy and Wakeling, 1983) measuring autonomic arousal by skin conductance level have found little or no response differences between anorexics and bulimics suggesting that physiological functioning, when unstressed, does not differentiate between these groups of eating disorders.

Further, the pattern of responses from the light flashes did not follow the model of fatigue defined by Lowenstein and Loewenfeld (1951). It appears the hyperactivity found in anorexics and bulimics (eg. Blitzer et al, 1961; Bruch, 1973 and Halumi, 1974) may not relate to sympathetic/parasympathetic damage associated with delay in the natural occurrence of fatigue (Lowenstein and Loewenfeld, 1951). Normal sympathetic functioning has been found in other studies examining neuroendocrine functioning and sympathetic nervous system activity in anorexia nervosa (Gerner, 1981 and Gross, Lake, Ebert, Ziegler and Kopin, 1979). These studies found endocrine and sympathetic system abnormalities in primary anorexia nervosa due to starvation, however after weight gain their sympathetic functioning returned to normal. As the subjects in the present study were at various stages of treatment and not at starvation levels, their normal sympathetic functioning supports the findings of these studies who found normal sympathetic functioning in anorexics following weight gain. These results provide supportive information for the

theories (Bruch, 1973, and Casper and Davies, 1977) which indicate that anorexics are denying on lack awareness of their feelings of hunger and fatigue. The pattern of results did not display altered physiological functioning to suggest physiological delay in feelings hunger or fatigue.

The physiological functioning of anorexic individuals within this study did not reveal significant arousal effects when thinking about food or eating a chocolate bar, while the bulimics expressed and displayed significant arousal when asked to eat the chocolate bar. This pattern is suggestive of two groups or subgroups who respond distinctively different (ie. bulimics may be more easily activated). This pattern of responses provides corroboration for identifying the disorders separately, or at least as bulimia as a subgroups of anorexia nervosa. These findings can be related to findings by Casper et al(1980) who found bulimics had strong appetites and great desire to eat. The hunger and preoccupation with food identified by bulimics creates intense anxiety when presented with food as they maintain a strong desire to eat and feel they have little control over their eating following even a single taste of food. Schlesier-Stropp (1984) in a review of the literature reported bulimics are totally preoccupied with thoughts of food, fear losing control over eating and that ingestion of even small amounts of food may trigger a binge. The significant arousal produced from thinking about eating is felt to have stemmed from the bulimics extreme fear that eating the chocolate bar in the

study would trigger a binge. Conversely, anorexics did not display a physiological arousal response when asked to eat the chocolate bar. The lack of response is felt to reflect the anorexics ability to maintain control and consistently abstain from eating (Feighner et al, 1972).

Personality

The Eysenck Personality Inventory failed to differentiate the groups in the predicted manner. Research (Russel, 1979, and Schlesier-Stropp, 1984) has consistently identified anorexics as introverts and bulimics as extraverts, however, within the present investigation all subjects were found to be introverted. These results are consistent with Ben-Tovim et al (1979), who also did not find significant differences between anorexics, bulimics and normals on the introversion-extraversion scale of the Eysenck Personality Inventory. These results are difficult to evaluate as the sample size in the present study was small and could account for the results not reaching significance.

Conclusion

In conclusion, the most significant finding in this study is that anorexics and bulimics differ significantly in their physiological functioning when anxious, with bulimics displaying significantly higher levels of arousal than anorexics. This finding lends support to the identification of anorexia and bulimia as separate disorders, by use of a physiological measure. Use of a physiological response is often considered more veridical more

valid than self report measures with anorexics and bulimics, as they have been consistently been found to be 'deniers and liars'. The use of self report measures in many studies with these individuals have found inconsistent and questionable results due to unreliable reports from anorexics and bulimics.

The natural fatigue pattern present for all groups tends not to support the theories that these individuals deny or are not aware of hunger and fatigue these feelings. Further, the normal sympathetic/parasympathetic functioning of these individuals provides evidence of normal sympathetic nervous system functioning following treatment and weight gain.

The subject groups did not identify anxiety or respond with arousal to the initial word stimuli, whether the limited anxiety ratings and physiological responses relate to poor choice of words, lack of support for the etiological theories or effect of treatment remains unclear.

Further research utilizing physiological responses, including the pupillary response, is likely to provide fruitful results in further identifying characteristics of anorexia and bulimia as well as providing additional support for the etiology of these disorders.

As the anxiety self report results were questionable it is felt added anxiety measures should be incorporated into future pupillometric studies in this area, such as heart rate. Studies should clearly define the characteristics of the subject groups

being investigated. It appears important to identify the age of onset of the disorder, duration, degree of weight loss or gain, stage of treatment etc. Future research should measure pupillary response during arousal with pre-treatment, treatment (divided into stages) and recovered anorexics and bulimics to allow further understanding of the process of this disorder. This would also provide information about the effectiveness of treatment as the subjects should respond with varying levels of arousal to the same stimuli depending on their stage of treatment. For example, presenting pre-treatment, treatment and recovered anorexics and bulimics with a chocolate bar should provide differential pupillary responses, if treatment has been successful. Vital to utilizing the pupillary response to investigate the etiology of anorexia and bulimia is to determine anxiety provoking stimuli related to the etiological theories prior to measuring pupillary response.

Finally, it is unlikely any single theoretical system will be able to account for all the aspects of these disorders, and contributions from all areas must be incorporated. It is likely that in order to understand these disorders, recognition of multiple factors of causation is needed and a range of treatments designed.

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APPENDIX A

INSTRUCTIONS

Taped Instructions

Introduction

The procedures that we will go through today will take about 45 minutes. You should find them interesting and perhaps even enjoyable. What we are testing today is the body's reaction, specifically the nervous system's reaction to a variety of situations. In order to measure how the nervous system is reacting in these situations we take television pictures of the pupil. We measure how fast the pupil constricts or gets smaller to a flash of light and to various other stimuli.

Treatment One

In the first part of the experiment we want you to listen to some words. Try to picture the image suggested by each word as you hear it, until you hear the word 'relax'. You will hear a word about every ten seconds, and five seconds later you will hear the word 'relax'. There will be 25 words altogether. Remember, try to picture the image that the word suggests. I will begin in a moment.

- words presented -

That was the last word, you may now sit back and relax.

Treatment Two

Trial 1. In the second part of the experiment we will measure how fast the pupil constricts or gets smaller to a flash of light. There will be ten, one second light flashes with four seconds

between each light flash. The tape will now be turned off and the light flashes administered.

Trail 2. In a moment you are going to be asked to eat this chocolate bar. Before you do this, however, we are going to do another light test. The tape will now be turned off and the light flashes administered.

Trail 3. You, in fact, will not be required to eat the chocolate bar and may relax. There will now be one final set of light flashes.

Paper and Pencil Measures

Before you is a rating scale which I would like you to complete. The scale requires you to rate the degree of anxiety you felt when hearing each word and when asked to eat the chocolate bar. The scale goes from 1 to 5 with 1 - little anxiety and 5 - high anxiety.

Eysenck Personality Inventory and the Eating Attitude Scale

Before you are two questionnaires I would like you to complete. Please read the instructions at the top of each questionnaire and complete all items. If you have any questions, please feel free to ask them.

Please begin.

APPENDIX B

WORDS

Neutral Words

- | | |
|-------------|-----------|
| 1. particle | 6. candle |
| 2. pillar | 7. plant |
| 3. bells | 8. boat |
| 4. shoe | 9. tag |
| 5. bench | 10. door |

food-related Words

1. pork
2. binge
3. ice cream
4. fat
5. buter

family-related Words

1. father
2. family
3. mother
4. grandparent
5. home

sex-related Words

1. breast
2. penis
3. pubic
4. kiss
5. intercourse

Order of Presentation

1. plant
2. candle
3. tag
4. door
5. boat
6. breast
7. pork
8. binge
9. father
10. ice cream
11. brother
12. fat
13. pillar
14. penis
15. bells
16. mother
17. pubic
18. shoe
19. kiss
20. particle
21. grandparent
22. home
23. butter
24. bench
25. intercourse

APPENDIX C

Attitudes Questionnaire

Please circle the number for each question which best applies to you, and then put that number in the corresponding box. All of the results will be STRICTLY confidential. Most of the questions directly relate to food or eating, although some questions concerning other areas have been included. Please answer each question carefully. Thank you.

	Always	Very Often	Often	Sometimes	Rarely	Never	
1. I like eating with other people.	1	2	3	4	5	6	7
2. I prepare foods for others but do not eat what I cook.	1	2	3	4	5	6	8
3. I become anxious prior to eating.	1	2	3	4	5	6	9
4. I am terrified about being overweight.	1	2	3	4	5	6	10
5. I avoid eating when I am hungry.	1	2	3	4	5	6	11
6. I find myself preoccupied with food.	1	2	3	4	5	6	12
7. I have gone on eating binges where I feel that I may not be able to stop.	1	2	3	4	5	6	13
8. I cut my food into small pieces.	1	2	3	4	5	6	14
9. I am aware of the calorie content of foods that I eat.	1	2	3	4	5	6	15
10. I particularly avoid foods with a high carbohydrate content (e.g. bread, potatoes, rice, etc.).	1	2	3	4	5	6	16
11. I feel bloated after meals.	1	2	3	4	5	6	17
12. I feel that others would prefer if I ate more.	1	2	3	4	5	6	18
13. I feel extremely guilty after eating.	1	2	3	4	5	6	19

	Always	Very Often	Often	Sometimes	Rarely	Never	
14. I am preoccupied with a desire to be thinner.	1	2	3	4	5	6	20
15. I exercise strenuously to burn off calories.	1	2	3	4	5	6	21
16. I weigh myself several times a day.	1	2	3	4	5	6	22
17. I like my clothes to fit tightly.	1	2	3	4	5	6	23
18. I enjoy eating meat.	1	2	3	4	5	6	24
19. I wake up early in the morning.	1	2	3	4	5	6	25
20. I eat the same foods day after day.	1	2	3	4	5	6	26
21. I think about burning up calories when I exercise.	1	2	3	4	5	6	27
22. (FOR FEMALES ONLY) I have regular menstrual periods.	1	2	3	4	5	6	28
23. I feel that other people think I am too thin.	1	2	3	4	5	6	29
24. I am preoccupied with the thought of having fat on my body.	1	2	3	4	5	6	30
25. I take longer than others to eat my meals.	1	2	3	4	5	6	31
26. I enjoy eating at restaurants.	1	2	3	4	5	6	32
27. I take laxatives.	1	2	3	4	5	6	33
28. I avoid foods with sugar in them.	1	2	3	4	5	6	34
29. I eat diet foods.	1	2	3	4	5	6	35
30. I feel that food controls my life.	1	2	3	4	5	6	36
31. I display self control around food.	1	2	3	4	5	6	37
32. I feel that others pressure me to eat.	1	2	3	4	5	6	38
33. I am often constipated.	1	2	3	4	5	6	39

	Always	Very Often	Often	Sometimes	Rarely	Never	
34. I feel uncomfortable after eating sweets.	1	2	3	4	5	6	40
35. I engage in dieting behaviour.	1	2	3	4	5	6	41
36. I like my stomach to be empty.	1	2	3	4	5	6	42
37. I enjoy trying new rich foods.	1	2	3	4	5	6	43
38. I have the impulse to vomit after meals.	1	2	3	4	5	6	44
39. I vomit after I have eaten.	1	2	3	4	5	6	45
40. I give too much time and thought to food.	1	2	3	4	5	6	46

APPENDIX D

TRAIT SCALE

	Yes	No	E	N	L		Yes	No
Do you often long for excitement?	Yes	No						
Do you often need understanding friends to cheer you up?	Yes	No				31. Do ideas run through your head so that you cannot sleep?	Yes	No
Are you usually carefree?	Yes	No				32. If there is something you want to know about, would you rather look it up in a book than talk to someone about it?	Yes	No
Do you find it very hard to take no for an answer?	Yes	No				33. Do you get palpitations or thumping in your heart?	Yes	No
Do you stop and think things over before doing anything?	Yes	No				34. Do you like the kind of work that you need to pay close attention to?	Yes	No
When you say you will do something do you always keep your promise, no matter how inconvenient it might be to do so?	Yes	No				35. Do you get attacks of shaking or trembling?	Yes	No
Does your mood often go up and down?	Yes	No				36. Would you always declare everything at the customs, even if you knew that you could never be found out?	Yes	No
Do you generally do and say things quickly without stopping to think?	Yes	No				37. Do you hate being with a crowd who play jokes on one another?	Yes	No
Do you ever feel "just miserable" for no good reason?	Yes	No				38. Are you an irritable person?	Yes	No
Would you do almost anything for a dare?	Yes	No				39. Do you like doing things in which you have to act quickly?	Yes	No
Do you suddenly feel shy when you want to talk to an active stranger?	Yes	No				40. Do you worry about awful things that might happen?	Yes	No
Do you in a while do you lose your temper and get angry?	Yes	No				41. Are you slow and unhurried in the way you move?	Yes	No
Do you often do things on the spur of the moment?	Yes	No				42. Have you ever been late for an appointment or work?	Yes	No
Do you often worry about things you should not have said?	Yes	No				43. Do you have many nightmares?	Yes	No
Do you usually do you prefer reading to meeting people?	Yes	No				44. Do you like talking to people so much that you would never miss a chance of talking to a stranger?	Yes	No
Do your feelings rather easily hurt?	Yes	No				45. Are you troubled by aches and pains?	Yes	No
Do you like going out a lot?	Yes	No				46. Would you be very unhappy if you could not see lots of people most of the time?	Yes	No
Do you occasionally have thoughts and ideas that you do not like other people to know about?	Yes	No				47. Would you call yourself a nervous person?	Yes	No
Do you sometimes bubbling over with energy and sometimes very sluggish?	Yes	No				48. Of all the people you know are there some whom you definitely do not like?	Yes	No
Do you prefer to have few but special friends?	Yes	No				49. Would you say you were fairly self-confident?	Yes	No
Do you daydream a lot?	Yes	No				50. Are you easily hurt when people find fault with you or your work?	Yes	No
When people shout at you, do you shout back?	Yes	No				51. Do you find it hard to really enjoy yourself at a lively party?	Yes	No
Do you often troubled about feelings of guilt?	Yes	No				52. Are you troubled with feelings of inferiority?	Yes	No
Do your habits good and desirable ones?	Yes	No				53. Can you easily get some life into a rather dull party?	Yes	No
Do you usually let yourself go and enjoy yourself at a gay party?	Yes	No				54. Do you sometimes talk about things you know nothing about?	Yes	No
Do you call yourself tense or "highly-strung"?	Yes	No				55. Do you worry about your health?	Yes	No
Do people think of you as being very lively?	Yes	No				56. Do you like playing pranks on others?	Yes	No
When you have done something important, do you often say feeling you could have done better?	Yes	No				57. Do you suffer from sleeplessness?	Yes	No
Do you mostly quiet when you are with other people?	Yes	No						
Do you sometimes gossip?	Yes	No						

APPENDIX E

22. HOME	_____	_____	_____	_____	_____
	no anxiety		anxious		extremely anxious
23. BUTTER	_____	_____	_____	_____	_____
24. BENCH	_____	_____	_____	_____	_____
25. INTERCOURSE	_____	_____	_____	_____	_____
26. CHOCOLATE BAR	_____	_____	_____	_____	_____

How long has it been since:

- a) you ate _____
- b) you had a cup of coffee or tea _____ Number of cups _____
- c) you smoked a cigarette _____

APPENDIX F

TABLE 3

Analysis of Variance of Manipulation Check

<u>Source of Variation</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>p</u>
Mean	1	357.20	316.20	.000
Group	2	4.36	3.86	.036
Error	23	1.13	-	-
Word Type	3	9.27	21.26	.000
Word X Group	6	1.74	1.69	.136
Error	69	.45	-	-

Table 4

Mean Ratings of Anxiety for the Word Types

<u>Group</u>	<u>Word Types</u>			
	<u>Sex</u>	<u>Food</u>	<u>Family</u>	<u>Neutral</u>
Anorexic	2.06	2.94	1.84	1.16
Bulimic	2.17	3.09	2.27	1.16
Control	1.74	1.69	1.37	1.00

TABLE 5

Analysis of Variance of Word Type Data

<u>Source of Variation</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>p</u>
Mean	1	487.83	2.95	.09
Group	2	469.60	2.84	.07
Error	23	165.25	-	-
Word Type	3	587.65	3.40	.02
Word X Group	6	210.21	1.22	.31
Error	69	172.97	-	-
Epoch	7	14.60	.74	.64
Epoch X Group	14	24.43	1.24	.25
Error	161	19.74	-	-
Word X Epoch	21	12.67	.93	.55
Word X Epoch X Group	42	11.75	.86	.71
Error	483	13.58	-	-

TABLE 6

Analysis of Variance of Light Flash Data

<u>Source of Variation</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>p</u>
Mean	1	47993134.31	638.46	.00
Group	2	20348.73	.27	.77
Error	20	75169.84	-	-
Cond	2	4398.25	3.30	.047
Cond X Group	4	2460.96	1.85	.14
Error	40	1331.68	-	-
Flash	8	750.15	2.07	.04
Flash X Group	16	288.00	.85	.63
Error	160	340.17	-	-
Cond X Flash	16	496.52	1.69	.047
Cond	32	223.61	.76	.82
Error	320	293.75	-	-
Epoch	9	33939.66	65.57	.00
Epoch X Groups	18	438.79	.85	.64
Error	180	517.61	-	-

Pupillary Response
100

<u>Source of Variation</u>	<u>df</u>	<u>MS</u>	<u>F</u>	<u>p</u>
Cond X Epoch	18	88.88	.77	.73
Cond X Epoch X Group	36	123.59	1.07	.36
Error	360	115.42	-	-
Flash X Epoch	72	67.18	1.17	.16
Flash X Epoch X Group	144	58.59	1.02	.42
Error	1440	57.39	1.02	.42
Cond X Flash X Epoch	144	70.36	1.10	.21
Cond X Flash X Epoch Group	288	51.19	.80	.99
Error	2880	64.13	-	-

Cond = Condition