THE ROLE OF BEHAVIORAL TECHNOLOGY IN THE PROMOTION OF ORAL HEALTH BEHAVIOR

by

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(ABSTRACT)

This study implemented two behavior management strategies, self-monitoring and monetary incentives, in a dental clinic and a private periodontal practice to explore the effects of these intervention strategies on subjects' dental flossing frequencies and to compare these strategies to standard educational procedures. Group analysis of four dependent variables genreally showed minimal impact of the intervention strategies on flossing frequency. However, when the percentages of subjects within groups who improved on the dependent measures were evaluated, differential effects for some dependent variables were noted between settings and among intervention strategies. Based on those findings, the behavioral strategies of self-monitoring and monetary incentives did appear to enhance the effectiveness of education.

Multimodal measures were used to assess changes in the target behavior. The general lack of covariance found among the dependent measures used in this study

demonstrated that the interpretation varied with the choice of dependent variable. This finding suggested that past researchers, who used only physiological dependent measures to assess changes in the frequencies of dental flossing and brushing behaviors, should have selected more direct measures of the targeted behaviors (e.g. unobtrusive measures or direct observations).

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Introduction

> When (investigating) a disease, I never think of finding a remedy for it, but instead a means of preventing it (Louis Pasteur, 1884; as cited in Weinstein & Getz, 1978, p.72).

Compliance with health and medical regimens has been a major topic of concern in the past several decades and has spawned much scientific research. During that time there has been a proliferation of effective preventive and treatment-oriented therapies for many major diseases. Adherence to these specific medical prescriptions is crucial for disease prevention, health protection, and health promotion. For example, it is clear that compliance with certain recommended prescriptions, such as immunizations, has proven benefical to both individuals and society.

A major reason for studying compliance with appropriate health behaviors is to develop and evaluate strategies for encouraging adherence to beneficial, preventive medical regimens. As Feinstein (1979) stated concisely and cogently "With these goals in mind, we may investigate the various clinical, social, and behavioral features that are determinants of compliance and the educational, communicational, and packaging features that may enhance it" (p.309).

In recent years, a general paradigm shift has occurred within the health community. Primary prevention of disease, health protection, and health promotion have come of age as topics worthy of scientific investigation. Dentistry is an area in which this line of inquiry has been particularly fruitful. In fact, researchers have demonstrated that the vast majority of dental disease can be prevented. As Bailit & Silversin (1980) noted: "The only practical solution to the oral disease problem is prevention. This is true for many common chronic diseases, of course, but perhaps the dental area is unique in that effective preventive technology is available" (p.243). Even with the availability of such knowledge, the incidence of dental disease is still extremely high. Therefore, an issue of great importance is to determine optimal methodology for promoting oral health behaviors that potentially prevent disease. One such methodology is behavioral engineering or contingency management (Geller, Winett, & Everett, 1982).

A potential role exists for the behavior management strategies of self-monitoring and positive reinforcement in the promotion of appropriate oral health behaviors. Motivating individuals to practice optimal dental hygiene potentially could prevent dental disease. This study addressed issues in preventive dentistry by examining the motivating effects of behavior technology in the promotion of oral health behavior.

Characteristics of Dental Diseases

Dental disease is one of the most common diseases known to humans (Bailit & Silversin, 1981; Leske, Ripa, & Leske, 1980; USDHEW, 1979). "Although oral health problems are rarely matters of life and death, there are indications that they have significant consequences on social, economic, and psychological areas of life including the quality of life" (Nikias, 1985, p.11). Not only can dental disease cause pain and interfere with masticatory function and speech, but orofacial appearance can contribute to emotional distress. Few are spared the attack as almost everyone has had some form of periodontal disease and/or at least one carious lesion during their lifetime.

Dental caries appear to be the result of a bacterial-chemical reaction on the tooth surface. This is the acidogenic theory of caries as it is widely accepted by dental professionals (Harris & Christen, 1981; Jones, 1982; Schatele, 1982). This theory states that when food products, particularly refined sugars, enter the mouth, they are ingested by the bacteria in plaque; their waste product is acidic. This acid has the potential to dissolve the tooth structure slowly and eventually produce a cavity in the tooth. Once the dissolution reaches the dentin of the tooth, the disease is irreversible. At this point, the tooth must be repaired by a dental professional. If not

treated, the disease progresses and can ultimately result in infection and/or loss of the tooth.

Epidemiological research has identified caries as the most common disease of young people (Sheiham & Croog, 1981), but the disease attacks all ages. Kelly & Harvey (1974) estimated that 25 percent of the 12 to 17 year age group lose one or more permanent teeth due to caries. However, these statistics only reflect those individuals who have sought treatment. Since only half of the population visit a dentist annually (Jong, 1981), this suggests that there is a tremendous backlog of unmet dental needs in the United States.

Community water fluoridation has had a dramatic impact on the incidence of caries in the past decade. It has been estimated that a 50 percent reduction in caries in the 5 to 17 year age group has been a direct result of water fluoridation (Ayer, 1984). However, only about half of the United States' population has access to fluoridated water. Therefore, oral health behaviors, such as flossing, targeted to reduce the incidence of caries are still warranted.

Another prevalent oral health problem is periodontal disease, an inflammatory reaction to toxic waste products of bacteria in plaque which destroys the supporting structures of the teeth, i.e., the gingiva (gum), ligaments, and/or bone. The apical movement of the

gingival attachment down the tooth is a protective mechanism by which the body attempts to prevent invasion of the bacteria. As a deeper pocket is formed around the tooth, it becomes progressively more difficult to remove bacterial plaque with standard oral hygiene measures. Ultimately, this requires treatment by a periodontist. If left untreated, the disease can progress until there is little or no support for the tooth, eventually leading to tooth loss.

The exact prevalence of periodontal disease is unknown, but it is estimated that the distribution is universal, and that approximately 90 to 95 percent of the population have some form of the disease (Sheiman & Croog, 1981; Stallard, 1982). Like caries, periodontal disease affects all ages, but after the age of 35, more teeth are extracted due to periodontal disease than to caries. Further investigation of epidemiological data reveal that extractions due to caries do not decrease with age, but those attributed to periodontal disease increase by a ratio of three to one (Zaki & Bakdash, 1982). This leaves a substantial portion of the population edentulous, i.e., without teeth. For example, after 65 years of age, one out of every two persons are edentulous (Kelly & Harvey, 1979), and many others will not have a full complement of teeth. "Although a significant amount of tooth decay can be reduced or eliminated through community water fluoridation,

reduction or elimination of periodontal disease seems largely dependent on individual home self-care procedures, such as daily flossing" (Ayer, 1984, p.890).

Periodontal disease and caries are slow, insidious processes that take years to develop to advanced stages. Brown (1974) identified three unique characteristics of caries and periodontal disease. First, the diseases have almost universal prevalence and the attack is recurring. Thus, individuals require continuous, periodic treatment. Second, the diseases are not reversible for the most part, and over time the effects of the diseases accumulate. Third, the treatment of the diseases requires technically demanding, expensive, and time-consuming surgical and prosthetic treatment. Therefore, oral hygiene homecare procedures which prevent periodontal disease, as well as caries, must be instituted if teeth are to last a lifetime.

Preventive Dentistry

The scientific knowledge of dental disease has advanced to the point where sufficient knowledge is available to prevent the vast majority of dental diseases (Bailit & Silversin, 1981). However, these preventive behaviors are not being widely applied. This can be demonstrated by examination of epidemiological data on the incidence and prevalence of dental disease. In the past, dental professionals have invested most of their time in

repairing the ravages of the disease. Although there has been a shift toward prevention in recent years, the dentist and periodontist still spend virtually all of their time treating the effects of these diseases. The responsibility of prevention is often delegated to others in the profession, such as dental hygienists and dental assistants. Although dental hygiene education stresses the promotion of oral health through prevention, often the majority of professional time with patients is spent removing the known etiology of dental diseases.

Dental disease presents a major economic liability as well as a health problem (Young, 1974). In 1980, $15.9 billion (i.e., 10.7 percent of all private expenditures for health services) were spent on treatment of dental disease (Nikias, 1985; Rich, 1981). The psychological costs (such as pain, fear, or embarrassment due to aesthetics and dysfunctional speech) appear prevalent, but are difficult to operationalize and measure. An attempt to measure the social cost of the impact of acute, dental conditions was estimated by Reisine (1985) when she reported that in 1981 there were 6.73 million days of bed disability, 17.7 million days of restricted activity, and 7.04 million days of work loss related to dental disease. Further, she suggested that the data underestimated disabilities due to dental conditions, since most are chronic and recurrent in nature. In addition to the above findings, economic costs

due to decreased productivity, absenteeism from work, and personal opportunity costs again are not easily measured.

When realizing the backlog of unmet dental needs, it becomes apparent that allocating resources to treat fully the diseases is "beyond the reach of even the most affluent nations" (Bailit & Silversin, 1981, p.243). If access to dental care was made available to all and this care was sought, the United States would not have the finances or person power to adequately treat the diseases. Although treatment and prevention cannot be totally divorced from one another, the only feasible solution to dental disease is through prevention.

Since dental disease is primarily caused by waste products produced by the bacterial flora, a variety of preventive techniques are available to counteract the effects of the waste products. The most effective strategy is to disrupt bacterial plaque at regular intervals, thereby preventing the absorption of toxic waste products (Jones, 1982). This can be done by proper brushing and flossing. Other oral hygiene devices are available as well, including proxabrushes, perio-aids, and floss aids. For a more complete description of oral health aids, the interested reader is referred to Harris & Christen (1981).

A combination of the following behavioral and environmental, preventive strategies could dramatically reduce the incidence of the majority of dental diseases:

- One can modify the diet to decrease the quantity and frequency of sugar intake, and thereby limit exposure to the toxic products;

- Fluoride can be ingested or applied topically and this repeated exposure to fluoride strengthens the tooth surface and makes it more resistant to dissolving; research also suggests that fluoride may have some antibacterial effects (Stallard, 1982);

- Pit and fissure sealants can be applied to teeth in order to prevent caries by forming a barrier between the acid and the tooth; and

- Frequent dental visits make available certain preventive measures and also ensure early diagnosis and treatment of dental disease.

Dental Health Education

Many dental health programs have emphasized two objectives: 1) stressing preventive services through screenings and referrals, and 2) educating people with films, pamphlets, and talks by teachers, dentists, and auxilliaries (Bailit & Silversin, 1981; Harris & Christen, 1981; McAlister & O'Shea, 1981). "Evaluation of the traditional programs has shown repeatedly that they have succeeded in increasing dental health knowledge but not in establishing adequate dental habits" (Leske et al., 1980, p.1460). Similar findings have been reported by Cohen and

Lucye (1970). As Bailit & Silversin (1981) stated, "One reason for the limited success of these traditional educational methods may be the failure of investigators to appreciate fully the importance of the environment in providing incentives or reinforcements [sic] for appropriate individual behavior. Individuals are both positively and negatively influenced in the practice of their oral health behaviors by a range of environmental factors outside their immediate control, such as access to cariogenic foods in school lunch rooms, Saturday morning television advertising of sugar-coated cereals, preventive health benefits covered in dental insurance plans, and acceptance of fluoride rinse programs by school administrators" (p. 244).

Thus, in addition to education, environmental changes may be necessary to maximize primary prevention efforts. As noted, the primary method for promoting appropriate preventive health action has been through educational efforts. Galli (1978) has stated that "the goal of health education is to provide information that individuals can use to enhance health status" (p.46). In past years, this has been the basis for dental health education. Certainly a directional or educational component is an integral part of a dental program. One cannot be expected to take appropriate action to prevent disease without knowing what that action is or how to carry it out. For example, a

dental professional must do more than tell a patient that s/he needs to floss. There is a correct way to floss and also a recommended schedule for flossing. Therefore, in addition to becoming aware of the need to floss, the patient must acquire appropriate flossing skills. Galli (1978) also pointed out that there is not a causal relationship between knowledge and behavior. Just because one acquires the skills of flossing does not guarantee that this behavior will be performed. It is therefore critical that dental professionals incorporate behavior change principles into their programs to motivate appropriate behaviors that will prevent dental diseases.

Teeth can last a lifetime if cared for properly. "The critical issue is the development, testing, and implementation of strategies that will motivate people to change their habits and increase utilization of preventive measures" (Bailit & Silversin, 1981, p.244). Many studies have identified factors that motivate individuals or groups to increase usage of dental health services (Kostiw , Stephenson, & Zarkowski, 1982; Reiss & Bailey, 1982; Reiss, Piotrowski, & Bailey, 1976; Rosenstock, 1974; Zaki & Bakdash, 1982), but the paucity of dental research which evaluates the motivating factors of prevention limits our understanding of those factors.

The initiation of preventive behaviors may be all that is necessary for some types of "one-shot" interventions

(Geller, et al., 1982). For example, visiting a dentist in order to have pit and fissure sealants applied is a "one-shot" intervention. However most preventive strategies, such as brushing and flossing, must be repeated frequently and maintained over long periods of time. Therefore, in many cases, both the initiation and the maintenance of preventive interventions need to be addressed.

Maintenance of preventive behaviors is particularly challenging in dentistry. Gallagher and Moody (1981) pointed out that, "although rational self-regard should lead a person to behave in such a way as to promote his own health, when the consequences of risky behavior are remote in time, and uncertain in their incidence, they are frequently ignored" (p. 289). This statement is particularly relevant to dentistry as the nature of dental disease is such that the symptoms are infrequent and often unobservable (except by a dental professional) and therefore, often ignored.

In a healthy mouth, attention is rarely focused on the teeth or gingiva. This may lead to a feeling of permanency or invulnerability. This difficulty is clarified by observing flossing behavior. Immediate reinforcers of flossing are not prevalent in everyday life. Some report a feeling of fresher breath, but not all develop this sensitivity. In addition, there is a long delay between the act of flossing and the subsequent reward that may

occur when the dentist reports that proper care of the teeth through flossing has led to no carious lesions. One may choose to sleep or watch television instead of flossing because the rewards are immediate for those activities. One option is to combine these two behaviors. Flossing can occur while watching television, and thus flossing becomes associated with a pleasant event and is potentially perceived as pleasant.

Because the prevention of dental disease relies on long-term maintenance of appropriate dental behaviors, preventive dentistry belongs in the realm of behavioral science (Gallagher & Moody, 1981) or applied behavior analysis (Geller, et al., 1982). There is a tremendous need for professionals working in the field of dentistry to increase their knowledge and application of the principles of behavior change, and to be more attentive to individual motivations, habits, and lifestyles that can influence the care of teeth and their supporting structures.

Two strategies that have been used to facilitate behavior change with other health behaviors (e.g., smoking cessation and weight control) are self-monitoring and behavioral management (Cormier & Cormier, 1979; Watson & Tharpe, 1981).

Self-Monitoring

As previously noted, health action to prevent disease often requires individual changes in lifestyle that are maintained over long periods of time and without the supervision of a health professional. Therefore, health action frequently necessitates behavior change strategies which allow individuals to monitor their own behavior. For example, self-monitoring has been used as part of self-management packages to facilitate behavior change (Watson & Tharp, 1981). The act of observing and recording a behavior can cause a change in frequency in the desired direction. This has been termed reactivity (Orne, 1970). Therefore, the behavior change strategy of self-monitoring holds potential for application to such health behaviors as dental flossing.

Self-monitoring is actually a two stage process, each step required to produce accurate recordings. First, the subject must be able to identify that the target behavior has occurred. Since dental flossing is a discrete behavior, it is assumed that the discrimination of this behavior could take place easily. Second, the subject has to record the behavior.

Nelson (1977) cited several studies that demonstrated the achievement of reactivity without accurate recordings, suggesting that it may be sufficient just to discriminate adequately the occurrence of the behavior for reactive

effects to occur and thus, accuracy of the recordings need not be a primary concern for effective intervention.

On the other hand, if one were using the technique of self-monitoring for evaluation purposes, accuracy would be desirable. Without accuracy, the data would not represent the behavior in question. However, accuracy is not always obtained with self-monitoring data. It is generally accepted that using retrospective data based on self-report lends itself to "bias, distortion, or deliberate falsification" (Frederiksen, Martin, & Webster, 1979, p.655). Self-monitoring was, therefore, employed in this study primarily as a behavior change strategy, although the data provided were subjected to statistical analysis.

Studies reviewed by Watson and Tharp (1981) indicated desired changes in the behaviors that the individual cared about and valued. For example, their review revealed self-monitoring being used effectively to reduce caloric intake and smoking behavior. Self-monitoring also has the advantage of being easy to implement and practical to use (Frederiksen et al., 1979). In addition, the data collected through this technique could be graphed and displayed as feedback, and thus serve to prompt increases in the desired behavior (Cormier & Cormier, 1979).

Although self-monitoring may be sufficient motivation to change some behaviors, certain disadvantages should be considered. The desired changes cannot be guaranteed for

all who self-monitor, and if changes occur, they may be transient. To increase effectiveness, self-monitoring could be coupled with other strategies, such as behavioral management; or the monitoring process could be continued over time to increase maintenance of the desired behavior (Cormier & Cormier, 1979; Watson & Tharp, 1981). Both of the above recommendations were employed in this study. Although Weinstein and Getz (1978) recommended using self-monitoring to prevent dental diseases, the impact of self-monitoring in preventive dentistry has not been empirically verified. The present study addressed this issue by including self-monitoring strategies in the intervention package.

Behavior Change

In reviewing the studies which employed behavior change techniques to promote appropriate dental behaviors, a variety of strategies were noted. For example, aversive stimuli were used in the behavioral management of thumbsucking and bruxism (Ayer & Gale, 1970). The habit of bruxism was also significantly reduced by applying habit reversal tactics (Azrin & Nunn, 1973; Azrin, Nunn, & Frantz-Renshaw, 1982). The majority of the studies reviewed, however, relied on the use of modeling and systematic desensitization to aid in the management of fearful and uncooperative dental patients (Adelson &

Goldfried, 1970; Ayer & Hirschman, 1972; Gale & Ayer, 1969; Gordon, Terdel, & Sterling, 1974; Melamed, Weinstein, Hawes, & Katin-Borland, 1976). More recently, cognitive strategies, such as stress inoculation, have been employed to reduce dental avoidance behaviors (Kleinknect & Bernstein, 1979; Klepac, Dowling, Hauge, & McDonald, 1981). In the above studies, coping strategies were taught via modeling while a patient viewed a videotape of a person preparing to leave for a dental visit. Although these studies have been successful in laboratory settings, initiation and maintenance of behaviors in the natural environment have not been assessed.

Other studies have focused on increasing the use of dental services, including research by Reiss and Bailey (1982) and Reiss, Piotrowski, and Bailey (1976). In this research, efficiency and cost effectiveness of several prompting techniques (e.g., notes, telephones, and/or home visits) and incentive strategies were used to encourage low-income, rural families, and Medicaid recipients to seek dental care. Multiple contacts plus incentives were found to be efficient and cost effective in increasing the number of dental visits among the population sampled.

All of the literature reviewed targeted the consumer of dental services, with the exception of Greene and Neistat (1983). In their study, the dental provider was targeted. After a baseline level of lead-shield usage was

obtained via contact with patients, letters were written to the dentists which described the study and the importance of such behavior. As a result of this feedback, statistically significant increases in the target behavior and long-term maintenance of lead-shield usage were shown among the target population.

Research in Preventive Dentistry

There is a marked dearth of research which applied behavioral management strategies to improve compliance with brushing regimens. However, even less attention has focused on the enhancement of dental flossing procedures. A survey done by the American Dental Association revealed that 94 percent of the sample brushed one or more times per day, while only 39 percent flossed daily (Ayer, 1984). Another survey revealed that less than 5 percent of the sample flossed on a daily basis (Craig & Monteque, 1976). Thus, compliance with flossing recommendations is apparently significantly lower than for brushing. This suggests that studies targeting flossing habits are needed.

Several studies were reviewed which employed behavior management strategies to increase compliance with oral hygiene prescriptions. In the area of prevention, the majority of the research has been applied to brushing behavior and has focused on the initiation, not on the maintenance, of appropriate behaviors. For example, Poche,

McCrubbrey, and Munn (1982) used modeling, physical guidance, and incentives to initiate proper brushing stategies among preschool children. Murray and Epstein (1981) also implemented modeling strategies to enhance tooth-brushing compliance. Other studies, which targeted brushing performance among elementary school children, applied token economies (Claerhout & Lutker, 1981; Martins, Frazier, Hirt, Meskin, & Proshek, 1973; Stacey, Abbott, & Jordon, 1972) or a game strategy (Swain, Allard, & Holborn, 1982) to increase the effectiveness of the brushing technique (as measured by amount of plaque present in the mouth).

Lattal (1969) applied the Premack Principle (Premack, 1962) to increase the brushing frequency of ten to twelve year old boys at a summer camp. The activity of swimming (a high frequency behavior) was allowed only if the boys had first brushed (a low frequency behavior). During the implementation of the program, the frequency of brushing increased. Although methodological weaknesses were noted in the studies which targeted brushing (including lack of random selection or assignment and lack of control groups), all subjects showed significant improvements in the brushing behaviors.

More recently, flossing behaviors have been targeted by researchers. For example, Dahlquist, Gil, Kalfus, Hodges, Ginsberg, and Holborn (1983) implemented a home-

based contingency management program which offered rewards for flossing and plaque reduction. In addition, prompts and self-monitoring procedures were used. The sample included three, nine year old children, and significant improvements in compliance with flossing recommendations were demonstrated via a multiple baseline design.

Iwata and Becksfort (1981) targeted flossing behavior in an adult population and found significant improvements in plaque reduction with the implementation of a fee reduction program. Their study included follow-up data to assess maintenance of the target behaviors six months after the intervention. The authors used a measure of plaque accumulation (the Simplified Oral Hygiene Index (OHI-S)) as their dependent measure. This is an improvement over research that used attendance or performance measures as dependent variables. However, there are limitations inherent in the use of the OHI-S and in using only physiological indices to measure flossing behavior. For example, one limitation of the OHI-S is that it designates measurement of plaque only on six teeth. The present study used a plaque and bleeding index and recorded accumulation on all interproximal tooth surfaces (when applicable, 32 teeth and 64 surfaces).

Several studies conducted during the past decade by Stephen Kegeles and Adrian Lund (1984) focused on the initiation and maintenance of preventive, oral health

behaviors (specifically compliance with fluoride rinse programs). Results were equivocal, at best. Their initial efforts to modify behavior by targeting beliefs and attitudes were repeatedly unsuccessful. In the second phase of the Kegeles and Lund research program, they used contingent rewards to modify behavior. This resulted in behavior change that returned to baseline when the rewards were no longer available. Thus, the available behavioral research in preventive dentistry has not established a methodology for long-term continuation of target behaviors (Kegeles & Lund, 1984; Lund & Kegeles, 1984).

The present study attempted to expand on prior research in preventive dentistry in several ways. First, multimodal assessment was used to measure more accurately the behavior in question. This also allowed comparisons across modalities. Second, the effectiveness of the intervention was compared between two populations, i.e., periodontal and clinic patients. Patients in a periodontal practice presumably are highly motivated to save their teeth and should respond more readily to a flossing program than patients from a dental clinic where services are provided free of charge. Third, two recorders were employed to collect data on all subjects at each observation session, and thus, interobserver reliability estimates were made after each examination. This is unique in that reliability estimates were not based on periodic

assessment, e.g., as in the Iwata et al., (1981) study, but on 100 percent of the examinations. In addition, enumerators were not informed that agreement percentages between the two recorders were being measured. Thus, inflated interobserver reliabilty estimates were potentially avoided. Finally, the intervention lasted for six months, and at approximately twelve months post-intervention, self-report follow-up data were collected. Such a lengthy intervention and follow-up generally were not offered in the literature reviewed.

Although scientific knowledge is available to prevent the vast majority of dental diseases, epidemiological data revealed that periodontal disease and caries are two of the most common diseases in the world. A survey conducted by the Bureau of Health Education of the American Dental Association (Craig & Montague, 1976) revealed that of those sampled, less than 50 percent had ever used dental floss and less than 5 percent flossed on a daily basis. Obviously preventive oral health behaviors, such as dental flossing, are not being widely applied. This presents major economic as well as health liabilities and indicates a clear need for applications of behavior change strategies to facilitate the initiation and maintenance of dental health actions.

Statement of the Problem

In this study, the behavioral strategies of self-monitoring and positive reinforcement were applied to preventive dentistry. The research evaluated the effects of self-monitoring and reward strategies on the maintenance of flossing behavior in samples of patients at a dental clinic and a periodontal practice.

Research Hypotheses

The following hypotheses were offered as a result of a thorough review of the relevant literature:

1) Those who receive standard dental health education and who also self-monitor will have higher frequencies of flossing behavior than those who only receive education.

2) Those who receive standard dental health education, who self-monitor, and also are exposed to monetary incentives will exhibit higher frequencies of flossing behavior than those who receive dental health education and only self-monitor.

3) All subjects from the periodontal practice will respond more favorably to the treatment interventions and will have higher frequencies of flossing behavior than subjects from the dental clinic setting.

Method

Subjects

Setting. This research was conducted with the cooperation of the Dental Hygiene Clinic at Virginia Western Community College (VWCC) in Roanoke, Virginia and a private, periodontal practice in Blacksburg, Virginia. The two cities are located approximately 34 miles apart. Subjects were selected and initial data collection was conducted over a two month period during the spring and summer of 1983.

Subject selection. As subjects arrived at each setting, they were asked to read a brief description of the study. If they volunteered to participate, a consent form was signed (see Appendix A) and a request was made for them to fill out a structured demographic form (see Appendix B). A sample size of 120 was obtained, with 60 subjects from each setting. Twenty subjects from each setting were randomly assigned to each of the three experimental conditions. Data collection indicated that subjects attending both settings were heterogeneous with regard to demographic variables.

Procedures

All intervention groups were examined on three occasions: 1) pre-intervention (at the initial exam), 2) during-intervention (approximately three months later), and 3) post-intervention (approximately six months after the interventions began). In addition, self-report data on flossing frequency were collected approximately 18 months after the intervention started for a follow-up contact.

For each subject, complete medical and dental histories were obtained by way of questionnaires and interviews. The medical and dental questionnaires followed the standard format employed in medical and dental practices. The obtainment of medical and dental histories is part of the routine procedures at the VWCC dental hygiene clinic and the periodontal practice. In order to gather more information about the characteristics of the sample population, however, additional data pertaining to education, income, age, race, and previous flossing behavior were collected via the structured demographic form previously mentioned (see Appendix B).

All groups received the standard services provided by the dental clinic and periodontal practice. These services included a soft and hard tissue examination, radiographic survey (if necessary), dental health education, and a dental prophylaxis. Subjects were then examined thoroughly by either an instructor at VWCC or a periodontist at the

private practice. The subjects were then dismissed or rescheduled if the prophylaxis was not completed.

At the end of their first appointment, subjects were asked to schedule a second exam that would take place in approximately three months. The same procedure was followed at the next appointment for the third data collection session. An appointment was made for all 120 subjects. Two weeks prior to that appointment, all subjects were mailed a handwritten reminder of the date and time of their appointment with a telephone number to call if they needed to reschedule. For each subject who did not show up for their appointment, a follow-up telephone contact was made. If the subject was not at home, attempts were made until s/he (or a significant other) was reached. If someone other than the subject was contacted, a brief explanation was given along with the author's name and phone number. Subjects were encouraged to call collect, if necessary, to set another date for the examination. All subjects were reached either directly or through a friend or family member.

Training for data enumerators. A total of 28 dental hygiene students participated in the data collection procedure at VWCC. All students had been trained at VWCC to disclose plaque and discriminate its presence. In addition, each had been trained to use a periodontal probe and were deemed proficient by the clinical faculty at VWCC.

Students had participated in clinical courses which began in the fall of 1982 and were continuing in the spring of 1983. In these clinical courses, didactic material was provided and practical experience in performing the above procedures was obtained. Students first practiced the procedures on each other during the fall of 1982 under the close supervision of the clinical faculty. In the winter of 1983, the students began seeing patients.

One week prior to the implementation of this study at VWCC, a seminar was held in which the author reviewed all procedures (except interrater reliabilty) with the students and the steps for collecting physiological data were clarified. On the first day of each data collection period, one hour prior to the clinic session, the author again briefly reviewed the procedures and answered any questions.

At the private periodontal office, five licensed dental professionals collected data. All were found competent by the licensing board of the state of Virginia in the use of a periodontal probe and the disclosing and discrimination of plaque. Meetings were held with the staff periodically during the course of the study to clarify aspects of the data collection procedure and to address any concerns of the enumerators.

Dependent variables. Four dependent measures were examined. Each modality of the target behavior was

assessed at various stages during the intervention (e.g., pre-, during-, post-intervention, and follow-up). These dependent variables included self-report measures of flossing frequency, an unobtrusive measure of flossing frequency, and two physiological indices of outcome of the potential effect of performing the target behavior.

First, prior to the intervention, all subjects were asked to report the frequency of their flossing behavior. In addition, subjects assigned to two of the intervention groups were asked to monitor daily their flossing behavior for the next six months. Also, approximately 18 months after the intervention began, a follow-up contact was made and 8 subjects from VWCC and 26 subjects from the periodontal practice were reached by telephone. No reference of this research project was made at that time and subjects were asked to answer several questions pertaining to dental health, one of which was "How many times per week do you floss your teeth?".

Second, an unobtrusive measure of the flossing frequency was selected. Dental floss was provided for all subjects and they were asked not to share it with other individuals. The subjects were further instructed to return all floss containers used to the examiner at each scheduled appointment. Furthermore, at all three exams, the subjects were asked to demonstrate their flossing technique. An average of the three floss lengths gave an

approximate measure of the amount of floss used at each flossing session. Subsequently, the floss remaining in the returned containers was measured and recorded. The amount of floss used during the intervention phases was divided by the estimate of floss used at each flossing session. This provided a measure of the frequency of flossing during the intervention.

Since the primary objective of dental flossing is to disrupt bacterial plaque, the last dependent measure assessed the outcome of this process via two physiological indices. One index, the Plaque Control Record (PCR), measured the presence of dental plaque, whereas the second, the Sulcular Bleeding Index (SBI), assessed the presence of bleeding.

A plaque control score represents the percentage of tooth surfaces that do not contain plaque. The first steps in obtaining the PCR are to examine the mesial and distal surfaces closest to the gingival margin, and record those surfaces with plaque present. Next, the total number of mesial and distal surfaces without plaque is divided by the total number of interproximal surfaces and multiplied by 100 (Zaki et al., 1982).

The PCR is the dependent measure most frequently used in dental research of this nature. Other modalities of the target behavior and other aspects of the physiological response are usually not addressed. However, it has been

suggested that plaque scores alone may not be accurate enough to assess flossing behavior (Stallard, 1982). For example, a patient who flosses daily but forgets to floss the day of the appointment may have considerably higher percentages of plaque than normal. On the other hand, a patient who flosses infrequently may spend additional time removing plaque the day the scores are taken and may have a lower PCR score the day of the exam. Therefore, a second physiological, dependent measure (i.e., the SBI) was chosen for this study.

Since one of the major reactions of the body to bacterial plaque is gingival inflammation, another indicator of flossing behavior is the presence of bleeding. Thus, the SBI index assessed the amount of gingival bleeding present.

A sulcular bleeding score represents the percentage of gingival surfaces that do not exhibit signs of inflammation. This score is obtained by probing the mesial and distal surfaces and observing the presence of bleeding. The number of non-bleeding surfaces is divided by the total number of interproximal surfaces and multiplied by 100 (Zaki et al., 1982).

Interobserver reliability estimates. For each subject examined, there was a possible total of 64 occurrence-nonoccurrence choices made for each physiological index. Point-by-point comparisons of the two observers recordings

were made between the PCR and SBI, and the percent agreement was determined for each index by dividing the total number of agreements by the total number agreements and disagreements. The product was multiplied by one hundred in order to obtain a reliabilty coefficient (i.e., percent agreement) for each index and each data set.

In addition to the above comparisons and calculations for the physiological indices, percent agreement was obtained for the unobtrusive measure after two data recorders measured the length of dental floss not used during the intervention. Recall that this was one step in the calculation of flossing frequency determined from the unobtrusive measure. Two individuals measured the amount of floss remaining in each floss container. Floss was measured with a ruler and lengths were rounded to the nearest inch.

Interventions

The effects of a standard dental health education program were compared to the same program plus self-monitoring. A third group received the program plus a self-monitoring and monetary incentive package.

Education program (Ed). Dental health education is an on-going program at both facilities and all subjects were exposed to individual instruction, visual aids, feedback, and patient participation (e.g., guided practice in the

development of flossing and brushing skills). In addition, each subject received information verbally and in written form from dental hygiene students and dental professionals regarding the etiology of caries and periodontal disease, and the importance of prevention. Direct observation of the education delivered in both settings revealed comparable processes with students and professionals being equally thorough in the delivery of information.

In each setting, similar educational strategies were employed. For example, disclosing solution was used and the subjects learned to identify plaque in their own mouths. At this time, the examiners assessed the subjects' dental needs and adapted the instructions as necessary. Oral physiotherapy aids were chosen and in the vast majority of cases, this included flossing and brushing. Skill development was taught primarily through guided practice. If the subject was seen for a second prophylaxis appointment, feedback was provided to the subject on skill proficiency. This was done by observing the subject's technique and also by assessing the amount of plaque and calculus buildup.

Education plus self-monitoring (Ed/S.Mon). Subjects assigned to this condition received the same educational program previously described. In addition, subjects were given a pack of six 3 X 5 postcards on which their daily flossing behavior was to be charted (see Appendix D). Each

card covered a 14-day period and was stamped and addressed. A card was to be mailed in every two weeks during the course of the study. Six cards were given to the subjects at the initial appointment and again at the second observation session.

Education, self-monitoring, and monetary incentives (Ed/S.Mon/MI). Subjects assigned to this group received the same interventions as the two previously described (i.e., Ed and Ed/S.Mon). In addition, the subjects had the opportunity to participate in a raffle for a monetary incentive. All self-monitoring cards that were mailed to the specified location were collected, and on two occassions (i.e., approximately three and six months after the interventions began) one card was drawn from each setting. On each selected card, the two weeks of recorded flossing behavior could be tallied. For each day of flossing that was recorded, the winners were awarded $1.00 for a potential sum of $14.00 per person.

Experimental Design

Compliance with the advised flossing regimen of six independent groups from two settings was compared across four specific phases (i.e., at Pre-intervention, During-intervention, Post-intervention and Follow-up). This presented a mixed factoral design, which is a blending of the within-subjects (repeated measures) and between-

subjects designs (Keppel, 1982). The between factors included: 1) the interventions or experimental conditions (three levels), and 2) the settings (two levels). The within factor was measurement phase (pre-intervention, during-intervention, post-intervention and follow-up). Thus, the design was a factorial of 2 populations (VWCC vs. periodontal practice) X 3 interventions (Ed, Ed/S.Mon, vs. Ed/S.Mon/MI) X 4 contacts (Pre-intervention, During-intervention, Post-intervention vs. Follow-up).

Results

Demographics of Sample

A close examination of the data revealed that subjects from both settings consisted of patients with similar age ranges (e.g., 13 to 71 years of age for VWCC subjects and 15 to 74 years of age for Periodontal subjects). In addition, a larger percentage of subjects from each setting were Caucasian and female. However, as previously noted, patients attending both settings were, on the whole, quite heterogeneous with regard to other aspects of the demographic variables. The data for age, education, sex, race, and income are summarized in Table 1 and 2.

As depicted in Table 1, the median educational level was 1.5 years higher for the Periodontal subjects than for the VWCC sample. Further, the subjects from the private, periodontal practice were older and more frequently in the higher income brackets (see Table 2). For example, the mean age of the peridontal subjects was 15 years more than the VWCC sample. Further, a comparison of the incomes revealed that only 7.3 percent of the Periodontal sample reported an income below $10,000 (as compared to 18.4 percent from VWCC); 14.6 percent below $19,999 (as compared to 51.1 percent from VWCC); and 56.4 percent above $30,000 (as compared to 22.5 percent from VWCC).

Table 1

Summary Statistics for Age and Education
for Subjects from Both Settings

A. VWCC

Variable	N	Mean	Median	Standard Error	Minimum Value	Maximum Value
Age	53	31.9	29.0	15.7	13.0	71.0
Education	54	13.4	13.0	3.4	5.0	20.0

B. Perioiodontal Practice

Variable	N	Mean	Median	Standard Error	Minimum Value	Maximum Value
Age	60	46.9	46.0	11.3	15.0	74.0
Education	60	14.6	14.5	3.3	6.0	20.0

Table 2

Summary Statistics for Sex, Income, and Race for Subjects from Both Settings

	VWCC		Perio. Practice	
VARIABLE	FREQ.	PERCENT	FREQ.	PERCENT
SEX:				
Male	24	42.9%	19	31.7%
Female	32	57.1%	41	68.3%
INCOME:				
<10,000	9	18.4%	4	7.3%
10,000-14,999	9	18.4%	1	1.8%
15,000-19,999	7	14.3%	3	5.5%
20,000-20,999	13	26.5%	16	29.1%
>30,000	11	22.5%	31	56.4%
RACE:				
Caucasian	46	82.1%	60	100%
Afro-Amer.	8	14.3%	___	___
Asian	1	1.8%	___	___
Hispanic	1	1.8%	___	___

Statistical analysis using the t-test showed that subjects from the periodontal practice had a significantly higher amount of education, $t(112) = 3.16$; $p < .001$. Further analysis revealed significant differences in the mean age of the two samples $t(110) = 5.78$; $p < .001$, and the mean income level, $t(110) = 3.15$; $p < .001$, with periodontal subjects being older (e.g., 46.9 versus 31.9 mean ages for periodontal and VWCC subjects, respectively) and making a higher income (e.g., 56.4 percent versus 22.5 percent earning more than $30,000 for periodontal and VWCC subjects respectively).

Subjects' Participation

Of the 60 subjects from VWCC who volunteered to participate in this study, 35 dropped out prior to the second data collection period. This left 41.7 percent of the original VWCC sample participating at the second observation session (i.e., during-intervention). For the Ed group, 7 subjects returned resulting in a participation rate of 35 percent; 10 participants from the Ed/S.Mon treatment group returned for a participation rate of 50 percent; and 8 participants from the Ed/S.Mon/MI treatment group returned for a participation rate of 40 percent.

By the end of the intervention (approximately 6 months later), an additional 10 subjects from VWCC dropped out of the study. This brought the total participation rate from

that setting to 25 percent. For the Ed group, no subjects returned; 8 participants returned from the Ed/S.Mon group, which resulted in a participation rate of 40 percent; and 7 participants from the Ed/S.Mon/MI group returned for a participation rate of 35 percent.

Of the 60 subjects volunteering from the private periodontal practice, 15 dropped out prior to the second data collection period for a 75 percent participation rate. Only two subjects did not return from the Ed group which resulted in a participation rate of 90 percent; 13 returned from the Ed/S.Mon group for a 65 percent participation rate; and 14 participants from the Ed/S.Mon/MIgroup returned for a participation rate of 70 percent.

By the third observation session, an additional 16 periodontal patients dropped from the study for an overall participation rate from that setting of 48.3 percent. Eleven subjects returned from the Ed group for a participation rate of 55 percent; 9 participants from each of the other two groups returned for a participation rate of 45 percent each. The total participation rate for all three groups during the final three months was 48 percent. Furthermore, fewer subjects dropped out of the study from the periodontal practice than from the clinic at VWCC. See Figure 1 for a summary of the participation frequencies per

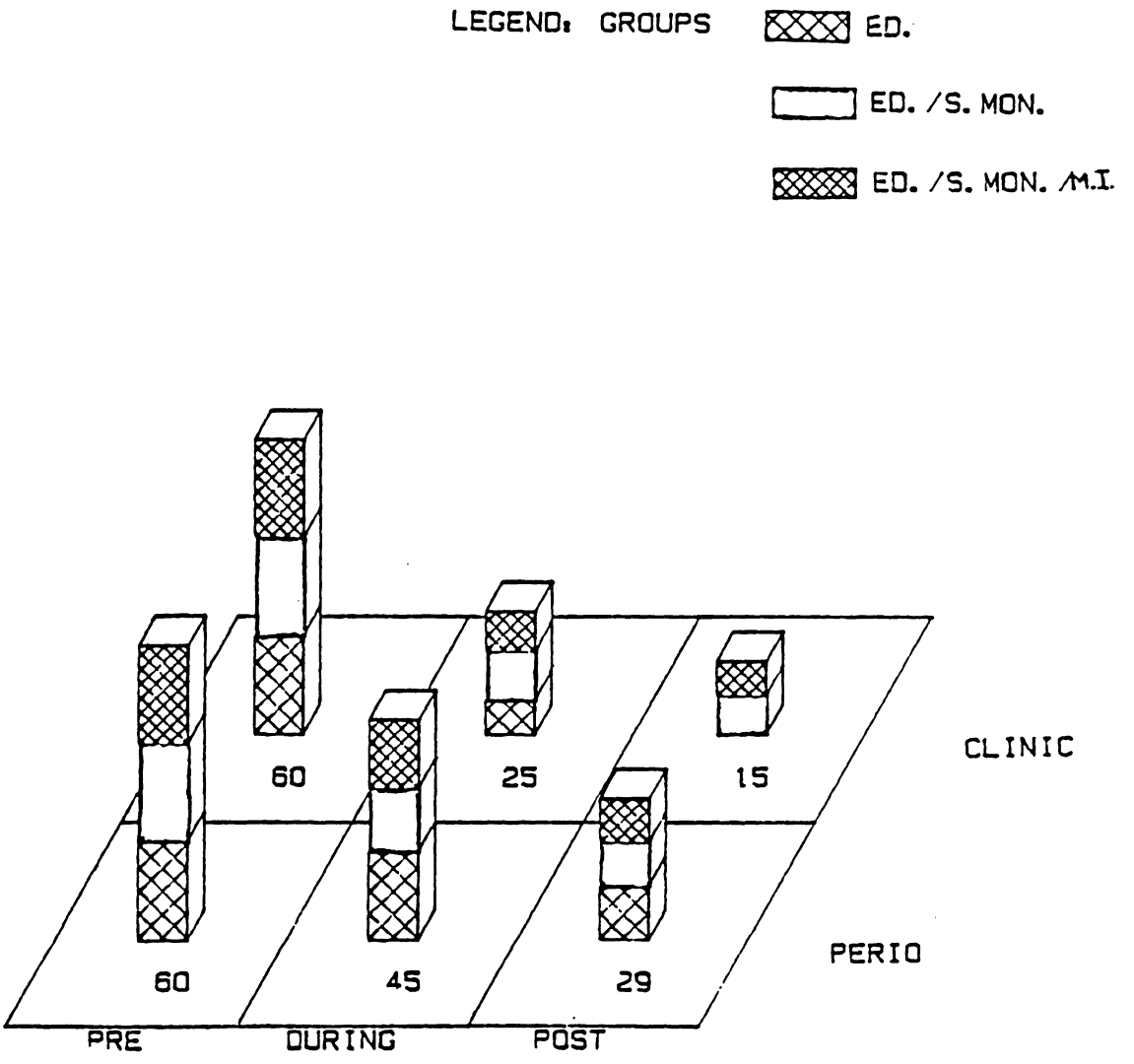

Figure 1. Frequency of Subjects Participating in Various Stages of the Study

setting and data collection session.

A cursory examination of the data on dropout rates suggested a difference between the Ed group and the Ed/S.Mon and Ed/S.Mon/MI groups from VWCC and also a difference between settings. Therefore, a statistical analysis of the attrition rate was performed. At VWCC, A Chi-square test showed significant differences between the Ed group and the other intervention groups from that setting with regard to attendance (χ (4) = 14.16; p < .05). However, no significant differences were noted among the intervention groups at the periodontal practice (χ (4) = 9.48; p < .05). Thus, with regard to attrition, differential effects appear to have occurred between settings.

Interobserver Agreement

As shown in Table 3, the interobserver reliabilities for both settings were within acceptable ranges (ranging from 71 to 93 percent). At VWCC, the average PCR and SBI agreements for all three data collection sessions were 77 percent and 78 percent, respectively. The interobserver agreements of the examiners were slightly higher at the private practice than at VWCC, with average PCR and SBI percent agreements for all three data collection sessions at the periodontal practice being 90.3 percent and 89.3 percent, respectively.

Table 3

Interobserver Percent Agreements
for Subjects from Both Settings

	VWCC				Perio. Practice			
	n	PCR	n	SBI	n	PCR	n	SBI
Pre-Interv.	60	78%	60	80%	60	88%	60	85%
Dur.-Interv.	25	71%	25	89%	45	90%	45	91%
Post-Interv.	15	82%	15	65%	29	93%	29	92%
Totals		77.0%		78.0%		90.3%		89.3%

In addition to the above percent agreements, reliability was estimated after two data recorders measured floss for the calculation of flossing frequencies for the unobtrusive measure. One hundred percent agreement was attained for measurements to the nearest inch.

Plaque Scores

Table 4 lists the mean percentages of subjects' plaque scores (individually scored via the PCR and averaged within groups) for each group and each setting. The differences between the mean plaque scores at the first physiological exam (i.e., pre-intervention) and the last physiological exam (i.e., post-intervention) were calculated. Included in this table are group means for only subjects within groups who were present and provided PCR data at all three exams (n=51). All groups from both settings (with the exception of the VWCC/Ed group which had 100 percent attrition) presented decreases in plaque accumulation from pre-intervention to post-intervention.

From all scores depicted in Table 4, both Ed/S.Mon/MI treatment groups showed the greatest amount of change during the interventions. Furthermore, both Ed/S.Mon and Ed/S.Mon/MI treatment groups from the periodontal practice demonstrated greater decreases in the amount of plaque present than did the comparable VWCC groups (e.g., -38.7 percent (n=9) versus -26.1 percent (n=7) for the

Table 4

Group Means of Plaque Percentages at
Pre- and Post-Intervention for Both Settings

A. Periodontal Practice
(n = 29)

	Pre	Post	Change
ED (n = 11)	50.8%	22.8%	-28.0%
ED/S.MON (n = 9)	59.3%	34.9%	-24.4%
ED/S.MON/MI (n = 9)	72.4%	33.7%	-38.7%

B. VWCC
(n = 22)

	Pre	Post	Change
ED (n = 7 at Pre) (n = 0 at Post)	59.7%	———	———
ED/S.MON (n = 8)	54.9%	31.9%	-23.0%
ED/S.MON/MI (n = 7)	64.5%	38.4%	-26.1%

Ed/S.Mon/MI groups and -24.4 percent (n=9) versus -23.0 percent (n=8) for the Ed/S.Mon groups).

Figure 2 graphically depicts the changes in plaque scores from pre-, during-, to post-intervention for the PCR group means from both settings. Generally a steady decline in plaque scores was noted for each group from the periodontal practice. For the VWCC samples, less change in mean PCR scores was noted between pre- and during-intervention while the VWCC groups did show a sharp decline in percentage of plaque present from during- to post-intervention.

The percentage of subjects who reduced their plaque levels during the intervention is depicted in Table 5. From pre- to during-intervention, the Ed/S.Mon and Ed/S.Mon/MI groups from both settings had higher proportions of subjects improving (i.e., reducing their plaque levels) than did either Ed group. This same trend was noted for the periodontal practice from during- to post-intervention. Since the VWCC Ed group had 100 percent attrition at post-intervention, a comparison between the VWCC intervention groups from during- to post-intervention cannot be made.

From the periodontal practice, higher percentages of subjects within groups improved (i.e., reduced) their plaque levels than did those subjects from VWCC. For example, the Ed group from the periodontal practice (n=11)

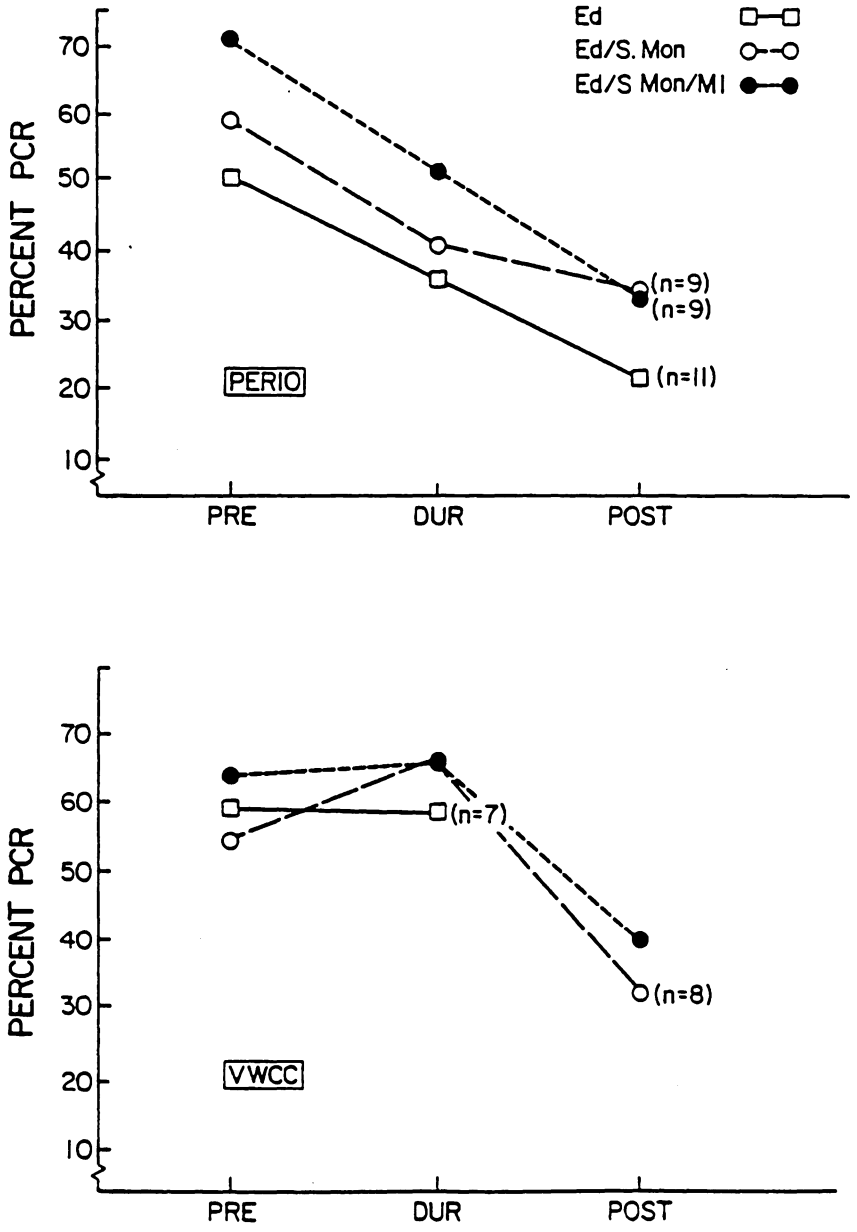

Figure 2. Mean PCRs as a Function of Intervention Condition and Experimental Phase

Table 5

Percentage of Subjects from Each Group Whose Plaque Scores Reduced from Pre- to During-, During- to Post- and Pre- to Post-Intervention

A. Periodontal Practice (n=29)

	Pre to Dur	Dur to Post	Pre to Post
ED (n = 11)	81.8%	0.0%	72.7%
ED/S.MON (n = 9)	100.0%	33.3%	55.0%
ED/S.MON/MI (n = 9)	100.0%	28.5%	71.4%

B. VWCC (n=22)

	Pre to Dur	Dur to Post	Pre to Post
ED (n = 7)	28.6%	———	———
ED/S.MON (n = 8)	40.0%	87.5%	87.5%
ED/S.MON/MI (n = 7)	62.5%	57.1%	80.0%

had 81.8 percent of the subjects reducing plaque levels versus 28.6 percent from the VWCC/Ed group (n=7); the Ed/S.Mon group (n=9) had 100 percent versus 40 percent (n=8); and the Ed/S.Mon/MI group (n=9) had 100 percent versus 62.5 percent (n=7).

The opposite trend was noticed between settings at the third observation session, with a larger percentage of subjects within groups from VWCC versus the periodontal practice demonstrating lower plaque levels than was recorded at the previous data collection session. For example, the Ed/S.Mon group from VWCC (n=8) had 87.5 percent of subjects with a plaque reduction versus 33.3 percent from the periodontal practice (n=9) and 57.1 percent of the Ed/S.Mon/MI from VWCC (n=7) versus 28.5 percent from the periodontal practice (n=9). At the third observation session, no subjects from the Ed group at the periodontal practice (n=11) reduced their plaque levels.

A comparison of pre- to post-intervention changes in plaque scores showed that a majority of subjects from each group (e.g., a range of 55.0 to 87.5 percent) improved their plaque scores (see Table 5). In this comparison, a higher proportion of subjects from the VWCC Ed/S.Mon and Ed/S.Mon/MI groups reduced their plaque levels than from the comparable Periodontal groups.

Sulcular Bleeding Scores

As with the PCR, data reflect subjects from each setting who provided SBI data at all observation sessions (n=51). Again, no subjects from the VWCC/Ed group attended the post-intervention observation session.

Table 6 lists the mean percentages of subjects' bleeding scores for each group and each setting. Also included in this table are the differences between the mean bleeding scores at pre- and post-intervention. From the periodontal practice, each group demonstrated a reduction in SBI bleeding scores during the interventions. The E./S.Mon group (n=9) showed the greatest decline in bleeding, with a difference in scores of -16.4 percentage points from pre- to post- intervention as compared to -10.1 percent in the Ed/S.Mon/MI group (n=9) and -7.6 percent in the Ed group (n=11).

Both Ed/S.Mon and Ed/S.Mon/MI groups from VWCC showed increased bleeding scores instead of the decline found with the comparable groups from the periodontal practice (see Table 6). The Ed/S.Mon/MI group from VWCC (n=7) had greater increases in bleeding than the Ed/S.Mon group (n=8) with an increase of 32.6 percentage points in bleeding versus 15.6 percent respectively.

Figure 3 portrays the changes in bleeding from pre- to during- to post-intervention and is based on within group, mean SBI scores from each setting. This allowed

Table 6

Group Means of Bleeding Percentages at
Pre- and Post-Intervention for Both Settings

A. Periodontal Practice
(n = 29)

	Pre	Post	Change
ED (n = 11)	24.2%	16.6%	-7.6%
ED/S.MON (n = 9)	29.9%	13.5%	-16.4%
ED/S.MON/MI (n = 9)	38.6%	28.5%	-10.1%

B. VWCC
(n = 22)

	Pre	Post	Change
ED (n = 7 at Pre) (n = 0 at Post)	13.8%	_____	_____
ED/S.MON (n = 8)	14.5%	30.1%	15.6%
ED/S.MON/MI (n = 7)	7.9%	40.5%	32.6%

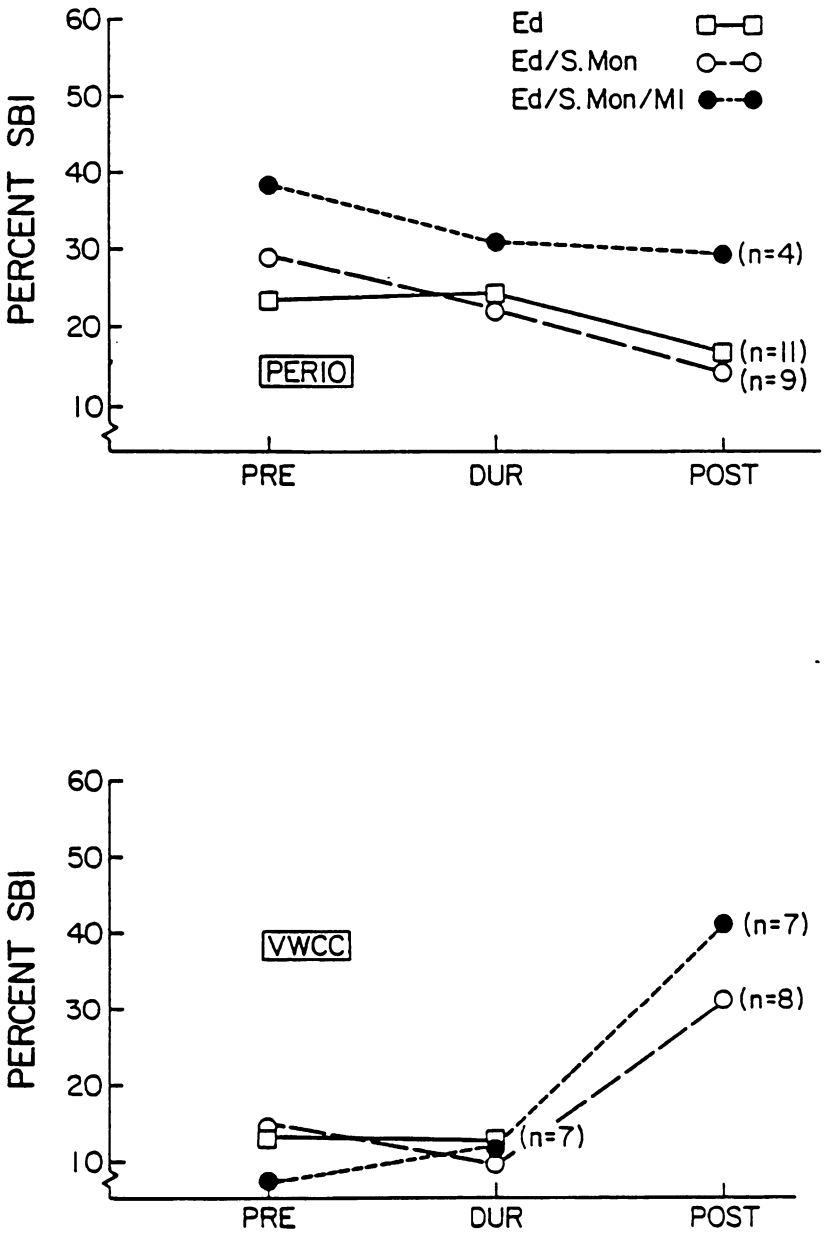

Figure 3. Mean SBIs as a Function of Intervention Condition and Experimental Phase

comparison between groups and settings. From pre- to post-intervention, Figure 3 depicts a relatively steady decline in bleeding for the Ed/S.Mon and Ed/S.Mon/MI groups from the periodontal practice. The Ed group, however, demonstrated minimal change from pre- to during-intervention, but a sharp decline from during- to post-intervention. In contrast, with each VWCC group, minimal changes were noted from pre- to during-intervention, but a considerable increase in bleeding scores occurred from during- to post-intervention.

Table 7 depicts the percentage of subjects from each group who reduced their bleeding levels from the pre- to during- to post-intervention. At the second observation session (i.e., during-intervention), more subjects from the Ed/S.Mon/MI (n=9) and the Ed/S.Mon (n=9) at the periodontal practice had reduced their bleeding levels as compared to scores at the previous observation (e.g., 100 percent for both groups) than had subjects in the Ed group, e.g., 72.7 percent (n=11). Each Periodontal group had a larger proportion of subjects with reduced bleeding at the second session than did VWCC groups, where within groups, 28.6 percent of the Ed group from VWCC (n=7), 60 percent of the Ed/S.Mon (n=8), and 62.5 percent of the Ed/S.Mon/M./I. (n=7) exhibited less bleeding.

At post-intervention (i.e., third observation session), a smaller proportion of subjects from both

Table 7

Percentage of Subjects from Each Group Whose Bleeding Scores Reduced from Pre- to During-, During- to Post- and Pre- to Post-Intervention

A. Periodontal Practice (n = 29)

	Pre to Dur	Dur to Post	Pre to Post
ED (n = 11)	72.7%	27.3%	63.6%
ED/S.MON (n = 9)	100.0%	22.2%	88.8%
ED/S.MON/MI (n = 9)	100.0%	28.5%	85.7%

B. VWCC (n = 22)

	Pre to Dur	Dur to Post	Pre to Post
ED (n = 7)	28.6%	———	———
ED/S.MON (n = 8)	60.0%	25.0%	12.5%
ED/S.MON/MI (n = 7)	62.5%	0.0%	71.4%

settings demonstrated lowered bleeding levels (see Table 7). Furthermore, a comparison of pre- to post-intervention scores showed that a larger percentage of subjects from the periodontal practice reduced their bleeding scores than did the Ed group from that setting. From VWCC, more subjects from the Ed/S.Mon/MI group reduced their bleeding than did subjects from the Ed/S.Mon group. A comparison between settings revealed that a larger proportion of subjects from the periodontal practice Ed/S.Mon and Ed/S.Mon/MI groups reduced their bleeding than did the same groups from VWCC .

Unobtrusive Measure of Flossing Frequency

Recall that subjects were given dental floss (i.e., 100 yards each at the first and second observation session). At the second and third observation session, subjects returned the floss containers. Floss that was remaining in each container (i.e., not used) was measured. This amount was subtracted from 100 yards and then divided by the individual estimates of amount of floss used per flossing session. This final amount was divided by the appropriate time period, providing weekly flossing frequencies per subject.

Table 8 shows the group means of weekly flossing frequencies which were calculated from the unobtrusive measure. Data from this measure indicated that each group from the periodontal practice averaged flossing frequencies

Table 8

Group Means of Weekly Flossing Frequencies from Both Settings with Change in Frequency from During- to Post-Intervention

A. Periodontal Practice
(n = 15)

	During	Post	Change
ED (n = 6)	14.1	10.4	-3.7
ED/S.MON (n = 4)	9.8	10.9	1.1
ED/S.MON/MI (n = 5)	13.2	13.3	0.1

B. VWCC
(n = 14)

	During	Post	Change
ED (n = 4 at Pre) (n = 0 at Post)	3.2	___	___
ED/S.MON (n = 6)	9.9	5.1	-4.8
ED/S.MON/MI (n = 4)	9.8	6.4	-3.4

that approached twice per day. From during to post intervention, a decrease in flossing frequency was noted for the periodontal Ed group. Only slight increases in flossing frequencies were found for the periodontal Ed/S.Mon and Ed/S.Mon/MI groups during the same time period.

For the Ed/S.Mon and the Ed/S.Mon/MI groups from VWCC, the flossing frequency, based on the unobtrusive measure showed similar decreases in flossing frequency from during to post intervention (e.g., -4.8 and -3.4 respectively). Although there were substantial decreases for those groups, flossing frequencies still approached a daily schedule at the post examination.

Table 9 depicts the percentage of subjects within groups who increased their flossing frequency from during-to post-intervention. The Ed group from VWCC had dropped out of the study by the post examination and therefore, no comparison can be made. None of the subjects from the periodontal Ed group or the VWCC Ed/S.Mon group showed improvements on the unobtrusive measure during this time period. For the other three groups, 20 to 25 percent of the subjects exhibited improved flossing frequencies.

Table 10 depicts the group means of individual, average floss lengths (in inches) used at the observation sessions. This allowed a comparison among groups and between settings to ascertain whether more or less floss was being used by subjects as a result of the intervention.

Table 9

Percentage of Subjects from Each Group Whose Unobtrusive Data Showed an Increase in Reported Flossing Frequencies from During- to Post-Intervention

	Perio. Practice (n=15)	VWCC (n=10)
ED	0 % (n=6)	____ (n=0)
ED/S.MON	25 % (n=4)	0 % (n=6)
ED/S.MON/MI	20 % (n=5)	25 % (n=4)

Table 10

Average Length of Floss Used (in Inches) per Group and Change in Average Length from During- to Post-Intervention

A. Periodontal Practice
(n = 26)

	During	Post	Change
ED (n = 9)	23.1	25.3	2.1
ED/S.MON (n = 8)	21.7	17.5	-4.2
ED/S.MON/MI (n = 9)	17.8	17.6	-0.2

B. VWCC
(n = 21)

	During	Post	Change
ED (n = 8 at Pre) (n = 0 at Post)	27.4	___	___
ED/S.MON (n = 6)	18.6	18.0	-0.6
ED/S.MON/MI (n = 7)	24.0	23.9	-0.1

Average estimates of the amount of floss used (in inches) for each group from both settings remained relatively stable during the intervention. For the periodontal practice (n=26) the range in mean floss lengths was 17.8 to 23.1 during-intervention and 17.5 to 25.3 at post-intervention. For the VWCC groups (n=21) the range varied from 18.6 to 27.4 during-intervention and 18.0 to 23.9 at post-intervention. The Ed/S.Mon groups from the periodontal practice (n=8) and from VWCC (n=6) used on the average slightly less floss by the end of the intervention. In addition, the Ed/S.Mon/MI groups also demonstrated minor changes in average floss lengths used, with the Periodontal group (n=9) and the VWCC group (n=7) using slightly less floss by the last observation session.

Self-Monitoring

Group means of subjects' weekly flossing frequencies, which were calculated from the self-monitoring data, are given in Table 11. As shown, slight increases in flossing frequencies were reported for all groups from both settings except the Ed/S.Mon/MI group from the periodontal practice (n=8) where a slight drop in flossing frequency (7 to 6.7) was found. Note that this latter frequency still approximated a daily flossing schedule. During that same time period, the Ed/S.Mon/MI group from VWCC (n=5) reportedly increased their mean flossing frequency from 6.5

Table 11

Group Means of Self-Monitoring Data of Reported Weekly Flossing Frequencies for Both Settings with Change from During- to Post-Intervention

A. Periodontal Practice (n = 16)

	During	Post	Change
ED/S.MON (n = 8)	10.5	11.0	.5
ED/S.MON/MI (n = 8)	7.0	6.7	-.3

B. VWCC (n = 14)

	During	Post	Change
ED/S.MON (n = 9)	6.0	6.3	.3
ED/S.MON/MI (n = 5)	6.5	6.9	.4

to 6.9 times per week. All other groups reportedly increased their flossing frequencies during the intervention as well.

Table 12 depicts the percentage of subjects from each setting whose self-monitoring data showed a reported increase in flossing frequencies from during- to post-intervention. Increased flossing frequencies across settings ranged from no subjects increasing their frequencies to 50 percent showing an increase.

Table 13 shows the proportion of subjects from both settings who reportedly self-monitored their daily flossing behavior and during the interventions, mailed to the author their self-monitoring cards. Compliance with this self-monitoring procedure was greater for each group from both settings from pre- to during-intervention than during the second time period. From pre- to during-intervention, a range of 60 to 75 percent of the subjects across both settings self-monitored and mailed in their cards. For the same groups from each setting, the compliance rate dropped during the second time period (i.e., during- to post-intervention) with 25 to 40 percent of the original samples complying with the procedure.

Self-Reported Pre-Intervention and Follow-Up Data

Baseline measures of the subjects' flossing frequencies, prior to the implementation of the

Table 12

Percentage of Subjects from Each Group Whose Self-Monitoring Data Showed an Increase in Reported Flossing Frequencies from During to Post Intervention

	Perio. Practice	VWCC
ED/S.MON	50 % (n=8)	25 % (n=9)
ED/S.MON/MI	0.0% (n=8)	20 % (n=5)

Table 13

Compliance with Self-Monitoring Procedure from Pre- to During- and During- to Post- with Groups from Both Settings

A. Periodontal Practice

	Pre to Dur	Dur to Post
ED/S.MON	70 % (n=14)	40 % (n=8)
ED/S.MON/MI	75 % (n=15)	40 % (n=8)

B. VWCC

	Pre to Dur	Dur to Post
ED/S.MON	60 % (n=12)	45 % (n=9)
ED/S.MON/MI	70 % (n=14)	25 % (n=5)

intervention program, were obtained via a self-report questionnaire (see Appendix B). Of those from VWCC who reported their flossing frequency (n=54), 29.6 percent indicated that they never flossed their teeth, while only 13 percent stated that they flossed daily (see Table 14). This suggested that the behavior in question was initially practiced infrequently in this sample.

Significantly higher monthly flossing frequencies were reported by the subjects from the periodontal practice as compared to VWCC subjects, $t(112) = 5.909$; $p < .001$. As depicted in Table 14, 28.3 percent of the subjects (n=60) stated that they flossed on a daily basis while only 3.3 percent indicated that they never flossed their teeth.

As shown in Table 15, minimal changes in self-reported, weekly flossing frequencies from pre-intervention to follow-up was found among groups from the periodontal practice. The Ed group from the periodontal practice (n=8) reported a slight increase in flossing frequency, while those from the comparable group from VWCC (n=3) reported a decrease. The Ed/S.Mon group from the periodontal practice (n=9) showed no change from pre- to post-intervention, while the Ed/S.Mon group from VWCC (n=3) reportedly increased. The Ed/S.Mon/MI group from the periodontal practice (n=9) actually reported a slight decrease in flossing frequency, while the comparable group from VWCC (n=2) reported a slight increase.

Table 14

Reported Pre-Intervention Flossing Frequencies for Subjects from Both Settings

	VWCC (n=54)	Perio. Practice (n=60)
Never Floss	29.6%	3.3%
Floss Daily	13.0%	28.3%

Table 15

Mean Self-Reported, Weekly Flossing Frequencies of Subjects from Both Settings at Pre-Intervention and Follow-up

A. Periodontal Practice
(n = 26)

	Pre	Follow-Up	Change
ED (n = 8)	6.1	6.3	.2
ED/S.MON (n = 9)	6.1	6.1	0.0
ED/S.MON/MI (n = 9)	7.5	7.0	-.5

B. VWCC
(n = 8)

	Pre	Follow-Up	Change
ED (n = 3)	7.0	4.7	-2.3
ED/S.MON (n = 3)	2.0	4.3	2.3
ED/S.MON/MI (n = 2)	3.0	3.5	.5

Table 16 depicts the percentage of subjects from each group and setting whose self-reported flossing frequency increased from pre-intervention to follow-up. Note that all three intervention groups from the periodontal practice had similar proportions of subjects increasing their flossing frequencies (e.g., a range of 25.0 to 33.3 percent). However, from VWCC, no one from the Ed group improved, but the other two groups showed substantial numbers of subjects improving their frequencies of flossing.

A Comparison of Dependent Variables

Figure 4 graphically compares the results of four of the dependent variables (e.g. PCR, SBI, unobtrusive measure, and self-report) for each of the groups at various points during the interventions. This multimodal comparison clearly showed a lack of covariance between variables. There was one exception, however, where the physiological indices for the periodontal groups showed a similar decrease in PCR and SBI scores over time.

Based on the composite graph, it appears that each intervention had the same relative impact among the Periodontal groups, with the exception of the unobtrusive index where the Ed group showed a decline in flossing frequency while the groups showed an increase. Comparable results were also noted among the VWCC Ed/S.Mon and

Table 16

Percentage of Subjects from Each Group
Whose Self-Reported Flossing Frequencies
Increased from Pre-Intervention to Follow-up

	Perio. Practice	VWCC
ED	25.0% (n = 8)	0.0% (n = 3)
ED/S.MON	22.2% (n = 9)	66.6% (n = 3)
ED/S.MON/MI	33.3% (n = 9)	50.0% (n = 3)

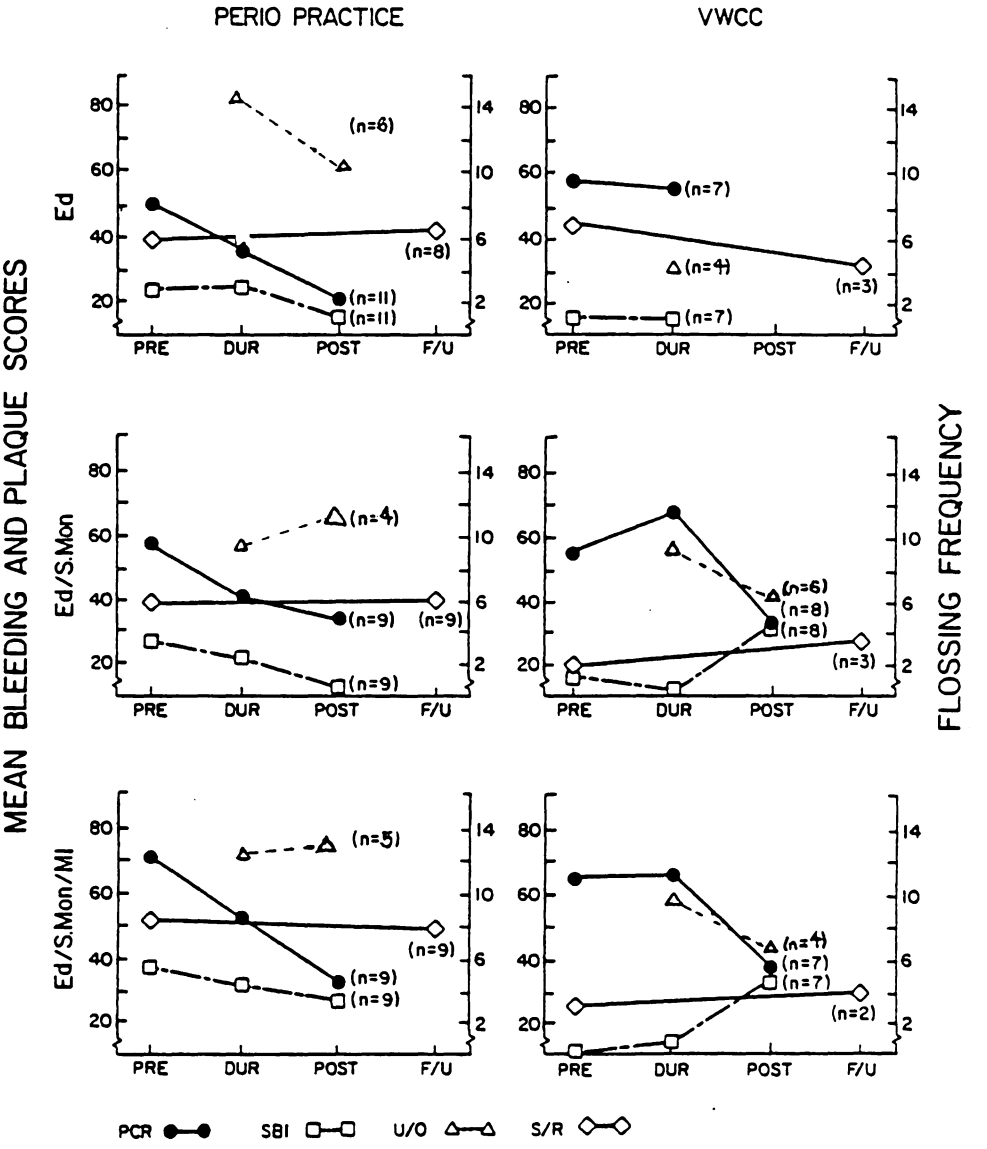

Figure 4. A Composite of PCR, SBI, Unobtrusive, and Self-Report Indicies as a Function of Intervention Condition and Experimental Phase

Ed/S.Mon/MI groups. However, the VWCC Ed/S.Mon and Ed/S.Mon/MI groups did show substantial increases in self-reported flossing frequencies, while the Ed group reported a decrease.

A comparison of the two Ed groups suggests that education generally resulted in favorable results from the Periodontal subjects, but not from the VWCC subjects. THis suppports the notion of differences between settings in initial motivation to implement preventive strategies. Therefore, a comparison between settings suggests that the self-monitoring procedures and the monetary incentives generally have the greatest motivating effects with the VWCC samples.

Discussion

The primary purpose of this study was to explore the efficacy of two behavioral strategies (i.e., self-monitoring and monetary incentives) in the promotion of oral health. Since the reactive effects of self-monitoring and the motivating effects of reinforcement are well documented in the literature, their impact on subjects in two different settings was of interest.

Two important research questions were addressed. First, could behavioral strategies enhance the effects of standard educational approaches in oral health promotion? Second, would the effectiveness of the behavioral strategies vary with different samples? This study was designed to tackle these issues, hoping to demonstrate the utility of incorporating behavioral principles into the field of dentistry. A review of the literature revealed only a few prior attempts to apply behavior change technology in the oral health promotion domain.

Findings from this study suggested that subjects from the periodontal practice had more initial motivation to implement oral hygiene strategies to prevent dental disease than did subjects from VWCC. Since subjects from the periodontal practice were paying patients reportedly committed to saving their teeth, subjects in each group from this setting may have a vested interest in taking advantage of strategies that could enhance compliance with

the recommended oral hygiene procedures and promote dental health.

It is known that all will not respond to the same motivational strategies. Therefore, different motivational strategies may be needed to facilitate relevant behavior changes with different individuals. For example, since periodontal patients are actively seeking treatment to save their teeth, it is assumed that they have decided to take preventive action to facilitate dental health. Thus, periodontal patients generally would be classified in the action and/or maintenance stage of change (DiClemente & Prochaska, 1982). On the other hand, patients who frequent a free dental clinic may not be seeking long-term, preventive care to save teeth, but rather short-term, crisis intervention (e.g., to alleviate pain from inflammed gums and teeth that are mobile). Those patients may be at earlier stages in the process of change than periodontal patients (e.g., at the precontemplation, contemplation, or decision making stage). The assumptions of DiClimente and Prochaska (1982) may be applicable in the interpretation of this study's findings, in that generally, differential effects between settings were found. This further substantiates the need to match individual characteristics with interventions.

This match between interventions and individual or group characteristics might be best achieved through social

marketing technology. It has been recommended that by integrating the disciplines of social marketing and applied behavior analysis, significant, long-term behavior change could occur and enhance large-scale quality of life (Geller & Nimmer, 1985). By conducting formative research, one could obtain critical information about the needs, wants, attitudes, beliefs, and behaviors of the target samples. This information could be integrated with the applied psychologists' knowledge about behavior change technology to determine the most appropriate interventions for the target population.

Multimodal Evaluation

As this multimodal study exemplifies, plaque records alone may not accurately measure changes in the targeted behavior. Relative comparisons among the PCR, SBI, unobtrusive, and self-report measures indicated a general lack of covariance among the dependent measures. Given this general lack of covariance, the conclusions of the experiment depend upon the dependent variable chosen.

Thus, experimental findings based on one dependent variable, as in the Iwata et al. (1981) study, may not accurately represent changes in the target behavior. This is particularly true of the physiological indicies, since they do not directly measure performance of a specific target behavior. Therefore, difficulty arises in

attempting to draw conclusions from the variety of data collected in the present study, as interpretations are dependent upon the variable being examined.

Dependent Measures

Plaque control index. Idiographic analysis of the plaque data supported the hypothesis of differential effects among interventions and between settings. An examination of the percentage of individuals within groups who reduced their plaque levels showed that the self-monitoring and monetary incentive procedures were more effective than education only during the intervention. For example, a greater proportion of subjects within each Ed/S.Mon and Ed/S.Mon/MI group at each setting exhibited greater decreased plaque levels than did either Ed group. In addition, a greater proportion of subjects from all periodontal groups demonstrated improvements in plaque levels than did comparable groups from VWCC. As discussed earlier, the differential effects between settings may have been due to differences in initial motivation to take steps toward preventing dental disease.

Comparisons of group means indicated that, overall, the Ed/S.Mon/MI groups from both settings showed greater decreases in plaque than either the Ed/S.Mon or Ed groups. This supports the hypothesis that the combined strategies of education, self-monitoring, and monetary incentives are

more effective than the other two conditions. However, the hypothesis that education combined with self-monitoring would be more effective than education alone was not supported from the periodontal groups' plaque scores. Again, one explanation is that the subjects had substantial initial motivation to floss, and in this case, either education or education and self-monitoring would have facilitated behavior change. In that the E./S.Mon/MI groups showed greater improvement than the other groups, the addition of monetary incentives may have been sufficiently rewarding and contributed to the differential effects among groups. No conclusion can be drawn from the VWCC sample, as the Ed group had a 100 percent attrition rate.

Sulcular bleeding index. Individual analysis of the SBI data supported the hypothesis of differential effects between settings and between intervention groups. From pre- to during-intervention, all Ed/S.Mon and Ed/S.Mon/MI groups showed greater reductions in bleeding than the Ed groups. The greatest improvement in bleeding was found at the periodontal practice. The same differences were not found, however, during the during- to post-intervention.

Analysis of the average SBI scores among and between groups supported the hypothesis of differential effects between settings. Bleeding scores from the periodontal practice reduced from pre- to post-intervention, but

increased for VWCC groups. Similar findings were noted for the plaque scores.

One explanation for the aforementioned findings is that thorough and invasive procedures are used by periodontists to clean teeth and debride tissue (e.g., root planing and curettage), and these treatments may have contributed to reduced inflammation and plaque. These same procedures are not commonly practiced by dental hygienists and were not performed by the VWCC students. Thus, the more variable results found between the SBI and PCR indices at VWCC may have been due to factors (such as plaque, calculus, and irregular root surfaces) remaining on the patients' teeth. If these factors were remaining, they would inhibit the effectiveness of the flossing procedure. If on the other hand, calculus and plaque were thoroughly removed, then with proper home care, healing would be facilitated. Therefore, this suggests that quality professional care and self-care procedures would be the most effective combination for promoting oral health.

A between group comparison for the periodontal subjects revealed that both the Ed/S.Mon and Ed/S.Mon/MI groups had greater reductions in bleeding than did the education only group. The hypothesis that the Ed/S.Mon/MI group would have lower bleeding scores than the Ed/S.Mon group was not supported from the periodontal data.

Self-report data. At the periodontal practice, the self-reported daily flossing frequencies at pre-intervention and follow-up remained consistent. At VWCC, the education only group reported a decrease in flossing frequency, while the other groups reported an increase. Therefore, differential effects were noted at VWCC. In addition, between settings there were differences noted in effectiveness of the intervention. Based on the self-report measure, the periodontal samples essentially had no room for improvement, as most were already flossing daily. The opposite was true for VWCC where improvements were noted for the Ed/S.Mon and Ed/S.Mon/MI groups.

Self-monitoring, which was not performed by the Ed groups, provided data which showed within group flossing averages ranging from 6 to 11 times per week during the intervention. This data could only be compared from during- to post-intervention and minimal improvements were noted during that time. Due to the minimal improvements during the latter phase, it was assumed that self-monitoring may have been more efficacious during the first few months of the intervention (i.e., pre- to during-).

In order to speculate further about this interpretation, a comparison of pre-intervention, self-reported flossing frequencies and the self-monitoring data was made. This comparison showed that improvements in flossing frequencies were made by all groups during the

initial phase of the intervention. Since the above conclusion was based on self-report data collected through two different methods, it is therefore questionable. However, it should be pointed out that the above comparison is presented for consideration in future research endeavors.

Unobtrusive index. A comparison of the unobtrusive data with that collected via self-report showed a discrepancy. Much higher frequencies of flossing behavior were shown for the unobtrusive data. As dental flossing is most likely a desirable behavior to report in this experimental situation, one would expect subjects to report the higher frequencies found with the unobtrusive index, if flossing was actually being performed at those frequencies. As this was not the case, questions about the reliability and validity of the unobtrusive measure were raised. Since survey data has revealed that only a small percentage of the population floss on a daily basis, it seems more reasonable to assume that the self-reported range of 3.5 to 7.0 times per week reflects the true flossing frequencies of the subjects, and that the unobtrusive measure was inflated.

Higher frequencies could have been obtained with the unobtrusive index of flossing if subjects used more floss at home than they did when demonstrating their technique in the dental setting. More floss could be used if, for

example, floss gets stuck between the teeth and breaks and more floss is needed to complete the home care procedure. Another possible explanation for the high flossing frequencies is that subjects may have allowed others to use their dental floss. Both of the above explanations may have been responsible for the seemingly inflated estimates of flossing frequencies.

Interobserver Agreement

The percent agreements between the two sets of observations of plaque and gingival bleeding were within an acceptable range. The reliability coefficients were actually higher than expected, given the difficulty in discriminating and recording the dependent variables in question. Differences in agreement were noted between settings, however, with slightly higher agreements found at the periodontal practice. One explanation for the difference is that the enumerators at the periodontal practice were more experienced and thus, may have increased accuracy and agreement of recordings. Another explanation for this setting difference may have been that fewer individuals were used as examiners at the periodontal practice (e.g., 5 persons), whereas 28 dental hygiene students recorded data at VWCC. Actually, the probability for disagreements among observers increases directly with the number of different observers. In other words, with

behaviors that are not discrete and require subjective input from the recorders, such as the discrimination of gingival bleeding and bacterial plaque, the probability for disagreements would be expected to increase as the number of recorders increase.

Recall that the examiners were not informed that the second recorder was employed as a reliability check. Thus, it was assumed that the reliability coefficients in this study were representative estimates of actual agreement between observers under nonexperimental conditions. Studies which only employ periodic reliability checks could have inflated coefficients that are not representative of the actual recorded data. For example, recorders often get tired, bored, or simply commit errors in recording. If however, a second recorder arrives periodically to collect data, both recorders might become more careful about their discriminations and recordings. Thus, with periodic reliability checks, one could obtain high reliability coefficients, while not over the long term be obtaining accurate and reliable recordings from the enumerators. In other words, the recorded data may not be as reliable as intermittently obtained coefficients suggest, and this would threaten the internal validity of the study. It appears that the methodology for obtaining reliability coefficients in this study is a more appropriate measure of

percent agreement.

Attrition

The attrition rates in both settings were a particular concern and did present a threat to the internal validity of the study. In addition, there was a significant difference in the attrition rate between the Ed group and the other intervention groups at VWCC. Recall that all 20 subjects from the VWCC/Ed group dropped out of the study (i.e., a 100 percent attrition rate) as compared to 60 and 65 percent attrition rates for the Ed/S.Mon and the Ed/S.Mon/MI groups respectively. This suggests that there may have been aspects of the intervention (e.g., either the incentives were sufficiently rewarding and/or the activities were intrinsically motivating) that kept people participating in the Ed/S.Mon and Ed/S.Mon/MI groups at VWCC.

A similar difference in attrition between groups was not found among the periodontal sample. To reiterate, since periodontal subjects were paying patients reportedly committed to saving their teeth, they may have a vested interest in attending the dental office and taking advantage of strategies that could improve their dental condition. Thus, systematic differences in initial motivation could account for the differential effects in attrition between settings.

In addition to the differences noted in attrition, there were significant differences between the settings in regard to education and income level. Research has shown that higher education and income level is related to the use of health care services. Thus, the differences in attrition between settings may have been related to these demographic characteristics. For example, fewer subjects from the periodontal practice dropped out of the study than from VWCC. Furthermore, subjects from the periodontal setting had significantly higher education and income levels than subjects from VWCC. Therefore, it appears that commitment to preventive behaviors, as was found among the periodontal subjects, may also be related to the demographic characteristics (such as higher education and income levels).

Conclusions

The present study has several advantages over other related research. First, intervention impact was compared across two settings with patients of different sociodemographic characteristics. A second advantage was that more subjects were used in this study than was the case in earlier studies. This improved external validity and helped to offset the high rates of attrition that are frequently found in dental research. Thirdly, the research was carried out in the natural setting with the aid of the

indigenous staff. This added external validity and also allowed an observation of the feasibility of implementing the interventions under natural contingencies. For example, the procedures used in this study for collecting and recording physiological data were incorporated into the routine procedures at the periodontal office and are at this date, still being used.

There were limitations, however, in this study. First, the feasibility of implementing all aspects of the intervention procedures was not formally assessed. This could have been done by surveying and/or interviewing the indigenous staff. Second, although differential effects of the interventions between settings were predicted, primarily differences in demographic characteristics were evaluated. Measures to assess initial differences in knowledge, attitudes, beliefs, perceived self-efficacy, and behaviors would have been informative. Thirdly, improvements in the research design could have been made. For example, 1)a no education control group could have been included; 2) baseline measures for the unobtrusive measure were needed; 3) self-reported flossing frequencies could have been collected at each observation session via the same modality; and 4) follow-up data, after a withdrawal period, was needed for the physiological and unobtrusive indices.

The efficacy of incorporating behavior change technology into the field of dentistry was supported, under certain conditions, in this study. Although one would expect covariance among the dependent variables used in this study, it is clear from the results that covariance may not be realized. Therefore, one has to be cautious about the choice of dependent measures in dental research. If frequency of behaviors, such as flossing and brushing, are targeted, then a direct measure of that behavior would be needed (e.g, direct observation or an unobtrusive measure).

Determining optimal strategies for promoting oral health behaviors among various segments of the population continues to be an issue of great importance. To date, much of the research methodology in the field of dentistry has been wrought with weaknesses. As future researchers examine more closely issues such as appropriate selection of dependent variables, attempts to identify efficacious interventions may be maximized.

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APPENDIX A-1

HUMAN PERFORMANCE LABORATORY

Division of Health, Physical Education and Recreation
Virginia Polytechnic Institute and State University

INFORMED CONSENT

I, _____, do hereby voluntarily agree and consent to participate in a testing program conducted by the personnel of the Human Performance Laboratory of the Division of Health, Physical Education and Recreation of Virginia Polytechnic Institute and State University.

Title of Study:

Self-Monitoring, Pledging, and Reinforcement Strategies: Effects on the Maintenance of Flossing Behavior

The purposes of this experiment include:

To investigate the effects of various motivational strategies on the maintenance of flossing behavior.

I voluntarily agree to participate in this testing program. It is my understanding that my participation will include:

1) A ten minute examination to determine the extent of any periodontal disease (gum disease) or plaque present in the mouth.

2) The participant will be asked to return to clinic in three months and in six months for a brief reexamination of the mouth.

APPENDIX A-2

HUMAN PERFORMANCE LABORATORY

Division of Health, Physical Education and Recreation
Virginia Polytechnic Institute and State University

INFORMED CONSENT

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2) The participant will be asked to return to the clinic in three months and in six months for a brief reexamination of the mouth.

3) The subject will be asked to pledge to floss his/her teeth during the course of the study.

In addition, he/she will be asked to keep records on his/her flossing behavior. These records are to be mailed to the investigator every two weeks. All materials and stamps will be provided.

APPENDIX A-3

HUMAN PERFORMANCE LABORATORY

Division of Health, Physical Education and Recreation
Virginia Polytechnic Institute and State University

INFORMED CONSENT

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3) The subject will be asked to pledge to floss his/her teeth during the course of the study.

4) In addition, he/she will be asked to keep records on his/her flossing behavior. These records are to be mailed to the investigator every two weeks. <u>All materials and stamps will be provided</u>.

5) At each of the follow-up appointments, a raffle will be held. If your record keeping card is drawn, $1.00 will be awarded for each day that you flossed within the two week period. A maximum of $14.00 could be awarded at each drawing.

APPENDIX B

BACKGROUND INFORMATION

The following questions are more personal in nature. All information provided will be strictly confidential and used only for research purposes.

Name _____ Date _____

Address_____ Phone _____

Sex: Male: _____ Female _____ Age _____

Race: Caucasian ___ Afro-American ___ Hispanic ___ Asian ___ Other _____

Circle the highest grade you have completed:

0 1 2 3 4 5 6 7 8	9 10 11 12	13 14 15 16	17 18 19 20+
Grade School	High School	College or Vocational Training	Graduate School

Income: Please indicate your approximate family income.

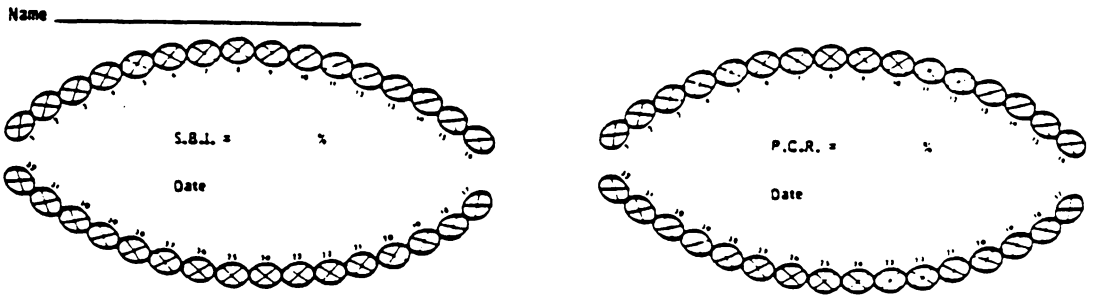
____Under $10,000/year
____$10,000 to $14,999/Year
____$15,000 to $19,999/year
____$20,000 to $29,999/year
____$30,000 or more per year

Do you floss your teeth? ____ Yes ____ No

If you answered yes to the above question, please specify how many times per month_____or how many times per week_____ _____ you perform the behavior.

APPENDIX C

SULCULAR BLEEDING INDEX AND PLAQUE CONTROL RECORD FORMS



APPENDIX D

SELF-MONITORING CARD

NAME_____

WEEK	Sun	Mon	Tue	Wed	Thu	Fri	Sat
No.1 DATES___TO___							
No.2 DATES___TO___							

Please check each day that you floss. If you floss more than once per day or use additional floss, place another check on that day.

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