A BEHAVIORAL ASSESSMENT TEST

FOR DENTAL PHOBIA

BY

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FOR DENTAL PHOBIA

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Abstract

Research has suggested that dental fear has multiple components. Frequently cited dimensions include fear of pain, blood, negative social evaluation, dental instruments, and feeling "closed-in." In the present study, 18 DSM-IV diagnosed dental phobia patients and 18 matched controls were compared during a behavioral assessment test specifically targeting these five dental fear components. Dental phobia patients reported more fear and anxiety than matched controls during the "closed-in," negative social evaluation, and dental instruments tasks. Across all tasks, dental phobia patients reported less pleasure, more arousal, and less dominance relative to control participants. Group classification and avoidance/escape behavior were significantly related for the "closed-in," evaluation, and pain tasks, with dental phobia patients engaging in more avoidance/escape than matched controls. Heart rate responsivity was higher in the blood and dental instruments tasks. Findings support fear of being "closed-in," negative social evaluation, pain, and dental instruments as important components of dental phobia.

A Behavioral Assessment Test for Dental Phobia

Dental Phobia

Individuals experiencing clinically significant levels of dental fear and/or anxiety receive a diagnosis of Specific Phobia in the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV; American Psychiatric Association, 1994). Individuals with a Specific Phobia experience immediate, intense fear and/or anxiety upon exposure to a specific situation, such as dental treatment. These individuals recognize that their fear and/or anxiety is excessive, but, nevertheless avoid the phobic situation or endure it with great distress. In order for a diagnosis to be given, the phobia must be a significant source of discomfort or interfere with the individual's functioning.

The DSM-IV requires that animal, natural environment, blood-injection-injury, situational, or other subtypes of Specific Phobia be specified. An individual with dental phobia would be classified as having either a blood-injection-injury or a situational subtype of Specific Phobia in DSM-IV. Some researchers cite blood and injury fears as possible components of dental phobia (Marks, 1988; McNeil & Berryman, 1989), while other investigators suggest that blood and injury fears are infrequent among dental phobia patients (Moore, Brodsgaard, & Birn, 1991; Roy-Byrne, Milgrom, Khoon-Mei, Weinstein, & Katon, 1994). Some research has shown that blood phobia and injection phobia are more similar than different on a variety of variables (Ost, 1992), and distress regarding injections has been widely cited in the literature as a component of dental fear (Berggren & Meynert, 1984; Bernstein et al., 1979; Kleinknecht, Klepac, & Alexander, 1973; Milgrom, Fiset, Melnick, & Weinstein, 1988; Roy-Byrne et al., 1994). It is nevertheless unclear how many dental phobia patients display characteristics that have been observed among blood phobia patients, such as a strong physiological response characterized by an initial heart rate acceleration followed by a large deceleration of heart rate and drop in blood pressure upon exposure to phobic stimuli. Moreover, the

issue of whether the majority of dental phobia patients should be classified as blood-injection-injury subtype or situational subtype calls for further exploration.

Anxiety, Fear, and Phobia

Many contemporary researchers suggest that anxiety, fear, and phobia are related but not identical constructs (e.g., McNeil, Turk, & Ries, 1994). In general, each is characterized by apprehensive verbalizations, physiological activation, behavioral mobilization, and cognitive disruption. More specifically, anxiety is defined primarily by disruption of cognitive processing and verbal reports of distress and by only moderate levels of physiological arousal and overt avoidance/escape behavior. Furthermore, anxiety is often associated with diffuse and disparate stimuli. In contrast, fear is characterized predominantly by intense physiological arousal and avoidance/escape behaviors and is typically a response to a clearly defined threat. Phobia is a persistent tendency to respond with fear and/or anxiety to a specific object or situation. The fear and/or anxiety involved in a phobia is out of proportion to the actual threat of the situation, is recognized by the individual as unreasonable or excessive, is not amenable to argument or reason, and results in avoidance/escape behavior or endurance of the object with intense distress (Marks, 1987; McNeil et al., 1994).

Research by McNeil, Vrana, Melamed, Cuthbert, and Lang (1993) suggests that the constructs of fear and anxiety can be differentiated empirically. They further propose that most simple (specific) phobia patients are best classified as fearful rather than anxious. Based upon the results of this research, it seems likely that most dental phobia patients are fearful, although some patients may be anxious, or both fearful and anxious.

Throughout this document, the terms anxiety, fear, and phobia will be used in accordance with the previously described definitions. When referring to the work of another author, the terms anxiety, fear, and phobia will be selected based on the terms used by that author.

Continuum of Dental Fear

Dental fear, like other fears, can be conceptualized as existing along a continuum, ranging from fearlessness, to typical levels of fear, to dental phobia. Based on this premise, normal levels of dental fear are not discontinuous with clinical manifestations of dental phobia. Furthermore, dental treatment is a stressful situation for many individuals; as a result, individuals who are generally fearful may manifest dental phobia as well. Therefore, research based upon individuals with high levels of dental fear and/or dental anxiety, although of nonclinical proportions, has important implications for the understanding of dental phobia.

Prevalence

Research examining the prevalence rates for dental fear and anxiety indicate that approximately 5-15% of adults experience significant distress regarding dental treatment (Freidson & Feldman, 1958; Gatchel, Ingersoll, Bowman, Robertson, & Walker, 1983; Milgrom et al., 1988; Scott & Hirschman, 1982). In one study of the prevalence rates of fears and phobias in the general population, Agras, Sylvester, and Oliveau (1969) reported that fear of the dentist ranked fourth among common fears and eighth among intense fears.

Potential Health Consequences

Avoidance behavior is frequently encountered among individuals who are fearful or anxious about dental treatment. Like dental fear and anxiety, ability to comply with dental treatment and receive timely dental care varies along a continuum among patients (Milgrom, Weinstein, Kleinknecht, & Getz, 1985). Some individuals look forward to going to the dentist and have no difficulty complying with treatment. Other people may be apprehensive about dental care but are able to cooperate relatively well with treatment. Other fearful and/or anxious individuals have been described as "goers but haters" (Milgrom et al., 1985) or "white knuckle" (Kleinknecht & Bernstein, 1978) patients; these individuals experience high levels of distress in the dental operatory but

continue to receive regular dental treatment. Lastly, many fearful and anxious individuals avoid dental care altogether.

Kleinknecht and Bernstein (1978) found that high fear patients missed scheduled dental appointments significantly more often than low fear patients. Gatchel et al. (1983) reported that 54% of individuals with high levels of dental fear had not gone to the dentist in over one year. Similarly, Milgrom et al. (1988) found that 41% of dentally fearful individuals had not been to the dentist within the last year, and 24% had not been to the dentist in more than two years. In several recent studies examining patients seeking treatment for dental fear and/or anxiety, the average period of avoidance ranged from 7.8 to 24.4 years (Berggren, 1992; Berggren & Meynert, 1984; Jerremalm, Jansson, & Ost, 1986; Moore et al., 1991).

Avoidance of timely dental care and inability to cooperate with the dentist during treatment can result in the development of preventable tooth decay and gum disease (Berggren & Meynert, 1984; Kleinknecht, Klepac, & Bernstein, 1976; Shoben & Borland, 1954). Individuals with high levels of dental fear have been shown to report more dissatisfaction with the appearance of their teeth as well as more symptoms of dental pathology, including toothaches, difficulty chewing, and bleeding gums, than individuals with low levels of dental fear (Milgrom et al., 1988). Seriously deteriorated oral health has been observed among individuals who avoid dental treatment (Berggren & Meynert, 1984). Moreover, individuals who do not receive proper dental care due to fear often eventually suffer greater pain and expense when emergency treatment is necessary. Failure to obtain needed dental treatment can lead to serious general health problems as well, including brain abscesses or even death resulting from infection (Reitan & Wolfson, 1992).

Theories of Dental Phobia

In recent years, anxiety and fear researchers have used behavioral theories to explain the etiology and maintenance of specific phobias, including dental phobia (Barlow, 1988; Kleinknecht et al., 1973).

Classical conditioning theory. Classical conditioning theory provides one theoretical explanation for the development of dental phobia (Melamed, 1979; Thrash, Russel-Duggan, & Mizes, 1984). This theory asserts that aversive dental procedures such as injections and probing (unconditioned stimuli) reflexively evoke feelings of pain and/or anxiety (unconditioned responses). These aversive procedures become paired with other harmless aspects of the dental situation such the dentist and the smell of the operatory (conditioned stimuli). Ultimately, the formerly neutral aspects of the dental situation acquire the ability to produce anxiety (conditioned response) without the presence of noxious stimuli (unconditioned stimuli). Treatment implications of this model of acquisition include desensitization procedures and teaching strategies to improve coping with pain (Melamed, 1979; Thrash et al., 1984). One limitation of this theory is the fact that some individuals report associating pain with dental treatment but never develop fear (Bernstein, Kleinknecht, & Alexander, 1979). Another limitation is the fact that many dental phobia patients report aspects of dentistry other than pain as being the primary reason for their fear (Roy-Byrne et al., 1994). Lastly, some individuals have never been exposed to an aversive procedure in the dentist's office (e.g., they have never been exposed to the unconditioned stimulus), but still experience fear and/or anxiety regarding dental treatment.

Operant conditioning theory. This theory suggests that dental phobia may develop due to contingencies that operate during dental treatment, including positive reinforcement, negative reinforcement, punishment, and response cost (Thrash et al., 1984). For example, critical comments (punishment) by the dentists when the patient is anxious but enduring an aversive procedure may result in a reduction of the patient's

coping behavior in the future. Treatment implications of this model include using the principles of operant conditioning to treat dental phobia. For example, instances of cooperative behavior in the dental operatory could be positively reinforced by the dentist.

Two-factor theory. Two factor theory combines the principles of classical conditioning and operant conditioning in order to explain the development and maintenance of phobia (Mowrer, 1947). According to this theory, dental phobia is initially acquired through classical conditioning. Overt avoidance behavior then occurs in order to escape the negative situation. This avoidance behavior results in a reduction of fear and/or anxiety, which serves as a source of negative reinforcement. Therefore, avoidance behavior becomes more likely, and the dental phobia is less subject to extinction. Treatment implications include a focus upon eliminating avoidance behaviors and using desensitization and learning principles. One major criticism of the two-factor theory is that it ignores cognitive processes.

Social learning theory. Social learning theory proposes that direct and/or vicarious negative dental experiences result in a fear of dentistry (Melamed, 1979; Thrash et al., 1984). This theory is consistent with research which cites traumatic dental experiences in childhood (Berggren & Meynert, 1984; Bernstein et al., 1979; Lautch, 1971; Moore et al., 1991) and observation of fearful attitudes in family members and others (Bernstein et al., 1979; Shoben & Borland, 1954) as the most important precursors to the development of dental fear and anxiety. The negative image of the dentist and dental treatment frequently portrayed in the mass media also exerts an influence upon people's attitudes and level of anxiety (Thrash et al., 1984). The treatments indicated by this theory include modeling, desensitization, and cognitive approaches.

Components of Dental Fear

Various researchers have suggested that dental fear and/or anxiety has multiple components (Berggren & Meynert, 1984; Johnson, Mayberry, & McGlynn, 1990; Kleinknecht et al., 1973; McNeil & Berryman, 1989). However, while various components have been hypothesized as being important in the manifestation of dental phobia, no consistent picture has emerged from the literature regarding which components differentiate dentally phobic individuals from individuals without high levels of dental fear and/or anxiety.

Fear of pain. The component of dental fear which has received the most attention in the literature is pain. Pain has been cited as a source of dental fear in studies with the general population (Freidson & Feldman, 1958), college students (Bernstein et al., 1979), dental patients (Johnson et al., 1990), individuals seeking outpatient psychotherapy for dental fear (Moore et al., 1991), and patients diagnosed with dental phobia (Roy-Byrne et al., 1994).

McNeil et al. (1989) found fear of pain to be the most significant predictor of dental fear in college students. In another study examining individuals seeking treatment for dental fear, an item assessing fear of pain received the highest mean score among feared objects and situations (Berggren, 1992). McNeil and Rainwater (1996) presented undergraduates high and low in fear of pain with video vignettes depicting painful dental procedures without anesthetic; high fear of pain individuals were shown to engage in more avoidance and escape behaviors during this behavioral assessment test than low fear of pain individuals.

Some researchers have speculated that fear of pain is more pronounced among individuals with high levels of dental fear because they actually have less pain tolerance and a lower pain threshold than other people. In one study, patients who appeared intensely distressed in the dentist office reported lower pain tolerance than patients who showed little fear (Forgione & Clark, 1974). Lautch (1971) found that fearful dental

patients had lower pain thresholds for electrical tooth pulp stimulation than less fearful dental patients. Klepac, McDonald, Hauge, and Dowling (1980) reported that college students highly fearful of dental treatment did not differ from their less fearful counterparts in pain threshold or pain tolerance during electrical tooth pulp or forearm stimulation; however, the high fear group retrospectively rated the tooth pulp stimulation as being more painful than the low fear group. In another study, dental patients seeking treatment for their fear were found to have lower pain tolerance for electrical tooth pulp stimulation than low fear dental patients; however, the two groups did not differ in terms of pain threshold during tooth shock or pain tolerance or threshold during arm shock (Klepac, Dowling, & Hauge, 1982). Retrospective pain intensity ratings also did not differentiate the two groups for either the tooth shock or the arm shock (Klepac et al., 1982).

Moreover, pain appears to be an important component of dental fear and/or anxiety. At this time, the relationship among fear of pain, pain threshold, pain tolerance, and perceived pain intensity is unclear. Research generally supports the conclusion that dental phobia patients have lower pain threshold and pain tolerance for dental-related pain but not unrelated pain. Similarly, one study found retrospective pain intensity ratings for electric tooth shock to be greater among high fear than low fear individuals. Ideally, a behavioral assessment of the pain component of dental fear would involve induced oral pain such as electric tooth pulp stimulation. This type of assessment, however, is typically not feasible within most nondental clinical and research settings. An alternative, although less ideal approach, is studying the effects of dental fear and anxiety on unrelated pain using a procedure other than electric shock to induce pain. For example, focal pressure pain has not yet been used with dental phobia patients and may provide another means of studying the relationship among fear and pain threshold, pain tolerance, and perceived pain intensity. Additionally, pain intensity ratings have been obtained only retrospectively in the study of dental fear and anxiety. Obtaining pain

intensity ratings during the pain task itself would represent an improvement in methodology.

Blood/injury fears. Few studies have directly examined the hypothesis that blood-injury fears are a component of dental phobia. McNeil et al. (1989) found that a mutilation questionnaire, which includes fears of blood, injury and tissue damage, was a significant predictor of dental fear among college women. In a sample of DSM-III-R (American Psychiatric Association, 1987) dental phobia patients, blood phobia had a prevalence rate of 4%, but was considered by the authors unrelated to the patients' fear of dentistry (Roy-Byrne et al., 1994). Similarly, Moore et al. (1991) reported that severe fear of blood was infrequent among a sample of patients seeking treatment for dental fears, but that fear of blood did have a significant positive correlation with a measure of dental anxiety.

Ost (1992) directly compared three groups of DSM-III-R (American Psychiatric Association, 1987) simple phobia patients: blood phobia patients, injection phobia patients, and dental phobia patients. Few differences were found between blood phobia and injection phobia patients. Blood and injection phobia patients, however, differed from dental phobia patients on several variables. Blood and injection phobia patients were found to have an age of onset of approximately 8 years, which was significantly younger than dental phobia patients, who had an age of onset of approximately 11 years. Over half of the blood and injection phobia patients reported a history of fainting, while none of the dental phobia patients reported this problem. Blood and injection phobia patients also had a higher heart rate and reported more anxiety during a behavior test. It is notable, however, that each of the three groups completed different behavior tests specific to their own phobia: Blood phobia patients watched a film of thoracic operations; injection phobia patients underwent a 20 step behavior test culminating in a venipuncture; dental phobia patients went through a 15 step dental examination terminating in an agreement to receive an injection. Therefore, the meaning of results

based upon direct comparisons among different diagnostic groups during unique behavior tests is unclear. Similarities found among the three groups included resting heart rate and Fear Survey Schedule - III scores.

Clearly, more work is needed in order to establish whether fear of blood is a component of dental phobia. Blood/injury phobia patients have been shown to have a unique psychophysiological response to blood/injury stimuli characterized by an initial increase in heart rate and blood pressure followed by bradycardia, hypotension, and, at times, fainting (Marks, 1988). Therefore, psychophysiological measures are of particular importance, as this diphasic response pattern has specific treatment implications (Marks, 1988). As with much of the research on the components of dental phobia, fear of blood has been assessed primarily through verbal report.

Negative social evaluation fears. A number of studies have suggested that social evaluation fears may be a component of dental phobia. In a study of patients diagnosed with dental phobia according to DSM-III-R (American Psychiatric Association, 1987) criteria, embarrassment about fear and poor dental health was reported as being the primary complaint related to dentistry for 11% of the sample (Roy-Byrne et al., 1994). Moore et al. (1991), using a sample of individuals seeking treatment for dental fear, found that 66% of these patients reported suffering from embarrassment in the dental situation due to their problems with dental fear. Negative evaluation by the dentist due to poor oral health was ranked as being highly fear-evoking by a sample of dental patients (Gale, 1972) and a sample of college students (Stouthard & Hoogstraten, 1987). Johnson et al. (1990) had dental patients rate their degree of fear for 60 events occurring during routine dental examinations; fear of negative evaluation by the dentist emerged as a factor in an exploratory factor analysis of this questionnaire.

Despite the available evidence that social fears are a component of dental fear, McNeil et al. (1989) did not find a measure of social avoidance and distress, or a measure of interaction anxiety, to be predictive of dental fear in an undergraduate

population. This lack of demonstrated relationship, however, could be due to the fact that the questionnaires were not specific to the dental situation, or that a normative rather than dental phobic population was tested.

In general, the majority of evidence supports the hypothesis that negative social evaluation fears are a component of dental fear. The studies to date, however, have several weaknesses. One criticism is that they rely solely upon verbal reports of social evaluation fears. Furthermore, it is unclear whether social evaluation fears differentiate individuals with dental phobia from individuals not suffering from clinically severe levels of dental fear and/or anxiety.

Fears of being closed-in. Another possible component of dental phobia is fear and/or anxiety related to being closed in, due to the proximity of the dentist, dental assistant, and equipment, while confined to the dental chair. Such fear may be intensified by the difficulty of escaping from this situation in a socially appropriate manner. McNeil et al. (1989) found claustrophobia fears to be a significant predictor of dental fear in an undergraduate population. In a survey of dental fears and other common fears, Fiset, Milgram, Weinstein, and Melnick (1989) found dental fear to be most closely associated with fear of heights, flying, and enclosures. Moore et al. (1991) found that a fear of closed spaces was the fifth most common severe fear reported among a sample of individuals seeking treatment for dental fear, but stated that this fear appeared independent of dental fear in most cases. Additional research needs to be conducted in order to determine whether fear of being closed-in is an important component of dental phobia.

Fear of dental instruments. Specific dental stimuli have been well documented as sources of fear. The sight and feeling of the anesthetic needle have been substantiated as a source of fear in studies using verbal report methods (Berggren & Meynert, 1984; Bernstein et al., 1979; Kleinknecht et al., 1973; Milgrom et al., 1988; Roy-Byrne et al., 1994), as well as studies using overt behavior methods in which willingness to receive an

injection is the last step in a behavior test (Jerremalm, Jansson & Ost, 1986; Mathews & Rezin, 1977; Shaw & Thoresen, 1974). Similarly, the sight, feeling, and/or sound of the dental drill have been shown to be fear-evoking in studies relying on verbal report (Berggren & Meynert, 1984; Bernstein et al., 1979; Kleinknecht et al., 1973; McNeil, Lipson, & Williams, 1988; Milgrom et al., 1988; Roy-Byrne et al., 1994) and psychophysiological response (Meldman, 1972).

Other fears. Other possible components of dental fear which have been cited in the literature include "loss of control" (Roy-Byrne et al., 1994; Johnson et al., 1990), the dentist's professional behavior and personal characteristics (Bernstein et al., 1979), fear of panic in the dental chair (Roy-Byrne et al., 1994), and fear of gagging/retching (Roy-Byrne et al., 1994).

Assessment of Fear and Anxiety

Three-channel response system. Behavior therapists have traditionally made assumptions about the nature of anxiety and fear in order to scientifically inquire about clinical disorders and select the most appropriate treatments for those disorders (Borkovec, Weerts, & Bernstein, 1977). Historically, fear and anxiety have been conceptualized as measurable responses expressed in three systems (Lang, 1968): verbal-report (e.g., expressions of distress), overt behavior (e.g., avoidance and escape), and psychophysiological response (e.g., heart rate, muscle tension). A basic assumption of this three systems approach is that the response channels are independent of one another and are of equal importance (Lang, 1968). Given this independence, the three anxiety channels frequently do not co-vary, resulting in discordance, or change at different rates, resulting in desynchrony (Hodgson & Rachman, 1974; Rachman & Hodgson, 1974). Therefore, a comprehensive behavioral assessment demands that behavior from all three systems be sampled.

Four-channel response system. Eifert and Wilson (1991) criticized the three channel response system approach to assessment as confounding content (what is

assessed) and method (how it is assessed). As an alternative, they proposed that behavior from four content areas be assessed: motoric, physiological, cognitive, and affective. These four areas may be measured using three different methods: self-report, observation, and instrumentation/apparatus. While innovative, Eifert and Wilson's (1991) approach to assessment has potential limitations as well, such as difficulty differentiating cognitive and affective content and difficulty in classifying some methods of assessments according to one particular category.

Dental Phobia Assessment Methodologies

Self-report methodologies. The development of assessment methods for dental phobia has focused largely on the verbal report domain. Within this area, several questionnaires and a structured interview have received attention in the literature. Corah (1969) developed a four item Dental Anxiety Scale designed to assess an individual's reactions to going to the dentist, to anticipating treatment while in the waiting room, and to waiting for drilling and scraping procedures while in the dental chair. This scale has been widely used, has been suggested as having adequate reliability and validity, has been shown to be sensitive to changes following treatment, and is quick and easy to administer (Corah, Gale, & Illig, 1978). A limitation of the DAS is its low content validity due to its brevity and narrow focus.

Kleinknecht et al. (1973) developed the Dental Fear Survey in order to more broadly assess dental fear by identifying responsivity to specific dental stimuli. This instrument has been used in a large number of studies (e.g., Bernstein et al., 1979; McNeil & Berryman, 1989; Roy-Byrne et al., 1994), has a stable factor structure (Kleinknecht, Thorndike, McGlynn, & Harkavy, 1984; McGlynn, McNeil, Gallagher, & Vrana, 1987), and has been shown to be related to overt behavior variables such as dental appointment cancellations and motor activity in the waiting room (Kleinknecht & Bernstein, 1978).

The 60 Item Dental Questionnaire (Johnson et al., 1990) assesses fear elicited by events occurring during routine dental care and has been administered to 701 dental school outpatients. An exploratory factor analysis of this questionnaire resulted in four meaningful factors: a Pain/Antecedents of Pain factor, an Anticipatory Fear factor, a Negative Social Evaluation factor, and a Perceived Loss of Control factor.

In addition to these questionnaire measures, a Dental Fear Interview has been developed (Vrana et al., 1986). This structured interview assesses feelings regarding dentistry, recent avoidance behavior, and level of distress in various dental situations. Good reliability and validity has been reported for this interview (Vrana et al., 1986).

Overt behavior methodologies. Less work has been done regarding development of methods of assessment for the overt behavior domain. Kleinknecht and Bernstein (1978) employed a methodology which involved coding dental patients' motor behaviors in the dental waiting room and operatory from videotapes. High fear patients were found to exhibit more movement in the waiting room than low fear patients. The two groups were similar in activity level while in the dental chair. Kleinknecht and Bernstein (1978) concluded that gross bodily movements may not be strongly related to adult dental fear and that more global overt behaviors such as missed and canceled appointments may be the most clinically useful indicators of dental fear.

Coding of overt motoric indices of fear and anxiety has been more successful with children, who demonstrate a wider range of activity in the dental chair (Melamed, 1979; Melamed & Siegel, 1980). A Behavior Profile Rating Scale has been used to record the frequency of children's disruptive behaviors during dental treatment (e.g., crying, attempts to dislodge instrument); these behaviors are assumed to be related to anxiety (Melamed, 1979; Melamed & Siegel, 1980). This scale has demonstrated good validity and interrater reliability (Melamed, 1979).

Additionally, the overt behavior domain of dental fear and anxiety has been assessed using behavior tests which take participants through a step-by-step oral

examination. This methodology, which can be used to assess self-reports and psychophysiological responses as well, will be reviewed separately in a later section.

Psychophysiological methodologies. Some work has been done regarding the development of methodologies to assess the psychophysiological domain of dental fear and anxiety. Psychophysiological responsivity to videotapes simulating a dental procedure has been examined in several studies. Individuals with high levels of dental anxiety have been shown to demonstrate significant increases in skin conductance while viewing a dental treatment videotape filmed from an eye-view perspective (Corah & Pantera, 1968). In a study using a similar methodology, individuals with an impending dental appointment demonstrated significant increases in skin conductance and finger pulse volume in response to a dental videotape (Corah & Salmonson, 1970). Using another first-person videotape of a cavity restoration and a neutral control videotape of cooking instructions, Hirschman, Revland, Hawk, and Young (1980) found a higher frequency of galvanic skin responses to the dental film relative to the control film; however, when the dental film was analyzed according to nine individual segments (e.g., injection, high speed drilling), no differences in autonomic responsivity were observed between high and low dental anxiety individuals. Melamed (1979) concluded that research suggests that videotaped dental simulation is a useful methodological approach for the study of autonomic arousal in dental patients.

The Dental Drill Phobia Test (Meldman, 1972) involves measuring changes in heart rate response to the sound of a low speed dentist's drill. Meldman (1972) observed increases in heart rate among individuals reporting fear of the sound of the drill. In study involving exposure to the sound of a high speed dentist's drill, Gang and Teft (1975) found that individuals who were less familiar with the sound of the drill and who rated the sound as more unpleasant experienced greater heart rate acceleration. McNeil et al. (1988) reported that undergraduates who reported dental fear demonstrated greater

cardiac reactivity than their less fearful counterparts when exposed to a drill sound within the context of fear-relevant dental imagery.

Behavioral Assessment Test (BAT) methodologies. The Behavioral Assessment Test (BAT) is a methodology which involves the presentation of a feared stimulus in a controlled manner so that avoidance and escape behavior can be quantified (Borkovec et al., 1977). Typically, the primary purpose of a BAT is to assess the overt behavior dimension of the three-channel response system, although self reports and psychophysiological responses can be measured during BATs as well. The logic behind BATs is that fear behavior observed during a BAT has relevance in relationship to the individual's fear behavior in the natural environment (McGlynn, 1988).

The first reported use of a BAT was in 1973 when Lang and Lazovik employed this methodology in order to assess the degree that women who reported fear of snakes would approach a caged snake. This study's methodology served as the prototype for the many procedural variations of BATs that followed (Bernstein & Nietzel, 1973).

Many of the aspects of BATs have been varied. For example, Miller and Bernstein (1972) manipulated the demand characteristics of a BAT by asking individuals with claustrophobia fears to stay in a small, dark, closed chamber for a set period of time (high demand instructions) or until they felt uncomfortable (low demand instructions); participants remained in the chamber longer under high demand instructions. In a study manipulating the context of a BAT, female undergraduates who were in a laboratory environment and instructed that they were participating in a study about nonverbal communication between humans and other species were more likely to approach a white rat than female undergraduates who were in a clinic environment and instructed that they were participating in a study about fear assessment (Bernstein, 1973). The particular characteristics of the target stimulus have also been found to influence BAT performance: A king snake six inches longer than another king snake was found to produce longer latencies to touch among female undergraduates (Bernstein, 1973). In a

study which manipulated the method of instruction presentation, snake fearful female undergraduates given live instructions by an experimenter showed greater approach to a caged snake than fearful individuals given tape-recorded instructions while alone (Bernstein & Nietzel, 1973). While small animal fears have been most frequently studied using BATs, the content of the tests may be varied in order to study various fears, including, among many others, public speaking fears (e.g., Levin et al., 1993), fear of pain (e.g., McNeil & Rainwater, 1996), agoraphobia fears (e.g., Barlow, 1988), fear of blood (e.g., Ost, 1992), and fear of injections (e.g., Ost, 1992).

Dental BATs developed to date have consisted of stepwise oral examinations. Mathews and Rezin (1977) and Jerremalm et al. (1986) describe similar dental BATs consisting of a 15 step oral examination which terminates in an agreement by the participant to receive an analgesic injection for a small cavity restoration. Shaw and Thoresen (1974) similarly describe a progressive BAT culminating in a request to administer an injection and permit drilling to fill a cavity. Wroblewski, Jacob, and Rehm (1977) developed a sequential BAT comprised of 30 progressively more difficult steps, terminating in making a phone call for a dental appointment. A few studies have used actual dental examinations as opportunities to do assessments (Bernstein & Kleinknecht, 1982; Kleinknecht & Bernstein, 1978; Miller, Murphy, & Miller, 1978). While having the advantage of being naturalistic, actual dental examinations implicitly lack the avoidance/escape component that is a strength of most behavioral assessment tests for anxiety.

McNeil et al. (1989) pointed out that one weakness in current dental BAT methodology is that psychophysiological measures frequently are not utilized or only a few periods during the test are sampled. As evidence of the importance of more specificity in BAT methodology, McNeil, McGlynn, Cassisi, and Vrana (1989) reported a complex relationship between high and low fear groups when psychophysiological responses and verbal reports were monitored repeatedly during a BAT consisting of an

eight step mock oral examination. Cardiac responsivity and verbal reports of arousal, displeasure, and feeling out-of-control increased as the BAT progressed for the high fear group but not the low fear group. The entry of the "dentist" into the operatory resulted in heart rate deceleration in the high fear group only and resulted in the greatest electrodermal response relative to the other trials. Presentation of the dental drill and its sound produced an acceleration of heart rate in the high fear group and a reduction in heart rate for the low fear group. Another weakness of current dental BAT methodology cited by other researchers is the lack of avoidance/escape behavior frequently observed during the tests, despite the high rate of avoidance which occurs among fearful individuals in real life (Jerremalm et al., 1986; Mathews & Rezin, 1977).

Statement of the Problem

Most of the hypothesized components of dental fear have been assessed solely in the domain of verbal report. This limitation is consistent with a general need in dental fear research for improved methodologies assessing the psychophysiological response and overt behavior domains of the three-channel response system (McNeil et al., 1989). The development of new standardized behavioral assessment tests would be particularly useful in addressing this need.

Sequential BATs, which take a patient through a dental procedure step by step, have typically resulted in little avoidance/escape behavior, despite the fact that avoidance behavior is a hallmark of dental phobia. One explanation for this occurrence may be that sequential BATs are inadequate because they fail to directly assess many components of dental fear which have been hypothesized to be important. Specifically, no sequential behavioral avoidance test for dental phobia has directly assessed pain threshold, tolerance, and intensity, social fears, blood/injury fears, fears of being closed-in, and dental instrument fears. Furthermore, BATs conducted to date frequently have not included measures of psychophysiological response or else have measured

psychophysiological response during only a few selected periods of the test (McNeil et al., 1989).

Development of standardized BATs assessing the components of dental fear may eventually result in more specific, individualized treatment of dental phobia patients. Ultimately, it may be desirable to compare sequential BATs with component BATs. However, the first step is to begin by developing a standardized BAT procedure to directly test some of the most frequently hypothesized components of dental fear and discover whether or not dental phobia patients exhibit more verbal reports of distress, more overt avoidance/escape behavior, and more psychophysiological responding than matched controls. In this study, patients and matched controls were compared in a standardized BAT consisting of five components: (a) a pain component, in which the participant was exposed to laboratory-induced pain; (b) a blood component, in which the participant was asked to hold an IV bag containing artificial blood; (c) a negative social-evaluation component, in which an experimenter playing the role of a dental assistant made critical statements regarding the participant's oral health; (d) a "closed-in" component, in which the participant was exposed to closed-in conditions while in the dental chair; and (e) a dental instruments component, in which the participant was asked to hold a tray containing dental tools while listening to a recording of a dental drill.

Hypotheses

All five BATs were expected to generate more verbal reports of anxiety, fear, unpleasantness, arousal, and submissiveness, more avoidance/escape behavior, and more heart rate acceleration among patients than control participants. For the pain BAT, dental phobia patients were expected to report higher pain intensity ratings in addition to demonstrating lower pain threshold and tolerance.

Differences were anticipated among the five BAT components in the verbal report, overt behavior, and psychophysiological domains. However, these predictions

were not directional in that it was not known which components would evoke the most fear and/or anxiety.

Standardized dental fear and anxiety measures and a structured dental interview were administered in order to substantiate diagnostic differences between the two groups. Measures of depression and general anxiety were administered in order to assess for global differences between groups in these areas. Differences between groups were anticipated on all dental fear measures, as well as measures of general depression and anxiety. See Appendix A for a comprehensive list of independent and dependent variables.

Method

Participants

Participants were 18 outpatients (13 women) diagnosed with Specific Dental Phobia and 18 controls (13 women) matched for gender, age, ethnicity, and socioeconomic status. The average age of the dental phobia participants ($M = 33.7$, $SD = 11.8$) and the control participants ($M = 34.7$, $SD = 12.2$) was not significantly different, $t(34) = .24$, $p > .10$. All participants were Caucasian. The frequency of social classification ranking among participants is presented in Table 1. DSM-IV diagnoses were assigned based upon the results of structured clinical interviews. Videotapes of 25% of these interviews were randomly selected and viewed by the advisor of this study, a licensed clinical psychologist. There was complete agreement regarding presence or absence of a diagnosis of Specific Dental Phobia in all cases. Dental phobia patients with additional diagnoses were included in the study; control individuals with any DSM-IV diagnosis were excluded from the study. The frequency of comorbid diagnoses in the dental phobia group is depicted in Table 2. Two additional dental phobia patients initiated the study but dropped out prior to BAT data collection; their data are not included in any analyses. Two potential control participants were found to be ineligible due to current DSM-IV diagnoses; their data are not included in any analyses. Patients

were offered free group treatment for dental phobia in exchange for participation. Control participants received a payment of $20 in return for taking part in the study.

Materials

Anxiety Disorders Interview Schedule-IV (ADIS-IV). All participants were administered a structured clinical interview, the ADIS-IV, in order to determine Axis I diagnoses. Barlow (1988) reported that an earlier version of this instrument, the Anxiety Disorders Interview Schedule-Revised (ADIS-R; Di Nardo, Barlow, Cerny, Vermilyea, Vermilyea, Himadi, & Waddell, 1985), demonstrated good reliability and has performed well at providing differential diagnoses among the anxiety disorders. Furthermore, the ADIS-R and ADIS-IV were designed to provide a more comprehensive assessment of the anxiety disorders than the Structured Clinical Interview for DSM-III-R Axis I disorders (SCID-R; Spitzer, Williams, Gibbon, & First, 1990).

Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II). The newly revised version of the SCID-II was used to assess for the presence of personality disorders. While reliability data are not yet available for the revised version of the SCID-II, the Structured Clinical Interview for DSM-III-R Personality Disorders (Spitzer, Williams, Gibbon, & First, 1990) has been shown to be similar to other personality assessment instruments in terms of reliability.

Dental Fear Interview (DFI). The DFI (Vrana et al., 1986) is a structured interview designed to assess feelings regarding going to the dentist, recent dental avoidance behavior, and degree of comfort in various dental situations. This instrument has been demonstrated to have adequate reliability based upon interviewer agreement regarding severity of dental fear and impairment in obtaining dental care (Vrana et al., 1986).

Dental Anxiety Scale (DAS). The DAS (Corah, 1969) is a 4-item scale measuring dental anxiety. Each item is rated on a 5-point Likert-type scale (1 - 5), and scores range from 4 to 20. Higher scores reflect more dental anxiety.

Dental Fear Survey (DFS). The DFS (Kleinknecht et al., 1973) contains 20 items which assess avoidance of dentistry, physiological arousal during treatment, and fearfulness in response to various aspects of the dental environment. Items are rated on a 5-point Likert-type scale (1 - 5). Scores range from 20 to 100, with higher scores being indicative of more dental anxiety. The DFS also contains three factorially-derived subscales (Kleinknecht et al., 1984; McGlynn et al., 1987): (a) the Anticipation/Avoidance subscale, which consists of 8 items and has a range of 8 to 40; (b) the Fear of Specific Stimuli subscale, which consists of 6 items and has a range of 6 to 30; and (c) the Physiological Arousal subscale, which consists of 5 items and has a range of 5 to 25.

60-item Dental Questionnaire (60-DQ). The 60-DQ (Johnson et al., 1990) measures degree of fear elicited by events which frequently occur during routine dental care. Items are rated on a 7-point Likert-type scale (1 - 7). The range of scores is 60 to 420, with higher scores reflecting greater fear. Four factor scores may also be obtained with the 60-DQ (Johnson et al., 1990): (a) the Pain/Antecedents of Pain factor contains 17 items and has a range of 17 to 119; (b) the Anticipatory Fear factor contains 12 items and has a range of 12 to 84; (c) the Negative Social Evaluation factor contains 7 items and has a range of 7 to 49; and (d) the Perceived Loss of Control factor contains 5 items and has a range of 5 to 35.

Self-Assessment Manikin (SAM). SAM (Hodes, Cook, & Lang, 1985; Lang, 1980) is a computer-generated video character whose expressions and postures can be changed by a participant using a joystick in order to give ratings along three affective dimensions: (a) valence (e.g., happy--sad); (b) arousal (e.g., aroused--calm); and (c) dominance (e.g., in control--controlled). All three dimensions are measured on a 21 point (0--20) scale. Higher scores are indicative of more positive valence, higher arousal, and greater dominance.

Emotion Assessment Scale (EAS). The EAS (Carlson et al., 1989) consists of 24 items. Eight subscales can be scored: Anger, anxiety, disgust, fear, guilt, happiness, sadness, and surprise. Only the fear and anxiety subscales were examined in this study.

State-Trait Anxiety Inventory - Form Y (STAI). The STAI (Speilberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) contains one scale measuring state anxiety and another scale assessing trait anxiety. The STAI-State consists of 20 items designed to assess acute (state) anxiety level. The STAI-Trait consists of 20 items designed to evaluate chronic (trait) anxiety level. Items are rated on a 4 point Likert-type scale (1-4), and total scores range from 20 to 80, with higher scores indicative of more anxiety.

Two-Factor Index of Social Position. The Two-Factor Index of Social Position (Myers & Bean, 1968) classifies individuals according to socioeconomic groups. An individual's occupational status is ranked on a seven position scale and multiplied by a factor weight of seven. An individual's educational status is ranked on a seven position scale and multiplied by a factor weight of four. The occupational and educational factors are then added together. The range of scores for this instrument is 11 to 77. The continuum of scores may also be broken down into five groups which have been found to be useful in predicting social-class position. The five social strata categories are: (a) upper (range 11-17); (b) upper middle (range 18-27); (c) middle (range 28-43); (d) lower middle (range 44-60); and (e) lower (range 61-77). Because the Two-Factor Index of Social Position bases its classification of individuals on both education status and occupation, it was judged to be inappropriate for use with students, for whom college attendance is their primary occupation. Therefore, a separate "student" category was created in which college students were considered to be of equivalent social class standing.

Medical/Social History Interview. This short interview was designed specifically for this study (See Appendix B). Similar versions of this interview have been used in previous studies (e.g., Boone, 1993). This instrument was used to document

demographic variables (i.e., gender, age, ethnicity, job, educational attainment), obtain information relevant to participation in the BAT (i.e., dominant hand, hearing problem requiring an increase in audio volume), and to screen for exclusionary medical conditions (i.e., serious heart conditions, serious bone, joint or muscle problems). It was not necessary to exclude any participants based on responses to the Medical/Social History Interview.

Laboratory

Data were collected in a research laboratory consisting of three adjacent rooms. The center room was an instrumentation room with one-way mirrors which allowed for observation of procedures in the rooms on both sides. This center instrumentation room contained an IBM PC/XT microcomputer equipped with a Scientific Solutions LabMaster interface board, which includes a programmable clock, and Virtual Processing Machine (VPM) software (Cook, Atkinson, & Lang, 1987). This equipment automated and timed laboratory procedures, controlled stimulus presentations, and collected electrocardiogram (EKG), pain intensity, and SAM data. EKG data were collected using Medi-Trace Ag-AgCl pre-gelled disposable foam electrodes (model GC-11) attached to the right (negative) and left (positive) side of the chest just below the clavicle and to the lower left side of the chest at the level of the lowest palpable rib (ground). Computer-interfaced Coulbourn Instruments (CI) modules consisting of a CI S75-01 High Gain Bioamplifier/Coupler and a Schmitt trigger device (CI Bipolar Comparator, S21-06, and a CI Retriggerable One Shot, S52-12) collected and processed the EKG signal. The time interval between cardiac R waves was recorded by the computer.

One experimental room adjacent to the instrumentation room contained a reclining chair, a table, and a video monitor for SAM presentation; this room was used for prebaseline and postbaseline relaxation periods. The experimental room on the opposite side of the instrumentation room contained a dental chair, a table, an Emerson

EC-131 video monitor, which was used for SAM presentation, and a Realistic cassette recorder, which was used to play audiotaped BAT instructions. An intercom system allowed for two-way communication between the central instrumentation room and the two experimental rooms.

Procedure

Recruitment and procedure overview. Patients were recruited by: (a) advertisements describing the nature of the study, (b) referrals from dentists, (c) referrals from other mental health care providers, and (d) presentations given to community groups. Matched control subjects were recruited through advertisements and presentations to community groups. See Appendix C for a summary of experimental procedures.

Administration of the ADIS-IV. During the first session, both patients and individuals participating in the study as matched controls received an informed consent statement. After the informed consent statement was explained and signed, the ADIS-IV was administered by one of three advanced clinical psychology graduate students. All interviewers were trained by first watching the Anxiety Disorders Interview Schedule for DSM-IV Therapist Training Video and then meeting the criterion of correctly diagnosing two individuals portraying the role of a patient.

Administration of the SCID-II, DFI, and questionnaires. Patients and matched controls qualifying for participation based upon the results of the ADIS-IV interview received further assessment, which typically took place during a second session. The SCID-II and Dental Fear Interview were administered by the same advanced clinical psychology graduate student who administered the ADIS-IV. A licensed clinical psychologist randomly selected and reviewed videotapes of 25% of the ADIS-IV and SCID-II interviews in order to ascertain diagnostic reliability. Following completion of the SCID-II and DFI, participants completed, in a random order, the DAS, DFS, 60-DQ, STAI, and BDI.

Medical Social/History Interview and Stroop assessment. The Medical Social History Interview and Stroop test assessment were typically completed during a third session. All subjects completed a modified Stroop color-naming task, a standard dental Stroop task, an idiographic dental Stroop task, and a single-word presentation Stroop task. These Stroop tasks were administered as part of another related study.

Dental BAT. The BAT procedure was completed during the final assessment session. Each BAT was run by a team consisting of one graduate student experimenter and one male and one female undergraduate experimenter. The two undergraduate experimenters wore white lab coats and were individuals with whom the patient had never previously interacted. For consistency, the male undergraduate experimenter was the "dental assistant" interacting with the participant during all five BAT tasks. The female undergraduate experimenter was the "dental assistant" who participated in BAT tasks requiring two people. The two undergraduate experimenters were blind regarding the patient/nonpatient status of the participant. The graduate student experimenter, who was not blind to the participant's status, provided a general overview of the BAT procedure, gave initial instructions regarding questionnaire completion, operated the physiological equipment, computer, and stopwatch from the instrumentation room during the BAT tasks, and conducted the debriefing.

All BAT task instructions were audiotaped, and the male experimenter provided brief clarification of the directions as needed. The taped instructions were of a "low demand" style in order to allow for avoidance and escape behavior (Miller & Bernstein, 1972). A small, plastic replica of a traffic stop sign was clipped to the participant's shirt prior to the beginning of the series of BAT tasks. The participant was instructed to grasp the stop sign or say "stop" upon feeling "fairly uncomfortable" in order to terminate a BAT task, even if that was before the task began. These directions for avoidance/escape were repeated during the instructions for each BAT task. Regarding the duration of the tasks, participants were told only that each task would last "a short

while." Each task began with the onset of the noxious stimuli and ended when either the time limit expired or the participant grasped the stop sign or said "stop." Heart rate data were collected continuously. SAM and EAS ratings were made upon discontinuation or completion of each task. Participants were instructed to complete verbal report instruments according to how they felt during each BAT task. Order of BAT components was counterbalanced across participants to avoid confound.

Upon arriving at the laboratory, the participant was escorted by the graduate student experimenter into the experimental room containing the relaxation chair. Heart rate monitoring equipment was attached, and the participant was seated in the recliner. After the graduate student experimenter explained the directions for SAM and the EAS, the lights in the room were dimmed, and the graduate student experimenter exited the room. Audiotaped relaxation instructions were presented, and the participant sat quietly with eyes closed while prebaseline heart rate data were collected for five minutes. At the end of the prebaseline period, the participant was asked to make SAM and EAS ratings describing how he or she felt during the relaxation period. Upon completion of these measures, the participant was escorted to the second experimental room and seated in the dental chair, where he or she remained for all BAT tasks.

For the pain task, audiotaped instructions described the procedure and assured the participant that the algometer causes no physical damage. The algometer is a noninvasive laboratory device designed to create pain in a reliable and safe manner. The participant's non-dominant hand is secured in the device to prevent movement. A dull Lucite edge is then lowered onto the second phalanx of one finger and a 750 g weight is applied. The weight applies continuous focal pressure, which results in an aching pain. The device employed in this study is based on a model introduced by Forgione and Barber (1971) and modified by Rainwater and McNeil (1991).

The algometer was placed on a table beside the dental chair within comfortable reach of the participant. The index finger of the participant's nondominant hand was

inserted into the device. Participants were instructed to make a tally mark on a sheet of paper when they first noticed pain and at every perceptible increase in pain. Timing of the task began when the weight was lowered onto the participant's finger. The maximum length of time for this task was five minutes. Pain tolerance was calculated as the length of time the participant remained in the task. Pain threshold was recorded as the length of time between the onset of the pain stimulus and the point at which the participant made the first tally mark. Time intervals between tally marks were recorded, and pain intensity ratings were later transformed so that ratings could be compared among individuals at 15 second intervals (see Carter, 1994; Fernandez, Nygren, & Thorn, 1991).

For the blood task, the stimulus was an IV bag containing artificial blood. Audiotaped directions described the procedure and instructed the participant to pick up the IV bag containing blood after the tray cover was lifted by the male experimenter. Participants were unaware that the blood in the IV bag was artificial. The task began when the blood stimulus was revealed to the participant. This task lasted a maximum of one minute.

For the negative social evaluation task, the stimuli were statements made by the male "dental assistant." Audiotaped instructions described the procedure and informed the participant that the dental assistant would look into his or her mouth and make evaluative comments about the condition of his or her teeth. The task began when the participant opened his or her mouth for the examination. The experimenter then looked inside the participant's mouth using a tongue depressor to lightly probe the front of the participant's mouth so that the participant's teeth could be viewed. The experimenter made five critical comments evenly spaced in time over the one minute period: (a) "It looks like it has been a long time since you have been to the dentist;" (b) "You have not been taking good care of your teeth;" (c) "You have bad teeth;" (d) "This is what happens when people neglect their teeth;" and (e) "You have bad gums." Participants

were not informed that the male experimenter was making standardized evaluative statements. During this task, the experimenter used a neutral tone of voice.

For the "closed-in" task, the stimuli were the proximity of the two experimenters and the equipment. Audiotaped instructions described the procedure and informed the participant that two dental assistants would be looking into his or her mouth. The dental chair light was turned on and pulled down to approximately 25 cm from the participant's face. The male experimenter lightly probed the front of the participant's mouth with a tongue depressor so that the participant's teeth could be viewed. The female experimenter stood on the other side of the dental chair and also used a tongue depressor. The experimenters maintained this position for a maximum of one minute. The task began when the participant opened his or her mouth for the examination. This task differed from the negative social-evaluation task by using two experimenters and by having the experimenters and lamp closer to the patient.

For the dental instruments task, the stimuli were the sound of a high speed dental drill and a tray containing an anesthetic needle, a scraping instrument, and a mirror. Following audiotaped instructions, the participant's task was to hold the instrument tray as the recording of the drill sound was played. Timing of the task began when the tray's cover was removed. This task lasted for a maximum of one minute.

After all five BAT tasks were completed, the participant was escorted into the other experimental room and seated in the recliner. The lights were dimmed, the experimenter left the room, and audiotaped directions instructed the participant to relax with eyes closed while EKG data was collected. At the end of the 5 minute postbaseline, the participant was asked to make SAM ratings and complete the EAS.

After all BAT procedures were completed, a debriefing was conducted. During this debriefing, the graduate student experimenter asked the participant about his or her thoughts and feelings regarding the experiment, inquired about and inspected the status of the finger placed in the algometer, answered any questions the participant might have

had, and explained expected results and benefits from the research project. Additionally, the experimenter informed the participant that the IV bag had contained artificial rather than real blood and that the negative statements made during the BAT were standardized comments received by all participants and were not a reflection of the person's true oral health. Following the debriefing, individuals participating as matched controls received a $20 payment, and individuals participating as patients were given information regarding treatment.

Results

Data Reduction

Heart rate. A computer software program (Cook et al., 1987) provided for continuous collection of heart rate data in a series of 10 second intervals. Median heart rates (in beats per minute)were derived for each 10 second interval for the prebaseline period, each of the five BAT tasks, and the postbaseline period. The median heart rates for all intervals during the five minute prebaseline rest period were averaged in order to obtain an overall mean heart rate value. Similarly, the median heart rates for all intervals during the five minute postbaseline rest period were averaged in order to obtain an overall mean heart rate value. Since this study's methodology specifically allowed for avoidance and escape behavior, the amount of time spent in the five BAT tasks differed according to each participant. As a result, the number of available intervals of heart rate data varied for each participant. Because heart rate might be influenced by the length of time spent in a task, the first two 10 s intervals of each task were averaged and used in the analysis so that equivalent portions of heart rate data would be compared across participants and tasks.

Pain intensity ratings. Pain intensity ratings were obtained by the method recommended by Fernandez et al. (1991). Ratings were transformed such that participants' pain ratings were estimated as if participants had made pain intensity ratings every 15 seconds using a zero to ten scale (Carter, 1994; see Appendix D for details).

According to this method, zero is assumed to equal no pain, one is equivalent to pain threshold (the point at which a participant first indicated pain), and ten is equal to pain tolerance (the point at which a participant ended the pain task). If a participant did not escape the pain task before the maximum time (300 s) expired, the participant's data were treated as if the participant had reached pain tolerance when the task was terminated by the experimenter.

Design and Statistical Approach

Initial descriptive verbal report data from the DAS, DFI, DFS, 60-DQ, BDI, STAI-State, and STAI-Trait were analyzed using a series of one-tailed *t*-tests. Initial verbal report questionnaires were grouped into a family, and Dunn's method was used to control alpha, such that $p < .003$ was the criteria for an analysis to be considered significant. Additionally, Pearson Product Moment Correlations were computed among the dental fear instruments.

A 2 Group (dental phobia patients and matched controls) by 7 Trials (prebaseline, blood task, closed-in task, evaluation task, instruments task, pain task, and postbaseline) analysis of variance (ANOVA) was the statistical approach used with the heart rate and verbal report data collected during the BAT. All significant ANOVAs were followed up using Tukey's Honestly Significant Difference tests at the .05 alpha level.

The behavioral avoidance/escape data for the control group and the dental phobia group did not follow a normal distribution. In fact, there was no variance in the control group's behavioral data for the blood, closed-in, evaluation, and instruments tasks (i.e., all control participants remained in the task the maximum time of 60 s). Because the data violated the assumption of a normal distribution for an ANOVA, a dichotomous variable was created which classified individuals as either engaging in or not engaging in avoidance or escape behavior for each task. Pearson's Chi-square test of independence was conducted for each task using a 2 (dental phobia or matched control) X 2

(occurrence or nonoccurrence of avoidance or escape behavior) contingency table. The Chi-square test of independence has been found to provide satisfactory estimates of Type I error probability when the total number of observations is less than 20 and when the expected cell frequency is less than 1 (Camilli & Hopkins, 1978; 1979). Pain threshold, tolerance, and intensity ratings were compared between groups using one-tailed t-tests.

Because behavioral avoidance and escape were allowed, the number of participants varies across analyses. For the initial verbal report data and the behavioral avoidance/escape data, all participants were available for inclusion in all analyses (N = 36). Verbal report data collected during the BAT tasks were used to describe how the participant felt during the task; therefore, if complete avoidance occurred, verbal data were not included for that task. Verbal report data were, however, included if the participant terminated the task early. If verbal report data were not available for a dental phobia participant due to complete avoidance, the corresponding verbal report data from the matched control participant were excluded from analyses; note that no instances of complete avoidance occurred in the control group. These constraints reduced the number of participants included in the BAT verbal report analyses to 28 (14 dental phobia patients, 14 matched controls). Similarly, the number of participants included in the heart rate analyses was reduced to 22 (11 dental phobia patients, 11 matched controls) due to: (a) complete avoidance of at least one task by 4 dental phobia patients (which excluded their 4 matched controls), (b) experimenter error during the data collection for 2 control participants (which excluded the 2 dental phobia patients to whom they were matched), and (c) escape behavior during two tasks by 1 dental phobia patient before 20 s of heart rate data were collected, which also excluded that participant's matched control. Lastly, because escape behavior was allowed as a measure of pain tolerance, the number of participants making pain intensity ratings decreased as the maximum pain task time (300 s) was approached. The number of participants making pain intensity ratings decreased over time in the following manner: 15 s (N =

34), 30 s (N = 29), 45 s (N = 24), 60 s (N = 18), 75 s (N = 16), 90 s (N = 12), 105 s (N = 11), 120 s (N = 11), 135 s (N = 11), 150 s (N = 9), 165 s (N = 8), 180 s (N = 8), 195 s (N = 8), 210 s (N = 7), 225 s (N = 7), 240 s (N = 7), 255 s (N = 7), 270 s (N = 7), 285 s (N = 7), and 300 s (N = 7).

Initial Descriptive Verbal Report Data

The results of the series of one-tailed t-tests conducted on the dental fear instruments, along with their subscales, are presented in Table 3. On all dental measures, the dental phobia patients self-reported significantly higher levels of fear and anxiety than the matched controls. Table 4 depicts frequency data obtained from the DFI regarding the length of time since each participant visited the dentist. All dental fear instrument scales and subscales were significantly intercorrelated, as shown in Table 5.

The results from the BDI and STAI are depicted in Table 6. Given the criterion of $p < .003$ to be considered significant, no significant differences were observed between dental phobia patients and matched controls for these measures.

BAT Verbal Report Data

EAS. The EAS has a total of eight subscales, but specific predictions were made only for the anxiety and fear subscales; therefore, only the results of the fear and anxiety subscales are presented. A 2 Group (dental phobia patients and matched controls) X 7 Trials (prebaseline, 5 BAT tasks, and postbaseline) ANOVA was conducted for both scales. A significant interaction was observed for the anxiety subscale, $F(6, 156) = 3.83$, $p < .001$. Figure 1 presents these results. Follow-up tests revealed that the dental phobia patients self-reported greater anxiety than the control participants during the closed-in, evaluation, and instruments tasks. Within the dental phobia group, the evaluation task elicited higher anxiety ratings than the prebaseline, postbaseline, and blood task. The dental phobia group also indicated greater anxiety during the closed-in task than during the postbaseline period.

Similarly, a significant interaction was observed for the fear subscale of the EAS, $F(6, 156) = 4.56$, $p < .0001$. These data are illustrated in Figure 2. Follow-up tests revealed that the dental phobia patients self-reported more fear than the control participants during the closed-in, evaluation, and instruments tasks. Additionally, dental phobia participants' fear ratings following the evaluation task were significantly higher than prebaseline and postbaseline ratings. The dental phobia patients also rated the closed-in task as more fear-provoking than postbaseline.

SAM. A 2 Group (dental phobia patients or matched controls) X 7 Trials (prebaseline, 5 BAT tasks, and postbaseline) ANOVA was conducted for the valence, arousal, and dominance SAM dimensions. A significant trials main effect was observed for the valence dimension, $F(6, 156) = 20.59$, $p < .0001$. Follow-up tests indicated that, for all participants, the evaluation task elicited lower pleasure ratings ($M = 6.5$, $SD = 3.4$) than the blood task ($M = 9.4$, $SD = 3.0$) and the instrument task ($M = 10.0$, $SD = 3.2$). Furthermore, the prebaseline period ($M = 13.1$, $SD = 3.3$) and postbaseline period ($M = 12.7$, $SD = 3.3$) received significantly higher pleasure ratings than all five tasks, but did not differ significantly from each other. The group main effect was significant as well, $F(1, 26) = 13.63$, $p < .001$. Lower pleasure ratings were obtained across tasks from the dental phobia patients ($M = 8.7$, $SD = 1.5$) relative to their matched controls ($M = 11.0$, $SD = 1.8$). The interaction was not significant, $F(6, 156) = 1.46$, $p > .10$.

Similarly, a significant trials main effect was observed for the arousal dimension, $F(6, 156) = 20.37$, $p < .0001$. Follow-up tests indicated that participants self-reported more arousal following the evaluation task ($M = 13.0$, $SD = 5.1$) than following the blood task ($M = 9.5$, $SD = 6.2$) and the instrument task ($M = 9.0$, $SD = 6.0$). Additionally, the prebaseline period ($M = 4.3$, $SD = 4.6$) and postbaseline period ($M = 4.0$, $SD = 5.3$) received significantly lower ratings of arousal than all five tasks, but did not differ significantly from each other. The group main effect was also significant, $F(1, 26) = 10.26$, $p < .004$. Overall, arousal ratings were higher among dental phobia

participants (M = 10.9, SD = 2.5) than matched controls (M = 7.2, SD = 3.6). The interaction was not significant, F(6, 156) = 2.01, p < .07.

A significant trials main effect also was observed for the dominance dimension, F(6, 156) = 11.94, p < .0001. Follow-up tests revealed that dominance ratings following the evaluation task (M = 7.1, SD = 4.5) were significantly lower than following the prebaseline (M = 11.7, SD = 3.9), postbaseline (M = 14.2, SD = 4.3), blood task (M = 12.1, SD = 5.2), instruments task (M = 12.1, SD = 4.5), and pain task (M = 10.3, SD = 4.6). Additionally, dominance ratings were significantly lower following the closed-in task (M = 8.4, SD = 5.4) relative to prebaseline, postbaseline, blood task, and instrument task. A group main effect, in which the dental phobia group (M = 9.3, SD = 2.5) self-reported less dominance than the control group (M = 12.4, SD = 3.1), was present, F(1, 26) = 9.04, p < .006. The interaction was not significant, F(6, 156) = 1.01, p > .10.

Pain intensity. Group changes in pain intensity ratings over time are illustrated in Figure 3. Separate one-tailed t-tests were used to analyze pain intensity ratings at 15 second intervals across the first 90 seconds of the pain task. Other t-tests were not conducted at subsequent time intervals due to an insufficient number of participants in the dental phobia group (n < 4). The dental phobia group (M = 6.6, SD = 2.7) indicated greater pain intensity than the control group (M = 4.7, SD = 2.0) at the 45 second mark, t(22) = 1.97, p < .03. No significant group differences were observed at any other time interval. The time at which a participant made the first pain intensity rating served as pain threshold. No difference in latency to pain threshold was observed between the dental phobia patients (M = 6.4, SD = 4.9) and their corresponding controls (M = 11.2, SD = 11.7), t(30) = 1.51, p > .10. Pain tolerance was reached sooner by dental phobia patients (M = 78.6, SD = 72.9) than control individuals (M = 151.7, SD = 119.0), t(30) = 2.22, p < .05.

BAT Behavioral Data

Pearson's Chi-square test of independence was conducted for each of the five BAT tasks using a 2 (dental phobia patient or matched control) X 2 (occurrence or nonoccurrence of avoidance/escape behavior) contingency table. Figure 4 exhibits the number of individuals engaging in avoidance/escape behavior during each task. There was a trend for avoidance/escape behavior to be associated with group membership for the blood task, $X^2(1, N = 36) = 3.27$, $p < .07$, and the instruments task, $X^2(1, N = 36) = 3.27$, $p < .07$. Group membership was significantly associated with avoidance/escape behavior for the closed-in task, $X^2(1, N = 36) = 5.81$, $p < .02$, for the evaluation task, $X^2(1, N = 36) = 5.81$, $p < .02$, and for the pain task, $X^2(1, N = 36) = 4.43$, $p < .04$. No avoidance or escape behavior was observed among control participants for the blood, closed-in, evaluation, and instruments tasks. Table 7 illustrates the individual pattern of behavioral avoidance/escape among the dental phobia patients in response to the BAT stimuli.

BAT Heart Rate Data

A 2 Group (dental phobia patients or matched controls) X 7 Trials (prebaseline, 5 BAT tasks, and postbaseline) ANOVA was conducted. Figure 5 exhibits the heart rate reactivity of the groups across trials. The trials main effect was significant, $F(6, 120) = 8.70$, $p < .0001$. Follow-up tests revealed significantly higher heart rate during the blood task ($M = 81.0$, $SD = 13.0$) relative to prebaseline ($M = 76.2$, $SD = 11.8$), postbaseline ($M = 72.6$, $SD = 10.0$), the closed-in task ($M = 74.5$, $SD = 12.5$), the evaluation task ($M = 73.3$, $SD = 12.3$), and the pain task ($M = 74.7$, $SD = 11.2$); the blood task and the instrument task ($M = 77.7$, $SD = 11.4$) did not elicit significantly different heart rate acceleration. Higher heart rates were observed during the instrument task relative to postbaseline and the evaluation task. The interaction, $F(6, 120) = .69$, $p > .10$, and group main effect, $F(1, 20) = .50$, $p > .10$, were not significant.

An examination of the data suggested an overall decrease in heart rate from prebaseline to postbaseline. A 2 Group (dental phobia patients or matched controls) X 2 Baseline (prebaseline/ postbaseline) ANOVA was conducted. This analysis has greater power for detecting prebaseline to postbaseline changes in heart rate because participants are not excluded due to avoidance behavior, as in the 2 Group X 7 Trials ANOVA (with the exception of one dental phobia patient with missing postbaseline heart rate data and that participant's matched control). A trials main effect confirmed that prebaseline heart rates (M = 77.0, SD = 10.6) were elevated compared to postbaseline heart rates (M = 72.9, SD = 9.1), $F(1, 32) = 17.50$, $p < .0001$. No group main effect, $F(1, 32) = .14$, $p > .10$, or interaction, $F(1, 32) = 5.10$, $p > .10$, was observed.

Discussion

Group Differences

Dental phobia patients and matched controls were assessed using a dental BAT targeting hypothesized components of dental phobia. Unlike much of the previous research examining components of dental fear and anxiety, a three systems approach was taken. This three systems approach proved important, given that group differences were observed in the behavioral and verbal report response systems but not in the one measure (i.e., heart rate) of the psychophysiological response system.

Initial descriptive verbal report data. As predicted, dental phobia patients indicated greater fear and/or anxiety than control participants on all initial dental questionnaire measures. The elevated scores obtained from this sample of dental phobia patients are consistent with the scores of other highly fearful, anxious, or phobic individuals in the existing literature. The dental phobia sample's average score of 14.7 on the DAS surpasses the recommended cut-off score of 13 or greater for phobic/highly fearful individuals (Corah et al., 1978). The control sample's average score of 6.7 on the DAS is similar to the mean of 8.9 for a large, unselected undergraduate sample (Corah et al., 1978). Similarly, the dental phobia sample's average DFS total score of 71 is similar

to the total score of 73 obtained in a sample of DSM-III-R diagnosed dental phobics (Roy-Byrne et al., 1994) and exceeds the total score of 66 obtained in a sample of high dental fear undergraduates (McGlynn et al., 1987). The control group's average DFS total score of 31.4 is similar to the total score of 39 found in McGlynn et al.'s (1987) control group. Average scores are not available from the existing literature for the 60-DQ. These initial questionnaire data provide additional support for the diagnosed differences in dental fear and anxiety between the two groups.

While group differences emerged for dental fear and anxiety measures, groups indicated similar levels of overall anxiety and depression. Scores on the Beck Depression Inventory for both groups were well below the suggested cut-off (e.g., a score of 11) for mild depression. Neither the mean state nor the mean trait anxiety scores for either group exceeded the 50th percentile of normal adults of similar age. Therefore, while some members of the dental phobia group had additional diagnoses, the evidence suggests that the groups were fairly equivalent and within normal limits in terms of general measures of anxiety and depression. These data provide limited evidence that observed findings are related to differing levels of dental fear/anxiety rather than differences in level of general psychopathology, although this competing hypothesis cannot be completely eliminated.

BAT verbal report data. Overall, verbal reports of fear and anxiety were extremely low for all tasks for the control group and in the mild to moderate range for the dental phobia patients. In comparison to the highly elevated rates of fear and anxiety reported in the initial verbal report measures, results appear to indicate that even phobic participants found the BAT tasks only moderately challenging. Nevertheless, the groups demonstrated differential responses to the tasks. Specifically, the dental phobia patients reported experiencing the closed-in, evaluation, and instruments tasks as the most fear and anxiety provoking, while the matched controls generally described experiencing these tasks as the least fear and anxiety provoking. Results also indicated that, for the

dental phobia group, the evaluation and closed-in tasks were particularly distressing: Only these two tasks evoked reports of fear and anxiety beyond baseline levels for the dental phobia patients. Groups were similar in their experience of the blood and pain tasks as mildly fear and anxiety provoking, but this level of fear and anxiety was not significantly different than baseline levels.

As would be expected among individuals experiencing a fear or anxiety response, the dental phobia group reported lower pleasure ratings, more arousal, and lower dominance relative to the control group across tasks. While differing in the magnitude of their responses, both groups found the evaluation task particularly distressing, and both groups indicated that each of five tasks was more challenging along all three dimensions relative to prebaseline and postbaseline.

BAT behavioral data. Only the pain task was sufficiently aversive to induce escape behavior among control participants. Among dental phobia patients, avoidance and escape behavior occurred to some degree across all tasks; however, dental phobia group membership was significantly associated with increased avoidance/escape behavior only for the closed-in, evaluation, and pain tasks.

With these results, synchrony is observed across the verbal report and behavioral response domains for the closed-in, evaluation, and blood tasks. Both verbal report data and behavioral data suggest a unique pattern of dysfunctional responding to the stimuli or situations of being "closed-in" and receiving negative social evaluation that is present among phobic individuals but not among nonfearful individuals. Conversely, a consistently low level of self-reported fear and anxiety and a low level of behavioral avoidance/escape in response to blood stimuli for both groups calls into question whether fear of blood is indeed a typical component of dental phobia.

Inconsistency across verbal report and behavioral response domains was observed for the instrument and pain tasks. Being asked to hold and look at dental instruments while listening to dental drill sounds produced mild to moderate complaints

of fear and anxiety among dental phobia patients but was not sufficient to induce high levels of avoidance/escape behavior--perhaps because participants were aware that no dental procedures would be performed in the laboratory. For the pain task, all individuals described it as being mildly to moderately aversive, but control individuals exhibited greater behavioral pain tolerance relative to the phobic individuals. Dental phobia patients and matched controls did not differ in initial pain threshold. However, at the 45 second point in the task, dental phobia participants (n = 12) described experiencing the stimuli as producing greater pain intensity relative to matched controls (n = 12). Differences in pain intensity ratings were not observed between groups at subsequent 15 second intervals; however, the number of dental phobia patients (n = 7) available for statistical analysis at the next 15 second interval (60 s) was substantially reduced relative to the remaining control participants (n = 11). Therefore, unlike nonphobic individuals, many dental phobia patients appear to experience a rapid escalation in the intensity of experienced pain and then quickly engage in escape behavior.

BAT heart rate data. No group differences in heart rate responsivity were detected. Several possible reasons may exist for the lack of differences between groups. Given the findings of greater autonomic responsivity among fearful and anxious individuals exposed to various dental stimuli in other studies, one possibility is that the tasks were not sufficiently intense or anxiety-provoking enough for group differences to emerge. Alternatively, the stimuli presented in the tasks may have been too disparate from the conditioned and unconditioned stimuli in the dental office to produce heart rate reactivity. Another possibility may be that dental phobia patients primarily respond in the verbal report and behavioral domains or in a psychophysiological system (e.g., muscle tension) that was not sampled.

Given that prebaseline heart rate was greater than postbaseline heart rate, regardless of group membership, it is suggested that most individuals experience some

physiological arousal in anticipation of exposure to dental stimuli, habituate to the situation, and/or experience a relief phenomenon at its conclusion. Given their lack of responsivity in the verbal report and behavioral domains, nonfearful individuals, unlike dental phobics, do not appear to attribute this increased arousal to problem fear or anxiety. Additional time to habituate to the experimental setting during the prebaseline period and additional time to habituate to the room containing the dental chair might have allowed group differences to emerge during the tasks or the baseline periods.

A small but significant increase in heart rate was observed in both groups in response to the blood and instrument tasks. These tasks elicited heart rate acceleration, but not behavioral avoidance/escape, or particularly strong verbal reports of fear or anxiety. Additionally, consideration of the behavioral data and verbal report data would lead to the expectation of the greatest heart rate reactivity to the closed-in, evaluation, and pain tasks. The unexpected response pattern obtained is most parsimoniously explained by the greater physical demands of the blood and instrument tasks. The blood task required that the individual hold an IV bag containing blood (which several control and phobic individuals accomplished by grasping the bag by its corner and holding it with their arm straight out to their side at a 90 degree angle to their body). The instrument task required that the participant hold a tray containing dental instruments in front of him/her, which was presumably less physically demanding than the blood task, and thus elicited a smaller increase in heart rate. The evaluation, closed-in, and pain tasks did not require the participant to hold anything, other than a pencil during the pain task. Heart rate acceleration has been found in response to the sound of a dental drill in prior research (Gang & Teft, 1975; McNeil et al., 1988; Meldman, 1972), and, while group differences did not emerge, the heart acceleration during the instruments task, which included the sound of a dental drill, could possibly be considered a replication of these results. As previously stated, however, the confound of physical exertion and the instruments task limits the interpretability these findings. Lastly, given that pain intensity

builds over time using the algometer, analyzing only the first 20 seconds of heart rate data for the pain task might have obscured group differences.

Conclusions

This study sought to assess dental phobia broadly, focusing on its possible components. Additionally, goals were to discover whether or not dental phobia patients exhibited more verbal reports of distress, more overt avoidance/escape behavior, and more psychophysiological responding than matched controls in response to a standardized BAT. Overall, phobic individuals were differentiated from matched controls in the behavioral and verbal report domains but not the psychophysiological domain. Evidence was found to support fear of being closed-in, evaluation, pain, and dental instruments as being important components of dental phobia.

Little evidence supported fear of blood as a unique component of dental fear. A diphasic physiological response pattern was not observed in any research participant, but the acute nature of this response may not have been captured by this study's methodology. The blood stimulus elicited little verbal distress and little behavioral avoidance/escape. Informal observation suggested that disgust, rather than fear, was a more typical response to the blood stimulus. Given the confound of physical exertion within the blood task, additional research is needed to replicate the finding of heart rate acceleration in response to a blood stimulus. Another issue that needs to be addressed is whether it is possible that seeing one's own blood or blood in a context more directly related to dental treatment (e.g., on a tooth that has been removed, when rinsing following a procedure) might be necessary to produce a fear response.

Dental phobia patients self-reported more fear and anxiety and engaged in more avoidance/escape behavior than matched controls in response to the negative social evaluation task. Eight dental phobia patients had the additional diagnosis of social phobia, and in accordance with participation requirements, no matched control had social phobia. Therefore, social phobia, rather than dental phobia, may account for differences

in response to the evaluation task. Additionally, given that over 1/3 of the dental phobia patients had not been to the dentist in over 2 years, the evaluative comments made by the experimenter might have seemed more credible and personally-relevant to the phobics than to the control participants. Whether dental phobia patients are more sensitive to negative social evaluation in general, or whether fear of negative social evaluation is more limited to criticism of their dental hygiene in particular, is an area for future research.

Limitations

The most significant limitation of this study is the fact that the dental phobia participants and matched controls differed in terms of patient status and additional diagnoses. It is possible that the observed findings are a consequence of these factors rather than differing levels of dental fear. Another important limitation is that this study employed an entirely Caucasian sample, which limits the generalizability of these results to other populations. Similarly, there were no participants from the lower-middle or lower social strata.

Limitations also existed in the methodology employed during the BAT. Although the two undergraduate "dental assistants" who interacted with the participants during the BATs were blind to group membership and the BAT instructions were tape recorded, the graduate student experimenters who provided the general overview of BAT procedures and who operated the equipment from the instrumentation room was not blind to patient/nonpatient status. Because the graduate student experimenters were not blind regarding group membership, inadvertent experimenter bias could be an issue.

Ideally, the pain task used in the BAT would have involved an induction of oral pain, which has been found to differentiate high and low dental fear individuals in previous research (Lautch, 1971; Klepac et al., 1980; Klepac et al., 1982). Nevertheless, the pain task methodology employed in this study has several strengths: (a) the simplicity of the algometer procedure makes its use practical in both research and clinical settings

in which assessing response to pain is desirable; (b) the procedure allows for the assessment of pain intensity while the task in progress rather than retrospectively; and (c) group differences in pain tolerance and pattern of pain intensity ratings were revealed by this methodology.

As previously discussed, all participants, including the dental phobia patients, appeared to find the BAT tasks moderately challenging at best, given the low to moderate verbal reports of fear and anxiety, the limited avoidance/escape behavior, and the lack of heart rate responsivity to the tasks. If it were possible to present the stimuli in a more intense form during the study, more group differences across response systems and between tasks might have emerged. It seems likely that the intensity of the stimuli was limited by the fact that many of the tasks (e.g., holding an IV bad containing blood) were quite removed from what actually occurs in a dental operatory and the fact that the participants were aware that they would not be subjected to any invasive dental procedures during the BAT.

Clinical Implications and Future Directions

Current treatment protocols for dental phobia are primarily focused on helping the patient better cope with pain (e.g., Klepac & Purcell, 1986). The results of this study support the importance of targeting fear of pain and teaching the patient strategies for coping with pain. The findings, however, also suggest that this approach to treatment might be limited in its scope, and overlook other potentially relevant fear stimuli. Concerns about negative social evaluation and fears regarding being closed-in and unable to easily escape the dentist office in a socially-appropriate manner appear to be particularly relevant targets for assessment and intervention. The variability seen among dental phobia patients in terms of their pattern of task avoidance/escape illustrates the point that, while commonalties may be observed among a group of patients, a comprehensive assessment should be followed by an ideographic approach to treatment.

This study was exploratory in the sense that components of dental fear have not previously been directly targeted in a standardized behavior test. Future research should attempt to replicate these findings and extend them by comparing dental phobia patients to other patient populations in their responses to a standardized dental BAT targeting dental fear components. Given that all tasks in this study were rated as mild to moderately fear provoking and produced a only limited degree of avoidance/escape behavior, ways in which to increase the intensity of the tasks should be explored as well.

References

Agras, S., Sylvester, D., & Oliveau, D. (1969). The epidemiology of common fears and phobia. Comprehensive Psychiatry, 10, 151-156.

American Psychiatric Association. (1987). Diagnostic and statistical manual of mental disorders (3rd ed., rev.). Washington, DC: Author.

American Psychiatric Association. (1994). Diagnostic and statistical manual of mental disorders (4th ed.). Washington, DC: Author.

Barlow, D. H. (1988). Anxiety and its disorders: The nature and treatment of anxiety and panic. New York: Guilford Press.

Berggren, U. (1992). General and specific fears in referred and self-referred adult patients with extreme dental anxiety. Behaviour Research and Therapy, 30, 395-401.

Berggren, U., & Meynert, G. (1984). Dental fear and avoidance: Causes, symptoms, and consequences. Journal of the American Dental Association, 109, 247-251.

Bernstein, D. A. (1973). Situational factors in behavioral fear assessment: A progress report. Behavior Therapy, 4, 41-48.

Bernstein, D. A., & Kleinknecht, R. A. (1982). Multiple approaches to the reduction of dental fear. Journal of Behavior Therapy and Experimental Psychiatry, 13, 287-292.

Bernstein, D. A., Kleinknecht, R. A., & Alexander, L. D. (1979). Antecedents of dental fear. Journal of Public Health Dentistry, 39, 113-124.

Bernstein, D. A., & Nietzel, M. T. (1973). Procedural variations in behavioral avoidance tests. Journal of Consulting and Clinical Psychology, 41, 165-174.

Boone, M. L. (1993). Differential manifestations of generalized social phobia and circumscribed speech phobia. Unpublished doctoral dissertation, Oklahoma State University, Stillwater.

Borkovec, T. D., Weerts, T. C., & Bernstein, D. A. (1977). Assessment of anxiety. In A. R. Ciminero, K. S. Calhoun, & H. E. Adams (Eds.), Handbook of behavioral assessment. New York: Wiley.

Camilli, G., & Hopkins, K. D. (1978). Applicability of Chi-square to 2 X 2 contingency tables with small expected cell frequencies. Psychological Bulletin, 85, 163-167.

Camilli, G., & Hopkins, K. D. (1979). Testing for association in 2 X 2 contingency tables with very small sample sizes. Psychological Bulletin, 86, 1011-1014.

Carlson, C. R., Collins, F. L., Jr., Stewart, J. F., Porzelius, J., Nitz, J. A., & Lind, C. O. (1989). The assessment of emotional reactivity: A scale development and validation study. Journal of Psychopathology and Behavioral Assessment, 11, 313-325.

Carter, L. E. (1994). Effects of emotion on pain reports, tolerance, and physiology. Unpublished doctoral dissertation, Oklahoma State University, Stillwater.

Cook, E. W., III, Atkinson, L., & Lang, K. G. (1987). Stimulus control and data acquisition for IBM PC's and compatibles. Psychophysiology, 24, 726-727. (Abstract)

Corah, N. L. (1969). Development of a dental anxiety scale. Journal of Dental Research, 48, 596.

Corah, N. L., Gale, E. N., & Illig, S. J. (1978). Assessment of a dental anxiety scale. Journal of the American Dental Association, 97, 816-819.

Corah, N. L., & Pantera, R. E. (1968). Controlled study of psychologic stress in a dental procedure. Journal of Dental Research, 47, 154-157.

Corah, N. L., & Salmonson, R. J. (1970). Psychologic response to a simulated dental procedure as a function of proximity to an actual dental appointment. Journal of Dental Research, 49, 438-441.

Di Nardo, P. A., Barlow, D. H., Cerny, J. A., Vermilyea, B. B., Vermilyea, J. A., Himadi, W. G., & Waddell, M. T. (1985). Anxiety Disorders Interview Schedule-Revised (ADIS-R). Albany, NY: Center for Stress and Anxiety Disorders.

Eifert, G. H., & Wilson, P. H. (1991). The triple response approach to assessment: A conceptual and methodological reappraisal. Behaviour Research and Therapy, 29, 283-292.

Fernandez, E., Nygren, T. E., & Thorn, B. E. (1991). An "open-transformed scale" for correcting ceiling effects and enhancing retest reliability: The example of pain. Perceptions and Psychophysics, 49, 572-578.

Fiset, L., Milgram, P., Weinstein, P., & Melnick, S. (1989). Common fears and their relationship to dental fear and utilization of the dentist. Anesthesia Progress, 36, 258-264.

Forgione, A. G., & Barber, T. X. (1971). A strain gauge pain stimulator. Psychophysiology, 8, 102-106.

Forgione, A. G., & Clark, R. E. (1974). Comments on an empirical study of the causes of dental fears. Journal of Dental Research, 53, 496.

Freidson, E., & Feldman, J. (1958). The public looks at dental care. Journal of the American Dental Association, 57, 325-335.

Gale, E. N. (1972). Fears of the dentist. Journal of Dental Research, 51, 964-966.

Gang, M. J., & Teft, L. (1972). Individual differences in heart rate responses to affective sound. Psychophysiology, 12, 423-426.

Gatchel, R. J., Ingersoll, B. D., Bowman, L., Robertson, M. C., & Walker, C. (1983). The prevalence of dental fear and avoidance: a recent survey study. Journal of the American Dental Association, 107, 609-610.

Hirschman, R., Revland, P., Hawk, G., & Young, D. (1980). Effects of dental anxiety and phase of treatment on discomfort during dental simulation. Journal of Dental Research, 59, 1064.

Hodes, R. L., Cook, E. W., & Lang, P. J. (1985). Individual differences in autonomic response: Conditioned association or conditioned fear? Psychophysiology, 22, 545-560.

Hodgson, R., & Rachman, S. (1974). II. Desynchrony in measures of fear. Behaviour Research and Therapy, 12, 319-326.

Jerremalm, A., Jansson, L., & Ost, L. G.. (1986). Individual Response Patterns and the effects of different behavioral methods in the treatment of dental phobia. Behaviour Research and Therapy, 24, 587-596.

Johnson, B., Mayberry, W. E., & McGlynn, F. D. (1990). Exploratory factor analysis of a sixty-item questionnaire concerned with fear of dental treatment. Journal of Behavior Therapy and Experimental Psychiatry, 21, 199-203.

Kleinknecht, R. A. & Bernstein, D. A. (1978). The assessment of dental fear. Behavior Therapy, 9, 626-634.

Kleinknecht, R. A., Klepac, R. D., and Alexander, D. A. (1973). Origins and characteristics of fear of dentistry. Journal of the American Dental Association, 86, 842-848.

Kleinknecht, R. A., Klepac, R. K., & Bernstein, D. A. (1976). Psychology and dentistry: Potential benefits from a health care liaison. Professional Psychology, 7, 585-592.

Kleinknecht, R. A., Thorndike, R. M., McGlynn, F. D., & Harkavy, J. (1984). Factor analysis of the dental fear survey with cross validation. Journal of the American Dental Association, 108, 59-61.

Klepac, R. K., Dowling, J., & Hauge, G. (1982). Characteristics of clients seeking therapy for the reduction of dental avoidance: Reactions to pain. Journal of Behavior Therapy and Experimental Psychiatry, 13, 293-300.

Klepac, R. K., McDonald, M., Hauge, G., & Dowling, J. (1980). Reactions to pain among subjects high and low in dental fear. Journal of Behavioral Medicine, 3, 373-384.

Klepac, R. K., & Purcell, E. L. (1986). Overcoming fear of dentistry: A self-help manual. Unpublished manuscript.

Lang, P. J. (1968). Fear reduction and fear behavior: Problems in treating a construct. In J. M. Shlien (Ed.), Research in psychotherapy, (Vol. 3). Washington, D.C.: American Psychological Association.

Lang, P. J. (1980). Behavioral treatment and bio-behavioral assessment: Computer applications. In J. B. Sidowski, J. H. Johnson, & T. A. Williams (Eds.), Technology in mental health care delivery systems. Norwood, NJ: Ablex.

Lang, P. J. (1985). The cognitive psychophysiology of emotion: fear and anxiety. In A. H. Tuma & J. D. Maser (Eds.), Anxiety and the anxiety disorders. Hillsdale, NJ: Erlbaum.

Lang, P. J., & Lazovik, A. D. (1963). Experimental desensitization of a phobia. Journal of Abnormal and Social Psychology, 66, 519-525.

Lautch, H. (1971). Dental phobia. British Journal of Psychiatry, 119, 151-158.

Levin, A. P., Saoud, J. B., Strauman, T., Gorman, J. M., Fyer, A. J., Crawford, R., & Liebowitz, M. R. (1993). Responses of "generalized" and "discrete" social phobics during public speaking. Journal of Anxiety Disorders, 7, 207-221.

Marks, I. M. (1987). Fears, phobias, and rituals: Panic, anxiety, and their disorders. NY: Oxford University Press.

Marks, I. M. (1988). Blood-injury phobia: A review. American Journal of Psychiatry, 149, 1207-1213.

Mathews, A., & Rezin, V. (1977). Treatment of dental fears by imaginal flooding and rehearsal of coping behavior. Behaviour Research and Therapy, 15, 321-328.

McGlynn, F. D. (1988). Behavioral avoidance test. In M. Hersen & A. S. Bellack (Eds.), Dictionary of behavioral assessment techniques. New York: Pergamon.

McGlynn, F. D. (1987). Factor structure, stability, and internal consistency of the dental fear survey. Behavioral Assessment, 9, 57-66.

McNeil, D. W., & Berryman, M. L. (1989). Components of dental fear in adults? Behaviour Research and Therapy, 27, 233-236.

McNeil, D. W., Lipson, J. M., & Williams, E. C. (1988). Cardiac response to fear-evoking sounds in relevant and irrelevant imagery contexts. Psychophysiology, 25, 468-469. (Abstract)

McNeil, D. W., McGlynn, F. D., Cassisi, J. E., & Vrana, S. R. (1989, October). Cardiac and electrodermal reactivity in a mock dental operatory behavioral assessment test. Poster presented at the meeting of the Society for Physiological Research, New Orleans, LA.

McNeil, D. W., & Rainwater, A. J., III (1996). Development of the Fear of Pain Questionnaire - III. Manuscript submitted for publication.

McNeil, D. W., Turk, C. L., & Ries, B. J. (1994). Anxiety and fear. In V. S. Ramachandran (Ed.), Encyclopedia of human behavior. San Diego: Academic Press.

McNeil, D. W., Vrana, S. R., Melamed, B. G., Cuthbert, B. N., & Lang, P. J. (1993). Emotion imagery in simple and social phobia: Fear versus anxiety. Journal of Abnormal Psychology, 102, 212-225.

Melamed, B. G. (1979). Behavioral approaches to fear in dental settings. In Hersen, M., Eisler, R. M., & Miller, P. M. (Eds.), Progress in Behavior Modification. Academic Press: New York.

Melamed, B. G., & Siegel, L. J. (1980). Behavioral medicine: Practical applications in health care. New York: Springer Publishing.

Meldman, M. J. (1972). The dental-phobia test. Psychosomatics, 13, 371-372.

Milgrom, P., Fiset, L., Melnick, S., & Weinstein, P. (1988). Journal of the American Dental Association, 116, 641-647.

Milgrom, P., Weinstein, P., Kleinknecht, R., & Getz, T. (1985). Treating fearful dental patients: A patient management handbook. Reston, VA: Reston Publishing.

Miller, B. V., & Bernstein, D. A. (1972). Instructional demand in behavioral avoidance test for claustrophobic fears. Journal of Abnormal Psychology, 80, 206-210.

Miller, M. P., Murphy, P. J., and Miller, T. P. (1978). Comparison of electromyographic feedback and progressive relaxation training in treating circumscribed anxiety stress reactions. Journal of Consulting and Clinical Psychology, 46, 1291-1298.

Moore, R., Brodsgaard, I., & Birn, H. (1991). Manifestations, acquisitions, and diagnostic categories of dental fear in a self-referred population. Behaviour Research and Therapy, 29, 51-60.

Mowrer, O. H. (1947). On the dual nature of learning: A re-interpretation of "conditioning" and "problem-solving." Harvard Educational Review, 17, 102-148.

Myers, J. R., & Bean, L. L. (1968). A decade later: A follow-up of social class and mental illness. New York: Wiley.

Ost, L. G. (1992). Blood and injection phobia: Background and cognitive, physiological, and behavioral variables. Journal of Abnormal Psychology, 101, 68-74.

Rachman, S., & Hodgson, R. (1974). I. Synchrony and desynchrony in fear and avoidance. Behaviour Research and Therapy, 12, 311-318.

Rainwater, A. J., III, & McNeil, D. W. (1991). Reinventing the algometer: Synopsis of the literature and presentation of a reliable, inexpensive model. Behavior Research Methods, Instruments, and Computers, 23, 486-492.

Reitan, R. M., & Wolfson, D. (1992). Neuroanatomy and neuropathology: A clinical guide for neuropsychologists. Tucson, AZ: Neuropsychology Press.

Roy-Byrne, P. P., Milgrom, P., Khoon-Mei, T., Weinstein, P., & Katon, W. (1994). Psychopathology and psychiatric diagnosis in subjects with dental phobia. Journal of Anxiety Disorders, 8, 19-31.

Scott, D. S., & Hirschman, R. (1982). Psychological aspects of dental anxiety in adults. Journal of the American Dental Association, 104, 27-31.

Shaw, D. W., & Thoresen, C. E. (1974). Effects of modeling and desensitization in reducing dentist phobia. Journal of Counseling in Psychology, 21, 415-420.

Shoben, E. J., & Borland, L. (1954). An empirical study of the etiology of dental fears. Journal of Clinical Psychology, 10, 171-174.

Speilberger, C. D., Gorsuch, R. L., Lushene, R. E., Vagg, P. R., & Jacobs, G. A. (1983). Manual for the State-Trait Anxiety Inventory (STAI Form Y). Palo Alto, CA: Consulting Psychologists Press.

Spitzer, R. L., Williams, J. B., Gibbon, M., & First, M. B. (1990). Structured clinical interview for DSM-III-R. Washington, DC: American Psychiatric Press.

Spitzer, R. L., Williams, J. B., Gibbon, M., & First, M. B. (1990). Structured clinical interview for DSM-III-R Personality Disorders (SCID-II, Version 1.0). Washington, DC: American Psychiatric Press.

Stouthard, M. E. A., & Hoogstraten, J. (1987). Ratings of fears associated with twelve dental situations. Journal of Dental Research, 66, 1175-1178.

Thrash, W. J., Russel-Duggan, J., & Mizes, J. S. (1984). The origin and prevention of dental fears. Clinical Preventive Dentistry, 6, 28-32.

Vrana, S., McNeil, D. W., & McGlynn, F. D. (1986). A structured interview for assessing dental fear. Journal of Behavior Therapy and Experimental Psychiatry, 17, 175-178.

Wroblewski, P. F., Jacob, T., & Rehm, L. P. (1977). The contribution of relaxation to symbolic modeling in the modification of dental fears. Behaviour Research and Therapy, 15, 113-117.

Appendix A

Variable List

Independent variable: Group (dental phobia or control)

Dependent variables:

A. Behavioral Assessment Test

1. Verbal report: SAM valence
   SAM arousal
   SAM dominance
   EAS anxiety
   EAS fear
   Pain intensity ratings
   Pain threshold
   Pain tolerance
2. Overt behavior: Avoidance/escape
3. Physiological: Cardiac responsivity

B. Supplemental measures

1. Dental Anxiety Scale
2. Dental Fear Survey
3. Dental Fear Interview
4. 60-item Dental Questionnaire
5. State-Trait Anxiety Inventory
6. Beck Depression Inventory

Appendix B

Medical/Social History Interview

Name_____Date_____Subj#: AX24 ___ ___

Age_____DOB_____Ethnicity_____Gender: M F

==========

Y N 1. Do you wear glasses or contact lenses? If yes, were they used during the Stroop? Y N

Y N 2. Do you have difficulty distinguishing colors (e.g., color blindness)?

Explain_____

Y N 3. Any past or present hearing problems?

Y N 4. Do you have, or have you ever had a seizure disorder?

Explain_____

Y N 5. Have you ever had periods of unconsciousness?

Explain_____

Y N 6. Have you ever had any serious head injuries?

Explain_____

Y N 7. Any current or past heart problems?

Explain_____

Y N 8. Have you ever had rheumatic or scarlet fever?

Explain_____

Y N 9. Have you ever had cushing disease?

Explain_____

Y N 10. Have you ever had bone, joint, or muscle problems?

Explain_____

Y N 11. Have you had any experience with severe or prolonged pain?

Explain_____

Appendix B (continued)

Y N 12. Any current serious health problem, illness, or accident that has not yet mentioned? Explain_____

Y N 13. Have you taken any medication (either prescription or over-the-counter) or recreational drugs in the last 24 hours? List type, dosage, and times for each_____

Y N 14. Have you used any caffeinated beverages or alcohol in the last 12 hours. List amount and times for each_____

Y N 15. Are you presently pregnant, or do you have any reason to believe you are pregnant?

_____ 16. How many hours of sleep did you get last night?

_____ 17. How many hours of sleep do you usually get per night?

R L 18. Are you right or left handed?

Using the numbers from the list below, indicate the occupations of yourself and your spouse; if unsure how to categorize, just write a brief description of your job.

_____ 19. Your occupation: _____

_____ 20. Spouse's occupation: _____

(1) Executive, major professional

(2) Manager, minor professional

(3) Administrator, owner of a small business, semi-professional

(4) Clerical and sales worker

(5) Skilled worker

(6) Semi-skilled worker

(7) Unskilled worker

(8) Unemployed

(9) Homemaker

Appendix B (continued)

Using the numbers from the list below, indicate how far each of you went in school.

_____ 21. Self

_____ 22. Spouse

(1) Graduate or professional training (degree obtained)

(2) Partial graduate or professional training

(3) College graduate (degree obtained)

(4) Partial college training (including technical schooling beyond high school)

(5) High school graduate (graduate of technical or trade school)

(6) Partial high school (10th grade through partial 12th grade)

(7) Partial junior high school (7th grade through 9th grade)

(8) Elementary school (6th grade)

Appendix C

Experimental Procedure

Session #1	Informed Consent ADIS-IV Interview
Session #2	SCID-II Interview Dental Fear Interview Questionnaires: DAS, DFS, 60-DQ, STAI, BDI
Session #3	Medical/Social History Interview Stroop Test Assessment
Session #4	Behavioral Assessment Test: Blood task Closed-in task Dental instruments task Pain task Social evaluation task

Appendix D

Transformation algorithms for open-scale pain intensity ratings

Formula I

$CT_{int} = CT_{ll} + [(TR_{int} - TR_{ll})/(TR_{ul} - TR_{ll})] * (CT_{ul} - CT_{ll})$

Where $TR_{interval} = 9/(RR - 1)$

Formula II

$TR_{int} = TR_{ll} + [(CT_{int} - CT_{ll})/(CT_{ul} - CT_{ll})] * (TR_{ul} - TR_{ll})$

Where $TR_{interval} = 9/(RR - 1)$

Note:

RR	refers to the total number of ratings (i.e., tally marks) given by the participant through the time of pain escape.
$TR_{interval}$	refers to the value used to calculate each transformed rating, as indicated above.
CT_{int}	refers to the cumulative time for which an interpolated transformed rating is desired.
CT_{ll}	refers to the nearest cumulative time that is less than the CT_{int} value.
CT_{ul}	refers to the nearest cumulative time that is greater than the CT_{int} value.
TR_{int}	refers to the pain severity rating that corresponds to the desired cumulative time interval.
TR_{ll}	refers to the nearest transformed rating that is less than the TR_{int} value.
TR_{ul}	refers to the nearest transformed rating that is greater than the TR_{int} value.

Note. These algorithms adapted from Fernandez et al., 1991, as presented by Carter, 1994.

Table 1

Frequency of Social Classification Ranking among Dental Phobia Patients and Matched Controls

Social Strata	Dental Phobia Group	Matched Control Group
Upper	4	4
Upper-middle	5	5
Middle	3	3
Lower-middle	0	0
Lower	0	0
Student	6	6

Table 2

Frequency of comorbid diagnoses in the dental phobia group

Diagnosis	Frequency
Social Phobia	8
Generalized Anxiety Disorder	4
Specific Phobia	4
Obsessive Compulsive Personality Disorder	2
Agoraphobia	1
Panic Disorder with Agoraphobia	1
Borderline Personality Disorder	1
Narcissistic Personality Disorder	1
Paranoid Personality Disorder	1

Table 3

Mean scores for dental verbal report instruments (standard deviations in parentheses)

Instrument	Possible Range	Phobia Group	Control Group	t	p
Dental Anxiety Scale (DAS)	4-20	14.7 (2.5)	6.7 (1.4)	11.60	.0001
Dental Fear Interview-Severity Rating (DFI SEVR)	1-14	10.0 (2.8)	1.7 (1.0)	11.84	.0001
Dental Fear Interview-Impairment Rating (DFI IMP)	1-14	9.1 (3.3)	1.4 (0.6)	9.62	.0001
Dental Fear Survey-Total (DFI TOT)	20-100	71.0 (15.7)	31.4 (6.9)	9.79	.0001
Dental Fear Survey-Avoidance (DFS AVOID)	8-40	24.4 (7.3)	9.5 (1.9)	8.46	.0001
Dental Fear Survey-Specific Stimuli (DFS STIM)	6-30	25.7 (5.3)	12.5 (4.4)	8.12	.0001
Dental Fear Survey-Physiological (DFS PHYS)	5-25	16.6 (4.3)	7.8 (1.4)	8.22	.0001
60-item Dental Questionnaire-Total (60-DQ TOT)	60-420	240.4 (64.5)	112.1 (33.5)	7.49	.0001
60-item Dental Questionnaire-Pain (60-DQ PAIN)	17-119	91.1 (20.6)	40.5 (14.0)	8.64	.0001
60-item Dental Questionnaire-Neg. Soc. Eval.(60-DQ NEG)	7-49	30.2 (7.3)	17.9 (9.4)	4.38	.0001
60-item Dental Questionnaire-Anticipatory (60-DQ ANT)	12-84	34.2 (14.2)	13.5 (2.0)	6.11	.0001
60-item Dental Questionnaire-Loss of Control(60-DQ LOS)	5-35	14.7 (7.3)	7.5 (2.9)	3.89	.0001

Note. Higher scores indicate report of greater dental fear.

Table 4

Self-reported length of time since last dental appointment

Date of last appointment	Dental Phobia Group	Matched Control Group
Six months ago or less	7	9
Six months to 1 year ago	3	3
1 year to 2 years ago	1	6
2 years to 5 years ago	5	0
5 years to 10 years ago	2	0

Table 5

Intercorrelations among dental fear verbal report instruments

Dental Phobia Verbal Report Instruments	Dental Phobia Verbal Report Instruments					
	DAS	60-DQ TOT	60-DQ PAIN	60-DQ NEG	60-DQ ANT	60-DQ LOSS
Dental Fear Interview - Severity Rating (DFI SEVR)	.89	.80	.82	.58	.73	.57
Dental Fear Interview - Impairment Rating (DFI IMP)	.88	.82	.85	.53	.80	.59
Dental Fear Survey - Total (DFI TOT)	.94	.93	.96	.68	.88	.65
Dental Fear Survey - Avoidance (DFS AVOID)	.90	.88	.89	.65	.86	.61
Dental Fear Survey - Specific Stimuli (DFS STIM)	.88	.92	.95	.68	.82	.68
Dental Fear Survey - Physiological (DFS PHYS)	.89	.84	.89	.59	.80	.54
Dental Anxiety Scale (DAS)		.88	.90	.64	.84	.60
60-item Dental Questionnaire - Total (60-DQ TOT)			.96	.83	.93	.82
60-item Dental Questionnaire - Pain (60-DQ PAIN)				.75	.84	.70
60-item Dental Questionnaire - Neg. Soc. Eval. (60-DQ NEG)					.68	.61
60-item Dental Questionnaire - Anticipatory (60-DQ ANT)						.78
60-item Dental Questionnaire - Loss of Control (60-DQ LOSS)						

Table 5 (continued)

Dental Phobia Verbal Report Instruments	Dental Phobia Verbal Report Instruments					
	DFI SEVR	DFI IMP	DFS TOT	DFS AVOID	DFS STIM	DFS PHYS
Dental Fear Interview - Severity Rating (DFI SEVR)		.92	.88	.87	.83	.81
Dental Fear Interview - Impairment Rating (DFI IMP)			.90	.89	.85	.83
Dental Fear Survey - Total (DFI TOT)				.96	.95	.94
Dental Fear Survey - Avoidance (DFS AVOID)					.86	.87
Dental Fear Survey - Specific Stimuli (DFS STIM)						.84
Dental Fear Survey - Physiological (DFS PHYS)						

Note. All p's < .0001, with the exception of the correlation between the DFS PHYS and 60-DQ LOSS, which is p < .001 and the correlation between the DFI IMP and 60-DQ NEG, which is p < .001.

Table 6

Mean scores for general anxiety and depression verbal report instruments (standard deviations in parentheses)

Instrument	Possible Range	Phobia Group	Control Group	t	p
Beck Depression Inventory (BDI)	0-63	5.3 (6.8)	2.4 (3.1)	1.67	.05
State-Trait Anxiety Inventory-Trait (STAI - Trait)	20-80	32.7 (11.5)	27.5 (6.1)	1.73	.05
State-Trait Anxiety Inventory-State (STAI - State)	20-80	32.9 (11.8)	27.0 (7.8)	1.78	.04

Note. Higher scores indicate report of greater anxiety or depression.

Table 7

Pattern of avoidance/escape behavior among dental phobia patients

Participants	Tasks				
	Blood	Closed-in	Negative Evaluation	Dental Instruments	Pain
1		✓			✓
2					✓
3		✓			✓
4					✓
5	✓	✓			✓
6		✓	✓	✓	✓
7	✓	✓	✓	✓	✓
8					✓
9					✓
10					✓
11					✓
12			✓	✓	✓
13			✓		✓
14					✓
15					✓
16					
17	✓				✓
18			✓		✓

Note. Columns marked with ✓ indicate that escape or avoidance behavior occurred during that task for the corresponding participant.

Figure Captions

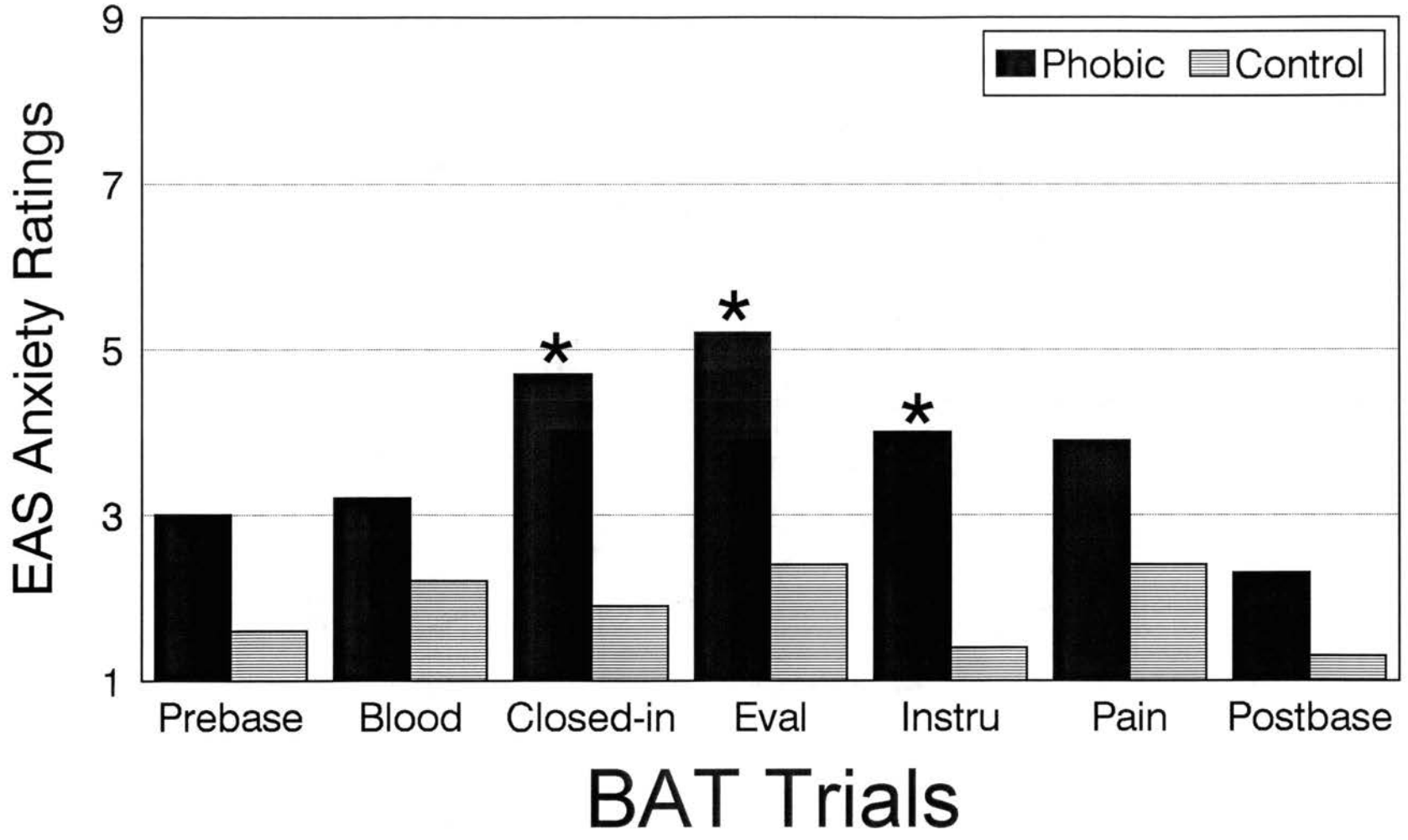
Figure 1. EAS anxiety ratings across trials (prebaseline, blood task, closed-in task, evaluation task, dental instruments task, and pain task) for the dental phobia and matched control groups (N = 28). Group differences for a task are denoted with an asterisk.

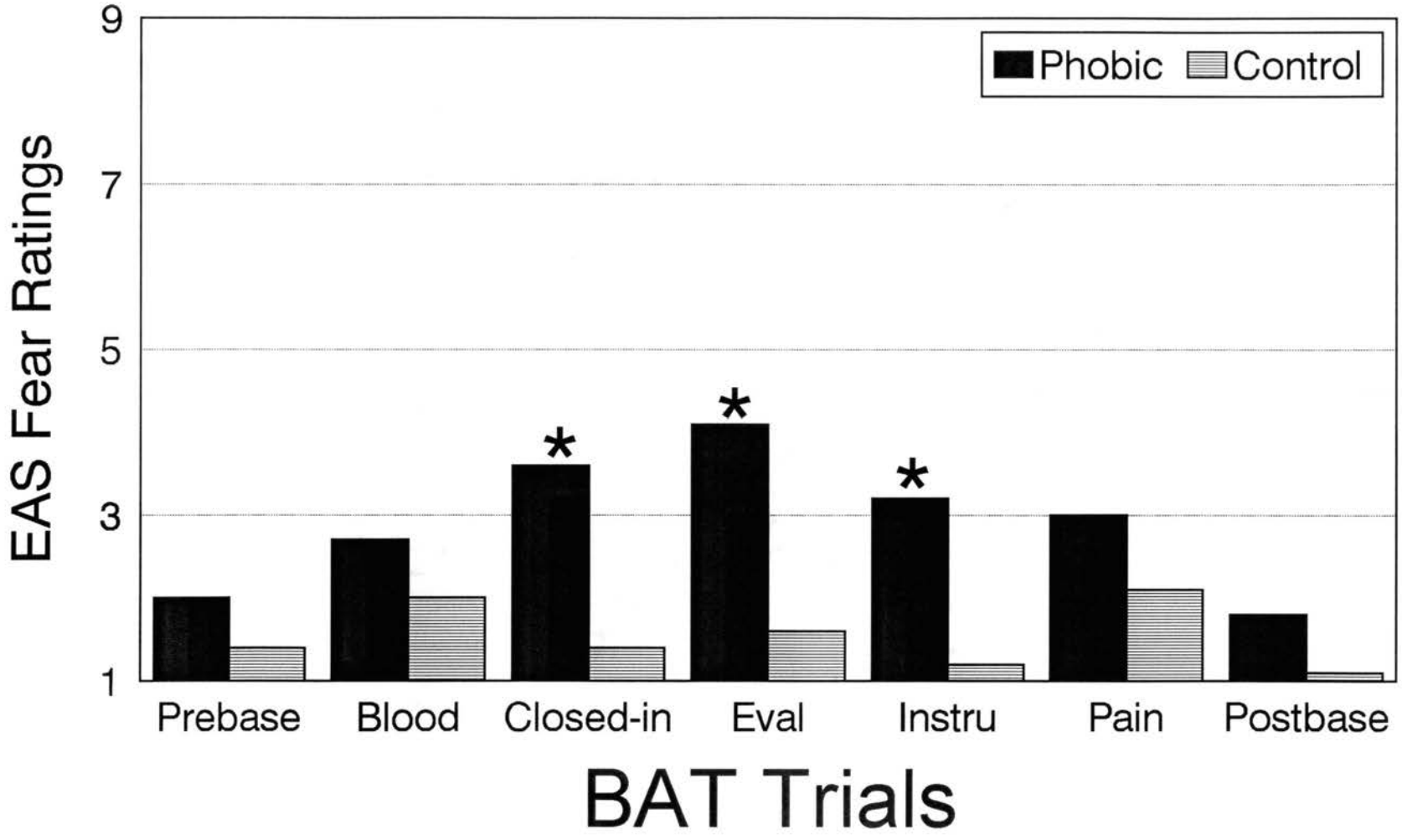
Figure 2. EAS fear ratings across trials (prebaseline, blood task, closed-in task, evaluation task, dental instruments task, and pain task) for the dental phobia and matched control groups (N = 28). Group differences for a task are denoted with an asterisk.

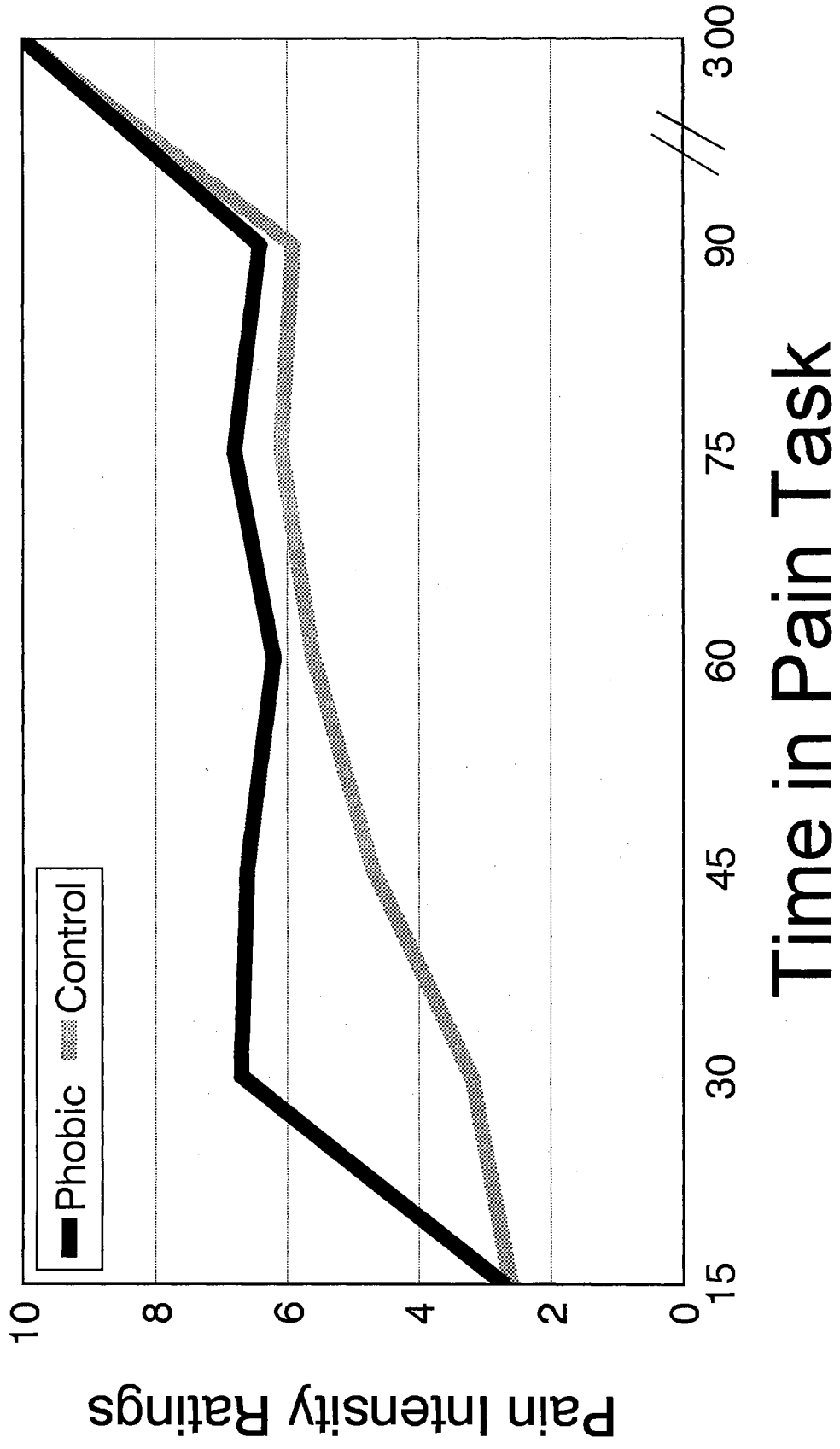
Figure 3. Changes in pain intensity ratings over time for the dental phobia and matched control groups. Significant group differences are present only for the 45 second interval. The number of participants decreases over time due to escape behavior (N = 34 at 15 seconds).

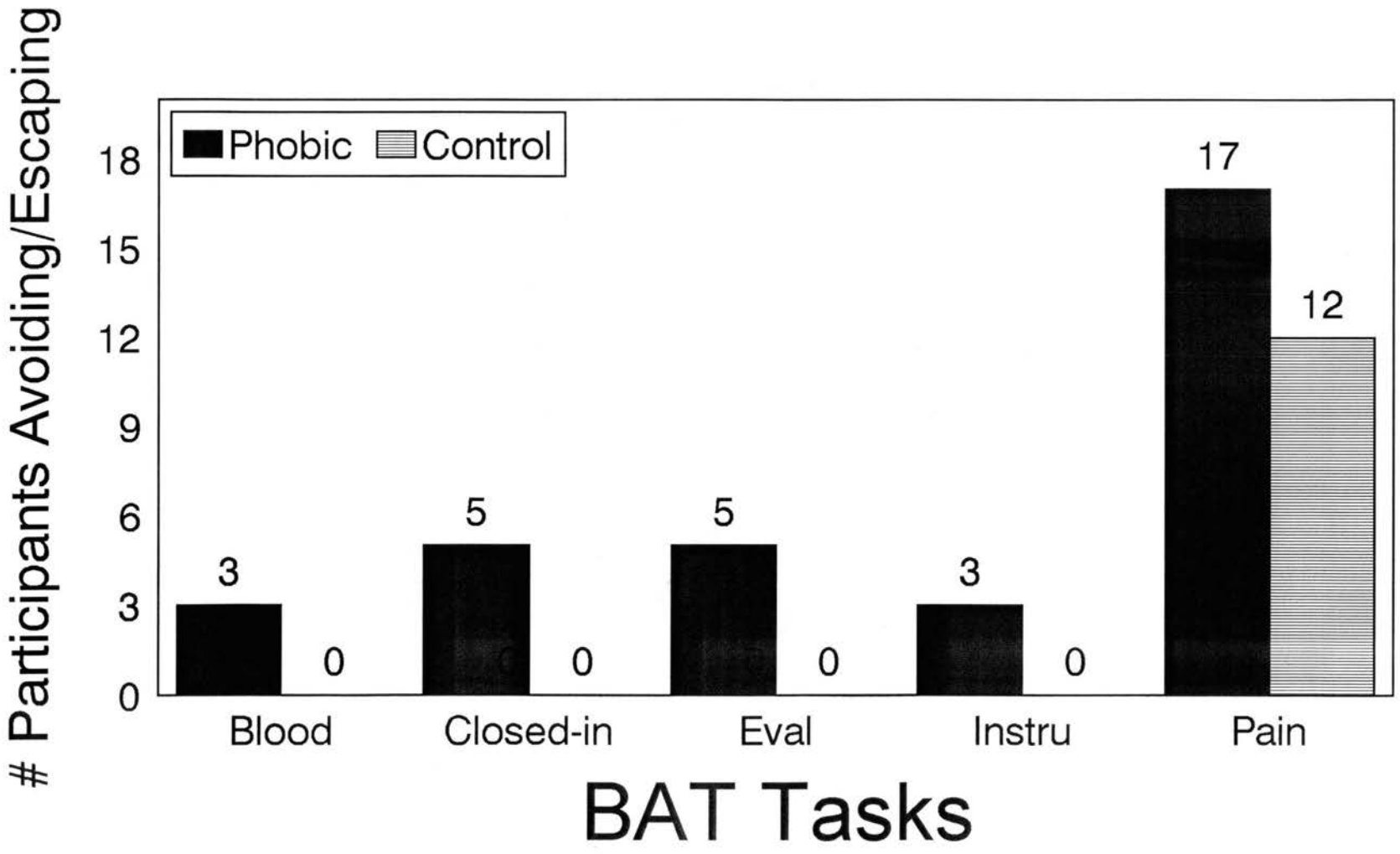
Figure 4. Number of dental phobia and control participants engaging in avoidance or escape behavior during the blood, closed-in, evaluation, dental instruments, and pain tasks.

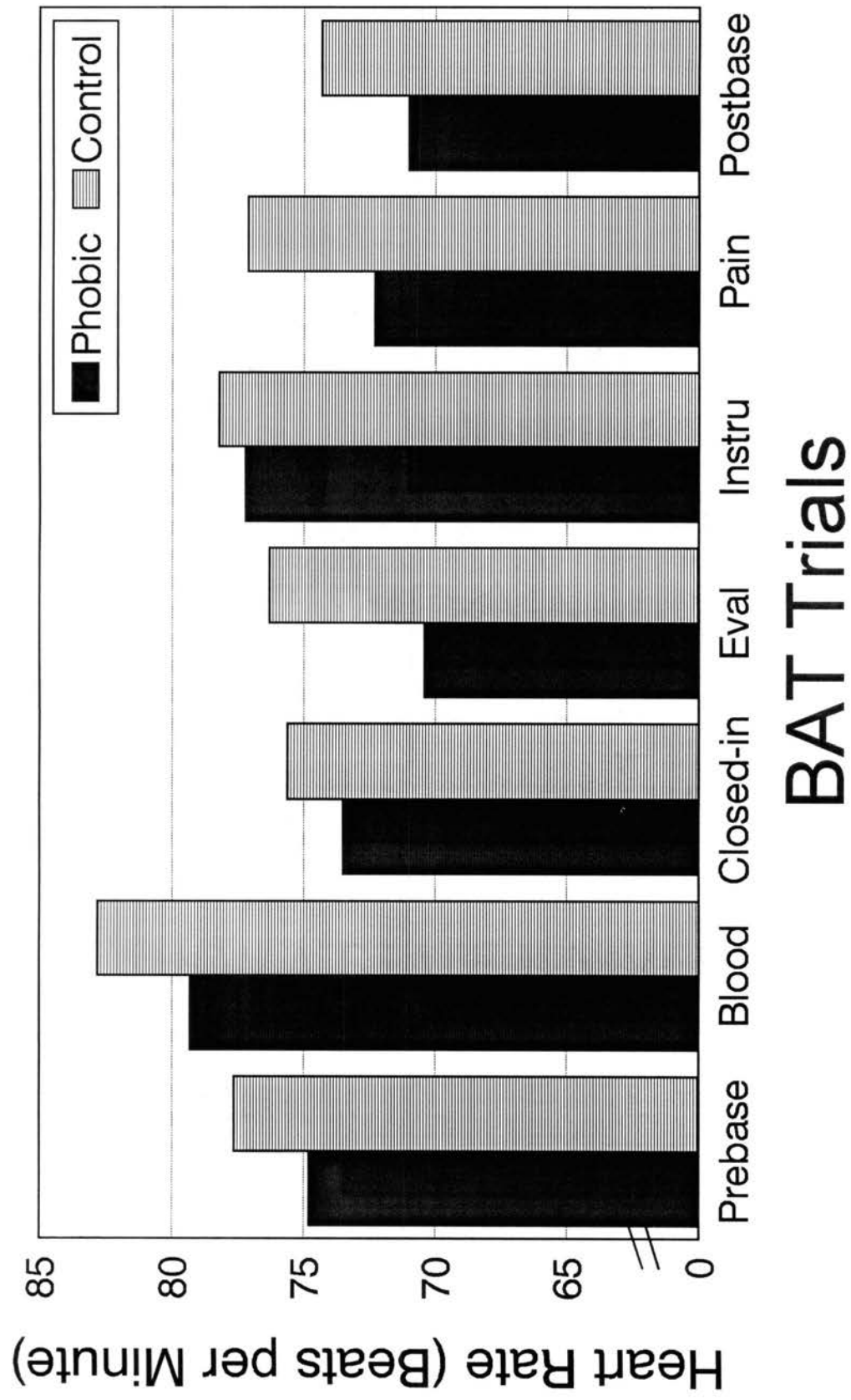
Figure 5. Mean heart rate for each group (N = 22) for the five minute prebaseline period, the first 20 seconds of each BAT task (blood, closed-in, evaluation, dental instruments, and pain), and the five minute postbaseline period.


EAS Anxiety Ratings
9
7
5
3
1
Phobic
Control
*
*
*
Prebase
Blood
Closed-in
Eval
Instru
Pain
Postbase
BAT Trials


EAS Fear Ratings
9
7
5
3
1
Phobic
Control
*
*
*
Prebase
Blood
Closed-in
Eval
Instru
Pain
Postbase
BAT Trials


Pain Intensity Ratings
10
8
6
4
2
0
15
30
45
60
75
90
300
Time in Pain Task
Phobic
Control


Participants Avoiding/Escaping
Phobic
Control
18
15
12
9
6
3
0
3
0
5
0
5
0
3
0
17
12
Blood
Closed-in
Eval
Instru
Pain
BAT Tasks


Heart Rate (Beats per Minute)
85
80
75
70
65
0
Phobic
Control
Prebase
Blood
Closed-in
Eval
Instru
Pain
Postbase
BAT Trials

2

VITA

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OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 10-24-94 **IRB#:** AS-95-023

Proposal Title: ASSESSMENT AND TREATMENT OF DENTAL PHOBIA

Principal Investigator(s): Patricia J. Long, Barry J. Ries, Cynthia L. Turk, Dennis E. McChargue, Daniel W. McNeil

Reviewed and Processed as: Expedited

Approval Status Recommended by Reviewer(s): Approved

APPROVAL STATUS SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING.
APPROVAL STATUS PERIOD VALID FOR ONE CALENDAR YEAR AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Reasons for Deferral or Disapproval are as follows:

Signature: _____ Date: November 16, 1994

Chair of Institutional Review Board