STROOP INTERFERENCE: A COMPARISON OF DENTAL PHOBIA STROOP TESTS

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Running Head: INTERFERENCE AND STROOP TESTS

Abstract

The current investigation assessed group differences in modified Stroop color naming tests between patients with a DSM-IV diagnosis of specific dental phobia ($\underline{n}$ = 18) and their matched controls ($\underline{n}$ = 18). Control participants did not have DSM-IV axis I or II diagnoses, and were matched to patients on the variables of age, ethnicity, socioeconomic status, and sex. All participants were presented with a standardized dental Stroop test, and an idiographic dental Stroop test, in which they were allowed to select their personally-relevant dental fear stimuli. The two dental Stroop tests were each presented in two different formats. In the full screen presentation format, 100 words were displayed simultaneously on a computer monitor in five columns. When the 100 stimuli were presented in the single word format, each word was presented singly on the computer monitor. As expected on the full screen presentation format, patients with specific dental phobia demonstrated greater cognitive interference across the standardized and the idiographic dental Stroop tests than their matched counterparts. Both groups also demonstrated greater cognitive interference on the idiographic dental Stroop test than on the standardized dental Stroop test. Results of the single word presentation format replicated the significant differences between the specific dental phobia group and their matched controls. No differences, however, were noted between the idiographic dental Stroop test and the standardized dental Stroop test in the single word presentation format. Findings are discussed in relation to the current Stroop test literature, as well as possible theoretical explanations for differences between the full screen and single word presentation format.

Stroop Interference:

A Comparison of Dental Phobia Stroop Tests

Assessment of Fear and Anxiety

Three-channel response system. One of the hallmarks of Clinical Psychology has been the empirical development and validation of multimodal assessment strategies. Lang (1968) introduced the three response systems (i.e., overt behavior, physiology, and verbal report), which have been embraced by clinicians and researchers as the customary way to conceptualize and measure anxiety and other emotional problems.

Overt behavior refers to the motoric and observable behaviors associated with aspects of the problem, for instance, running away from a dog, number of hair pulls, and foot stomps. Overt behaviors can also be characterized by avoidance and escape behaviors. During avoidance behavior, the individual does not interact with the object or situation that is associated with the severe instantiation of fear and/or anxiety. Escape is a related behavior, but instead of avoiding the fear situation, the individual initially confronts the situation, but then prematurely leaves. As an example, an individual may schedule and arrive on time for a dental appointment, but after remaining in the waiting room for a short while, may leave before being called for the examination.

Marks (1987) suggested that fear behaviors are exhibited in one of four strategies: withdrawal, immobility, aggressive defense, or deflection of attack. Withdrawal is the active avoidance or escape from the fearful stimuli or situation. The fear strategy of immobility is the freezing of the individual or organism in the presence of fear or danger. Whenever attack is imminent, the organism may choose to display an aggressive defense

to intimidate the attacker. Finally, deflection of attack away from oneself or others is another fear strategy to inhibit assault.

Physiological activity refers to those features of the problem which involve changes in various bodily organs and systems, such as heart rate, respiration, or muscle tension. Physiological recording instrumentation is generally used to assess these activities.

The verbal report component typically refers to the measurement of thoughts and feelings which precede, accompany or follow the fearful situation. The verbal report system of fear and anxiety can become quite complicated in that individuals can describe private, internal states, but they can also make reports on their physiology and overt behaviors (e.g., "I felt like my heart was racing").

Four-channel response system. The three systems structure has been criticized, both methodologically and conceptually. Eifert and Wilson (1991) suggest that the three systems approach has two main problems: (a) a confounding of content and method of assessment; and (b) the vague and imprecise use of the "verbal-subjective mode." As an alternative assessment system, they have expanded the three systems approach and propose four content areas of emotion: affective, cognitive, motoric, and physiological. They further suggest that these content areas can be measured by three different methods: self-report (both verbal and nonverbal), observation, and instruments or technical equipment. Eifert and Wilson's (1991) system has limitations as well, such as difficulty classifying certain methods of assessments according to one particular category and discriminating between cognitive and affective components of content.

When utilizing a multimodal method of assessment, researchers and clinicians must anticipate independence among differing systems. Using the three systems approach, researchers have often found low correlations among behavior, physiology, and self report (Hodgson & Rachman, 1974; Rachman & Hodgson, 1974). In fact, correlations are strengthened when there are higher manifestations of fear and/or anxiety (Hodgson & Rachman, 1974). Although the lack of concordance may be due to methodological differences (Eifert & Wilson, 1991), it can also be viewed as individual differences in response manifestations.

The question then arises as to which of the four systems is the "gold" standard. Unfortunately, there is no simple answer. No one system has risen as the primary standard for assessment. Rather, assessment should incorporate all four systems using methods from each of the categories of self-report, observation, and instrumentation.

Cognitive Tasks

Recently, there has been much attention in the literature dedicated to the assessment of cognition by instrumentation. Specifically, cognitive psychology techniques for studying attention, memory, and other cognitive processes have been applied to the study of emotion and its disorders (Dalgleish & Watts, 1990; Logan & Goetsch, 1993).

Free recall and memory. One such technique has been the examination of free recall and recognition memory by use of explicit memory tasks in which participants consciously try to retrieve information. Using explicit memory tasks, depressed patients demonstrated deficits in short- and long-term memory in both visuospatial and verbal areas (Brand & Jolles, 1987; Richards & Ruff, 1989). These findings have been

expanded to implicit memory tasks, in which a person's responses can be influenced by exposure to recent information without the person necessarily being aware of the prior presentation. Implicit tasks include spelling a homophone, completing a word fragment, or performing a related task in which no instructions to remember information are given. Elliott and Greene (1992) reported that subjects with depression showed impaired performance on both explicit and implicit tasks in comparison to matched, nondepressed controls.

Dichotic listening tasks. Another strategy that has been used to investigate cognitive processing is the dichotic listening task (Dalgleish & Watts, 1990; Logan & Goetsch, 1993). This task involves the simultaneous presentation of two auditory messages. Participants are instructed to listen to one message and repeat it aloud while disregarding the other. In general, participants can determine the content of the repeated message but have difficulty determining the content of the unattended message unless the words are particularly meaningful. For example, phobic participants detected more phobic targets specific to their disorder in the disregarded message than did nonphobic controls (Burgess, Jones, Robertson, Radcliffe, & Emerson, 1981).

Reaction time. Reaction time studies have also been used to study anxiety and other emotion-disordered patients (Logan & Goetsch, 1993). In these studies, visual probes in the same approximate location as threat words are detected faster by participants whose disorder is specific to the threat words. Patients who were diagnosed with panic disorder responded to probes following physical threat words more quickly than those following social threat words (Asmundson, Sandler, Wilson, & Walker, 1992).

Stroop Color-Word Task

The cognitive psychology method that has been receiving the most attention within the last 10 years has been the Stroop color naming test (Stroop, 1935). Comprehensive review articles have appeared three times in the literature (Dyer, 1973; Jensen & Rohwer, 1966; MacLeod, 1991). The roots of Stroop's research are grounded in the work of James McKeen Cattell (1886). In a project supervised by Wilhelm Wundt, Cattell reported that color patches took longer to color name aloud than the corresponding words took to read aloud. For example, saying "blue" to a blue color patch was slower than saying "blue" to the word blue. Most of the early research before Stroop tested the intuitive differential practice accounts for Cattell's finding. No universally accepted theory or explanation was agreed upon to explain Cattell's observation (MacLeod, 1991).

It was John Ridley Stroop (1935) who first reported the combination of colors and words into one task. Since that time, over 700 manuscripts have been published in the literature that use or modify his original methodology (MacLeod, 1991). In his landmark article, which included three experiments, Stroop was interested in investigating how to best explain cognitive interference. He had been studying color naming versus word reading for quite some time, and developed the idea of a compound stimulus in which the word was incongruent with the ink color. His two major questions were: (a) what effect each dimension of the compound stimulus would have on trying to name the other dimension; and (b) the effects of practice on the observed interference.

In experiment 1, Stroop examined the effect of incompatible ink colors on reading words aloud. Stroop used five ink colors and their matching words: blue, brown, green,

purple, and red. On a stimulus card, each ink color appeared twice in each column and row. Each color word appeared twice on every line, in each of the five ink colors. In a second experimental condition card, the stimuli appeared in reverse order. The control condition cards were identical to the experimental cards except the color names were always printed in black ink. After a practice card, all subjects were to read the words aloud as quickly as possible and were instructed to correct errors. Although it took 2.3 s longer to read 100 color names printed in colors different from that named by the word, than to read the names printed in black ink, this difference was not significant.

In experiment 2, the task was altered so that the subjects had to name aloud the ink colors in which the words were printed. The experimental cards were identical to experiment 1; solid color squares printed in the appropriate colors were substituted for the color names printed in black ink on the control cards. Using this methodology, subjects took 47 s longer to name ink colors of incongruent words than the matched solid color squares. This phenomenon is the Stroop interference effect (Stroop, 1935). These results indicated highly significant interference from incongruent words in color naming.

In a third experiment, Stroop investigated the effects of practice upon interference. Subjects named the ink colors of incompatible words for 8 days. Over this period of time, color naming times decreased 16.8 s for 50 words. Therefore, Stroop reported that practice decreased the interference caused by conflictual stimuli, but did not eliminate it totally. Experiment 3 also investigated the effects of practiced color naming on interference with word reading. After 8 days of color naming practice, subjects were asked to ignore the color in which the words were printed and read the names of the

color words. Interference in word reading was introduced; this phenomena has been called the "reverse Stroop effect."

In summary, Stroop successfully introduced a new methodology by which cognitive interference could be studied empirically. The Stroop color naming test provided a unique way to compare the associations of two related constructs or tasks. Emotion and anxiety researchers have been stimulated by Stroop's early work and have adapted his paradigm to investigate varying theoretical orientations of emotion and anxiety.

Stroop Test Variations

Stroop Color-Word Test. Researchers have utilized different variations or modifications of the Stroop procedure. The method used by Stroop (1935) in his second experiment is the most common and has been called the standard Stroop Color-Word Test. Generally, participants are asked to color name incongruent words (i.e., color words in antagonistic ink colors) and control stimuli. The total time to color name the control stimuli is then subtracted from the total time to color name the incongruent stimuli. This difference is the Stroop interference effect (Stroop, 1935).

Individual stimulus presentation. Tecce and Dimartino (1965) were the first to introduce the individual stimulus version of the Stroop test to the literature. In their study, a word stimulus was presented one item at a time so a more precise measurement of color naming could be achieved. Once the word stimulus was presented on a computer screen, timing began and continued until the subject color named the stimulus. Using this technique, color naming of individual stimuli could be recorded in milliseconds and offered a more precise measure. The dependent measure most often used with this

methodology was the average time needed to color name the stimuli (sum of times to color name the stimuli/number of stimuli). Interference scores (time to color name a stimuli minus the response time for its corresponding control word) can also be calculated when matched control words are presented as well.

Sorting version. Tecce and Happ (1964) were credited with the introduction of the sorting version of the Stroop task. Rather than naming the stimuli out loud, participants were asked to sort stimuli into categories usually identified with color patches. Participants were able to sort color-only cards much faster than incongruent color-word cards. The sorting task appears periodically in the literature, but is seldom used because it may not be analogous to the standard Stroop tasks.

Picture-word interference task. Another variation of the Stroop test is the Picture-word interference task. First introduced by Hentscel (1973), words were embedded inside line drawings and participants were required to name the pictures. When the word preceded the presentation of the picture, the word interfered with the participants' ability to name the picture. Rosinski, Golinkoff, and Kukish (1975) demonstrated that incongruent words printed inside a picture interfered with picture naming, but that incongruent pictures had little effect on word reading. A question still remains as to how similar the picture-word and color-word tasks are to each other.

Auditory analog. The final variation of the Stroop test that shall be discussed is the auditory analog. Hamers and Lambert (1972) investigated interference by asking participants to listen to stimuli, but then respond orally. She presented participants with a compatible condition (saying "low" to the word low presented at a low pitch and saying

"high" to the word high presented at a high pitch) and an incompatible condition (the word low presented at a high pitch and the word high presented at a low pitch). Hamers reported strong interference with the incompatible case taking longer to respond to than the compatible case. Further support for the auditory analog are described in reviews by Dyer (1973) and MacLeod (1991). Although the auditory investigators argue for a close analogy between their task and the Stroop test, and as was the case with the picture-word interference, this connection has not been firmly established.

Stroop Test Presentation Formats

Card format. Returning to the most common variation of the Stroop test, there are varying ways that the stimuli can be presented. Typically, stimulus words printed in different ink colors are presented in rows and columns on a single card. The stimulus card has a corresponding control card containing neutral words matched for number of letters and syllables, and average word frequency. The card format has been adapted so that it can easily be used by clinicians as a diagnostic aid (McNally, English, & Lipke, 1993).

Computer presentation. With the introduction of computers and color monitors, programs have been written that present the Stroop stimuli in the same fashion as the card format (MacLeod, 1991). The methodology for the computer presentation is identical to the card format, with the exception of the stimuli being presented on the computer screen. One of the advantages of this format is the exactness of timing that can be achieved by use of an internal computer clock. McNeil et al. (1995) offer a precise description of this methodology.

Single-word presentation. As was described earlier, Tecce and Dimartino (1965) created the individual stimulus version of the Stroop test. Commonly referred to as the single word presentation test, this format allows a more precise measurement of color naming latencies to an individual stimulus. The single word presentation format has been used to investigate spider phobia (Lavy, Van Hout, & Arntz, 1993), post-traumatic stress disorder (Foa, Feske, Murdock, Kozak & McCarthy, 1991; McNally et al., 1993), and panic disorder (McNally, Riemann, Louro, Lukach & Kim, 1992), among other disorders.

Idiographic Format. A very recent development in the Stroop test arena has been the introduction of the idiographic paradigm. One format allows the participant to select personally relevant words that will then be used in an individualized Stroop test. Theoretically, the idiographic format should enhance the sensitivity of the Stroop paradigm since all participants will be presented with stimuli of personal emotional significance. Using the standard formats, studies have employed words judged as being threatening for the typical patient meeting criteria for a particular disorder. The possibility exists that certain stimuli may not be threatening for some individuals. For example, some patients with dental phobia may fear needles or injections, whereas others are concerned about loss of control. Research using the idiographic Stroop format has been limited to the investigation of panic disorder (McNally et al., 1994) and dental phobia (Ries, Turk, & McNeil, 1993).

Subliminal Stroop tests. The final presentation method that has received attention among Stroop test researchers is the subliminal Stroop test. Utilizing this methodology, Stroop stimuli are presented subliminally, outside of conscious awareness. The stimulus

word and a color background patch are presented simultaneously for a very short time (e.g., 1 ms). Participants are instructed to ignore the word and to color name the background patch as quickly as possible. Awareness checks are utilized to validate that the participants were unaware of stimulus words in the subliminal condition. Mogg, Bradley, Williams, and Mathews (1993) have used this presentation format and reported that anxious subjects showed slower color naming for both subliminal and supraliminal negative words.

Stroop Test Scoring Procedures

Basic color naming score. Over the course of its use, many different ways of scoring the Stroop test have been investigated. In his original work, Stroop (1935) utilized a basic color naming score by summing the participant's total time to color name all stimuli on the card. Since that time, other researchers have created derived scores to further investigate Stroop test effects (Jensen & Rohwer, 1966).

Interference scores. A very popular scoring adaptation for anxiety and emotional Stroop test research has been the use of interference scores. As discussed previously, the stimulus card has a corresponding control card containing neutral words that are matched for number of letters and syllables, and average word frequency. A basic score is then calculated for each of the companion cards. Interference/facilitation indices are calculated by subtracting the time required to color name a group of corresponding control words from the response time for the stimulus words. For example, if a participant takes 67 s to color name the stimulus card and 60 s to color name the control

card, the interference index would be 7 s. MacLeod (1991) suggests that the interference score is a very powerful way to investigate Stroop phenomenon.

Facilitation scores. A Stroop facilitation effect, speeding of processing word stimuli compared to control words, has also been observed (MacLeod, 1991). Intuitively, if an incongruent word can slow color naming performance, then a congruent word may speed up processing. Sichel and Chandler (1969) empirically investigated this hypothesis and reported that color naming was indeed faster for congruent items than for incongruent items. MacLeod (1991) summarizes the facilitation effect literature by suggesting that congruency between the stimuli often produces facilitation. Facilitation effects, however, are typically much less than the corresponding interference effect in the incongruent condition.

Summing of correct responses. An alternative for Stroop test scoring that has received limited attention is the method of summing the number of correct responses given in a predetermined time period. Instead of recording the time needed to color name a set number of stimuli, the dependent measure is the number of correct responses in a predetermined time period (e.g., 45 s). Franzen, Tishelman, Sharp, and Friedman (1987) utilized this methodology in the investigation of test-retest reliability of the Stroop color word test.

Serial scoring. Another way that Stroop test data can be scored is by use of a method known as serial scoring (Jensen & Rohwer, 1966). This method is based on the time the participant takes to color name every two rows on a ten row stimulus card. Thus, the participant has five time scores; the point of interest is the pattern of these scores.

These five scores can then be analyzed into the variability due to linear regression (i.e., improvement in speed from the first set of responses to the fifth set of responses) and the residual variability. Obviously, the serial scoring method is quite different than the traditional methods of scoring. This method appears to tap the effects of practice, fatigue, and possibly fluctuations in attention (Jensen & Rohwer, 1966).

Scoring concerns. A related scoring concern has been the effects of errors committed during Stroop testing. Very complex scoring methods have been derived to assess some of the scoreable features of errors (Jensen & Rohwer, 1966). Stroop test review articles (Jensen & Rohwer, 1966; MacLeod, 1991), suggest that errors occur very infrequently in anxiety and emotional Stroop tests and may not need to be scored at all, especially since participants often self-correct their errors. Although most research confirms that there are no differences among groups on covert errors during Stroop testing, Richards and Millwood (1989) reported that participants with high trait anxiety produced significantly more errors during Stroop testing than participants with low trait anxiety. When Stroop tests are used for neuropsychological assessment, it is very important to note the number of color naming errors, as they can be associated with impairment in central nervous system functioning (Berg, Franzen, & Wedding, 1987).

Practice Effects Associated With Stroop Tests

Researchers who use the Stroop methodology as a way to assess cognitive interference have expressed concern about practice effects during testing (Jensen & Rohwer, 1966; MacLeod, 1991). Stroop (1935) was the first to explore the effects of practice across the three differing cards (i.e, word reading, color naming of patches, color

naming of words in antagonistic colors). Performance on the color naming of words in antagonistic ink colors improved the most with practice over eight trials, followed by the task of color naming squares. Word reading showed the least effect of practice. These results were replicated by Jensen (1965) in a later study. When practice effects occur, they primarily do so within the first few trials. Smith and Nyman (1959) reported that Stroop test performance becomes more or less asymptotic after five trials. There is limited evidence, however, that extended practice with the Stroop task may lead to reduced interference as the participants develop a coping strategy for the task (Ogura, 1980). Contradictorily, there is literature to suggest that practice does not lead to interference reduction (Shor, Hatch, Hudson, Landrigan, & Shaffer, 1972; White, 1978). Although the research findings are unclear, reviews (Dyer, 1973; Jensen & Rohwer, 1966; MacLeod, 1991) suggest that the Stroop effect is reduced by practice, but not eliminated. As is evident, the importance of practice effects warrants further investigation.

Psychometric Properties of the Stroop Test

Comparative norms. When reporting Stroop test results, most investigators report the means and standard deviations from their own studies. Comparative norms have been reported by Jensen (1965), which presented the means and standard deviations of 436 university undergraduates. Undergraduate students were asked to color name 100 words printed on cards in one of five colors (blue, green, orange, red and yellow). The basic time scores are: word reading = 38.09 s , color naming of squares = 58.24 s , and color naming of words in antagonistic colors = 100.36 s. They further report a product-moment

correlation between color naming of squares and color naming of words in antagonistic colors as r = .66.

Reliability and validity. MacLeod (1991) reported that the Stroop color word test appears to have reasonable reliability and validity. Specifically, test-retest reliabilities of the basic scores, based on the above 436 participants, are presented by Jensen (1965). Jensen reported that the length of the test-retest interval made no significant difference within the range of a few minutes to one week. The obtained test-retest reliability scores were .88 for word reading, .79 for color naming of squares, and .71 for color naming of words in antagonistic colors. In a more recent study, Franzen et al. (1987) reported reliability coefficients for one and two week intervals. Since there were no differences between the two time intervals, the data were pooled and overall reliability coefficients were calculated. The reliability coefficients were .83 for the word score, .74 for the color score, and .67 for the color-word score. In a study that modified the Stroop test methodology to assess color naming latencies for posttraumatic stress disorder (PTSD) words, test-retest reliability for a one week interval was r = .80 for the PTSD interference indices (McNally et al., 1993).

Individual Differences with Stroop Tests

Sex differences. Many articles have examined the relationship between Stroop interference and individual differences. Even before the original Stroop article, Ligon (1932) examined individual differences with children. He noted that females named colors faster than males, although there was no difference in word-reading speed. Stroop (1935) confirmed these differences but expanded the findings to report that men and

women did not display differential interference scores to the Stroop tasks. These results have been often replicated (e.g., Golden, 1974; Izawa & Silver, 1988). Stroop (1935) suggested that females are faster at color naming because of differential practice in color naming as well as interest in and being more responsive to color. In 1965, a more empirical explanation was offered by Jensen (1965) who suggested that females simply respond faster to all stimuli. Although research has failed to find much difference in Stroop interference between men and women at any age, there are still unanswered questions about time differences in color naming.

Developmental differences. Almost everyone who can read shows a robust Stroop effect from an early age (MacLeod, 1991). A comprehensive investigation of the Stroop test relative to varying ages is reported by Comalli, Wapner, and Werner (1962). The results of this study summarize fairly accurately and concisely the overall picture of Stroop test interference and development (MacLeod, 1991). Stroop color naming interference begins early during the school years, reaching its highest level at Grades 2 to 3 as reading skill develops. Once reading skills have developed, interference declines and is consistent, until approximately age 60, at which point interference begins to increase again.

Language differences. The Stroop interference effect has been observed in Turkish (Kiyak, 1982), Japanese (Hatta, 1981), and many other languages other than English (Izawa & Silver, 1988) . Dyer (1971) showed that Spanish-English bilinguals exhibited maximal interference when the naming and distracting languages coincided, but that there was also substantial interference when the languages did not coincide. The different

language conditions showed about 63% of the interference seen in the same language condition. Furthermore, the dominant language produces more interference than the nondominant language (Magiste, 1984).

Theoretical Explanations of the Stroop Phenomenon

Investigators have attempted to explain the Stroop phenomenon for many years. They have revived old theories and have introduced new explanations (Dyer, 1973). Theoretical investigations have proposed that disruption might occur at various levels: (a) attention to the stimuli, (b) processing of the information, or (c) production of the response. Although much attention has been devoted to the quest for a theoretical explanation for the Stroop phenomenon, no universally accepted explanation exists (MacLeod, 1991).

Stroop's original explanation. Stroop (1935) began the search for a theoretical explanation of the phenomenon and offered his own interpretation for his data. He concluded:

> The associations that have been formed between the word stimuli and the reading response are evidently more effective than those that have been formed between the color stimuli and the naming response. Since these associations are products of training, and since the difference in their strength corresponds roughly to the difference in training in reading words and naming colors, it seems reasonable to conclude that the difference in speed in reading names of colors and in naming colors may be satisfactorily accounted for by the difference in training in the two activities. (Stroop, 1935, pp. 659-660).

Speed-of-processing theory. Stroop's general view is very closely related to the prevalent theoretical account that has been referred to as the relative speed-of-processing theory. In its very basic form, the relative speed-of-processing theory begins with the fact that words are read faster than colors can be named (Cattell, 1886). This speed difference is seen as important when two potential responses are competing to be produced or verbalized. The time cost of this competition is seen as the "interference." The two responses are seen as "racing" to achieve final output.

The relative speed-of-processing hypothesis contains three important assumptions (MacLeod, 1991). First, parallel processing of the two dimensions of the stimulus at differing speeds is assumed. Second, the response channel is limited and only one of the two responses can be admitted at a time; priority is given to the fastest response. Third, there is the potential for priming of responses from varying sources. Although this seems to be a very powerful account of the Stroop effect, it fails to support the critical findings necessary to explain the Stroop effect proposed by MacLeod (1991).

Automaticity. The second explanation is the automaticity account which was introduced by Cattell (1886). The basic idea is that processing of one dimension requires much more attention than the processing of the other dimension. Thus, color naming requires attentional resources relative to reading irrelevant words. Furthermore, reading the word is seen as mandatory, whereas naming the color is not. This imbalance is rooted in the practice of reading words and not naming colors. Based on this theory, words are read automatically; color naming requires much more attention. The more automated processing can interfere with the less automatic processing, thereby causing interference.

MacLeod (1991) suggested that this theory comes closer to explaining the empirical results required of a successful account of the Stroop effect than did the relative speed-of-processing model. The automaticity account, however, still fails to provide a comprehensive account of the Stroop effect.

The above explanations have attempted to explain the phenomenon in terms of response competition. Such explanations appear to be the preferred choices of researchers throughout the history of Stroop investigations. Some theories suggest, however, that interference occurs at an earlier stage of encoding instead of a later response stage.

Perceptual-encoding account. The best known encoding version, the perceptual-encoding account, was introduced by Hock and Egeth (1970). The basic idea of this theory is that perceptual encoding of ink-color information is slowed by incompatible information received from a color word as opposed to a neutral control. Based on their investigations, Hock and Egeth suggested that color-related words are recognized earlier, and thereby are more likely to interfere with encoding of ink color. Dyer (1973) strongly questioned and criticized their assumption about the rates of processing word versus color information. Since that time, the perceptual encoding theory has not received much attention. MacLeod (1991) agreed with Dyer's criticism and suggested that it does not fully explain all the empirical results necessary to account for the Stroop effect.

Almost all early theories of the Stroop task were sequential. Information was encoded from each dimension and then analyzed, followed by a response. Processing at

one stage had to be complete before the next stage could begin. Recently, investigators have discarded the idea of a limited-capacity response stage and have begun exploring parallel models.

Decision processing model. Logan (1980) introduced his model of the Stroop effect as a decision process gathering model. He suggested that evidence accumulates over time until a response threshold is reached; evidence from different dimensions is processed according to their weight. There are two types of weights: a stable automatic weight and a flexible, strategic attentional weight. Total evidence at threshold is the sum of all evidence from all dimensions. If the evidence from other dimensions is consistent, this reduces the threshold and the processing time required for the desired dimension. If other dimensions, however, provide conflictual evidence, interference will occur and response speed will be slowed. MacLeod (1991) suggests that this is a good model and with some fine tuning, Logan's model may encompass all of the existing Stroop test data.

Parallel distributed processing model. A recent cognitive development that has been adapted as an explanation of the Stroop phenomenon is the parallel distributed processing model (Cohen, Dunbar, & McClelland, 1990). The heart of the Cohen et al. (1990) model is the idea that processing occurs in a system through activation along pathways of different strengths. Therefore, speed-of-processing predictions must not always hold true. Rather, it is the strength of the association, not the speed, that is important.

Processing takes place in a system comprised of interconnecting models and occurs by the spread of activation along connections that exist within and between models.

When the model is instructed to perform a task, it chooses a pathway that contains the units necessary to complete the task. During certain tasks, more than one pathway may become activated and pathways may intersect. If these two pathways are active simultaneously and produce conflictual information, interference occurs. Such interference can occur anywhere in processing and at multiple times.

MacLeod (1991), along with Williams, Andrew, and Matthews (1996), excitingly endorse the parallel distributed processing model as a possible theoretical explanation for the Stroop effect. They do suggest, however, that the model continue to be empirically investigated before it is embraced as the preeminent theoretical explanation for the Stroop phenomenon.

Contemporary Stroop Test Theories in Anxiety Research

Threat-relatedness hypothesis. Since much of the research with Stroop methodology focuses on patients with anxiety disorders, various contemporary theoretical perspectives have been offered to explain the Stroop phenomenon in anxious individuals. The first theory proposed in the literature was the threat-relatedness hypothesis (Mathews & MacLeod, 1985). Mathew and MacLeod suggested that anxious patients often show the most color naming disruption on those threat words that are specific to their own particular domain of anxiety. For example, generalized anxiety patients who report worrying most about health issues showed greater interference on specific threat words related to health. In contrast, those generalized anxiety patients who reported concerns about social issues showed more interference on threat words related to social concerns (Mogg, Mathews & Weinman, 1989). Therefore, color naming appears to be disrupted

by threat words specific to the patients anxiety domain. Until recently, the threat-relatedness hypothesis was the accepted theory for Stroop interference among attentional bias researchers.

Emotionality model. Martin, Williams, and Clark (1991) criticized the threat-relatedness theory and suggested that threat was confounded with emotionality. They demonstrated that participants not only showed bias towards threatening stimuli, but also to positive stimuli which were as emotionally charged as the threat words. According to Martin et al. (1991), the threat-relatedness hypothesis should be replaced by the emotionality hypothesis, since anxious participants exhibit interference to general emotional material as well as to threatening stimuli.

Concerns-relatedness hypothesis. The emotionality hypothesis has not fared well in attempts to replicate and extend its theories (Mathews & Klug, 1993). Specifically, Mathews and Klug (1993) pointed out that many of the positive words utilized by Martin et al. (1991) were exact antonyms of anxiety words and could be just as threatening as anxiety words. In an attempt to clarify this issue, Mathews and Klug (1993) constructed five sets of words (anxiety-related and -unrelated positive words, anxiety-related and -unrelated negative words, and emotionally neutral words) to be color named by anxious patients with diverse diagnoses. Compared with normal controls, anxious patients did not show Stroop interference for emotional words that were unrelated to anxiety, but did attend to both positive and negative anxiety-related stimuli. For this reason, Mathews and Klug (1993) rejected the emotionality hypothesis and proposed the concern-relatedness hypothesis. They attributed the Stroop interference effects in anxious

patients to the extent that the words are judged to be semantically linked with the current emotional concerns of the individual.

As was the case with the theoretical explanations of the Stroop effect in general, there is no accepted theoretical orientation specific to the Stroop effect demonstrated by patients with anxiety disorders. In a study that directly investigated the three possible explanations for attentional bias among patients with obsessive compulsive disorder, reliable evidence was found only for the threat-relatedness hypothesis (Lavy, Van Oppen, & Van Hout, 1994). Their data were inconclusive concerning the emotionality hypothesis, and did not support the concerns-relatedness hypothesis.

Riemann and Amir (1994) investigated the theoretical perspectives of the Stroop effect with patients diagnosed with panic disorder and normal control subjects. In their studies, both patients and control subjects demonstrated an interference effect in support of the concerns-relatedness hypothesis. Furthermore, in an unexpected interaction, panic disorder patients' data supported the threat-related hypothesis. Riemann and Amir (1994) concluded that the Stroop interference effect may be a complex interaction of current concerns and threat words. In another attempt to explain the Stroop phenomenon, Ruiter and Brosschot (1994) suggest that two stages of processing are involved. In the early stage, attentional bias occurs, followed by cognitive avoidance or "repressing" in a later stage. It is evident that continued investigation is warranted to explore the theoretical basis of the Stroop effect in anxious individuals.

Neuropsychological Assessment with Stroop Tests

The Stroop test has been used to assess neuropsychological functioning. More specifically, Stroop tests have been used to measure verbal fluency (Berg et al., 1987) and shifts in perceptual sets to conform to changing demands (Lezak, 1983). The original neuropsychological Stroop test included three white cards, each of which contained ten rows of five items. Randomized color names (i.e., blue green, red) are in black print on the first card. Card two is identical to the first card with the exception that each color name is printed in some color other than its name. Card three displays arrays of colored dots in one of the three colors. Throughout the four different trials, patients are instructed to read or color name as fast as possible. On the first trial, patients are to read card one. During the second trial, the patients are to read the printed names on card two; for trial three, they are to name the color of the print on card three. During trial four, patients are to name the colors of the print on card two. Normative performance data have been presented for 50-item cards (Talland, 1965) and 100-item cards (Nehemkis & Lewinsohn, 1972).

Golden (1975) developed another version of the Stroop test that has been useful in the identification of neuropsychological dysfunction. This version was able to reliably differentiate among normal, psychiatric, and brain-damaged patients. Golden (1979) later reported that this task was able to assist in the localization of lesions and has been found to be useful in the identification of dyslexia.

Perret (1974) investigated the performance of patients classified as having frontal, temporal, and posterior brain damage on a color-word Stroop task. This investigation

demonstrated that left-frontal patients were less likely to suppress conflictual information than patients with other types of lesions.

Current Anxiety Research with Modified Stroop Tests

The field of psychology has capitalized on the Stroop phenomenon and has used the Stroop test as a way to explore differing cognitive processes. Touted by Dyer (1973) as one of the most important Stroop papers since Stroop's original work, Klein (1964) demonstrated that color naming interference could occur for words other than incongruent color names. In his study, color-related words (e.g., sky, grass) caused more interference in color naming than did nonsense syllables, rare words, and common words.

Based on Klein's (1964) results, psychological investigators have modified Stroop tests to investigate specific disorders. More specifically, researchers have used Stroop tests to examine cognitive processing associated with emotional disturbances, including anxiety and phobias (Logan & Goetsch, 1993; Williams et al., 1996)

Specific spider phobia. Watts, McKenna, Shrock, and Trezise (1986) are credited with the first Stroop test that was modified to use emotionally salient words in the investigation of an anxiety disorder. Participants with spider phobia and nonphobic controls were presented with the color naming Stroop test and two emotional Stroop tests and their corresponding matched control test. One of the emotional Stroop tests was the McKenna Stroop test and contained the words crash, fail, fear, death, and grief. The other Stroop test was the Spider Stroop test and contained the words creepy, hairy, crawl, legs, and spider.

Watts et al. (1986) reported that the participants with spider phobia took significantly longer to color name the spider threat words, but did not differ from the controls on the general threat words or the color naming Stroop tests. The same phobic participants, however, demonstrated less interference on the Spider Stroop test following desensitization. Watts and colleagues successfully introduced the Stroop test as a sensitive measure of an individual's response to emotionally salient words. The Stroop interference effect with spider phobia patients have been replicated with adults (Lavy et al., 1993) and children (Martin, Horder, & Jones, 1992).

Panic disorder. Investigators have also used the Stroop test to investigate Stroop interference effects in patients who have panic disorder. Ehlers, Margraf, Davies, and Roth (1988) presented physical threat words (e.g., disease, fatal), separation words (e.g., separation, lonely) and words related to embarrassment (e.g., stupid, humiliation) in a Stroop format to patients experiencing panic attacks and to control participants. Patients took significantly longer to color name all threat words when compared to matched control words. Interestingly, this finding was replicated with nonclinical panicers as well (Ehlers et al., 1988). Stroop effects are very robust among patients with panic disorder and have been supported with card presentations (Hope, Rapee, Heimberg, & Dombeck, 1990; Carter, Maddock, & Magliozzi, 1992), single word presentations (McNally, Riemann, & Kim, 1990; McNally et al., 1991), and idiographic methodology (McNally et al., 1994).

Posttraumatic stress disorder. The selective processing of threat cues in patients with PTSD has also been investigated using Stroop methodology. McNally et al. (1993)

investigated Vietnam combat veterans with PTSD using modified Stroop tests in which they color named neutral words (e.g., input), positive words (e.g., love), Obsessive Compulsive Disorder (OCD) words, (e.g., germs) and PTSD words (e.g. bodybags). PTSD patients took significantly longer to color name PTSD words than to color name OCD, neutral, and positive words.

Similar findings have been reported with PTSD patients who experienced traumatic experiences other than combat. Survivors of fear-inducing disasters who have high PTSD symptomology demonstrated Stroop interference to disaster related words (Thrasher, Dalgleish, & Yule, 1994). Rape victims with PTSD were also slower at color naming specific high-threat words (Cassiday et al., 1992; Foa et al., 1991).

Obsessive-compulsive disorder. Lavy et al. (1993) investigated the Stroop phenomenon in patients with OCD. In their experiment that was designed to assess the three theoretical explanations for attentional bias in anxious subjects, they reported that patients with OCD selectively attended to negative obsessive-compulsive related threat cues. No other differences emerged on the other Stroop tests.

In a study by McNally et al. (1992), OCD patients again demonstrated selective attention to specific threat cues related to OCD. Contrary to expectations, OCD patients also showed interference to stimuli presumably specific to panic disorder. Further research is needed to explain this finding.

Generalized anxiety disorder. Stroop test methodology has also investigated patients with generalized anxiety disorder (GAD). In a study that introduced the emotionality hypothesis, Martin et al. (1991) compared the data of psychiatric outpatients

diagnosed with GAD to anxiety matched normal participants. Results indicated that generalized anxiety disorder patients were slower at color naming threat words when compared to equally anxious normals.

Social phobia. In an early attempt to use Stroop methodology to investigate shyness and social phobia, Arnold and Cheek (1986) reported that shy female undergraduates performed slower on the original Stroop color naming test then their less shy counterparts. Using a Negative Social Evaluative Stroop Test, Hope et al. (1990) reported that a social phobia sample took longer to color name negative social-relevant feeling state words (e.g., foolish, stupid) than to color name control words; no differences were found for physical threat or control words. Mattia, Heimberg, and Hope (1993) found that patients with social phobia and matched normal controls both showed interference to physical and social threat words. Relative to control participants, the social phobia patients were slower in responding to all stimuli, but had the greatest interference to the negative social evaluative words. Following successful therapy, treatment responders demonstrated a significant reduction in latencies to social threat words while nonresponders did not.

In a study that further illustrated the specificity of Stroop tasks with social phobia patients, McNeil et al. (1995) compared patients with circumscribed speech phobia, generalized social phobia, and generalized social phobia with avoidant personality disorder using three different Stroop color naming tests. The two generalized social phobia groups demonstrated interference on a General Social Stimuli Stroop Test (e.g., party), which was not evident among patients with circumscribed speech phobia.

Cognitive interference was manifested across all groups in a Specific Speech Stimuli Stroop Test (e.g., speech) and Mattia et al.'s (1993) Negative Social Evaluative Stroop Test (e.g., embarrassed).

Specific dental phobia. The Stroop test has also been modified to be used with individuals who exhibit dental fear. Previous studies have developed a 5 word version (Kahle, Brunetti, Owens, Gray, & McNeil, 1990) and a 20 word version (Carter, Lunsford, Scott, Tressler, Carter, & McNeil, 1991) of a Dental Stroop test that utilized dental-relevant stimulus words (e.g, drill, dentist, injection). Previous studies with undergraduate populations have shown that individuals who are highly dental fearful tend to perform slower on both versions of the Dental Stroop Test than do individuals with low dental fear (Carter et al., 1991; Kahle et al., 1990).

In an applied setting, Holderby et al. (1992) reported that the Stroop effect was demonstrated using dental words in a dental office, across a heterogeneous group of dental patients, regardless of the reason for the dental appointment. Ries et al. (1993) utilized the idiographic Stroop test methodology and reported that individuals demonstrated the Stroop interference effect regardless of intensity of dental fear when they chose their specific fear-relevant dental words.

Although the Stroop interference effect has been seen in individuals with high dental fear and in applied settings, the phenomenon has yet to be investigated with anxiety patients with specific dental phobia. Application of the Stroop methodology to this particular population appears to be a natural extension of this research.

Anxiety, Fear, and Phobia

Anxiety, fear and phobia are emotional states that are characterized by verbal reports of distress (e.g., worry), physiological arousal (e.g., increased muscle tension), cognitive disruption (e.g., hypersensitivity to threat stimuli), and overt behavior (e.g., escape). Although these terms are often used interchangeably, current research suggests they are not identical. McNeil, Vrana, Melamed, Cutbert, and Lang (1993) have recently suggested that anxiety and fear may actually consist of separate typologies. Anxiety is generally characterized by feelings of distress or worry, and events that occur are perceived as being unpredictable and uncontrollable. Anxiety is usually associated with cognitive symptoms and little physiological activation. Conversely, fear involves a greater preparedness for physiological arousal and activates the individual for avoidance or escape. Fear is usually triggered by a specific object or situation.

Phobia is an extreme and persistent anxiety and/or fear that is excessive and unreasonable to any actual danger present (McNeil, Turk, & Ries, 1994). The phobia is cued by the anticipation or actual presence of a specific object or situation, involves avoidance or enduring exposure to the object with much discomfort, and interferes with the person's normal life activities. Using these definitions, patients with specific phobias related to dental stimuli or situations will be classified as dental phobia patients rather than being anxious and/or fearful.

Dental Phobia

Dental phobia is characterized by a marked and persistent fear that is excessive or unreasonable, which is cued by the presence or anticipation of a specific object or

situation (e.g., dentist, injection, dental appointment). More specifically, the Diagnostic and Statistical Manual, 4th edition (DSM-IV; American Psychiatric Association, 1994) classifies dental fear as a specific phobia, blood-injection-injury type. Under the Diagnostic and Statistical Manual, third edition, revised (DSM-III-R; American Psychiatric Association, 1987) dental phobia was classified as a simple phobia.

DSM-IV outlines that along with the persistent fear, exposure to the dental stimulus invariably causes an anxiety response, which may take the form of situational panic attacks. The person must also recognize that the fear is unreasonable or excessive. The dental situation is either avoided or endured with intense distress. This avoidance or distress significantly interferes with the person's normal functioning or there is marked distress about the dental phobia.

Roy-Byrne, Milgrom, Khoon-Mei, and Weinstein (1994) examined the diagnostic and psychopathological characteristics of 73 patients with dental phobia. Of these patients, 40% had Axis I diagnoses along with simple phobia, including anxiety, mood, substance abuse and eating disorders. Also, 45% of the participants had at least one additional simple phobia besides dental phobia. There were additional past Axis I diagnoses present in 51% of the patients. When investigating Axis II disorders, 61% of the patients had at least one Axis II personality disorder. The most prevalent personality disorder was avoidant personality disorder.

Prevalence

Fear and concomitant avoidance of dental treatment is highly prevalent in the United States. Milgrom, Fiset, Melnick, and Weinstein (1988) reported that 50% of all

telephone survey respondents in the Seattle area reported some fear of dental stimuli, with 29.8% acknowledging a small amount of fear, 13.1% being somewhat afraid, 4.3% being very afraid, and 3.0% being terrified of dental treatment. Furthermore, 10% of the individuals avoided the dentist, and 50% delayed treatment, broke appointments, or did not follow dental treatment and hygiene regimens. In a similar study, a telephone survey used using a random dialing procedure as a means of data collection (Gatchel, Ingersoll, Bowman, Robertson, & Walker, 1983). Results indicated that 12% had high dental fear, and another 18% reported moderate fear. It was further disclosed that 37% of the survey participants had not been to the dentist in over a year and 16% of the respondents had some dental fear and avoidance. In summary, prevalence rates for dental fear in the United States have been approximated at 5-15% of the adult population (Gatchel et al., 1983; Milgrom et al., 1988).

Dental fear has been investigated in countries other than the United States. Researchers have established that prevalence rates are similar in England (Mellor, 1992), Denmark (Schwartz, 1990), Singapore (Milgrom, Vignehsa, & Weinstein, 1992; Teo, Fong, Vignesha, & Elliot, 1990), and other countries.

Although dental fear is usually acquired during childhood (Bernstein, Kleinknecht, & Alexander, 1979), it can develop and be maintained at all ages. Dental fear has been investigated in children (Alwin, Murray, & Britton, 1991), adolescents (Milgrom et al., 1992), young adults (Teo et al., 1990) and older adults (Locker & Liddell, 1991).

As the data suggest, dental fear is a prevalent problem. As a result, patients avoid proper dental care and/or endure frightening treatment; dentists deal with cancellations, missed appointments, and uncooperative patients in and out of the dental operatory.

Consequences of Dental Avoidance

Individuals who avoid dental care and do not cooperate with treatment and maintenance procedures may develop tooth decay and gum disease (Kleinknect, Klepac, & Bernstein, 1976; Shoben & Borland, 1954), which may have general health implications. Furthermore, individuals with high dental fear reported more dissatisfaction with the appearance of their teeth, as well as more symptoms of dental pathology, such as toothaches, difficulty chewing, and bleeding gums (Milgrom et al., 1988). When individuals with high dental fear receive emergency treatment, they typically experience greater pain and more expensive treatment (Melamed, 1979).

Etiology of Dental Fear

The etiology of dental fear has been of interest for quite some time. Shoben and Borland (1954) developed four classes of hypotheses concerning the etiology of dental fears: (a) pain; (b) traumatic experience; (c) parental attitudes and family background; and (d) personality. After interviewing fearful and nonfearful individuals, the only consistent element in the etiology of dental fear appeared to be the attitudes of the patient's family. In a similar study, the number of traumatic experiences during a dental procedure differentiated fearful and nonfearful dental patients (Lautch, 1971). Individuals with high dental fear had more negative familial attitudes concerning dental treatment as well. Melamed (1979) reported that dental phobia includes fear of: (a) criticism for poor oral

hygiene; (b) loss of control; (c) pain; (d) the anesthetic injection; and (e) the sounds and feel of the drilling.

Origin and Maintenance of Dental Fear

Classical conditioning. Different theoretical explanations have been offered to explain the origin and maintenance of dental fear. Thrash, Russel-Duggan, and Mizes (1984), suggest that classical or reflexive conditioning may be responsible for dental fear. In the dental setting, many patients report anxiety and fear even though nothing aversive is happening. These anxiety responses have been acquired via classical conditioning. Aversive dental procedures such as injections and scrapings (unconditioned stimuli) become paired with feelings of pain or discomfort (unconditioned responses). Neutral stimuli such as the dental chair, white uniforms, and the sight of the dental equipment (conditioned stimuli), though harmless themselves, are over time consistently paired with the aversive or painful procedures. Later, these "harmless stimuli," when presented without painful procedures, elicit a fear response (conditioned response).

Operant conditioning. Thrash et al. (1984) suggest that dental fear may also be maintained by operant conditioning principles such as positive reinforcement, negative reinforcement, punishment, and response cost. For example, when a child becomes fearful before a dental appointment, a parent may cancel the office visit. The principal effect is that the fear is negatively reinforced because of the cessation of the aversive procedure, thus, making it more likely that the fear will be repeated.

Observational learning. Observational learning is another way that dental fear can be learned (Thrash et al., 1984). By observing a "model," an individual can acquire fear

without ever experiencing the feared situation directly. Dental investigations have indicated that the main arena for the observational learning of dental fears is among family and friends (Kleinknecht, Klepac, & Alexander, 1973).

Social learning model. Bernstein et al. (1979) support the social-learning model of dental fear acquisition. Painful early dental experiences in the operatories emerged as an antecedent to dental fear. Half of their high-fear participants cited negative dentist behavior or personal attributes as part of the basis of their fear. High-fear participants described dentists as impersonal, nasty, uncaring, incompetent, disinterested, cold, careless, rough, and mean. Thus, early negative experiences with dentists who displayed these traits appeared to be related to the development of dental fear.

Components of Dental Fear

Investigators have attempted to identify components of dental fear. Unfortunately, attempts to delineate the various components have yet to produce a consistent and reliable construct (Johnson, Mayberry, & McGlynn, 1990).

Kleinknecht, Thorndike, McGlynn, and Harakavay (1984) administered a dental fear questionnaire to 518 dental patients and 415 introductory psychology students. Anticipatory fear and avoidance, fear of pain, and physiological arousal were the three highly stable factors that emerged. McGlynn, McNeil, Gallagher and Vrana (1987) replicated the factor structure with a large sample of introductory psychology students.

Based on a large sample of patients with dental phobia, Milgrom, Weinstein, Kleinknecht and Getz (1985) developed their model of dental fear. The components of their model are: fear of specific procedures, fear due to distrust of dental personnel,

generalized anxiety, and fear of catastrophe during treatment. McNeil and Berryman (1989) used self-reported dental fear scores as criterion variables for a step-wise multiple regression procedure. Fear of pain was found to be the most significant predictor of dental fear, followed by fear of being closed-in. For females only, they reported fear of disfigurement or injury from dental treatment. Using individuals who were seeking treatment for dental fear, Moore, Brodsgaard, and Birn (1991) reported that 66% of these patients suffered from embarrassment in a dental situation. Similarly, negative evaluation by the dentist has been ranked as highly fear-evoking by dental patients (Gale, 1972).

Using an exploratory factor analysis, Johnson et al. (1990) asked 701 dental school outpatients to rate the degree of fear occasioned by 60 dental events. Four meaningful factors were identified: fear of pain and its antecedents, anticipatory fear, fear of negative evaluation, and fear due to perceived loss of control.

As stated earlier, the components of dental fear are unclear. Given the varying methods used to investigate the different components, it is not surprising that a clear picture has not emerged.

Assessment of Dental Fear

Multimodal assessment strategies (Eifert, & Wilson, 1991; Lang, 1968) have been applied to the assessment of dental fear. Typically, a three-systems approach is used to assess verbal reports, physiology, and behaviors associated with dental fear (Melamed & Siegel, 1980).

Verbal report. The assessment of dental fear has focused largely on the development of verbal report instruments. Kleinknect et al. (1973) have developed a

Dental Fear Survey (DFS) that provides an index of an individual's fear reaction to specific dental stimuli and situations. McGlynn et al. (1987) reported that anticipatory fear and avoidance, fear of pain, and physiological arousal were three highly stable factors on the DFS. A sixty-item dental questionnaire (60-DQ; Johnson et al., 1990) was developed to measure the degree of fear elicited by routine dental care. The 60-DQ has also been used to identify the four principal components of dental fear: fear of pain, anticipatory fear, fear of negative evaluation, and fear due to perceived loss of control (Johnson et al., 1990). The Dental Anxiety Scale (DAS; Corah, 1969) has been used to very quickly assess the dental fear of individuals. Although it only contains four items, it demonstrated good reliability and validity (Corah, 1969). Questionnaires have been administered in dental waiting rooms to evaluate the need for special preparation (Melamed & Siegel, 1980).

Physiological arousal. Physiological reactivity has also been used to assess dental fear. Heart rate is generally recorded since it appears to be a valid indicator of dental fear (Melamed & Siegel, 1980). Meldman (1972) reported that participants who reported fear of dentists and drilling demonstrated an increase in heart rate to the sound of a drill. Heart rate has also been found to be more accelerated in participants who rated the sounds of a drill unpleasant (Gang & Teft, 1975). Utilizing a dental imagery procedure, McNeil et al. (1993) suggested that cardiac reactivity was positively correlated with reported dental distress. Researchers have also investigated the feasibility of using polygraphic recordings of heart rate, hand and face temperature, and galvanic skin response in the assessment of dental phobia (Lewis & Law, 1958).

Overt behavior. The behavioral assessment test (BAT) is generally used to quantify the avoidance or escape behavior exhibited by an individual in the presence of a feared stimuli. Thus, the primary purpose of the BAT is to assess the overt behavior of the three-channel response system. The BAT methodology has been applied to the assessment of dental fear. Shaw and Thoresen (1974) described the progressive BAT that ended with the request to administer an injection followed by drilling to fill a cavity. In a similar study, Matthews and Rezin (1977) presented a 15 step oral examination that also terminated in an analgesic injection. Wroblewski, Jacob, and Rehm (1977) developed a BAT consisting of 30 progressively more difficult steps, ending with the individual scheduling a dental appointment. The BAT may also be used to record psychophysiological measures and verbal reports of dental fear (McNeil, McGlynn, Cassisi, & Vrana, 1989).

Cognitive Assessment. Although researchers have explored Stroop interference among college students who reported dental fear (Carter et al., 1991; Kahle et al., 1990; Ries et al., 1993), there has been little or no investigation of cognitive disruption in patients diagnosed with dental phobia. The basic methodology has been developed but needs to be modified and applied to this specific population. It is the goal of this study to develop and apply Stroop test methodology to the investigation of Stroop interference effects in patients with specific, dental phobia.

Goals of Current Study.

The goals of the present project were to extend the findings of Stroop phenomenon in individuals with high dental fear to clinical patients who received a DSM-IV diagnosis

of specific phobia, blood-injection-injury type, related to dental fear. Replication of nonclinical samples with patient populations is important for verifying the usefulness of methodological procedures and in extending results to a clinical population.

Secondly, different Stroop test methodologies were compared using dental phobia and control participants. Although the single word presentation format has been suggested as a more sensitive measure of Stroop interference in cognitive processing, limited research has directly compared findings across differing presentation formats. In an investigation comparing high- and low-trait anxious participants, Dalgleish (1995) reported that both the card and the single word presentation formats were sensitive measures of threat-related interference. Across both presentation formats, high-trait anxious individuals took longer to color name threat-related stimuli than did the low-trait anxious participants.

Finally, a new Stroop test methodology was used in this study. Limited research has investigated the contributions of the idiographic Stroop test. It is also possible that if idiographic stimuli produce interference in nonphobic individuals, this new empirical evidence would support the threat-relatedness hypothesis of Stroop interference effects. Furthermore, methodological concerns pertaining to idiographic Stroop tests were addressed.

The experimental questions of the current investigation concern hypothesized differences between dental phobia patients and matched controls and among different Stroop presentation formats. Specifically, it was predicted that patients with dental phobia would exhibit more interference on all Dental Stroop tests when compared to

control individuals. Secondly, it was expected that the single word presentation Stroop test would be a more sensitive measure of attentional bias than the full screen presentation format. Finally, participants with and without specific phobia were expected to exhibit greater interference for the idiographic dental stimuli than for the standard dental stimuli.

Method

Participants

Participants were 18 outpatients and 18 matched controls. Outpatients met the criteria for a DSM-IV diagnosis of specific phobia, blood-injection-injury type, related to dental fear. Although 20 outpatients were interviewed and met full criteria for dental phobia, two patients were excluded from the study. One patient was excluded for color-blindness, and the other became seriously ill and could not complete the study. Table 1 presents the frequencies of comorbid diagnoses for the 18 dental phobia patients. Control participants did not have DSM-IV axis I or II diagnoses, and were matched to patients on the variables of age, ethnicity, socioeconomic status, and sex. Among the control participants screened for inclusion in this study, two were excluded based on current Axis I diagnoses. They were referred to local mental health providers. There was no significant age difference between the dental phobia group ($M = 35.8$, $SD = 12.7$) and the matched controls ($M = 36.4$, $SD = 12.4$), $t(34) = -0.15$, $p > .10$. Each group contained four Caucasian males and 14 Caucasian females. Within each group, there were four participants in the upper social class, six participants in the upper-middle social class,

three participants in the middle class, and five students. None of the participants were in the lower-middle or lower socioeconomic classes.

Participants were diagnosed and chosen for inclusion on the basis of structured clinical interviews. All dental phobia patients were offered free psychological treatment for dental phobia if they met criteria for inclusion in the study. Control participants received $20.00 for their participation.

Materials

Anxiety Disorders Interview Schedule - IV (ADIS-IV; Di Nardo et al., 1994). The ADIS-IV was used to assist in the assessment of specific phobia and other comorbid diagnoses. Since the ADIS - IV is a newly revised instrument, psychometric data have yet to be reported. The Anxiety Disorders Interview Schedule-Revised (ADIS-R; Di Nardo et al., 1985), on which the ADIS - IV is based, has demonstrated good interrater reliability (Beidel, Turner, Jacob, & Cooley, 1989; Boone, 1993). Barlow (1988) confirms the reliability and further adds that the ADIS-R provides an assessment of the anxiety disorders that is more comprehensive than the Structured Clinical Interview for DSM-III-R Axis I disorders (SCID; Spitzer, Williams, Gibbon, & First, 1990).

Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II; Spitzer et al., 1994). The SCID-II interview was used to identify axis II personality disorders. A 113 item true/false questionnaire was used in conjunction with the SCID-II interview (Spitzer et al., 1994). Spitzer et al. (1990) reported adequate kappas for the SCID-II based on DSM-III-R (American Psychiatric Association, 1987) criteria.

Furthermore, they reported that the kappas were similar to the test-retest kappas for other diagnostic instruments.

Beck Depression Inventory (BDI; Beck & Steer, 1987). The BDI is a 21 item questionnaire that was developed to measure the presence and severity of the affective, cognitive, motivational, and psychomotor aspects of depression. Each item is rated on a 4-point Likert-type scale (0 - 3), with a score range of 0 - 63. Higher scores on the BDI are indicative of more depression.

State-Trait Anxiety Inventory Form - Y (STAI; Speilberger, Gorsuch, Lushene, Vogg, P.R., & Jacobs, G.A., 1983). The STAI consists of two scales designed to assess acute anxiety level (state) and chronic anxiety level (trait). Each of these consists of 20 face valid items which participants rate on a 4 point Likert-type scale (1 - 4). Scores range on each of the STAI scales from 20 - 80, in which higher scores are an indicator of more anxiety.

Dental Fear Survey (DFS; Kleinknect et al., 1973). The DFS is an instrument designed to assess fear of dental situations and stimuli. The survey consists of 20 items which individuals rate on a 5 point Likert-type scale (1 - 5). The DFS total score is derived by summing all responses and has a range of 20 - 100. The DFS also has three subscales which measure avoidance and anticipatory fear, physiological arousal, and fear of specific dental stimuli. Higher total and subscale scores are indicative of more dental fear.

Dental Anxiety Scale (DAS; Corah, 1969). The DAS is a 4-item scale that measures dental anxiety. All items are rated on a 5-point Likert-type scale (1 - 5), with scores ranging from 4 to 20. Higher scores reflect greater dental anxiety.

Sixty-Item Dental Questionnaire (60-DQ; Johnson et al., 1990). This questionnaire is a 60-item instrument that measures the degree of fear associated with events that occur during routine dental care. Items are rated on a 7-point Likert-type scale (1 - 7), and scores range from 60 to 420, with higher scores reflecting greater fear. Four factor scores may also be calculated: (a) the pain/antecedents of pain factor consists of 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 with a range of 7 to 49; and (d) the perceived loss of control factors consists of 5 items and has a range of 5 to 35.

Two-Factor Index of Social Position (Myers & Bean, 1967). The Two-Factor Index of Social Position is a modification of the Edwards' system of classifying individuals into socioeconomic groups. To calculate the score for an individual, the scale value for occupation is multiplied by the factor weight for occupation, and the scale value for education is multiplied by the factor weight for education. The range of scores is from a low of 11 to a high of 77. The score is then assigned to one of five social-class positions. Higher scores are associated with a lower socioeconomic classification. The Two-Factor Index of Social Position (Myers & Bean, 1967) does not include a category for students. Since the index is calculated based on the individuals occupation and years of education, it seemed most consistent to classify students as a separate classification.

Medical/social history interview. A short medical and social history interview was used to collect medical, social, and demographic data (see Appendix A). Information was obtained regarding demographic variables, previous and current medical history, psychoactive substance use, and color vision deficits.

Standard pseudoisochromatic plates: Part 1, for congenital color vision defects (Ichikawa, Hukami, Tanabe, & Kawakami, 1978). The standard psedoischromatic plates were used to screen for color vision deficiencies.

Laboratory and Apparatus

The study was conducted in a laboratory with a suite of three adjacent rooms. There was an instrumentation room in the center which was equipped with one-way mirrors for observing participants' behaviors in the side rooms. The instrumentation room contained an IBM PC/XT microcomputer and color monitor (27.0 cm X 19.5 cm) equipped with a Scientific Solutions Labmaster interface board and specialized software (Cook, Atkinson, & Lang, 1987). This equipment was used to present Stroop test stimuli and to time participants' responses. A Realistic microphone was connected to a Coulbourn Instruments (CI) Schmitt trigger apparatus (CI Bipolar Comparator, S21-06; CI Retriggerable One Shot, S52-12) and relayed voice activation to the computer. A Micronta LED Quartz stopwatch was used for timing of rest periods between Stroop test presentations.

The experiment began in one of the side rooms, a small conference room that was equipped with a large table, chairs, and a recliner. In this room, a brief description of the

study was given, as well as an opportunity for questions. Debriefing occurred in this same conference room.

Stroop Tests

A total of six Stroop tests was presented on the IBM PC/XT computer monitor. Table 2 presents these Stroop tests. In addition, an initial set of neutral stimuli (e.g., cloth) was presented for practice, to ensure that the participant understood the procedure and was aware of the proper color names. There were two dental Stroop tests: the Standardized Dental Stroop test (Kahle et al., 1990) and the Idiographic Dental Stroop test (Ries et al., 1993). Each of these tests had a corresponding control test that contained neutral words matched for number of letters, syllables, and relative frequency of usage in the English Language (Carroll, Davies, & Richman, 1971). The dental Stroop tests were presented in the full screen presentation and the single word presentation formats. A Standard Color-Word Stroop test, and its control test which contained a grouping of five X's (i.e., XXXXX), were presented in the full screen presentation format. Screen presentation order was counterbalanced to avoid confounding of results based on practice effects.

Full screen presentation format. The Idiographic Dental Stroop stimuli consisted of the five dental words selected by the participant. In the full screen presentation format, each word appeared 20 times, for a total of 100 stimulus words per screen. Selected stimuli appeared 4 times each on a black background in the following colors: blue, green, red, white, and yellow. Color and word stimulus order was random, with the one exception that no color or word immediately followed itself within a column.

The Standard Color-Word Stroop test and the Standardized Dental Stroop test utilized the above guidelines as well, but with different stimuli. Table 3 presents the dental stimuli and matched control words for the Standardized Dental Stroop test.

The experimenter controlled the presentation and computer timing of each screen. The IBM X/T computer measured and recorded the amount of time it took for the participant to color-name all 100 words. Interference/facilitation indices (time to color-name a group of anxiety stimuli minus the response time for its corresponding control task) for the full screen presentation Stroop tests were calculated for each participant.

Single word presentation format. When the Standardized Dental Stroop test and the Idiographic Dental Stroop test was presented in the single word presentation format, each stimulus and control word were presented individually on the screen. The word stimuli were presented in capital letters (6 mm) and randomly positioned in a 20 mm by 115 mm section of the computer monitor. Each stimulus remained on the screen for two seconds, regardless of when it was color named. After the word was removed from the screen, a randomized period between 1.0 s and 2.0 s elapsed before the new stimulus appeared. Word placement and timing was randomized to control for heuristics that participants could develop to aid in color naming.

Since this task was different from the full screen presentation format, 10 neutral words were first presented for practice. All five dental fear words and five control words appeared four times in each color for a total of 200 words. After 100 words had been color named, a one minute rest period was given.

The IBM X/T computer recorded the latency to color-naming the stimuli. The computer measured the time from the presentation of the visual stimul on the computer screen, to the onset of the participant's response. In order to calculate a total interference index for the single word presentation format, an individual word interference score was derived for each of the five words. This was accomplished by subtracting the average time to color name the control word from the average time to color name its matched dental word. The total interference index was the summation of the five individual word interference scores.

Procedure

Recruitment of participants. Participants were solicited for this investigation by three methods: (a) referrals from mental health professionals, (b) referrals from dental professionals, and (c) advertisements that briefly described the nature of the study.

Screening with the ADIS-IV and the SCID-II. Potential participants who responded to advertisements or were referred by health professionals were scheduled for an initial appointment at the Oklahoma State University Psychological Services Center (PSC). Informed consent statements for the PSC and the study were explained and signed. Participants were then given the ADIS-IV structured clinical interview, followed by the SCID-II. All interviews were performed by one of three Clinical Psychology doctoral students. The doctoral students were trained in the use of the ADIS-IV interview. First they diagnosedthe videotaped vignette provided by DiNardo et al. (1995); following the vignettes, the interviewers met criterion once they correctly assigned two consecutive diagnoses to students who role-played psychological disorders. The clinical interviews

during the study were videotaped and 25% of them were randomly selected and reviewed by a licensed clinical psychologist. There was complete agreement for the presence or absence of a dental phobia diagnosis between the videotaped interviews and the reviewer. Following the structured clinical interviews, participants completed measures of depression (BDI), anxiety (STAI), and dental fear (DFS; DAS; 60-DQ). Presentation order of verbal report instruments was random. Additionally, participants selected the five dental words they found most fear-arousing from a list of 100 words which contained 50 dental words and 50 matched neutral words (Ries et al., 1993). Table 4 presents these words. Participants then rated their fear of these selected dental words and matched control words on an 11-point Likert-type scale (0 - 10). Participants were then scheduled to return to the clinic for Stroop test assessment.

Stroop test assessment. Following a brief description of the study, participants were escorted to the instrumentation room of the laboratory. The Stroop testing procedure was held in a dimly lit room, in which participants were individually tested while seated at a computer monitor. The experimenter sat in a chair to the right of and facing the participant. A brief set of standardized instructions was read to each participant (see Appendix B). Directions were to name the colors of the words displayed on the computer monitor as quickly as possible without sacrificing accuracy.

The experimenter controlled the presentation and computer timing of each Stroop test screen. Between screen presentations, participants were given a 30 s rest period. At the mid point of the procedure, the participants were given a 10 minute rest period.

Color-vision screening. Following the Stroop testing procedure, participants were screened for color-vision deficits. This screening was completed at the end of testing, instead of the beginning, to avoid biasing the Stroop test procedure.

Additional procedures. All participants also completed additional procedures to assess their fear of dental situations. Participants' responses were assessed by Behavioral Assessment Tests (BATs), physiological measures (i.e., heart rate), as well as saliva collection for cortisol measures. The data obtained from these procedures are not part of this dissertation.

Results

Data Analysis

Repeated measures analyses of covariances (ANCOVAs) were conducted on total time and interference Stroop test scores. The STAI-Trait was utilized as a covariate since past Stroop test research has demonstrated that trait anxiety can be an important factor in Stroop test performance (MacLeod & Hagan, 1992). An analyses of variance (ANOVA) was conducted on the fear ratings for the idiographic dental and matched control words. For the significant ANOVA interaction, Tukey's Honestly Significant Difference (HSD) tests, at the .05 alpha level, were used for follow-up analyses. The depression and anxiety instruments, as well as the dental fear verbal report instruments, were analyzed with one-tailed independent *t*-tests. In order to control for an inflated alpha, $p < .005$ was considered significant when investigating *t*-tests results. A series of Pearson Product Moment Correlations was also computed among the dental fear verbal report instruments and Stroop test scores.

Verbal Report Instruments

Anxiety/fear and depression instruments. Table 5 presents data from the BDI and STAI, along with t-test results. There were no significant differences between the dental phobia patients and their matched controls on these instruments.

Dental fear instruments. The data and t-test results for the dental fear instruments, as well as their subscales, are presented in Table 6. On all verbal report dental instruments, the dental phobia patients reported significantly higher levels of dental fears than their matched counterparts (all t's > 4.0, all p's <.0001).

Idiographic Dental and Control Word Fear Ratings

Word selection. The dental words selected by the participants as the most fear arousing, and their respective frequencies, are listed in Table 7. These words were chosen from the list of 50 dental words presented in Table 4. Participants selected 41 of the 50 possible words.

Word fear ratings. A Group (dental phobia or matched control) by Word Type (dental or control) ANOVA revealed a significant main effect for group $F(1,34) = 28.57$, $p < .0001$, and word type $F(1,34) = 360.70$, $p < .0001$. Dental words were rated as more fear arousing than control words. Therefore, the dental words selected by the participants apparently were fear-inducing and the matched control words were seen as neutral and not fear inducing. The above main effects were mediated by a significant group by word type interaction $F(1,34) = 35.58$, $p < .0001$. Follow-up Tukey's HSD tests revealed that the dental phobia group rated the dental words as more fear arousing than the control

words, and both kinds of words rated by the matched control participants. Figure 1 presents these results.

Stroop Test Data

Standardized Color-Word Stroop test. In order to assess for differences between groups on color naming ability, a t-test was performed on the interference scores for the standardized Stroop test. Results indicated that there were no differences between the dental phobia group ($M = 42.5$, $SD = 13.3$) and the matched control group ($M = 42.4$, $SD = 11.3$) in interference on the standard color-word Stroop test, $t(34) = 0.02$, $p > .10$.

Average time to color name dental words. A Group (dental patients or matched controls) by Presentation format (single word or full screen) by Dental Stroop test (standardized or idiographic) ANCOVA was utilized to examine difference among groups on the average response time to color name dental fear words. Since the single word presentation data are measured in ms, the full screen presentation data were converted to the same scale. This conversion was accomplished by multiplying the response time to color name the full screen presentation dental fear words by 1000. The ms value was then divided by 100 in order to arrive at an average color naming time per word. The ANCOVA revealed a significant main effect for group, $F(1, 33) = 13.39$, $p < .001$. Specifically, dental phobia patients ($M = 885.1$) took longer to color name dental words than did their matched controls ($M = 727.5$). Additionally, the main effect for presentation format was also significant, $F(1,34) = 20.92$, $p < .0001$. Dental stimuli that were presented in the single word presentation format ($M = 860.5$) took longer to color name than the full screen presentation format ($M = 751.3$). The main effect for dental

Stroop tests approached significance, $F(1,34) = 4.11$, $p = .051$. Participants took longer to color name idiographic dental words ($M = 813.5$) than the standardized dental words ($M = 798.3$). None of the interactions were significant (all F's $<.78$, all p's $> .55$).

Full screen presentation format. In order to further investigate differences between groups and Stroop tests, a 2 X 2 (group by Stroop test) ANCOVA was performed on the interference scores for the full screen presentation format. Results revealed a significant main effect for group $F(1,33) = 8.82$, $p < .01$ and a significant main effect for Stroop tests, $F(1,34) = 12.63$, $p < .001$. Figure 2 presents the results of this analysis. Adjusted means for patients with dental phobia ($M = 6.9$), were significantly higher, in the direction of interference, compared to the adjusted means of their matched counterparts ($M = 0.9$). Significantly more interference was produced by the idiographic Stroop test ($M = 6.6$) than the standardized Stroop test ($M = 1.2$). The interaction was not significant, $F(1,34) = 1.17$, $p = .287$.

The results for the full screen interference scores were replicated when the ANCOVA was repeated utilizing the response time to color name the 100 dental stimuli presented in the full screen presentation format as the dependent measure. Again, significant main effects for group, $F(1,33) = 7.32$, $p < .05$, and Stroop test, $F(1,34) = 4.82$, $p < .05$ were revealed. The interaction was not significant, $F(1,34) = 0.04$, $p = .839$.

Single word presentation format. Similarly, a 2 X 2 (group by Stroop test) ANCOVA was performed on total interference scores for the single word presentation format. In order to calculate a total interference index for the single word presentation format, an individual word interference score was derived for each of the five words by

subtracting the average time to color name the control word from the average time to color name its matched dental word. The participant's total interference score was the summation of the five individual word interference scores. Results revealed a significant main effect for group, $F(1,33) = 4.39$, $p < .05$. Figure 3 presents the data from this analysis. Adjusted means for patients with dental phobia ($M = 163.7$), were significantly higher, in the direction of interference, compared to the means of the matched control group ($M = -44.1$). The main effect for Stroop test type and the interaction were not significant (all F's < 1.02 , all p's > .57).

Stroop test interference by fear rating. With the methodology employed in this study, it is possible to investigate differences among the five individual word interference/facilitation scores. As part of this investigation, words were ranked by participants from the most fear arousing (word 1) to the least fear arousing (word 5). Words were placed in the appropriate category based on their rankings. Separate 2 X 5 (group by word ranking) ANCOVAs were utilized to investigate differences on the standardized and idiographic dental fear word interference/facilitation scores.

Utilizing the single word standardized dental fear interference/facilitation scores, a 2 X 5 (group by word ranking) ANCOVA revealed a significant main effect for group, $F(1,33) = 4.45$, $p < .05$. Figure 4 presents the mean interference/facilitation score in each of the groups for the five separate words. Adjusted means for dental phobia patients ($M =$ 30.2), were significantly higher, in the direction of interference, compared to the adjusted means of the matched control group ($M = -14.0$). The main effect for word ranking and the interaction were not significant (all F's < 0.92 , all p's > .46).

A 2 X 5 (group by word ranking) ANCOVA utilizing the single word idiographic dental fear interference/ facilitation scores did not reveal significant main effects or interactions (all F's < 2.27 , all p's > .14). Figure 5 presents these data.

Verbal Report Instruments and Stroop Test Data Comparisons

Correlations of dental fear verbal report instruments. A series of Pearson Product Moment Correlations was computed on the DAS, DFS total score and subscales, and 60-DQ total score and subscales. Table 8 presents these intercorrelations. All dental fear verbal report instruments' scales and subscales were significantly intercorrelated (all r's > .55, all p's < .001).

Correlations of dental fear verbal report instruments with Stroop test data. Additional correlations were computed among the total scores for the dental fear instruments, interference scores on the full screen presentation format and the single word presentation format, as well as the total time to color name the dental words on the full screen presentation format. Table 9 presents the results from this analysis.

Correlations of dental fear verbal report instruments with single word response data. Correlations were also computed between the dental fear verbal report instruments and the interference score for each standard and idiographic dental word. Tables 10 and 11 present these intercorrelations, respectively.

Discussion

Differences Between Patients with Specific Dental Phobia and Matched Control Participants on Dental Stroop Color Naming Tests

As predicted, patients with dental phobia demonstrated greater interference to dental words than did their matched counterparts. Individuals with dental phobia took longer to color name dental words than matched control words. These findings were consistent across the full screen and single word presentation formats.

The results of this study expand the findings of previous research with highly dental fearful undergraduate populations (Kahle et al., 1990; Carter et al., 1991; Ries et al., 1993) to patients who received a DSM-IV specific dental phobia diagnosis. Furthermore, the Stroop interference effect was also demonstrated using the more contemporary single word presentation methodology. Although the Stroop interference effect has been demonstrated across several anxiety disorders (Logan & Getsch, 1993), the current investigation is the first study to demonstrate the interference effect among individuals with a specific dental phobia.

Differences Between the Standard Dental Stroop Test and Idiographic Dental Stroop Test

The innovative component of this study investigated differences between a standardized dental Stroop test (Kahle et al., 1990) and an idiographic dental Stroop test (Ries et al., 1993). As expected on the full screen presentation format, participants exhibited a greater interference effect for idiographic stimuli than for the standard dental words. These results, however, were not replicated with the single word presentation format. The full screen presentation format result expands the findings of Ries et al.

(1993), who utilized an undergraduate population, to a DSM-IV clinical sample of specific dental phobics. Based on these results, it appears that stimuli specific to an individual's domain of fear will cause more interference in color-naming than standardized dental words. Therefore, patients with specific dental phobia may have differing domains of fear. One individual may fear needles or injections, while another individual may fear tooth extractions. Moreover, an individual may attend an appointment for routine teeth cleanings, but could avoid appointments for fillings or crowns. The clinical implications of this finding are important. When assessing fear domains of specific phobias or other anxiety disorders, the clinician should attend to the idiographic nature of the fear-inducing situations.

Although this study was not designed to directly compare the contemporary theories of anxiety research, the increase in interference caused by the idiographic stimuli appears to support the threat-related hypothesis (Mathews & MacLeod, 1985). Threat words that are specific to an individual's domain of fear cause more disruption in color naming than a standardized selection of words. Therefore, the higher the perceived threat, the greater the disruption in color naming. Nevertheless, these findings are not inconsistent with other theoretical accounts.

Interestingly, the idiographic finding was not replicated in the single word presentation format. Although the means were in the appropriate direction, with the idiographic stimuli causing more interference than the standard stimuli, the difference between the two groups did not reach significance. There are several methodological problems associated with the single word presentation format that are discussed later that

may have contributed to this lack of significance. Furthermore, this study may lack statistical power, specifically related to the limited numbers of participants. Also, participants varied greatly in their ability to color name words during the single word presentation format. Standard deviations were extremely large, making it difficult to detect significant differences. Additionally, several participants selected idiographic words that were included on the standard Stroop test. Therefore, there was little difference between the two sets of stimuli for these individuals.

From a more theoretical perspective, the different results across the two presentation formats are of great interest. Although the formats have generally been described as similar cognitive tasks, they may actually assess different domains of anxiety. The single word presentation format appears to identify a specifically focused attentional bias for threat. This presentation may not be sensitive to increased threat caused by idiographic stimuli since color naming is the only activity that can be disrupted. The full screen presentation format, however, has multiple activities or sources of possible interference. Not only do the participants have to color name the stimuli, but they also initiate responses, keep track of their location on the word list, and move their eyes from one word to another, including column changes. All of these behaviors may be slowed by the cognitive interference initiated by the stimuli. These multiple opportunities for decrease in behavior performance, may explain why significant differences between the standard and idiographic stimuli were noted on the full screen presentation format, but not the single word presentation format. The single word presentation format appears to

be a purer measure of attentional bias for threat. The full screen presentation format, however, may be more of a behavioral measure initiated by cognitive interference.

When comparing the Stroop test data and the verbal report instruments, correlations suggested a stronger relationship between the total scores of the three dental fear verbal report scales with the standardized Stroop tests, than with the idiographic Stroop tests. It is likely that if idiographic questionnaires had been designed, the idiographic Stroop test data would have correlated more highly with the idiographic verbal report instruments. Verbal report of dental fears would have been increased because of the greater sensitivity of the idiographic assessment. The standardized questionnaires utilized in this study were not design to assess the idiographic fears of the participants.

Stroop Test Interference by Fear Rating

Performance similarities across the five individual words in the single word presentation format were unexpected. Interference scores did not differ between words ranked by the participants as most fear arousing to least fear arousing. Although it was expected that the most feared words would cause greater interference than the least feared words, this hypothesis was not supported by the data. It is likely that the limitations discussed concerning the single word presentation format contributed to these results as well. Also, many of the participants rated their five fear words as equally fear arousing. Among the phobia patients, there was little or no difference between the ratings assigned to the highest feared words and the lowest feared words. It is possible that the Stroop test methodology may not be sensitive to these subtle differences.

Comorbid Diagnoses Among Dental Phobia Patients

Reviewing Table 1's listing of the comorbid Axis I diagnoses among dental phobia patients in this study indicates that 9of 18 patients (50%) had additional current Axis I diagnoses, all of which were anxiety disorders. The most common comorbid diagnosis was social phobia (39%), followed by generalized anxiety disorder (28%). Given that negative social evaluation fears have been suggested as a possible component of dental phobia (Roy-Byrne et al., 1994; Moore et al., 1991), the high prevalence rate of social phobia is not surprising. Individuals with social phobia diagnoses fear negative evaluation and scrutiny by others in social situations (DSM-IV; American Psychiatric Association, 1994). It should also be noted that the high number of dental phobia patients who also received a diagnosis of social phobia may have influenced the results of this study. It is possible that the Stroop intereference effects were increased because of their performance anxieties.

An inspection of the Axis II personality disorder diagnoses among these patients revealed that 5 of 18 (28%) patients had an Axis II disorder. Obsessive-compulsive personality disorder was the most common, with three of five patients assigned this diagnosis.

The percentage of comorbid Axis I diagnoses in this study may be slightly higher than the findings of the Roy-Byrne et al. (1994) investigation. In their study which utilized the SCID-R as the structured interview instrument, they reported a 40% rate of comorbid Axis I diagnoses. The percentage of patients with Axis II diagnoses, however, appears greater in the Roy-Byrne et al. (1994) study than in this current investigation.

Roy-Byrne et al. (1994) reported that 61% of their patients had at least one Axis II personality disorder, while the current investigation diagnosed only 28% of the patients with a personality disorder.

Limitations

Several limitations of this study's design and methodology should be discussed. First of all, the study is limited by low statistical power. Specifically, if more patients and matched controls were utilized in the study, it is likely that the differences between the idiographic stimuli and the standard stimuli on the single word presentation format may have reached significance. Second, the methodology of the single word presentation format would benefit from several changes. It was noted that while collecting the Stroop test data, participants reported fatigue during the color naming task and appeared quite taxed by the procedure. In order to eliminate this effect, the number of stimuli should be decreased. For the same reason, the stimuli should be presented more quickly. In order to make the task more positively reinforcing, once the word has been color named, the stimuli should disappear from the screen. Again, it is likely that these changes may increase the likelihood of differences between the idiographic and standard stimuli. Furthermore, such changes may allow the detection of significant differences between fear words that are presented in the single word presentation format. Third, there may have been an overall fatiguing of the participants across all Stroop tests. Several Stroop tests were presented and it is possible that differences did not emerge where predicted because of the mundaneness of the task or physical fatigue. Fourth, this study compared patients with DSM-IV diagnoses to matched control participants who did not meet

criteria for a psychological disorder. It could be suggested that differences noted between groups were related to the presence of psychological distress associated with a DSM-IV diagnosis. Although impractical, the strongest design would have included matching control participants on all diagnoses other than the presence of specific dental phobia. A more practical design could compare patients with specific dental phobia to patients who had DSM-IV diagnoses other than specific dental phobia. Finally, the generalizability of this study is limited, given that all participants were Caucasian and the lower-middle and lower socioeconomic classes were not represented.

Directions for Future Research

The results of this study are exciting and contribute to the theoretical and clinical utility of Stroop test methodology. It is important that the idiographic findings of this study be replicated in order to establish its usefulness as an assessment device and its reliability and validity. It is also important to determine if the findings of this study will generalize to another anxiety population, such as patients with PTSD or panic disorder.

The single word presentation format utilized in this study could benefit from several changes as discussed earlier. It is likely that after employing these changes, differences between the standardized Stroop test and the idiographic Stroop test may be noted. If after making these changes, the replicated results are similar to this study, theoretical differences between the single word and full screen presentation formats are more strongly supported.

The Stroop test paradigm has typically been used as an initial assessment instrument. Further research needs to explore it usefulness as a treatment outcome

measure. Following treatment, the Stroop test could be used as an indicator of changes in cognitive processing mediated by behavior or cognitive therapy.

Summary

In conclusion, the results of this study make a significant contribution to the phobia and Stroop test literature. Patients with a DSM-IV specific dental phobia diagnosis demonstrated greater interference across the standardized and the idiographic dental Stroop tests than their matched counterparts on the full screen presentation format. Also, both groups demonstrated greater interference on the idiographic dental Stroop test than on the standardized dental Stroop test. On the single word presentation format, significant differences between the specific dental phobia group and their matched controls were replicated. No differences, however, were noted between the idiographic dental Stroop test and the standardized dental Stroop test. These results suggest that the single word presentation format may be a purer measure of attentional bias for threat. The full screen presentation format, however, appears to be a behavioral measure initiated by cognitive interference. Further research is needed to confirm these theoretical assumptions.

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Appendix A

BRIEF MEDICAL/SOCIAL HISTORY INTERVIEW

Name_____ Date_____ Subj#: AX24 _ _

Age ____ DOB _____ Ethnicity _____ Gender: M F

==========

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

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

Explain_____

Y N 3. Do you have, or have you ever had a seizure disorder?

Explain_____

Y N 4. Have you ever had periods of unconsciousness?

Explain_____

Y N 5. Have you ever had any serious head injuries?

Explain_____

Y N 6. Any current serious health problems, illness, or accident that has not yet been mentioned?

Explain_____

Y N 7. 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 8. Have you used any caffeinated beverages or alcohol in the last 12 hours.

List amount and times for each_____

Y N 9. Are you presently pregnant, or do you have any reason to believe you are pregnant?

____ 10. How many hours of sleep did you get last night?

____ 11. How many hours of sleep do you usually get per night?

Appendix B

Full Screen Stroop Test Presentation Instructions

"It is important that everyone who participates in this program gets exactly the same instructions, so I am going to read these instructions to you."

"You will be asked to look at a series of screens displayed on this computer monitor. Each screen will contain either a list of words in different colors, or a list of X's in different colors. Your task is to ignore the word and name the colors out loud."

"This screen is an example. Your task is to color-name each color as quickly as you can, without sacrificing accuracy. This is a timed task. Read down each column. Once you reach the end of a column, move immediately to the top of the next column."

"This screen is for practice. When you do this task 'for real' I will touch the space bar to make the screen appear. Start color-naming the first column as soon as the screen appears. After you read the last word in the last column, I will touch the space bar to stop the timer. What questions do you have?"

"Go ahead and begin this screen to practice."

"Okay, you can stop now since this screen is just for practice.

You will be shown a total of eight more screens. Remember:"

Begin as soon as the screen appears

Work down the columns

Say the colors out loud

Work quickly but accurately

I will start and stop the timer.

"There will be a 30 second rest period following each screen. During these rest periods, please sit quietly: I will be unable to talk with you during these times."

"What questions do you have?"

"Are you ready?"

"Begin"

Appendix C

Single Word Stroop Test Presentation Instructions

"This task is slightly different, words will appear on the computer screen one at a time. Your task is to ignore the word and name the color out loud.

"This screen is an example. Your task is to again name the colors as quickly as you can, without sacrificing accuracy. Remember, this is a timed task."

"The computer will be recording the time it takes for you to color name the words through voice activation. Therefore, please refrain from cough, clearing your throat, or other vocal and nonvocal sounds.

"What questions do you have?"

"Are you ready?" "Begin"

Table 1

Frequency of comorbid diagnoses among dental phobia patients

Diagnosis	Frequency
Axis I	
Social Phobia	7
Generalized Anxiety Disorder	5
Specific Phobia (other than dental phobia)	3
Agoraphobia	1
Panic Disorder without Agoraphobia	1
Axis II	
Obsessive-Compulsive Personality Disorder	3
Borderline Personality Disorder	1
Narcissistic Personality Disorder	1
Paranoid Personality Disorder	1

Note. Of the 18 patients, four had one comorbid diagnosis, four had two comorbid diagnoses, one had three comorbid diagnoses, two had four comorbid diagnoses.

Table 2

Stroop tests and presentation formats

Stroop tests	Presentation formats
Standardized Color-Word Stroop Test	Full Screen
Standardized Dental Stroop Test	Full Screen
Standardized Dental Stroop Test	Single Word
Idiographic Dental Stroop Test	Full Screen
Idiographic Dental Stroop Test	Single Word

Table 3

Threat-related words of the standardized Dental Stroop Test

Threat-related words	Control words
CAVITY	GALAXY
DENTIST	PEASANT
DRILL	BENCH
INJECTION	SHOVELING
TOOTHACHE	LUNCHTIME

Table 4

Threat-related and control words for the idiographic Dental Stroop Test

Threat-related words	Control words
AGONIZING	NAVIGATED
BLOODY	SLIDES
CAVITY	GALAXY
CHIPPING	SIGHTING
CHISELED	GESTURED
CONFINED	POWDERED
CUTTING	KEEPING
DECAY	ARMOR
DENTIST	PEASANT
DRILL	BENCH
EXCRUCIATING	POLYURETHANE
EXTRACTION	COUNCILMAN
FEARFUL	SPONSOR
FILING	POSING
FILLINGS	SPECKLED
FLUORIDE	APPARENT

(table continues)

(table 4 continued)

GAGGED	TEEMED
GRINDING	TROUSERS
IMPACTED	TABULATE
INJECTION	SHOVELING
JABBING	CLICKER
LACERATING	ALLOCATING
MANGLE	UNVEIL
MUTILATED	VARIOUSLY
NAUSEA	NOTIFY
NEEDLE	BASKET
NERVE	VERSE
PAIN	MAIL
PANICKY	THEATRE
PICK	DEAL
PIERCING	BLENDING
PLIERS	GALLEY
POKING	MINDED
POUNDING	ATTEMPTS
PULLING	CALLING

(table continues)

(table 4 continued)

PUNCTURING	INTRIGUING
PUS	PUN
RIPPING	DOUBLES
ROT	CUE
SALIVA	AVENUE
SCRAPING	COASTING
SHARP	THICK
STABBING	CHECKOUT
SUCTION	PLATTER
SUTURE	WINDUP
SYRINGE	CAPTION
TEARING	JOINING
TOOTHACHE	LUNCHTIME
UNBEARABLE	UNAFFECTED
WRENCHING	CLEARNESS

Note. Threat-related words are listed alphabetically.

Table 5

Mean scores for general anxiety/fear and depression verbal report instruments

(standard deviations in parentheses)

Instrument	Possible Range	Groups: Dental Phobia	Groups: Matched Controls	t	p
Beck Depression Inventory (BDI)	0 - 63	5.1 (6.7)	2.6 (3.0)	1.48	.15
State-Trait Anxiety Inventory-Trait (STAI - Trait)	20 - 80	32.7 (11.5)	27.3 (6.2)	1.73	.09
State-Trait Anxiety Inventory- State (STAI - State)	20 - 80	31.8 (11.9)	26.5 (7.9)	1.58	.12

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

Table 6

Mean scores for dental fear verbal report instruments

(standard deviations in parentheses)

Dental fear verbal report instruments	Possible Range	Groups: Dental Phobia	Groups: Matched Controls	t
Dental Anxiety Scale (DAS)	4 -20	14.8 (2.7)	6.6 (1.3)	11.63
Dental Fear Survey - Total (DFS TOT)	20 - 100	71.8 (15.9)	30.2 (6.4)	10.32
Dental Fear Survey - Avoidance (DFS AVOID)	8 - 40	25.4 (7.3)	9.2 (1.5)	9.16
Dental Fear Survey - Specific Stimuli (DFS STIM)	6 - 30	25.4 (5.2)	11.8 (4.3)	9.52
Dental Fear Survey - Physiological (DFS PHYS)	5 - 25	16.7 (4.4)	7.5 (1.5)	8.41
60-item Dental Quest. - Total (60-DQ TOT)	60 - 420	245.0 (67.2)	107.2 (32.9)	7.82
60-item Dental Quest. - Pain (60-DQ PAIN)	17 - 119	90.8 (20.4)	38.3 (13.2)	9.19
60-item Dental Quest. - Neg. Social Eval. (60-DQ NEG)	7 - 49	30.8 (6.9)	17.1 (9.6)	4.92
60-item Dental Quest. - Anticipatory (60-DQ ANTIC)	12 - 84	36.0 (14.9)	13.1 (1.5)	6.47
60-item Dental Quest. - Loss of Control (60-DQ LOSS)	5 - 35	14.7 (7.3)	7.3 (2.9)	4.00

Note. Higher scores indicate report of greater dental fear; all p's $< .0001$

Table 7

Frequency of idiographic dental word selection

Dental Word	Frequency
Drill	12
Needle	12
Impacted	9
Injection	9
Stabbing	9
Excruciating	8
Extraction	7
Mutilated	7
Nerve	7
Pain	7
Cutting	6
Grinding	6
Ripping	6
Jabbing	5
Pliers	5
Dentist	4
Gagged	4

(table continues)

(table 7 continued)

Lacerating	4
Pulling	4
Puncturing	4
Rot	4
Scraping	4
Syringe	4
Agonizing	3
Chipping	3
Chiseled	3
Fillings	3
Mangle	3
Pus	3
Bloody	2
Nausea	2
Suture	2
Cavity	1
Confined	1
Panicky	1
Piercing	1

(table continues)

(table 7 continued)

Poking	1
Pounding	1
Sharp	1
Suction	1
Unbearable	1

Table 8

Intercorrelations among dental fear verbal-report instruments

	Dental Phobia Verbal-Report Instruments				
Dental Phobia Verbal-Report Instruments	60-DQ TOT	60-DQ PAIN	60-DQ NEG	60-DQ ANTIC	60-DQ LOSS
Dental Anxiety Scale (DAS)	.89	.90	.68	.87	.60
Dental Fear Survey - Total (DFS TOT)	.93	.97	.71	.88	.65
Dental Fear Survey - Avoidance (DFS AVOID)	.90	.91	.66	.87	.61
Dental Fear Survey - Specific Stimuli (DFS STIM)	.91	.95	.73	.82	.69
Dental Fear Survey - Physiological (DFS PHYS)	.86	.90	.64	.84	.55
60-item Dental Questionnaire - Total (60-DQ TOT)		.96	.84	.94	.81
60-item Dental Questionnaire - Pain (60-DQ PAIN)			.80	.86	.71
60-item Dental Questionnaire - Neg. Social Eval. (60-DQ NEG)				.68	.63
60-item Dental Questionnaire - Anticipatory (60-DQ ANTIC)					.76
60-item Dental Questionnaire - Loss of Control (60-DQ LOSS)					

(table continues)

(table 8 continued)

	Dental Phobia Verbal-Report Instruments				
Dental Phobia Verbal-Report Instruments	DAS	DFS TOT	DFS AVOID	DFS STIM	DFS PHYS
Dental Anxiety Scale (DAS)		.94	.93	.86	.90
Dental Fear Survey - Total (DFS TOT)			.97	.95	.94
Dental Fear Survey - Avoidance (DFS AVOID)				.86	.90
Dental Fear Survey - Specific Stimuli (DFS STIM)					.84
Dental Fear Survey - Physiological (DFS PHYS)					

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

Table 9

Intercorrelations among dental fear verbal-report instruments and dental Stroop tests response times.

	Dental Phobia Verbal-Report Instruments		
Dental Stroop Tests	DAS	DFS	60-DQ
Full Screen Presentation Format			
Idiographic Stroop Dental Screen Score	.31	.23	.15
Standardized Stroop Dental Screen Score	.40*	.34*	.28
Idiographic Stroop Interference Score	.20	.13	.07
Standardized Stroop Interference Score	.46**	.46**	.48**
Single Word Presentation Format			
Idiographic Stroop Interference Score	.30	.28	.23
Standardized Stroop Interference Score	.41*	.40*	.34*

Note. DAS = Dental Anxiety Scale; DFS = Dental Fear Scale; 60-DQ = 60 Item Dental Questionnaire total score; * $p < .05$. ** $p < .01$

Table 10

Intercorrelations among dental fear verbal report instruments and average interference time for single presentation standard dental words

	Standard fear word ranking				
Dental fear verbal-report instruments	Word One	Word Two	Word Three	Word Four	Word Five
Dental Anxiety Scale (DAS)	.06	.47**	.40*	.41*	.12
Dental Fear Survey - Total (DFS TOT)	.06	.46**	.37*	.38*	.15
Dental Fear Survey - Avoidance (DFS AVOID)	.04	.39*	.34*	.42**	.10
Dental Fear Survey - Specific Stimuli (DFS STIM)	.09	.51**	.38*	.30	.22
Dental Fear Survey - Physiological (DFS PHYS)	.03	.41*	.35*	.36*	.09
60-item Dental Questionnaire - Total (60-DQ TOT)	-.03	.44**	.40*	.37*	.13
60-item Dental Questionnaire - Pain (60-DQ PAIN)	.01	.45**	.31	.33*	.09
60-item Dental Questionnaire - Neg. Social Eval. (60-DQ NEG)	-.02	.44**	.44**	.32	.18
60-item Dental Questionnaire - Anticipatory (60-DQ ANTIC)	-.05	.40*	.40*	.37*	.12
60-item Dental Questionnaire - Loss of Control (60-DQ LOSS)	-.09	.22	.16	.14	.06

Note. * $p < .05$. ** $p < .01$; Word one is the most feared; word five is the least feared.

Table 11

Intercorrelations among dental fear verbal report instruments and average interference time for single presentation idiographic dental words

Dental fear verbal-report instruments	Idiographic fear word ranking				
	Word One	Word Two	Word Three	Word Four	Word Five
Dental Anxiety Scale (DAS)	.20	.16	.33	.16	.31
Dental Fear Survey - Total (DFS TOT)	.16	.18	.33	.20	.27
Dental Fear Survey - Avoidance (DFS AVOID)	.21	.21	.31	.23	.26
Dental Fear Survey - Specific Stimuli (DFS STIM)	.08	.15	.31	.13	.25
Dental Fear Survey - Physiological (DFS PHYS)	.19	.18	.34*	.21	.24
60-item Dental Questionnaire - Total (60-DQ TOT)	.09	.12	.29	.19	.24
60-item Dental Questionnaire - Pain (60-DQ PAIN)	.09	.15	.32	.19	.25
60-item Dental Questionnaire - Neg. Social Eval. (60-DQ NEG)	.13	.04	.32	.14	.22
60-item Dental Questionnaire - Anticipatory (60-DQ ANTIC)	.09	.13	.22	.18	.20
60-item Dental Questionnaire - Loss of Control (60-DQ LOSS)	-.07	-.09	.03	.06	.07

Note. * $p < .05$; Word one is the most feared, word five is the least feared.

Figure Captions

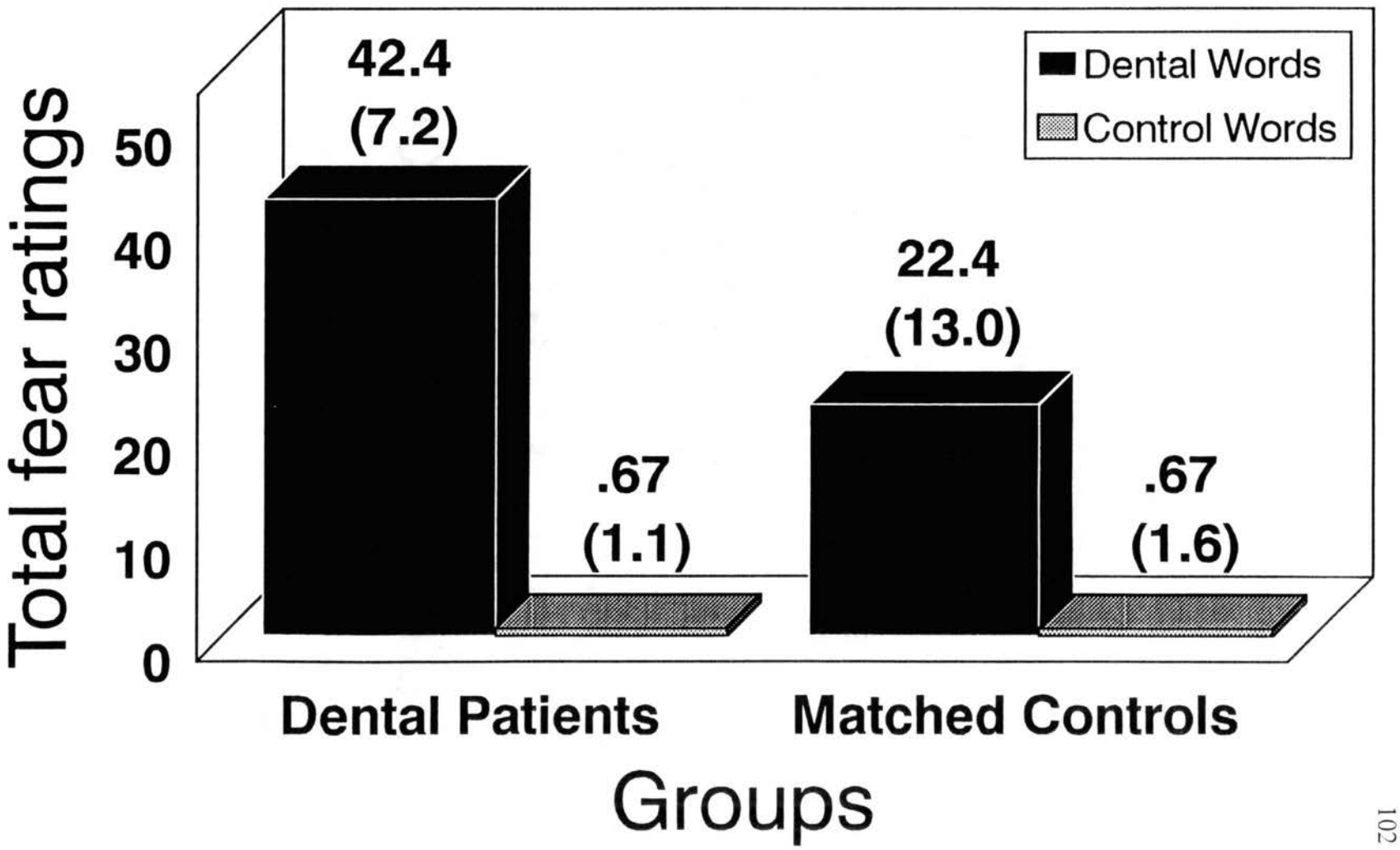
Figure 1. Means (unadjusted) and standard deviations (in parentheses) for idiographic word fear ratings.

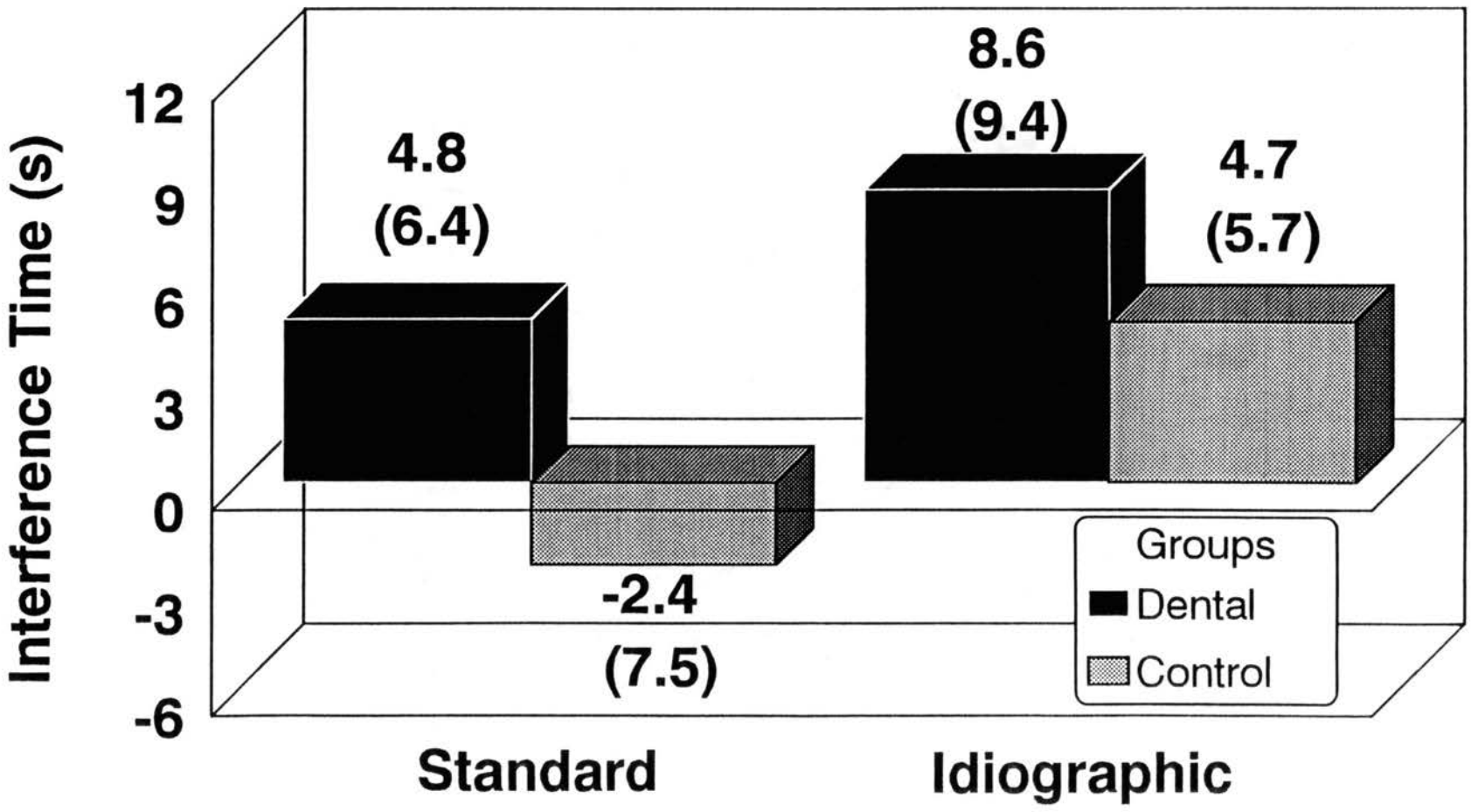
Figure 2. Means (unadjusted) and standard deviations (in parentheses) for full screen presentation interference scores.

Figure 3. Means (unadjusted) and standard deviations (in parentheses) for single word presentation interference scores.

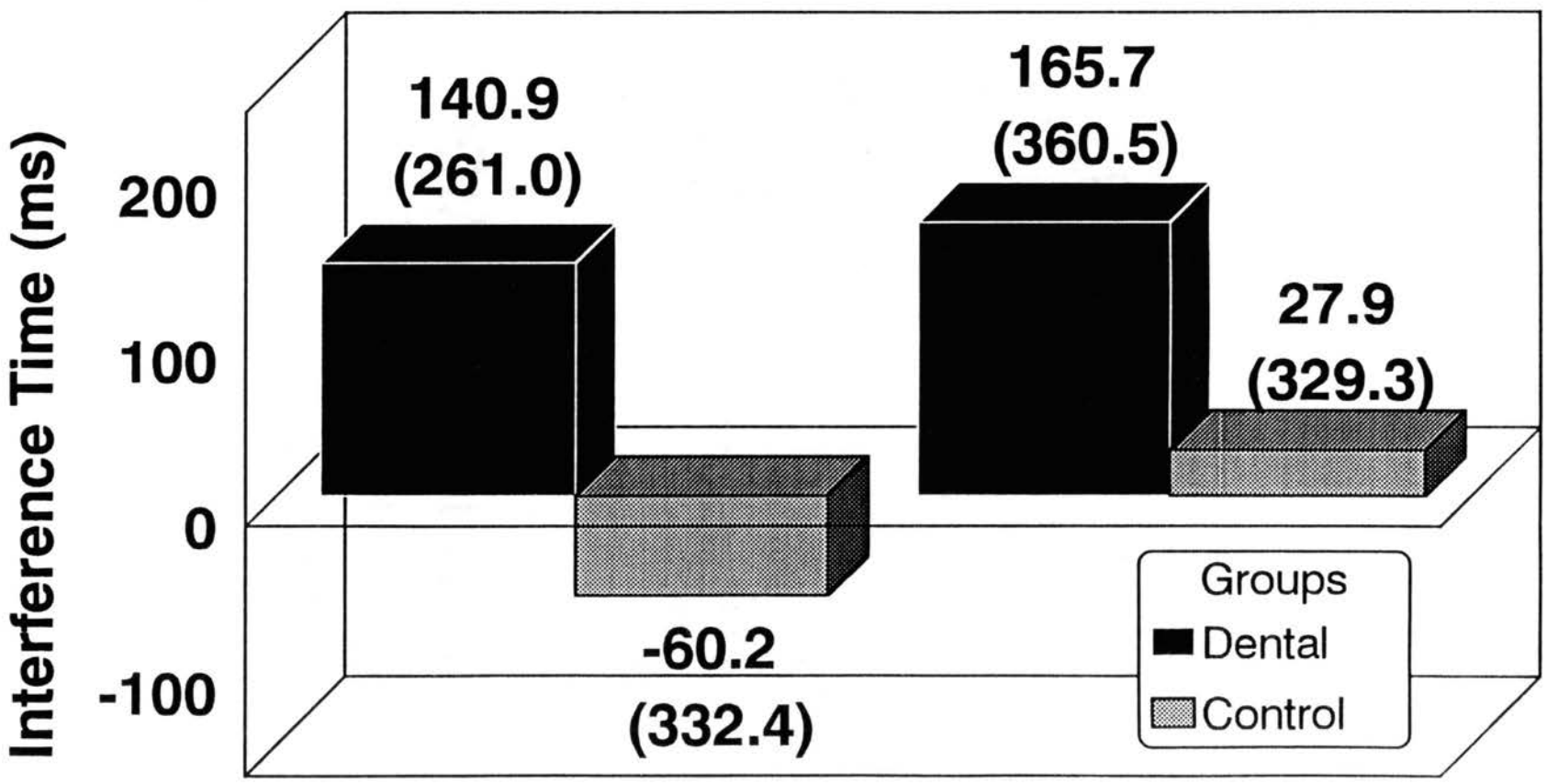
Figure 4. Means (unadjusted) and standard deviations (in parentheses) for interference/facilitation scores by word ranking on standardized dental words.

Figure 5. Means (unadjusted) and standard deviations (in parentheses) for interference/facilitation scores by word ranking on idiographic dental words.

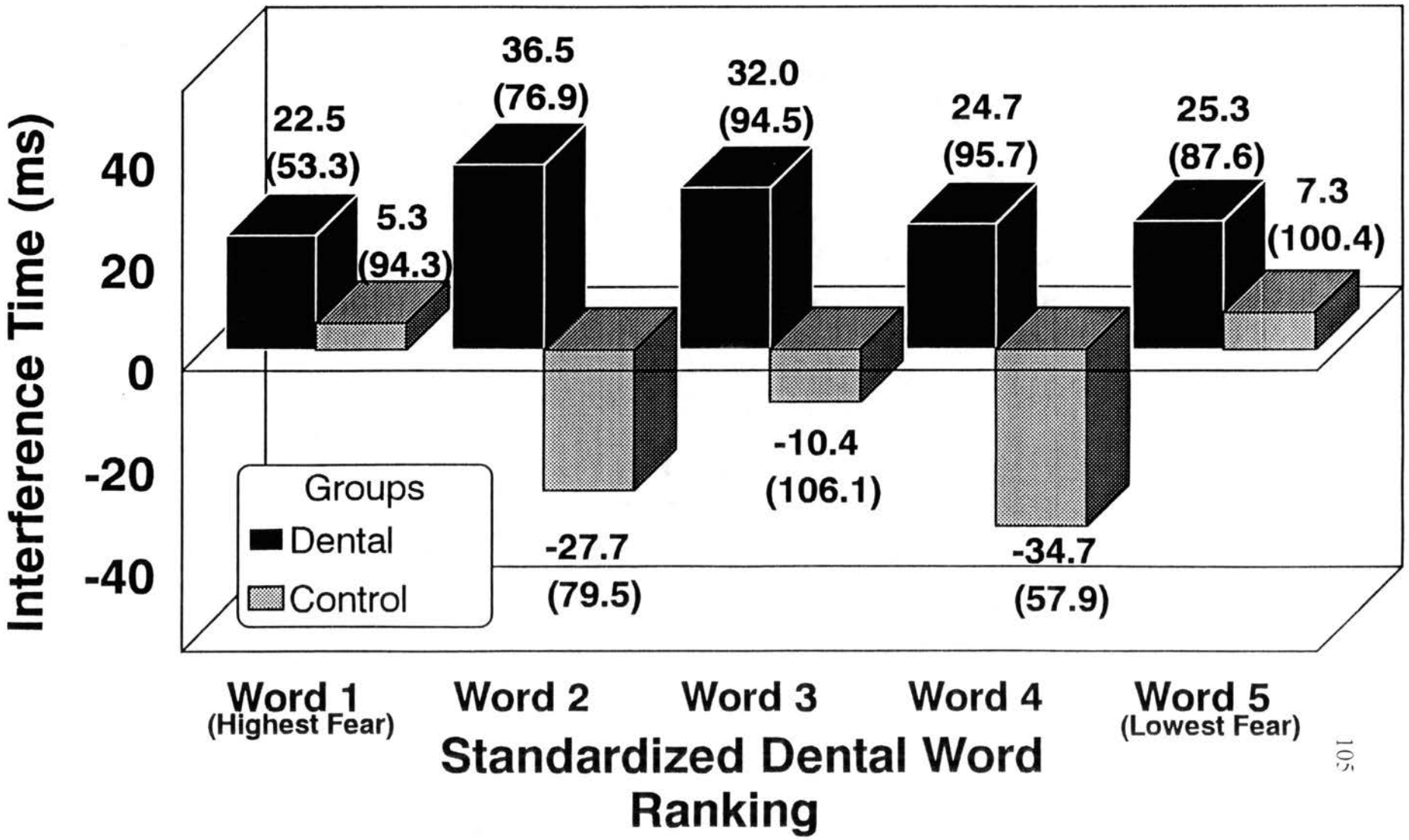

Total fear ratings
50
40
30
20
10
0
42.4
(7.2)
.67
(1.1)
22.4
(13.0)
.67
(1.6)
Dental Words
Control Words
Dental Patients
Matched Controls
Groups

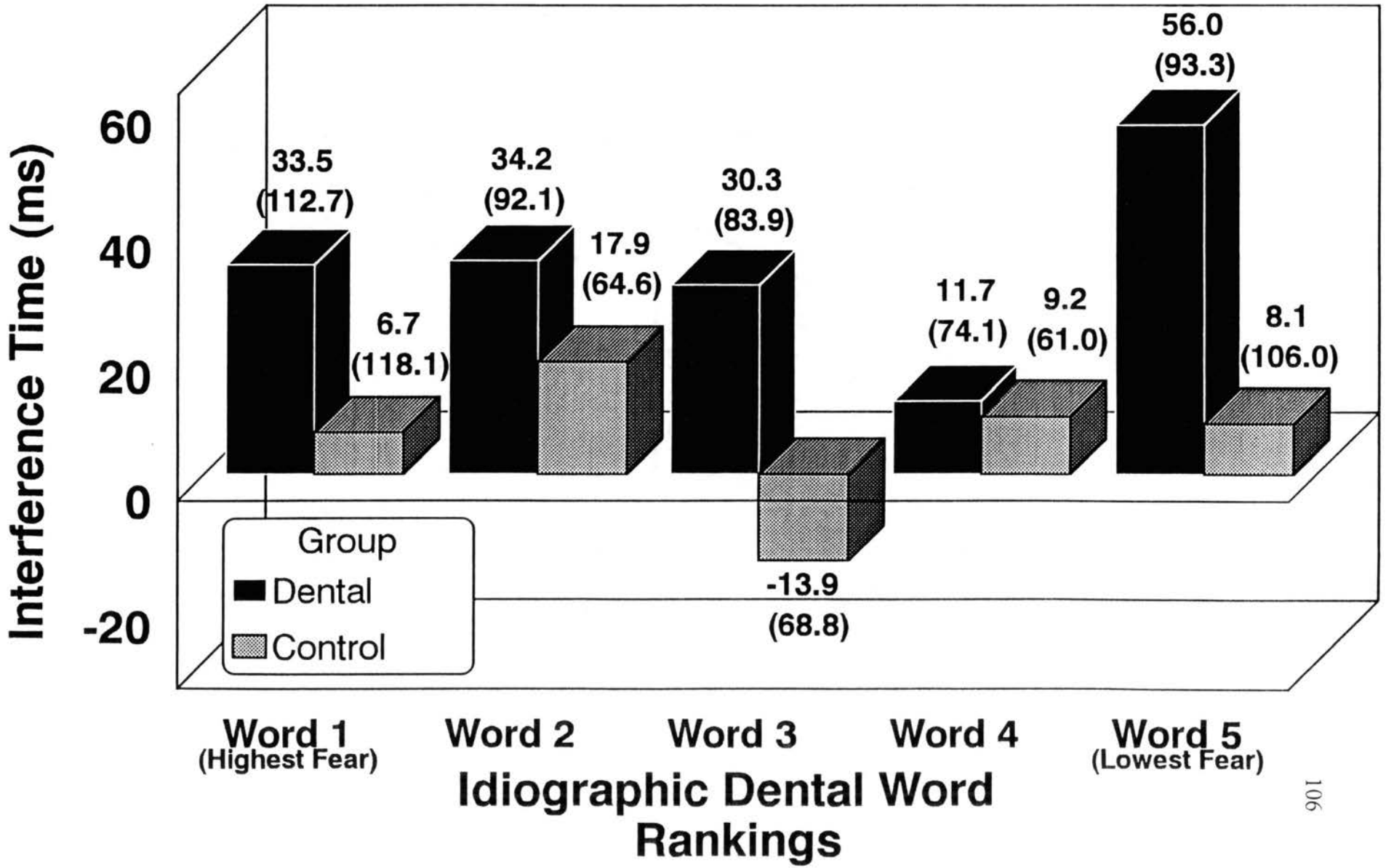


Dental Stroop Tests: Full Screen Format



Dental Stroop Tests: Single Word Format


Interference Time (ms)
40
20
0
-20
-40
22.5
(53.3)
5.3
(94.3)
36.5
(76.9)
-27.7
(79.5)
32.0
(94.5)
-10.4
(106.1)
24.7
(95.7)
-34.7
(57.9)
25.3
(87.6)
7.3
(100.4)
Groups
Dental
Control
Word 1
(Highest Fear)
Word 2
Word 3
Word 4
Word 5
(Lowest Fear)
Standardized Dental Word Ranking


Interference Time (ms)
60
40
20
0
-20
33.5
(112.7)
6.7
(118.1)
34.2
(92.1)
17.9
(64.6)
30.3
(83.9)
-13.9
(68.8)
11.7
(74.1)
9.2
(61.0)
56.0
(93.3)
8.1
(106.0)
Group
Dental
Control
Word 1
(Highest Fear)
Word 2
Word 3
Word 4
Word 5
(Lowest Fear)
Idiographic Dental Word Rankings

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

VITA

Barry J. Ries

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Doctor of Philosophy

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